



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

# Supplement

## Well Control Equipment Estimated System Component Counts



# Revision Log

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Version No.	Date	Revision Description
1.0	12/3/2021	Version 1

# Estimated WCE System Component Counts

## Overview

This supplement provides a listing of the types of components that could comprise a typical well control equipment (WCE) system configuration and estimates of the count of each type. These estimates are used to provide context for reported WCE failures, and they may provide insight into how often events occur relative to the number of similar components in use. The major topics discussed in this supplement include:

- Component population analysis
- Surface WCE system component counts
- Subsea WCE system component counts

## Component Population Analysis

Component counts vary by rig type, WCE system configuration, and make, model, and generation of the component type. Still, it is useful to formulate estimates for a more typical or “baseline” WCE system that is likely to largely reflect many existing configurations. SafeOCS developed estimates of the number of components for a baseline subsea WCE system with one or two subsea BOP stacks, as well as a baseline surface WCE system. These estimates were developed by subject matter experts and considered previous estimations by BSEE and the IOGP/IADC BOP Reliability JIP.<sup>1</sup>

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<sup>1</sup> International Association of Oil & Gas Producers (IOGP) / International Association of Drilling Contractors (IADC) BOP Reliability Joint Industry Project (JIP). The JIP developed and manages RAPID-53, the Reliability and Performance Information Database for Well Control Equipment covered under API Standard 53.

Table 1 shows the estimated number of components for these baseline WCE systems broken down by subunit. Complete listings of the components considered in developing the estimates are provided in

Table 2 (page 5) for subsea WCE systems and Table 3 (page 14) for surface WCE systems. Parts (e.g., fasteners) were distinguished from

components and excluded due to difficulty quantifying and their potential to mask or hinder identifying patterns and trends. Similarly, the multitudes of hoses and tubing runs are generally counted as one component for each item, rather than quantified, because of wide variance across WCE systems and the potential to skew the data due to overcounting. Even though these parts are not counted as individual components, any events attributed to them are still reported.

For subsea systems, these estimates include the number of BOP stacks on each rig and the estimated riser joints in use on a subsea well of average water depth (5,200 ft.) in the GOM. Based on these baseline estimates, a rig with two subsea BOP has approximately 1.48 times the number of WCE components as a rig with one BOP stack.

**Table 1: Number of Components Per Rig**

SUBUNIT	TYPE OF WCE SYSTEM		
	SUBSEA		SURFACE
	1 Stack	2 Stacks	1 Stack
Auxiliary Equipment	40	42	34
BOP Control Systems	1,390	2,497	143
BOP Stack System	380	760	141
Choke Manifold System	383	383	383
Diverter System	108	108	107
Riser System	788	788	0
<b>TOTAL</b>	<b>3,089</b>	<b>4,578</b>	<b>808</b>

1 : 1.48

**SOURCE:** U.S. DOT, BTS, SafeOCS program.

### Subsea WCE System Component Counts Estimates

Table 2 shows the estimated components in a baseline subsea BOP system with one or two BOP stacks. The population headings have been matched to the data collection form and adjusted to include the riser components required for the 5,200-foot average water depth of a GOM subsea well.

**Table 2: Listing of Subsea WCE System Component Count Estimates**

	# BOP Stacks		1	2	1	2	1	2	1	2
<b>Grand Total</b>									3,089	4,578
<b>Auxiliary Equipment</b>						40	42			
Drill String Valve				4	4					
Float Valve	1	1								
Kelly Valve	2	2								
Stabbing Valve	1	1								
<b>Gas Separation Equipment</b>				2	2					
Mud Gas Separator	1	1								
Poor Boy Degasser	1	1								
<b>Test Equipment</b>				31	33					
Cable	1	1								
Check Valve	2	2								
End Connection	2	2								
Hose	1	1								
Needle Valve	10	10								
Piping / Tubing	1	1								
Pressure Gauge	3	3								
Pressure Recorder	3	3								
Pump	2	2								
Relief Valve	2	2								
Ring Gasket	2	3								
Test Stump	2	3								
<b>Top Drive</b>				3	3					
Hose	1	1								
Inside BOP	1	1								
Swivel	1	1								
<b>BOP Stack System</b>						380	760			
<b>Annular Preventers</b>				8	16					
End Connection	2	4								
Fasteners	0	0								
Hardware	3	6								
Operating System Seal	1	2								
Packing Element	1	2								
Ring Gasket	1	2								
<b>Ram BOP Body</b>				24	48					
End Connection	4	8								
Fasteners	0	0								
Ram Cavity	6	12								
Ring Gaskets	2	4								
Side Outlets	12	24								
<b>Lower Flex Joint</b>				6	12					
End Connection	2	4								

