

## AADE Meeting Jan. 2017

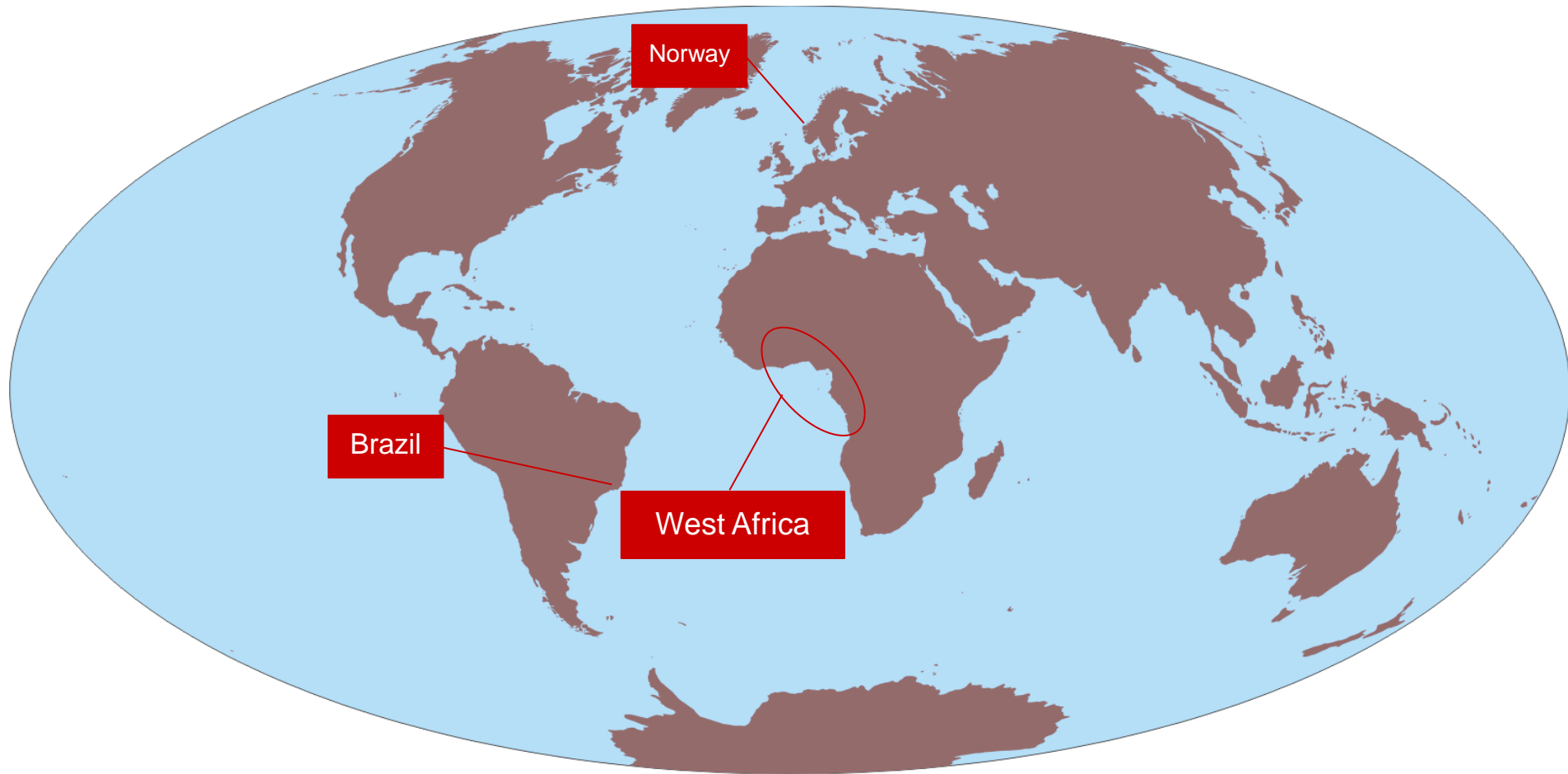
Horizontal Open Hole Gravel Pack Completions,  
Single Trip Gravel Pack and Treat System,  
State of the Art and way forward

