



Corrosion under insulation: no longer a hidden risk?

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How CUI sensors help detect moisture before damage occurs

Corrosion Under Insulation (CUI) remains one of the most insidious and persistent challenges across many industrial sectors. It mainly affects petrochemical plants, oil and gas installations, power generation facilities, and marine assets. When insulation materials are exposed to moisture, they become ideal environments for corrosion. This process often remains undetected until significant damage has already occurred.

Why corrosion under insulation is still a major challenge

One of the main reasons CUI poses such a serious risk is that it often goes unnoticed. Detection usually occurs only after structural damage, leaks, or even catastrophic failures have taken place. Traditional inspection methods, such as visual inspections, are ineffective when corrosion develops beneath insulation layers.

Despite decades of awareness, CUI continues to affect industrial installations. It leads to unplanned shutdowns, increased safety risks, and high financial losses. This persistence is partly explained by the difficulty of predicting and diagnosing CUI in real time. Accurate monitoring requires advanced technologies, materials expertise, and improved inspection methods.

InnovateCUI: testing sensors under realistic conditions

Over the past five to ten years, many different CUI moisture sensor technologies have come to the market. These innovations create new opportunities to monitor corrosion under insulation risks and support a truly data-driven approach to Risk Based Inspection. For many years, Sirris has been conducting dedicated research on sensor methodologies and coating testing. The goal is to improve prevention, detection, and mitigation strategies for CUI.

In 2023, Sirris launched the **InnovateCUI Joint Industry Project (JIP)** together with eleven partners from the oil and gas sector, coating suppliers, and energy facilities. Drawing on their practical experience, a **unique test infrastructure** was built in the port of Antwerp.

This installation consists of a 50-meter replica of a 3-inch piping system and is mainly insulated with mineral wool and aluminium cladding. Water injection points allow controlled infiltration of moisture into the insulation. This setup makes it possible to observe how different sensor types respond to water ingress and changes in relative humidity.



Which CUI sensor technologies were evaluated?

The project assessed a wide range of sensor technologies. Each system relies on a different physical measurement principle.

The evaluated technologies include:

1. Air humidity spot sensors installed inside the insulation
2. Sensors using electromagnetic guided waves travelling through the annulus Between pipe and cladding
3. Sensors measuring electrical capacitance or resistance across the insulation
4. Optical fibres placed on the outside of the cladding to measure temperature profiles
5. Sensor wires installed on the pipe surface based on Electro-Magnetic Guided Radar (EMGR)

