NOPSEMA
Australia's offshore energy regulator

SAFETY ALERT

Pipeline Loss of Containment

Date: Thursday, 28 September 2023

What happened?

Shortly after arriving by helicopter, on an unmanned platform, the crew observed a small amount of gas bubbles on the ocean surface, approximately 20 m from the platform. The wells were shut-in, the platform powered down and all personnel were evacuated. The leak was confirmed via ROV, to be from the upstream flange of a tie-in spool adjacent to the flange pipe weld interface connecting the gas export pipeline to the platform.

Why did this happen?

The pipeline was designed to industry codes and practice with material selection based on the expected service conditions including high temperature and carbon dioxide content production fluids. The riser and tie-in spools were designed to be internally clad with corrosion resistant alloy (CRA).

The investigation identified that ~100 mm of CRA cladding within the tie-in spool's upstream flange (i.e. at the failure location) was missing. Additionally, once the spool was inspected, the downstream flange was found to be completely unclad, contrary to the design. The exposed carbon steel areas on the flanges were subject to severe top of line (TOL) corrosion, with the upstream flange ultimately failing after over 15 years in-service.

The investigation determined that the incorrect material flanges were installed on the tie-in spool. Two factors contributed to this:

- The operator organised the procurement of the flanges, a mix of CRA clad and unclad flanges, and shipped them to the pipe yard for spool fabrication. For material traceability, two unique identification numbers were assigned to each flange component, the hubs and swivel rings. The unique identification system was not correctly implemented, and it was found that the unique identifier on the hubs was obscured after assembly with the rings preventing subsequent visual verification, contributing to the incorrect material flanges being installed on the tie-in spool and a failure to enable identification of the errors.
- The tie-in spool passed all quality control checks even though the some of the unique identifiers indicated both flanges had unclad components. Close visual inspection failed to identify any surface corrosion (blooming) on the unclad carbon steel sections of the flanges, that would have been present and clearly visible.

The integrity management of the pipeline was consistent with industry codes and standards, which included In-line Inspection (ILI) and subsea C-scan Non-Destructive Testing (NDT). ILI had been performed six (6) times over the operating life of the pipeline. The ILI tool detected the internal corrosion at both flanges, but the corrosion at the upstream flange was misinterpreted by the data analyst as sensor lift-off (movement) and not reported to the operator. There was no consideration that 'lift-off' in a clad pipe could be uniform corrosion due to a fabrication defect /error, though confirmation bias may have also been a factor.

The corrosion of the downstream flange was reported, but the operator believed the reported corrosion was located within the Subsea Isolation Valve (SSIV) assembly, which was located immediately downstream of the tie-in spool. This was partly due to the ILI vendor reporting the downstream tie-in spool flange as the starting point of the SSIV assembly.

What could have happened?

The corrosion of a tie-in spool flange could result in equipment failure under pressure and a subsea gas release resulting in a potential fire and explosion threat.

Key lessons

Quality Control

An *effective* system for ensuring correct traceability of the materials is required where component items are uniquely marked for identification. This identification of materials used in the manufacture of pipelines and tie-in spools must be preserved during handling, storage and fabrication activities. The identification marking needs to connect the product with the related inspection documentation.

Quality Assurance / Quality Control and associated inspections should be sufficiently robust to ensure the specifications of the product is met. Operators should consider Positive Material Identification (PMI) as a key quality requirement for CRA clad pipe and components.

Inline Inspections

Integrity management processes should consider implementation of a diverse range of inspection / monitoring measures to minimise the risk of any defects going undetected.

Attention should be paid to the potential for "confirmation bias" when inspection data is assumed to correspond to the design or "as-built" data when errors may have occurred and the subsequent anomalous inspection data could reveal such errors well before safety risks eventuate.

The legislation

Operators of a facility should refer to their general and specific duties as defined in Schedule 3 Part 2 Division 1 Clause 9 of the *Offshore Petroleum and Greenhouse Gas Storage Act 2006*:

(1)(a) to take all reasonably practicable steps to ensure that: the facility is safe and without risk to the health of any person at or near the facility

(2)(c) to take all reasonably practicable steps to ensure that any plant, equipment, materials and substances at the facility are safe and without risk to health;

(2)(f) to provide all members of the workforce with the information, training and supervision necessary for them to carry out their activities in a manner that does not adversely affect the safety of persons at the facility.

Referring to Regulation 2.5 of the Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009:

(3)(f) The safety case for the facility must also contain a detailed description of the safety management system that: provides for inspection, testing and maintenance of the equipment and hardware that are the physical control measures for those risks.

Contact

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