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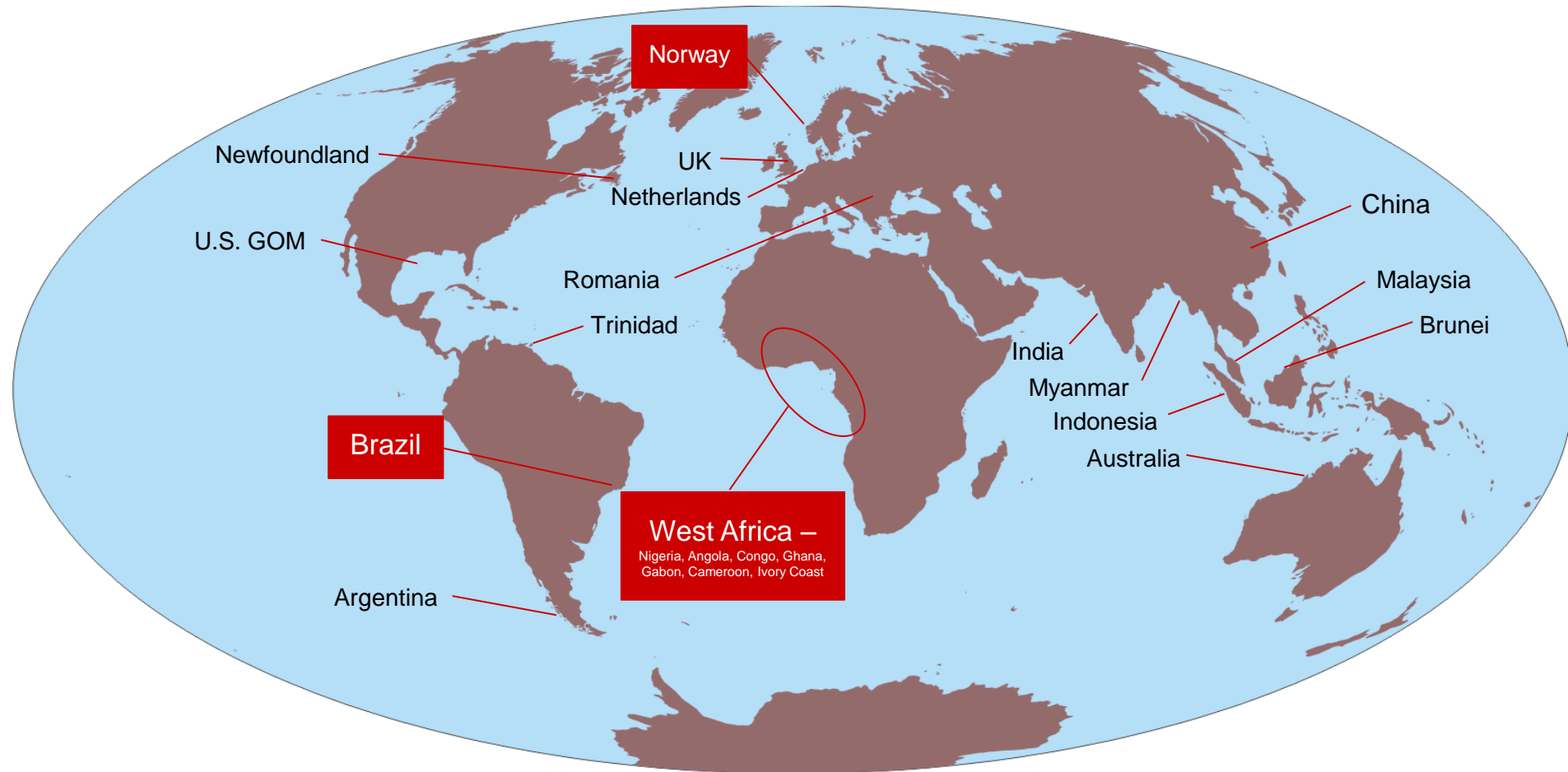
# Outline

1. Locations running Horizontal Gravel Packs
2. Horizontal Open-hole Primary objectives
3. Current Challenges and Solutions
4. Recent Challenges from the Industry and Solutions
5. Challenges with Emerging Solutions
6. Conclusion and Questions