	# BOP Stacks		1	2	1	2	1	2	1	2
Fasteners			0	0						
Flex Element			1	2						
Hardware			2	4						
Ring Gasket			1	2						
<b>Riser Mandrel</b>					2	4				
Fasteners			0	0						
Hardware			1	2						
Ring Gasket			1	2						
<b>Pipe Ram Preventers</b>					56	112				
Bonnet Face Seal			8	16						
Hardware			24	48						
Locking Device			4	8						
Operating System Seal			8	16						
Ram Block Hardware			4	8						
Ram Block Seal			8	16						
<b>Riser Adaptor</b>					11	22				
End Connection			1	2						
Fasteners			0	0						
Kick-out Sub			5	10						
Mud Boost Valve			1	2						
Ring Gasket			3	6						
Riser Coupling			1	2						
<b>Riser Connector</b>					56	112				
End Connection			2	4						
Fasteners			0	0						
Hardware			52	104						
Operating System Seal			1	2						
Ring Gasket			1	2						
<b>Shear Ram Preventers</b>					34	68				
Bonnet Face Seal			4	8						
Hardware			12	24						
Locking Device			4	8						
Operating System Seal			4	8						
Shear Ram Block Hardware			4	8						
Shear Ram Block Seal			6	12						
<b>Stack Choke and Kill System</b>					127	254				
Operating System Seal			14	28						
C/K Spools			8	16						
C/K Valves			14	28						
C/K Receptacle			2	4						
C/K Stab			2	4						
End Connection			54	108						
Fasteners			0	0						
Flex Loop / Hose			2	4						

	# BOP Stacks		1	2	1	2	1	2	1	2
Hardware			2	4						
Hub Clamp			2	4						
Ring Gaskets			27	54						
<b>Wellhead Connector</b>					56	112				
End Connection			2	4						
Fasteners			0	0						
Hardware			52	104						
Operating System Seal			1	2						
Ring Gasket			1	2						
<b>BOP Control System</b>							1,390	2,497		
<b>Control Panels</b>					7	7				
Auxiliary Control Panel			0	0						
Central Control Console			1	1						
Driller's Control Panel			1	1						
Rig Manager Control Panel			0	0						
Software			1	1						
Subsea Control Panel			1	1						
Toolpusher's Control Panel			1	1						
Uninterruptible Power Supply (UPS)			2	2						
<b>BOP Control Pod</b>					681	1,348				
Accumulator			10	20						
Ball Valve			2	4						
Check Valve			4	8						
Compensated Chamber			2	4						
Control Valve			230	460						
Cylinder			4	8						
Electrical Connector			8	16						
Filter			8	16						
Flowmeter			2	4						
Inclinometer			2	4						
Interconnect Cable			4	8						
Interface Seal			18	36						
Metering Needle Valve			21	28						
Piping / Tubing			1	2						
Pod Hose			6	12						
Pod Stab			2	4						
Pressure Gauge			30	60						
Pressure Transducer			30	60						
Primary Gripper			2	4						
Regulator			14	28						
Relief valve			5	10						
Secondary Gripper			2	4						
Shuttle Valve			10	20						
Software			2	4						

	# BOP Stacks		1	2	1	2	1	2	1	2
Solenoid Valve	258	516								
Subsea Electronic Assembly Module	4	8								
<b>Stack Mounted Controls</b>					194	388				
Accumulator	8	16								
Cable	8	16								
Check Valve	4	8								
Conduit Manifold	2	4								
Control Valve	12	24								
Electrical Connector	16	32								
Flowmeter	2	4								
Hose	1	2								
Hot Line Manifold	2	4								
Hydraulic Stab	2	4								
Inclinometer	1	2								
Metering Needle Valve	4	8								
Pilot Operated Check Valve	2	4								
Piping / Tubing	1	2								
Pod Receptacle	2	4								
Pressure Gauge	0	0								
Pressure Transducer	0	0								
P / T Sensor	2	4								
Quick Dump Valve	4	8								
Regulator	1	2								
Relief Valve	1	2								
Riser Control Box (RCB)	1	2								
Shuttle Valve	117	234								
Wet Mate Connector	1	2								
<b>Hydraulic Power Unit (HPU) / Mix System</b>					217	217				
Accumulator	82	82								
Ball Valve	38	38								
Check Valve	14	14								
Control Valve	8	8								
Filter	4	4								
Flowmeter	2	2								
Fluid	1	1								
Fluid Recovery Unit	0	0								
Gate Valve	3	3								
Hose	1	1								
HPU Control Panel	1	1								
Instrumentation	0	0								
Mix System	1	1								
Metering Needle Valve	4	4								
Piping / Tubing	1	1								
Plug Valve	0	0								



