Welcome!

The program will begin soon.

You will not hear audio until we begin.

Gas Lift Design Optimization Using Intelligent Gas Lift Valves a KJO Case Study

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Webinars

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Introduction

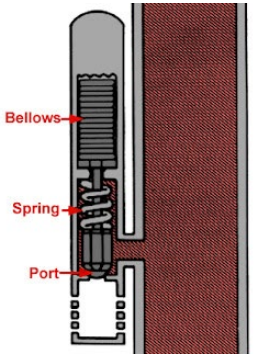
Gas lift

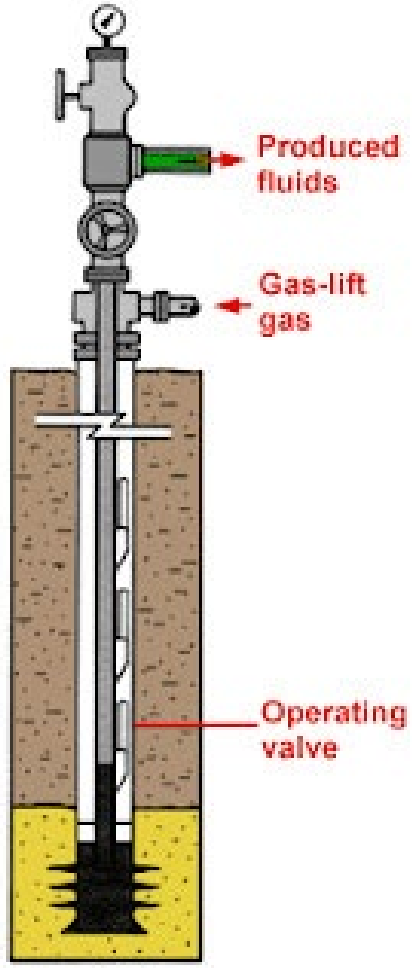
Decrease in reservoir pressure or increase in water cut

Existing technology

- Conventional gas-lift valves are attached to gas-lift mandrels and wireline retrievable
- Gas-lift valves are set in side-pocket mandrels, SPM valve.
- The valves will be located at appropriate intervals in the tubing string

The pressure-operated valve (also called a pressure valve) requires a buildup in casing pressure to open and a reduction in casing pressure to close





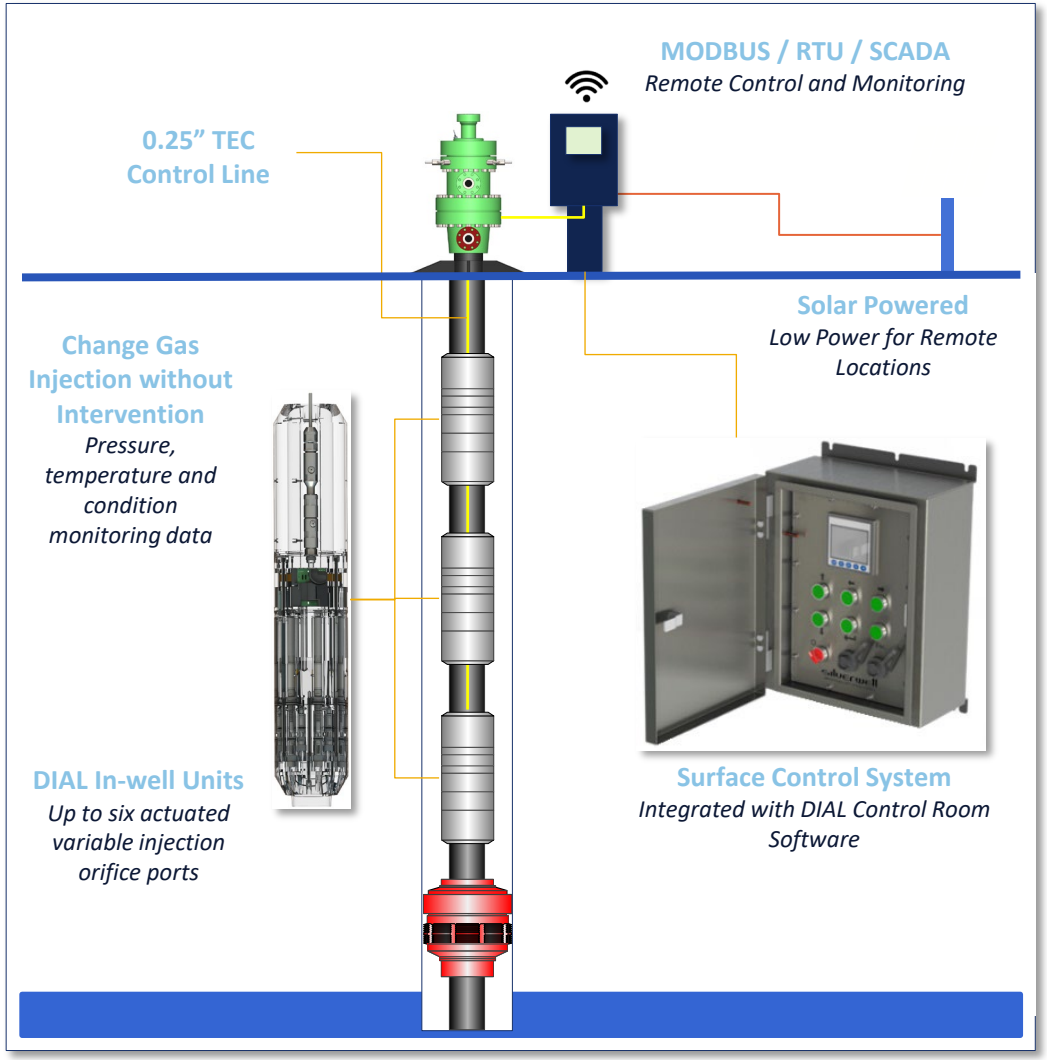
Introduction

Digital Intelligent Artificial Lift (DIAL) System

Tubing deployed DIAL units are strategically positioned in the well. They are connected together by the TEC which provides power and comms. A surface control system allows local or remote actuation of the DIAL units to adjust injection rate and depth. Flowing pressure gradient data is acquired to inform optimization decisions.

