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City Centre, Houston, Texas
ShaleTechConference.com

SHALETECH™

Digital Gas Lift

Applied Technology & Business Justification

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Silverwell

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Gas Lift Production Optimization is Difficult

- Is my well completely unloaded?
- Is the well multi-point injecting?
- What is my lift depth?
- Am I optimized on gas lift?
- Can I lift deeper?
- Is my hydraulic model a good match to actual well performance?
- Should I run a well test and production log?
- How much will I have to intervene?
- Do I have enough gas?
- What should be my lifting life-cycle?

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Overcome limitations of existing gas-lift technology

Improve life-of-well production economics

TECHNOLOGY & APPLICATION

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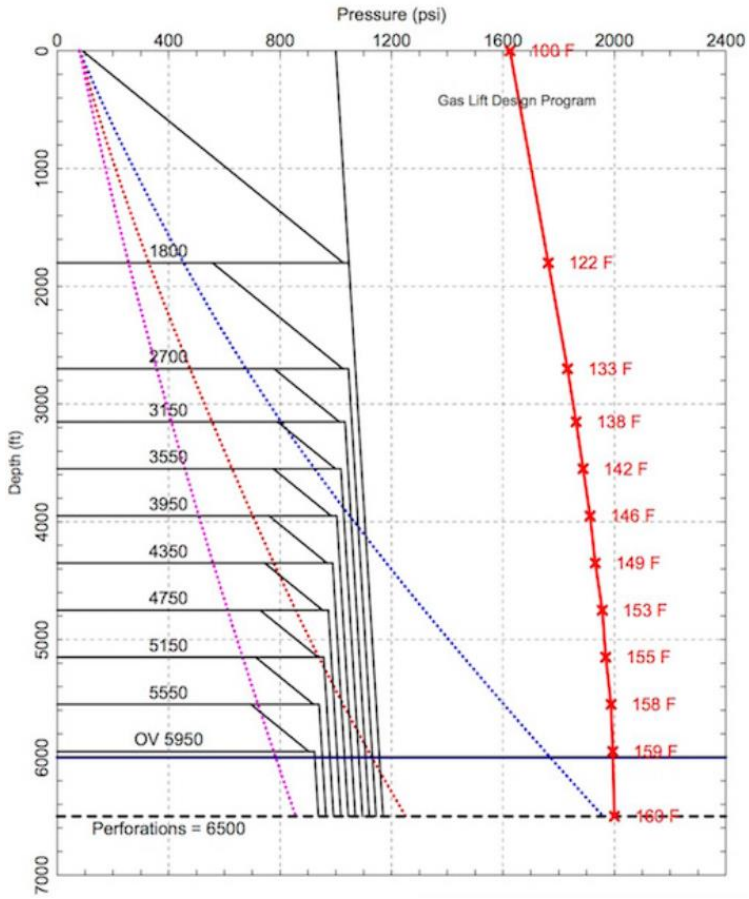
Legacy Technology Challenges

- Narrow Operating Window.
- Design safety margins.
- Injection depth limited.
- Difficult to assess lift effectiveness.
- Intervention to optimize.
- Sensitive to well dynamics.
- Multi-point injection.
- Valve Chatter



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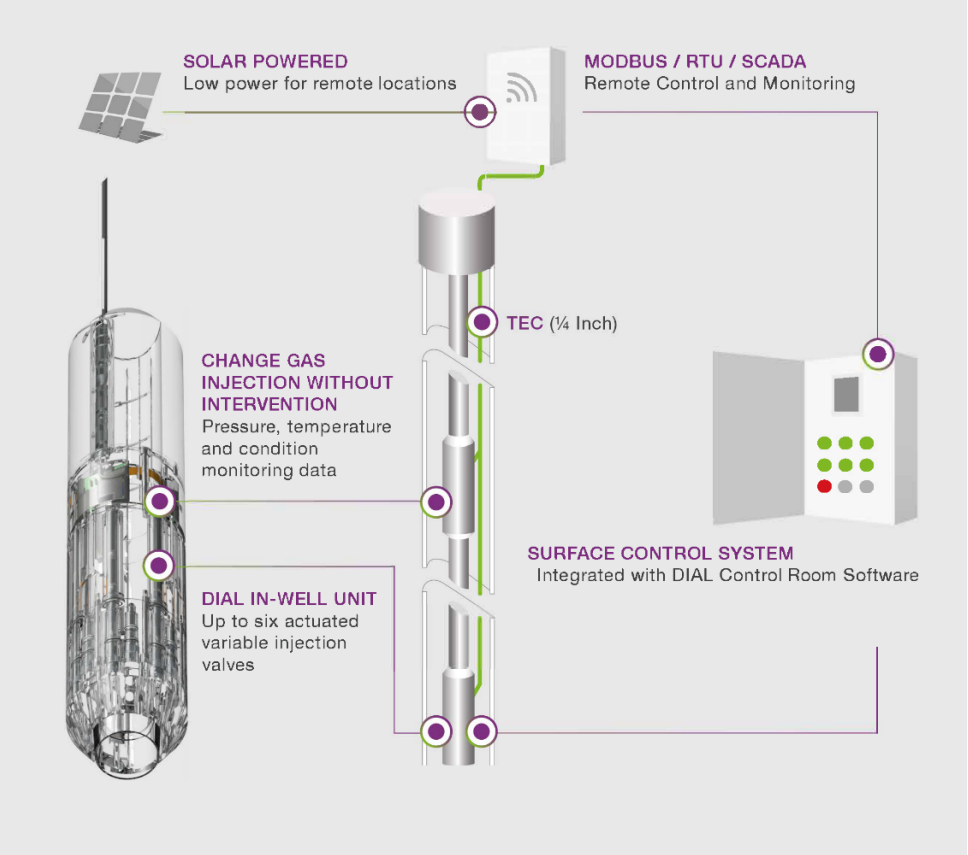
Digital Intelligent Artificial Lift - DIAL