	# BOP Stacks	1	2	1	2	1	2	1	2
Pressure Gauge		20	20						
Pressure Switch		12	12						
Pressure Transducer		4	4						
Pump		3	3						
Regulator		2	2						
Relief Valve		5	5						
Selector/Manipulator Valve		0	0						
Shuttle Valve		0	0						
Solenoid Valve		0	0						
Solenoid Valve (Pneumatic)		11	11						
<b>Reels, Hoses, Cables</b>				19	19				
Hot-line Hose		1	1						
HP Swivel		1	1						
Junction Box		2	2						
Multiplex (MUX) Cable		2	2						
MUX Cable Connector		2	2						
RBQ Hydraulic Junction Plate		0	0						
Reel		3	3						
Sheave		6	6						
Slip Ring		2	2						
Umbilical Hose		0	0						
<b>Secondary - Acoustic System</b>				102	182				
Accumulator		22	22						
Battery		1	2						
Check Valve		3	6						
Compensated Chamber		1	2						
Compensator		1	2						
Control Valve		9	18						
Filter		4	8						
Hose		1	2						
Hydraulic Stab		1	2						
Interface Seal		5	10						
Metering Needle Valve		1	2						
Pilot Operated Check Valve		8	16						
Piping / Tubing		1	2						
Pressure Gauge		2	4						
Pressure Transducer		9	18						
Regulator		1	2						
Relief Valve		2	4						
Shuttle Valve		12	24						
Software		1	2						
Solenoid Valve		8	16						
Surface Control Unit (SCU)		1	2						
Transducer		2	4						

	# BOP Stacks		1	2	1	2	1	2	1	2
Transducer Deployment Arms	2	4								
Transponder	2	4								
Trigger Valve	1	2								
Wet Mate Connector	1	2								
<b>Secondary - (ROV) Intervention</b>			31	60						
Accumulator	1	2								
Hose	1	2								
Piping / Tubing	1	2								
Pressure Gauge	3	6								
Regulator	2	4								
ROV Receptacle	11	22								
ROV Stinger / Hot Stab	2	2								
ROV Valve	10	20								
<b>Emergency - Autoshear / Deadman (EHBS)</b>			138	275						
Accumulator	71	142								
Battery	1	2								
Check Valve	5	10								
Control Valve	15	30								
Cylinder	0	0								
Hose	1	2								
Hydraulic Stab	1	2								
Metering Needle Valve	1	2								
Pilot Operated Check Valve	11	22								
Piping / Tubing	1	1								
Pressure Gauge	1	2								
Pressure Transducer	8	16								
Regulator	1	2								
Relief Valve	4	8								
Shuttle Valve	5	10								
Solenoid Valve	10	20								
Timing Circuit	1	2								
Trigger Valve	1	2								
<b>Emergency - EDS</b>			1	1						
Software	1	1								
<b>Choke Manifold System</b>			383	383						
<b>Auto-Choke</b>			8	8						
Actuator	1	1								
End Connection	2	2								
Fasteners	0	0								
Hardware	5	5								
<b>Choke / Kill Drape Hose</b>			6	6						
Choke Hose	1	1								
HP Swivel	2	2								
Hub Clamp	2	2								

	# BOP Stacks		1	2	1	2	1	2	1	2
Kill Hose			1	1						
<b>Choke / Kill Piping Components</b>					24	24				
Block			14	14						
Fasteners			0	0						
Fluid Cushion			4	4						
Spools			4	4						
Vessel Piping			2	2						
<b>Choke Manifold Controls</b>					11	11				
Accumulator			2	2						
Cable			1	1						
Control Valve			5	5						
HPU			1	1						
Hose			1	1						
Piping / Tubing			1	1						
<b>Instruments</b>					14	14				
Pressure Gauge			6	6						
Pressure Transducer			8	8						
<b>Gate Valves</b>					312	312				
End Connection			104	104						
Fasteners			0	0						
Hardware			203	203						
Actuator			5	5						
<b>Manual Choke</b>					8	8				
End Connection			2	2						
Fasteners			0	0						
Hardware			5	5						
Actuator			1	1						
<b>Diverter System</b>					108	108				
<b>Diverter Assembly</b>					13	13				
Flowline Seal			2	2						
Hose			1	1						
Hydraulic Control Interface			1	1						
Insert Packer			1	1						
Locking Dog			4	4						
Operating System Seal			1	1						
Packing Element			1	1						
Piping / Tubing			1	1						
Ring Gasket			1	1						
Fasteners			0	0						
<b>Diverter Control System</b>					39	39				
Accumulator			6	6						
Ball Valve			6	6						
Check Valve			2	2						
Pressure Gauge			6	6						

