Blowout Prevention System Safety Events

2018 Annual Report

Highlights

U.S. Department of Transportation
Office of the Secretary of Transportation
Bureau of Transportation Statistics

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INTRODUCTION

Information in this document is collected from the *2018 Annual Report: Blowout Prevention System Safety Events*. The report is published by the Bureau of Transportation Statistics (BTS) and provides information on component failure events occurring during drilling and non-drilling operations on rigs in the Outer Continental Shelf (OCS). Failure event notifications were received from one region of the OCS, the Gulf of Mexico (GoM).

Table 1: Numbers at a Glance

Measure	2016	2017	2018
Total activity level			
Wells with Activity	D.N.A.$^{\beta}$	329	388
New Wells Spudded	165	153	190
Active Operators	20	25	31
Rigs Operating	D.N.A.	60	59
*BOP Days**	6,711	18,886	20,074
Reporting Operators	14	18	14
Rigs with Events	38	46	40
Total Events Reported**	825	1418	1197
Not in Operation	642	1173	1015
In Operation (no stack pull)	183	245	182
Stack pull †	≥ 13	≥ 20	32
LOC Events †	0	1	0
Top four operators' portion‡			
Events	81.3%	85.7%	87.2%
Wells with Activity	D.N.A.	D.N.A	36.3%
New Wells Spudded	D.N.A.	32.7%	43.7%
BOP Days	56.6%	60.7%	50.7%

From 2017 to 2018, the amount of drilling and non-drilling activity increased, as evidenced by the higher number of wells with activity, the higher number of new wells spudded, the increase in the number of active operators, and the increase in total BOP days. Though activity increased overall, the number of operators reporting failure events, as well as the number of rigs involved in those events, decreased, pointing to potential lapses in compliance with the failure reporting requirement of the Well Control Rule.

$^{\beta}$Data not available.

*BOP days offers an approximate measure of *rig activity* (the time in days when an equipment component failure could have occurred). BOP days is adjusted for the number of BOPs on a rig.

**Total events reported includes those on rigs with subsea BOPs and those on rigs with surface BOPs.

†Stack pulls are a subset of *in operation* events and LOC events are a subset of stack pulls. Loss of Containment (LOC) is an external leak of wellbore fluids outside of the “pressure containing” equipment boundary.

‡Top four operators’ portion is for the top 4 operators that submitted WCR notifications in the listed year.

Equipment Component Events

Table 2: Subsea Figures

Subsea Measure	2016	2017	2018
Reporting Operators	10	11	10
Events Reported	758	1304	1119
Not-in-Operation	611	1116	981
In-Operation (no stack pull)	147	188	138
Stack pull	≥ 11	≥ 10	12
LOC Events	0	1	0

Reporting Operators

Based on the number of notifications, the top four reporting operators represented a higher percentage of events in 2018 as compared to 2017. This pattern holds for both subsea and surface operators: 84.4 percent to 89.9 percent for subsea; 72.9 percent to 82.6 percent for surface.

Table 3: Surface Figures

Surface Measure	2016	2017	2018
Reporting Operators	6	10	8
Events Reported	67	114	78
Not-in-Operation	31	57	34
In-Operation (no stack pull)	36	57	44
Stack pull	≥ 2	≥ 10	20
LOC Events	0	0	0

Not in Operation Events

Data for all reporting years suggest that rigs with a higher incidence of *not in operation* events tend to have fewer events while *in operation*. *Not in operation* events usually occur during inspection, maintenance, and testing.

