

Well Control System Performance Improvement through Data Sharing

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RAPID-S53 JIP

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the Reliability Technology and Cost Area*

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General Statement

- The RAPID-S53 database is central to the mission of the joint industry project (JIP). The development of the database was benchmarked against ISO 14224 and both the input to, and output from, the database meet the intent of that standard.
- The mission statement of the JIP is to advance the safety and efficiency of global drilling operations by promoting improvements in the reliability and performance of well control equipment.

Participating Companies

Contractors

- Constellation
- Diamond Offshore
- Dolphin Drilling
- Noble Drilling
- Saipem
- Seadrill
- Stena Drilling
- Transocean
- Valaris
- Vantage Drilling

Operators

- BP
- Chevron
- CNOOC Energy
- Eni S.p.A
- Equinor
- ExxonMobil
- Hess
- Petrobras
- Shell
- TotalEnergies

OEMs

- Cameron/Schlumberger
- HMH
- NOV

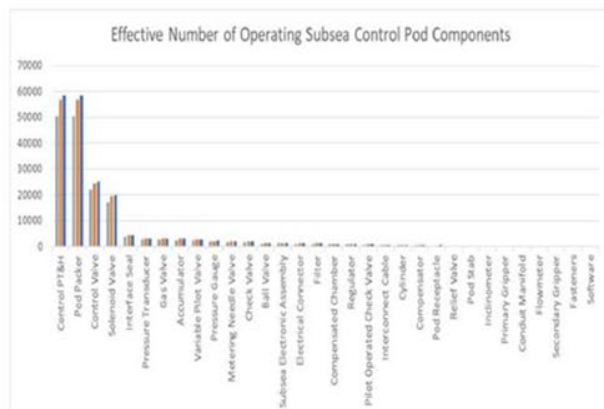
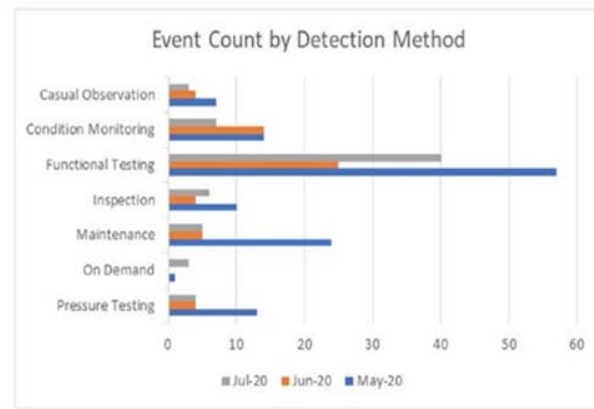
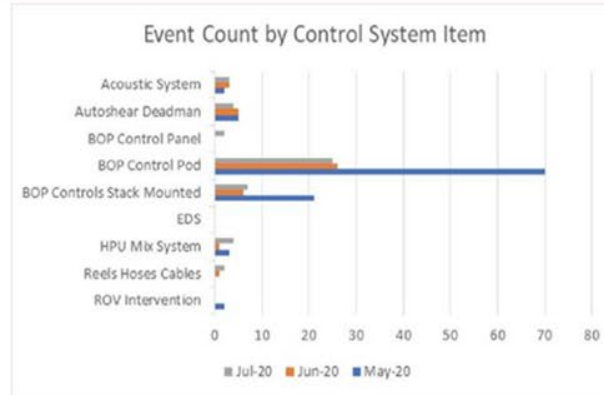
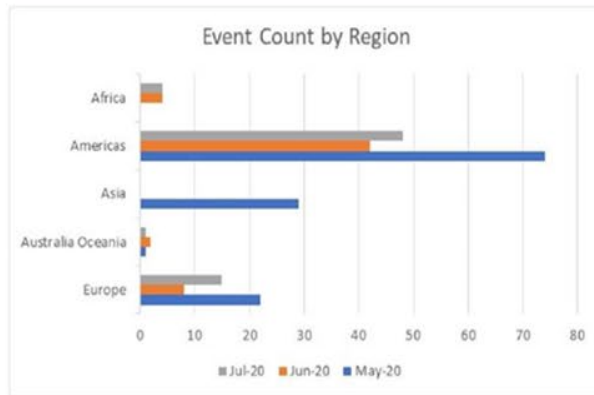
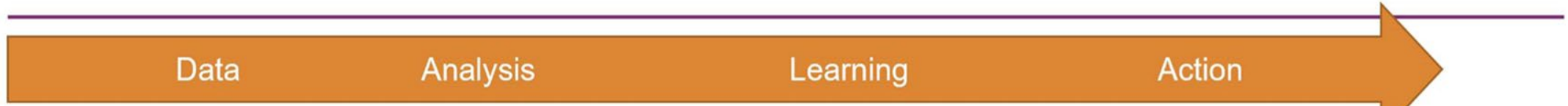
Component Manufacturers

- Gilmore Proserv
- Parker Hannifin
- Oilgear

Database Contents

- The database was designed for use at the ‘coal face’ by ‘fire-fighters’.
- The database contains two categories of data.
- The first category consists of all the technical information relating to equipment events that have occurred to the fleet of rigs reporting into the database
- The second category provides details of the equipment that makes up the well control systems of each rig in the fleet and the operational use of that equipment during the reporting period.
- This provides JIP participants with the ability to evaluate the performance of components in terms of the number of events that occurred during a given period compared with the number of such components operating during that same period.