	# BOP Stacks		1	2	1	2	1	2	1	2
Pressure Switch			6	6						
Pump			0	0						
Regulator			5	5						
Relief Valve			2	2						
Selector / Manipulator Valve			6	6						
<b>Handling Tool</b>					2	2				
Hardware			2	2						
<b>Housing</b>					6	6				
Dog			4	4						
Fasteners			0	0						
Hose			1	1						
Piping / Tubing			1	1						
<b>Diverter Piping</b>					31	31				
End Connection			20	20						
Fasteners			0	0						
Gaskets			10	10						
Pipe			1	1						
<b>Diverter Valve</b>					12	12				
Actuator			5	5						
Valve			5	5						
Hose			0	0						
Instrumentation			1	1						
Piping / Tubing			1	1						
<b>Upper Flexjoint</b>					5	5				
End Connection			2	2						
Fasteners			0	0						
Flex Element			1	1						
Hardware			1	1						
Ring Gasket			1	1						
<b>Riser System (for the average GOM water depth of 5,200 feet)</b>					788	788				
<b>Handling Tool</b>					3	3				
Hydraulic Tool			2	2						
Manual Tool			1	1						
<b>Riser Joints</b>					731	731				
BLAT (BOP Landing Assist Tool)			1	1						
Buoyancy			278	278						
Choke and Kill Line			116	116						
Conduit Line			116	116						
Fasteners			0	0						
Riser Bolt			0	0						
Lift Tool			1	1						
Main Tube			58	58						
Mud Boost Line			58	58						
Other Line			0	0						

	# BOP Stacks	1	2	1	2	1	2	1	2
Riser Coupling		58	58						
Riser Protection		44	44						
Shuttle Tool		1	1						
<b>Telescopic Joint</b>				25	25				
Bearing		1	1						
Choke / Kill Line		2	2						
Fasteners		0	0						
Gooseneck		5	5						
HFGS		0	0						
Hose		1	1						
HP Swivel		1	1						
Hub Clamp		3	3						
Hydraulic Stab		2	2						
Inner Barrel		1	1						
Inner Barrel Lock		1	1						
Mud Boost Drape Hose		1	1						
Mud Boost Line		1	1						
Other Line		2	2						
Packer		2	2						
Piping Tubing		1	1						
Vessel Piping		1	1						
<b>Tension Ring</b>				16	16				
Bearing		1	1						
Fasteners		0	0						
Hardware		15	15						
<b>Riser Gas Handling Equipment</b>				13	13				
Ball Valve		2	2						
C / K Line		2	2						
Fasteners		0	0						
Gooseneck		2	2						
Hose		2	2						
Mud Boost Line		1	1						
Other Line		2	2						
Packer		1	1						
Piping / Tubing		1	1						

**KEY:**

Grand Total
Subunit
Item

Component

**SOURCE:** U.S. DOT, BTS, SafeOCS Program.

## Surface WCE System Component Count Estimates

Table 3 shows the estimated numbers of components in a baseline surface BOP system. The population headings have been matched to the data collection form.

**Table 3: Listing of Surface WCE System Component Count Estimates**

Grand Total		808
<b>Auxiliary Equipment</b>		<b>34</b>
Drillstring Valve		4
Float Valve	1	
Kelly Valve	2	
Stabbing Valve	1	
<b>Gas Separation Equipment</b>		<b>2</b>
Mud Gas Separator	1	
Poor Boy Degasser	1	
<b>Test Equipment</b>		<b>25</b>
Cable	1	
Check Valve	2	
End Connection	2	
Hose	1	
Needle Valve	10	
Piping / Tubing	1	
Pressure Gauge	2	
Pressure Recorder	2	
Pump	1	
Relief Valve	1	
Ring Gasket	1	
Test Stump	1	
<b>Top Drive</b>		<b>3</b>
Hose	1	
Inside BOP	1	
Swivel	1	
<b>BOP Stack System</b>		<b>141</b>
<b>Annular Preventers</b>		<b>8</b>
End Connection	2	
Fasteners	0	
Hardware	3	
Operating System Seal	1	
Packing Element	1	
Ring Gasket	1	
<b>Ram BOP Body</b>		<b>24</b>
End Connection	4	
Fasteners	0	

