

GATEKEEPER

A Technical Newsletter for the Oil & Gas Industry

SEPTEMBER 2018

Common Failures In Onshore Oil & Gas Wells

In the pursuit to further understand the challenges faced by oil and gas operators, Viking has maintained a failure database capable of determining common failures and failure trends. This information provides insight to aid in preventing common failures and improving industry practices to reduce incident rates in addition to saving time and money.

Logging and recording investigations in the failure database is one of the final actions completed in Viking's Failure Investigation Process as outlined in Figure 1. Data collected from clients and materials testing is analyzed to generate a failure report. Key points from these reports are recorded in the failure database including how a piece failed, why it failed, and the recommendation given to prevent similar failures in the future.

The failure database is comprised of the several hundred wells Viking has investigated over the past 17 years. It is inclusive of casing, tubing, and drill strings of various materials and sizes. These failures can be broken down to reveal which materials appear more susceptible to failure, which failure conditions and causes are most prevalent, and the recommendations to prevent these failures.

This GATEKEEPER will look at recommendations regarding the most prevalent failure conditions. The overall causes for these failures will be discussed in a general sense as well as in terms of pipe body versus connection failures.

General Failure Trend Overview

Most failed strings are parted, cracked, or split, with percentages of 29%, 12% and 11% respectively in terms of the number of cases. Often the cause of failure is unknown (20%), mainly because many of the failed joints are not recovered. In these cases it is difficult to determine a cause of failure even though computational analysis is conducted. However, roughly a third of failures are attributed to material deficiency or poor running and handling operations; 16% and 15% respectively. In relation to these causes, it is often recommended that operators make:

- A process change,
- A material change, or
- A design change.

Process Changes

Process changes address a variety of causes that tend to trace back to poor running handling procedures, even if they aren't the direct cause of failure. Popular process change recommendations include preventing acid from sitting in the well because acid can corrode the work string, reduction of cyclic loading to prevent fatigue, and following appropriate make-up procedures to avoid over torquing connections. Additional considerations may include QA assessments of critical vendors, QA TPI oversight during manufacturing, inspection and threading, as well as implementing enhanced material and/or inspection requirements.

Material Changes

Material change recommendations address optimizing pipe size, weight, grade, or connection for the application. Many investigations concluded that the incorrect material was used in a sour environment, notably P110 use in a sour environment below 175°F, which results in a corrosion failure. Another issue encountered is poor material manufacturing where the pipe was not properly heat treated or was poorly welded.

Design Changes

Design changes are recommended when design parameters for a well fail to meet an operator's design factor standards or severe doglegs are present. Low design factors indicate that a well may be more susceptible to burst, collapse, or failure under tension, compression, or triaxial stress. Severe doglegs (>10) can create bending stresses on the pipe that contribute to fatigue or overstress failures.

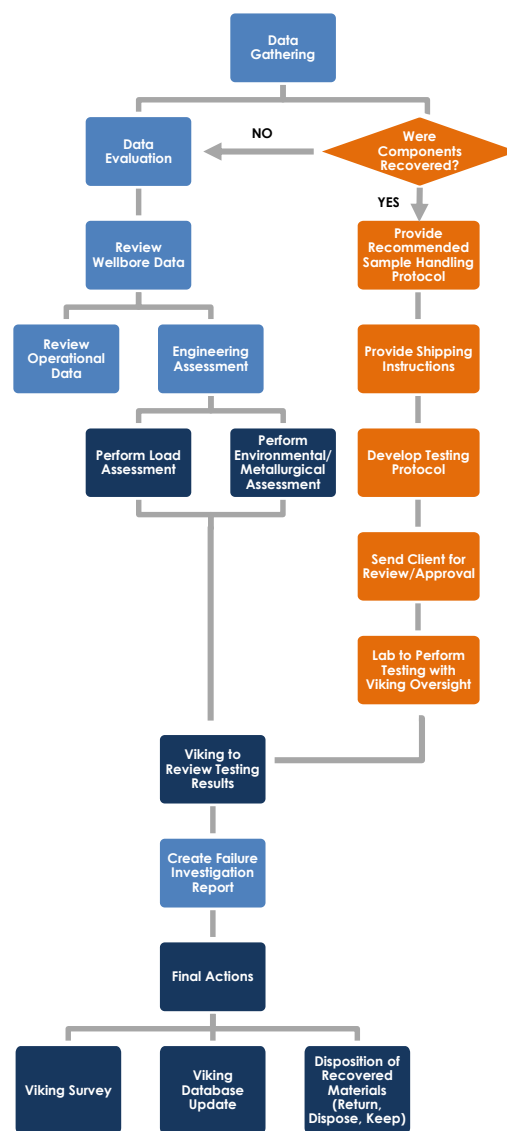


Figure 1: Failure Investigation Process



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Failure Trends: Connections

Connection failures account for 55% of Viking's investigations. LTC and BTC connections are commonly used, so it is not surprising that they account for the majority of failed connections. The connection failures are reflective of the overall failure trend because they exhibited failures mainly in the forms of parting, cracking, or splitting.

