CUI, C U LATER

John Musgrave and Kelly Morris, MISTRAS Group, USA, outline a pipeline inspection technology to provide advanced corrosion under insulation detection.

Corrosion under insulation (CUI) in piping can be difficult to detect and even harder to mitigate, particularly when CUI is present in areas that can be challenging to access or inspect through traditional methods.

Imagine this: owner-users are presented with a myriad of problems in conducting a thorough screening for CUI in piping systems and circuits. The limitations presented by access issues, surface condition, insulation type, probability of occurrence and speed of inspection, often lead to costly scaffolding builds and insulation removal to attain an appropriate level of assurance.

In these situations, many times, non-destructive evaluation (NDE) screening mechanisms leave an owner-user in the uncomfortable position of not having a complete picture of what is happening within their asset. Adjacent to that problem lays the unsustainable cost of massive insulation removal projects and/or an overwhelming commitment of manpower and money towards quantitative NDE methods – such as profile radiography or stripping, and using visual inspection and/or 3D corrosion mapping.

In this untenable situation, industry leaders in the non-destructive testing (NDT) field – such as MISTRAS Group, a global, OneSource provider of asset protection solutions – are constantly searching for new, more effective ways to combat CUI. To this end, MISTRAS utilises a cost-effective solution: the automated radiography (ART) system, an inspection tool designed to provide more insightful data and faster inspection results than before.

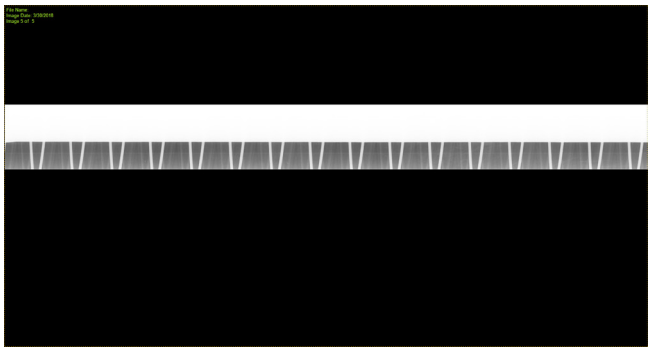

Figure 1. High-definition pipeline scans show potential pipeline abnormalities with DICONDE-compliant radiographs.

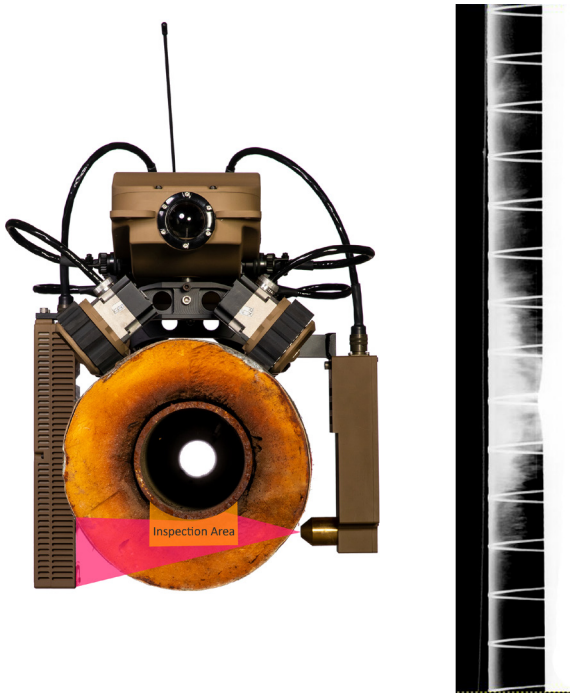

Figure 2. Using a tangential radiography technique, the SMART Crawler conducts scans through insulation, including lines with product in the pipeline.

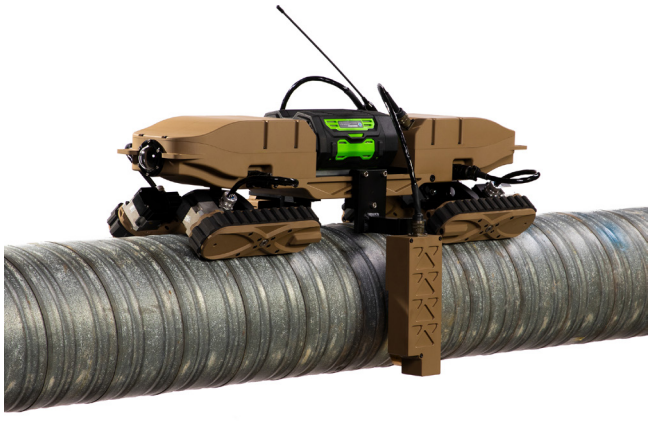

Figure 3. The SMART Crawler enables inspections in hard-to-access areas, with its mobility limited only by obstructions on the pipe itself.