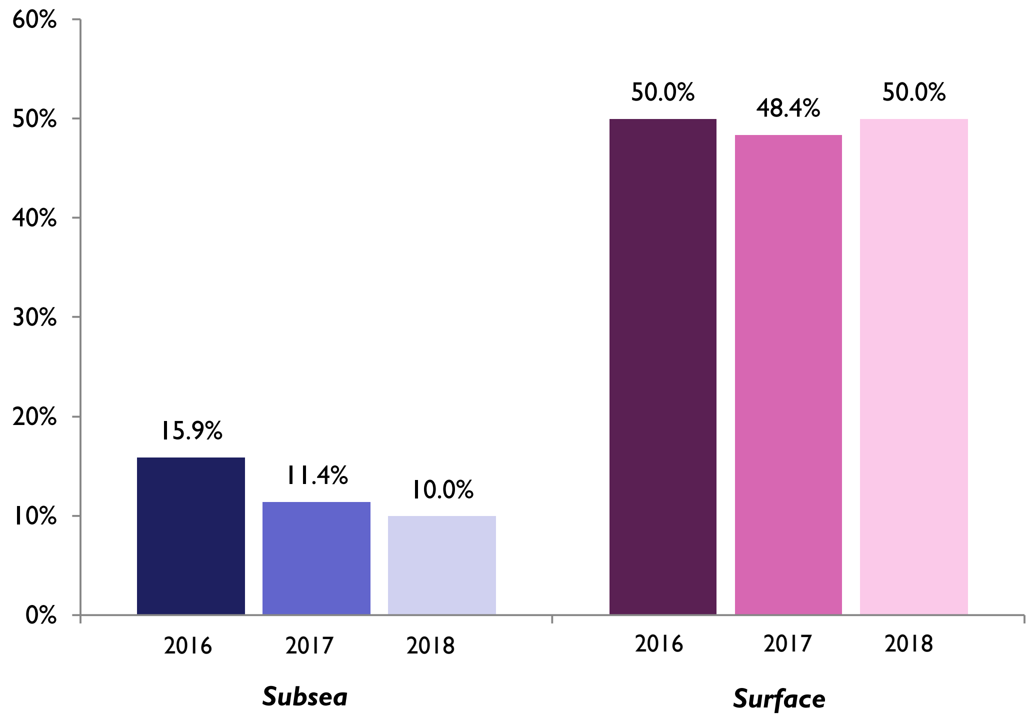
In Operation Events & Stack Pulls

Components that fail *in operation* have the potential to lead to stack pulls, if they cannot be corrected or bypassed with the BOP stack still attached to the wellhead. For rigs with subsea BOPs, there was a 3.4 percentage point increase in the rate of *in operation* events leading to stack pulls from 2017 to 2018. For surface BOPs, there was 28.0 percentage point increase.

Observed Failures & Detection Methods

External leaks (of water-based control fluids) continue to be the most frequently reported failure; however, as Figure I shows, for rigs with subsea BOPs, the percentage of those leaks *in operation* appears to be decreasing. For surface BOPs, the percentage *in operation* has remained stable. For subsea BOPs, events detected via *casual observation* have decreased and events detected through *inspection* have increased, relative to other detection methods. For surface BOPs, events were most frequently detected via *pressure testing* for all reporting years.