# Global Usage

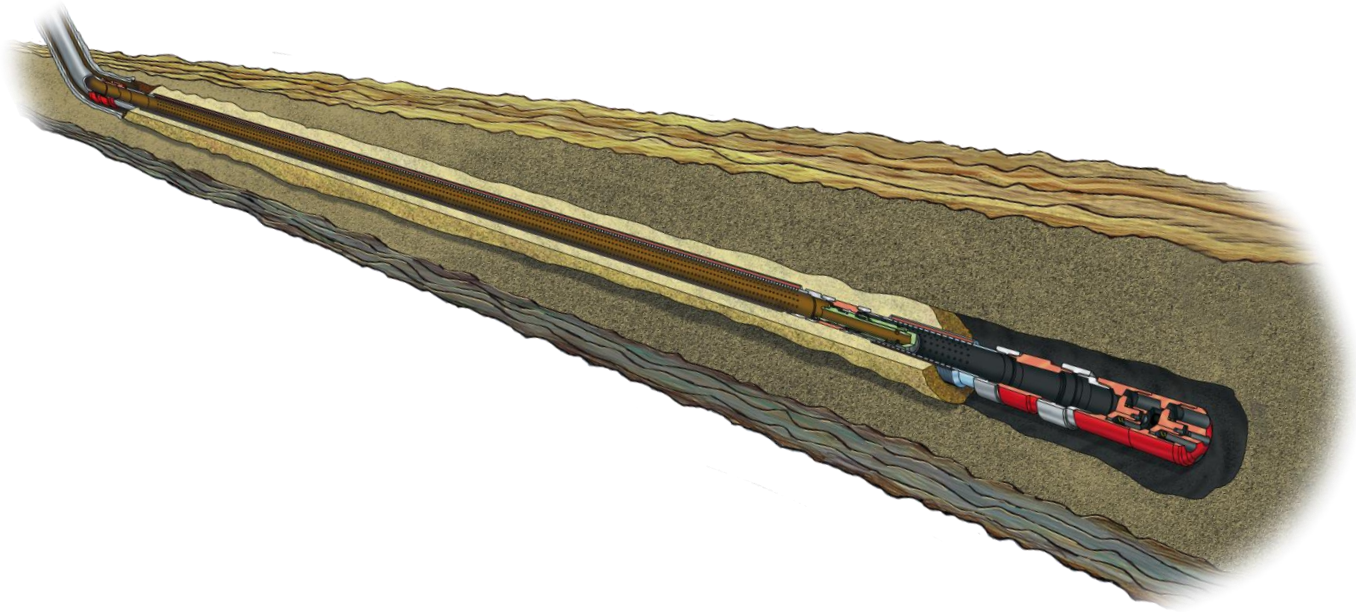


# Global Usage



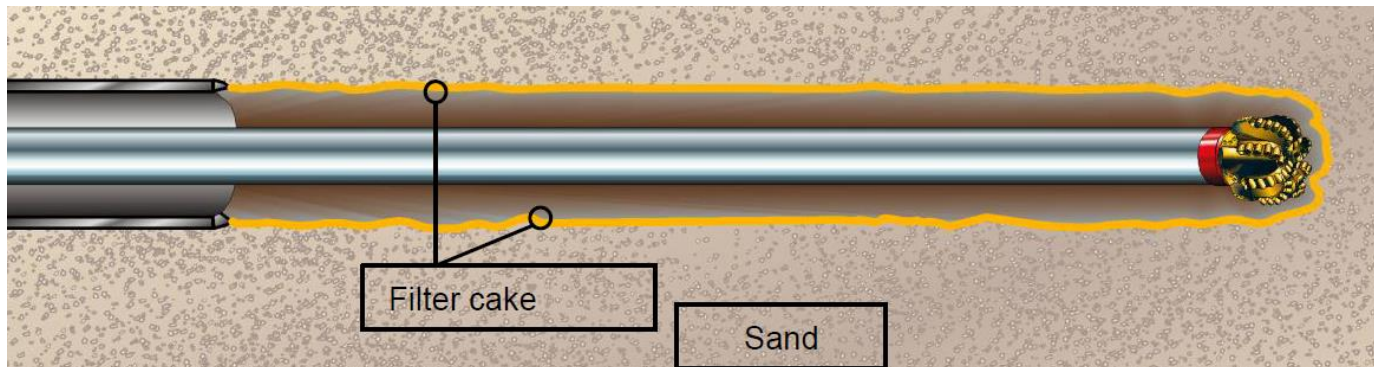
# Primary Objectives – STGP&T

- Control sand production
- Access more pay-zone – reduce pressure drop
- Improve reservoir productivity/depletion



# OH Horizontal GP System – Current Challenges

- Running the gravel pack assembly and long length of screens
  - heavy completion tool weights
- Maintain hydrostatic pressure on formation.
  - Borehole collapse
  - Maintain filter cake to control fluid losses
- Washing-down while running and for fluid displacement
- Removal of the filter cake or flowback after gravel packing
  - Water Based Mud System (WBM) – delayed breaker systems
  - Oil Based Mud Systems (OBM) – sized mud for flowback
- Post Gravel Pack Fluid Loss Control – system compatibility





