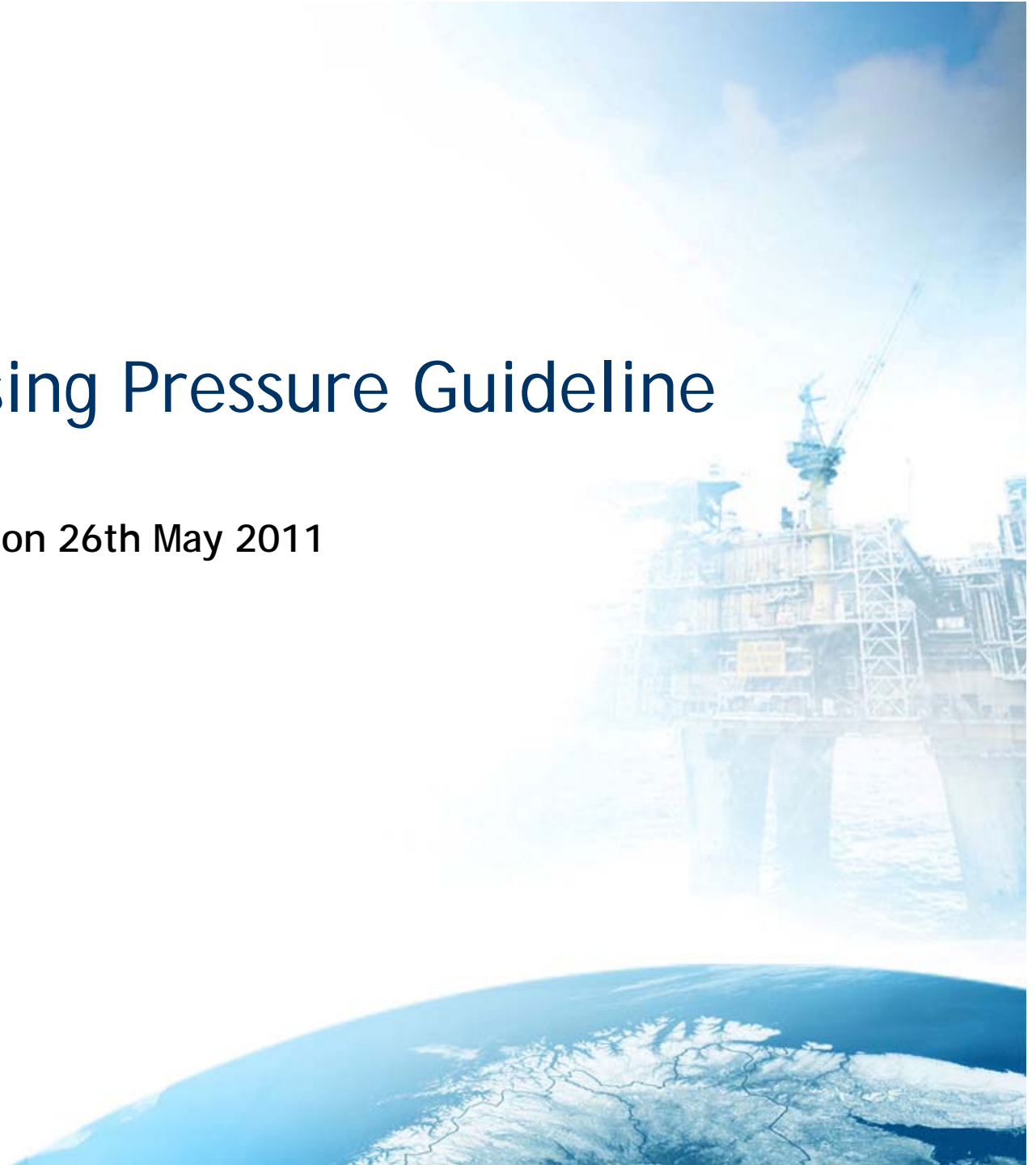


Sustained Casing Pressure Guideline

WI Workshop Presentation 26th May 2011

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What is Sustained Casing Pressure

Definition:

SCP is excessive casing pressures in wells that persistently rebuilds after bleed-down.

It is defined as a pressure in any well annulus that is measurable at the wellhead and rebuilds when bled down, not caused solely by temperature fluctuations or imposed by the operator.

In contrast, an *unsustained casing pressure determination is made if* either the casing pressure on a well is self-imposed (e.g., gas-lift pressure, gas- or water-injection pressure) or pressure is entirely thermally induced.

