Production and Integrity Assurance

Mitigating Corrosion Fatigue in Flexible Risers

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Intertek

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On Floating Production Storage and Offloading systems (FPSOs), flexible risers are used to efficiently transport oil and gas from the seabed.

However, flexible risers can suffer from a failure mechanism known as corrosion fatigue. This can cause significant issues for operators and result in production downtime.

There are several ways to mitigate the occurrence of corrosion fatigue and rectify the problem if it arises during production.

Causes of corrosion fatigue in flexible risers

Corrosion fatigue in flexible risers is brought about by the flooding of the pipe annulus. Flooding is initiated either by damage to the outer sheath (which causes ingress of seawater into the annulus) or by the transportation of condensed water through the inner sheath, caused by the high pressure inside the pipe.

These two wet environments, exposure to gases such as CO_2 and H_2S and the cyclic wave loading on the flexible riser can all contribute to corrosion fatigue failure and seriously impact the service life expectancy of flexible risers.

Recommended approaches

There are several methods that should be carried out as standard in order to mitigate and tackle corrosion fatigue in flexible risers. These include corrosion fatigue testing, environmental measurements and ascertaining surface scale composition.

Testing

Carrying out corrosion fatigue testing in different aqueous environments is a standard procedure. This testing should take into account chloride concentration and gases, carbon dioxide and hydrogen sulphide, present in the annular space and the high levels of iron confinement found in the annular space.

Environmental measurements

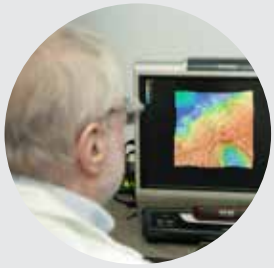
Corrosion fatigue testing work explores the effects of the different environments on the corrosion fatigue behaviour in terms of levels of iron (Fe^{2+}) and sulphide (S^{2-}) ions in solution and solution pH.

Iron saturation reduces the effects of hydrogen sulphide corrosion by the reaction of Fe^{2+} ions with the S^{2-} ions to produce an iron sulphide precipitate. Iron ion saturation will ultimately lead to a lowering of the corrosion rate.

The tests show the effects of the gases present in the environment on the acidity of the solution.

Surface scale composition analysis

X-ray diffraction (XRD) measurements show that the surface scale which typically forms on the surface of the high strength carbon steel is an iron sulphide known as mackinawite and iron carbonate.



Mitigating corrosion fatigue - our services

Our Production and Integrity Assurance team has over forty years of experience in conducting fatigue and corrosion fatigue testing.

Engaging our services can help to mitigate the problem and offer your organisation an awareness of the mechanisms responsible for it.

We carry out:

- **Fatigue and corrosion fatigue testing** to establish service life expectancy of materials. Tests can be carried out in aqueous environments containing nitrogen, carbon dioxide and hydrogen sulphide at ambient temperatures and high pressure.
- **Failure analysis of the materials** to establish failure mechanisms.
- **Surface scale analysis** carried out using X-ray diffraction techniques to establish sulphide and carbonate film formation - Iron, Calcium and Magnesium.
- **Chemical analysis** to assess solution chemistry considering Fe^{2+} and S^{2-} concentration and pH measurements.

Contact us any time for an informal discussion about your requirements.

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