# Current Challenges and Solutions – STGP&T™

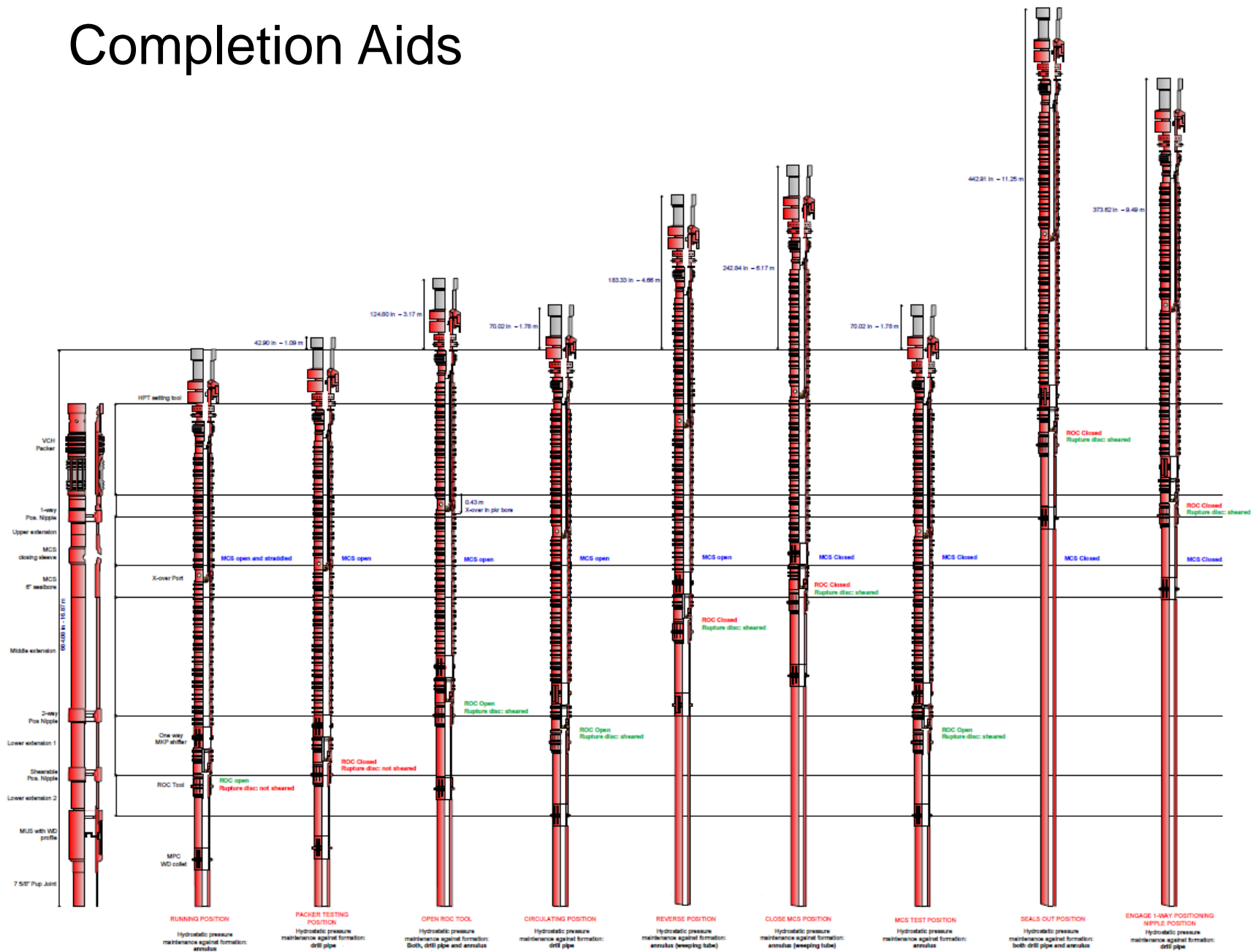
Challenge	Solution
Heavy Completion Weights	“Soft release” setting tool – not sensitive to completion tool weight or rig heave.
Pressure Maintenance	Open flow paths to the formation are maintained: <ul style="list-style-type: none"><li>• Running</li><li>• Packer setting and testing</li><li>• Pumping</li><li>• Moving the tool</li><li>• Reversing out – fluid rate control</li></ul>
Displacement of fluids	Tool positions that allow for fluid displacement – run position and GP position
Filter Cake removal	<b>Treatment position</b> – Pump acid treatment or delayed breaker spotting, to dissolve the filter cake. Provides a well control benefit as well.
	<b>Flowback</b> – Effective conditioning of the mud system. Particle sizing to pass through the screens.
Fluid Loss Control	Compatible FLCD that works with the system being run. Ball Type, Ceramic Flapper or Metal Flapper

