WHAT LIES BENEATH? CORROSION UNDER INSULATION

COMPLETE CUI MANAGEMENT ENCOMPASSING INSPECTION, MAINTENANCE AND REPAIR
TACKLING THE CHALLENGE OF CORROSION UNDER INSULATION

Corrosion Under Insulation (CUI) is perhaps one of the most significant integrity threats that the oil & gas industry faces today.

Water ingress causes damage to pipework and other susceptible steel elements, but the corrosion process underneath existing insulation materials is one of the most difficult to prevent.

A common inspection technique used for CUI is to simply remove the insulation and perform a visual inspection initially.

The removal and reinstatement of insulation is labour intensive, expensive and in many instances completely unnecessary, as the substrate can often be found to be in good condition.

With that in mind, Bilfinger Salamis has invested in solutions that allow asset owners to monitor the condition of insulated pipework more efficiently.

Bilfinger Salamis offers a complete CUI management programme encompassing inspection, maintenance and repair (IRM).

Combining knowledge and capability across a range of disciplines makes the management of CUI a seamless process with one contract and one fully integrated team.

“Up to 60% of pipe leaks are attributed to CUI.

Despite the problem being well understood and documented, the corrosion process under insulation is one of the most difficult to prevent.

It’s time that changed.”
CUI MANAGEMENT - THE BILFINGER WAY

• Significant cost savings through integrated team and improved scheduling
• Reduced onshore management team
• Reduced POB on site
• Increased contractor control of work-scopes
• Delivering Inspect/Repair/Maintain (IRM) strategy
• Accelerated identification and close out of anomalies/defects
• Fewer interfaces
ADVANCED DETECTION TECHNOLOGY - PEC

While CUI remains a wide spread problem, the need for more effective and more efficient inspections and NDT techniques is ever increasing.

Bilfinger Salamis has significant experience in a range of techniques, and can advise what would be most appropriate in any given situation, including:

- Visual Inspection
- Pulsed Eddy Current (PEC)
- Digital Radiography
- Passive-Infrared Thermography
- Drone Technology
- Rapid Close Visual Inspection Teams

**PEC - Reinvented**

PEC is one of the most effective and efficient methods of determining the severity of CUI, with minimal intervention - reducing the costly need for insulation removal and replacement in certain situations.

We are UKAS – ISO/IEC 17020:2012 accredited for the application of PEC, and with over 8 years’ experience across a range of applications worldwide.

Historically PEC has been used to inspect for corrosion beneath insulation, through fireproofing materials and even through marine growth on offshore structures, and though PEC imaging has been known for a long time, the technology used to carry out inspections has advanced rapidly in recent years.

PEC readings as recently as early 2016 needed to be carried out on a point-to-point basis, making it time consuming to capture all of the angles and positions required to scan a length of pipework.

Bilfinger own and use handheld Eddyfi Lyft™ PEC systems for rapid real-time inspection data of wall thickness with full traceability. The innovative system runs continuously, reducing the time required and significantly increasing the number of data points available, providing greater certainty of results.

**PULSED EDDY CURRENT**

Pulsed Eddy Current inspection is an established and proven electromagnetic technique.

It works by injecting an electrical current in the transmitting coil of the inspection probe, which in turn induces a magnetic field into the underlying structure.

This field penetrates through the non-conductive coating (in excess of 200mm) and magnetizes the steel wall which lies beneath the coating.

When the exiting coil is switched off there is a decrease in magnetic strength and the induced eddy currents, this decrease or decay is monitored by the PEC probe and used to determine the wall thickness.

The thicker the wall, the longer it takes for the eddy currents to decay to zero. PEC is therefore the analysis of transient eddy currents in a conductive component following a sharp electromagnetic transition.
**EDDYFI LYFT™**

Lyft™ contains all the typical design elements expected from a high-end NDT product, such as a large touch screen, battery operation and a harness to make it truly portable.

Lyft™ has specific embedded software to facilitate the process of creating an inspection set-up, conducting the examination and generating the associated report.

Coverage offers a vastly improved scan resolution in dynamic scan mode, with PEC measurements shown in a colour scale format as a % of the remaining wall thickness to clearly identify defect location and extent.

By taking multiple readings across the surface, the system can then provide an overall map of the area.