Functionality	Business Value
• Variable orifice size at any depth • Deeper injection • No deviation limitation • No well intervention • Pressure and temperature data • Remote monitoring and control • Intelligent field-wide management	Eliminate intervention Reduce OPEX Mitigate instabilities Enhance recoveries Optimize production Reduce HSE risk



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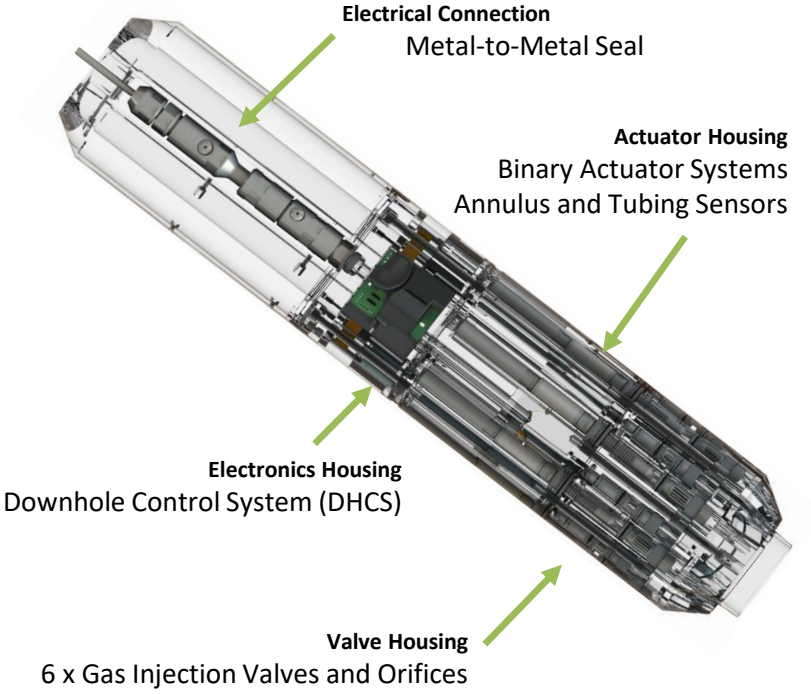
DIAL Unit Specification

- Multiple tubing deployed DIAL units per well.
- Controlled by a single ¼” TEC and SCS.
- 6,000psi Collapse rated Pressure.
- 10,000psi Burst rated Pressure.
- 2-7/8”, 3.5” and 4.5” tubing configurations.
- 125°C Max. rated Temperature.
- Binary Actuation, real time gas injection rate.
- Max. choked Flow Rate 6MMscfD.
- Fully MR0175 / ISO 15156 compliant.
- Electron Beam Welded construction.



