Safety Alert 009 - ANP/SSM

Production Riser Parted During Leak Test

The Superintendence of Operational Safety and Environment is issuing this safety alert to notify the petroleum and gas industry and other stakeholders about riser rupture during a leak test due to severe corrosion of the tensile armour wires.

What happened?

On April 7th, 2020, at 09:36 am, a leak test was being carried out in a subsea pipeline that connects two platforms, consisting of flexible lines (risers) and rigid lines (flowline). The job consisted of replacing the rigid line (flowline) and the leak test was a requirement for its installation. It was planned to leak test up to 136 bar. When reaching 124 bar, a strong noise and vibration on the Platform was noticed, and the pressure dropped to 0 bar. It was observed that the riser ruptured just below the end fitting (connection between the riser with the export line valves in the cellar deck floor). The flexible riser parted and fell inside the I-tube.

The incident occurred inside a restricted and controlled area (spider deck). Production was in shutdown previously the incident occurred and the parted riser was properly isolated for the leak test execution. The end fitting and the ruptured section of the riser have been sent to shore for analysis.

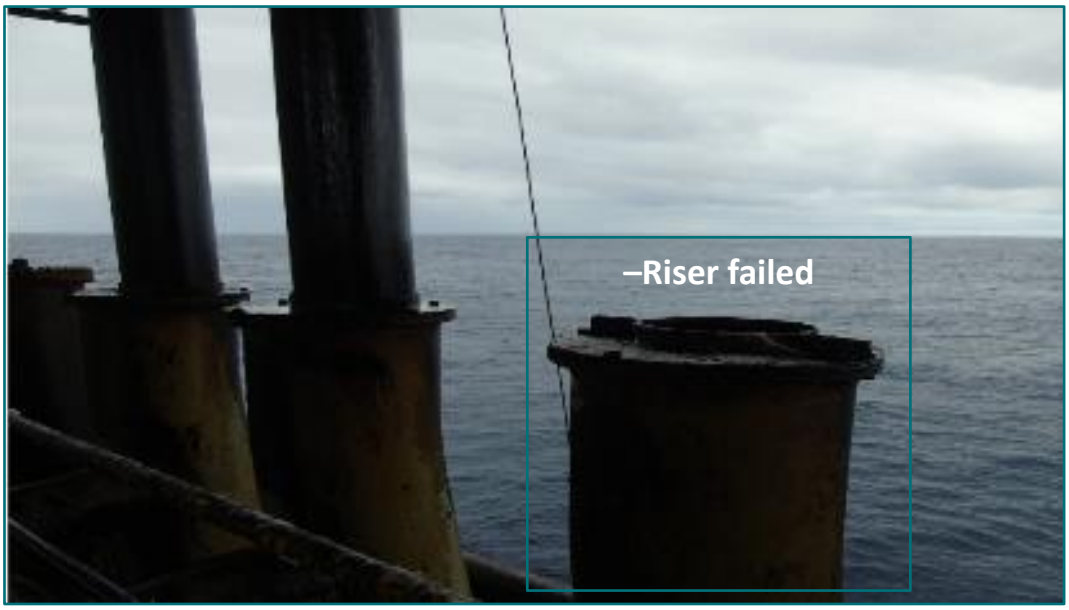

Figure 1 - Location of the I-tube of the ruptured riser (spider deck)

Consequences

There was a spill of oily water into the sea and a support vessel was mobilized to perform the mechanical dispersion of the oil sheen. Offshore Emergency Response and Onshore Incident Management Teams were activated.

If production was running at the time of the incident, a significant oil spill could have happened due to the time response for ESD activation and oil inventory inside the parted riser.

Identified causes

- Immediate Cause: Severe corrosion of the tensile armour wires due to oxygen in the riser annulus. This failure mode was not known by the industry until this event.
- Root Cause: Gas relief valves (GRV), which relieve internal pressure and prevent the return of atmospheric air, were not installed on the riser annulus vent system lines during platform construction, commissioning and operations phases, not complying with project criteria, which enabled ingress of oxygen into the annulus area.
- Other causes:
  - Project: Lack of effective methodology for monitoring and controlling internal corrosion of the riser, as well as the lack of knowledge of the failure mode due to the ingress of oxygen into the riser annulus.
  - Fabrication and Installation: Failure to implement the ventilation system of the risers as per project.
  - Integrity management: Failure in the inspection procedures that identified the lack of the gas relief valves, but without proper prioritization, due to the lack of a method to identify the integrity level of the risers' tensile armours.

