Neptune champions ACFM in Australia

At one of the world's busiest commodity ports, a Western Australian company, Neptune, has successfully applied an emerging technique of non-destructive testing (NDT) to the inspection of more than 6.3 kilometres of weld. This technique could revolutionise the examination of subsea and offshore structures, pipelines and ship hulls.

Combining technologies

The ACFM (alternating current field measurement) technique uses a combination of a surface sensor probe and an alternating current that is induced into the inspection area.

ACFM is commonly used for detecting and sizing surface breaking defects in metals. It is particularly suited to the inspection of welded structures that have been painted, as defects can be located and profiled through several millimetres of coating, thus negating the need for, and costs associated with, removing and reapplying protective coatings.

ACFM is also well suited to most applications where Magnetic Particle or Liquid Penetrant Testing is commonly used, for example, detection of stress corrosion cracking in stainless steels.

Explanation:

Under the ACFM method, if no defects are present, the alternating current produces a uniform magnetic field above the surface. Conversely, if a defect is present, the current is disrupted, thus creating non-uniformity in the magnetic field that is measured by the sensors in the probe.

Two components of this magnetic field are measured; one provides information about the depth or aspect ratio of the defect while the other shows the positions of the defects' ends. The two signals are used to confirm the presence of a defect and, together with a sizing algorithm, measure its length and depth.

Advantages of the ACFM method of inspection include:

- Equally effective application to parent material and welds on conductive metals (ferritic or non-ferritic). Particularly suited to the detection and sizing of fatigue cracks at the toes of welds, including all butt, fillet, node and nozzle welds
- Can be applied to hot surfaces and underwater
- Can provide length, depth and orientation information simultaneously. Defects up to 25mm in depth can be sized accurately
- No need to remove protective coatings from the inspection area
- Single pass scan
- Permanent digital data record for third party review
- ACFM Inspector does not need to be at the probe

*1. **Positive Defect Indication** The signal received below shows a clear butterfly plot of a more significant magnitude and deflection on the Bx and Bz traces. After Magnetic Particle Inspection this was identified as the "typical defect indication" which was an area of crazed like cracking and a more isolated linear defect measuring around 5mm.*

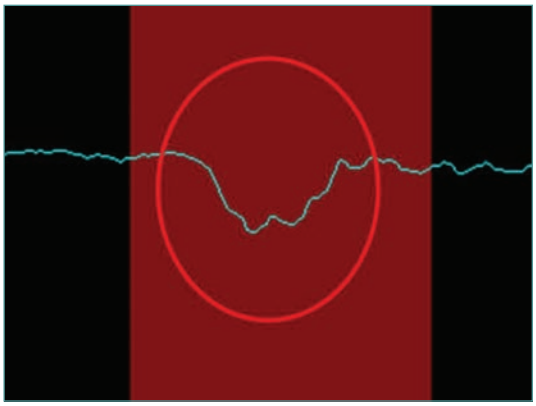


Image 1a: Bx Trace

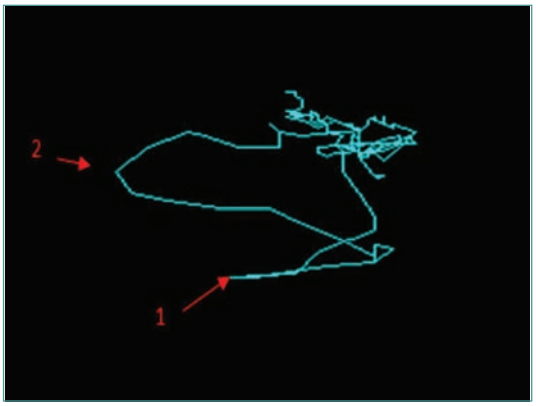


Image 1b: Butterfly Plot

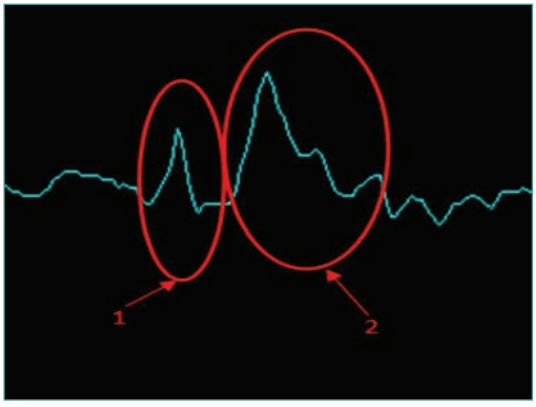


Image 1c: Bz Trace

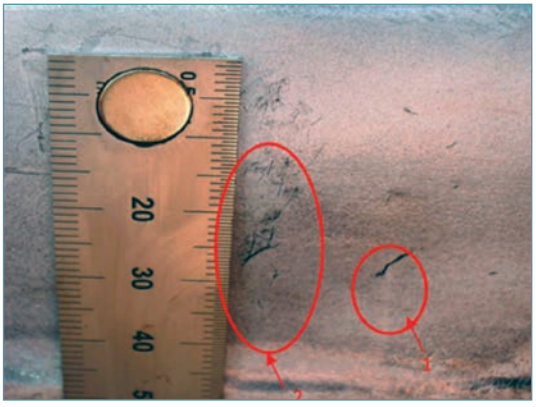


Image 1d: Corresponding test area after paint removal.

