

# Rigless, a Misnomer?

## Applications to late well lifecycles

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Aberdeen Section

[www.spe-uk.org](http://www.spe-uk.org)

4<sup>th</sup> October 2017  
Aberdeen | United Kingdom

# Safety Moment – Traveling Safely

## Immunisations

- ✓ Recommended
- ✓ Actually Required
- ✓ Time Lag
- ✓ Provider Misconceptions

## Insurance

- ✓ Local Offices
- ✓ Procedure
- ✓ Payment Bond
- ✓ Escalation

## Emergency

- ✓ How do you identify as an insured person?
- ✓ Identification
- ✓ Company Contact
- ✓ Payment Bond Issues





## Rigless...A Misnomer?

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“Its widely accepted Operators can derive cost savings through the utilization of Rigless Operations”

- Highly sensitive to well architecture, facility architecture, project execution models etc
- Numerous highly successful campaigns
- Tempered with unsuitable campaigns

“Wherever possible adopt Rigless Well Abandonment Operations”

- Evaluate where possible
- Data is Key!
- Well Categorization and project work scope generation to ensure commercial drivers are met

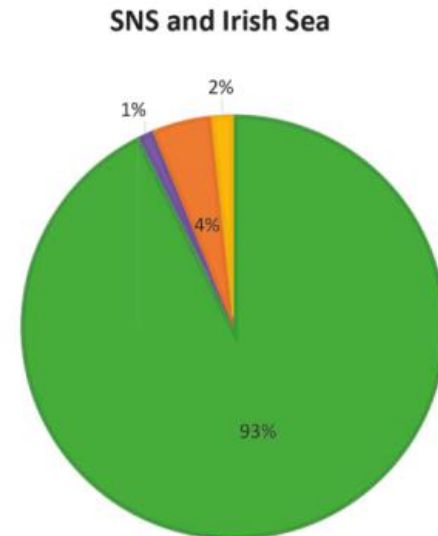
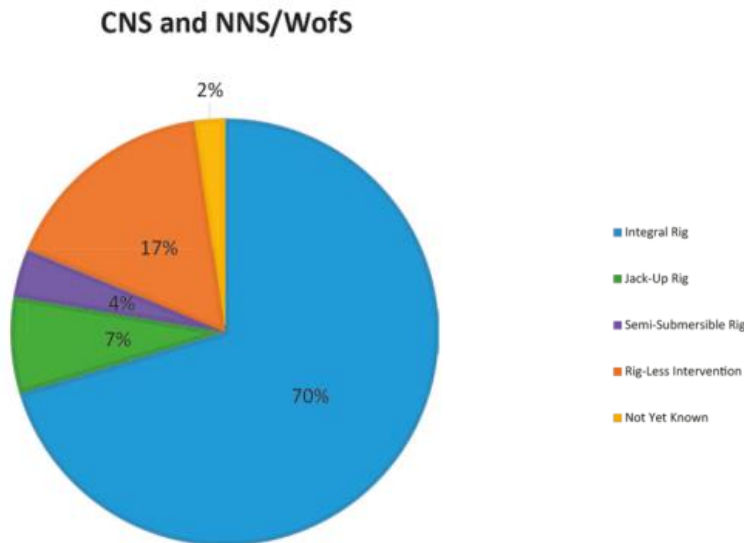
“Rigless Well Abandonment Services Help Kill, Plug 10 Wells in 234 Days, Save Operator \$10.8 Million”

- Technology Development with Operator specific to geo-region and facilities
- Consistent Well Architecture to develop Operator and Service Company competence

# Market Adoption of Rigless Techniques in UK Sector

- £16,900,000,000 spend forecast, partially underwritten by the Treasury
- 950 – UK Wells to permanently abandon in the next 10 years, 55% Platform wells
- Can Rigless Technologies be considered a viable alternative to Integral Rig's or Jack-Up's?

Platform Well P&A



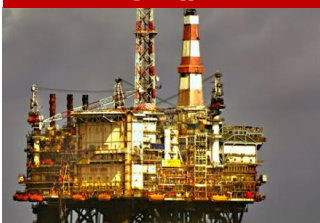
Well P&A	2014 Average	2015 Average
Platform wells	£4.8 million	£4.1 million

Well P&A	2014 Average	2015 Average
Platform wells	£2.7 million	£3 million

Source: Oil & Gas UK – Decommissioning Insight 2015

## Drilling Technology

Drilling Eqpt. Set



Jack-Up Rig

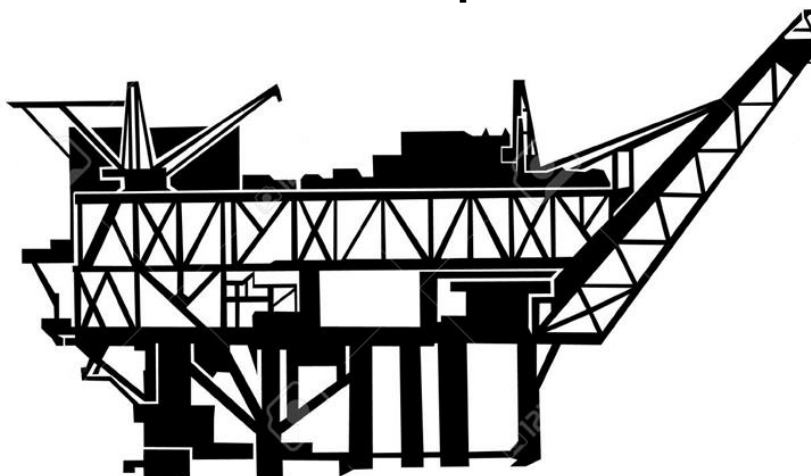


Modular Drilling Unit



## Facility Requiring Intervention Well Operations

Well Entry and Intervention  
Heavy Workover  
Planned Fishing (P&A)  
Well Slot Recovery  
Well Slot Preparation