ROI – Continuous Performance Improvement



Reliability and Performance Information Database for the Well Control Equipment (WCE)
RAPID – 553
 covered under API 553
Information Bulletin No. 1
Regulator Valve Improvement Initiative
 and use of control valve population study

Our Issue: A collaborative effort for improving the integrity and reliability of subsea control valves was kicked off in September 2015 between an operator, two contractors and two OEMs. A Continuous Improvement (CI) methodology was utilized during this process that focused on data driven problem selection.

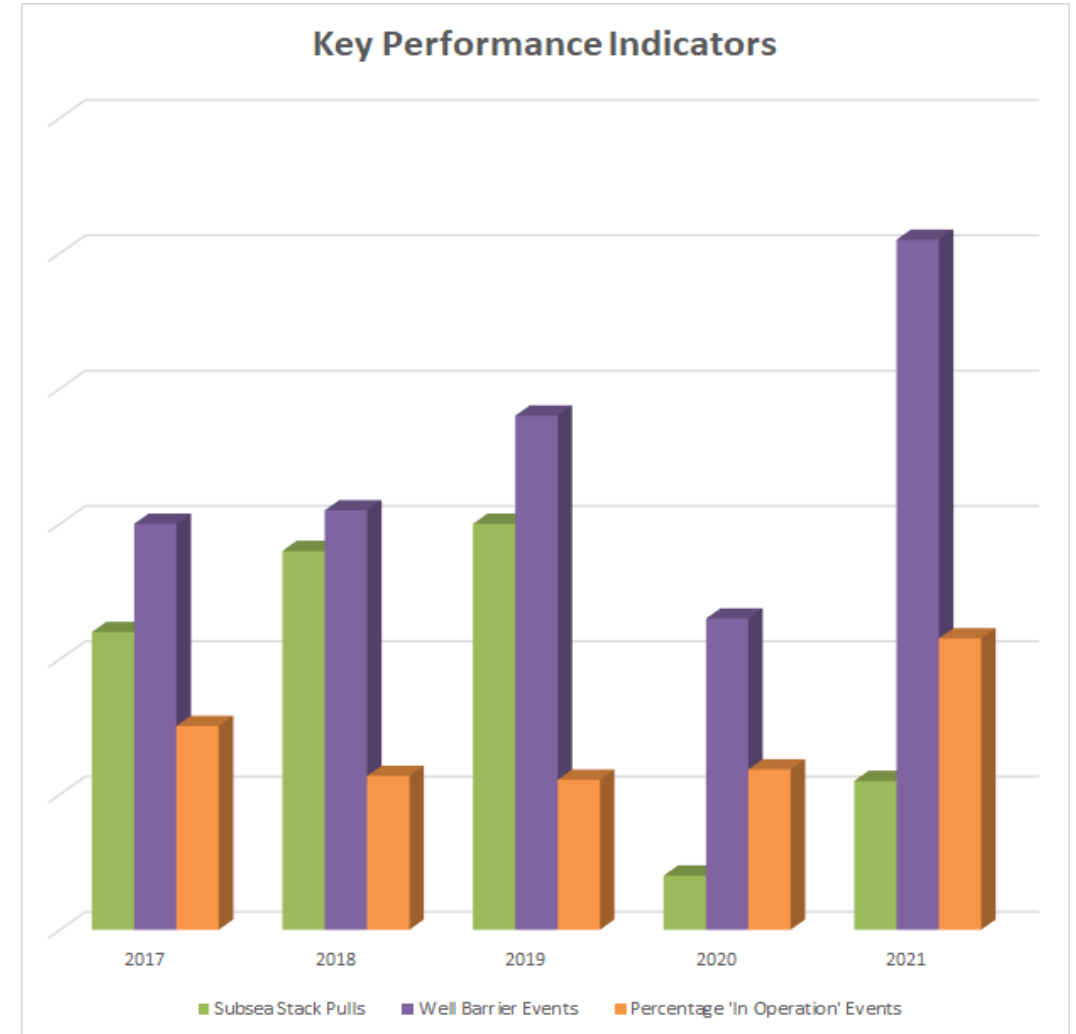
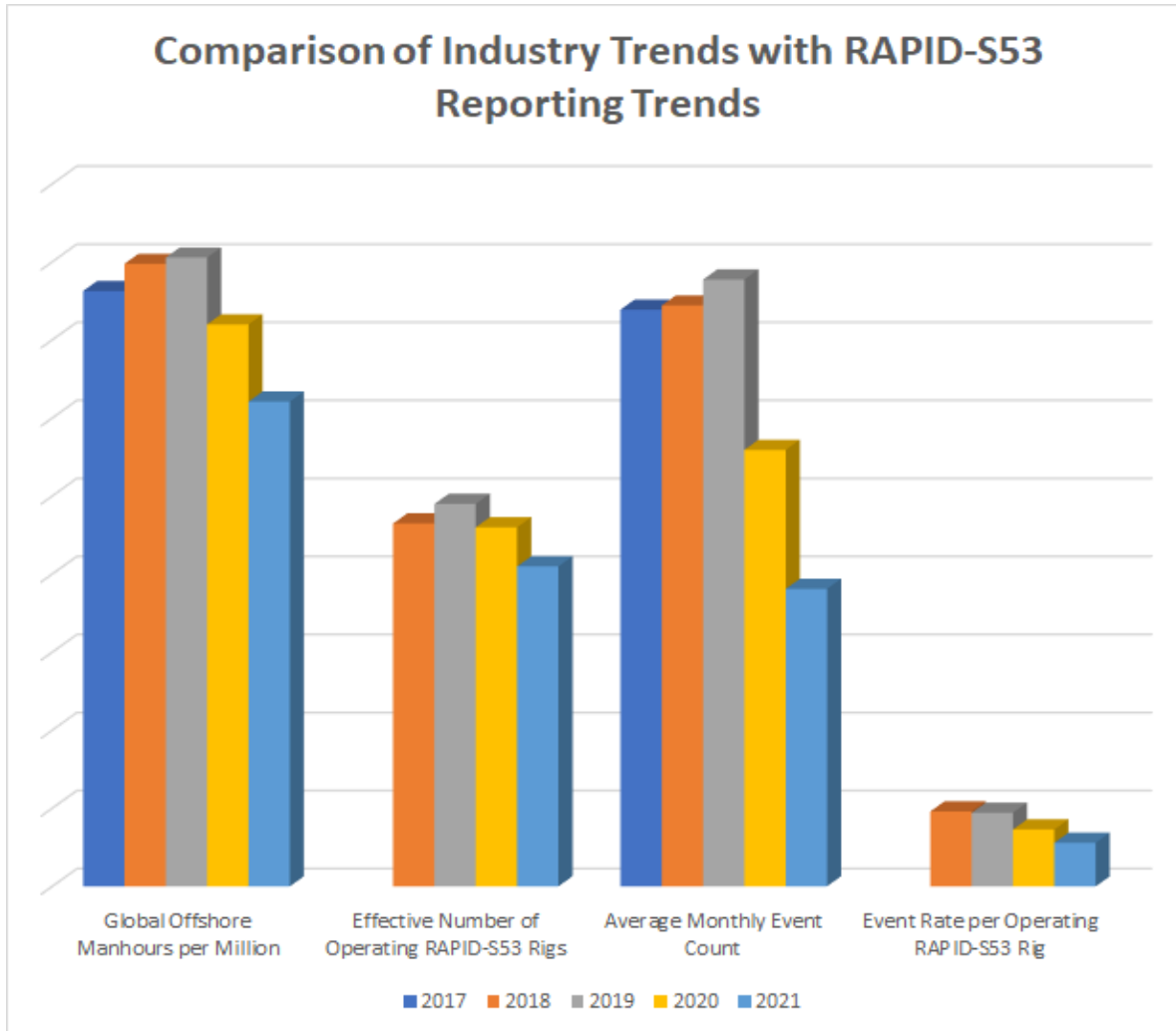
What We Found?: The deliverable was reviewed to look for trends in the future of the stem seal from leaking to the environment. It was discovered that the stem seal was responsible for approximately 45% of subsea manual seal regulator failures.

