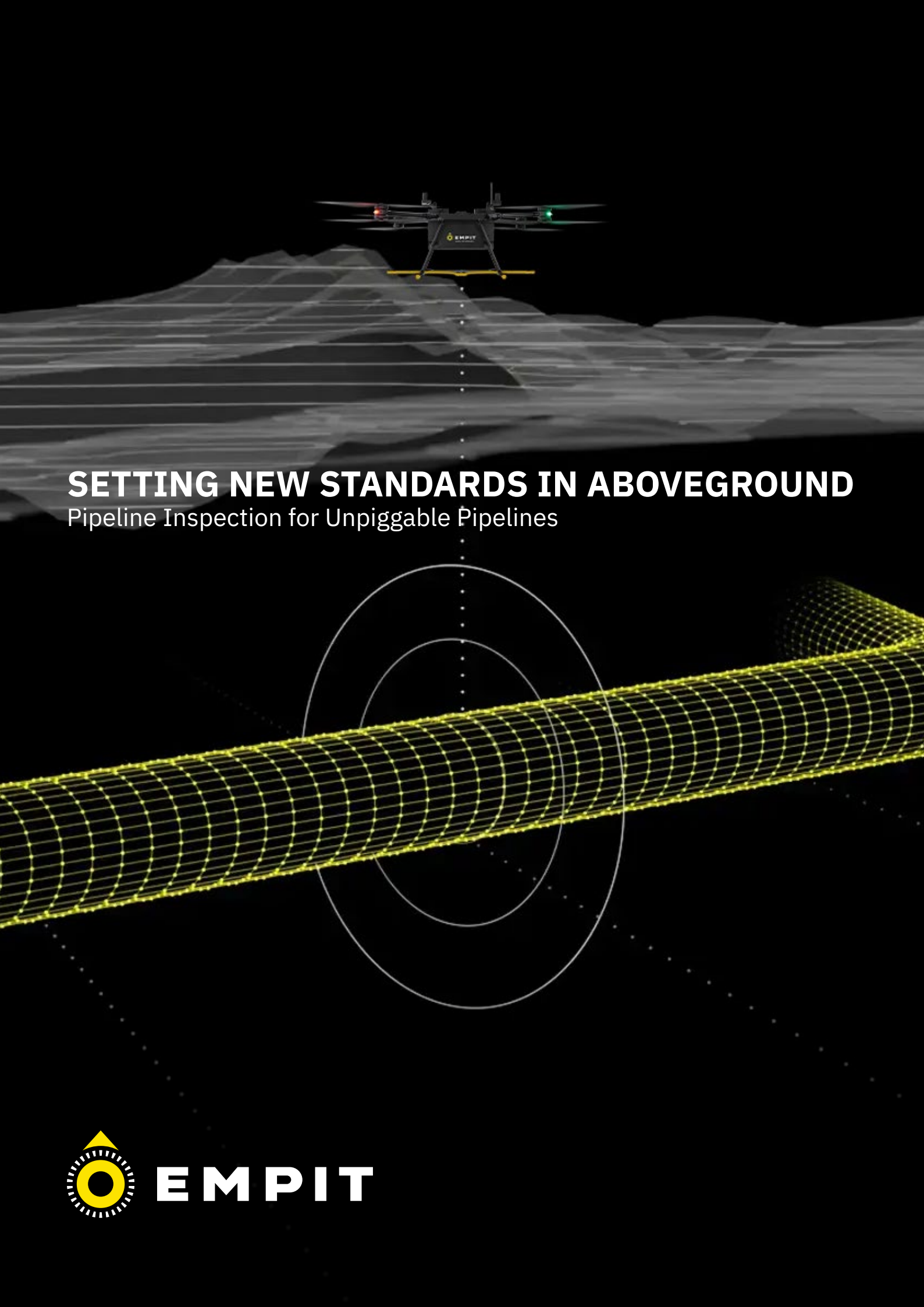

SETTING NEW STANDARDS IN ABOVEGROUND

Pipeline Inspection for Unpiggable Pipelines

EMPIT

Introduction

Roughly half of buried distribution and older transmission pipelines worldwide either lack the launch-and-receive infrastructure required or are limited by complex geometries for inline inspection (ILI) tools. These pipelines are thus, considered as “unpiggable”. This often applies to older pipelines that have in some cases already exceeded their original design lifetime. Since recurring inspections become increasingly important as pipelines age, innovative solutions are required to ensure their integrity and operational safety. This article delves into the advanced technologies and methodologies employed in the inspection and maintenance of unpiggable pipelines from above ground, highlighting the role of EMPIT and its groundbreaking Current Magnetometry Inspection (CMI) technology.