## "Rigless" Technology

Wireline



Coiled Tubing Units



Hydraulic Workover



Workover/Pulling





# Technology Selection Examples

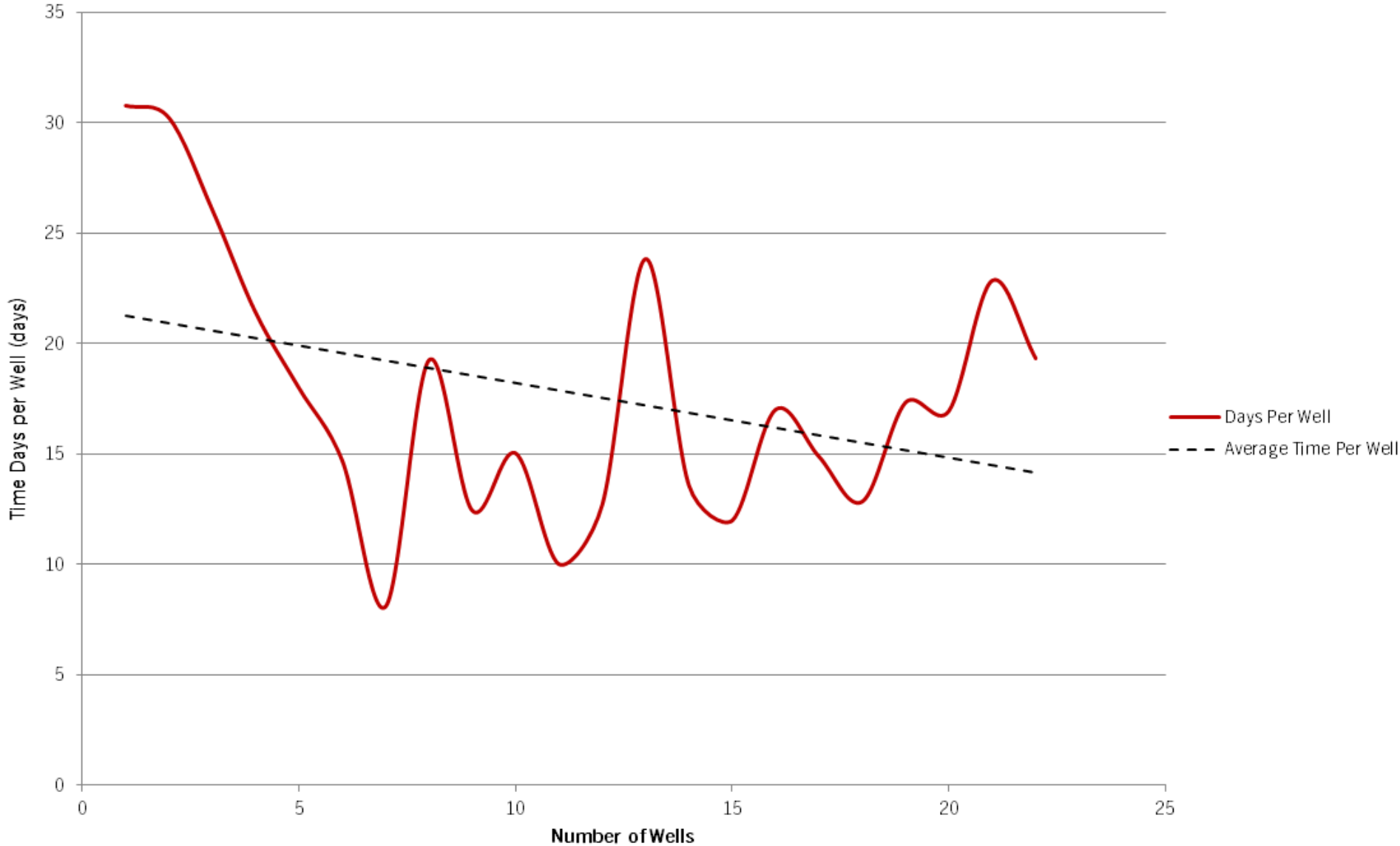
Parameter		Typ. Jack Up Rig	Typ. Semi-Tender Rig	Typ. Modular Drilling Unit	Typ. Pulling Unit	Typ. Hydraulic Workover Unit
Hoisting	Drive	Drawworks, Traveling Block	Drawworks, Traveling Block	Rack and Pinion Mast, Traveling Block	Hydraulic Mast, Rig Assist Jack	Casing Jack
	Capacity	> 2,100,000 lbf	> 1,000,000 lbf	800,000 lbf	Mast - 221,000 lbf Rig Assist - 600,000 lbf	460,000 lbf
	HP	> 5,750	> 3,000	1,000	430	600
	Setback	Yes	Yes	No	Yes	No
	Design Speed	1,800 ft/hr	1,400 ft/hr	1,200 ft/hr	1,500 ft/hr	800 ft/hr
Rotation	Drive	Top Drive	Top Drive	Top Drive	Power Swivel Top Drive	Rotary Table
	Capacity	Up to 120,000 lb.ft	Up to 60,000 lb.ft	Up to 60,000 lb.ft	12,000 lb.ft or 21,000 lb.ft	22,000 lb.ft
Setback	Type	Automated Iron Derrickman	Work board in Derrick		Gantry System	
	Capacity	> 2,250,000 lbf R II Triple or Quad Stands	> 750,000 lbf R II Stands 5.5" 19# 19,740ft		160,000 lbf R II 3.5" 13.3# 10,900 ft R III 3.5" 9.2# 17,380 ft	
Sub-Structure	Capacity	> 28,000,000 lbf combined loading	> 4,000,000 lbf combined loading	> 3,200,000 lbf combined loading	Up to 1,000,000 lbf combined loading	Up to 600,000 lbf combined loading
Pumping	Type	4 x Triplex 1600 BHP Pumps	3 x Triplex 1200 BHP Pumps	4 x Triplex 1200 BHP Pumps	2 x Triplex 600 BHP Pumps	2 x Triplex 600 BHP Pumps
	Capacity	>18 bbls/min @7,500 psi	>18 bbls/min @7,500 psi	>18 bbls/min @5,000 psi	11 bbls/min @3,000 psi	11 bbls/min @3,000 psi

# Discreet vs Integrated vs Rigless – Crew Approaches

	E/Wire/Slickline	Tubular Running	Pumping	Cementation	Fishing
<b>Discreet Services</b> 					
<b>Integrated Services</b> <b>Reduction in Crew POB</b>					
<b>Rigless Services</b> <b>Integrated Multi-Skilled Rigless Crew</b>					