Reliability Improvement Recommendations: The industry Reliability and Performance Information Database (RAPID-553) can be a helpful tool for identifying improvement opportunities to increase component reliability. It requires that OEMs of the regulators were approached to implement design changes intended in improving their reliability. Efforts are currently on going.

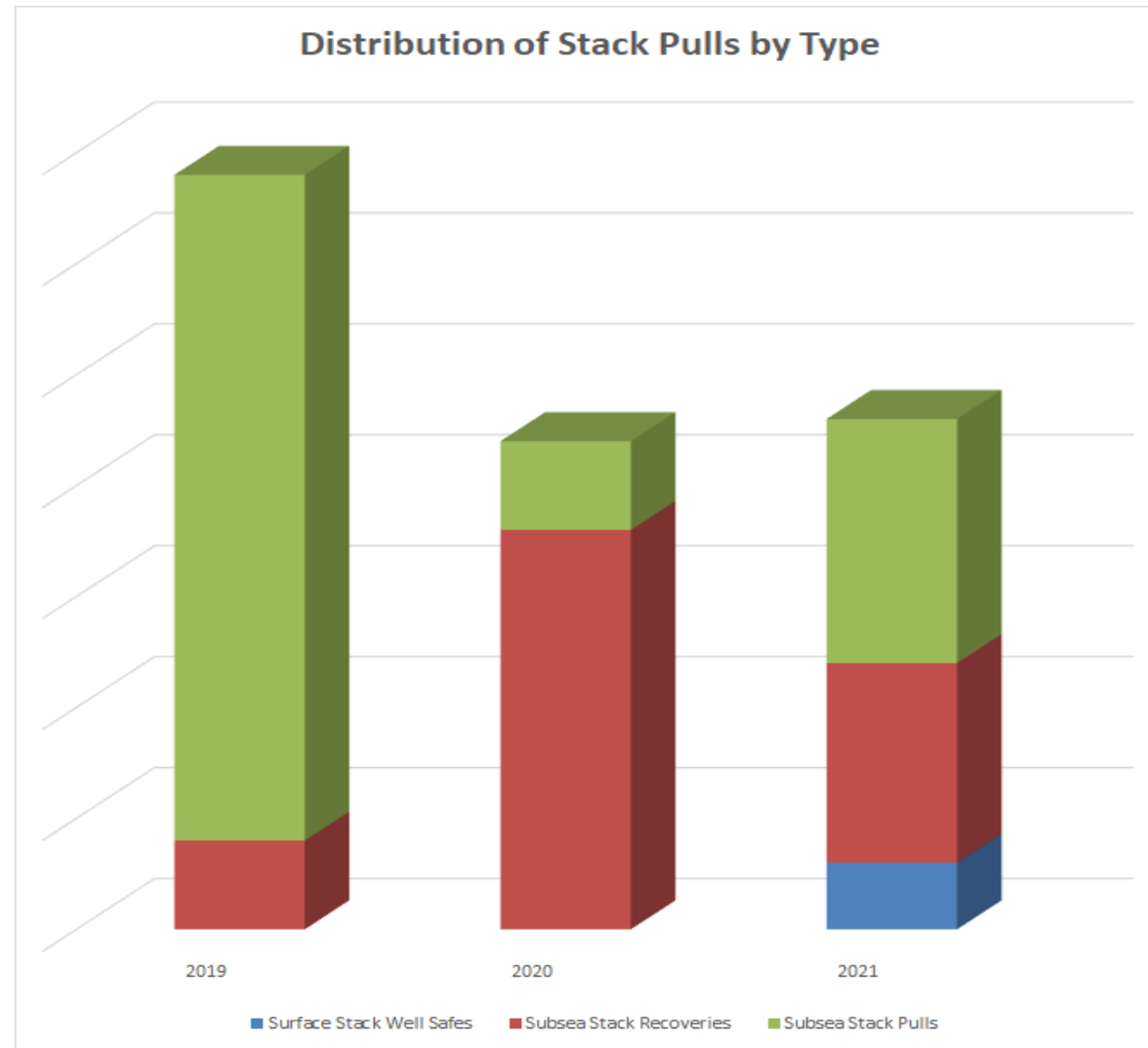
Seal Type: The stem seal forms a seal between the regulator body and the stem to prevent control fluid from leaking to the environment. The stem moves laterally (sometimes rapidly) during operation as it maintains the regulator's set pressure. A stem seal design that provides more meaningful results and an accurate representation of rate of failure.

