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R&D and Innovation for PG&E Gas Operations

CEC Natural Gas Infrastructure Safety and Integrity Research Program Workshop July 7, 2017

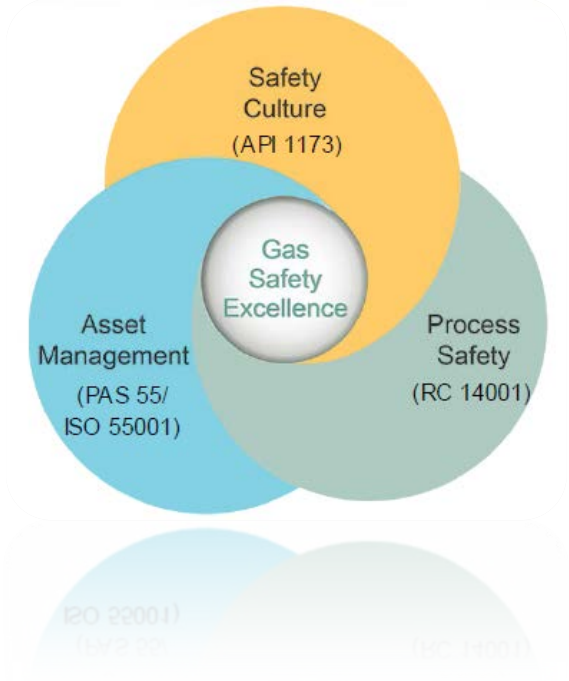
François Rongere

Together, Building a Better California

PAS 55 and ISO 14001 certifications are a central component of Gas Safety Excellence

PG&E created the GSE strategic framework in 2013, integrating **asset management, safety culture and process safety.**

The purpose of GSE is to align the goals and actions across these work groups to support our employees as they manage every aspect of Gas Operations