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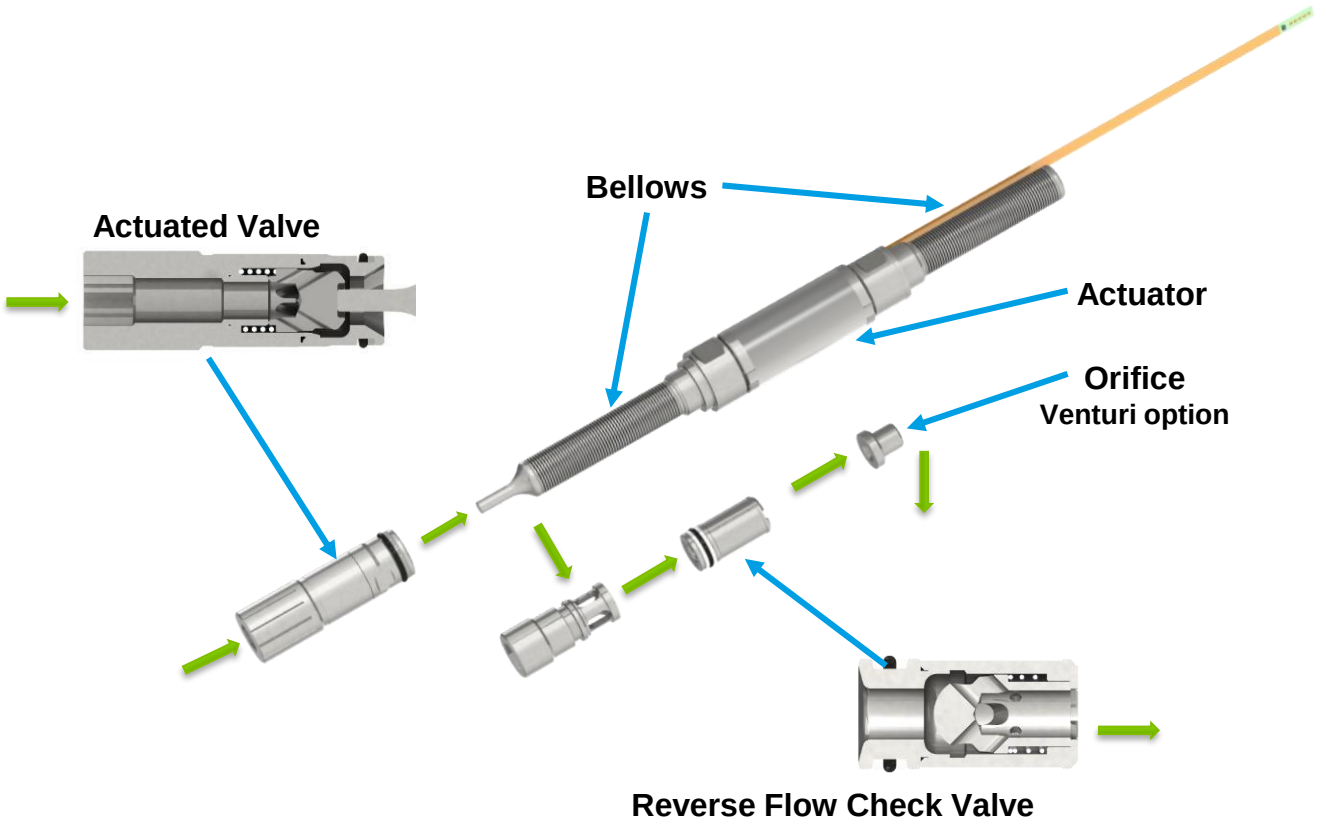
Actuator & Valve Technology



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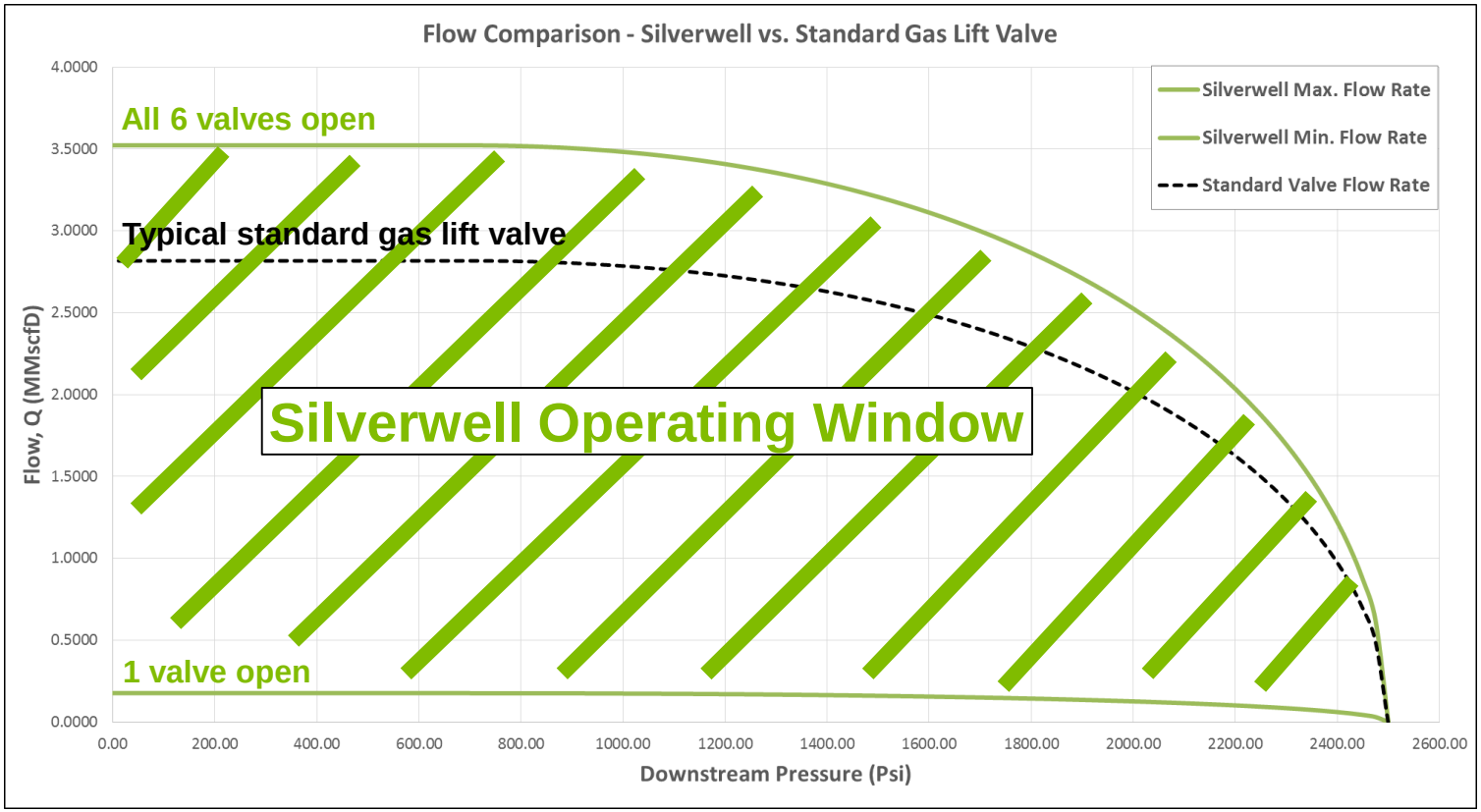
Operating Envelope