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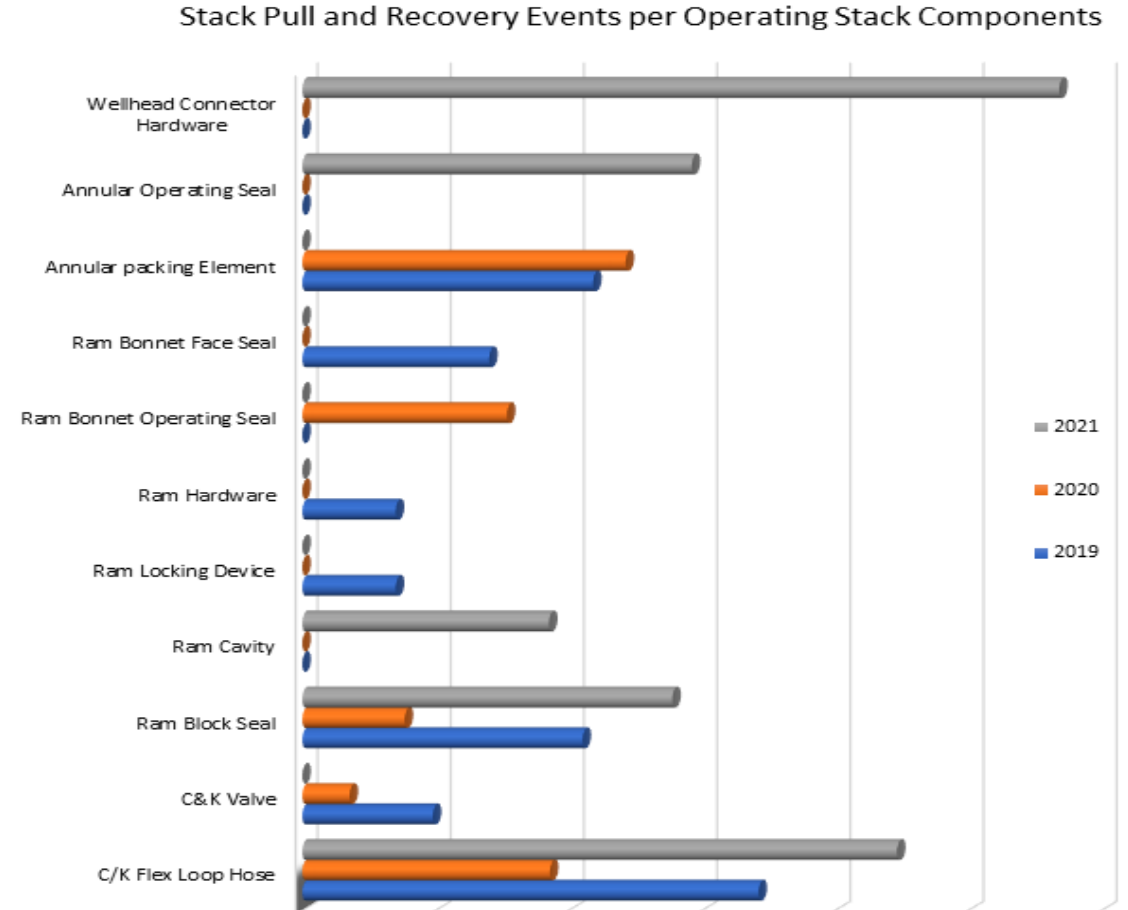
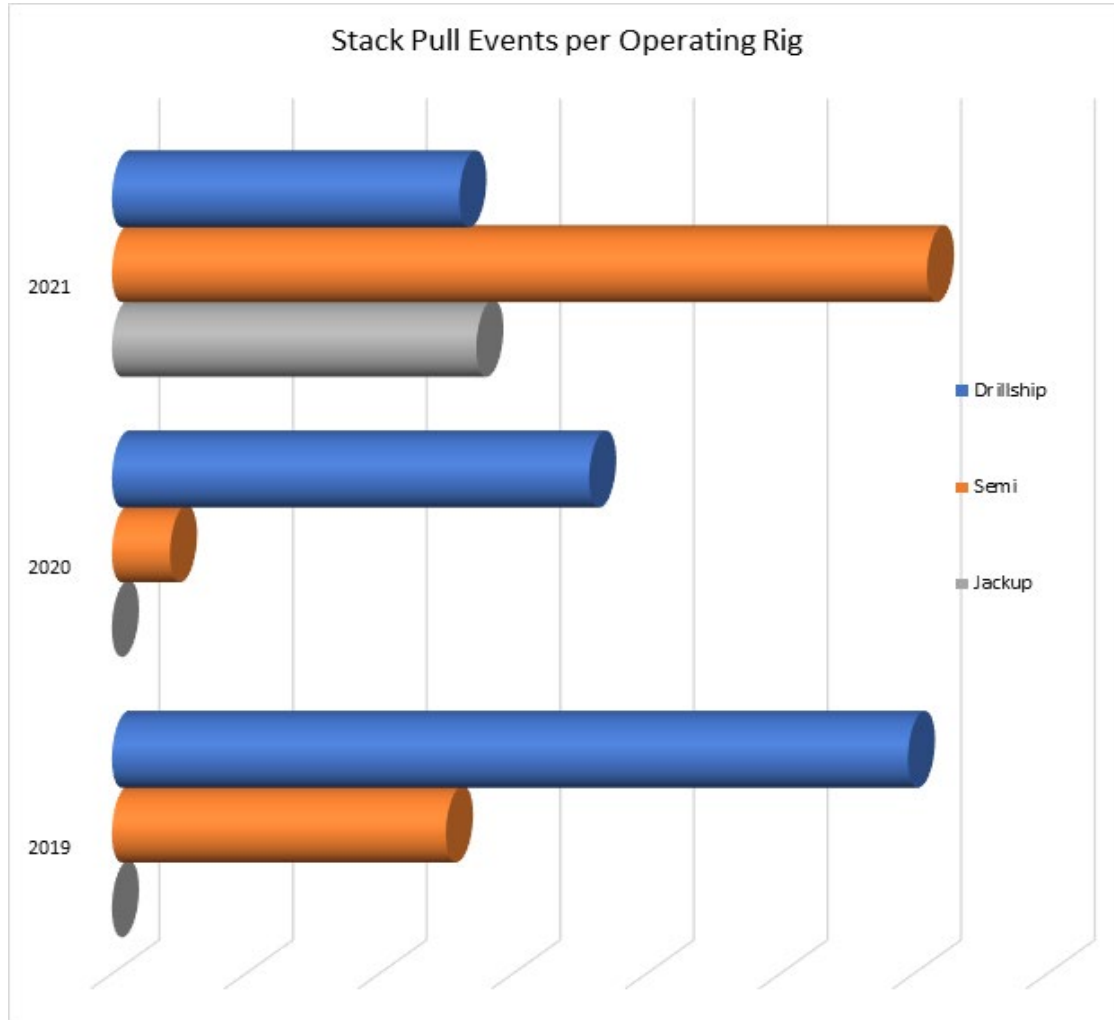
Key Performance Indicators



