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ADVANCEMENTS IN CUI DETECTION AND OVERVIEW OF MsS GUIDED WAVE

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INTRODUCTION

Corrosion is a leading cause of asset failure in the oil and gas industry. Over time, undetected corrosion degradation can cause an asset to fail before its projected lifespan, resulting in a costly repair or replacement, unplanned downtime, and lost revenue. Beyond the financial hits, undetected degradation can also lead to critical safety risks. Thus, to effectively manage mechanical integrity, organizations need reliable methods of identifying the current states of corrosion occurring within their assets. Therefore, effective inspection planning and monitoring of assets is essential to maintaining mechanical integrity.

CORROSION UNDER INSULATION

Corrosion under insulation (CUI) is a severe form of localized external corrosion that occurs in carbon and low alloy steel piping and equipment that has been insulated. This form of corrosion occurs when water is absorbed by or collected within the insulation. In these circumstances, corrosion occurs as the base material is exposed to water and oxygen. CUI commonly appears in temperatures ranging between 32°F and 300°F. Acceleration of CUI can be caused by cyclic thermal operation, intermittent service, and equipment design.

Common occurrences of CUI include the following:

- General and pitting corrosion of carbon steel, which may occur if wet insulation comes into contact with carbon steel—particularly if acidic product can leach material from the insulation.
- External stress corrosion cracking (ESCC) of austenitic stainless steel, which is a specific type of corrosion mainly caused by the action of water-soluble chlorides from rainwater or insulation that does not meet material standards.

GUIDED WAVE ULTRASONICS AND CUI DETECTION

Guided Wave Ultrasonic Testing (GUL), or Long Range Ultrasonic Testing (LRUT), is considered a viable screening approach for detecting CUI related problems in the oil and gas industry. Guided wave ultrasonic testing is a nondestructive inspection method in which low-frequency omnidirectional ultrasonic waves propagate along internal geometric boundaries, in order to detect corrosion. As the guided waves travel across the confined boundaries, the waves will then be reflected at areas with cross-sectional changes, identifying areas with corrosion. These low-frequency waves are able to travel great distances with less sound attenuation.

Not only can GUL provide expeditious and expansive coverage, it can also be used for the inspection of otherwise inaccessible assets (i.e. buried piping, roadway piping, etc.). Essentially, GUL can be used as a proactive screening tool to pinpoint specific areas

(i.e. suspect corrosion areas) which will need to be followed up with other Nondestructive Testing (NDT) methods, in order to quantify the severity of corrosion in suspect areas. By using this productive and minimally-invasive screening method, organizations can achieve efficient corrosion detection through the optimization of time, resources and efforts. For example, by screening large areas to identify which areas will need further NDT inspection, organizations will avoid the unnecessary downtime and expense associated with extensive insulation stripping, re-insulation of stripped equipment, and erection of scaffolding.

Some advantages of using GUL for CUI detection include:

- CUI detection on both carbon and alloy materials
- Large coverage area, with omnidirectional scans
- Full volumetric coverage
- Ability to inspect in-service equipment (i.e. operating ability with temperatures up to 500°C)
- Ability to be installed as a permanent CUI monitoring system

While some organizations have expressed concerns about GUL being overly sensitive, recent advancements in GUL technology and operating software have helped achieve a reduction in false calls, making GUL a viable and cost effective tool for inspection planning and asset reliability programs.



MsS SYSTEMS AND GUIDED WAVE INSPECTION

Magnetostrictive Sensory System (MsS) GUL uses a Torsional wave mode as opposed to a Flexural wave mode. This type of Guided Wave Inspection is not limited to the traditional operating frequency range of standard GUL, which ranges from 8KHz to 100KHz (typical operating frequency is between 20KHz to 100KHz). Rather, MsS GUL provides a wider frequency range of operation (ranging from 8KHz to 250kHz). Due to increased

sensitivity and resolution, MsS is able to detect areas as small as two percent cross-sectional area loss. MsS GUL also has the following advantageous capabilities:

- Increased near-field resolution
- Ability to use sectorial scan methods for large areas (i.e. no limitations on pipe diameter) and is capable of spot corrosion inspection
- Not limited to corrosion detection on just piping (i.e. can be used to inspect pressure vessels and storage tanks)
- Identification and assessment of corrosion under pipe supports
- Due to higher frequency capabilities, pipe supports, U bolts, and other geometric features have less effect on wave propagation

A PROJECT OVERVIEW DEMONSTRATING THE UTILIZATION OF MsS INSPECTION

One of the nation's largest refineries, located in the Gulf Coast region, produces heavy-sulfur crude oil and utilizes interstate pipelines to transport its products. To meet compliance, this organization's tunnel piping was due for inspection. Therefore, an inspection approach was needed to aid in the determination of both insulated and non-insulated tunnel piping conditions, and to identify areas affected by corrosion, as well as any associated leaks. Because the tunnel piping area was not accessible for visual inspection (VT) or remote visual inspection (RVI), MsS GUL inspection was identified as the optimal method, due to its advantages and capabilities.

To monitor the gulf coast refinery's tunnel piping, MsS GUL was utilized on 300 feet of pipeline. A scan was taken on each end of the tunnel, with scans in the range of 150 feet.

Key findings included:

- A thru-wall hole at pipe support
- Several areas of severe corrosion discovered at pipe supports throughout the tunnel
- Numerous lines did not meet compliance requirements due to percentage wall loss
- In two separate lines, leaks were discovered due to severe corrosion

These findings enabled the refinery to understand where to focus further inspection efforts in order to efficiently allocate time, resources, man-hours, repair efforts, and spending. Had MsS GUL not been used, this refinery would have had to alter product flow and possibly shut off active lines in the tunnel, remove the pipe supports to allow personnel into the tunnel (which involves numerous associated safety concerns), and invest significant time and planning hours in order to safely access and inspect the tunnel.

CONCLUSION

Despite advancements in insulation materials and coating applications, CUI remains a serious industry-wide problem, costing facilities millions of dollars each year. By applying asset integrity solutions, risk-based analysis, and the latest inspection practices—such as the GUL inspection demonstrated herein—many facilities can mitigate the likelihood of a catastrophic failure due to CUI. ■

For more information on this subject or the author, please email us at inquiries@inspectioneering.com.



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Adam Gardner has over 11 years of experience in power generation, alternative energy, and the oil and gas industry. His certifications include ASNT NDT Level III in Ultrasonic Testing, API Qualification of Ultrasonic Testing Examiners (QUTE), API Qualification of Sizing Examiners (QUSE), and API Qualification of Testing Examiners Phased Array (QUPA).

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