- Portability of the equipment
- Inspections can take place whilst equipment is in service
- Wide temperature range for inspection (-20° C to 500° C)
- Custom probes can be developed to suit specific inspection area/shape (e.g. turbine discs)

Common applications for the technique include: Lifting points, subsea/offshore structures; cranes, processing pipes, jacket legs, structural steel, pressure vessels, towers, ship hull welds, furnace wall tubing, theme park structures, and bridges, while many other applications can also be catered for with task specific procedures.

Taking on the Challenge

As the only company in Australia operating under combined accreditation from NATA for compliance with ISO 17025 (NDT), IRATA for Rope Access and DNV for ISO 9001, Neptune has actively championed the application of ACFM in Australia; a technique that it uses in combination with the more commonly used Ultrasonic Testing (UT) and Magnetic Particle Inspection (MPI) methods.

Their team of IRATA qualified ACFM technicians were to assess, and repair as required, over 6km of weld and adjacent parent metal without causing any disruption to the working ship loading facility, in the short time frame of 2 months.

Furthermore, the team had five weeks to mobilise (appoint and induct staff, arrange equipment, obtain all site approvals) across the Christmas/New Year period, amidst a record cyclone season.

"Onsite, most of the welds to be inspected were in difficult to access locations that required the use of specialised rope access techniques," explained Neptune Asset Integrity Services', Joe Mihic.

"In some instances, the ropes were anchored over rails that resulted in them lying across the path of a working ship loader, therefore stringent communications, scheduling, emergency stopping and standby rescue protocols had to be planned, implemented, rehearsed and observed.

"Similarly, with the majority of the wharf extending over the water, rigorous safety protocols were implemented to ensure the risks to personnel and those associated with equipment falling in to the water were minimised as much as possible. Specific rescue plans were created, rehearsed, implemented and audited.

"The need to comply with the (facility) operator's safety standards also required an audit of Neptune's safety record and safety management plan, while several planned and spot audits were conducted throughout the duration of the tender," he added.

Collaboration:

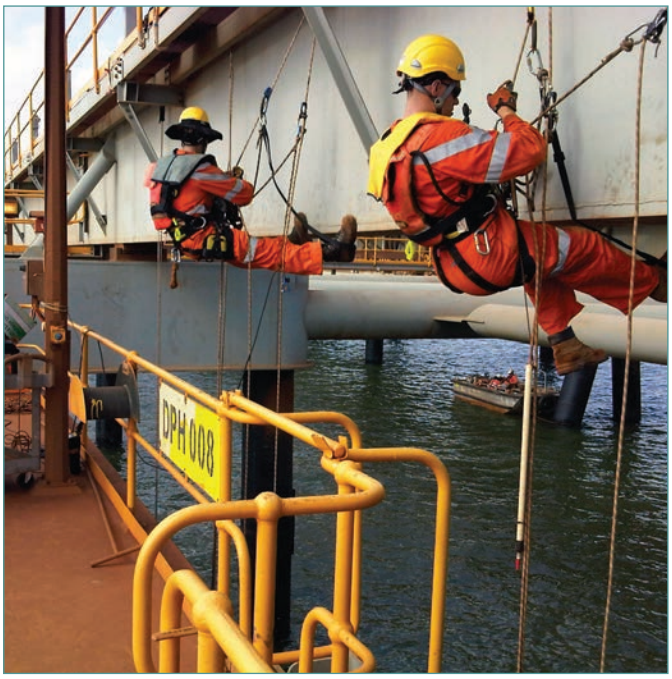
The combination of Neptune's expertise and the collaboration between all parties in relation to the tasks at hand resulted in the successful completion of the project to client specification, under budget and ahead of schedule.

The rope access technique that was employed uses adapted caving and climbing techniques to provide a safe method of working at height and gaining access to difficult locations. The primary advantage of rope access lies in the safety and speed with which technicians can get to and from difficult locations, enabling them to carry out their work, often with minimal impact to other operations.

The combination of total man hours and the particular risk level for a particular task (man at risk hours) is often reduced dramatically compared with other means of access. The technicians employed on the project worked 19,883 man hours with zero reportable incidents.

By T. Cunningham (Inspections Manager), **A.Leslie** (NDT Inspector-ACFM) & **D.Marr** (NDT Inspector-ACFM). Neptune – Asset integrity Services.

2. The work scope involved the testing of 6km of welds using ACFM NDT.



3. A team of IRATA trained ACFM technicians were mobilised to perform the NDT and repair works.