Figure 1: Percentage of External Leaks *in Operation*



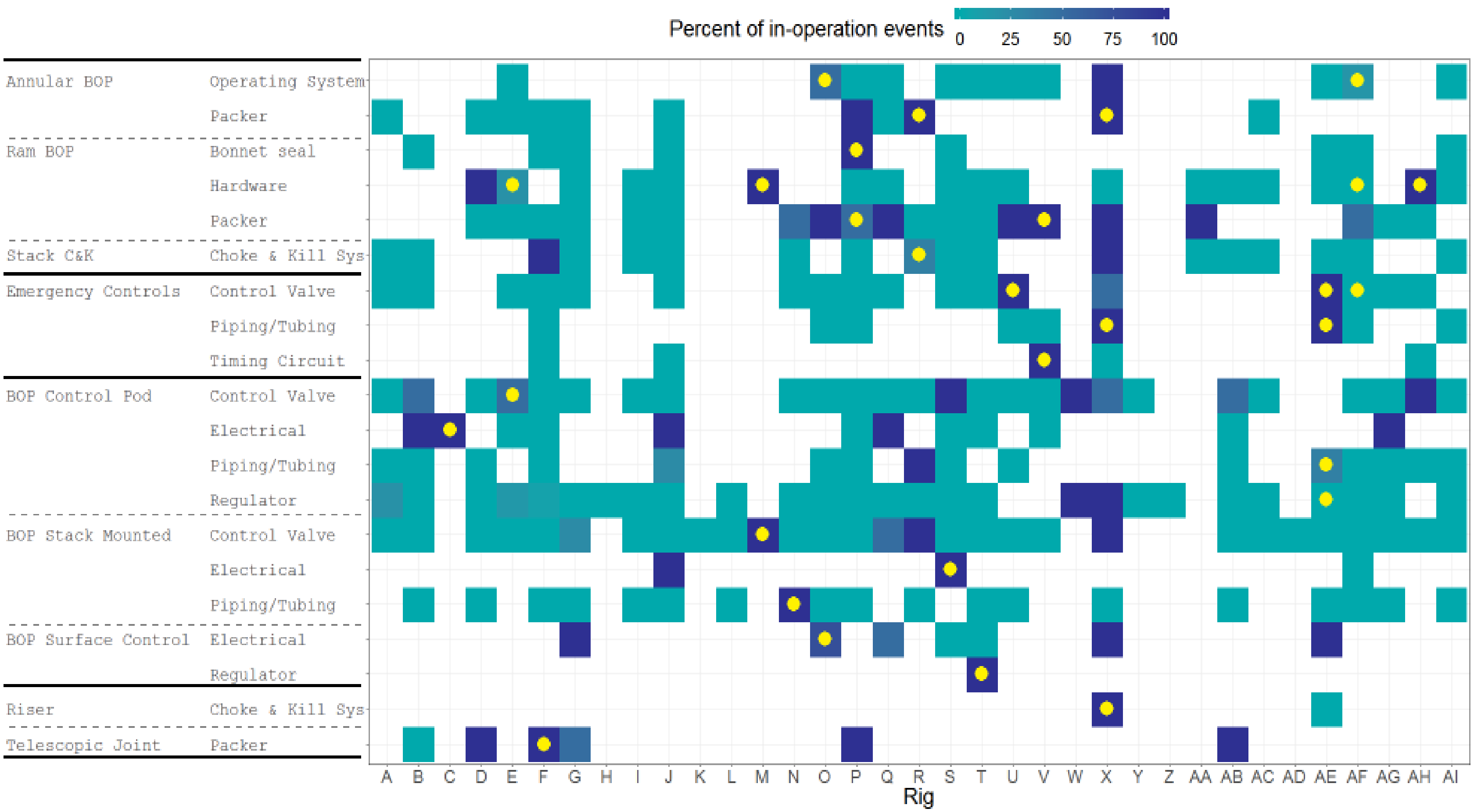
SUBSEA BOP STACK PULLS

Across all reporting years, there have been a total of 33[1] stack pulls on subsea rigs. As Figure 2 shows, stack pulls occur across a large variety of subunit, item, and component combinations. Component combinations listed in the heat map below were associated with at least one stack pull across all reporting years. Subsea rigs shown in the heat map experienced at least one event involving a listed component combination. The blue shaded boxes represent the number of *in operation* events relative to the total number of events of that component combination. The darker a box, the higher the rate of *in operation* events to the total number. Yellow dots represent the occurrence of a stack pull.

For all rig and component combinations which experienced a stack pull, 67.3 percent of the total events were *in operation*. For the remanining rig and component combinations, which did not experience a stack pull, the percent of events *in operation* was 8.7 percent. As the map shows, squares with a stack pull generally have a darker shade (higher *in operation* ratio), and squares without a stack pull generally have a lighter shade (lower *in operation* ratio). This points toward an increased likelihood for a stack pull on rigs that have a higher proportion of their events *in operation*.

[1] Four subsea stack pulls are not included in Figure 2 due to incomplete information.

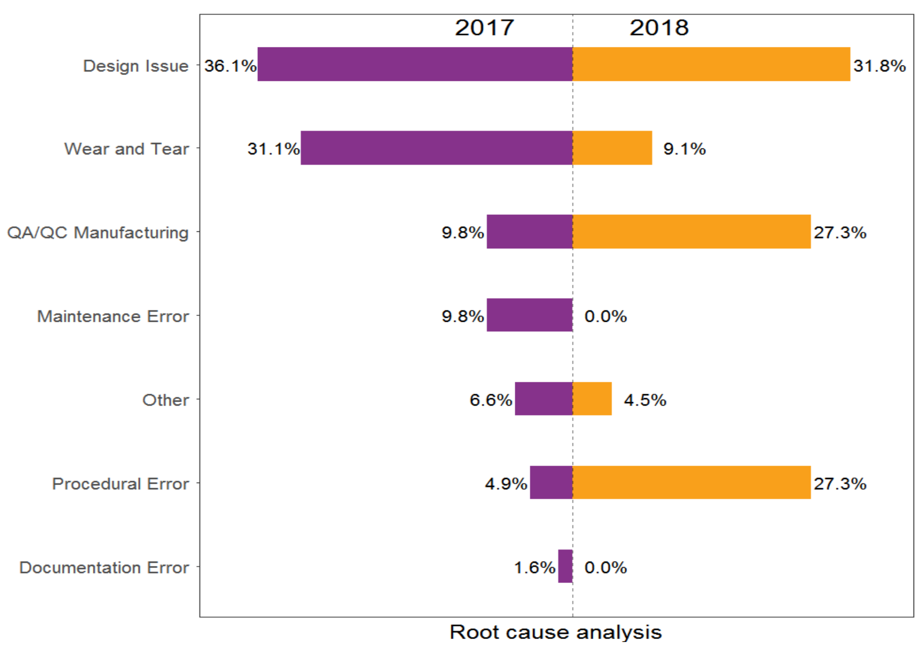
Figure 2: Events with Stack Pulls and Associated Component Combinations for All Years



