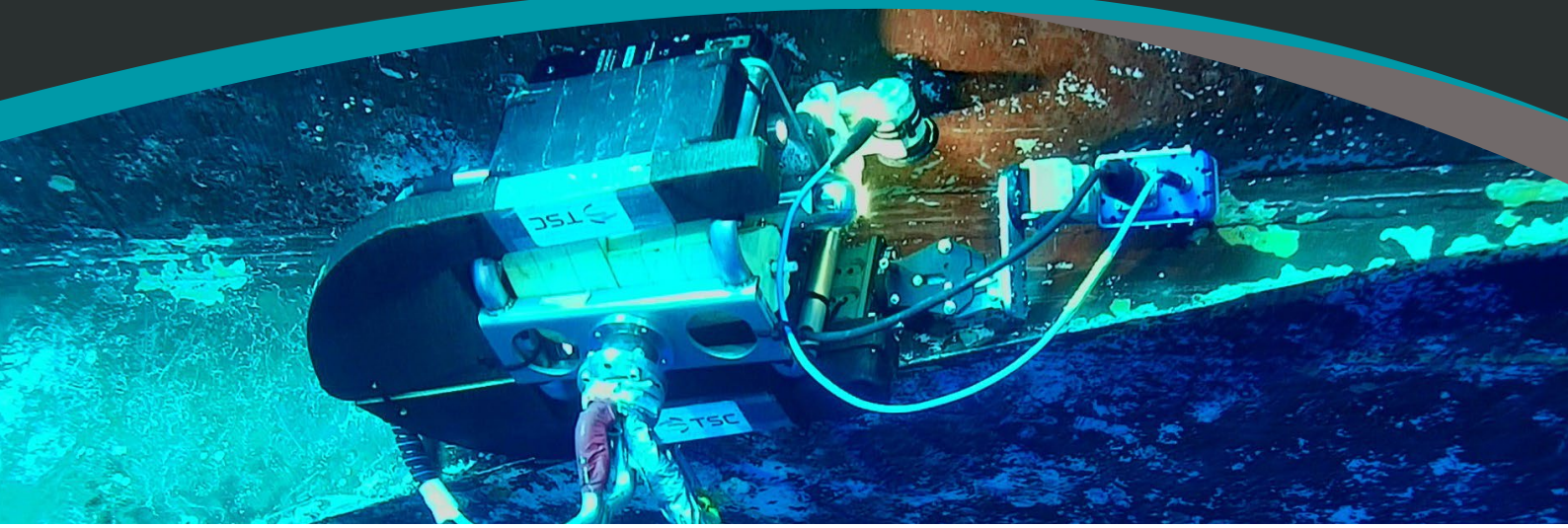
Diverless Bilge Keel Weld Inspection with Subsea Robotics and ACFM®.



INTRODUCTION

Floating Production Storage and Offloading (FPSO) operators are increasingly seeking ways to inspect their hulls below the waterline without resorting to drydocking, a costly process that entails significant production loss, rendering it inefficient and logistically challenging.

Recognising the benefits of a faster, more productive, and non-intrusive underwater weld inspection for a vessel's structure while it remains in service, FPSO operators are transitioning from traditional diver-based inspections to innovative diverless robotics solutions. This shift is primarily motivated by safety concerns and the quest for more efficient, data-rich, and practical solutions for in-service or Underwater Inspections in Lieu of Drydock (UWILD).

Since diving ranks among the most hazardous offshore activities, many operators have already implemented various initiatives for UWILD programs to minimise shallow diving. Our client is at the forefront of this evolution, actively exploring new technologies and delivery systems to enhance personal safety in underwater inspections. The focus is mainly on eliminating the reliance on divers and harnessing the capabilities of robotics. However, our client was still searching for a suitable diverless solution tailored for underwater bilge keel weld inspections.

THE CHALLENGE

Within the framework of a DNV UWILD program, our client embarked on a quest for a suitable inspection technology and a diverless deployment method to examine the bilge keel welds of FPSOs.

The challenge was twofold. Firstly, the aim was to devise a method to mitigate the risks associated with diver entering the water. Secondly, the goal was to identify a quantifiable Non-Destructive Testing (NDT) inspection technology capable of detecting and measuring cracks in welds, with a reporting threshold of 20 mm in length and 2 mm in depth.

The scope encompassed the inspection of four bilge keel end welds, each measuring 500mm in length, situated on both the port and starboard sides at the front and back of the keel.