Multi-Skilled Crew  
 Reduced Crew  
 Call off Crew

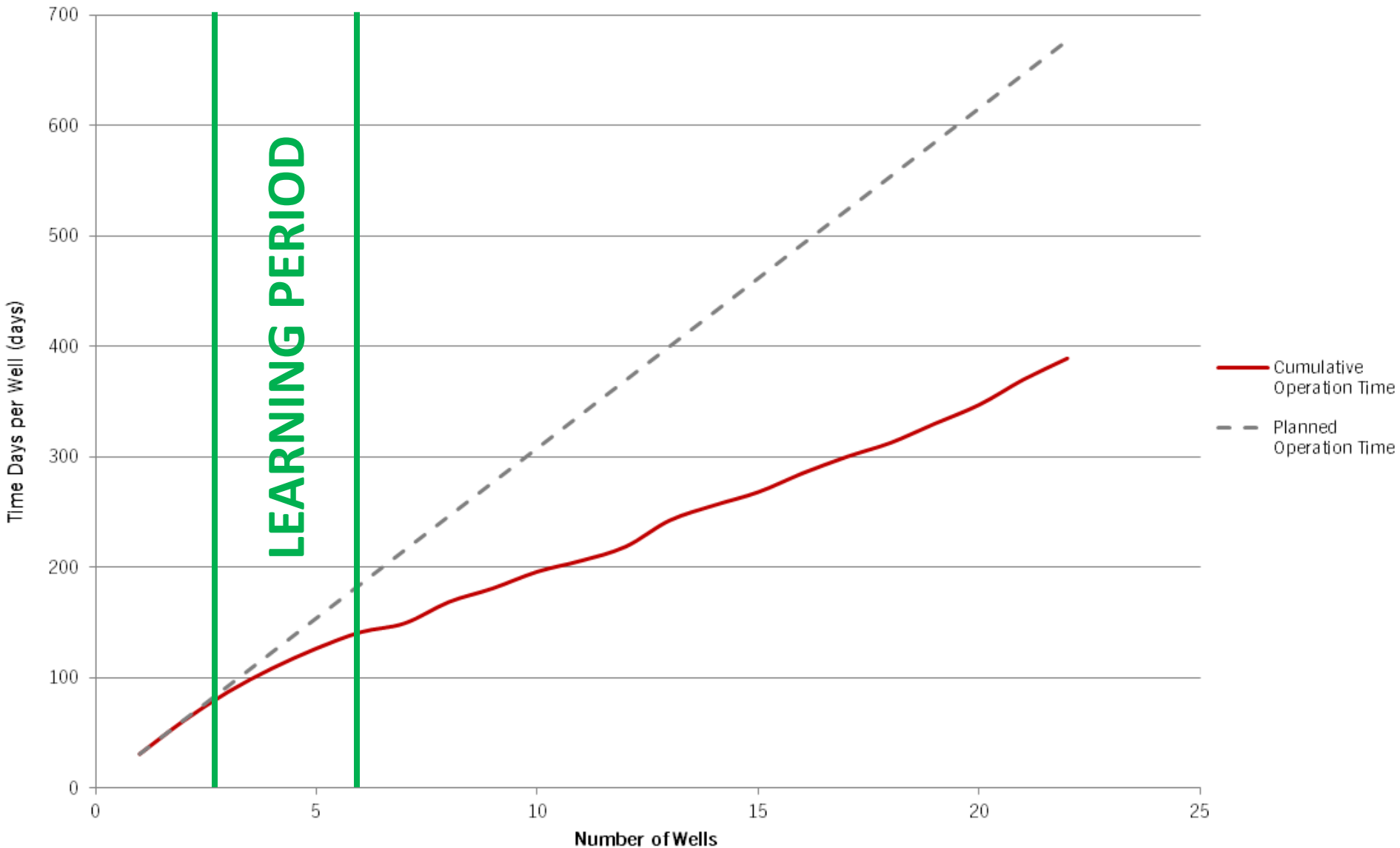
# Well Performance Times







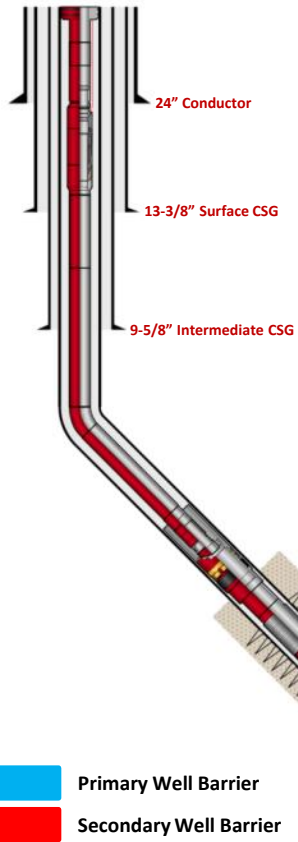
# Cumulative Performance Times vs Initial Time



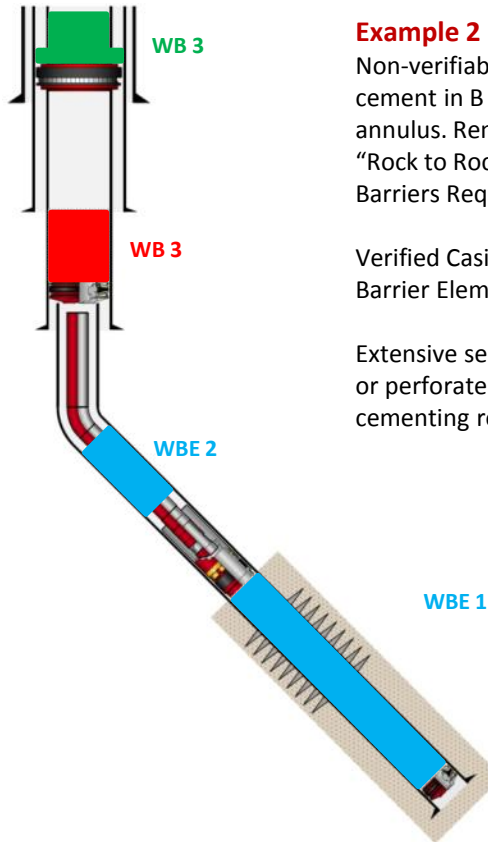
# Viability for Operations?

Driven by what is happening downstairs?

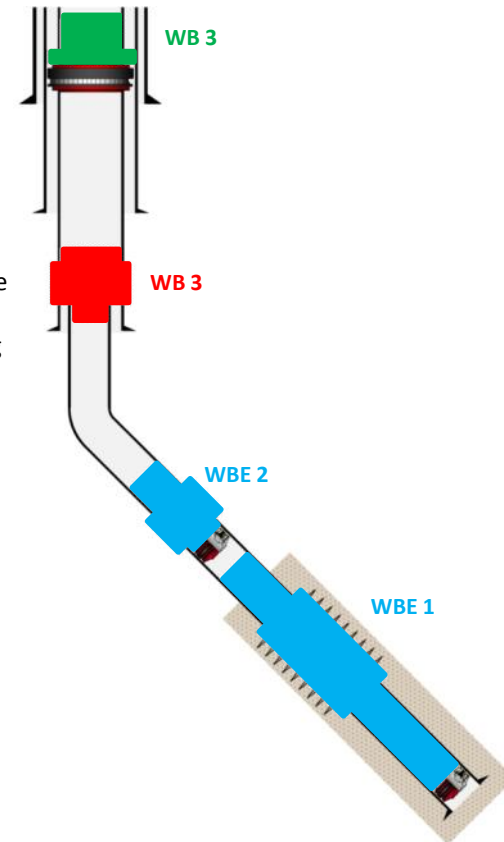
# Well Barriers in Suspension and Abandonment



**Example 1**  
Verified Annular Cement Well Barrier Elements in B and C Annulus.  
Verified Casing Well Barrier Elements in place  
Cased hole plugs required with section milling in WB3



**Example 2**  
Non-verifiable annular cement in B and C annulus. Removal and "Rock to Rock" Well Barriers Required  
Verified Casing Well Barrier Elements in place  
Extensive section milling or perforate and wash cementing required



- Primary Well Barrier
- Secondary Well Barrier
- Surface Well Barrier



# Surface Equipment Requirements Base on Downhole SOR

## Example 1

- 1x squeezed cement plug
- 3x cased hole plugs
- 7" casing cutting and recovery
- 9-5/8" window milling (25 ft)