Lyft makes it possible to take over 10,000 readings per shift compared with just 1,000 using previous technology.

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**Where Can Pulsed Eddy Currents Be Applied?**

- Any carbon steel product and through any non-conductive coating/insulation up to 200mm
- Rapid screening tool for CUI
- Inspection through fire-coatings and fire bricks
- Inspection through marine growth
- Detailed inspection of corrosion blisters

**Benefits**

Our innovative technology is a major improvement over previous PEC methods. The re-invented system has made a major leap not only in terms of inspection speed but also in defect detection size.

- Faster inspection time
- Wider coverage
- Repeatable and reliable results
- Better detection capabilities due to greater scan resolution
- Easier analysis thanks to simpler scan patterns
- Improved positioning and sizing due to encoded data
- Advanced wall thickness sizing compensation for greater defect sizing capabilities
Digital Radiography

Bilfinger Salamis UK utilises digital radiography (DR) as an accurate and efficient alternative to conventional film/computed radiography for the in-service inspection of wall loss in pipe, in particular under insulation, or to look at remaining thickness underneath scabs.

Exposure and image formation happen simultaneously, allowing near real-time image capture, with the image/radiograph available for review only seconds after the exposure.

This eliminates the need for darkroom and chemical waste disposal, with software allowing quick and simple interpretation of low thickness or corroded areas.

Passive Infra-Red Thermography

Passive infrared thermography is an indirect technique for CUI inspection, in that it is used to locate areas of wet insulation which are often associated with CUI.

Thermography is a rapid, non-contact screening technique in which the infrared camera can be used at a distance of up to about 20m from the component.

Visual Inspection - Drone Technology

Drone technology can be deployed on an ad-hoc basis, however Bilfinger’s experienced NDT technicians are also fully trained UAV pilots, minimising personnel requirements.

Bilfinger utilise the Falcon 8 UAV’s full inspection package which includes a high-resolution digital camera, making it ideal for visual inspection, including flare and under-deck inspections.

The Falcon 8 is also fitted with a fully functional FLIR camera which includes second generation digital enhancement technology making even small thermal leaks detectable from large distances.
MULTI-DISCIPLINED TEAMS: ONE PROVIDER, ONE CONTRACT

Bilfinger Salamis offers some of the most advanced methods and technologies available and combine this technology with multi-disciplined close visual inspection teams.

Rapid Close Visual Inspection Teams

Combining knowledge and capability across a range of disciplines makes the management of CUI a seamless process, with one point of contact and one fully integrated team.

Bilfinger Salamis has highly skilled rapid close visual inspection (RCVI) teams that consist of multi-disciplined rope access personnel who can quickly deploy a range of CUI management processes.

This is a single point process – one contact one contract.

These teams include specialists for access, survey inspection, and advanced NDT, as well as coatings, insulation and other specialist areas.

The RCVI teams can quickly access remote areas, conduct an initial survey to highlight potentially sensitive areas, perform relevant inspections, conduct any coating repairs, reinstall insulation and have an asset back in working order with minimal interruption to service.

We focus on minimising resources needed to carry out the work. Our inspection and fabric maintenance departments work together, using small three-man multi-skilled teams that include an inspector, insulator and painter, all of whom are rope access qualified.

Bilfinger are in a unique position within the industry to be able to combine all of the above services into one multi-disciplined team, reducing labour costs and providing optimum results for asset owners.
END TO END EFFICIENCY: STRATEGIES ALIGNED TO ASSET LIFE

In instances where CUI has been detected, our Remote Close Visual Inspection team will develop the most efficient and cost effective repair plan.

Bilfinger Salamis develop a fabric maintenance execution strategy for each of their workscopes dependent on asset life:

**Surface preparation methods**
- Blasting
- Bristle blasting
- Mechanical Preparation

**Coating systems**
- Late life coatings
- Reduced coating systems - guarantee asset life but reduce application time.
- Temporary flange and pipe repair systems inc. composite wraps

**Insulation systems**
- Heat conservation
- Winterisation
- Personal protection
- Cold conservation
- Acoustic insulation

**Access methods**
- Rope access
- Conventional scaffolding
- System scaffolding (both steel and lightweight aluminium)
- Tensioned under deck systems (SALdeck)
- Suspended work cradles
- Lightweight portable access platforms

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**ASSET LIFE: 10 + YEARS**
- Full integrity solution and focus on surface preparation and fit for life repairs and coatings.
- Implement a zonal approach to target all P1 and P2’s in local areas which will maximise close out rates.

