2025 GAS LIFT WORKSHOP

Dissolvable Packers: Improving Well Control in High-Pressure Annular Gas Lift Installations

Eric Sappington, Armon Radfar, Joe Koessler, Devon Energy

John Daniels, Matt Pomroy, Brian Kennedy, Shale Oil Tools

Matt Young, Flow Co

devon

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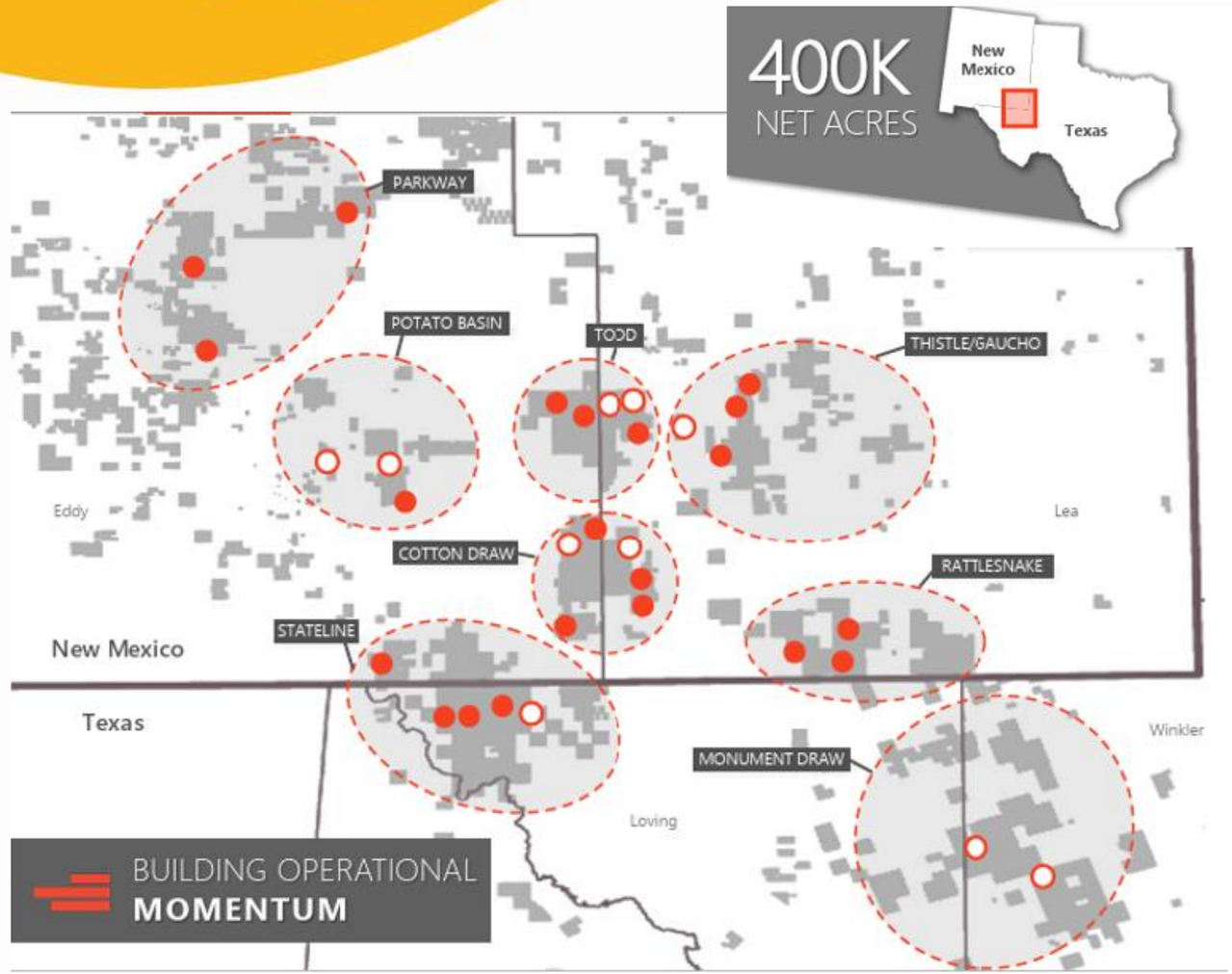
SHALE OIL TOOLS