INVESTIGATION & FAILURE ANALYSIS (I & A)

I & A refers to any level of investigation between a cursory visual inspection carried out by a subsea engineer on the rig, and a root cause failure analysis (RCFA) involving the original equipment manufacturer (OEM), or qualified third party. For most events, the root cause is immediately known; for the remainder, further investigation and analysis should be conducted to determine the root cause. For rigs with subsea BOPs, *design issue* has been an increasingly listed root cause of component events; however, the percentage of those events receiving I & A has decreased each year. For rigs with surface BOPs, events with the *cause immediately known* has increased, resulting in fewer events undergoing further analysis. Figure 3 shows the root causes for those events in 2017 and 2018 that had I & A completed. The largest changes in I & A root cause findings have been an increase in *procedural error* (4.9 percent to 27.3 percent), a decrease in *wear and tear* (31.1 percent to 9.1 percent) and an increase in *QA/QC Manufacturing* (9.8 percent to 27.3 percent).

Figure 3: Root Causes of Events in 2017 and 2018 Receiving I & A



Lessons Learned

Results of RCFA investigations that list follow-up actions have the potential to lead to findings with industry-wide impacts. For example, an identified issue could lead to a design change or procedural modification that affects multiple operators and/or equipment owners. The table below shows follow-up actions resulting from 10 RCFAs (for 16 events reported in 2018) including mitigation steps to improve training, equipment source accuracy, equipment design changes, or long-term corrective actions for the OEM, operator, and/or equipment owner. The listed actions serve as examples of how RCFAs lead to improvements not only for an individual entity, but also for the entire industry. For 14 additional events, there is evidence that further investigation was conducted; however, RCFA documentation with changes, corrective actions, and/or lessons learned has not yet been submitted to SafeOCS.

Table 4: Results of RCFAs and Recommended Follow-up Actions

Component	Root Cause	Root Cause Detail	Follow-up Action	Events with an RCFA	Events where an RCFA was recommended for the listed component	Total Events for the listed component
Accumulator	QA/QC Manufacturing	OEM substitute material was incorrect for the seal band.	OEM to accept back all faulty components for repair and revise applicable drawings.	4	28	82
Cylinder	Design Issue	Hard seal scuffing when stretching seal over shaft.	OEM updated design to prevent hard seal scuffing when stretching seal over shaft; new design was in testing at the time of this event.	2	4	5
Hydraulic Stab	Design Issue	Pipe alignment issue. Replace hard piping with flexible hoses.	Operator to change policy on hose usage. Rig Owner to update maintenance procedures.	3	5	10
Piping Tubing	Procedural Error	Tube fitting was loosened during either manufacturing, shipping, or installation. Defined processes are not in place to sufficiently test equipment after the manufacturing process.	OEM QA/QC procedures and Equipment Owner procedures to be updated.	1	12	79
	Wear and Tear	Vibration and water-hammer shocks loosened tubular pipe fitting.	Rig Owner to formalize the existing procedure to ensure proper torque of tubular pipe fittings before deploying the stack	1		
Ram Block Seal	Design Issue; Procedural Error	Variable Bore Rams inadequate bonding metal/elastomer.	OEM to redesign product to eliminate metal/elastomer bond line.	1	24	26
	Wear and Tear	Worn out; 70 closures recorded.	None	1		
		Metal shaving debris and metal part gouging.	None.	1		
Ring Gasket	Procedural Error	Bolt preload loss caused leak.	Rig Owner purchased new tool for checking torque and implemented previously released OEM procedures on checking proper torque.	1	1	2
Studs and Nuts	QA/QC Manufacturing	Surface flaw lead to heat treat crack on *20E API BSL 1* nut.	OEM applied additional QA/QC MPI process to lower grade of bolting.	1	4	6