ABSTRACT

Failures in the tensile armour wires of flexible risers can be detected through the reduction in applied stress in failed wires. Further the failure can be detected many metres from the point of failure and even within the end fitting because of the unbonded nature of the flexible riser. A magnetic system for measuring and comparing the stress in all the tensile armour wires around the circumference of a riser has been built and tested. The system successfully detected wire failures caused by cyclic fatigue in a full size riser undergoing fatigue test.

KEY WORDS: Riser; inspection; monitoring; tensile armour; failure; detection

INTRODUCTION

Flexible risers are widely used to link sub-sea production systems to floating offshore installations, such as FPSOs. In deep water oil and gas exploration flexible risers are used for oil and gas production, water and gas injection, and well control and monitoring. They are multi-layered structures; typically comprising an inner flexible metal carcass surrounded by polymer layers and spiral wound steel wires, all within an outer polymer shield layer (Figure 1). This complexity means that inspection is a challenge for current NDT technologies.

If a riser fails, the resulting loss of hydrocarbon products can affect both the safety of plant personnel and the adjacent marine environment. There will also be considerable disruption to production.

It is known that the majority of flexible riser damage occurs in the section from 30m water depth up to the platform connection (Muren et al, 2008). A region of particular concern is close to the end fitting where there is a significant change in stiffness between the riser and the connector. This structural discontinuity strongly influences the fatigue processes in the tensile axial wires at and embedded in the connector. Progressive fatigue failure, possible accelerated by corrosion, can occur. Figure 2 shows an example of this failure mode (Marinho et al, 2007).

In practice, the location of wire failure is often within the end fittings of the riser, where the fatigue loading is highest but there is no access for inspection. If wire failure is to be detected before riser integrity is breached, there is thus a need for a detection method that can detect armour wire breaks from outside the end fitting.

When in service the internal pressure and axial load on the riser cause the spiral wound steel wires of the tensile armour layers to be subject to applied tensile stress. In a failed wire, however, the applied tensile stress will be zero at the point of failure and reduced over some distance along the wire from the break. The length over which the...