Devon Activity in Delaware

- ~2500 operated wells
- 9,000 - 13,000 ft TVD in Core
  - ❑~2-3 Mile Laterals
- 13 Drilling Rigs running
- ~25 Workover rigs running
- 40 - 50 Frac Stages per lateral
- 250 H Wells drilled annually
- ~ 390 MBOE
- Hybrid Gas Lift design
- 95:5 Mix of GL and ESP for First AL install depending on GOR, sour gas, and access to Compression



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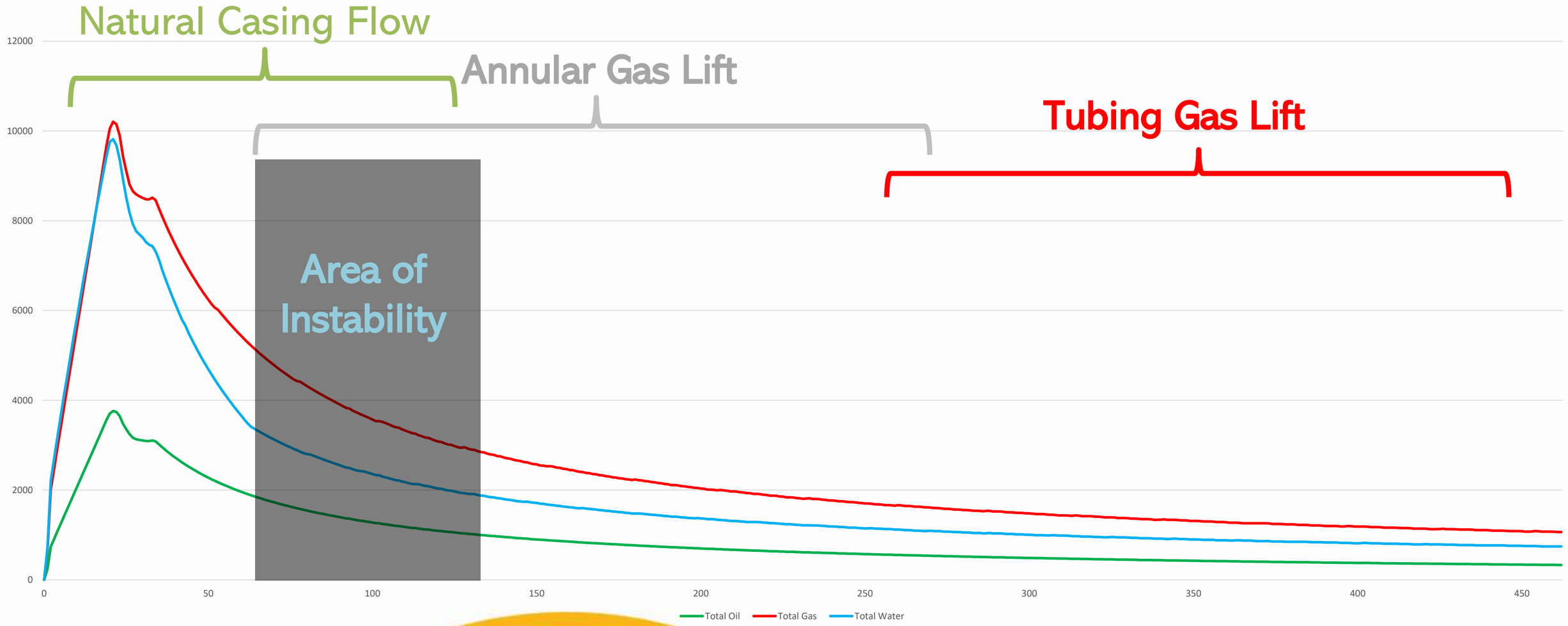
Typical Production Decline Curve



