ENERGY PIPELINE

COVERING THE ENERGY INDUSTRY IN THE ROCKY MOUNTAIN REGION

TRENDING UP

Rising rig count, fewer unemployment claims equate to oil and gas industry bounce-back

WELD OIL PRODUCTION SLIPS

Weld County oil production fell last year, but volumes should recover this year.

IMPROVING AIR QUALITY

Latest Colorado ozone plan nears finish line

MAKING HOLE

History column recalls the pumpjack capital of Texas

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ALISO CANYON GAS LEAK RENEWS PRESSURE ON PIPELINE INTEGRITY MEASURES

BY GARY BEERS • FOR ENERGY PIPELINE

In California's Aliso Canyon, a leak in the metal pipe in a breached casing of an injection well caused the worst natural gas leak in U.S. history during October 2015 to February 2016. Investigations into the causes of this disaster revealed lack of an adequate monitoring/emergency-response plan and removal of safety values on numerous old 1950's era pipes.

Four months later, the Protecting our Infrastructure of Pipelines and Enhancing Safety Act (PIPES Act) was extended until 2019 with increased regulations to address safe transmission of gas and hazardous liquids in U.S. pipelines. Importantly, more stringent regulations addressed improvements in pipeline leak detection systems and expansion of pipeline integrity management programs beyond high-consequence areas (Pipeline Law, Barnes & Thornburg, LLP, July 2016). Consequently, oil and gas companies are required to improve and expand pipeline inspection/monitoring systems.

Some of the "smart technology" tools available to support this needed improvement to minimize pipeline leaks are overviewed below.

SMART INLINE SENSORS

These inspection tools are free-swimming and travel inside the pipeline. The data collected by the sensors are not transmitted real-time and are stored onboard for downloading after exiting the pipe.

SMART PIG

Early pigs were dumb. Basically, cylindrical in shape, these pigs consisted of brushes and scrapers to loosen and push debris during transit in the pipeline. Earliest versions consisted of wire cylinders densely packed with straw.

A view of a typical smart pig (Pipeline Inspection Gauge) is shown in Figure 1. Depending on the overall length, the units may be separated by flexible joints to allow movement through bends in the pipeline. The drive package is the lead unit which is followed by a combination of sensor units, for example (Fact Sheet: In-Line Inspections, U.S. Department of Transportation, July 2014):

MAGNETIC FLUX MEASUREMENTS.

- Magnetic Flux Leakage — measure metal loss in longitudinal section of pipe wall through use of temporarily applied magnetic field.
- Transverse flux — measure metal loss in circumference of pipe wall through use of temporarily applied magnetic field.

ULTRASONIC MEASUREMENTS.

- **Compression wave** — measures pipe wall thickness and metal loss.
- **Shear wave** — detects longitudinal cracks and weld defects.

GEOMETRY MEASUREMENTS.

- **Mechanical or Electro-mechanical** — measures bore of pipe, including dents, deformations, changes in girth welds, and wall thickness.

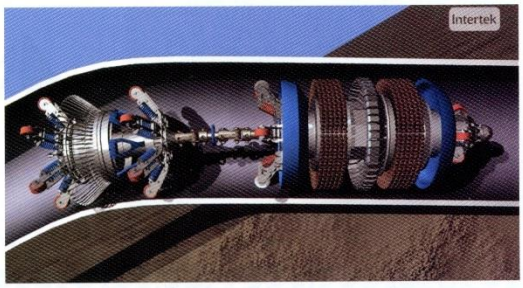

Figure 1. Smart Pig (Source: Intertek)

For over 50 years, **GARY BEERS**, has worked in numerous fields of environmental science as a consultant, regulator and educator. This career included senior management position with major consulting, nonprofit and public organizations. He has founded several successful firms to capture emerging resource management markets. One of his latest ventures, EnviroScienceINFO, provides content for public media.

After the pig is retrieved from the pipeline, the collected data is electronically downloaded.