Understanding Unpiggable Pipelines

Unpiggable pipelines are those that cannot be inspected using conventional pigging tools due to various physical and operational constraints. These pipelines may have multiple bends, diameter changes, or be located in hard-to-access areas, such as densely populated regions or environmentally sensitive zones. In addition, the documentation of especially elderly pipelines is often inaccurate or unreliable, leading to the uncertainty if they are suitable for ILI or whether the pigs might potentially get stuck in the pipeline and if so, where.

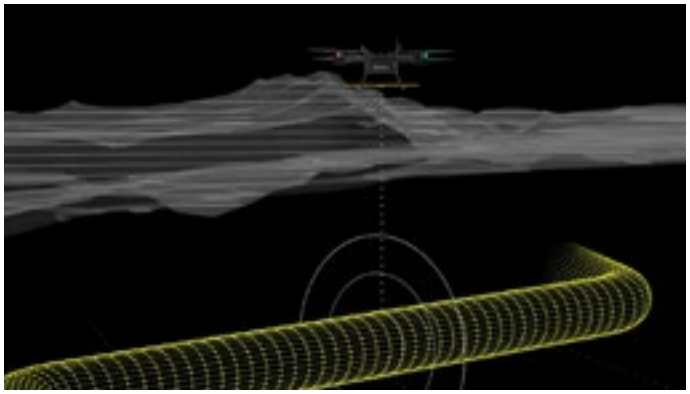

Figure 1: schematic image of the inspection of a pipeline with bends unsuitable for ILI assessment

Unpiggable Pipeline Inspection Technology

Innovations in pipeline inspection technology have significantly improved our ability to monitor and assess unpiggable pipelines. These advancements to assess 3D mapping and integrity assessment include robotic inspection tools, tethered inline inspection systems, and digital twin technology, all providing comprehensive data and insights into pipeline trajectory and conditions. While innovative inspection technologies have expanded the options for assessing unpiggable pipelines, their large-scale adoption remains limited due to several practical constraints (complexity, measurable distance, costs, specialized personnel).

To assess pipeline integrity without 3D-mapping, conventional over-the-line technologies to assess pipeline coating integrity are predominantly DCVG, and CIPS. They are used to detect coating failures and verify CP effectiveness using the IR-free potential (EIR-free) according to DIN EN ISO 15589-1. However, it can only be assessed for large coating defects with a sufficient potential gradient. It can, additionally, not be used to draw conclusions about active corrosion at defects where the CP system efficiency cannot be confirmed. According to several pipeline operators, evaluation of IR-free potential leads to an increased number of false positives, resulting in unnecessary excavations that would not have been required otherwise.

The Value of CMI

To overcome present limitations, EMPIT has emerged as a leader in unpiggable pipeline inspection with its innovative CMI technology. The method enables over-the-line, contact-free assessment of buried pipelines – including unpiggable segments – by measuring and analyzing a self-applied magnetic field around the pipe from the earth's surface. CMI combines advanced 3D mapping, including bending strain analysis, with precise defect localization and direct evaluation of the corrosion state for all defect sizes and locations. As the analyzed magnetic field is self-applied, CMI operates independently of existing CP systems and can even be applied on lines affected by strong stray currents – without shutdowns or operational interference.

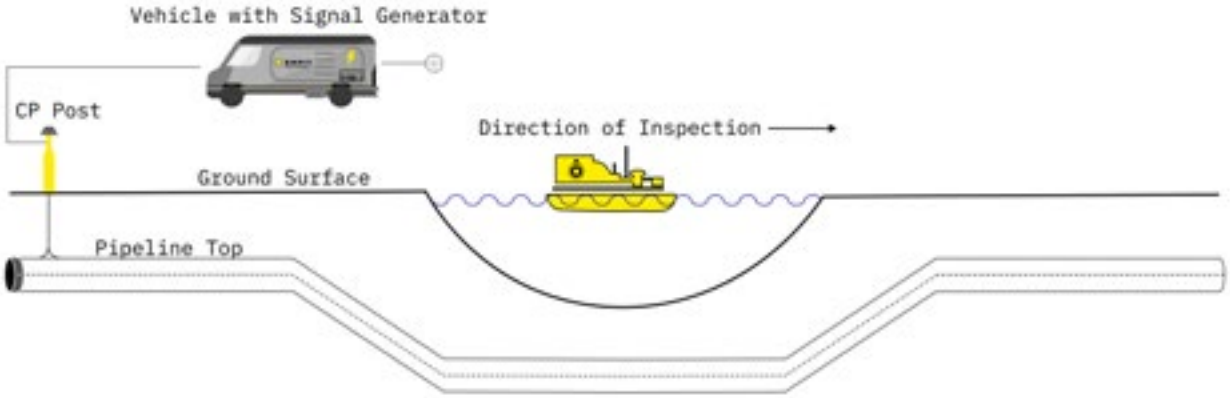

Figure 2: Schematic representation of the inspection setup with the boat serving as the inspection unit.