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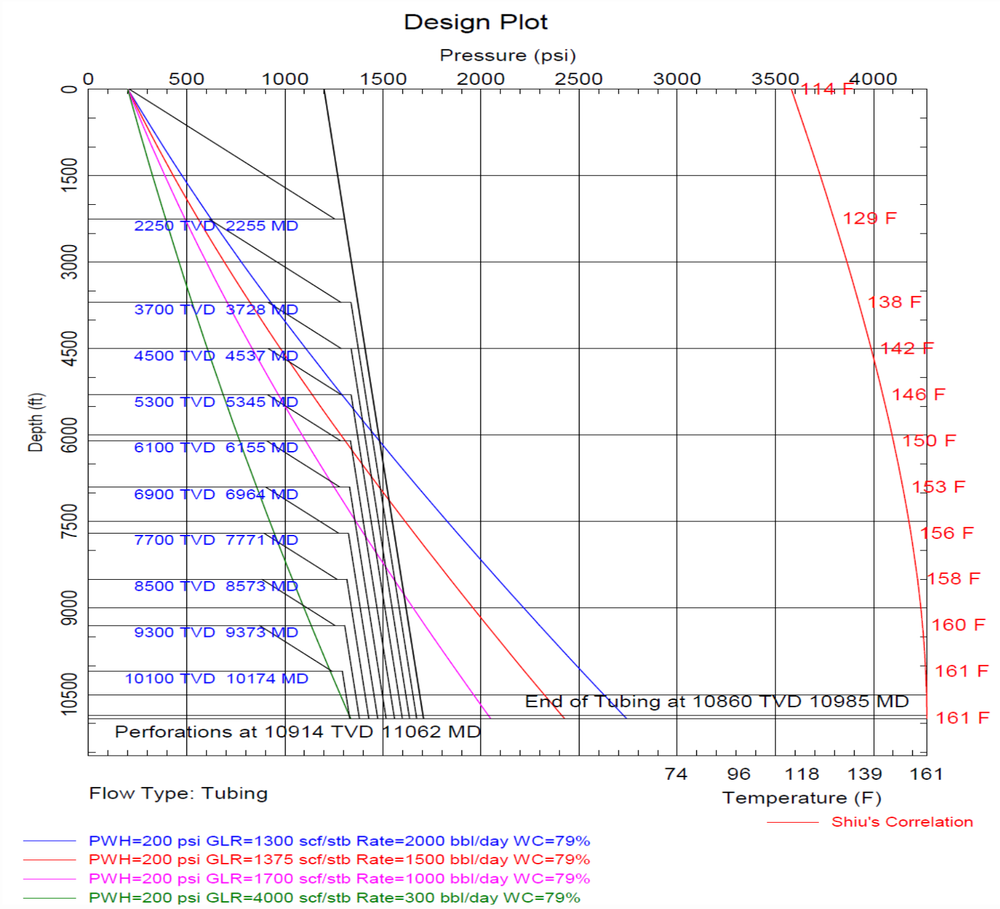
Artificial Lift Strategy in the Delaware Basin

- Hybrid Gas Lift design
- Natural flow (simul-flow, annulus and tubing)
- Annular Gas Lift - ~8 Valves
- Tubing Gas Lift ~ 10 Valves



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The Production Balancing Act

- Produce and Kill with Brine
- Packer
- Snub in tubing
- Dissolvable Packer

Production

Grow Production

Offset production decline with new production

Cost Effective

Bring in Well under budget

Look at Total Cost of Operation

Production Engineer

Option: Flow Well and Kill with Brine

Well Control Details

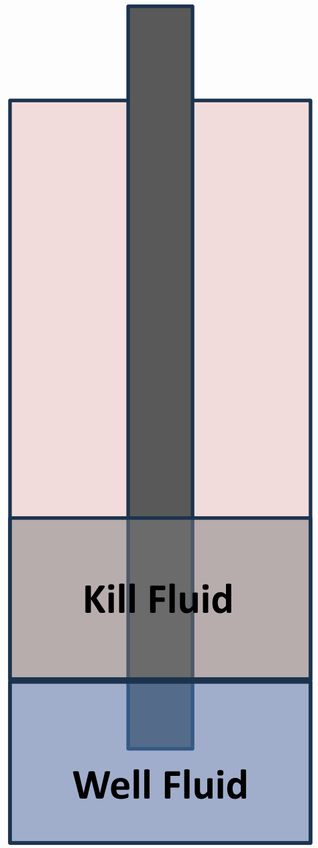
- Flow well to less than ~300 psi
- Kill well with 10-11ppg brine
- Balance pressure with fluid while running AL Assembly
- Run GL System and Start Production Operations