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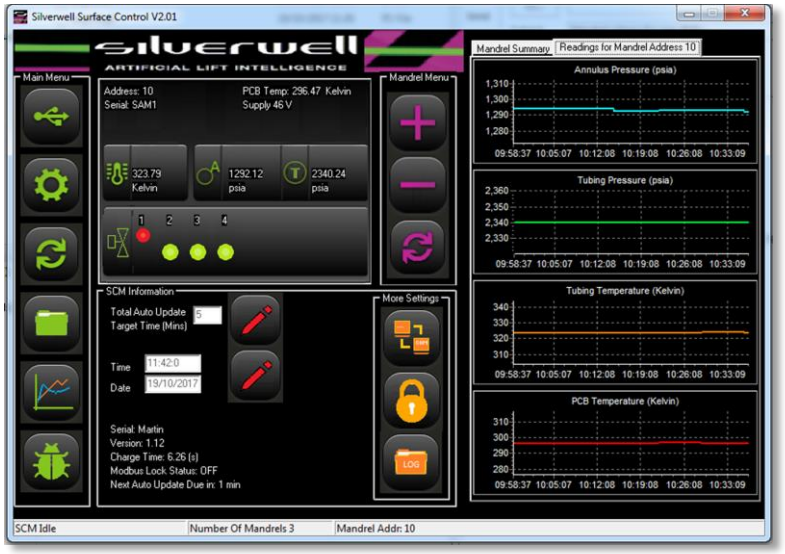
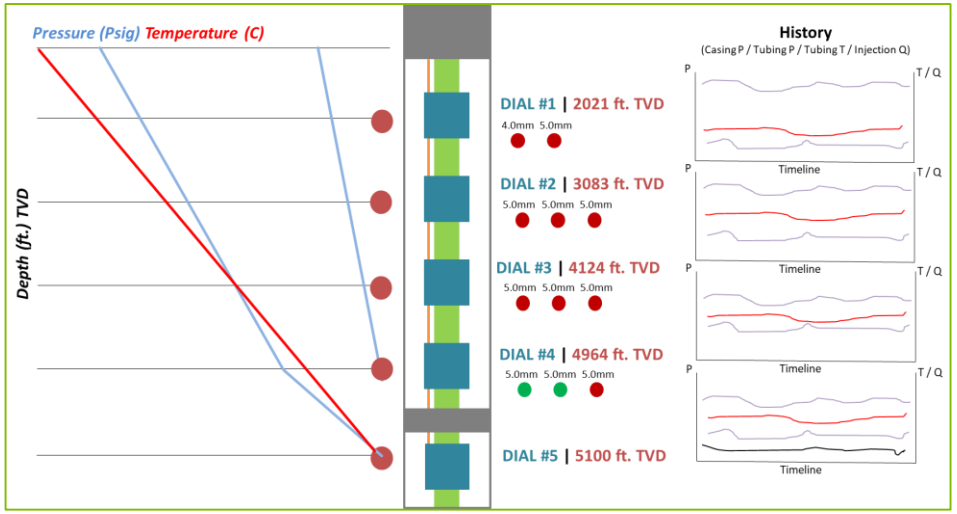
Efficient Production Optimization

DIAL User Interface – Concept to Reality





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Enhance life-of-well business case

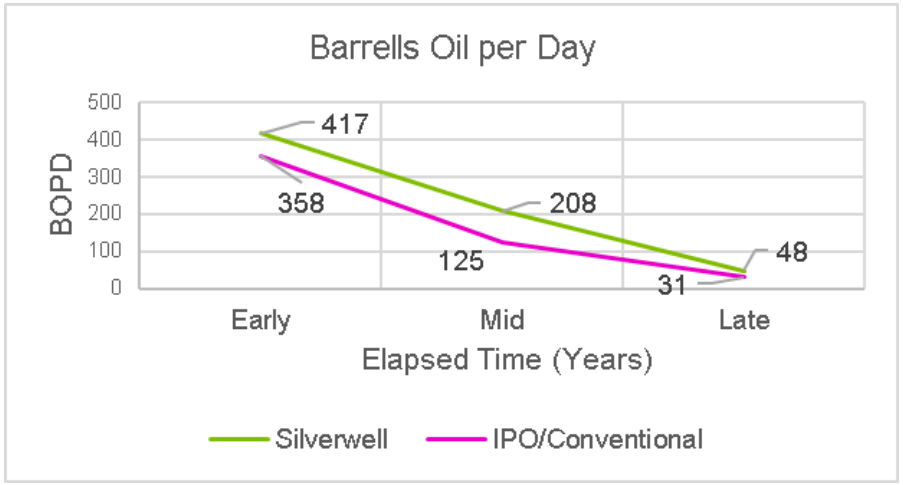
Field proven technology

JUSTIFICATION & OPERATION

Comparative Performance Testing

Improved Lift Performance Throughout Well Life in Permian

- In all three reservoir pressure cases, the Silverwell DIAL installation yields a **higher production rate through deeper injection**.
- DIAL technology **eliminates multipoint injection**.
- DIAL remote control technology enables Gas Assisted Plunger Lift (GAPL) in late life.