## Required Surface Equipment

### Rigless or Light Intervention Equipment

- Pressure Control Equipment
- Axial Hoisting – Casing Jack
- Well Servicing Pump
- Wireline PCE and Toolstrings

## Example 2

- 3x Formation to Formation Plug
- 1x cased hole plug
- Lower Completion Pilot Milling
- 7" Casing Section Milling (70 ft window)
- 7" Casing Section Under reaming (70 ft window)
- 7" Casing cutting and recovery
- 9-5/8" Casing Section Milling (70 ft window)
- 9-5/8" Casing Section Under reaming (70 ft window)
- 9-5/8" Section Milling (25 ft)

## Required Surface Equipment

### Well Construction Drilling Equipment

- Drilling Equipment Structure and Drilling Support Module

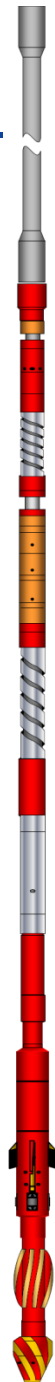
## Deviated well @ 72.5 degrees inclination in 7" Production Casing @ 8,400 ft MD

### Summary

- 14 x 49.36 lb/ft Collars - 69 kips
- 800 ft + of BHA
- S-135 Gr Drill Pipe with High Torque Tool Joints
- Surface Hoisting, cocking and handling of Drilling Jars
- 3x connection types (Tong Re-dressing Req.)

### Challenges

- Well Control
- Hydraulic requirements - conveyed via small ID Drill Pipe
- Surface handling of drill collars (4-7/8" x 30ft)
- Rotary Shoulder Connection Make Up/Brake Up – Joint Integrity
- Surface Torque – Rotary Table, Power Swivel or Top Drive?
  - Rotary Table – 22f ft.lbs @ 90 RPM
  - Power Swivel – 12k ft.lbs @ 160 RPM (8k ft.lbs @ 120 RPM)
  - Top Drive – 21k ft.lbs @ 90 RPM (16k ft.lbs @ 120 RPM)
- Swarf handling



## Sample BHAs Used in a Well

### Wellbore Clean Up

- Casing Scraper
- Jetting and fluid conditioning tools

### Plug Running Tools

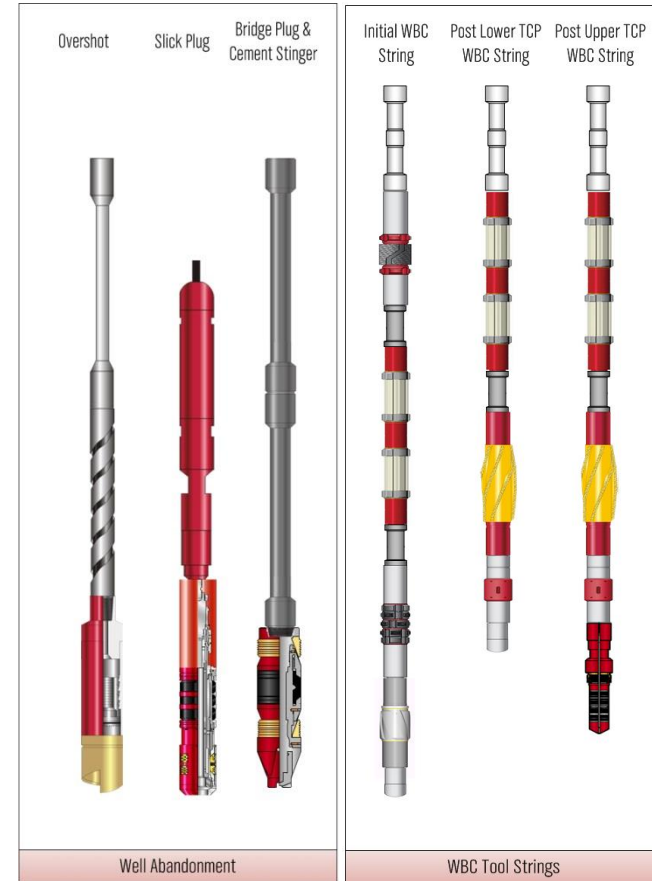
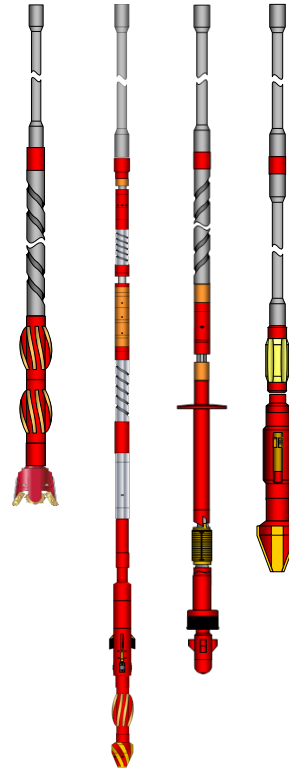
- Cement Retainers
- Retrievable Bridge Plugs
- Suspension Packers

### Fishing Tools

- Overshots
- Rotary Casing Cutters
- Casing Spears
- Rotary Shoe Mills
- Pilot Mills
- Section Mills

## In addition to Casing Recovered

- 7" Thru 30"



# Casing Tong Integration Options – Modular Trims



**OTC2017** \

OFFSHORE TECHNOLOGY CONFERENCE  
1-4 May 2017 \ Houston, Texas, USA \ NRG Park  
2017.otcnet.org

