Flooded Member Detection (FMD) of Complex Riser Caisson with Acoustic Resonance Technology (ART)

THE CHALLENGE

TSC Subsea received a request from Ocean Infinity on behalf of Orsted, a Danish multinational energy company, to perform a comprehensive Flooded Member Detection (FMD) inspection on a Riser Caisson. The purpose was to ascertain whether seawater had infiltrated the caisson or if it remained dry, as per the original system design.

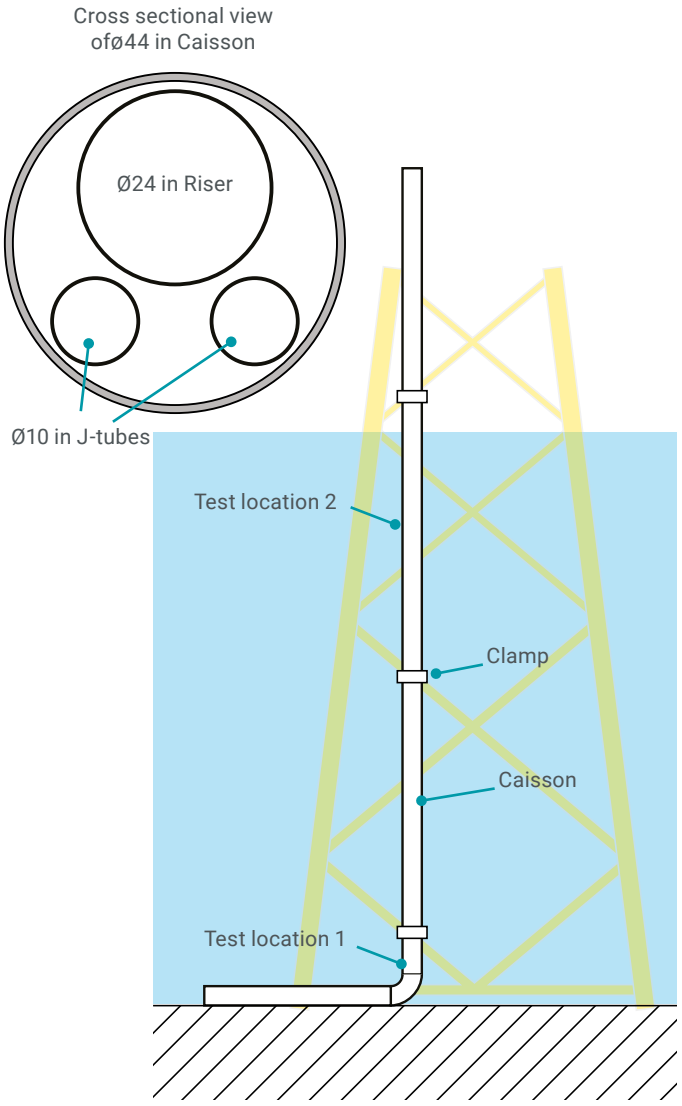
Previous attempts at FMD inspections, including traditional methods, yielded inconclusive results due to the caisson's unique characteristics.

The caisson had a diameter of 1118 mm (44 in), a wall thickness of 21 mm (0.8 in), and contained three internal risers, including a 610 mm (24 in) riser and two 254 mm (10 in) J-tubes, making the inspection even more challenging.

Orsted required a robust and field-proven technology that could be safely and cost-effectively deployed to the inspection areas and confirm for sure the status of the Caisson.

What is a Caisson?

A Riser Caisson, also known as a caisson, is a vital offshore structure used in the oil and gas industry. It is a large, hollow, cylindrical steel pipe extending from the seabed to the water's surface, protecting critical production equipment from the harsh marine environment.



THE SOLUTION

TSC Subsea proposed utilising its proprietary inspection technology, Acoustic Resonance Technology (ART), for this complex FMD inspection. ART stands out for its non-contact nature and remarkable tolerance to marine growth, making it a preferred choice for FMD assessments.

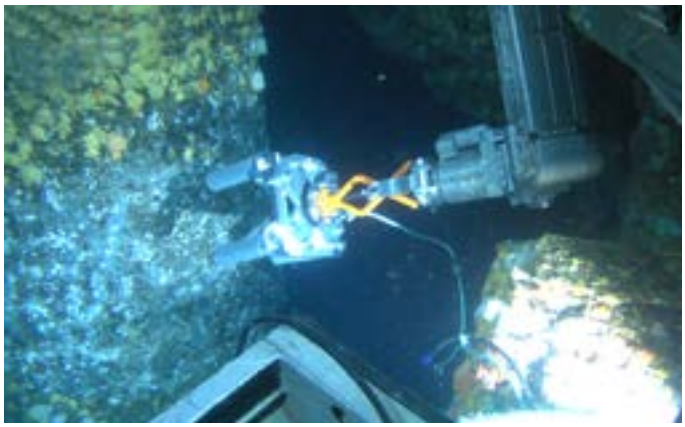
The advantage of ART is its ability to employ multiple assessment methods concurrently during the same operation, providing a more reliable conclusion. This involves combining various acoustic assessments using the same acoustic signal trace, expediting the assessment of the caisson's condition.

