Title of Innovation: 60-inch Real-Time Digital RT External Pipe Crawler

Category: Integrity Assessment

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Full Description:

When and how was it developed? 
BP Exploration Alaska began working with a global real-time digital radiographic service provider in 2010 on an external crawler proof-of-concept (POC). The project was intended to address the comprehensive inspection requirements associated with the Prudhoe Bay’s 60-inch gas gathering system. The POC matured to several designs, which were later followed by two field trails to refine the delivery system, inspection technique, and wall loss anomaly detection sensitivity specification.

Based on the potential for internal pitting degradation mechanism, the anomaly detection sensitivity of \(1t \times 1t \times 0.25 \ t (t = \text{nominal wall thickness})\) was chosen to meet or exceed current in-line inspection detection and sizing capabilities.

How does it work, in basic terms? 
The external pipe crawler weighs approximately 350 pounds. It encompasses four (4) independent programmable drive tracks, a chassis that holds a 300 kV mobile x-ray source, and remote controlled actuated arms that have two (2) 24-inch digital detector arrays integrated into the design. The NDT technician operates the crawler via a remote control touch screen. Power and crawler controls are delivered through a 300-ft umbilical control cable. To enhance the operator’s view, the crawler is equipped with forward and rear video cameras, allowing the operator to see and respond to field conditions as required. The crawler can travel up to 10 feet per minute and has successfully operated in -20 °F.
How was the innovation evaluated?
The digital images were independently interpreted in real-time by two separate parties to ensure the detection sensitivity was maintained throughout the project.

How or why is the innovation unique?
The collaborative effort yielded the industry’s first 60-inch real-time digital radiography external pipeline crawler that exceeded in-line inspection pitting detection and sizing sensitivity.

What type of corrosion problem does the innovation address?
A comprehensive corrosion threat analysis identified localized (bottom of pipe) internal pitting as well as corrosion under insulation (CUI) as the prevalent corrosion degradation mechanisms.

What is the need that sparked the development of the innovation?
BP Exploration (Alaska), Inc. operates a 60-inch, aboveground, insulated, gas gathering system on the North Slope of Alaska. The gas gathering system transports between ~12 billion cubic feet per day (BCF) of gas that is processed, compressed and re-injected into the Prudhoe Bay Gas Cap for light oil reservoir pressure maintenance. The system was built in 1989 and is comprised of two pipeline segments—the Western Operating Area and the Eastern Operating Areas respectively. To date, the system has been successfully managed by spot inspection (UT and RT) programs.

Are there technological challenges or limitations that the innovation overcomes?
In 2009, BP initiated an appraise project to evaluate comprehensive inspection options that included:

- In-Line Inspection (ILI)
- Radiographic (RT)
- Ultrasonic Testing (UT)
- Guided Wave Testing (GWT)

A comprehensive corrosion threat analysis identified localized (bottom of pipe) internal pitting and corrosion under insulation (CUI) as the prevalent corrosion degradation mechanism. Upon integrating the identified corrosion threats, with each of the inspection technologies’ implementation and life cycle costs, the decision was made to execute a real-time digital radiographic external crawler solution.

What are the potential applications of the innovation?
The technology can be deployed on any aboveground non-piggable gas pipeline. Smaller liquid lines may also be inspection candidates.

How does the innovation provide an improvement over existing methods, techniques, and technologies?
The real-time digital radiographic external pipeline crawler provides an effective asset inspection solution. It is the least intrusive inspection method, e.g., insulation removal for pipe access is not required, no production impacts are incurred during the inspection, and no pipeline/equipment modifications are required when compared to the following other inspection methods:

- In-Line Inspection (ILI)
What type of impact does the innovation have on the industry/industries it serves?
Real-time condition assessment that is equivalent and/or surpasses in-line inspection sensitivity.

Does the innovation fill a technology gap? If so, please explain the technological need and how it was addressed prior to the development of the innovation.
The technology can be deployed on any aboveground non-piggable gas pipeline.

Has the innovation been tested in the laboratory or in the field? If so, please describe any tests or field demonstrations and the results that support the capability and feasibility of the innovation.
The project team spent two years working the proof of concepts and refining the technique. The end product was successfully field deployed and delivered the baseline inspection project (35,000 feet in 43 days).

Is the innovation commercially available? If yes, how long has it been utilized? If not, what is the next step in making the innovation commercially available?
The key components are commercially available and were integrated by the project team. The digital radiography is a linear digital detector array system manufactured by a global solutions provider.

Are you aware of other organizations that have introduced similar innovations? If so, how is this innovation different?
This is an industry first.

Are there any patents related to this work? If yes, please provide the patent title, number, and inventor.
The key components are commercially available and were integrated by the project team. The digital radiography is a linear digital detector array system manufactured by a global solutions provider.

Supporting Photos:
Field Images – Mid-Span Thru Wall

Image Quality Indicators

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