# Pressure Maintenance and Tool Movement Tracking

SERVICE TOOL POSITION	INCREMENTAL MOUVEMENT (m)	TOOL MOVEMENT From RIH position (m)	TOOL MOVEMENT From WDC position (m)	TUBING PATH	ANNULAR PATH	COMMENT
RIH	0.00	0.00	N/A	Open	Open	MCS open but straddled. ROC tool open with rupture disk intact.
Set Packer	0.00	0.00	N/A	Closed	Open	MCS open but straddled. ROC tool open with rupture disk intact.
Packer Test: Close ROC Tool	1.09	1.09	N/A	Open	Closed	MCS open. ROC tool closed with rupture disk intact.
PU to open ROC Tool X-over port in pkr bore	2.51	3.60	1.82	Closed	Open	MCS open but X-over port in packer bore. ROC tool closed with rupture disk sheared.
Open ROC tool	-0.43	3.17	1.39	Open	Open	MCS open. ROC tool open with rupture disk sheared.
WDC Position	-1.39	1.78	0.00	Open	Open	MCS open. ROC tool open with rupture disk sheared.
PU to reverse X-over port in pkr bore	1.82	3.60	1.82	Closed	Open	MCS open but X-over port in packer bore. ROC tool closed with rupture disk sheared.
Reverse position	1.06	4.66	2.88	Open	Open	MCS open. ROC tool closed with rupture disk sheared.
Close MCS	1.51	6.17	4.39	Open	Open	MCS Closed. ROC tool closed with rupture disk sheared.
MCS Test position	-4.39	1.78	0.00	Closed	Open	MCS Closed. ROC tool open with rupture disk sheared.
Dump Seals Position	9.47	11.25	9.47	Open	Open	MCS Closed. ROC tool closed with rupture disk sheared.
Open ROC tool through 1 way PN	-1.76	9.49	7.71	Open	Open	MCS Closed. ROC tool open with rupture disk sheared.



# Completion Aids



# OH Horizontal GP System – Recent Challenges

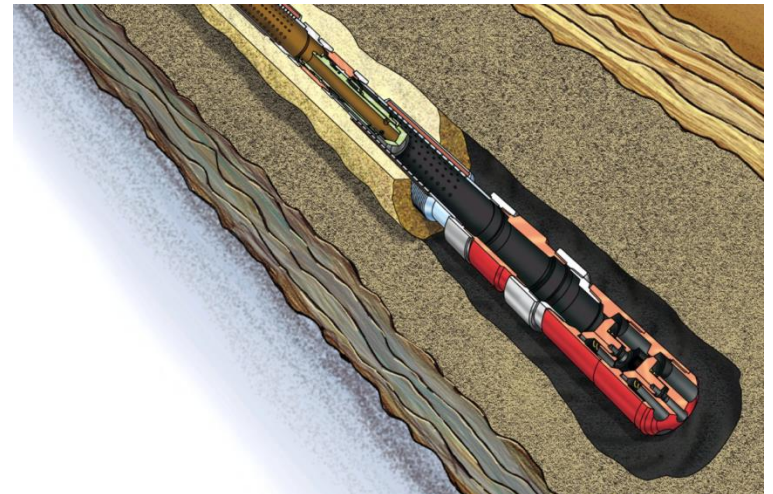
## Lower Screen Isolation Systems and the use of ICD's and AICD's



- Isolation of the end of the screen interval also has become more important. Several types of screen isolation systems now exist that suit different needs in the well completion. This depicts a screen isolation plug. Sleeve type systems also exist.

ICD and AICD use has increased significantly in the last several years.

The ICD's and AICD require isolation packers in many cases. Because of this special feed through packers for alternate path systems have had to be developed.



# OH Horizontal GP System – Recent Challenges

Isolation Packers including

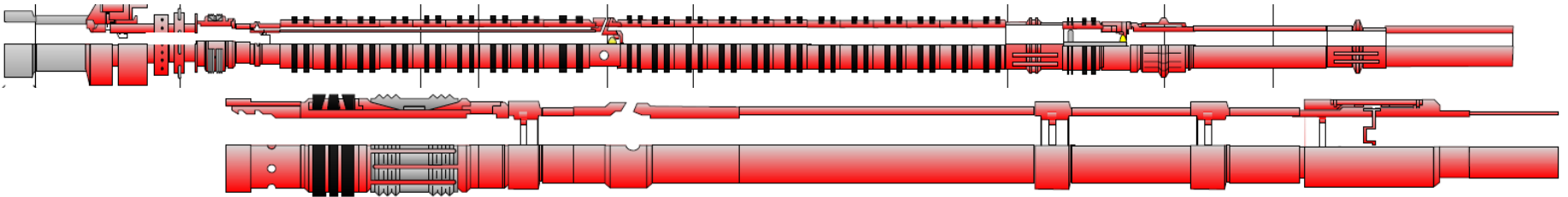
- Shunt Tube Bypass
- Swell Type Packers