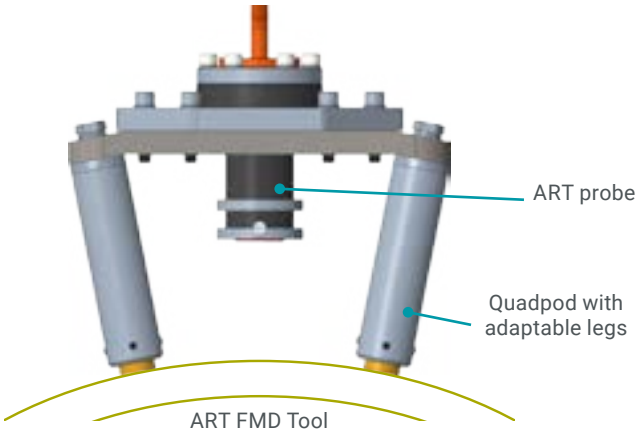
A proof-of-concept Factory Acceptance Test (FAT) was conducted at TSC Subsea's acoustic laboratory in Bergen, Norway, to prove the inspection technology and method.

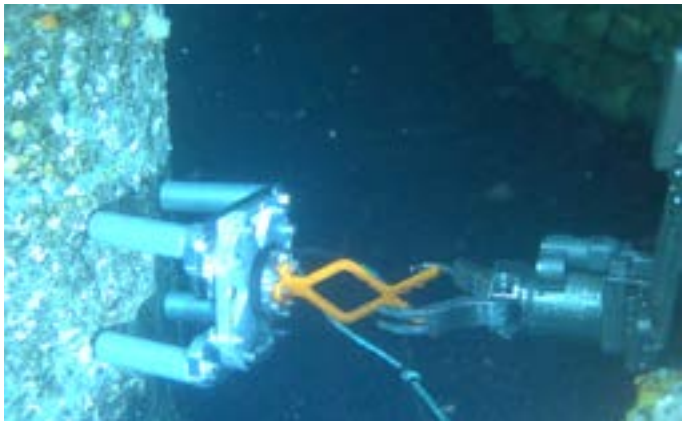
The ART FMD solution was demonstrated using a specialised mockup submerged in a purpose-built water tank to simulate subsea conditions. The FAT proved successful, with all stakeholders satisfied with the inspection procedure, detection system, and technology.

The offshore operation commenced with a Site Integration Test (SIT) to verify power, communications, and data acquisition software between the Remote Operated Vehicle (ROV). The first inspection took place approximately 500mm from the lowest bend of the caisson, with a second inspection at a higher elevation to establish a reference point where air behind the member wall was more likely.

The ROV's manipulator deployed the ART FMD inspection tool to the first inspection area. A simple mechanical assembly maintained the correct sensor standoff distance, with magnetic legs ensuring optimal acoustic angles. Fifteen scans were conducted at the first location around the caisson's external wall, followed by two additional scans at the second location.

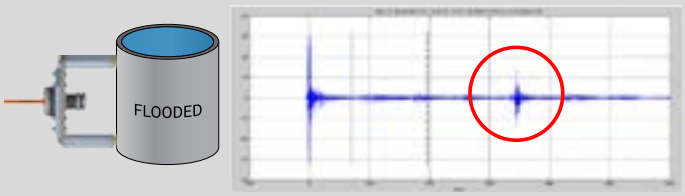






What is Acoustic Resonance Technology (ART):

At the core of ART, lies patented ultra-wideband acoustic inspection technology, surpassing existing methods in penetration capabilities. ART uses a transducer shooting a broadband sound signal toward a target. The signal duration is sufficiently long to generate oscillations in the target. As the oscillating target continues to be struck by the sound signal, the resonance greatly amplifies the oscillations. The resonating frequencies are characteristic of the thickness and material of the target.



Reflections from the back wall of the member (absent in dry member) clearly show that the member is flooded.

A clean trace confirms a dry member. Note also an undamped response from the front wall.

THE RESULT

A wet or flooded caisson posed a corrosion threat to internal production pipes, necessitating a reliable inspection. Confirming that the Caisson is not flooded reduces the risk of failure and lowers the probability of future failures.

The Flooded Member Detection (FMD) inspection was a success. The combination of ART technology and TSC Subsea's highly effective, efficient FMD tool proved to be the most dependable solution available.

The comprehensive inspection confirmed that the caisson remained dry, ensuring the asset owner's confidence in its integrity.

CONCLUSION

The presence of water within a Caisson or any other subsea structure can serve as an indication of potential through-wall defects or cracked welds. Left undetected, these issues can significantly elevate the risk of structural failure. It is of utmost importance to conduct thorough inspections to promptly identify and rectify these concerns, effectively mitigating the risks associated with water ingress and flooded members.

TSC Subsea's advanced and cost-effective ART FMD solution has excelled where other solutions have fallen short. ART's remarkable capability to penetrate thick subsea coatings and materials empowers it to identify undesired substances, such as water, within a subsea structure from its external surface. This is yet another testament to ART's status as one of the most versatile Non-Destructive Testing (NDT) technologies in the subsea inspection industry.

Thanks to TSC Subsea's ART FMD solution, we now have a powerful solution to identify water in subsea structures. This technology is essential for preventing structural issues, and it's a testament to ART's versatility in the subsea inspection field.

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