			IPO		Silverwell		Added Value	
Year	Water Cut	Reservoir P (Psi)	TBFD	BOPD	TBFD	BOPD	%	BOPD
Early life	50%	3456	718	**358**	839	**417**	16.5%	59
Mid life	60%	2112	313	**125**	519	**208**	66.4%	83
Late life	80%	1500	156	**31**	246	**48**	54.8%	17

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Early-life Performance Comparison

Deeper injection | More production | No multi-pointing | Less stations

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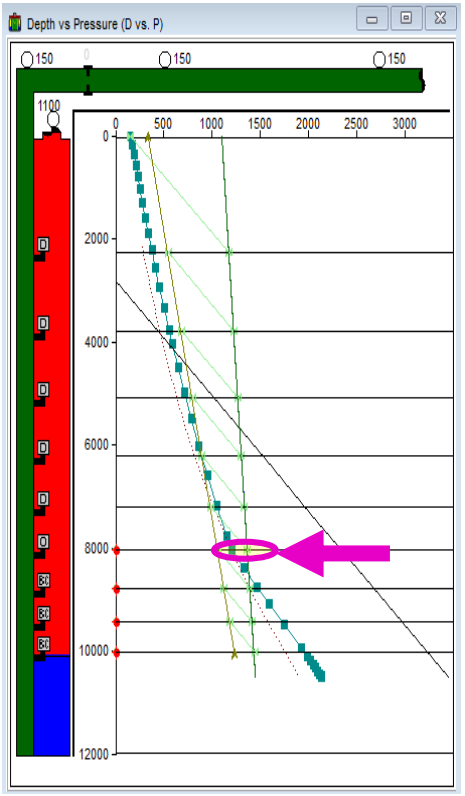
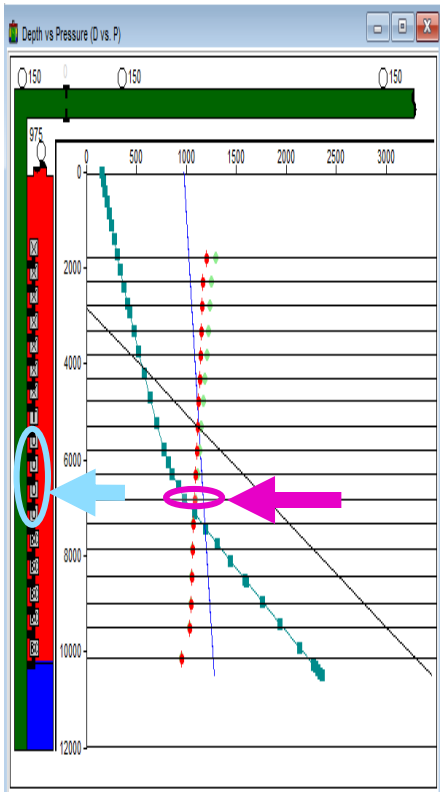
Gas Lifting from DIAL unit at **8056' MD – Station 6.**

Production Rate = **833 BFD**

The well is **injecting as deep as possible**, with the 1100 Psi compressor discharge at surface.





IPO

Gas Lifting from **11th IPO** at **6827' MD.**

Production Rate = **718 BFD**

The well is **multi-pointing as 4 IPO valves are open**, and capable of passing gas.

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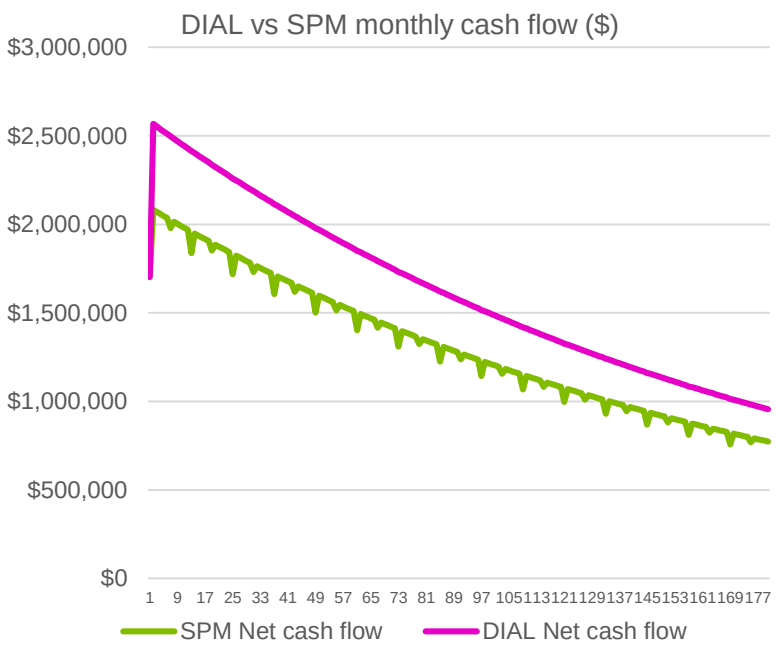
Cross-functional Business-case Development

