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Safety Alert 001 - ANP/SSM

CO₂ Stress Corrosion Cracking (SCC-CO₂)

The Superintendence of Operational Safety and Environment is issuing this safety alert to notify the petroleum and gas industry and other stakeholders about a corrosion mechanism known as **CO₂ Stress Corrosion Cracking (SCC)**.

What happened?

An accident of this nature was reported to this Superintendence in January 2017. It involved a gas injection flexible pipe failure in its second year of operation, although the manufacturer had evaluated its service life as 20 years.

Without any previous records of such accident, classification is still on its first stages, bringing new challenges to pre-salt exploration. Researchers, however, have already identified SCC-CO₂ causes, as stated below.

Potential consequences

CO₂ Stress Corrosion Cracking may cause unexpected and catastrophic failure of a flexible pipe, leading to production losses and environmental accidents.

Causes

- Environment containing H₂O and CO₂;
- Static, cyclic or residual stress on pipe;
- Time;
- Susceptible material.

According to the operator, the most likely reason for CO₂ existence within the annulus in such a concentration enough to activate the mechanism is gas permeation across pressure armor layer. Other possible but less likely causes could be failure in the internal seal connector or fluid injection with CO₂ level above design limit.

Concerning the presence of water in the annular, the most likely cause is external sheath damage, which could have allowed water inflow. There is also a minor possibility of water having entered the annular through the connector.

Regarding tensile armor's stress, there were residual and operational stress enough to trigger SCC mechanism. Besides, the tensile armor wires material was susceptible to environment-assisted fracture (nucleation and propagation) under the design operational conditions (CO₂, stress and water) within the exposed time.

Lessons learned

ANP will share research results (CO₂ stress and fugacity envelopes) as soon as they become known, for better risk definition associated to SCC-CO₂ occurrence in subsea systems.

Contact

For additional information regarding this safety alert, please contact ANP's Superintendence of Operational Safety and Environment at sgss@anp.gov.br.