Features

- Variable orifice size at any depth
- Deeper injection
- No deviation limitation
- No well intervention required
- Pressure and temperature data returned to surface
- Remote monitoring and control
- Intelligent field-wide management



Digital Intelligent Artificial Lift (DIAL) System

DIAL is a production optimization system integrating in-well monitoring and control of gas lift well performance, with surface analytics and automation, to continually optimize gas lifted fields remotely and without intervention.

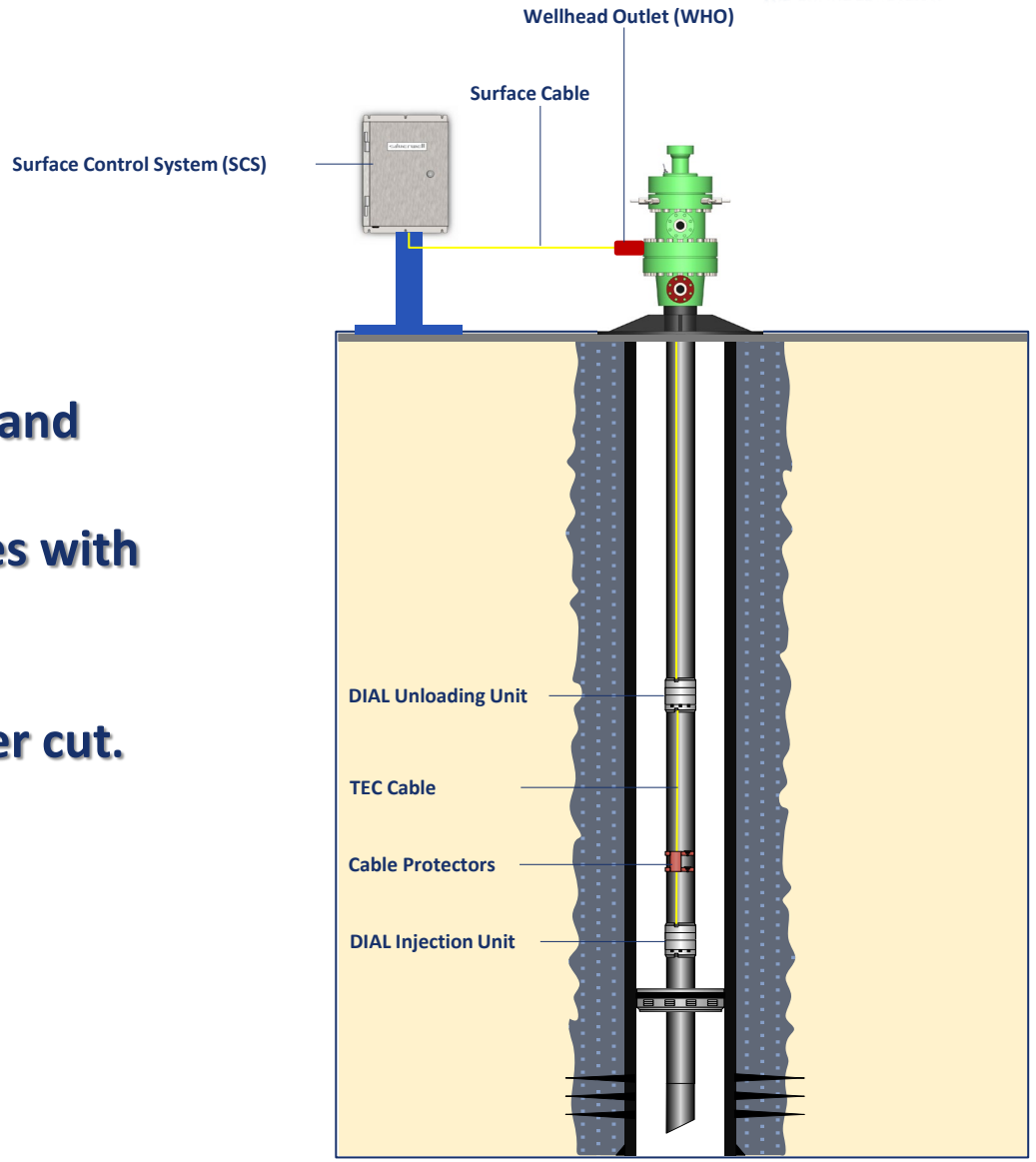
DIAL System Production Benefits

- Full downhole vertical lift performance monitoring in real-time.
- Deeper set: more reduce gradient & hence more drawdown and production gain
- FBHP measurement below the point of injection enabling gas lift automation.
- Using real-time data enabling well model calibration and continuous optimization through life cycle, reservoir management.
- Eliminates multipoint injection, and mitigate instability.
- No well intervention required to change gas injection rate, reduce OPEX.
- Remote control and monitoring without the need for field visits to make injection rate adjustments, reduce OPEX.