Benefits:

- No intervention or Jewelry
- Industry accepted practice
- Peak IP rates up casing
- Reduces risk of early tubing failure from high annular flow rates

Drawbacks:

- Risk of loading up early due to external takeaway issues
  - Leading to extended downtime with flowback on location due to rig scheduling
- Heavy Brines are costly
- Pressure balancing can be tricky posing risk
- Potential Formation damage from kill fluid
- Delaying high production and releasing reservoir gas pressure while well pressure subsides
- 2 trips to wellsite.



Option: AS1 X Packer

Well Control Details

- Set a Mechanical Packer with a Pump Out Plug
- Plug maintains well control
- 10K psi from Below
- Run GL System, Pup Out Plug and Start Production Operations

Benefits:

- Tested and Trusted method for controlling well
- Can handle all relevant pressure scenarios in field
- Limited kill fluid required
- A safe and reliable option to control the well during GL installs

Drawbacks:

- Downhole Jewelry is Expensive
- Downhole choke which can erode, corrode, Catch sand or scale up
- Limits accessibility to well if CT cleanout or subsequent ESP setting depth required
- Requires a retrieval/intervention trip
- Limited Setting depth due to retrieval requirement

Option: Snub in GL System after plug drillout

Well Control Details

- Use Snubbing unit to control pressure while installing Gas Lift system

Benefits:

- No downhole jewelry in well
- Industry accepted practice

Drawbacks:

- Complicated to achieve ideal hybrid GLV design
- IM valves pose least risk, but do not allow for tubing clearance
- IM valves also cause reduction of tubing flow rate due to cross-sectional area
- Snubbing units are costly
- Pressure balancing can be tricky posing risk

Option: Atlas Dissolvable Packer

Well Control Details

- Magnesium composition leaves only buttons and seal behind
- 8K psi differential rating from below, 275 deg F temperature rating
- Dissolves with normal production flow – expedited by chlorides
- At least 72 hr pressure seal – dissolved fully in roughly 14 days of production
- Utilized 8.34 Completion fluid for hydrostatic control

Benefits:

- Well Control with out intervention
- Avoids using kill fluid, and mechanical retrievable packers
- Pump out plug allows for immediate flow through – no need to wait on the packer to dissolve
- Saves on NPT by avoiding packer retrieval, fishing, milling
- No need to balance pressure with heavy and expensive brines while running GL System
- Able to be set in higher wellbore inclinations than industry standard packers

Drawbacks:

- Unable to be retrieved if improperly set
- Non-reusable
- Fear of well control risk from early dissolving
- Requires immediate workover activity to take advantage of efficiency gains

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ATLAS DISSOLVABLE PACKER

ATLAS DISSOLVABLE PACKER ™

BUSINESS DRIVER

- **Install** artificial lift equipment **earlier** in **packer-less** applications.

TECHNICAL ISSUES

- **Snubbing-in** tubing is both expensive and risky.
- Using **kill fluid** requires you to wait until the well dies down to acceptable levels. Also introduces safety risks.
- **Large-bore cast iron plugs** leave restrictions and often result in costly milling interventions.

SOLUTION

- Install artificial lift quickly after clean out, **potentially while workover equipment is on location**, using the Atlas Dissolvable Packer for well control.

VALUE

- **Operationally Efficient:** Install artificial lift sooner with fewer logistical headaches.
- **Cost Effective:** Less expensive than snubbing or using heavy kill fluids. Eliminates retrieval/milling interventions.
- **Enhance Production:** Convert from natural to artificial flow sooner.