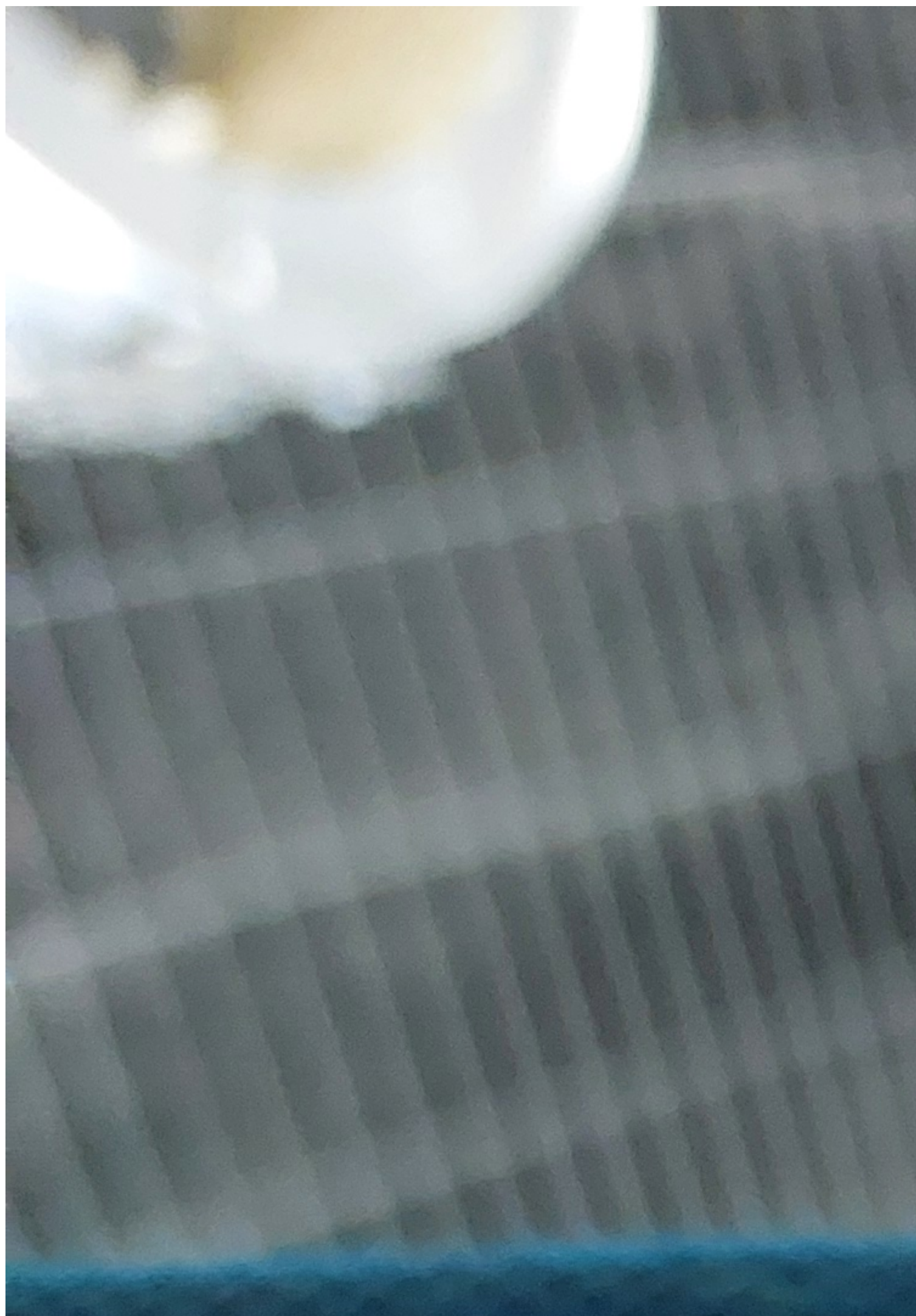
Some of these technologies also allow direct or indirect detection of corrosion activity.

Sensor performance was evaluated using several criteria. These include sensitivity, location accuracy, response at complex pipe features, and performance with different insulation types.

What 18 months of testing revealed

An extensive 1.5-year test programme was conducted in this simulated industrial environment. The InnovateCUI project clearly demonstrated that CUI sensors work.

The tested systems accurately detected water infiltration in mineral wool insulation. They also enabled continuous monitoring of moisture or liquid water presence. Since moisture is the main driver of CUI, these sensors provide a practical way to monitor corrosion risk before damage occurs.



Why different sensors report moisture differently

Although the InnovateCUI project showed that all tested sensor types can detect moisture, significant differences exist between technologies. Each sensor measures a different physical quantity. As a result, the interpretation of moisture varies from one system to another. A specific day may be classified as “wet” by one sensor but not by another. In both cases, the systems can still function correctly.

Understanding these differences is essential. It helps determine which sensor technology is suitable for specific use cases. It also supports informed O&M decisions based on sensor data.

Phase 2: moving closer to real industrial use cases

A second phase of the InnovateCUI JIP will be launched in April 2026, building on the insights gained from Phase 1. While the project has already demonstrated the potential of sensor systems to reduce risk and improve inspection programmes, several questions remain. These include performance for different insulation types and specific use cases, such as sweating service and pipe supports.

Phase 2 will therefore focus on **sensor behaviour under even more realistic industrial conditions** and across **different insulation system designs**. The goal is to provide clear guidance on where specific sensors deliver reliable results, and where they should not be applied.

Based on the results, participating companies will be able to develop internal guidelines tailored to their needs. At the same time, companies are encouraged to start **implementing CUI sensors in the field**. Only by combining controlled testing with real-world experience can this technology reach its full potential.



Understanding the degradation of CUI coatings

In addition, the project investigates the degradation of CUI protective coatings. The aim is not only to improve test methodologies, but also to better understand how these coatings degrade under realistic conditions. This insight is crucial for estimating coating lifetime and long-term performance in the field.

Is your company facing challenges related to corrosion under insulation?

Joint industry projects bring together complementary expertise to address complex problems that cannot be solved by one organisation alone. If you would like to learn more about Phase 1, access the final reports, or explore participation in Phase 2, feel free to contact us for more information.

[Contact us](#)

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