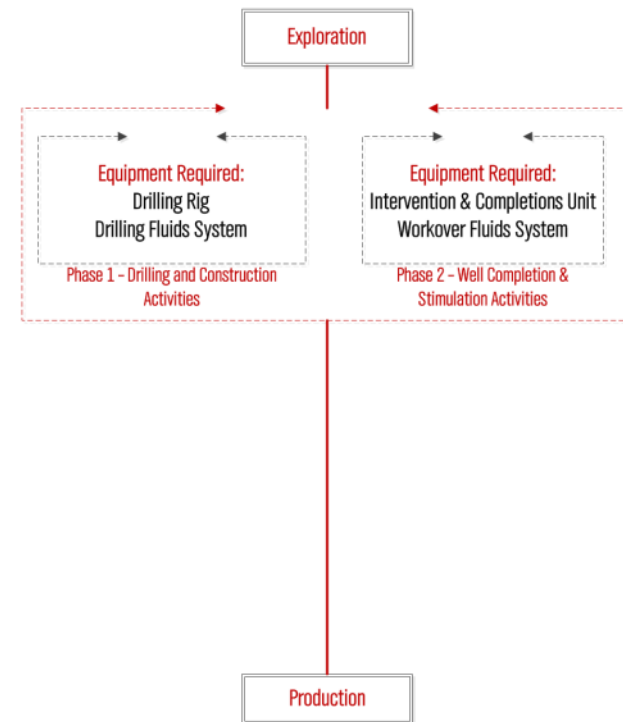
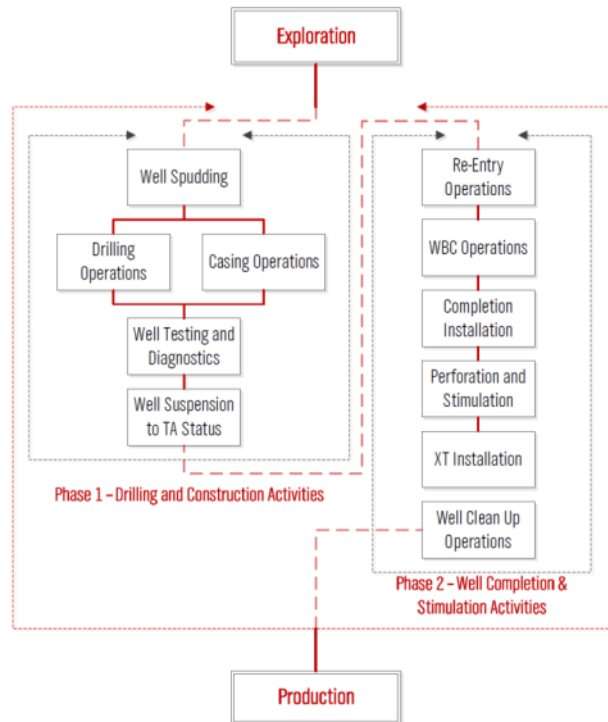
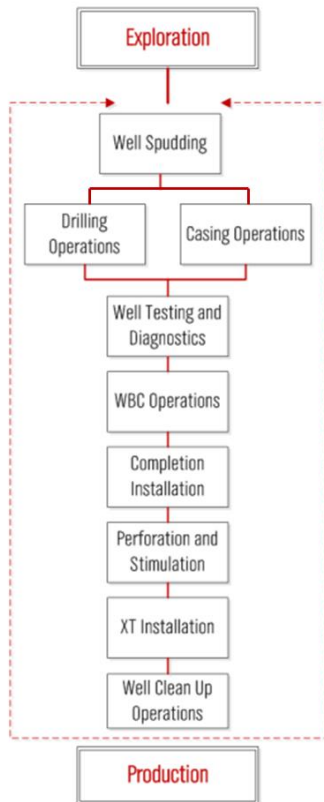
OTC-27607 | Life of Field Cost Reduction Strategy: The Deployment of Facilitating Intervention Technologies for Well Construction and Deconstruction | S A Canny & G Foubister

# Defining Requirements for “Rigless” Rig

Example Downhole Operations Statement of Requirements



***“If the SOR presents significantly differing requirements, batched operations in a segregated scope can be executed”***





## Phase II Completion Surface Equipment Requirements

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A Study was performed to determine the Surface Equipment Requirements, inclusive of the following key parameters:

### **Platforms**

- An assumed platform example with overview of the structure, construction, allowable loadings and available services

### **Well Operations**

- The well operations determined by the operations procedure and well example are presented, with the tool strings and completion equipment

### **SIMOPS and Offline Activities**

- Critical to the selection of technology, the ability to concurrently rig up or perform SIMOPS or activities offline can allow significant cost savings

## Reservoir

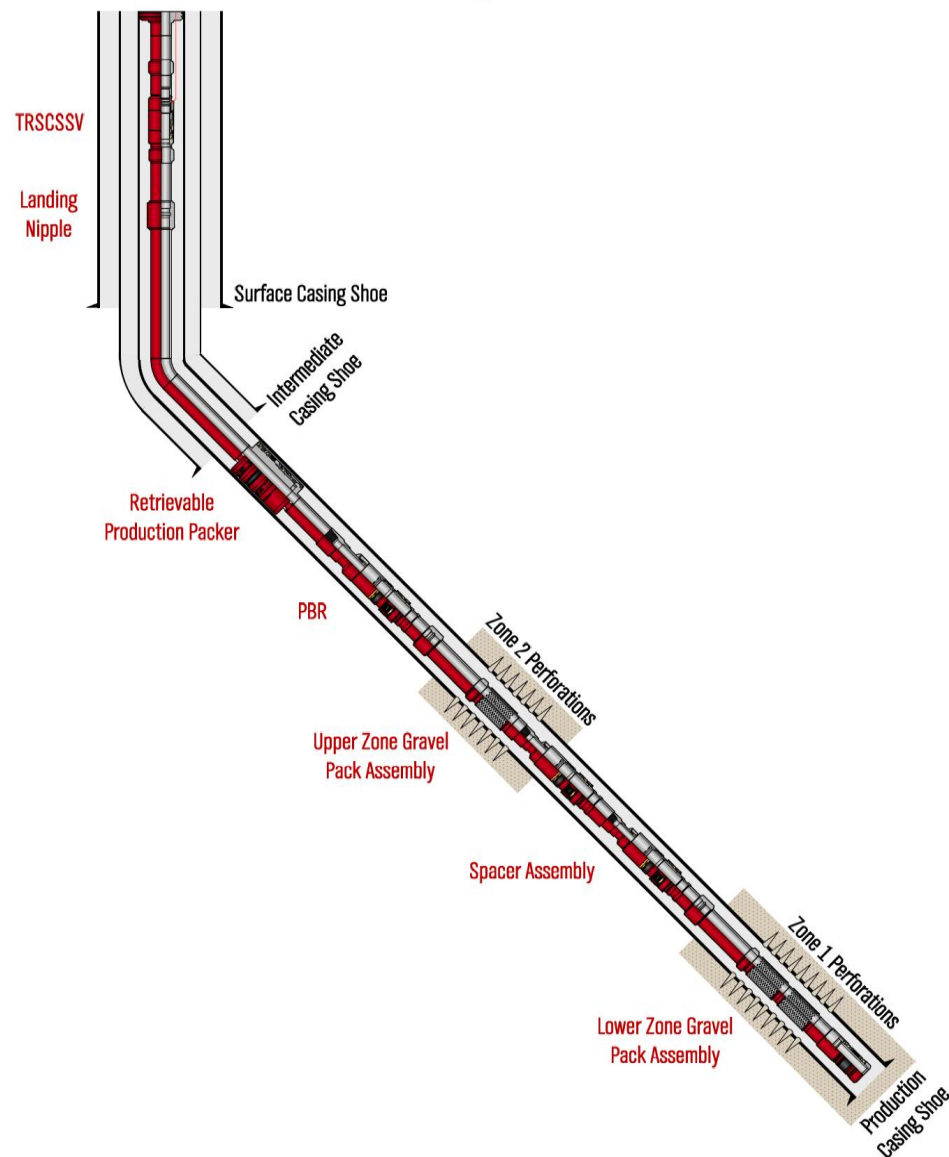
- Normally Pressurised Gas Reservoir
- Dual Target zones, with further shallow targets identified for mid life re-completion and sidetrack upon reservoir depletion

## Casing Plan

- 13-3/8" x 9-5/8" x 7" with 3-1/2" Completion tubing
- Sand Control Completion
- Deep Sidetrack intended in 7" Production casing in the case of well integrity issues