Traditional vs automated radiography: the results are clear

While both conventional radiographic testing (RT) and computed radiography (CR) provide a permanent record of inspection, they are both exceedingly slow when trying to conduct large scale screening efforts. A typical crew output in an 8 hour day would be hard pressed to provide more than 50 ft of quality inspection results. Utilising current handheld digital radiography (DR) units, crews are able to turn out 3 - 4× more work than RT or CR, but at a much lower quality of inspection.

The current handheld DR technology supplies radiographic images to the operator in low quality video; the detection of either wet insulation or corrosion issues are entirely dependent on the aptitude and attentiveness of the operator and a permanent, auditable record is not maintained. Confounding the issues with DR are the difficult ergonomics and overall reliability of the handheld DR systems.

MISTRAS' ART system utilises a tangential radiography method. The radiation beam is positioned perpendicular to the tangent of concern on the pipe (typically six o'clock, the bottom of the pipe), with the radiation detector (RT film, CR plate, DR panel) positioned perpendicular. The resulting radiograph displays the pipe to insulation interface, any associated corrosion scale or wall loss, and the moisture content of the insulation captured in the radiograph.

State-of-the-art

Utilising the ART system, many of these concerns in conducting a thorough CUI survey are addressed head on, specifically in terms of speed of data acquisition and the resulting imagery.

The crawler is capable of inspecting 100% of a piping circuit in the time it takes manual methods to inspect 10% of the line. It has also enabled a crew of three technicians to inspect over 1 mile/d of pipe.

ART's data archiving capabilities also offer significant benefits over traditional RT, by supplying images compliant with the Digital Imaging and Communication in Non-destructive Evaluation (DICONDE) standard. While traditional radiography provides data imaging by utilising film and subsequent slower process speeds, ART comes through with a more advanced alternative. Delivering a 100% image retention and corresponding DICONDE-compliant high quality radiographs, ART technology allows radiography operators to review video and radiographic results simultaneously, allowing for faster data collection, processing, and analysis. These images are also automatically digitally stored, providing a long-term, easily traceable, and readily available record of damage inception and growth.

Other advantages of utilising automated radiography in combination with a pipeline crawling device include:

- Crews only need to handle the unit when moving it around obstructions.
- Every foot scanned is saved and able to be reviewed and/or audited as operators use software-based measurement, analytical and annotation tools.
- Scans 20× the amount of piping accomplished by a manual method crew, enabling 100% screening when only a spot inspection was possible before.

- The system can be set on the pipe and driven to a dangerous or at height area for inspection – keeping personnel safe and access costs down.
- Typical end costs are reduced by 50 - 75%.
- Technicians can instantly email inspection results of concern to the appropriate owner-user.
- ART can be configured to take up to four radiographic views in one pass.
- With the system operating at full power, the exclusion zone is typically 6 ft.
- A singular data package is produced per work shift of DICONDE-compliant high-quality radiographs and accompanying NDE report.
- Produces a corresponding, customisable visual inspection record along with radiographic images.

Case studies: ART for CUI detection

The ART system is not only a proven high-quality inspection method, but offers significant savings in terms of time, costs and resources needed to complete inspections. Recent case studies comparing MISTRAS' ART for CUI detection to manual inspection technicians, demonstrate that the use of ART can be tremendously beneficial for owners.

In one case, 200 000 ft of insulated piping required inspection. Using handheld DR systems, the project would have taken an estimated 278 days, while costing the owner-user over US$1.5 million. When deploying the ART system in conjunction with manual DR methods (for elbows and vertical piping), inspection time was cut to merely 33 days, while the costs were reduced to just over US$300 000 – saving the company over US$1 million and eight months of inspection time.

In a second project, just over 95 000 ft of insulated piping was inspected for potential CUI concerns. The use of ART again proved to offer significant time and costs savings, completing the project in just 16 days (compared to an estimated 238 when using handheld DR) and providing savings of over US$1.1 million.

The ART system is proven to be a time-saving, economically-efficient inspection technique vs comparable manual radiography techniques.

Stepping into the future

While RT, CR and DR will continue to be used as reliable NDE inspection techniques for the detection of CUI, automated radiographic testing takes this task to much greater heights. With quicker inspection times, enhanced data archiving capabilities and safer operations, the ART system is an advanced technology to help owner-users detect CUI and make more informed decisions, while gaining required insight into the condition of their asset.