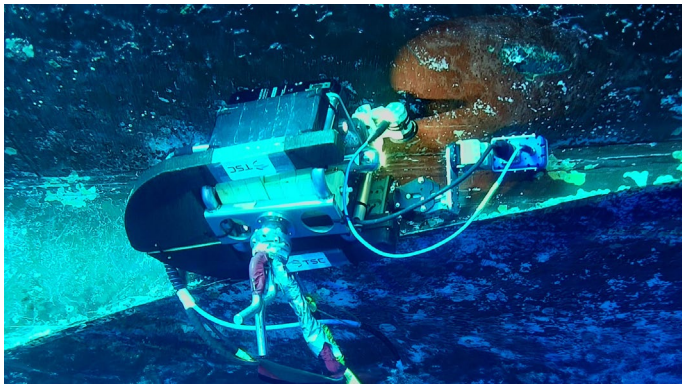
THE SOLUTION

TSC Subsea's True Alternating Current Field Measurement (ACFM®) electromagnetic inspection technology was the obvious choice. Many major operators already use ACFM for subsea inspections, and ACFM is the most widely accepted method in the subsea inspection industry for detecting and sizing surface-breaking cracks in critical welds.

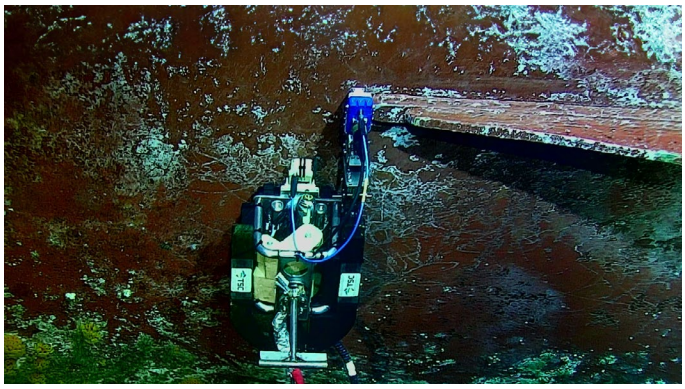
Recognised and approved by many certification bodies, including DNV and ABS, True ACFM has superseded traditional non-computerised and more user-dependent methods like magnetic particle inspection (MPI) for subsea weld inspections. ACFM is ideal for subsea environments as it is more tolerant to surface conditions compared to other more modern weld crack detection NDT techniques, such as Eddy Current (EC), which is suited to clean welds found in the aerospace and nuclear market.

Not only is True ACFM recognised by many certification bodies, but TSC Subsea is also a DNV-approved service provider for NDT utilising ACFM on Offshore Projects and Offshore Components.

TSC Subsea has a range of established subsea robotic systems proficient in conducting ACFM crack detection on subsea structures. The MagCrawler, a tried and trusted remotely operated vehicle (ROV)-deployed crawler, was the perfect solution for this particular challenge.

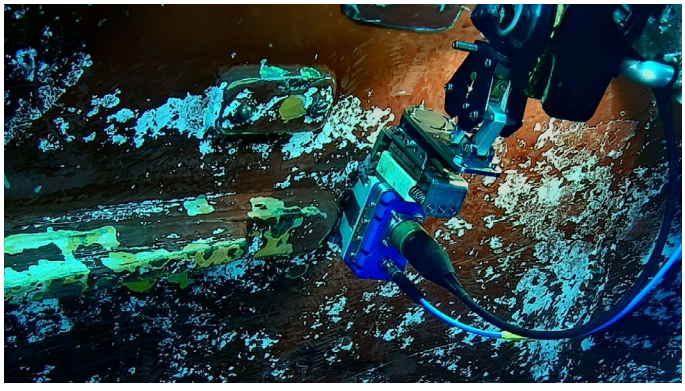


The MagCrawler's compact design makes it an ideal choice. Featuring an array probe, the crawler outperforms standard probes in speed and efficiency during weld inspections. Its rotating head facilitates seamless coverage of the entire weld and heat-affected zone (HAZ). Navigating the subsea environment, the crawler utilises two magnetic caterpillar tracks, ensuring secure adherence to the hull. Onboard cameras provide real-time visual feedback, ensuring comprehensive coverage and compliance with ACFM scan criteria.