Stack Pull KPI



Stack Pull Analytics



Safety Bulletin – SB028

RAPID – S53
Reliability and Performance Information Database for the Well Control Equipment (WCE) covered under API S53

Safety Bulletin No. 28
Participants of the IIP are encouraged to submit summaries of their experiences and practices for dissemination through project bulletins.

Ram BOP Seals Damaged After Completion of Testing

Ram BOP failure trend identified, many of which are occurring after completion of testing while resetting system, placing the integrity of the system at risk until the failure is identified at the next scheduled test.

Our Issue

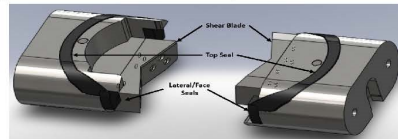
The annual review of RAPID-S53 data has identified a trend of ram BOP pressure test failures. Many of the events have root causes incorrectly classified as design issues.

The root cause failure analysis (RCFA) for some incidents have identified that the BOPs were opened with differential pressure across the ram after analyzing BOP monitoring data. Differential pressure may be caused by either applying wellbore pressure below a closed ram or by closing rams in a sequence that can increase pressure in the wellbore. The event depicted in Figure 2 highlights a soak test where wellbore pressure was increased by closing the upper blind shear ram (UBSR) and then closing multiple shear rams below the UBSR without relieving pressures caused by the displacement of the operator piston rods.

Differential wellbore pressure across a closed ram forces the ram blocks upward against the upper seat and inward against each block. Internal pressures increase the seal contact forces to maintain seals across high differential pressures. Typical seal arrangements include a top seal which seals against the upper seat area and against the opposing ram block face and a second seal as either a packer type seal that seals on the tubular in the wellbore and against the opposing block face or a shear ram type seal that seals against the opposing shear ram blade or block and against the opposing block face.