Sustained Casing Pressure - Problem Definition

- Problem of leaking wells in the GOM is massive, as 11,498 casing strings in 8122 wells exhibit sustained casing pressure.
- SCP represents a potential risk of losing hydrocarbon reserves and polluting aquifers and sea with hydrocarbons.
- Also presents significant HSE risks
- 90% of SCP's are small and can be contained by casing strength
- Potentially risky to produce or, more importantly, to abandon such wells without eliminating the pressure.

Final Report "Diagnosis and Remediation of SCP in Wells", A.K. Wojtanowicz et al., Louisiana State University. Submitted to US Dept of Interior, MMS, Virginia, July 31st 2001

No statistics found for North Sea environment, problem believed to be significant

Sustained Casing Pressure - US Regulations

- The US Minerals Management Service (MMS) regulations (30 CFR Part 250) require elimination of SCP.
- MMS also grants waivers ("departures") permitting operation of wells with small SCP problems.
- According to US MMS regulations, diagnostic testing is required in any well exhibiting sustained casing pressure (SCP). The departure (waiver) decisions are solely based on the results from casing pressure diagnostic tests.
- Results of the test determine if immediate SCP removal could be temporarily waived (departure permit) and continuing operation of the well permitted.

Sustained Casing Pressure - Norway Regulations

Norsok D-10:

- Pressures in all accessible annuli shall be monitored and maintained within min and max operational pressure limits to verify that the integrity status of well barriers is known at all times
- A-annulus pressure in all wells and B-annulus pressure in multi purpose and gas lifted wells shall be monitored through continuous recording
- Subsea wells, the B-annulus designed to withstand thermal pressure build up, or have an acceptable pressure management system
- Shall be possible to secure well in the event of failure
- If failed barrier, only activity in well should be to restore WI

Sustained Casing Pressure - Causes & Consequences

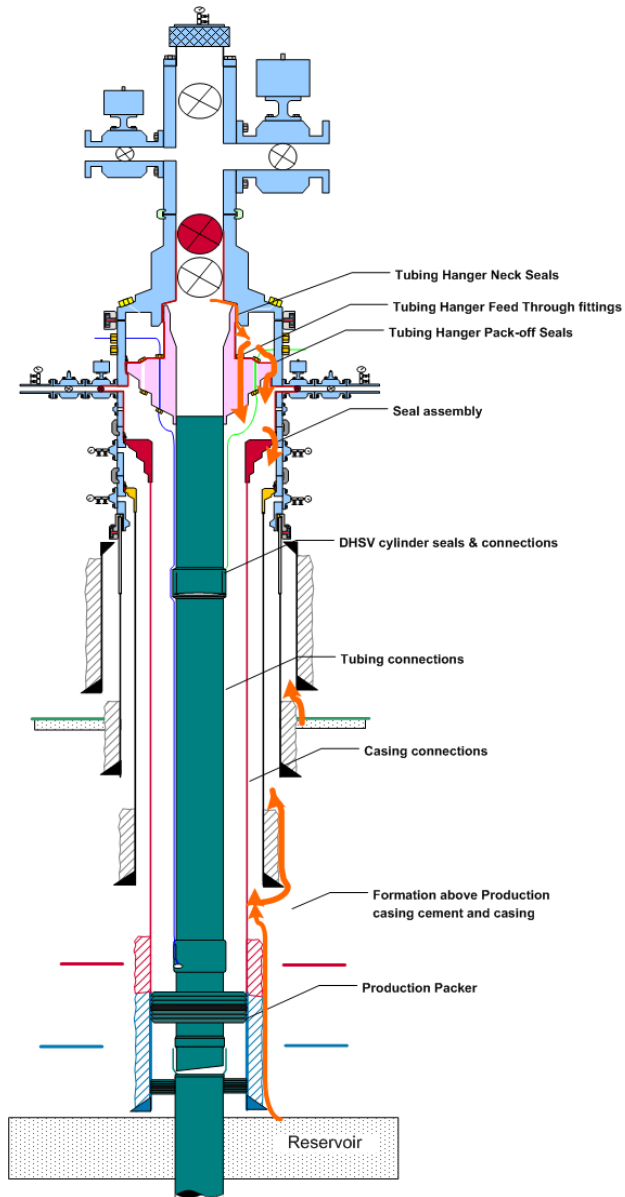
- SCP is caused by gas migration from a high-pressured subsurface formation through the leaking cement sheath in one of the well's casing annuli.
- It may also be caused by defect and leaking tubing connections, downhole accessories or wellhead seals
- Degradation or failure of well barriers
- The leak develops either due to:
 - poor primary cementing job
 - during production by temperature and pressure fluctuations
 - Corrosion/erosion of casing or tubing
 - Other type of Well integrity failures