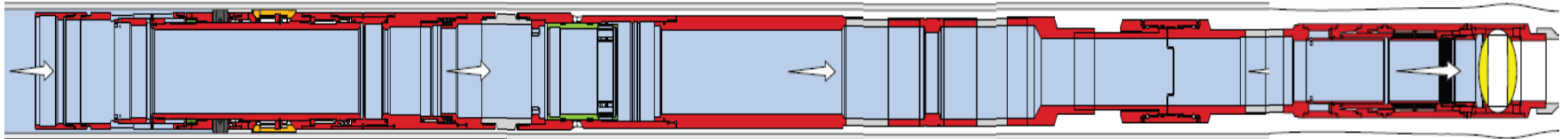


# OH Horizontal GP System – Recent Challenges

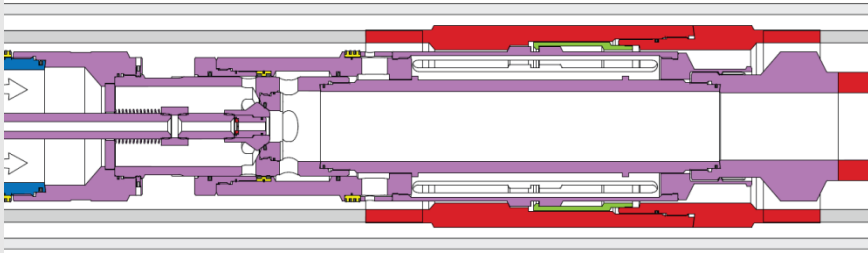
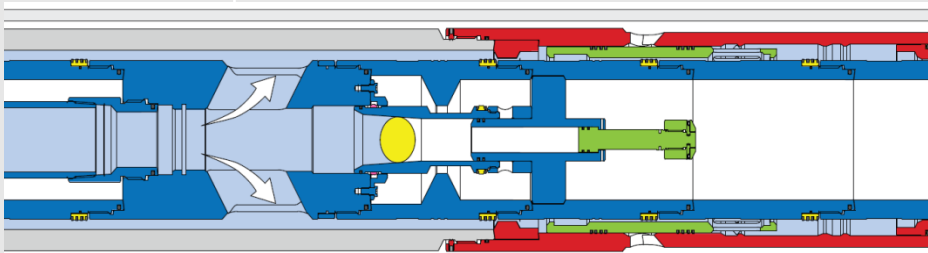
- Testing the packer from a fixed position
  - Rig heave and the deep well depths can make floating test positions difficult or impossible to hold for the duration of a test.



- Testing the closing sleeve prior to pulling the service tool
  - Provides a check that the closing sleeve is holding prior to pulling the service tool out of the well.