Digital Intelligent Artificial Lift (DIAL) System

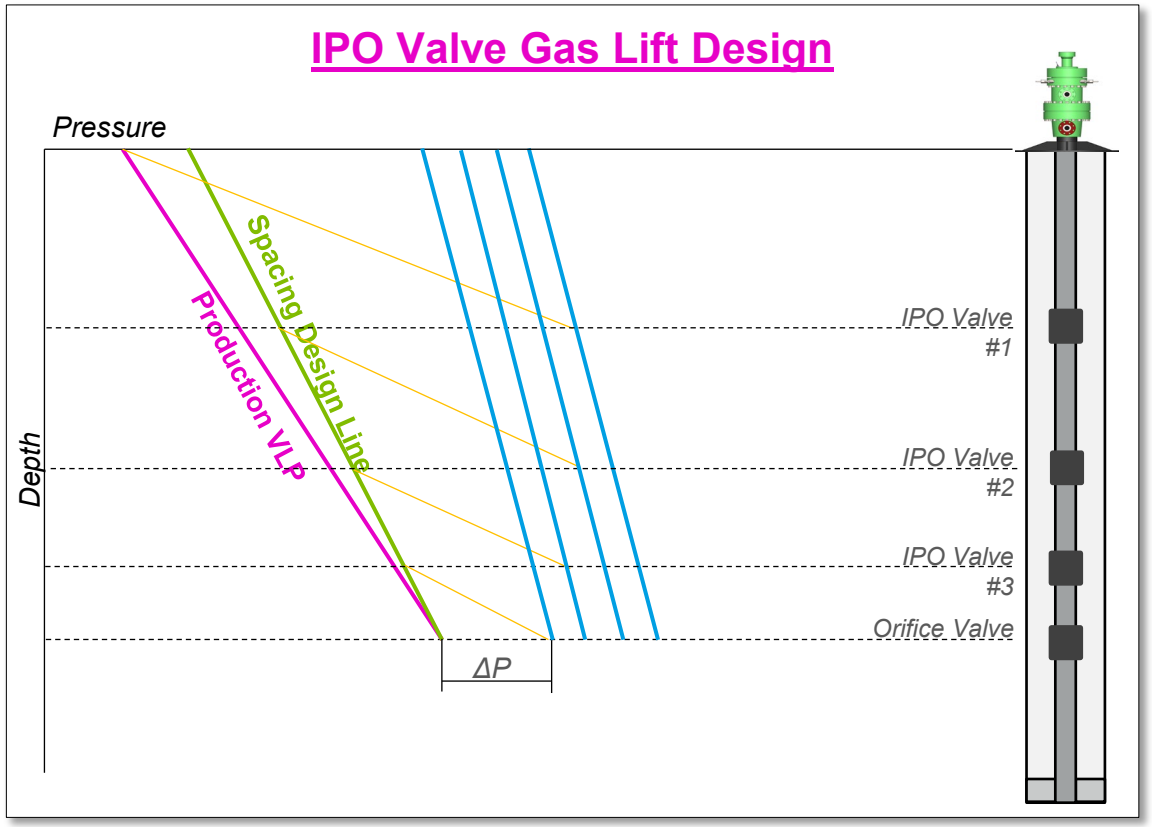
How optimization is achieved with DIAL?

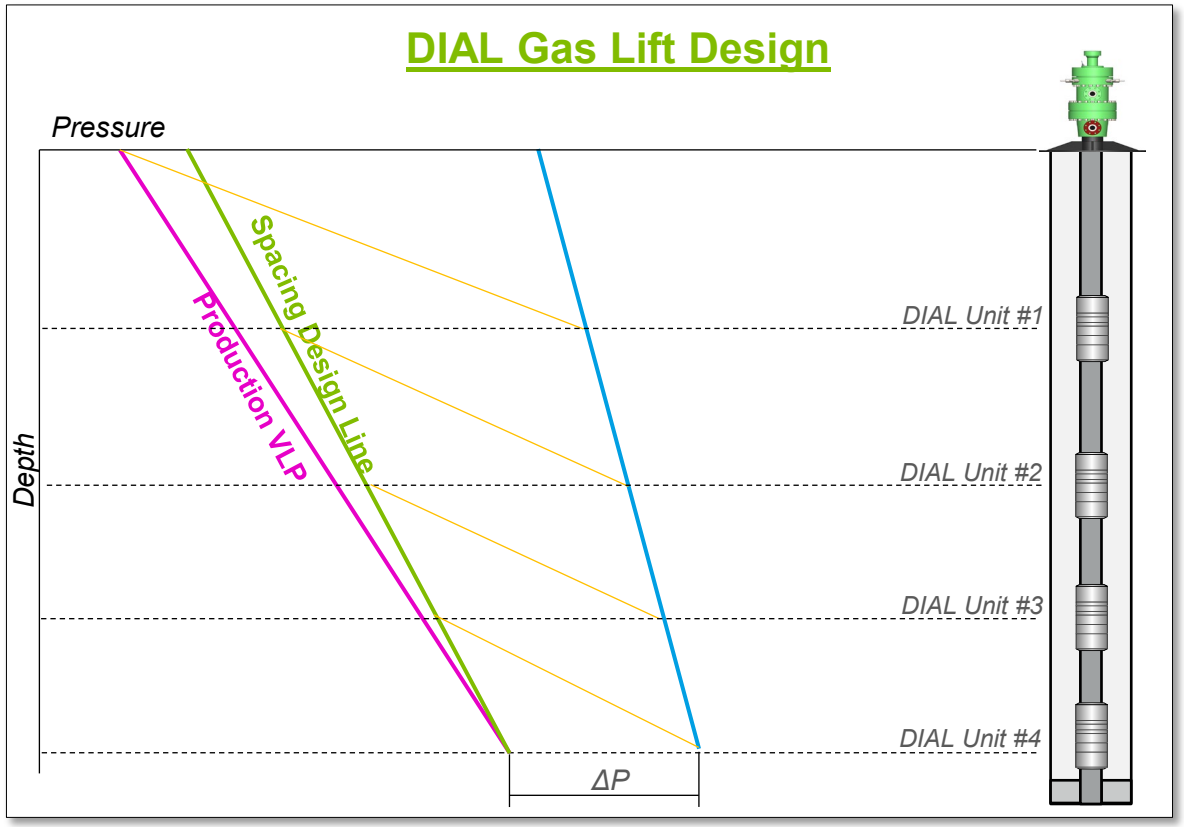
- Deeper set: more reduce gradient & more drawdown and production gain.
- Variable injection control at each valve; multiple valves with different flow capacity.
- Continuous monitoring on gas injected.
- Life-cycle adaptive control; change in pressure or water cut.