=> It will manifest itself at the wellhead as irreducible casing pressure

=> May result in loss of containment with environmental and material damages and/or production & human losses

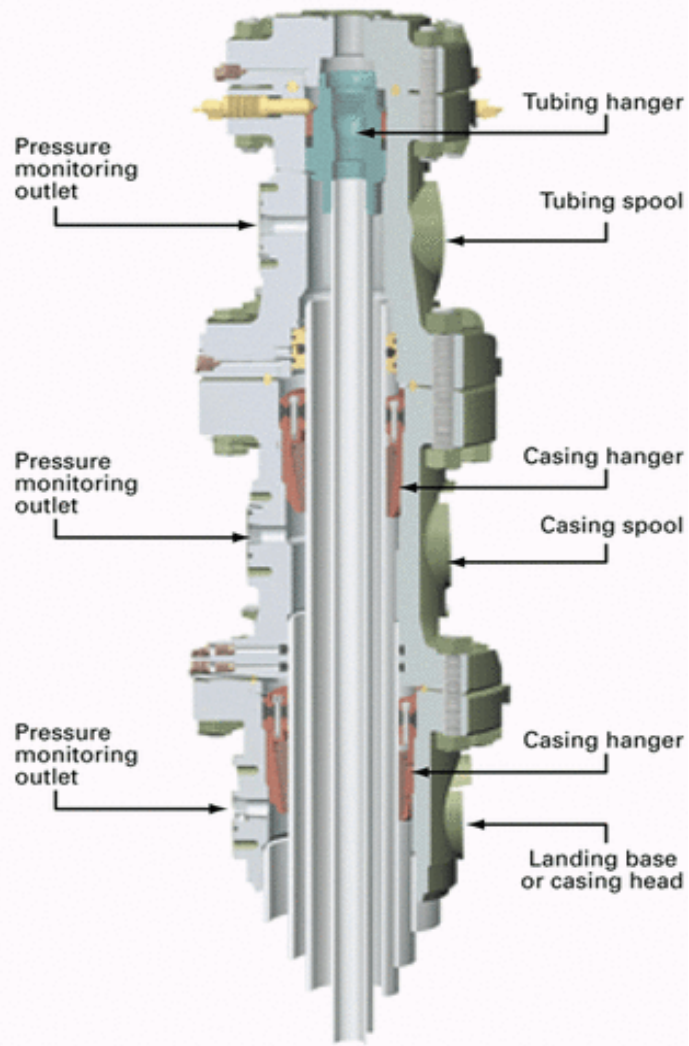
=> Can occur throughout lifetime of the well