There is a distribution of causes resulting in failed connections as seen below in Figure 2. Running and handling failures are usually attributed to incorrect make-up from either under torquing, over torquing, or lack of thread engagement or tong marks which can become initiation points for fatigue cracks. Additionally, the stresses generated during make-up can make the connection more susceptible to hydrogen stress cracking, this falls under environmental as the cause of failure.

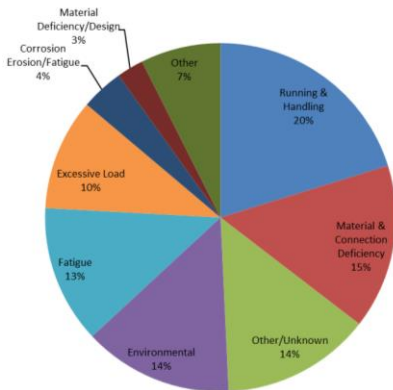


Figure 2: Connection Failures vs. Cause

The most popular recommendation regarding connections is a process change by operators. Problems related to incorrect make-up can be negated if operators follow the recommended make-up procedures, inspect the connections after make-up, and reject over torqued connections.

Failure Trends: Pipe Body

Pipe body failures account for 35% of the failures Viking has investigated. Of these, most failures are of the grade P110 or a variation of P110. This is not surprising considering P110 is a popular grade due to its combination of strength and low cost. It is also easier to meet the materials standards as per API 5CT for P110 than it is for higher strength grades.

Pipe body failures do not follow the overall trend; they more commonly experience restrictions or deformations and collapse over parting.

As per Figure 3, nearly 50% of pipe body failures are either unknown, due to a material deficiency, or due to corrosion erosion. Material deficiency is caused by lack of fusion from welding, poor tempering, or quench cracks. Corrosion results from a variety of sources, but is a common problem for carbon steel.

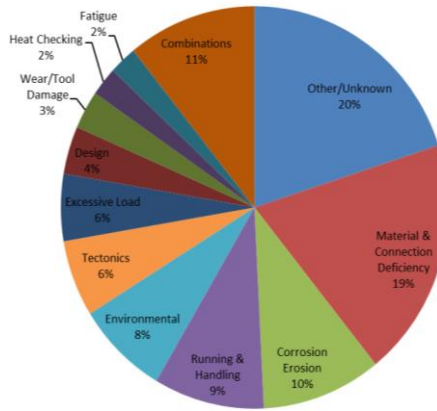


Figure 3: Pipe Body Failures vs. Cause

Process changes are the most recommended change. Corrosion problems can be better avoided if inhibitors are implemented properly and operators make sure acid treatments are displaced. The amount of material deficiency failures could be reduced if all pipes are thoroughly inspected.

Conclusion

This GATEKEEPER aims to make operators better aware of common issues found in the industry by providing recommendations to minimize risk of failure. While these recommendations vary case to case some notable and widespread recommendations are:

1. Inspections as a part of a fit-for-purpose and robust QA/QC program can limit the utilization of sub-standard joints of casing and pipe in wellbores.
2. Follow recommended procedures for connection makeup and the running of casing and tubing to mitigate handling and operations damage.
3. Limit dog leg severity and use appropriate materials to provide a stable wellbore and prevent casing failures.

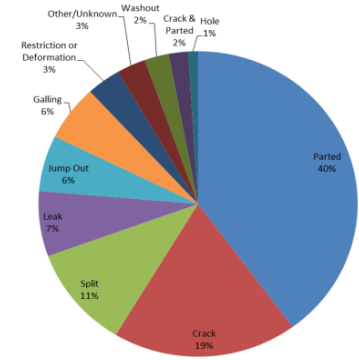


Figure 4: Connection Failures vs. Condition

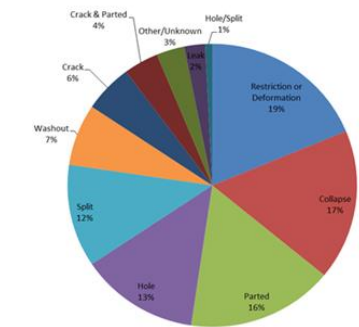


Figure 5: Pipe Body Failures vs. Condition



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