Smooth Sailing with ACFM® Crack Assessment on Cargo Ship Propellers.

INTRODUCTION

The Archon Gabriel Bulk Carrier was navigating the cold waters of the Gulf of Finland. The harsh sea conditions, laden with sea ice, posed significant navigational challenges and resulted in the ship's 6-meter diameter bronze propeller suffering ice damage.

Given the uncertainty surrounding the extent of the damage, the carrier's management team called Lloyd's Register, a leading provider of classification and compliance services to the marine and offshore industries. Lloyd's Register recommended that an Alternating Current Field Measurement (ACFM®) crack detection assessment by a trusted service provider be performed as soon as possible.

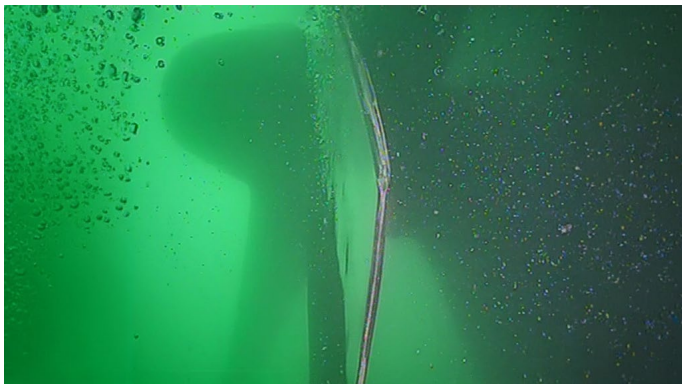
TSC Subsea pioneered the introduction of ACFM technology to the underwater inspection industry over two decades ago. Since then, it has set the standard for splash zone and underwater surface-breaking crack detection, offering the capability to not only measure crack lengths accurately but also depths of up to 25 mm (1 in).

Following an initial visual inspection by Seawide Services, it was decided to trim approximately 270 mm from the propeller's edges. However, this did not ensure the complete removal of ice-induced cracks, prompting the advice for TSC Subsea to conduct an ACFM inspection.

While TSC Subsea is renowned for its advanced robotic inspections, certain situations, like this one, called for diver deployment as the optimal solution. With the cargo ship falling behind schedule, time was of the essence. Unplanned port time results in income loss for vessel owners and potential financial claims for delays.

TSC Subsea received the call on Tuesday, and by the Thursday, two level 2 ACFM operators were on-site, accompanied by the Lloyds Register senior surveyor.

Diver entering the water



Propeller showing the trimmed edges

THE SOLUTION

The inspection scope involved scanning the full length of the recently cut edges of four propeller blades, each approximately 715 mm, and a short section on either side of about 50 mm. The propeller blades were cleaned to a suitable standard before the inspection.

Prior to the inspection, the ACFM® equipment was function-checked to ensure proper operation. This was repeated at the end of the day to validate the scan data.

The inspection system included TSC Subsea's U41 ACFM technology bottle and two ACFM probes, an array probe and a pencil probe, and a direct connection to the ACFM Level 2 analyst who remained topside.

A unique feature of the U41 system is that two probes can be connected to it simultaneously. This means the diver does not have to resurface to swap probes, which improves overall inspection efficiency.

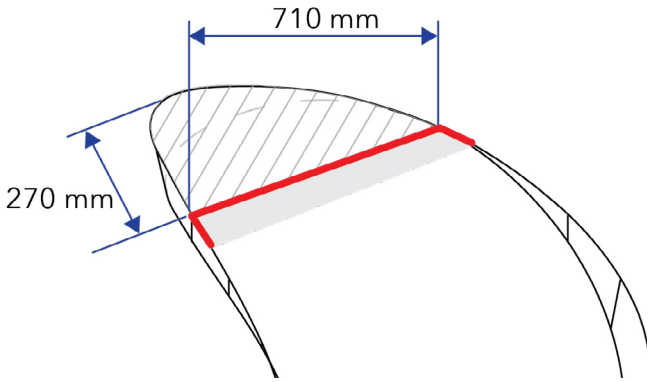
To deploy the ACFM equipment to the inspection area, the diver attached a downline to the propeller, and the topside team lowered the ACFM equipment down this line. The U41 remained on this line, with the diver retrieving the required probe from the U41 bottle at the inspection position.

