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Agência Nacional
do Petróleo,
Gás Natural e Biocombustíveis

Safety Alert 006 - ANP/SSM Abnormal Well Head Inclination

The Operational Safety and Environment Superintendency is issuing this safety alert to notify the oil and gas industry and other stakeholders about an abnormal inclination found in a pre-salt well.

What happened?

A pre-salt well suffered structural failure to its foundation leaving it in conditions of potential integrity failures and made it impossible to deploy BOP stack in order to abandon. The damage occurred as described below:

In February 2015 the well had its underwater foundation (LPWHH low-pressure wellhead housing + HPWHH high-pressure wellhead housing) installed. According to the project, the 20-meter torpedo conductor was not cemented. At that moment, it was reported an **inclination of 0.75°** in the bull's eye measurement (horizontal spherical indicator).

In March 2015, it was installed the high-pressure housing, and a **1° inclination** was reported. After landing the high-pressure housing, an overpull test was performed to check the locking between the housings. During the cement job, the cement slurry did not return to the surface. Technical difficulties were reported during the recovery of the high-pressure housing running tool. It was performed a cementing verification operation with wireline logs to verify the top of the cement behind casing.

No problems were reported during the installation of the Production Adapter Base (BAP) and the Christmas Tree (XT) during the same year.

Lines were installed and the well commissioned at the end of 2016. Nothing unusual was reported.

The well was designed and built by a company (at that time, the Field's Operator). During the period from September to December 2017, the well was closed due to a problem in its production unit. The field was transferred to new Operator in January 2018, when the field was already back in production. In the well handover's documentation, nothing abnormal was reported.

During a routine subsea ROV (Remote Operated Vehicle) survey in July 2018 it was detected an **abnormal inclination around 3°** in the High Pressure Well Head Housing (HPWHH), based on the bull's eye readings, disengagement from the Low Pressure Well Head Housing (LPWHH) of approximately 1.5 m, and seabed deformation around the subsea foundation. Later, it was installed a precision sensor and a **4.9° inclination** was observed.

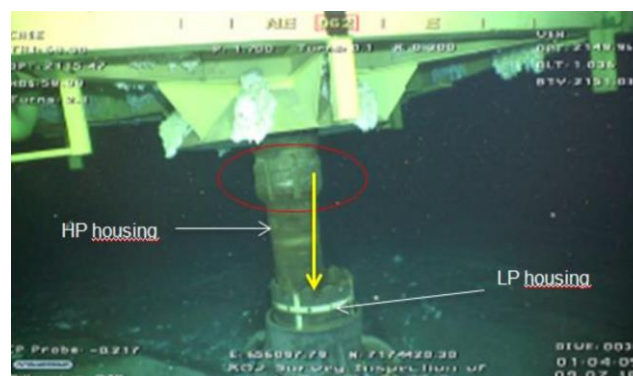


Figure 1 - First inspection of ROVs. HPWHH disengaged from LPWHH and inclination

The well was stable, with no further movement of the Christmas Tree identified. A risk assessment was conducted with associated mitigations measures identified and implemented, including:

- FPSO well parameters monitoring reinforced;
- Constant ROV visual monitoring;
- Wellhead inclination sensors installation;

- Task force mobilization to secure the well;
- Reservoir pressure management (non-eruptivity in the well was crucial to preserve safety and this was achieved three months after the discovery of the abnormal inclination, by means of stopping injection);
- XT and DHSVs tested;
- Independent well foundation analysis.

Potential Consequences

In case of additional movement and inclination of the Christmas Tree occurred leading to HP housing / 20" casing catastrophic failure downstream DHSV, a blowout could have happened, causing an oil leak and resulting in an even more challenging plug and abandonment operation.

This incident led to material damage, production shortfall and more complex source isolation operation for temporary abandonment.

Identified Causes

An investigation was carried out by the Operator on the well design and construction, and the following causes were identified:

Immediate causes

- Failure of the Connection between LP/HP housings;
- Wellhead foundation vertical movement;
- Failure of the well foundation;
- Absence of cement between 20" and formation, all the way to seabed.

Root causes

- Wellhead and well foundation design: The features of the well foundation did not provide enough axial resistance to maintain its structural aspect;
- Santos Basin geotechnical conditions unsuitable for deployment of so-called torpedo conductor;
- Fatigue cycle on well foundation induced by a long shutdown, possibly generates a movement of the assembly of casings;
- Cementing practice implemented: the cementing job of the 20" casing did not reach the torpedo base, what would have added structural reinforcement to the assembly.

Lessons Learned

- Evaluate the well architecture options as per the local specificities (for example the use of torpedo conductor vs. soil characteristics);
- Assess potential operational events (for example the impact on the well foundation if slurry does not reach seabed during the 20" casing cement job);
- The importance of performing a ROV survey of the subsea assets as soon as possible after transfer of operatorship;

Legislation

According to RESOLUTION ANP No. 46/2016 item 13.2.1 the Operator must establish, document and implement acceptance criteria, plans and procedures for inspection, verification, maintenance and monitoring the well integrity, considering the best practices of the industry. Item 10.1.1.1 the Operator must ensure that the well design is adherent to legal requirements, industry best practices and the premises of project and item 10.2.1.1 the Operator shall ensure that the construction of the well is adherent to legal requirements, industry best practices and the established program.

Contact

For additional information about this Safety Alert, please contact the ANP's Operational Safety and Environment Superintendency at incidentes@anp.gov.br