Figure 2 – Riser end fitting

Figure 3 – Severe corrosion of the riser end fitting tensile armour wires

Figure 4 – Severe corrosion of the tensile armour at the end of ruptured riser section

Figure 5 – Severe corrosion of the tensile armour at the end of ruptured riser section (~0,5m)

Figure 6 – GRVs installed on the riser annulus vent system lines after the incident

Lessons learned

In order to avoid similar occurrences, it is recommended:

- Project:
  - Update technical requirements to consider the ingress of oxygen in the riser annulus as a failure mode;
  - Update technical requirements to recommend methods of inspection and monitoring of internal corrosion;
  - Improve lessons learned systematic to ensure that important information is shared and acted on, with relevant facilities/organizations;
  - Improve collaboration and experience transfer between assets;
  - Address to Projects the importance of Quality Assurance and Control (QA/QC) during the project execution;
- Fabrication and Installation:
  - Assure the establishment of risers' vent system as per project design;
  - Improve quality of the handover process and focus on limiting punch items handed over from Project to Operation;
- Risk analysis;
  - Consider the ingress of oxygen in the riser annulus as a possible failure mode;
- Integrity management:
  - Improve the methods of analysis and evaluation of internal corrosion of the risers;
- Qualification, Training and Workforce Performance:
  - Assess and close potential competence gaps in technical department organizational structure.

Regulatory Framework

ANP Resolution nº 41/2015 - Technical Regulation of Operational Safety Management System of Subsea Systems (SGSS)

Management Practice 8 Qualification, Training and Workforce Performance
8.2 Training
8.2.1 Identify the levels of training, competence, skill and specific knowledge for each function, which enable employees to perform the tasks related to the position held, based on the classification of established functions and/or activities.

Management Practice 11 Monitoring and Performance Continuous Improvement
11.4 Safety Alerts
The Subsea System Operator shall
11.4.1 Create a database with Safety Alerts received and issued;
11.4.2 Assess the applicability of Safety Alerts received and;
11.4.3 Implement the relevant actions compatible with the risks involved, according to items 11.3.3.2 and 11.3.3.3.

Management Practice 16 Risk Analysis
16.1 Objective
In order to eliminate, reduce, control or mitigate risks in order to keep them within acceptable safety limits, the minimum requirements for risk analysis in an integrated manner shall be established to determine:
16.1.2 The Subsea System Sections and Critical Locations and the possible Failure Modes in all life cycle phases;
16.3.1 The methodology for risk analysis should, at a minimum:
c) Consider the historical analysis of Incidents that occurred in the Subsea System and similar Subsea Systems;
d) Consider all Failure Modes described in the applicable industry codes, standards and best practices;
g) Consider the changes that have occurred in the Subsea System since the last risk analysis;

16.5.1 A risk analysis report must be prepared by the multidisciplinary team containing, at least, the following items: h) Hazards identification, including the associated Failure Modes, when applicable;

Management Practice 20 Project

20.2.1 The best engineering practices and applicable standards that are internationally recognized in the industry must be adopted in the project.

20.10 Internal Corrosion Monitoring and Control Project

20.10.1 In the design of the Subsea System, the methodology for monitoring and controlling internal corrosion must be determined, considering the nature and properties of the fluid, the temperature profiles, the flow regime, the flow speed, the characteristics of the Pipelines, the expected use of chemicals and the expected corrosive processes throughout the Subsea System life cycle.

Management Practice 21 Fabrication and installation

21.8.1 A Commissioning report must be prepared, containing at least: d) Abnormalities found;

Management Practice 23 Integrity Management

23.4.2 Establish, implement and document appropriate maintenance, inspection, testing and testing plans, in order to guarantee mechanical integrity.

23.4.4 Establish, implement and document Corrosion monitoring and control program and procedures aiming at continuous monitoring of the structural integrity of the Subsea System.

23.5 Inspection Procedure

23.5.1 The inspection, testing and testing methodology must include at least: c) Evaluation of corrosive processes or other Failure Mechanisms;

23.5.2 The Subsea System Operator shall develop, implement and document, at least, procedures for: g) Inspection of the vent system, when applicable

23.10 Monitoring and Control of Internal Corrosion

23.10.1 The Internal Corrosion Monitoring and Control Program shall include, at a minimum:

a) Identification of the installations and the monitored sections;

b) Identification of the monitoring method(s) and instrument(s) used;

c) Justification of the method(s) and instrument(s) chosen and the acceptance criteria;

d) Periodicity of inspections and monitoring;

e) Resources required for inspections and monitoring; and

f) Normative references.

23.10.3 The Subsea System Operator shall develop procedures for monitoring and controlling internal corrosion, including at least:

b) Periodic passage of cleaning PIGs and water drag for displacement and collection of waste, when applicable;

Contact

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