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ATLAS DISSOLVABLE PACKER

ATLAS DISSOLVABLE PACKER ™

- ✓ **Integral Pump-Out Plug:** Creates a robust pressure barrier from below and once activated, enables unrestricted production flow through the packer bore.
- ✓ **Restriction Free:** Both the packer and pump-out plug are designed to fully dissolve during standard production flow, eliminating the need for retrieval.
- ✓ **Versatile Setting Options:** Can be set using either wireline or hydraulic methods with standard setting tools for flexible operation.
- ✓ **Accelerated Dissolution:** Magnesium alloy components dissolve gradually but can be expedited with exposure to chlorides for faster performance.

Casing Size (in)	Casing Weight (lb/ft)	Plug O.D. (in)	Packer Bore I.D. (in) (after expending plug)	Pressure Rating Below (psi)	Pressure Rating Above (psi/screw) Brass/Steel	Temperature Rating (°F)
4.5	11.6-13.5	3.700	1.500	8,000	1,025/1,500	275
5.5	17-20	4.500	1.900		575/835	
	20-26	4.400				

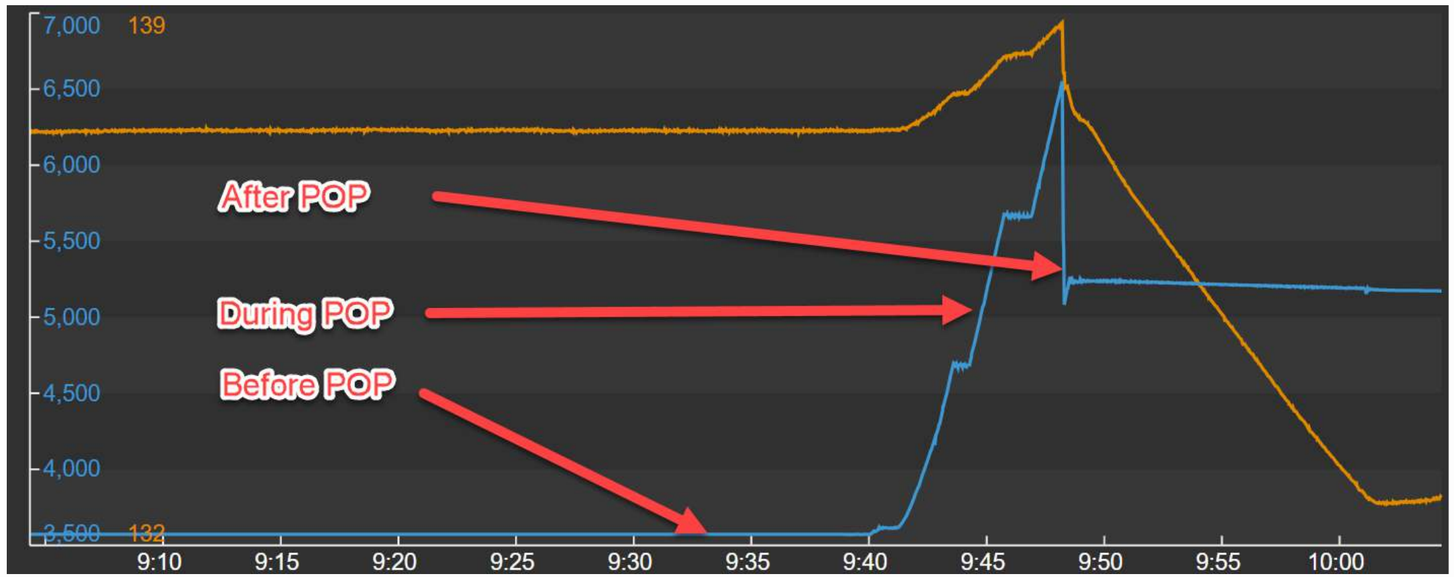
Initial Pilot Trials

Field Test Matrix				
Probability	High			
	Medium			
	Low			
Our Phased test aproach allows us to sysematically test the performance limits of the ATLAS Packer while mitigating Risk and Exposure		1	2	3
		Impact		