DIAL vs SPM Valve Well Design Comparison

Full Casing Pressure | Wider Spacing | Less Stations | Deeper Injection | Increased Production and Stability

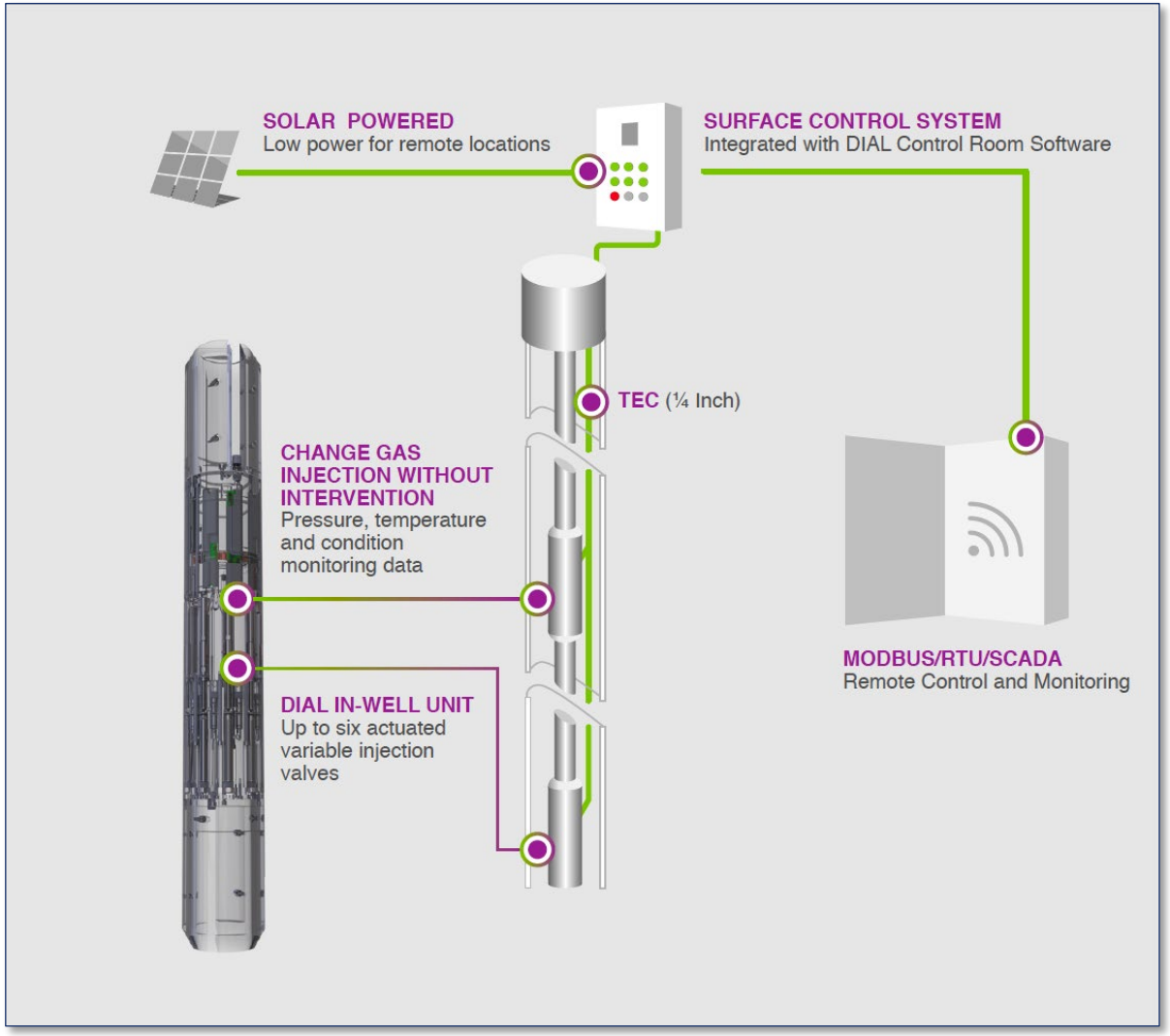




How DIAL was engineered

Digital Intelligent Artificial Lift (DIAL)

- Designed for the digital oilfield.
- Digitally controlled from the surface.
- Not effected by pressure or temperature.
- Multiple ports at each depth.
- Real-time pressure and temperature data.
- Simplified gas lift design.
- Deeper, single point injection.
- Interventionless technology.
- Continuous production optimization.

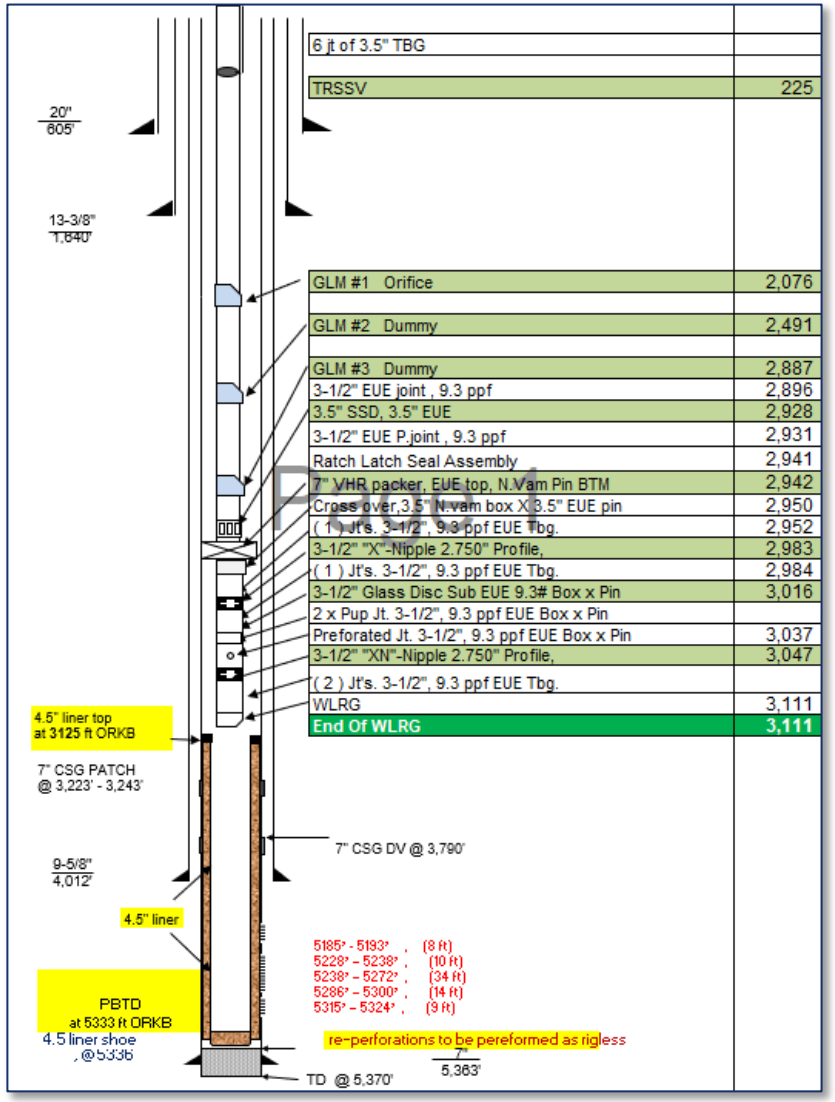


Objectives of this study

- Well study comparing the production performance of Side Pocket Mandrel (SPM) valve vs the Digital Intelligent Artificial Lift (DIAL) System under the same well conditions. (assumes perfectly optimum SPM valve system)
- Realization of economic benefits using DIAL