- Life of field finance model
- Enables case-by-case assessment when coupled with well performance modelling
- Coarse but directionally accurate
- Captures delta due to production up-lift, intervention OPEX reduction, CAPEX & optimization
- Reservoir Engineering “lens” under development



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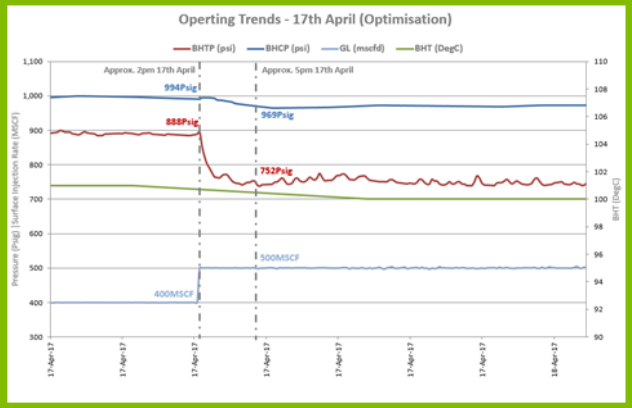
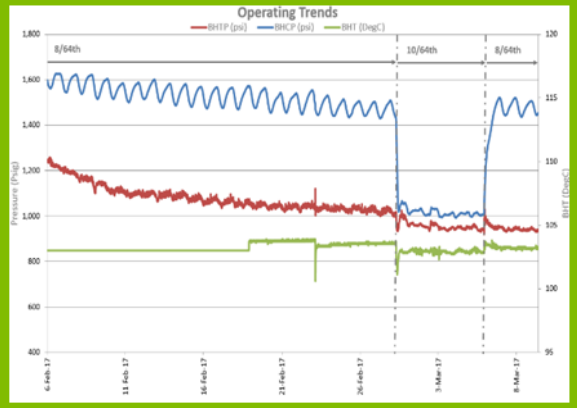
Benefits Observed



15% Oil Gain



Mitigating Instability

25% Gas Savings

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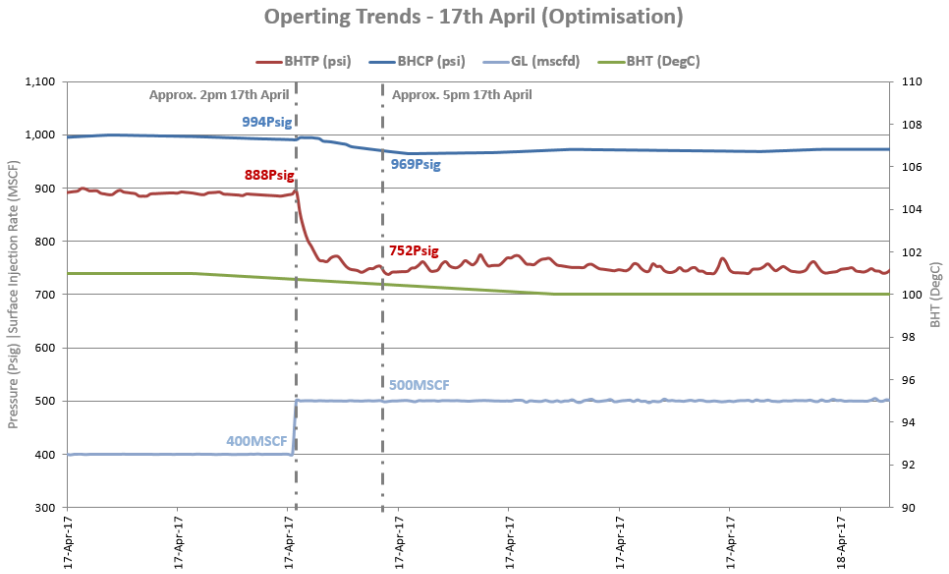
Case History 1 – Well Optimization

Through downhole gauge measurement, the operator recognised the opportunity to **increase gas injection rate from 400 to 500MCFD**.

Silverwell DIAL valves were opened, decreasing casing pressure.

Net Oil Production increased **10% from 217 to 239BOPD**.