Examples of potential leak paths resulting in SCP



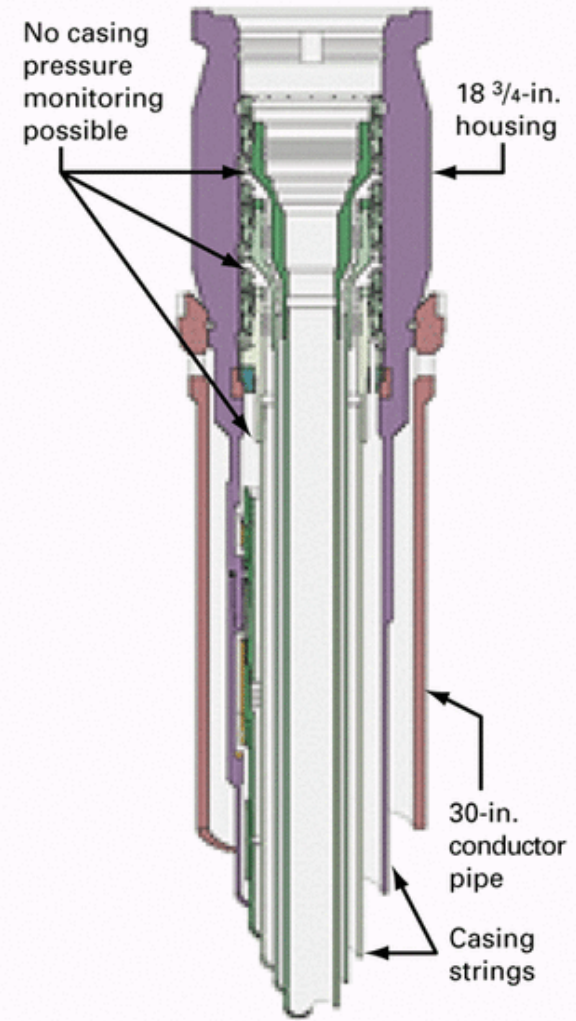
SCP - Platform versus Subsea wellheads

TYPICAL LAND AND PLATFORM WELLHEAD Fig. 2



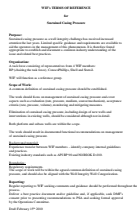
Source: Cooper Cameron Corp.

TYPICAL SUBSEA WELLHEAD Fig. 1



Source: Cooper Cameron Corp.

Sustained Casing Pressure Guideline Document - Process

- WIF Action Plan 2010
 - Establish chapter on Sustained Casing Pressure within the WI guideline document with recommendations and/or best practice (OLF 117)
 - A task force w/representatives from 4 WIF members:
BP, ConocoPhillips, Shell and Statoil. WIF functioned as a reference group.
 - ToR established in early 2010
- 
- Team worked throughout 2010, monthly meetings
 - Additional Review/Assurance by Operators, DMF and PSA in early 2011
 - SCP guideline document completed in May 2011

SCP - Guideline document - Purpose

- SCP as a WI challenge has received increased attention the last years, **many incidents reported** by the operators.
- **Limited specific guidance** and **requirements available** to aid operators in the management of this phenomenon.
- It was found appropriate to establish and **document a common industry understanding** of the issue and related best practices.

Intention was to develop a document that will promote a common understanding and best practice for management of SCP

Sustained Casing Pressure Guideline - Content and Main Sections

*The document focuses on management of SCP both for **platform** and **subsea wells** and covers aspects such as **monitoring, detection, evaluation, acceptance criteria and mitigating measures**.*

*Prevention and elimination of SCP, including **design of new wells and interventions in existing wells**, is also reviewed although not in detail.*

Document Structure:

- Sustained Casing Pressure Definition
- Sustained Casing Pressure Management
 - Monitoring & Detection
 - Evaluation
 - Acceptance Criteria Determination
 - Mitigating Measures
- Sustained Casing Pressure Prevention & Elimination

SCP Management - Document Sections 1.

Monitoring and Detection Section includes

- Normal annulus pressure behavior; regular monitoring of P, T, rates..
- Monitoring - Parameters, methods, trending & alarms
- Ensuring quality recording of representative values
- Annulus management - Operational limits, bleed downs & top ups
- Use of dedicated testing, inspection & logging to detect SCP

Evaluation Section includes

- Evaluation of source, mechanism and location; importance to understand these aspects for remedial action
- Leak rate evaluation, direct measurement best, but challenging in multiphase mixtures
- Annulus pressure evaluation, pressure build ups
- Hydrocarbon gas volume and mass evaluation => will impact on potential consequences of SCP
- Escalation potential evaluation => increasing leak rates over time (corrosion, erosion, bleed offs....)

SCP Management - Document Sections 2.

Acceptance Criteria Determination Section includes

- Leak rate criteria => depending on leak, to be assessed by operator
- Annulus pressure criteria, not to exceed MAASP of annuli
- Hydrocarbon gas mass criteria, to be assessed
- Escalation potential criteria, to be assessed by operator

Mitigating Measures Section includes

- Technical; e.g. install additional valves, reset alarm limits, equipment protection
- Operational; set to minimum MAASP, bleed downs, annulus top up, contingency plan...

SCP Prevention and Elimination Section includes

- Well Design and Operational Considerations
- Pumping Operations
- Workover & Interventions

Final Remarks

- A hands on document is now available to Operators so that they can approach SCP in a systematic and consistent way
 - Gives steer and alignment between operators
 - Not intended to give absolute or accurate answers, engineering judgment is still required in most situations
 - Does not replace any regulatory requirements
 - The document is available on the OLF Web-page, OLF Guidelines 117, Chapter 6 (to be published/uploaded)
- <http://www.olf.no/no/Publikasjoner/Retningslinjer/BoringDrilling/117/>