## Completion

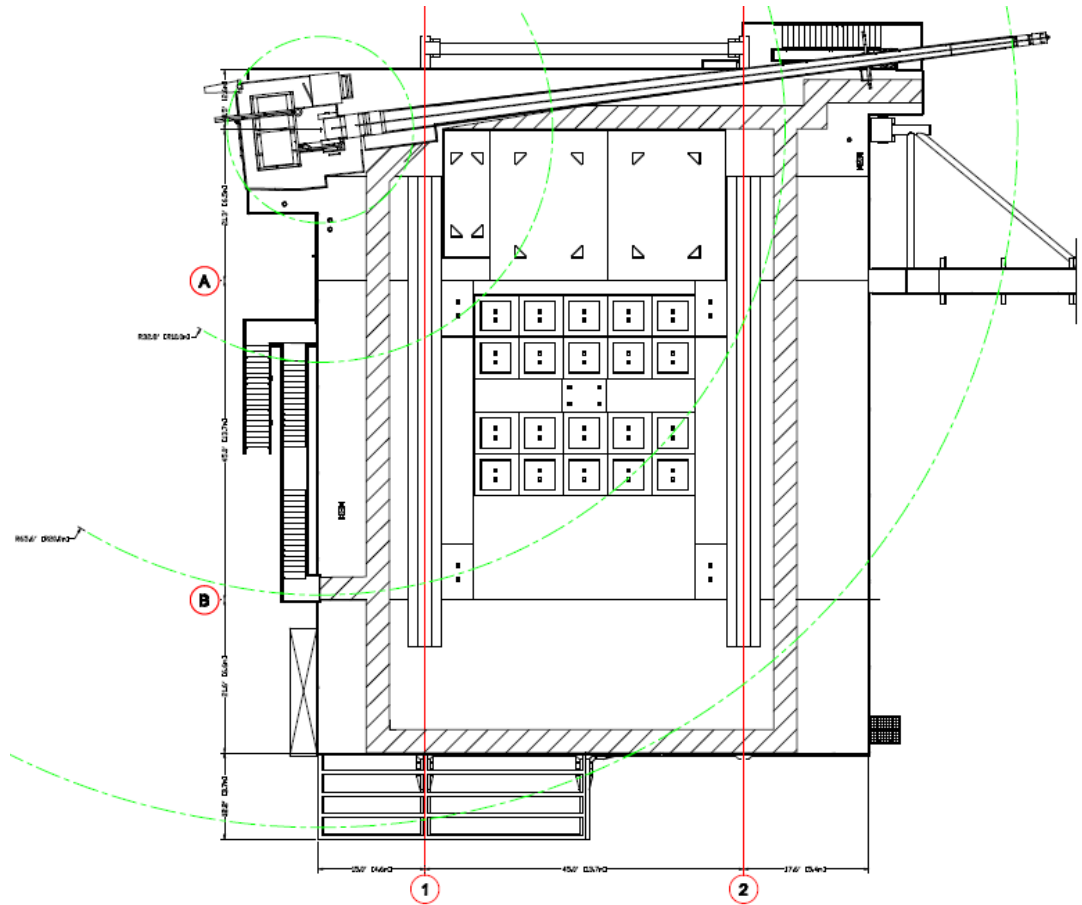
- Retrievable Production Packer to recover during workover



Description	Value
Water Depth	490 ft
No. Well Slots	20
Max. Variable Load	3,000,000 lbf
Max. Deck Loading	2,500 ft <sup>2</sup>
Max. Crane Load	28,000 lbf
Hazardous Area Classification	API RP 500

Metocean Data Sample				
Item (m/s)	Return Period			
	1	10	50	100
Extreme Wind Speed (m/s)	19	22	24	26
Extreme Wave Height (m)	4.6	5.4	6.0	6.2
<b>Notes:</b> Extreme Winds @ 10m above MSL – Not Cyclone				

- No Air Feed
- No Auxiliary Electrical Feed Available
- No Water Feed Available
- No Production Separation System Entry Available





# Well Operation Requirements

Operations		Required Concurrent Functionality				
No.	Step	Pressure Control	Hoisting	Rotation	Pumping	Other Conveyance
1	Well Re-Entry and Kill String Removal	YES	YES	YES	YES	YES
2	Initial WBC Run	YES	YES	YES	YES	NO
3	Set Sump Packer	YES	NO	NO	NO	YES
4	TCP Perforation for Lower Zone	YES	YES	YES	YES	YES
5	Post TCP WBC Run	YES	YES	YES	YES	NO
6	Run Lower Zone Gravel Pack Assembly	YES	YES	YES	YES	NO
7	Injectivity Testing and Acidizing	YES	NO	NO	YES	NO
8	Step Test and Frac	YES	NO	NO	NO*	YES
9	Gravel Pack Treatment and Logging	YES	YES	YES	YES	NO
10	Run Spacer Packer Assembly	YES	YES	YES	YES	NO
11	Set Bridge Plug	YES	YES	YES	YES	NO
12	TCP Perforation for Upper Zone	YES	YES	YES	YES	YES
13	Retrieve Bridge Plug	YES	YES	YES	YES	NO
14	Post TCP WBC Run	YES	YES	YES	YES	NO
15	Run Upper Zone Gravel Pack Assembly	YES	YES	YES	YES	NO
16	Injectivity Testing and Acidizing	YES	NO	NO	YES	NO
17	Step Test and Frac	YES	NO	NO	NO*	NO
18	Gravel Pack Treatment	YES	YES	YES	YES	YES
19	Run Upper Completion	YES	YES	YES	YES	YES



# Thru Unit Conveyance Requirements

Other Conveyance Requirements				
No.	Step	Wireline	Coiled Tubing	Comments
1	Well Re-Entry and Kill String Removal	Electric line	Not Expected Operation	
2	Initial WBC Run	Not Expected Operation	Not Expected Operation	
3	Set Sump Packer	Electric Line	Not Expected Operation	
4	TCP Perforation for Lower Zone	Electric line	Not Expected Operation	Rig Up between Jointed Pipe Operations
5	Post TCP WBC Run	Not Expected Operation	Not Expected Operation	
6	Run Lower Zone Gravel Pack Assembly	Not Expected Operation	Not Expected Operation	
7	Injectivity Testing and Acidizing	Not Expected Operation	Not Expected Operation	
8	Step Test and Frac	Not Expected Operation	Not Expected Operation	
9	Gravel Pack Treatment	Electric Line	Not Expected Operation	Logging Operations Inside Workstring
10	Run Spacer Packer Assembly	Not Expected Operation	Not Expected Operation	