Due to bronze's lower magnetic permeability compared to steel, a transverse signal would be absent or significantly smaller when scanning in the "A" or "C" directions. Consequently, detection scans were performed in the Transverse (T) direction

Array Probe: Each blade was inspected on both the pressure face and the suction face, with 5 scans carried out on each face.

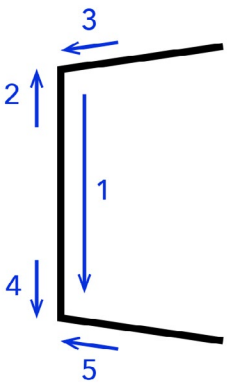
Scans 2 and 4 overlapped the start and end of Scan 1. Each scan involved 2 passes, one with the probe edge on the blade edge and another with the probe centre on the blade edge. All scans were conducted in the "T" direction.

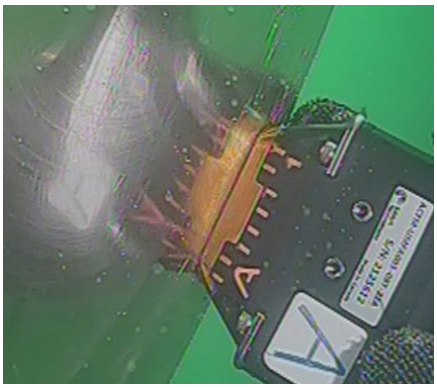
Pencil Probe: The pencil probe was used to scan the three edges (blade tip, leading edge, and trailing edge) of each blade. All scans were conducted in the "T" direction.

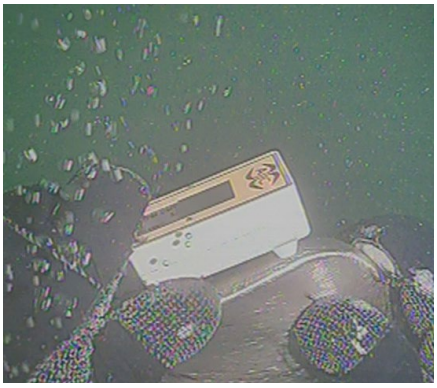


Propeller showing the trimmed section


ACFM equipment: U41 and array probe




ACFM array probe scanning


ACFM pencil probe scanning

BENEFITS OF THE ACFM INSPECTION

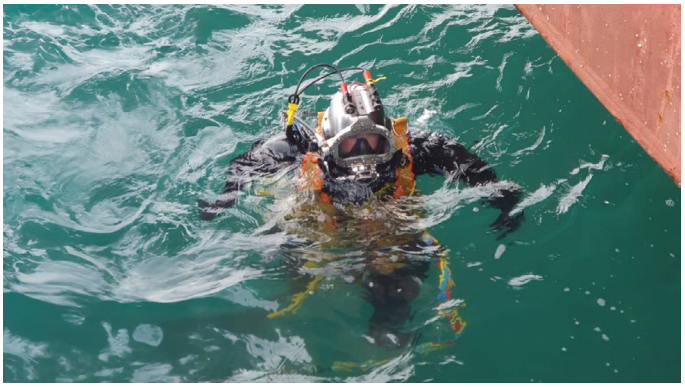
- ✓ **Accurate Damage Assessment:** The ACFM inspection provided a reliable evaluation of the propeller's condition, ensuring that any cracks or damages were detected and accurately assessed.
- ✓ **Cost Efficiency:** By confirming the absence of significant cracks, unnecessary repairs or replacements were avoided, resulting in substantial cost savings.
- ✓ **Enhanced Safety:** Ensuring the propeller was free of cracks maintained the vessel's structural integrity, thereby enhancing the safety of the crew and the ship.
- ✓ **Operational Efficiency:** The swift deployment and efficient inspection minimised downtime, allowing the vessel to resume its journey with minimal delay.