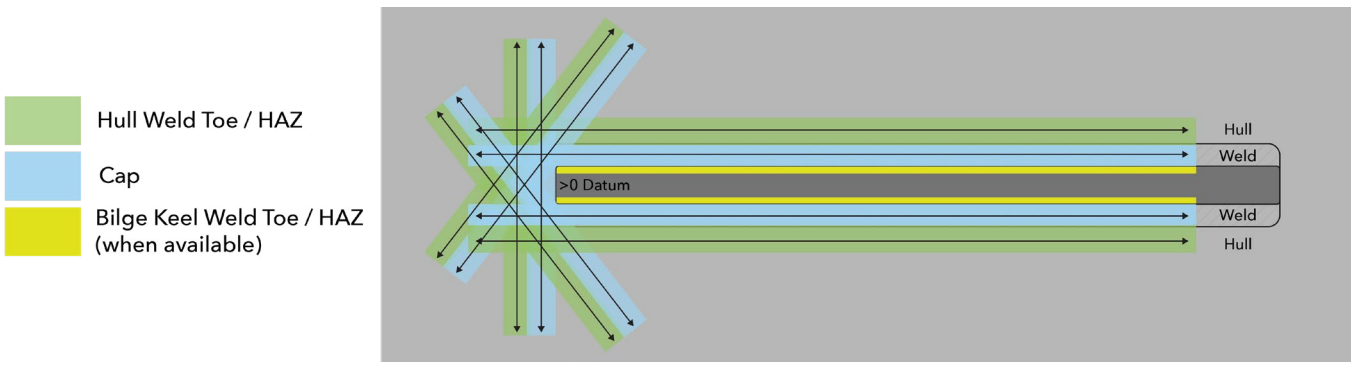


An experienced NDT technician devised a scan plan to ensure thorough coverage of all surfaces of interest, encompassing the hull weld, cap weld, plate weld, heat-affected zone (HAZ) on both sides and the Bilge Keel tip.

Before each dive, the ACFM L3 operator conducted a pre-dive function check on the ACFM equipment to confirm its proper operation. This check was reiterated at the end of a dive to validate the scan data collected.



Transported to the FPSO's hull by a Remote Operated Vehicle (ROV), the MagCrawler was securely attached using its powerful magnets. After ensuring a secure attachment, the ROV released and positioned itself to observe the inspection. The TSC Subsea operator, situated safely in the control room, manoeuvred the crawler into position. The inspection commenced with the first pass at the weld, followed by subsequent passes, each overlapping to guarantee 100% coverage.



Thanks to the consistent and controlled scan speed throughout the inspection, the scans exhibited a high signal-to-noise ratio, instilling confidence in the inspection results. This ensured that the reporting threshold for a surface-breaking defect of 20 mm in length x 2 mm in depth and larger could be easily detected throughout the inspection campaign.

The ROV operator noted that after the FPSOs had unloaded its product, the vessel's roll dramatically increased, making ROV control difficult. Unpredictable strong underwater currents generated by the FPSO were also observed. These factors highlight the dangers a diver would face and reinforce the requirement for a diverless solution.

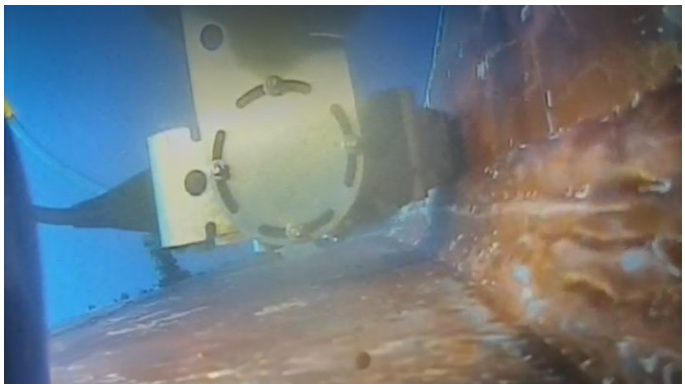
A client representative closely monitored the entire process to ensure a realistic schedule for all tasks related to the ACFM inspection.

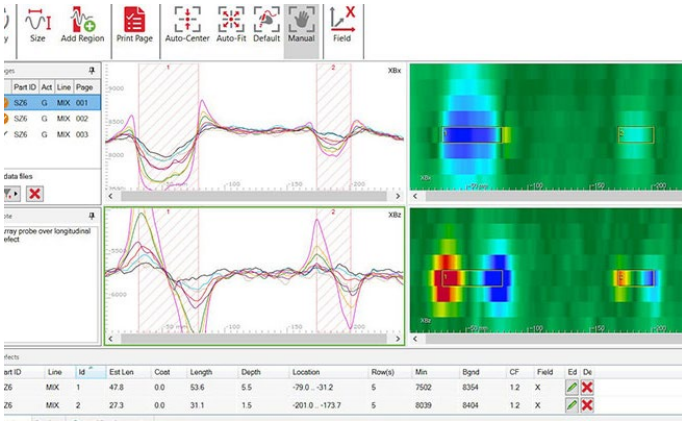
THE RESULT

The inspection proved successful, with all bilge keel welds examined within the designated time frame. No surface-breaking cracks or defects were identified above the reporting threshold of 20 mm in length and 2 mm in depth.

The utilisation of the ROV-deployed robotic solution led to a swifter and more efficient inspection in comparison to a diver-deployed approach, as the robots faced no time constraints while in the water. Additionally, the crawler's consistent and controlled scan speed contributed to more reliable inspection data, ensuring a higher probability of detection (POD).

Feedback from the Classification body indicated that the inspection yielded high-quality data suitable for integration into the life integrity assessment with the goal of obtaining a life extension certificate.





The overall inspection cost was reduced with no impact on production, and, most importantly, the inspection was conducted safely, eliminating any risk to operational personnel – an invaluable outcome.

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