**ASSET LIFE: 5-10 YEARS**
- Implement find and fix approach to execute local P1 and P2 priorities.
- Review fit for purpose mid-life coating and insulation specifications.
- Review surface preparation methods and reduce the need for blasting where possible.

**ASSET LIFE: 0-5 YEARS**
- Look to action safety/integrity critical items only.
- Review minimal surface preparation requirements, and utilise Bilfinger Late Life Coatings solutions.
- Minimise spend on access and encapsulation.
Tablet Technology - Integrity Reporting

Traditionally, significant non-productive time was spent by NDT technicians creating inspection reports and transferring inspection results onto clients’ integrity management systems onshore.

In conjunction with Apollo, Bilfinger have modernised the offshore integrity enactment process through electronic data harvesting with an onshore integrity management module - S.TAR.

The S.TAR tool allows OIEs to download and work to electronic workpacks whilst recording data in real time through ATEX-rated tablet devices. Once data has been collected according to the workpack, the tablet uploads the information wirelessly, and synchronises with the onshore office-based database.

This results in an efficiency increase of up to 20% in the offshore inspector’s time whilst providing immediate access to anomaly information.

Coatings and QC Reporting

Bilfinger Salamis has also developed a tablet-based coatings survey and QC reporting management tool in relation to our core integrity and FM services.

Working with Carboline and American software developers TruQC, we have developed Total Asset Management (TAM) which is a bespoke inspection/FM database to help survey and record details of any asset integrity or coating campaigns.

Specialising in worksite project controls, TAM is flexible allowing databases to be tailored to suit our offshore requirements.

This cutting edge software gives Bilfinger the opportunity to make considerable improvements in the efficiency of the integrity management and reporting process through simplification, improved record keeping, access to historical survey data, and bespoke reporting, contributing to significant cost saving.

Benefits:

• Eliminate Paperwork – Electronic reporting that can be easily retrieved. No more paper files that can get lost, damaged, or need to be archived for years.

• Real-Time Data – QC records sync every 5 minutes and are shared daily with the project team and client, as work is progressing and completed. No surprises at the end of the contract.

• Increase Efficiencies – Wireless device integration.

• Asset Management – Track assets throughout lifecycle. Coating work and maintenance is fully traceable

• Ensure Compliance – No more incorrect, incomplete copies of Quality Control records. Unlike paper copies, all required fields must be filled in prior to saving. Date and time. Date and time stamped, and fully traceable back to site applicators/inspectors.

• Documentation Storage – Link file notes, drawing, site maps, before and after photographs with just a few clicks.
BILFINGER REFERENCES
(SELECTION)

O1  TAQA
Scope: Provision of all inspection and FM integrated services across all 5 UKCS assets.

Highlights:
• Significant cost savings through integrated team and improving scheduling.
• Displaced a range of inspection and FM vendors into one single managed service.
• Increased contractor control of work scopes.
• Delivering IRM strategy.
• Removal and streamlining of various integrity survey databases.
• Accelerated close out of anomalies/defects.
• Fewer interfaces.

O2  CONOCOPHILLIPS
Scope: Provision of an integrated multiservice fabric maintenance service to CoP on manned and unmanned installations (onshore and offshore) across the UK.

Highlights:
• Utilisation of highly trained and multi-skilled flying squads, including HLO, rope access, inspection coating, insulation, welding and minor modifications shuttling around the field carrying out priority repairs.
BRITANNIA OPERATOR LTD

Scope: Development of a new innovative fabric maintenance strategy and integrated service to Britannia Operator Ltd.

Highlights:
- Reduced downtime and schedule provided significant cost savings.
- Small, highly trained multi-task team delivering a “find and fix” FM strategy.
- Introduced inspection technician into the core FM team to accelerate the release of pipework for blasting and rapid close out of anomalies.
- Introduced all year round blasting/coating capability through use of pioneering encapsulation techniques.
- Introduced specialist modern coating systems with a quality guarantee.
- Introduced lightweight quick erect systems scaffolding.
- Zonal campaign team also conduct repairs to pipework, flanges, deck penetrations, pipe supports, gratings, handrails etc.