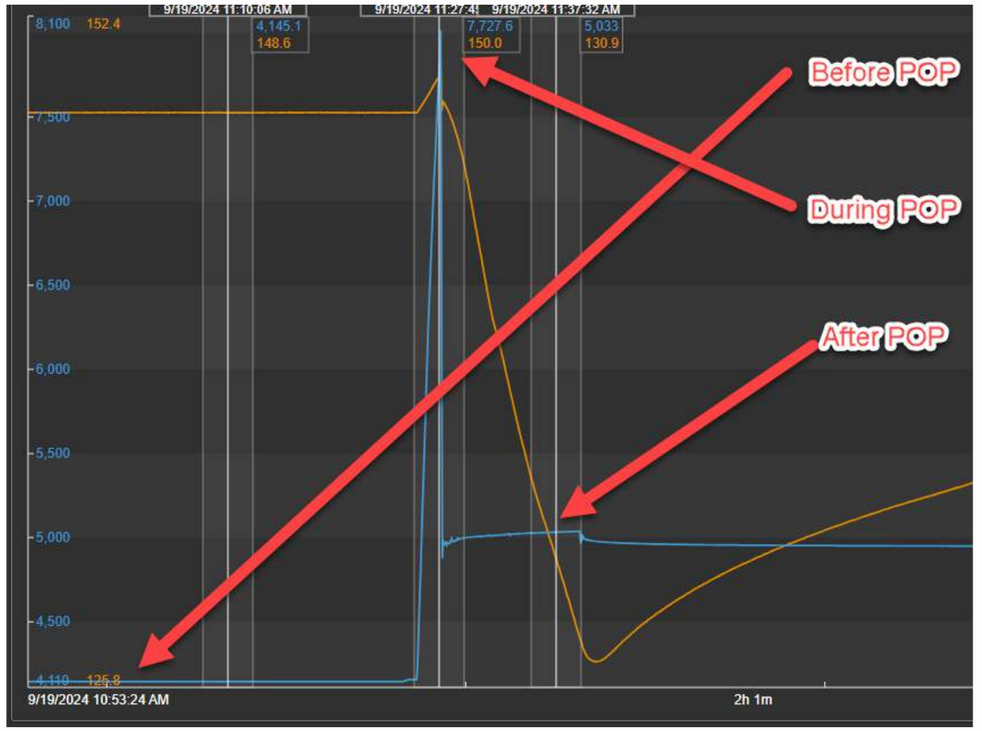
Phased and Monitored Field Trial			
Phase	**Objective**	**Risk**	**Wells**
First Install	Low Risk well, prove that ATLAS can Hold pressure and Dissolve	**Low**	**1**
Typical Gas Lift Install	Set ATLAS in Vertical while running GL Valves	**Low**	**10**
Improved Well Design, Earlier Install	Hold Larger Pressures in Excess of 4000 psi DP	**Medium**	**19**
Improved Well Design, Lower Set Point	Set ATLAS in deviated sections running GL Valves	**High**	**30**
Total			**60**

Continued Pilot Trials

- Confirmed Plug holds and Pumps out as expected with Gauge Data



2000 psi DP across Packer



1000 psi DP across Packer

Pilot Conclusions

- >60 successful installs in 9 months
- Monitored many Jobs with Downhole gauges
- Confirmed Packer dissolution by attempting to Tag after well flow.
- Proved that the ATLAS Packer can perform as advertised.
- On Average these plugs have been holding for 85 hours before we pump out plug and initiate flow.
- Average DP is 1500 psi
- The Max time we have tested is 600 hours, with 2500 psi DP
- Max Pressure we have tested to is 4500 psi DP which we held for 240 hours
- Majority of ATLAS Packers have been set at 45 deg or more.

After an iterative trial environment, The ATLAS packer has gained DVN's confidence as a primary barrier for well control during BOP NU Operations

Well Control Methods	Use Before ATLAS	Use After ATLAS	Cost	Risk	Production Impact
Traditional Packer	20%	0%	$$	Medium	Medium
Produce and kill with Brine	70%	70%	$	Medium	High
Snubbing	10%	0%	$$$	High	Low
Dissolvable Packer	0	30%	$$	Low	Low

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