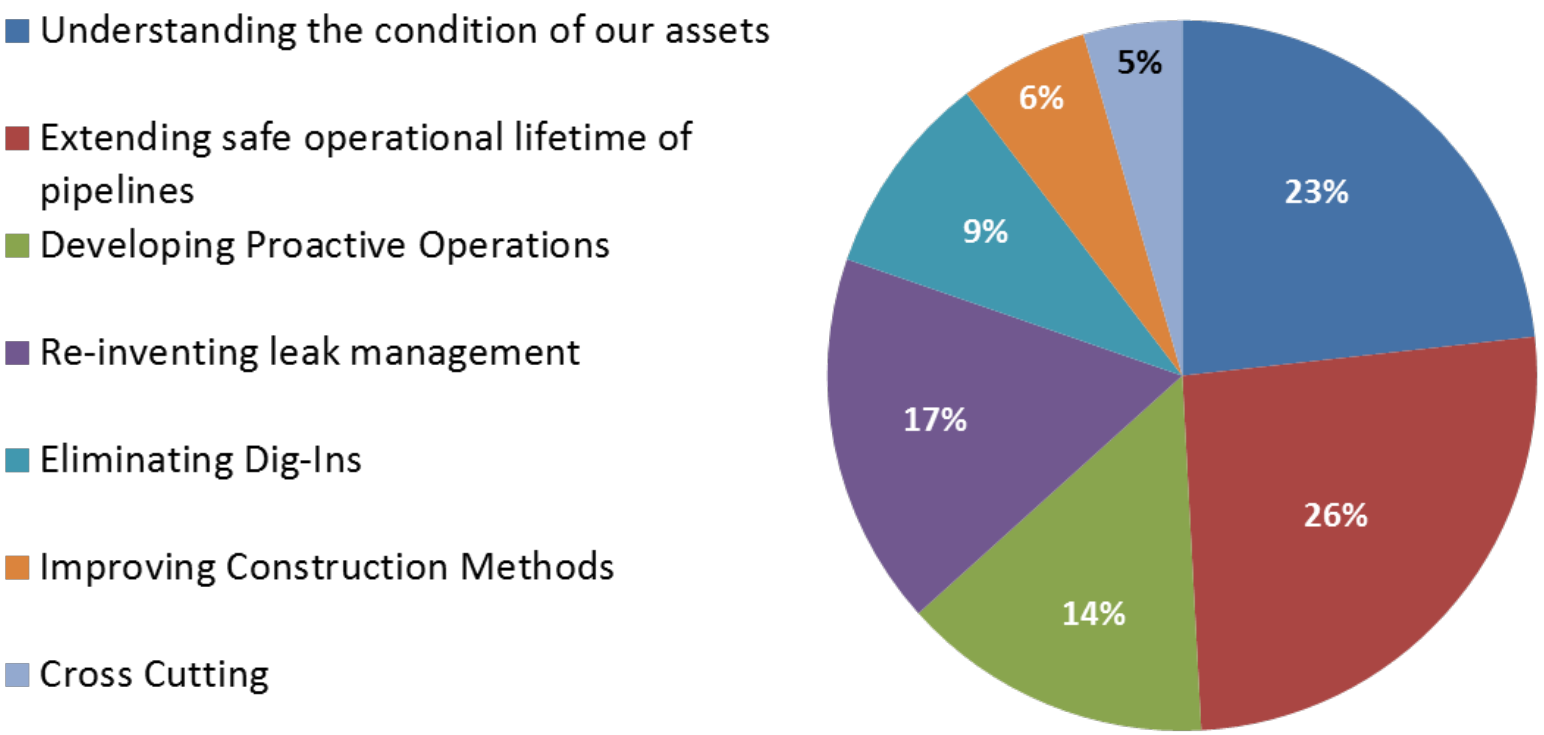


We will deliver gas safety excellence by:

- Putting **SAFETY** and people at the heart of everything
- Investing in the **RELIABILITY** and integrity of our gas system
- Continuously improving the effectiveness and **AFFORDABILITY** of our processes