When sealing internal pressures force the seals against the opposing seal areas. When opened under differential pressure the seals that are unsupported and sealing against an opposing block that are pressure energized will maintain pressure until the block face gap is too large and the seal can no longer maintain a seal. In these cases, the seals may experience rubber loss, tear, get cut, or extrude while the rams are opened, and the differential pressure equalizes. Seal integrity may be compromised after opening under differential pressure.

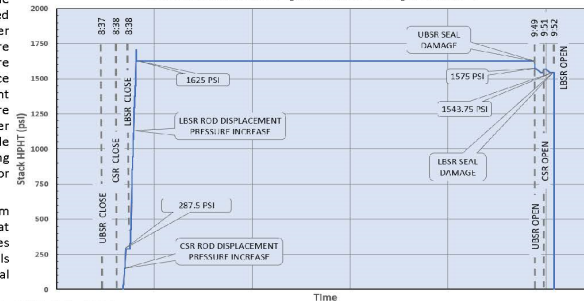
See RAPID-S53 Safety Bulletin No. 16 "Opening Ram BOPs under Differential Pressure" for additional examples and context.



Figures 1 – Shear Ram Block and Seals

Contributing Factors

Procedures – The BOP soak and function test procedures did not include steps to address the build up of wellbore pressure, or relieving of wellbore pressure, prior to opening the ram. This failure mode had not been attributed to soak testing or function testing of the BOP.



Figures 2 – Stack Wellbore Pressure Increase Sequence

What We Learned

Reliability Recommendations:

Procedural steps conducted after a successful test can be critical to the operational integrity of well control equipment, ensuring the system is set up correctly for operations and no damage to equipment occurs.

- Ensure rig BOP test procedures (function, pressure and soak) include steps to relieve differential wellbore pressure prior to opening ram BOPs.
- Apply the same steps into rig operational procedures that may include use of a ram BOP (MPD tripping, setting of seals, etc.).
- Promote BOP Control system engineering controls to identify and warn of potential trapped BOP well pressures when opening ram BOPs.

Possible Systems/Rigs Affected

Rigs with BOP systems.