CONCLUSION

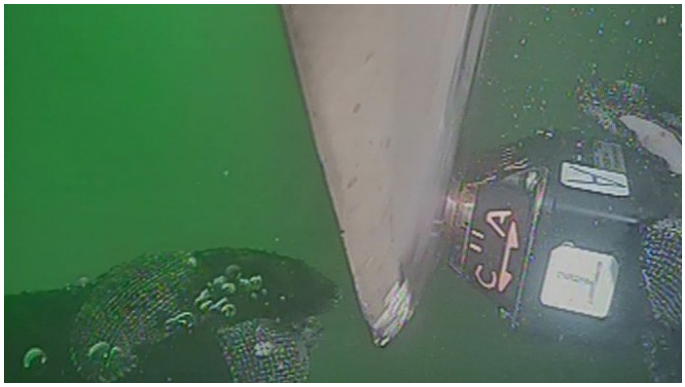
The ACFM inspection provided a reliable evaluation of the propeller's condition, ensuring that any potential cracks or damages would be detected and accurately assessed.

Throughout the inspection, detection scans exhibited a high signal-to-noise ratio due to the quality cleaning, slow and controlled scan speed, and smooth weld profiles. This suggests that surface-breaking defects at or above 20 mm long x 2 mm deep would have been reliably detected during this inspection campaign.

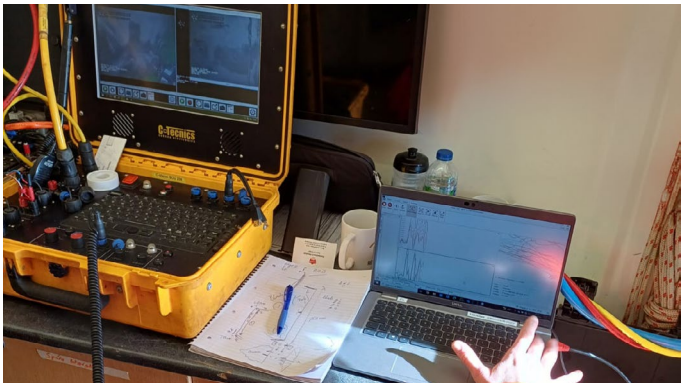
The inspection was conducted within 1 day, and no reportable defects or cracks were detected above the reporting threshold. The swift deployment and efficient inspection minimised downtime, allowing the vessel to resume within 48 hours after entering the port. By confirming the absence of significant cracks, unnecessary repairs or replacements were avoided, resulting in substantial cost savings.



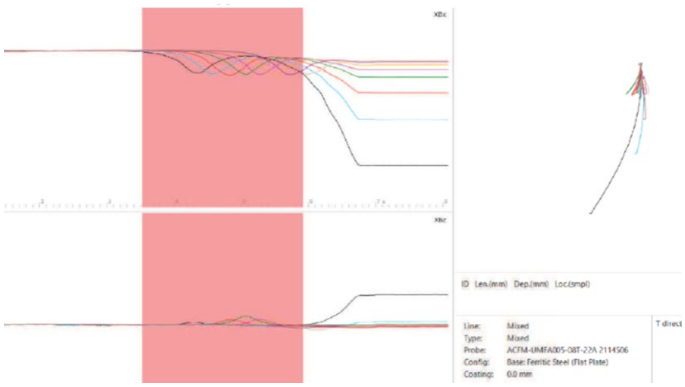
Diver preparing to inspect the propeller



Diver scanning the propeller with an ACFM array probe



ACFM technician analysing the scan data



ACFM signal from a transverse scan

Overall, the ACFM inspection was crucial in ensuring the vessel's propeller was in optimal condition, preventing potential failures and ensuring safe and efficient operations. The swift deployment and efficient inspection minimised downtime, allowing the vessel to resume its journey with minimal delay.

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