2021 Award Nomination

Title of Innovation:
Differential Reflectometry Mapping

Nominee(s)
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Category:
(select one below)

~~Coatings and Linings~~	~~Instrumentation~~
~~Cathodic Protection~~	Testing
~~Materials Design~~	~~Modeling/Risk Assessment~~
~~Chemical Treatment~~	~~Other—~~

Dates of Innovation Development:
(from [08, 2016] to [12, 2018])

Web site: https://heuristech.us/

Summary Description:

Differential Reflectometry Mapping (DRM) is a novel technology that uses electromagnetic reflectometry to assess the state of the coating on buried pipeline networks. This technology allows to detect, locate and characterize coating defects, including delaminations. DRM is non-invasive and ideally suited to assess pipelines in cities, under roads or waterways, and in other challenging environments.

Full Description:

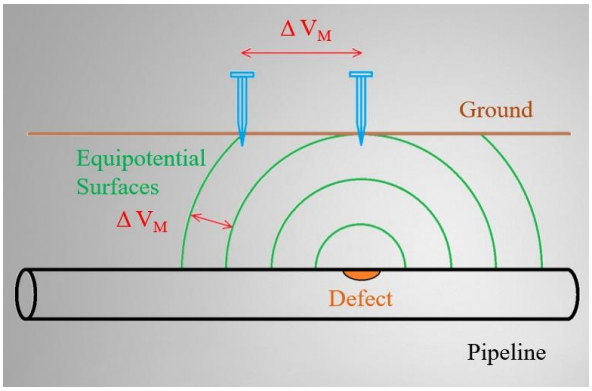
(Please provide complete answers to the questions below. Graphs, charts, and photos can be inserted to support the answers.)

1. What is the innovation?

Our innovation is about using electromagnetic reflectometry to detect and locate coating delaminations and other defects. This usage of reflectometry for pipelines represents a true scientific paradigm shift regarding pipe corrosion inspection:

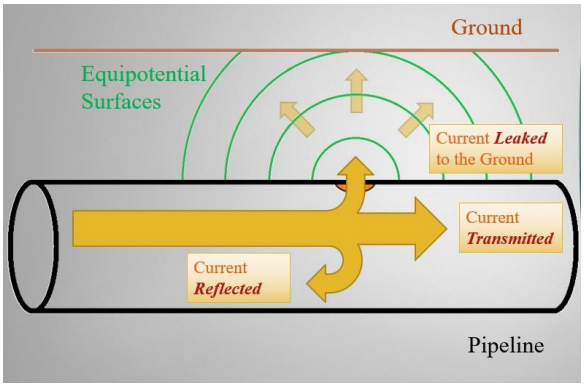
Ground-based Techniques

The voltage measured is a ground ohmic drop which is a fraction of the cathodic protection potential.



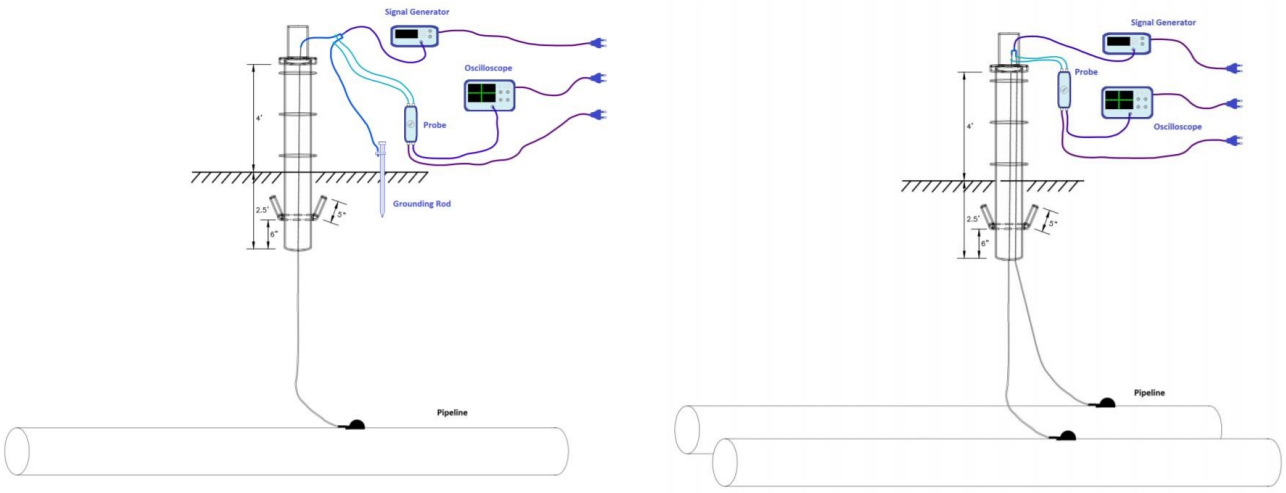
Differential Reflectometry Mapping

Current-based approach



2. How does the innovation work?

Electromagnetic waves are sent into the pipe and the location of the defect is worked out with the time delay of the signal reflection (same principle as a radar). The measurements are made according to two different processes depending on the pipeline configuration (multiple pipes configuration right-of-way or single pipe configuration).