Other Conveyance Requirements				
No.	Step	Wireline	Coiled Tubing	Comments
11	Set Bridge Plug	Not Expected Operation	Not Expected Operation	
12	TCP Perforation for Upper Zone	Electric line	Not Expected Operation	
13	Retrieve Bridge Plug	Not Expected Operation	Not Expected Operation	
14	Post TCP WBC Run	Not Expected Operation	Not Expected Operation	
15	Run Upper Zone Gravel Pack Assembly	Not Expected Operation	Not Expected Operation	
16	Injectivity Testing and Acidizing	Not Expected Operation	Not Expected Operation	
17	Step Test and Frac	Not Expected Operation	Not Expected Operation	
18	Gravel Pack Treatment	Electric Line	Not Expected Operation	Logging Operations Inside Workstring
19	Run Upper Completion	Electric Line	Not Expected Operation	
<b>Maximum Requirements</b>		Electric Line PCE and Equipment	Not Expected Operation, Provision for Contingency	Rigging of Electric Line Operations Concurrently with Jointed Pipe RIH
<u>Notes:</u>				

## BHA Handling

- Max. Length **45 ft**
- Max. Single Lift **3500 lbf**

## Running Lower Zone Completion

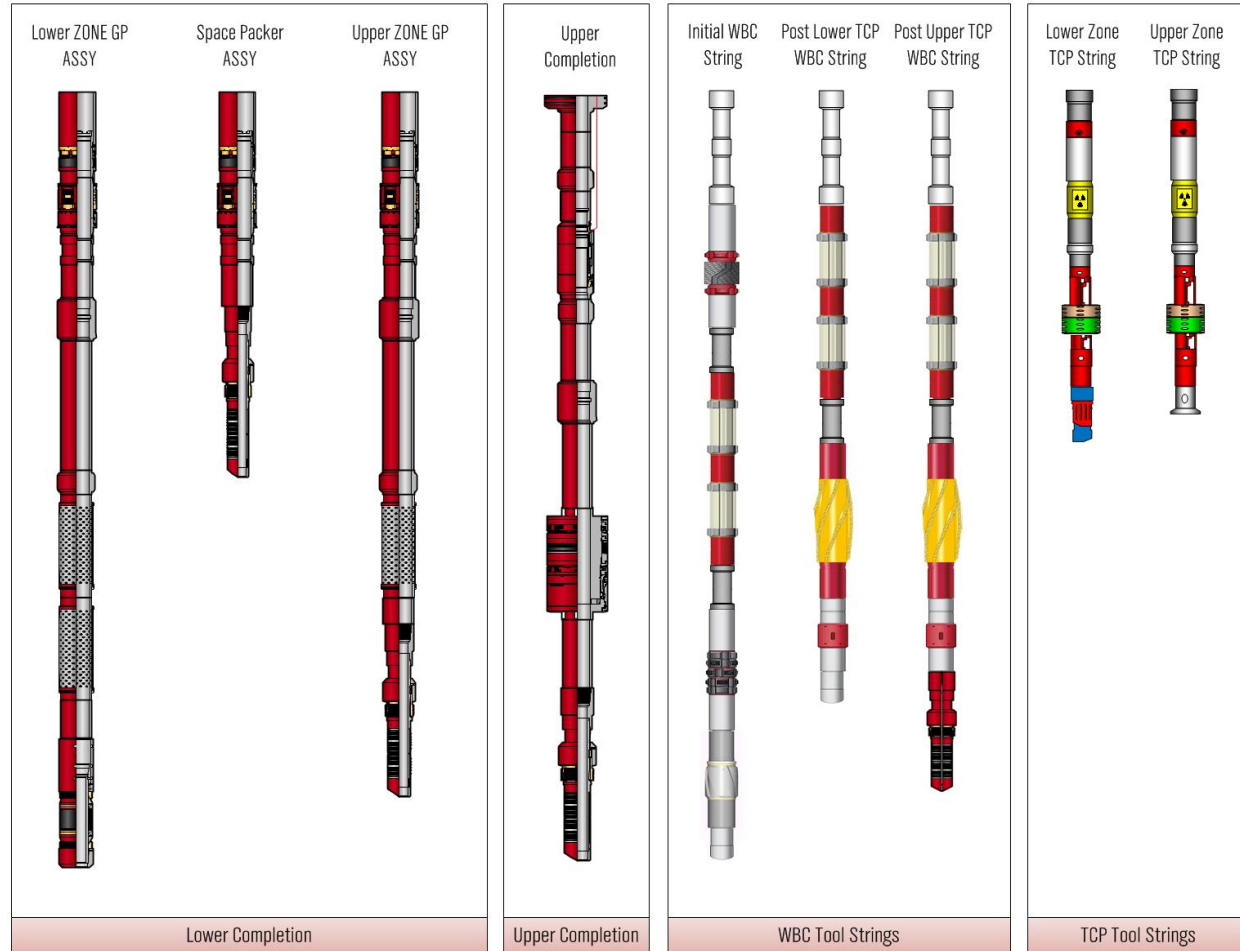
- With Workstring **117,500 lbf**

## Running Upper Zone Completion

- With Workstring **92,510 lbf**

## Running Upper Completion

- Inclusive **95,000 lbf**





# Surface Equipment Specification

Pressure Control Equipment								
Maximum Requirements	BOP Ram Configuration			API Class	Drilling Recorder			
	Element	Nominal Size						
	BSR	Per API Bore						
	VBR(s)	2-7/8" – 5-1/2", 2-7/8" – 5-1/2"						
Annular	Per API Bore		Class 3-A1-R3 13-5/8", 5K	Required				
Hoisting Equipment								
Maximum Requirements	Workstring		BHA		Combined End Load*	Max. Single Length	Max. Single Hoist	Lay Back Req.
	Length	End Load*	Length	End Load*				
	89,110 lbf		95,000 lbf		117,115 lbf	45 ft	3,500 lbf	YES
Surface Rotation Equipment								
Maximum Requirements	Rotary Shoulder Connections		RIH/POOH		Static Rotation			
	Connection	Max Torque	Vertical Speed	Rotation				
		10,500 ft.lbf		150 ft/min	75 RPM			
Pumping Equipment								
Maximum Requirements	Circulation Operations Max.		Pressure Testing		Comments			
	Flow Rate	Max. Pressure	Max. Pressure	Hold Period				
		10 bbls/min	3,000 psi	7,000 psi	10 minutes			
Other Conveyance								
Maximum Requirements	Wireline		Coiled Tubing		Comments			
	Electric Line PCE and Equipment		Not Expected Operation, Provision for Contingency		Rigging of Electric Line Operations Concurrently with Jointed Pipe RIH			

## Surface Equipment Specification Critical Performance Elements

- Hoisting System
- Tubular/BHA Handling
- Tubular Transfer from Support Barge
- Workover Pressure Control Management and Distribution
- Wellslot Movement Activities
- Offline Activities
- Thru-Unit Operations