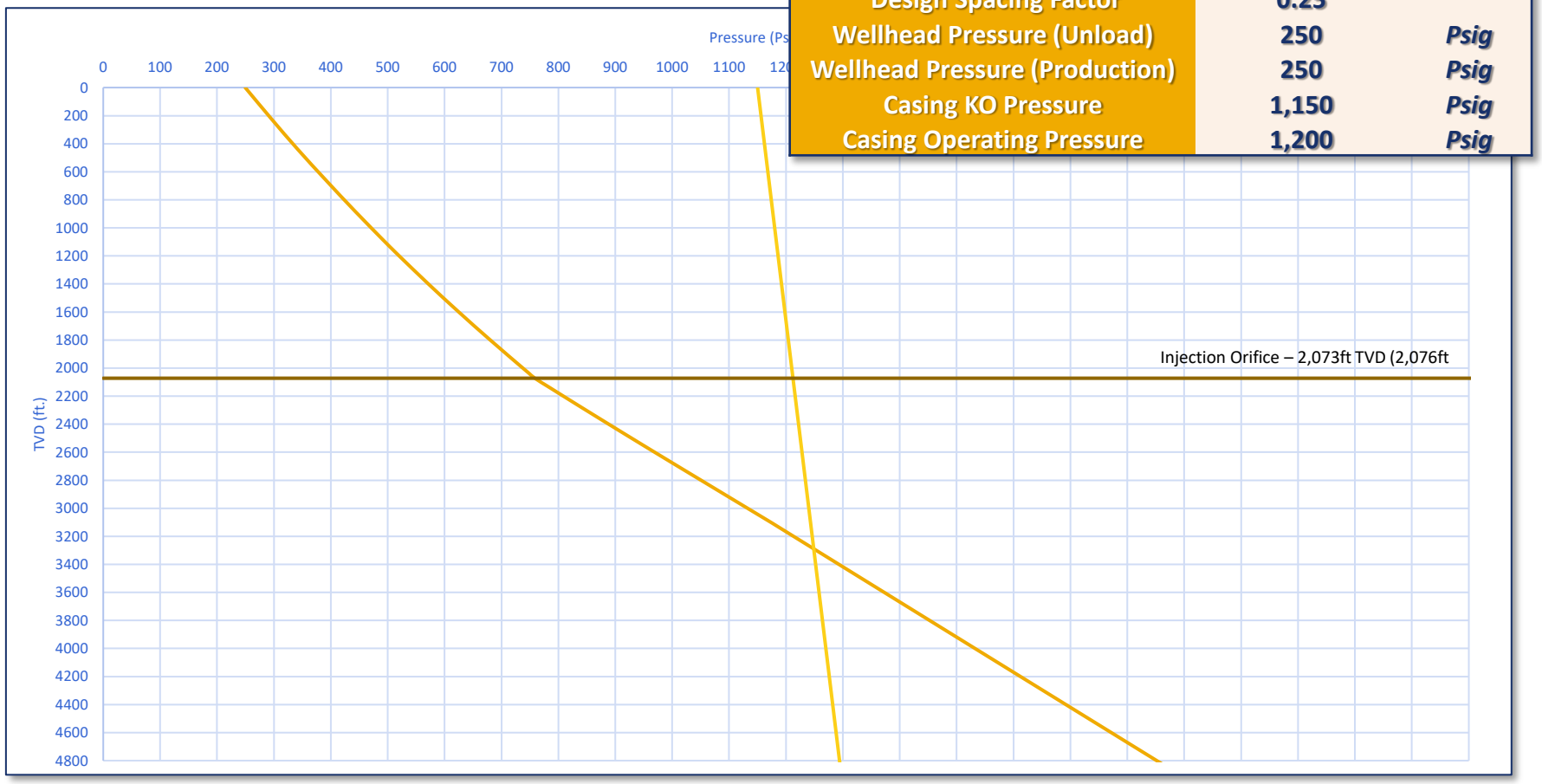
Well #XX001 | Existing Completion

- KJO provided gas lift design data and a well completion schematic for well XX-001.
- XX-001 have 3 x SPM installed down to the packer. Gas injection is currently at an orifice valve set at 2076ft. MD.
- The gas lift design data indicates that this well is producing 3,800 STB Liquid / Day (50% water cut) with an gas lift injection rate of 0.5MMsfcd.
- A Prosper model shall be created to match this well performance with an orifice valve. A model shall then be created for the DIAL System and the well production performance shall be compared against the existing SPM orifice completion.



SPM Orifice Well Model | Gas Lift Design

Kill Fluid Gradient	0.5	*Psi/ft.*
Injection Gas Gradient	0.03	*Psi/ft.*
Design Spacing Factor	0.25	
Wellhead Pressure (Unload)	250	*Psig*
Wellhead Pressure (Production)	250	*Psig*
Casing KO Pressure	1,150	*Psig*
Casing Operating Pressure	1,200	*Psig*