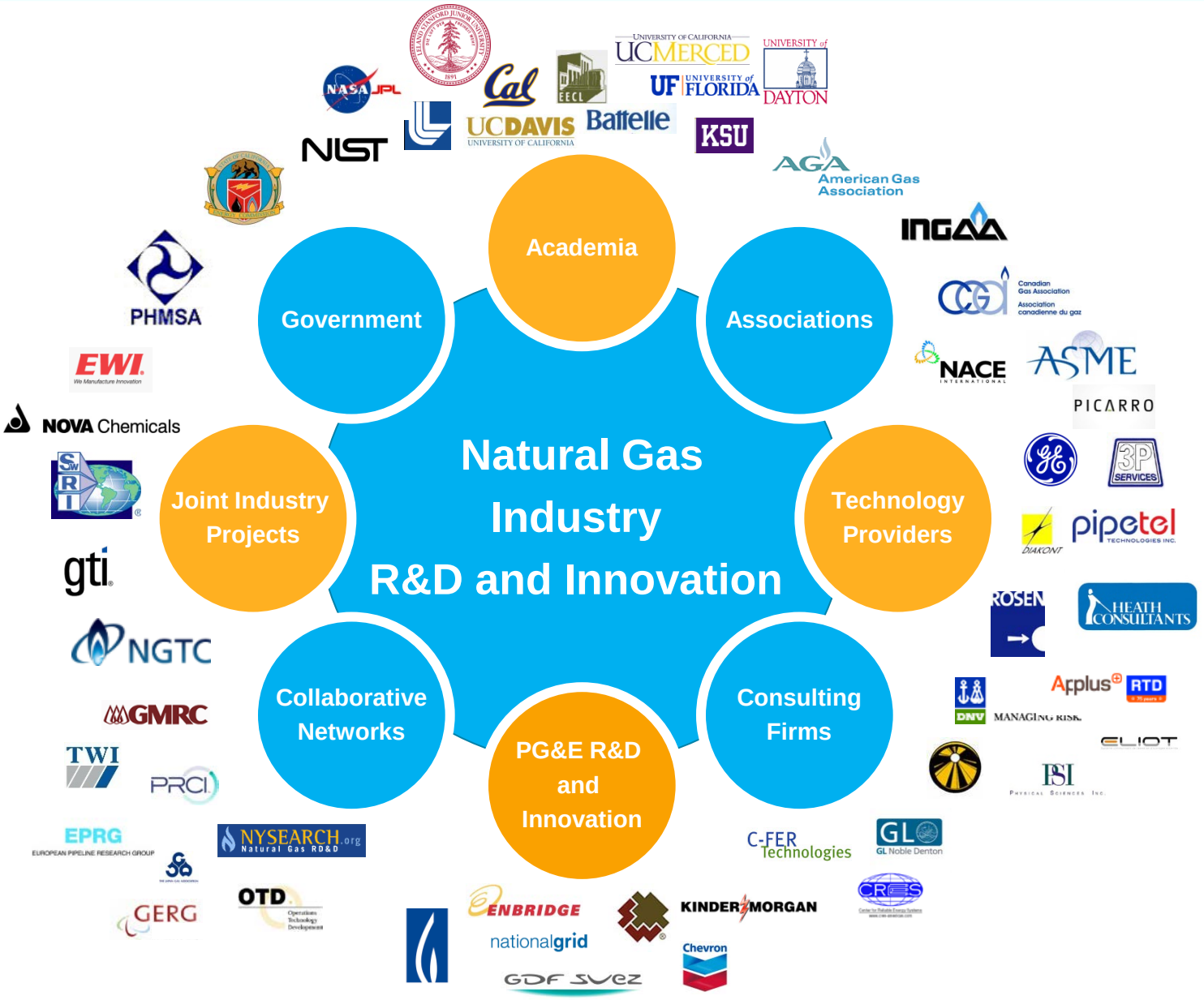
R&D and Innovation Portfolio

- Six major focus areas:



178 active projects (as of June 30th, 2017)

R&D and Innovation Connection



R&D and Innovation Road Map

Objectives	R&D and Innovation
Time line	<2015 | 2015 | 2016 | 2017 | 2020 | >2020

Understanding the condition of our assets

Inspecting Unpiggable Pipelines

- Untethered Robots
- Long Range Robots
- Automated Robots
- Low Flow Pigs
- Sharp bend Inspection
- Above Ground Inspection

Expanding ILI beyond Metal Loss

- Weld Scanners
- Crack Sensors
- Seam weld sensors
- Advanced Crack and Dents Models
- Cleaning Robot
- SCC detection

Extending safe operational lifetime of pipelines

Taming Corrosion

- 3D Camera
- Casing Inspection
- Continuous Monitoring
- Advanced Corrosion Models

Assessing Vintage Pipelines

- NDE Material Characterization
- In Line Material Characterization
- ERW Weld Assessment

Mitigating the Risk of Underground Movement

- Fitness for Service
- Lidar based Assessment
- Ground Movement Monitoring
- Girth weld integrity