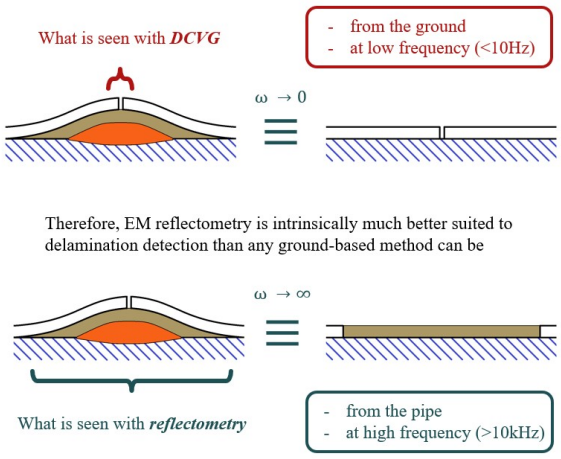
Then the data is remotely analyzed by a software. Precise localization and severity of each defect is computed.

3. Describe the corrosion problem or technological gap that sparked the development of the innovation. How does the innovation improve upon existing methods/technologies to address this corrosion problem or provide a new solution to bridge the technology gap?

Conservatives estimates of the cost of corrosion to US transmission pipelines are well above 10 billion dollars per year. The economic value of this project to mitigate those costs is obvious in regard to 2 main considerations.

1. First, oil & gas and utility companies need an alternative to traditional in-line and top-of-the-line method that could works as well in difficult environments like cities or under waterways. Indeed, surface detection methods (ACVG / DCVG) are strongly limited when network is buried under roads or water ways. Piggies are no solution either because cables or bents can prevent their travel in the pipeline.

2. Furthermore, this industry needs to be able to detect coating delaminations, which often induce accelerated rate corrosion beneath them (Corrosion Under Isolation), is giving eyes on a threat the industry was so far blind to.



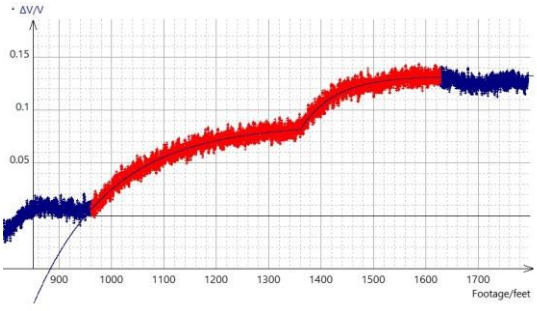
4. Has the innovation been tested in the laboratory or in the field? If so, please describe any tests or field demonstrations and the results that support the capability and feasibility of the innovation.

This technology was invented during a research project between Texas A&M University and a major East Coast utility company. It went through both lab and field phases and has been successfully tested and validated in the field with excavations on their network multiple times. Additional PoCs have been made with Total and Air Liquide.

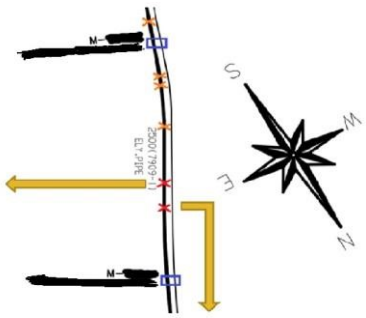
Here is a Case Study:

5000 feet surveyed
23 defects detected, located, and rated
6 most critical defects chosen to be excavated, successfully found with 15 feet excavation trenches, and repaired
What would have been done without this technology is to dig up the entire 5000 feet

Data collection



Section	Indication Number	Footage from South of MH1	Footage from North of MH2	Severity Rating
	1	636	1555	D
	2	862	1329	D
	3	1446	745	A
	4	1817	374	B
	5	1876	315	A



F*ragments of the reports after analyses*

All excavations have been successful: large areas of pitting were found under those delamination defects.

5. How can the innovation be incorporated into existing corrosion prevention and control activities and how does it benefit the industry/industries it serves (i.e., does it provide a cost and/or time savings; improve an inspection, testing, or data collection process; help to extend the service life of assets or corrosion-control systems, etc.)?

DRM new capability made available to the operator to detect and locate coating defects using existing or modified cathodic protection testing leads on buried transmission pipelines. DRM benefits to corrosion prevention and control activities are numerous:

1. Improved inspection:
    - DRM makes possible to inspect pipeline in difficult environment as well (cities, bridge, waterways, concrete, etc.)
    - DRM is also about certainty improvement (low probability of false-positive & detection of delaminations)
2. Time saving: our data collection process is especially efficient: more than 4 miles can be surveyed in 1 day.
3. Cost saving: detect corrosion sites at an early stage guide prevention. In urban environment, repairing the coating before a leak occurs allows to cut costs by over 80%. What's more, repairing coating defects makes the cathodic protection more efficient for the entire network, and hence improves the durability of the entire asset.

6. 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? What are the challenges, if any, that may affect further development or use of this innovation and how could they be overcome?

Our innovation is commercially available since September 2019. Con Edison is a regular client. We are at the PoC stage with Air Liquide and Total. The main challenge is to familiarize pipeline operators with this new tool for assets corrosion management.

Additionally, we keep our R&D active in order to customize and adapt our technology to each client specific network and needs. Specifically, we already adapted operational protocols to the differences between utilities networks (typically with manholes) and Oil & Gas networks (typically with cathodic protection testing sites).

7. Are there any patents related to this work? If yes, please provide the patent title, number, and inventor.

Covered by PCT/US2018/026526
"Reflectometry Devices and Methods for Detecting Pipe Defects"
Inventors: Tristan Petit de Servins d'Héricourt and Homero Castaneda-Lopez