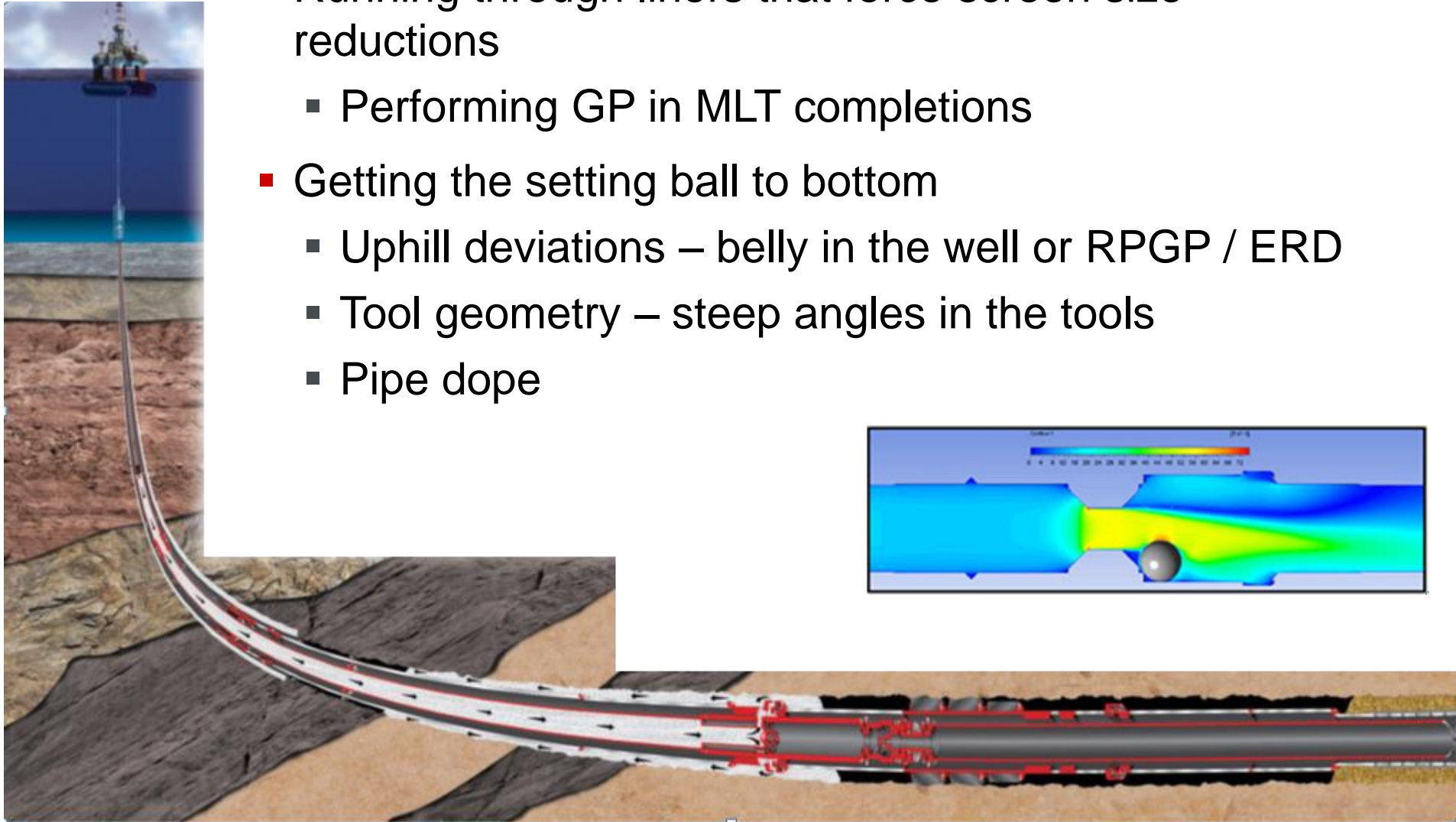


# Challenges with Solutions gaining acceptance

Challenge	Solution
Stationary Packer Test Position	Positioning nipple provides stable positioning in tension.
	
Closing Sleeve Testing (Barrier System Check)	Additional one way shifting tool is added . The test position provides a means to cycle closed and test the closing sleeve. Used extensively on Frac Pack completions.
	

# OH Horizontal GP – Challenges with Emerging Solutions

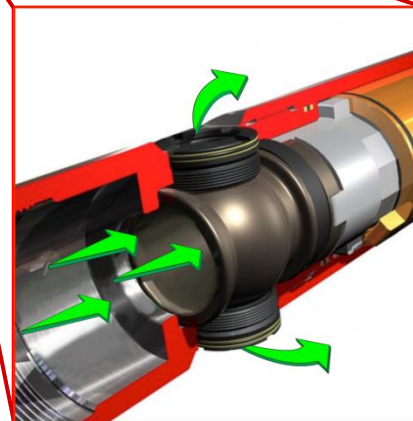
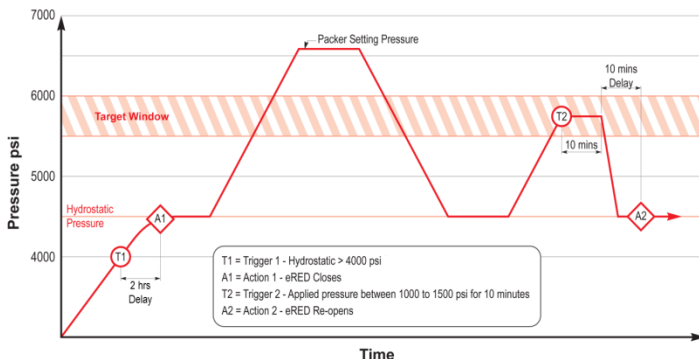
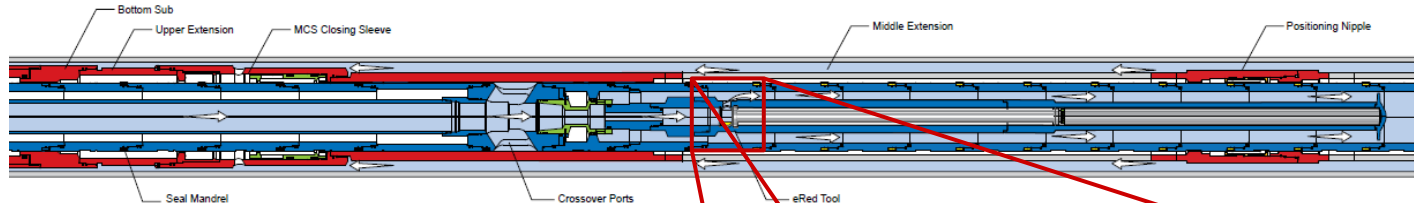
- Running through liners that force screen size reductions
  - Performing GP in MLT completions
- Getting the setting ball to bottom
  - Uphill deviations – belly in the well or RPGP / ERD
  - Tool geometry – steep angles in the tools
  - Pipe dope