R&D and Innovation Road Map

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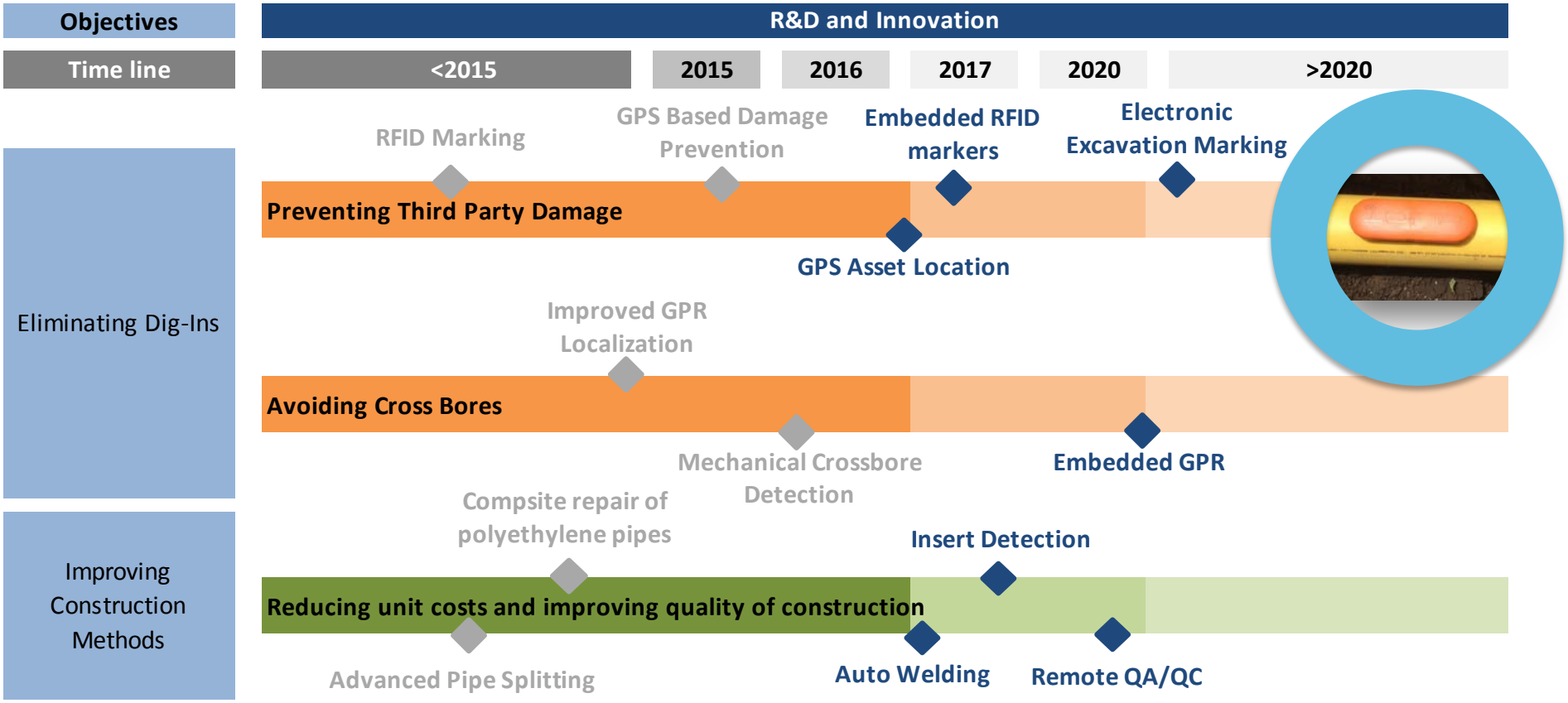
Developing Proactive Operations

- Secured Scada Access (<2015)
- Distributed Monitoring (2017)
- Automated field data collection (2020)
- **Increasing Visibility and Awareness**
- Material Traceability (2015)
- Paperless As-Built (2017)
- Interactive Threat Model (<2015)
- Aerial Imagery Change Detection (2015)
- Integrated Data Collection and Processing (2017)
- **Enabling Analytics**

Re-inventing leak management

- High Sensitivty Vehicle Surveys (<2015)
- Advanced Handheld Detector (2015)
- Continuous Monitoring (2016)
- UAV based Surveys (2017)
- Distributed Methane Detector (2020)
- **Improving leak surveys effectiveness**
- Leak Quantification (2017)