## Specification Ranking – Critical performance Element

**Hoisting operations were 12.9% of the *Workover data example*, project duration**

Workstring Tripping Speed Sensitivity Study							
Operations		Trip			Time, <i>per design speed</i>		
No.	Step	Trip In MD	Trip Out MD	Workstring	700ft/hr	1300 ft/hr	1600 ft/hr
2	Initial WBC Run	7,000 ft	N/A*	3-½" DP	10 hr	5.3 hr	4.3 hr
4	TCP Perforation for Lower Zone	6,900 ft	6,900 ft	3-½" DP	19.7 hr	10.6 hr	8.6 hr
5	Post TCP WBC Run	7,000 ft	N/A*	3-½" DP	10 hr	5.3 hr	4.3 hr
11	Set Bridge Plug	5,500 ft	5,500 ft	3-½" DP	15.7 hr	8.4 hr	6.8 hr
12	TCP Perforation for Upper Zone	5,500 ft	5,500 ft	3-½" DP	15.7 hr	8.4 hr	6.8 hr
13	Retrieve Bridge Plug	5,500 ft	5,500 ft	3-½" DP	15.7 hr	8.4 hr	6.8 hr
14	Post TCP WBC Run	5,050 ft	N/A*	3-½" DP	7.2 hr	3.8 hr	3.1 hr
Cumulative Time					94 hr	50.2 hr	40.7 hr
Rig Days Δ					2.2 days	0.4 days	-
<u>Notes:</u> *Determined by operation parameters and speed							

## Drilling Technology & Intervention Technology

- Equipment Capital Cost
- Daily Rental Cost
- Maintenance Cost
- POB Requirements
- Certification Cost
- Integration Costs

## Cost per Well

Parameter		Typ. Jack Up Rig	Typ. Semi-Tender Rig	Typ. Modular Drilling Unit	Typ. Pulling Unit	Typ. Hydraulic Workover Unit
Hoisting	Drive	Drawworks, Traveling Block	Drawworks, Traveling Block	Rack and Pinion Mast, Traveling Block	Hydraulic Mast, Rig Assist Jack	Casing Jack
	Capacity	> 2,100,000 lbf	> 1,000,000 lbf	800,000 lbf	Mast - 221,000 lbf Rig Assist - 600,000 lbf	460,000 lbf
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Rotation	Drive	Top Drive	Top Drive	Top Drive	Power Swivel Top Drive	Rotary Table
	Capacity	Up to 120,000 lb.ft	Up to 60,000 lb.ft	Up to 60,000 lb.ft	12,000 lb.ft or 21,000 lb.ft	22,000 lb.ft
Setback	Type	Automated Iron Derrickman	Work board in Derrick		Gantry System	
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Pumping	Type	4 x Triplex 1600 BHP Pumps	3 x Triplex 1200 BHP Pumps	4 x Triplex 1200 BHP Pumps	2 x Triplex 600 BHP Pumps	2 x Triplex 600 BHP Pumps
	Capacity	>18 bbls/min @7,500 psi	>18 bbls/min @7,500 psi	>18 bbls/min @5,000 psi	11 bbls/min @3,000 psi	11 bbls/min @3,000 psi



# New Market Entry Northern Europe



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# Market Entry and Certification

What entry approach in a young market?



## North Sea Certification

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### “It is North Sea Certified?”

- North Sea Certification does not yet exist in an RP, Standard or Guideline
- Various options, combinations and methods to gain partial certification exist
- No single system level approach adopted by the industry
- Type Approval is attractive for 3<sup>rd</sup> party verification

### “Normative and Expected Compliance”

- API RPs and STDs
- NORSOK
- ABS

### Regional Legislation Applicable to UKCS

- ATEX
- CE Marking w/EHSRs
- PUWER
- LOLER



## Applicable Standards

Document	Version	Description / Title	Status
API 4F	4th Edt	Specification for Drilling and Well Servicing Structures	Applicable
API RP 2A WSD	22 Edt	Planning, designing, and constructing fixed offshore platforms - Working stress design	Applicable
NORSOK D-001	3rd Edt	Drilling Facilities	Applicable
NORSOK D-002	Rev 2	Well Intervention Equipment	Applicable
NORSOK D-010	Rev 4	Well integrity in drilling and well operations	Applicable
NORSOK N-004	3rd Edt	Design of Steel Structures	Applicable
NORSOK Z-013	Rev 2	Risk and Emergency Preparedness Analysis	Applicable
NORSOK Z-015	Rev 4	Temporary Equipment	Applicable
NORSOK M-001	Rev 3	Materials Selection	Applicable
NORSOK M-101	Rev 5	Structural Steel Fabrication	Applicable
NORSOK S-001	4th Edt	Technical Safety	Applicable
NORSOK S-002	Rev 4	Working environment	Applicable
NORSOK S-005	Rev 1	Machinery, Working environment analyses and documentation	Applicable
DNV 2.7-1	Apr-16	Offshore Containers	Applicable
DNV 2.7-3	May-11	Portable Offshore Units	Applicable
DNV RP A203	Jul-11	Qualification of New Technology	Applicable



# In Closing

## *Data and Classification to Align Equipment Specification to Scopes of Work is Key*

### Data Mining

Well Life Established and examined

### Integrity Status

Well Integrity Status Established and Ranked

### Execution

Execute work scopes and incorporate lessons learned into further operations



### Stimulus

Operations  
Integrity  
Legislative

### Categorization

Eligible for Rigless, offline operation, Drilling Rig

### Work Scopes

Establish batched work scopes for technology suitability

### Tender

Tender work scopes based on Integrated or discreet services and technology

**OTC2017** OFFSHORE TECHNOLOGY CONFERENCE  
1-4 May 2017 | Houston, Texas, USA | NRG Park  
2017.ottcweb.org

**OTC-27607-MS**  
**Life of Field Cost Reduction Strategy: The Deployment of Facilitating Intervention Technologies for Well Construction and Deconstruction**

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**OTC-27608-MS**  
**Batch Completion Operations Cost Reduction in a Segregated Drilling Campaign: Surface Equipment Requirements**

Steven Allan Canny

**IPTC**  
14 - 16 November 2016  
BANGKOK, THAILAND  
Bangkok Convention Centre  
at CentralWorld

**IPTC-18625-MS**  
**Batch Completion Operations Cost Reduction in a Segregated Drilling Campaign: The Development of an Intervention and Completion Unit**

Steven A Canny, SPE, Weatherford  
M. Gary Rutland, PTTEP

**Well Design**  
Engineering out Cost for Intervention, Rejuvenation and Cessation of Production Operations

Steven Allan Canny  
DEC Technology Forum | Well Lifecycle Design  
Houston | Texas  
29<sup>th</sup> March 2017

**SPE-185381-MS**  
**Intervention and Abandonment Operations Utilising a Rigless Well Servicing Unit: Case Studies**

Steven Allan Canny

**SPE OIL AND GAS INDIA CONFERENCE AND EXHIBITION**  
4-8 APRIL 2017  
Bharatmahal Convention Centre, India

**OTC2016**  
Offshore Technology Conference  
ENDLESS INNOVATION  
2-5 May 2016  
HOUSTON, TEXAS, USA  
NRG Park

**OTC-27311-MS**  
**An Innovative Approach to Well Intervention and Workover Operations on Platforms with Limited Structural Capacity**

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