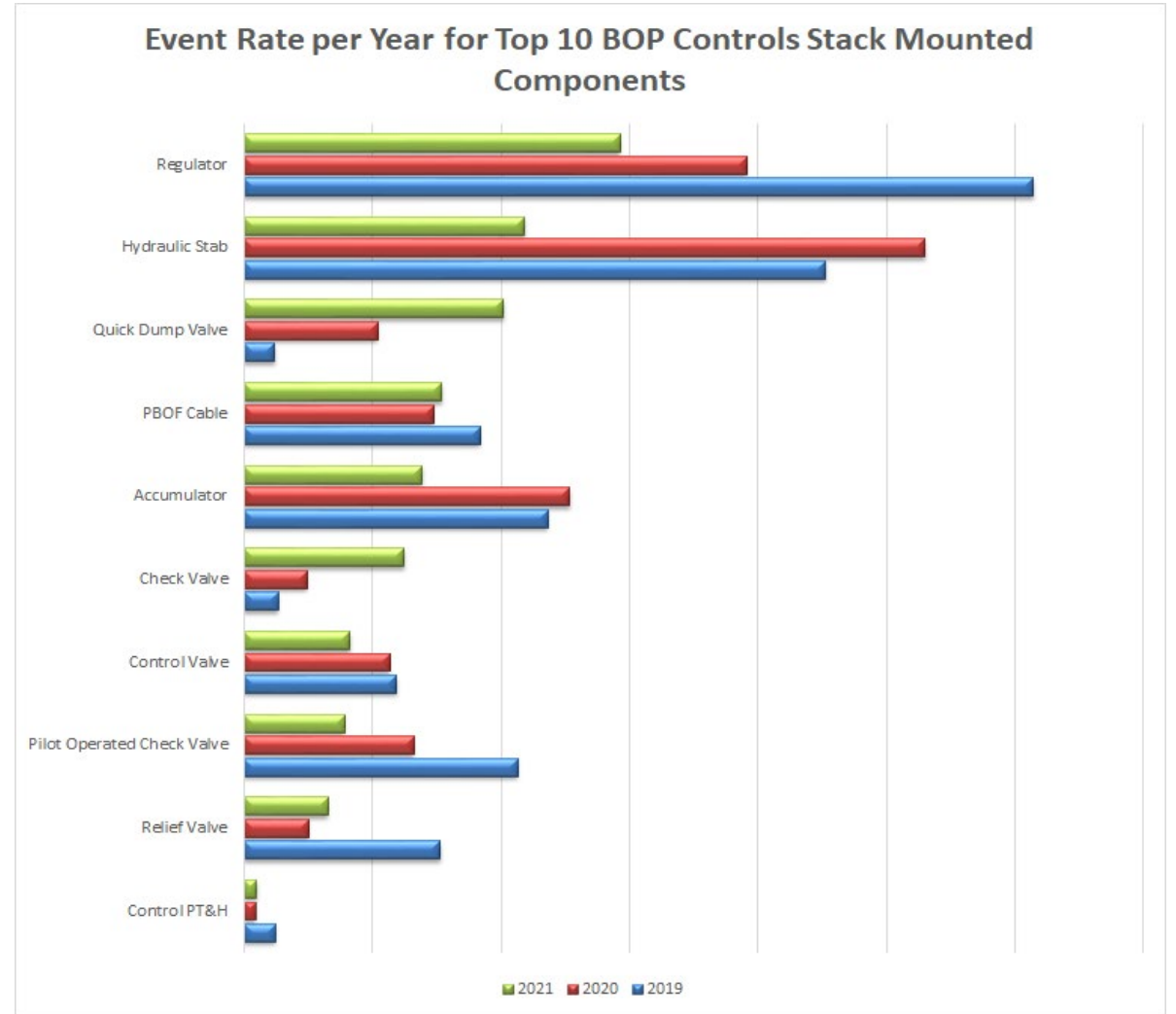
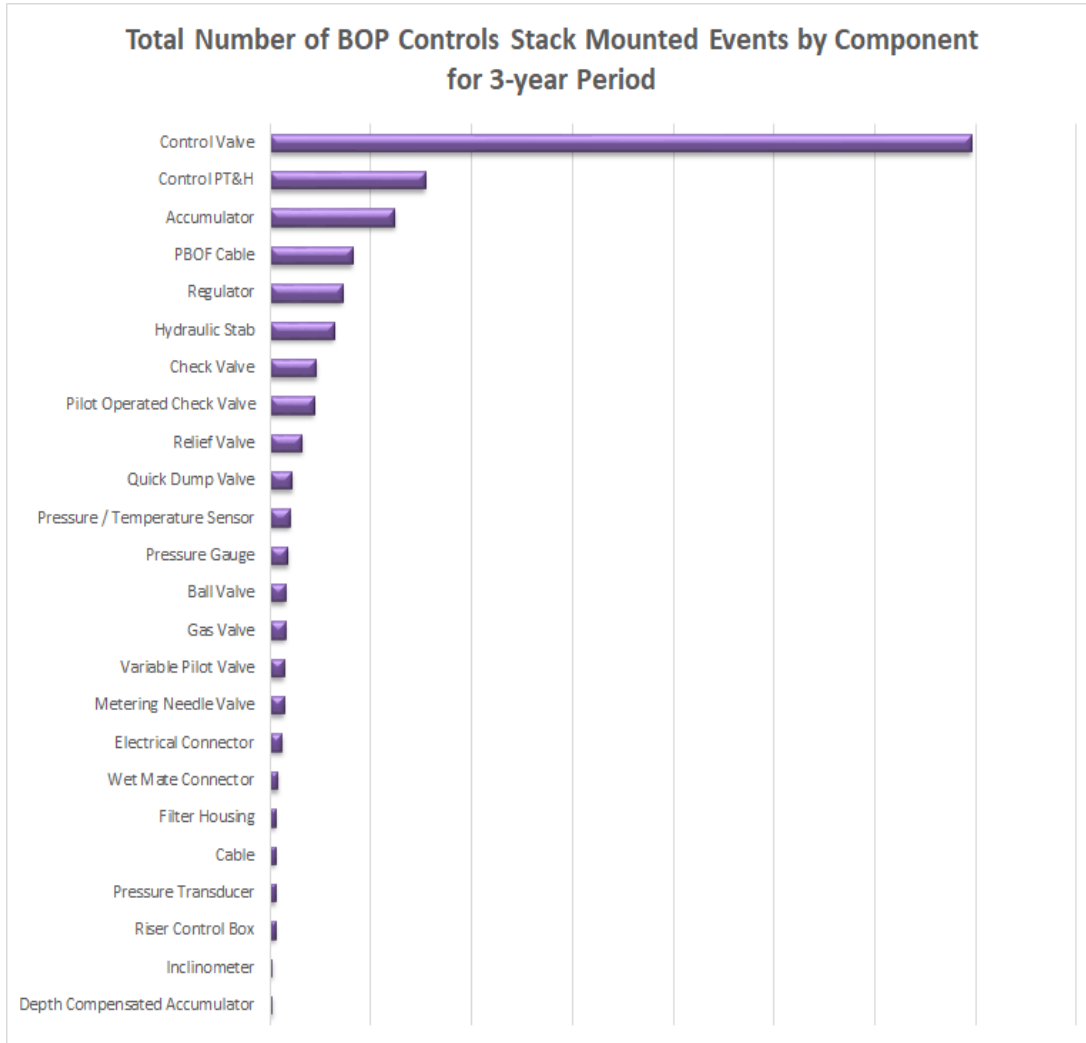