R&D and Innovation Road Map



Some Recent Developments

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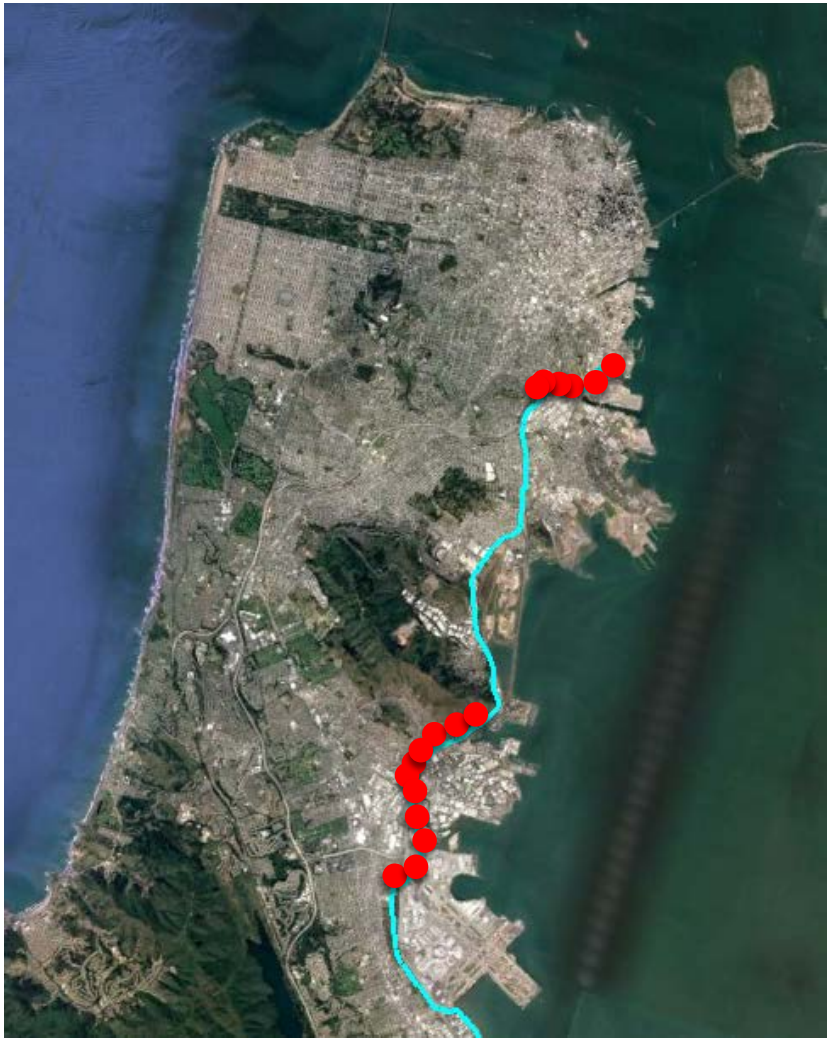
In Line Inspection Robots

Key Features

- Not-tethered, battery powered robot
- Launch and receive through pressure control fitting via hot tap (traditional pig launcher and receiver not required)
- Navigates through “unpiggable” features (1.5D radius bends, plug valves, low pressure and flow conditions)
- Performs NDE (Non Destructive Evaluation) and visual inspection for metal loss, cracks, and mechanical damage.
- Diameters: 6”, 8”, 10”-14”, 16-18”, 20”-24”, 30”-36”

In Line Inspection Robots



In Line Inspection of Line L101 using Explorer

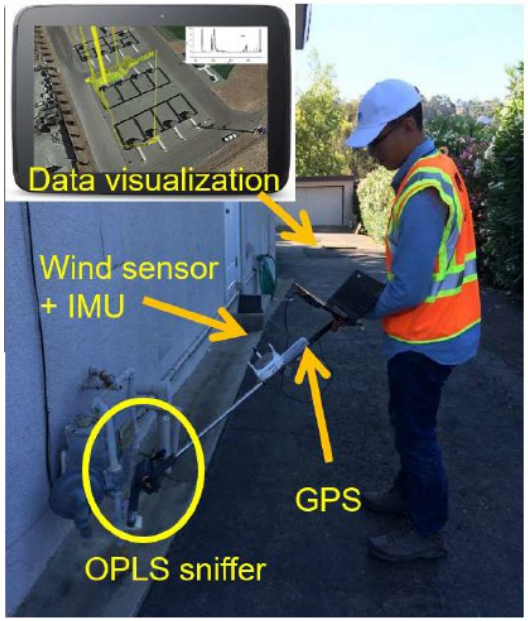
- 20” – 24” diameter
- MAOP 145 PSIG
- Frequent diameter changes
- Restrictive pipeline features
- Dense Urban area