Date	Time	Chk	FTHP	CHP_A	Gross Prod (bpd)	Net Oil Prod (bpd)	Gas (mscfd)	GL (mscfd)	FLP (psi)	Sep_P (psi)	Remark
18/04/2017	11:25:00	128	254	-	265.43	239.15	610	500	150	165	GL 500 MSCFD
18/04/2017	07:45:00	128	251	-	252.7	227.68	596	500	150	165	GL 500 Mscfd.
17/04/2017	08:00:00	128	234	-	247.79	217.87	521	400	140	152	-

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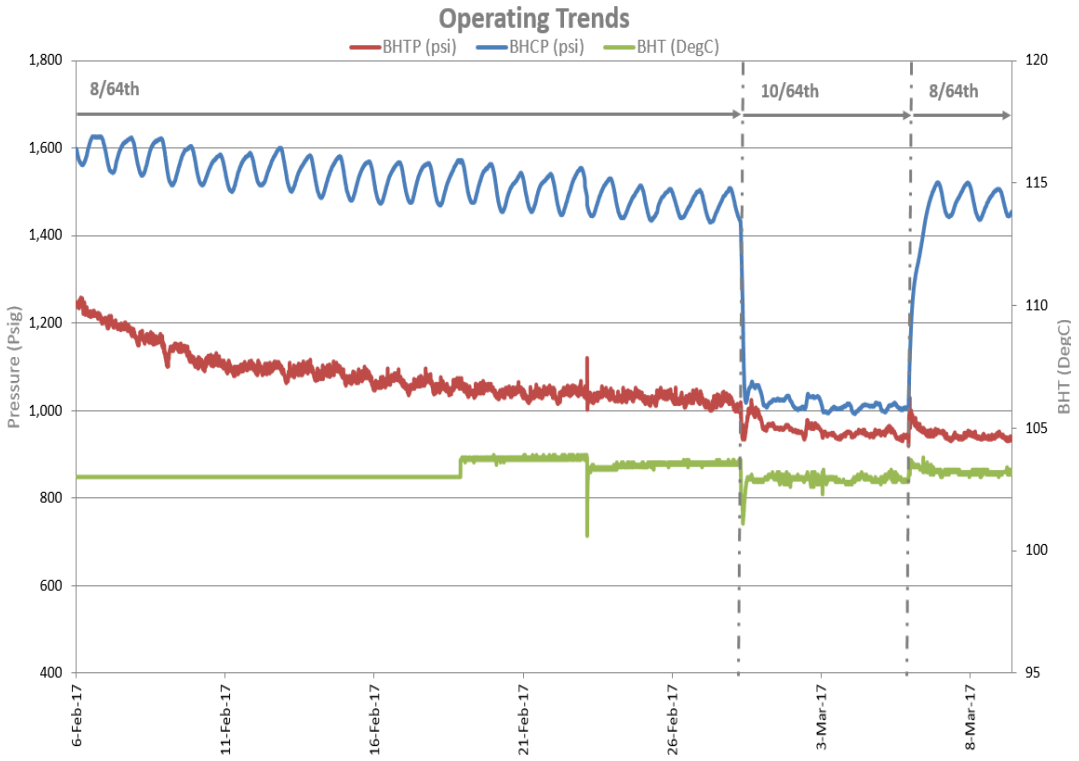
Case History 2 – Mitigating Instability

8/64th orifice size causing **multi-point injection** and well instability.

Upper IPO valve continuously **opening and closing**.

Operator **increased the port size** to 10/64 by opening an additional valve. **Well stability achieved**.

Valve closed to replicate issue and confirm the DIAL action.



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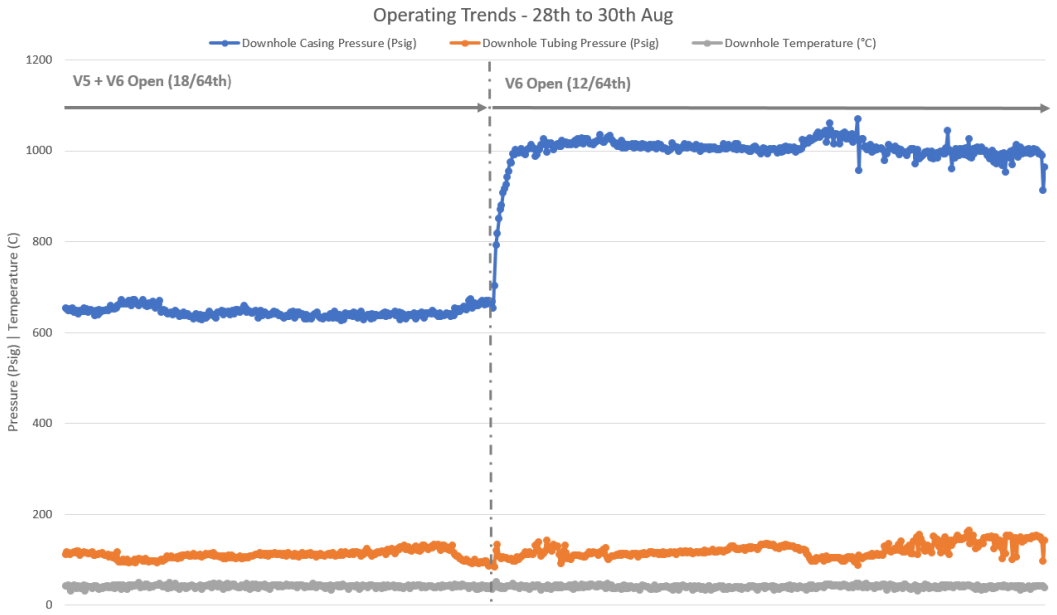
Case History 3 – Gas Management

Through downhole gauge measurement, the operator recognized the opportunity to **reduce the gas injection rate**.