Unpiggable Pipeline 3D Mapping

Precise 3D mapping forms the foundation of the entire inspection process. Geo-referenced magnetic field data enable the detection and digitalization of the pipeline's position and trajectory. Seamless inspection allows for the determination of additional parameters such as accurate evaluation of bends, Depth of Cover (DoC, burial depth), bending strain, or pipeline movement. Thus, it is crucial for identifying areas of concern and planning maintenance activities

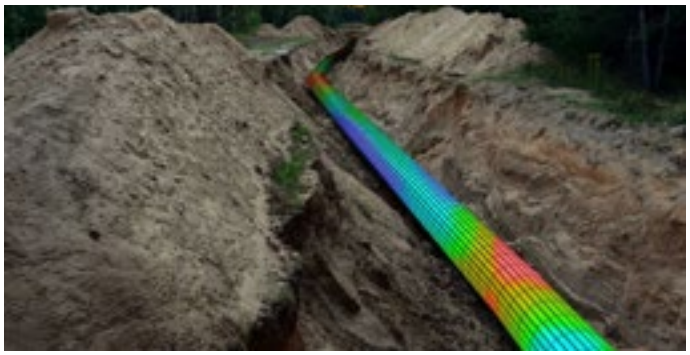

Figure 3: Representation of the determined bending strain due to pipleine movement

Unpiggable Pipeline Integrity & Assessment

Maintaining the integrity of unpiggable pipelines is crucial for preventing leaks or failures and protect the industry's assets. Regular assessments and advanced corrosion detection methods are key components of an effective pipeline integrity management program.
In contrast to conventional methods and for the first time, CMI enables reliable coating defect detection with direct corrosion assessment for each detected coating defect down to a holiday size of 1 mm². With knowledge of corrosion states (passivated conditions vs. high risk for active corrosion) it enables actionable insights into the condition of the pipeline.

It means that where ILI is not applicable, CMI can simply be used to reveal the necessary insights into these blind spots, thereby firstly allowing a reliable integrity management for unpiggable pipelines. Where ILI can be applied, CMI offers the advantage of assessing potentially hazardous areas based on their corrosion risk, rather than statically evaluating the wall loss at the time of inspection, providing actionable data instead of static conditions.

Inspection conditions

CMI is designed to inspect any conductive buried pipeline in any environment. Land-, water- and air-based inspection systems make CMI unreliable to the terrain, enabling assessments also underwater or in hard-to-access areas. Using a self-applied AC source allows the pipeline to be separated from other structures even in complex environments (for example stations) and makes it independent of its geographical alignment or geological surroundings.
In addition, the technology is non-intrusive – no shutdowns are required due to the external setup, while also cathodic protection (CP) systems are unaffected using AC current.

Real world impact

EMPIT's CMI technology has been successfully deployed on over 10,000 km of pipelines and implemented in asset strategies and maintenance strategies for some of the world's largest oil and gas companies. Independently challenged by operators and during the German research project "NEMEK", CMI proved its reliability and effectiveness in maintaining pipeline integrity and safety.

Figure 4: Overview of the inspection systems with examples of individual versions.

Conclusion

Effective asset management strategies are crucial for maintaining unpiggable pipelines, becoming even more critical with pipeline age. The inspection and maintenance of these pipelines require innovative solutions and advanced technologies. EMPIT‘s CMI technology ensures the integrity and safety of these critical infrastructures without the need of shutdowns or any operational interference.

Key advantages of CMI are:

Non-intrusive: CMI is an external procedure, inspecting contactless from the earth’s surface. No shutdowns are required, while even CP systems are operated continuously.

Designed for all conditions: Inspection systems and the external measurement of magnetic fields enable the inspection independent of terrain, pipeline geometry, ground composition or cross-industry complexity.

Actionable insights: Seamless inspections and AI-based algorithms enable cm-accuracy for advanced 3D mapping, including bend detection, DoC assessment, and bending strain evaluation.

In addition to the corrosion assessment for each detected coating defect (active corrosion vs. passivated conditions), CMI provides a reliable foundation for informed decision-making, making every dig count.

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