Series of 7 projects in 2015

- Magnetic Flux Leakage inspection
- Damage detection using laser and cameras
- 2,37 miles inspected

In Line Inspection Robots

Methane Detector



- Based on NASA's detector used on Mars.
- The detector has **superior sensitivity (parts per billion)** compared to other commercial handheld detectors. It is also lightweight (150g).
- **Handheld device** is in the industrialization phase.
- **UAS** (VTOL and fixed wing) version is being developed

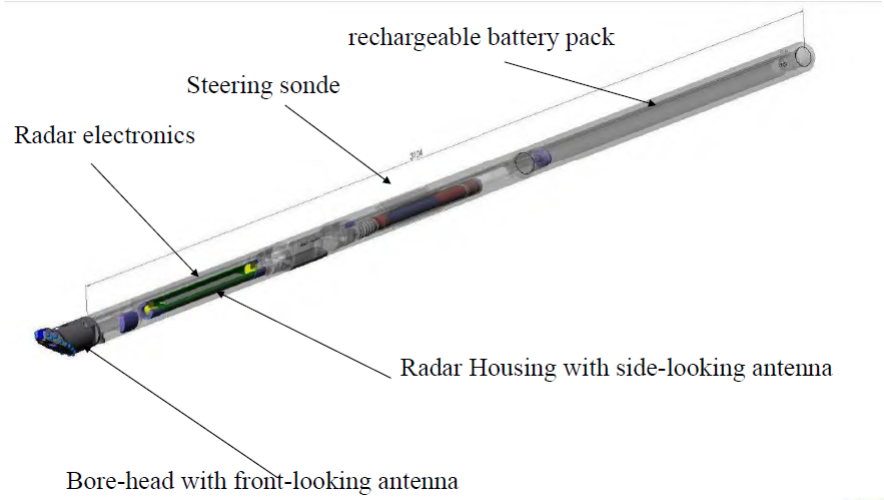
Embedded RFID Markers

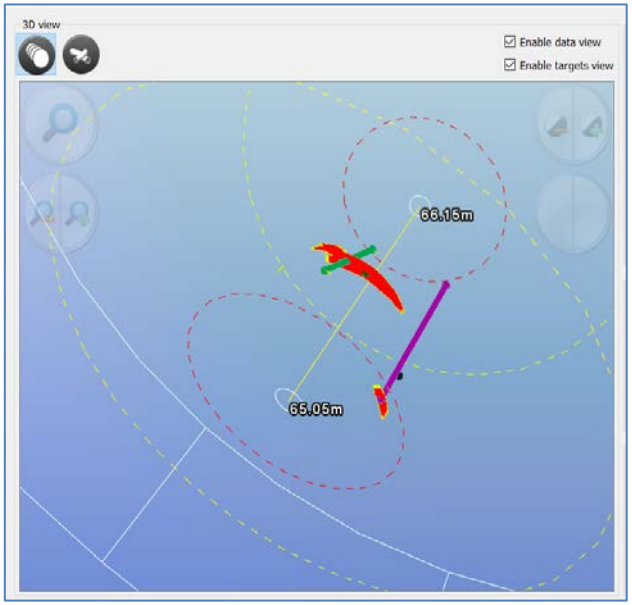
- RFID marker is embedded on the pipe.
- Precision is 1 inch laterally and 4 inches vertically to a depth of 5 feet.
- Additional information about the pipe is recorded in the RFID following ASTM 2897 standard to assure material traceability.
- Localization and information are checked with an antenna from above ground.

ORFEUS: GPR for horizontal Drilling

OTD Operations Technology Development

- Ground Penetrating Radar (GP) embedded in a horizontal drilling rod
- Detects assets close to the drilling head (2 ft)
- Provides visual information for the operator





Thank you

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