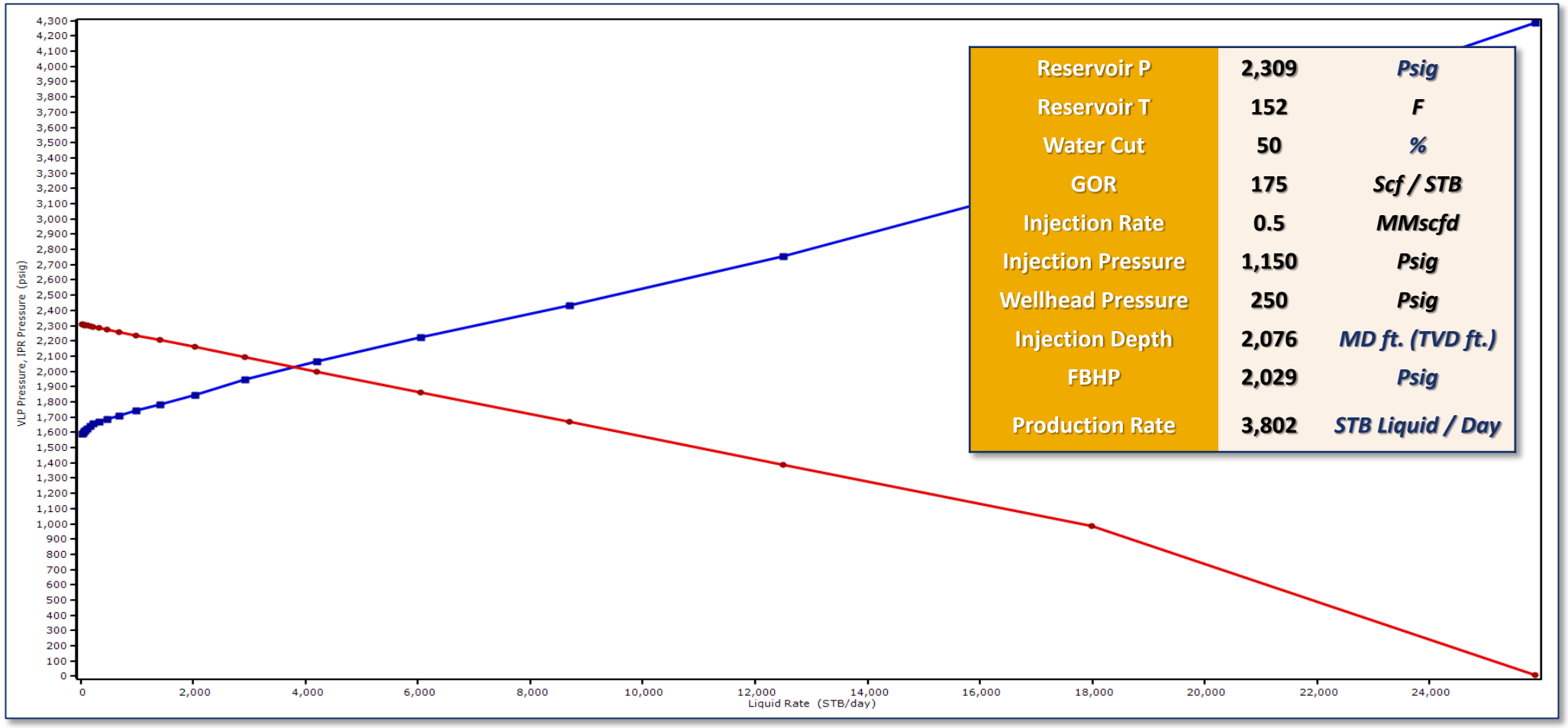


SPM with Orifice

SPM with Dummy

SPM with Dummy

SPM Orifice Well Model | Inflow vs Outflow Relationship



Reservoir P	2,309	*Psig*
Reservoir T	152	*F*
Water Cut	50	*%*
GOR	175	*Scf / STB*
Injection Rate	0.5	*MMscfd*
Injection Pressure	1,150	*Psig*
Wellhead Pressure	250	*Psig*
Injection Depth	2,076	*MD ft. (TVD ft.)*
FBHP	2,029	*Psig*
Production Rate	3,802	*STB Liquid / Day*

DIAL System Well Model | Gas Lift Design

Kill Fluid Gradient	0.5	*Psi/ft.*
Injection Gas Gradient	0.03	*Psi/ft.*
Design Spacing Factor	0.25	
Wellhead Pressure (Unload)	250	*Psig*
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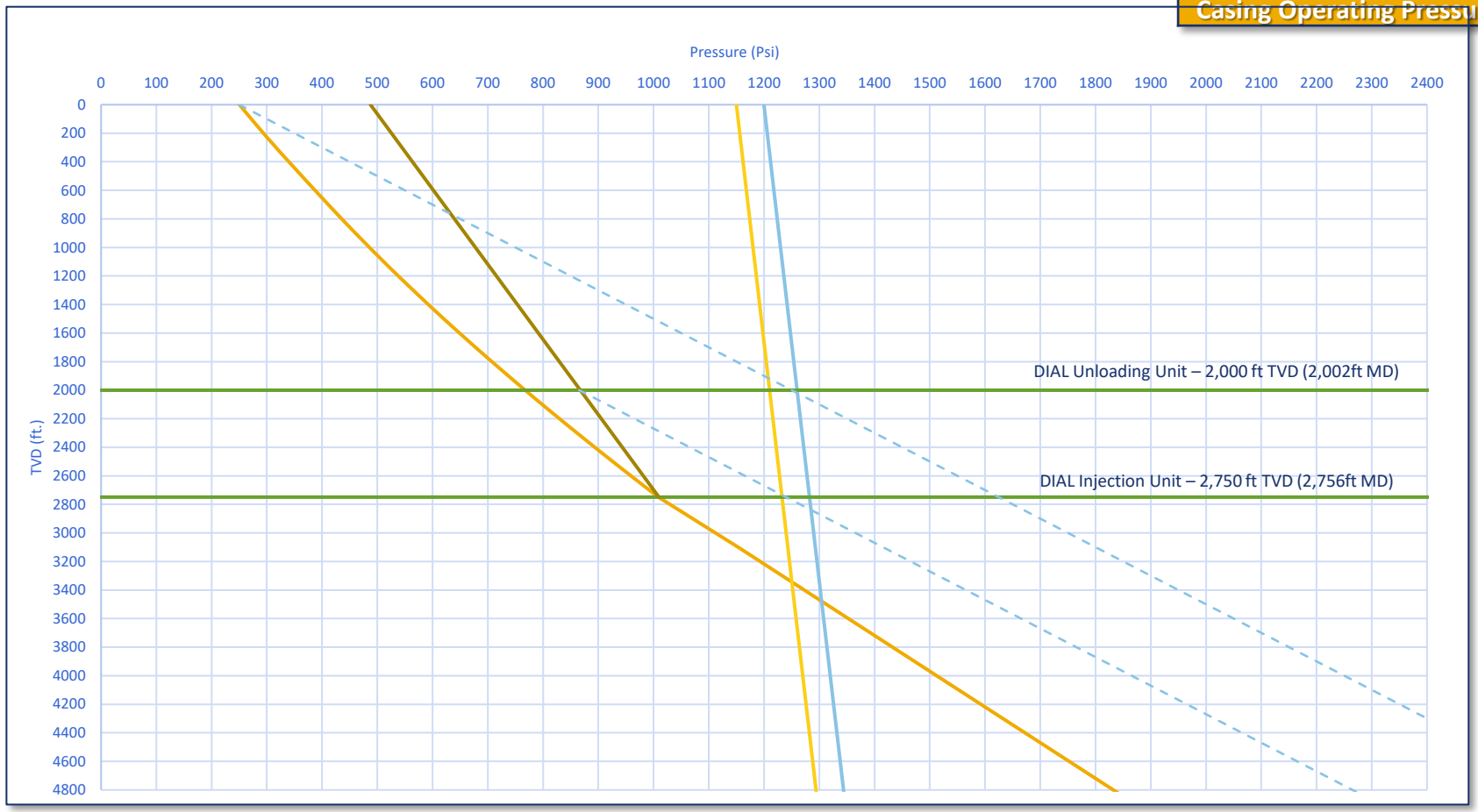
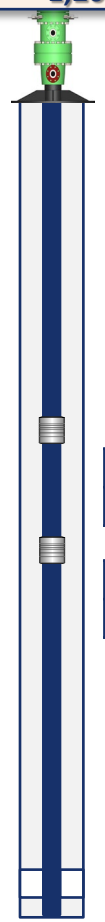