Ram Cavity	6	
Ring Gaskets	2	
Side Outlets	12	
<b>Pipe Ram Preventers</b>		<b>48</b>
Bonnet Face Seal	6	
Hardware	18	
Locking Device	6	
Operating System Seal	6	
Ram Block Hardware	6	
Ram Block Seal	6	
<b>Shear Ram Preventers</b>		<b>17</b>
Bonnet Face Seal	2	
Hardware	6	
Locking Device	2	
Operating System Seal	2	
Shear Ram Block Hardware	2	
Shear Ram Block Seal	3	
<b>Stack Choke and Kill System</b>		<b>44</b>
Operating System Seal	4	
C / K Spools	4	
C / K Valves	4	
End Connection	16	
Fasteners	0	
Flex Loop / Hose	2	
Hub Clamp	2	
Ring Gaskets	12	
<b>BOP Control System</b>		<b>143</b>
<b>Control Panels</b>		<b>5</b>
Auxiliary Control Panel	0	
Central Control Console	0	
Driller's Control Panel	1	
Rig Manager Control Panel	0	
Software	1	
Subsea Control Panel	0	
Toolpusher's Control Panel	1	
Uninterruptible Power Supply (UPS)	2	
<b>Stack Mounted Controls</b>		<b>4</b>
Hose	1	
Piping / Tubing	1	
P / T Sensor	2	
<b>Hydraulic Power Unit (HPU)</b>		<b>134</b>
Accumulator	40	
Ball Valve	19	
Check Valve	8	
Control Valve	8	

Filter	4
Flowmeter	1
Fluid	1
Gate Valve	3
Hose	1
HPU Control Panel	1
Instrumentation	0
Piping / Tubing	1
Plug Valve	0
Pressure Gauge	10
Pressure Switch	12
Pressure Transducer	4
Pump	3
Regulator	2
Relief Valve	5
Selector/Manipulator Valve	0
Shuttle Valve	0
Solenoid Valve	0
Solenoid Valve (Pneumatic)	11
<b>Choke Manifold System</b>	<b>383</b>
Auto-Choke	8
Actuator	1
End Connection	2
Fasteners	0
Hardware	5
Choke / Kill Drape Hose	6
Choke Hose	1
HP Swivel	2
Hub Clamp	2
Kill Hose	1
Choke / Kill Piping Components	24
Block	14
Fasteners	0
Fluid Cushion	4
Spools	4
Vessel Piping	2
Choke Manifold Controls	11
Accumulator	2
Cable	1
Control Valve	5
HPU	1
Hose	1
Piping / Tubing	1
Instruments	14
Pressure Gauge	6



Pressure Transducer	8	
<b>Gate Valves</b>		<b>312</b>
End Connection	104	
Fasteners	0	
Hardware	203	
Actuator	5	
<b>Manual Choke</b>		<b>8</b>
End Connection	2	
Fasteners	0	
Hardware	5	
Actuator	1	
<b>Diverter System</b>		<b>107</b>
<b>Diverter Assembly</b>		<b>13</b>
Flowline Seal	2	
Hose	1	
Hydraulic Control Interface	1	
Insert Packer	1	
Locking Dog	4	
Operating System Seal	1	
Packing Element	1	
Piping / Tubing	1	
Ring Gasket	1	
Fasteners	0	
<b>Diverter Control System</b>		<b>39</b>
Accumulator	6	
Ball Valve	6	
Check Valve	2	
Pressure Gauge	6	
Pressure Switch	6	
Pump	0	
Regulator	5	
Relief Valve	2	
Selector / Manipulator Valve	6	
<b>Handling Tool</b>		<b>2</b>
Hardware	2	
<b>Housing</b>		<b>6</b>
Dog	4	
Fasteners	0	
Hose	1	
Piping / Tubing	1	
<b>Diverter Piping</b>		<b>31</b>
End Connection	20	
Fasteners	0	
Gaskets	10	
Pipe	1	

Diverter Valve	12
Actuator	5
Valve	5
Hose	0
Instrumentation	1
Piping / Tubing	1
Diverter Spools	4
Spools	2
Overshots	2

**KEY:**

Grand Total
Subunit
Item

Component

**SOURCE:** U.S. DOT, BTS, SafeOCS Program.