Pigs can be modified to serve non-sensing purposes. Sealing pigs provide a good seal and separate dissimilar liquid products moving one after the other in a pipeline. A plug pig serves to seal end of pipeline when the pipeline is opened for maintenance or remedial work.

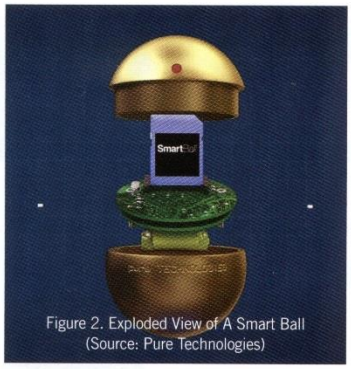

Figure 2. Exploded View of A Smart Ball (Source: Pure Technologies)

SMART BALL

In contrast to the smart pig, which collects physical measurements of the pipe integrity, the smart ball is an ancillary tool that locates leaks based on the sound generated by product exiting through a crack in the pipe wall.

The smart ball (Figure 2) is typically less than one-third the diameter of the pipe and consists of an instrument package enclosed in a plastic sphere. The advantages of this unit are increased acoustic sensitivity, accurate location capability, and useable in non–piggable pipelines. Also, the smart ball can be outfitted with magnetic sensors to identify areas of stress in the pipe wall. The smart ball rolls silently through the pipeline and can record measurements for 20 to 400 hours depending on pipeline diameter (Pure Technologies Ltd.)

SMART PIPELINES

A more effective approach to a long-term solution to quick detection of possible threats to pipeline integrity is the placement of sensors in pipe walls and buried along the outside of the pipeline.

SENSOR LININGS

These smart pipeline devices primarily report leaks.

A fiber-optic sensing cable is attached to the outer wall along the length of the pipeline. This cable provides for continuous monitoring of temperature (leak detection), vibration (warning of potential mechanical damage), and strain (indicator of material creep) (Smart Pipe Project, OXY, 2015). The cable is connected to an above-ground computer for real-time monitoring.

SENSOR BELTS

These smart devices monitor pipeline integrity and forecast potential breaks.

For subsea oil pipelines, Scandinavian engineers have installed belts around pipelines, at 74 foot intervals, which are packed with sensors that measure pipe wall thickness, tension, temperature, and vibration. A thick insulating layer of polypropylene, containing a cable, covers the length of the pipe and provides for wireless data transmission, in real-time, from the belt to offshore or onshore platforms (Green Light for the World's First Intelligent Oil Pipelines. Physical Organic News, March 2015).

IN GROUND SENSORS

These smart devices monitor soils and geologic conditions along the pipeline and forecast potential problems.

An approach of a Swiss firm (Omnisens SA), specializing in fiber optics, emphasizes monitoring conditions external to the pipeline as a basis for identifying leaks and forecasting threats to pipeline integrity. The prime components of their smart pipeline system (Figure 3) provide real-time monitoring of:

- **Geohazards and ground movement** – temperature and strain sensing fibers are sensitive to movement of soils, including landslide, rock fall, or seismic event
- **Third party intrusion** – vibration and acoustic sensing fibers detect any physical intrusion in the pipeline corridor
- **Leaks** – temperature sensing fibers can detect changes caused by leaks and groundwater movement.

SELF REPAIR

Taking the concept of a smart pipeline to the next level, a Canadian firm (Smart Pipeline Company Canada Inc) has developed a pipe that can self-repair leaks. The self-monitoring composite pipe, with on-board fiber optic and communication systems, can replace a corroded or compromised pipe wall from the inside, without the need to excavate the entire pipeline (Development of High Pressure Self-Monitoring Composite Pipeline System, Smartpipe Technology, to Improve Environmental Security for Oil sands Transportation. Sustainable Development Technology Canada, February 2017). ♠

Figure 3. Sensors Alongside Pipeline (Source: Omnisens SA)