The views expressed in the Information Bulletin represent the opinions and recommendations of the contributing IIP participating organization. They do not necessarily represent the opinions and recommendations of the larger participant group of the IIP. Each IIP participant is encouraged to review and interpret data, and to evaluate the applicability of recommendations based on their specific needs and requirements.
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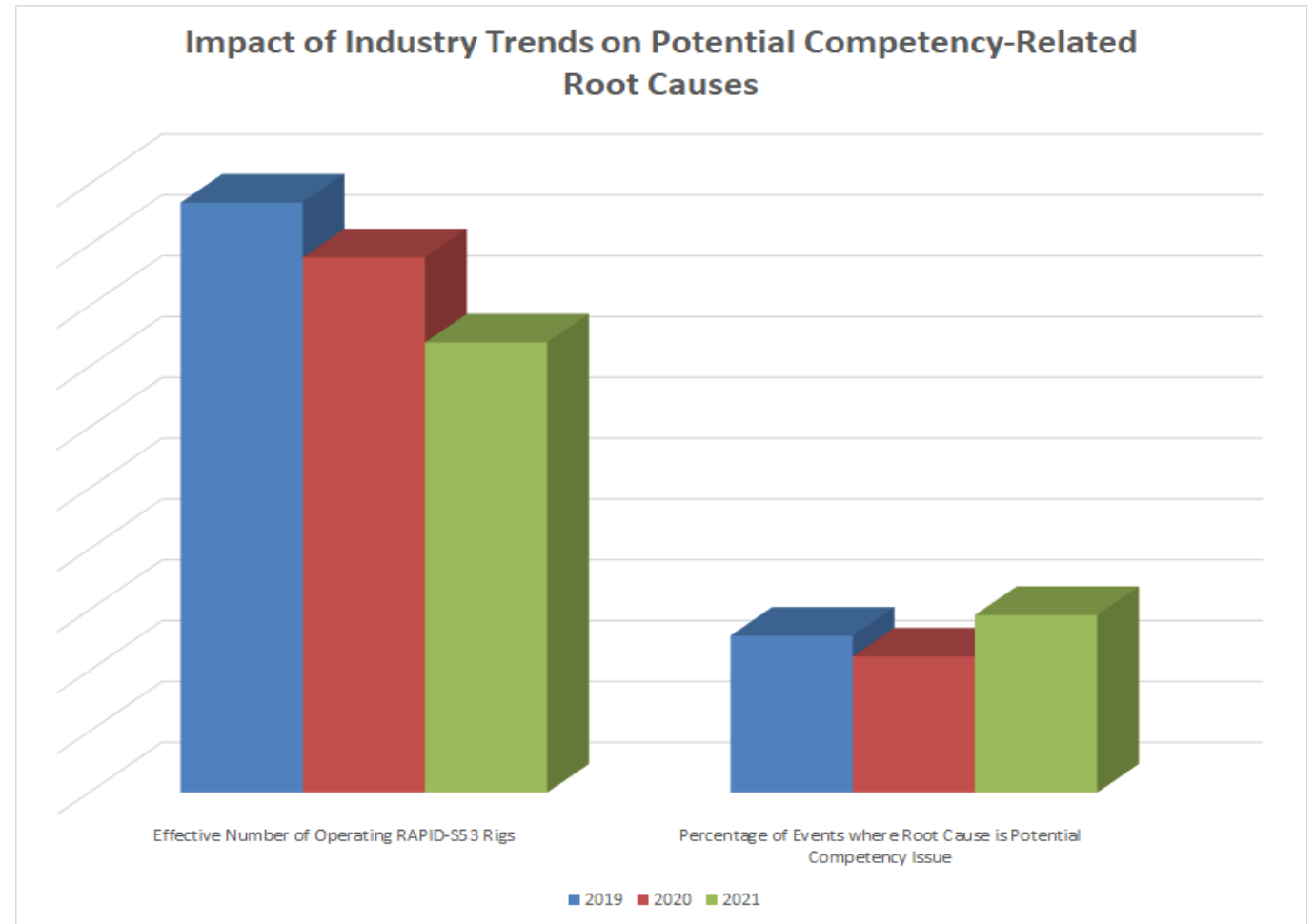
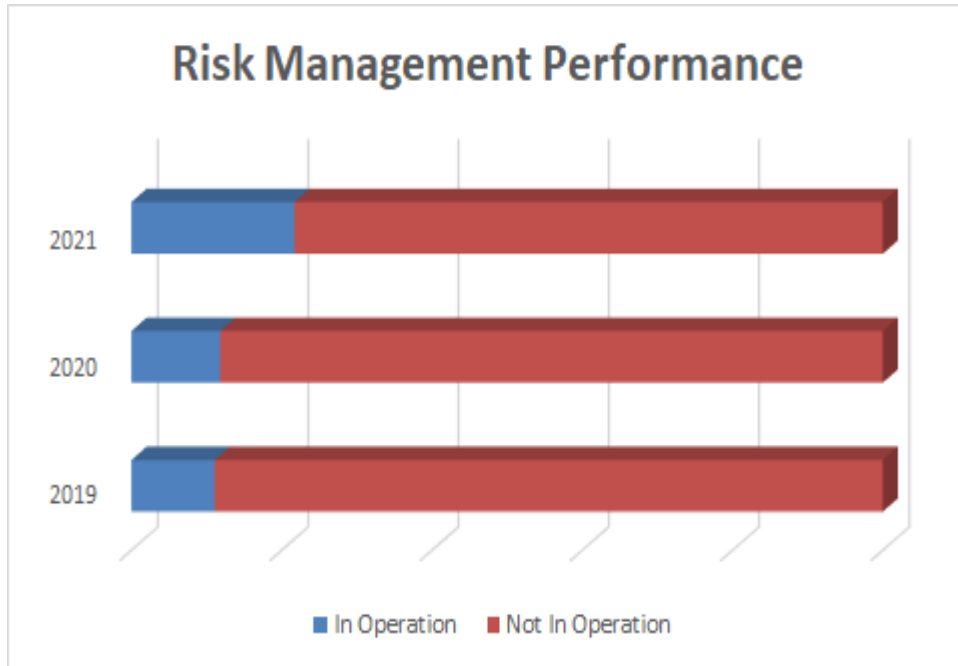


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Identifying Focus Areas for Potential Hardware Improvement



Identifying Focus Areas for Potential Competency Improvements



Lessons Learned Dissemination

- Monthly reports
- Annual reports
- Bulletins
- Oversight Committee meetings
- Technical Reference Group meetings
- Ad hoc working group meetings

Thank You / Questions?

Further information on the RAPID-S53 JIP

- Can be found on the following website: <https://www.rapid4s53.com/>
- By contacting:
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