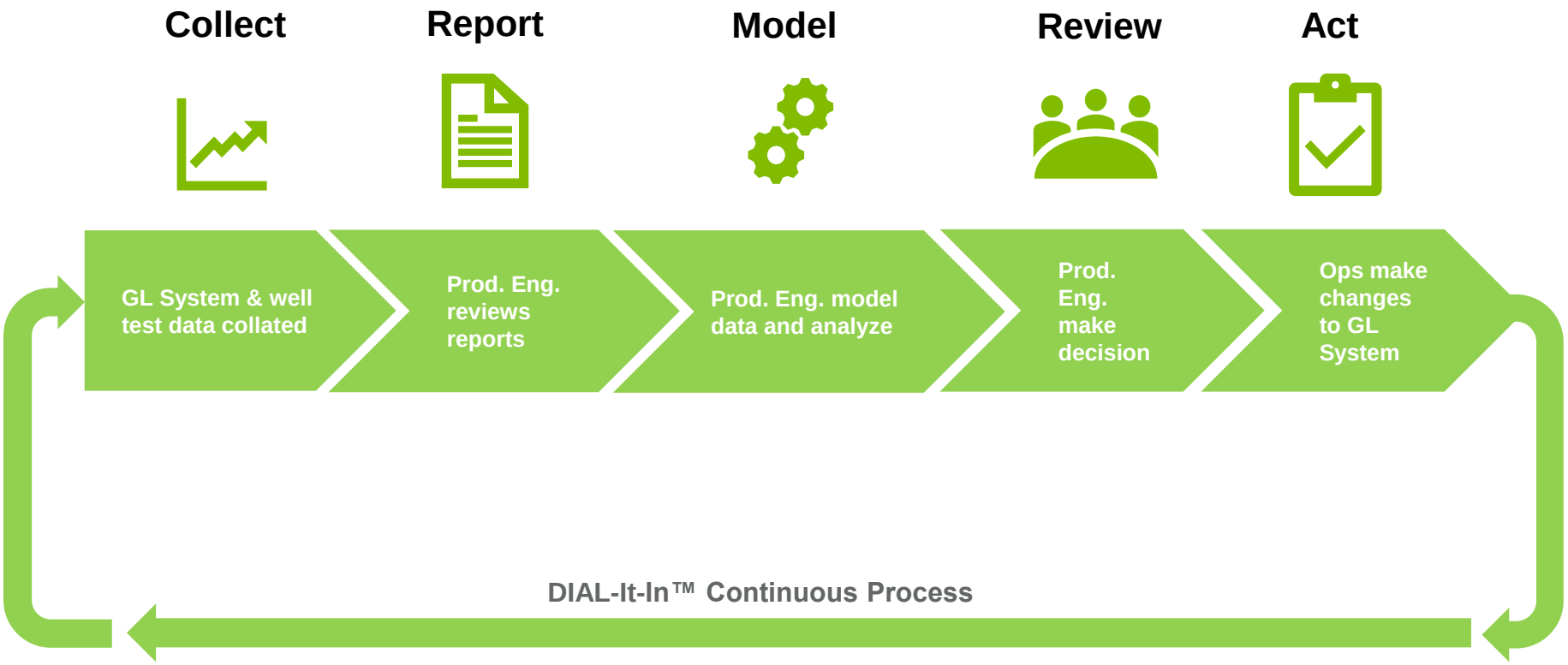
The **valve combination** was changed from **18/64** to **12/64ths**.

The operator increased casing pressure and **increased Net Oil Production by 18%.**



^Date	SPT Code	Total Fluid(bbl/d)	Oil	Water	Total Gas(MCF/D)	Gas Lift Gas(MCF/D)	Reservoir Gas(MCF/D)	GOR	Total GOR	Water Cut(%)	Tubing Pressure(PSIG)	Duration (Hrs)	Casing Pressure	Flow-Line Pressure(PSIG)	Test Separator Pressure
		stb/d	stb/d	stb/d	mscf/d	mscf/d	mscf/d	scf/stb		%	psig		psig	psig	psig
06/09/2017	0	81.36	81.36	0.00	472.12	356.54	115.59	1420.73	5803.12	0.00	999.00	10.00	755.71	45.82	39.93
01/09/2017	0	68.19	68.19	0.00	493.73	354.53	139.20	2041.23	7240.12	0.00	999.00	10.00	775.80	46.14	40.11
23/08/2017	0	69.38	66.30	3.08	591.11	480.89	110.22	1662.45	8916.00	4.44	999.00	10.00	449.03	46.78	39.84

Gas Lift Optimization
From Months to Minutes



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Eliminate production uncertainty, instabilities and operational costs with continuous, intervention-free, artificially lifted well optimization.

More production	**Accelerating return-on-investment** increased well production from **enhanced lift efficiency**
Less intervention	**Reducing opex & risk** reduced well down-time from **intervention-free operation**
More data	**Informing production optimization** increased insight from **multiple in-well sensors**
Less uncertainty	**Enabling management decisions** reduced misunderstanding from **integrated gas lift system**

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