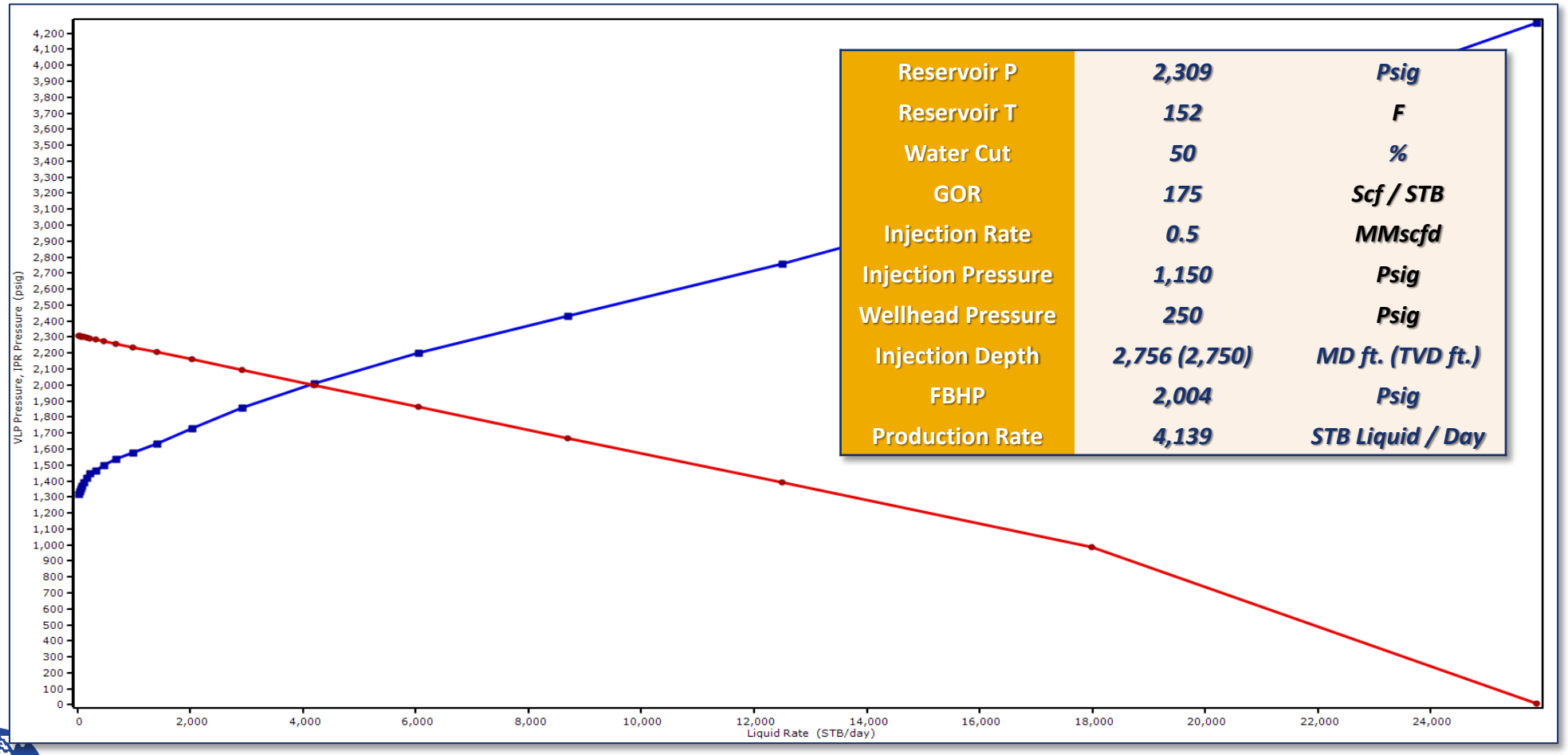
DIAL #1

V1	V2	V3
8/64	10/64	12/64

DIAL #2

V4	V5	V6
8/64	10/64	12/64

DIAL System Well Model | Inflow vs Outflow Relationship



Reservoir P	2,309	Psig
Reservoir T	152	F
Water Cut	50	%
GOR	175	Scf / STB
Injection Rate	0.5	MMscfd
Injection Pressure	1,150	Psig
Wellhead Pressure	250	Psig
Injection Depth	2,756 (2,750)	MD ft. (TVD ft.)
FBHP	2,004	Psig
Production Rate	4,139	STB Liquid / Day

Performance Summary

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Summary of Design Comparison

Compared to the SPM orifice gas lift system, DIAL increases initial liquid production by 9% (337 STB Liquid / Day). How is this achieved?