# OH Horizontal GP – Emerging Solutions

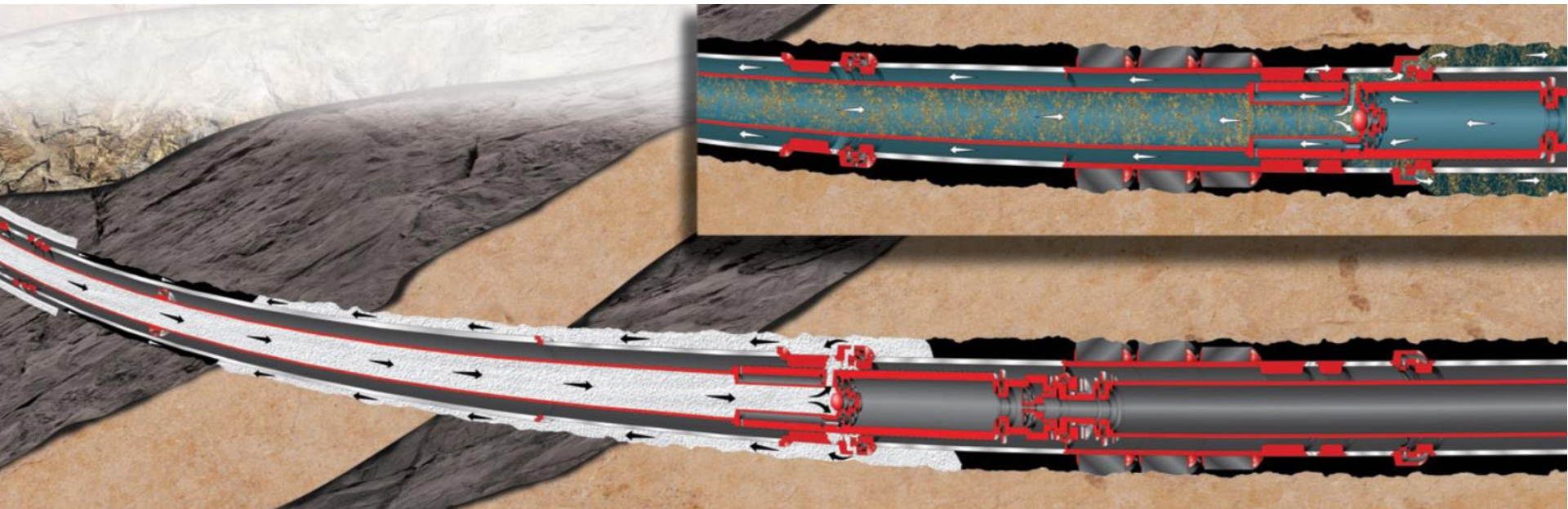
Challenge	Solution
<p>Getting the setting ball to bottom</p>	<ul style="list-style-type: none"> <li>• <b>Elimination of the setting ball</b> <ul style="list-style-type: none"> <li>• Use of remote open/close technology</li> <li>• Limited tool modification to existing tools</li> <li>• A number of triggering options (pressure, time, cycles)</li> <li>• Contingency use of a setting ball.</li> <li>• Programmed tool response</li> </ul> </li> <li>• <b>“Atom Ball” – Foam encased setting ball</b></li> </ul>



Atom Ball

# OH Horizontal GP – Emerging Solutions

Challenge	Solution
“Drilling” Liners that force size reduction	<p>Liner conveyed gravel pack systems (LCGP) that provide pressure maintenance and fluid displacement capabilities.</p> <ul style="list-style-type: none"><li>• Maintains screen size (9 5/8 x 5 1/2, 7” x 3 1/2”)</li><li>• Eliminates the separate liner trip</li><li>• Can be run with conventional screens or alt. path</li><li>• Can be run in MLT completions</li><li>• SPE 109070</li></ul>



# Summary and Conclusions

Horizontal gravel pack completions:

- Achieve well productivity expectations
- Must include some basic functionality
  - Pressure maintenance,
  - Washdown and displacement
  - Post pack treatment.

Additional improvements include:

- System testing improvements
- Setting without a ball
- Production enhancement tools – AICD and ICDs
- Liner options with LCGP.

# Questions

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**THANK YOU**