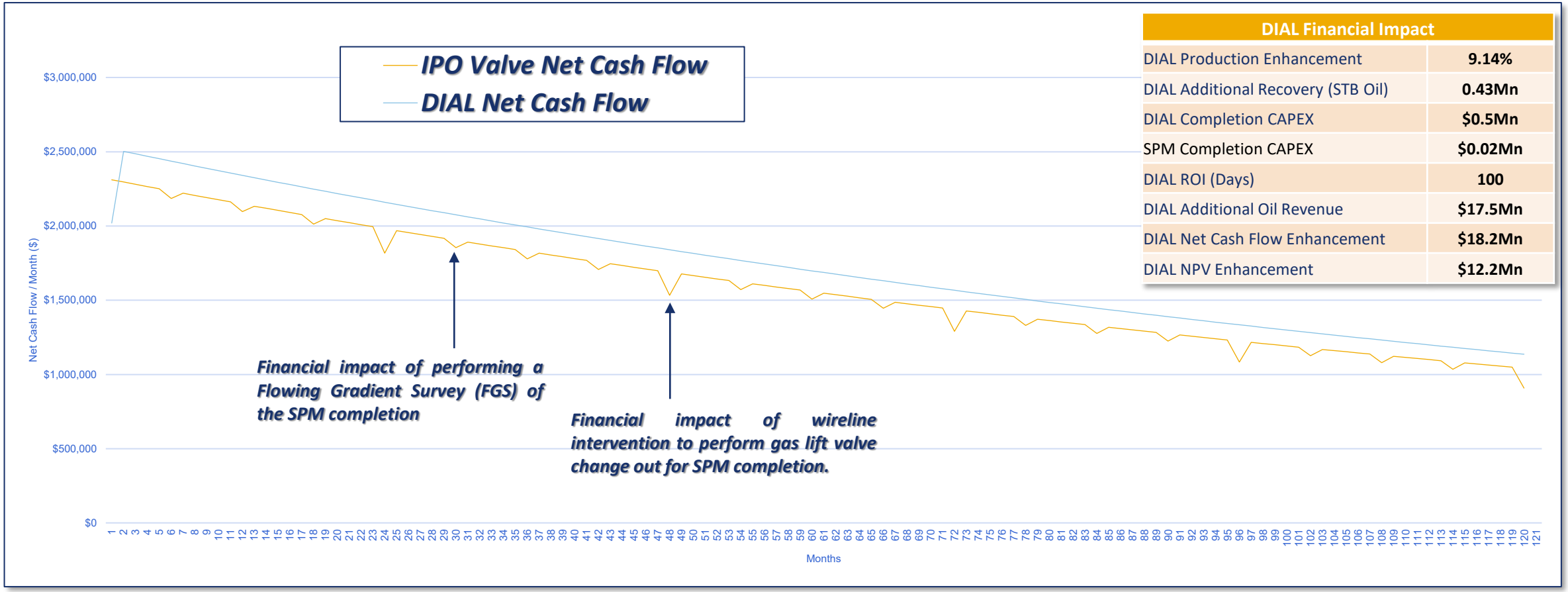
1) DIAL achieves deeper injection compared to the SPM orifice design.
2) The DIAL's multi-port capability enables continuous production optimization throughout life of well.
3) The DIAL system enables increased drawdown from the reservoir through increased injection depth and pressure.
4) The DIAL system enables accelerated NPV through deeper and single point injection.

DIAL System Production Benefits

- Full downhole visibility of well's vertical lift performance in real-time.
- FBHP measurement below the point of injection enabling gas lift automation.
- Using real-time data enabling well model calibration and continuous optimization.
- Eliminates multipoint injection.
- Production decline curve forecasting, enabling deeper injection quicker.
- Zero well intervention required to change gas injection rate.
- Remote control and monitoring without the need for field visits to make injection rate adjustments.

Parameter	SPM / Orifice	DIAL System
Injection Depth	2,000ft. TVD	2,750ft. TVD
Casing Head Pressure	1,150 Psi	1,150 Psi
Injection Rate	0.5 MMscfd (Max. available in the field)	0.5 MMscfd (Max. available in the field)
Initial Production Rate	3,802 STB Liquid / Day	4,139 STB Liquid / Day

Business Case



DIAL Financial Impact	
DIAL Production Enhancement	9.14%
DIAL Additional Recovery (STB Oil)	0.43Mn
DIAL Completion CAPEX	$0.5Mn
SPM Completion CAPEX	$0.02Mn
DIAL ROI (Days)	100
DIAL Additional Oil Revenue	$17.5Mn
DIAL Net Cash Flow Enhancement	$18.2Mn
DIAL NPV Enhancement	$12.2Mn

Notes:

[1] Production enhancement inclusive of DIAL deeper injection uplift and zero well intervention compared to SPM completion. SPM wireline intervention to change IPO valve at a cost of $50K per intervention, performed every 24 months with 1 days lost production per intervention. SPM FGS performed every 6 months at a cost of $50K per survey. Total intervention cost over 120 month well life is $1.25Mn with 5 lost days of production. Lost time is considered a conservative estimate.

[2] DIAL CAPEX inclusive of 2 x DIAL gas lift units, 1 x DIAL sensing unit, TEC control line, cable protectors, wellhead outlet, surface cable and surface control unit. Services not incl.

[3] SPM CAPEX assumed and inclusive of 3 x SPM and valves and accessories.

Conclusions

- This paper demonstrates the benefits of intelligent gas lift implementation through a case study.
- The benefits include production optimization, OPEX savings by avoiding interventions, and digitization of operations resulting in higher operational efficiency.
- The financial model concludes on an NPV enhancement of $12.2Mn over a 120 month period
- The DIAL is a key enabler for well & reservoir management.