Innovative Retrofit Straddle Deep Gas Lift Technology for Activating and Enhancing Oil Production

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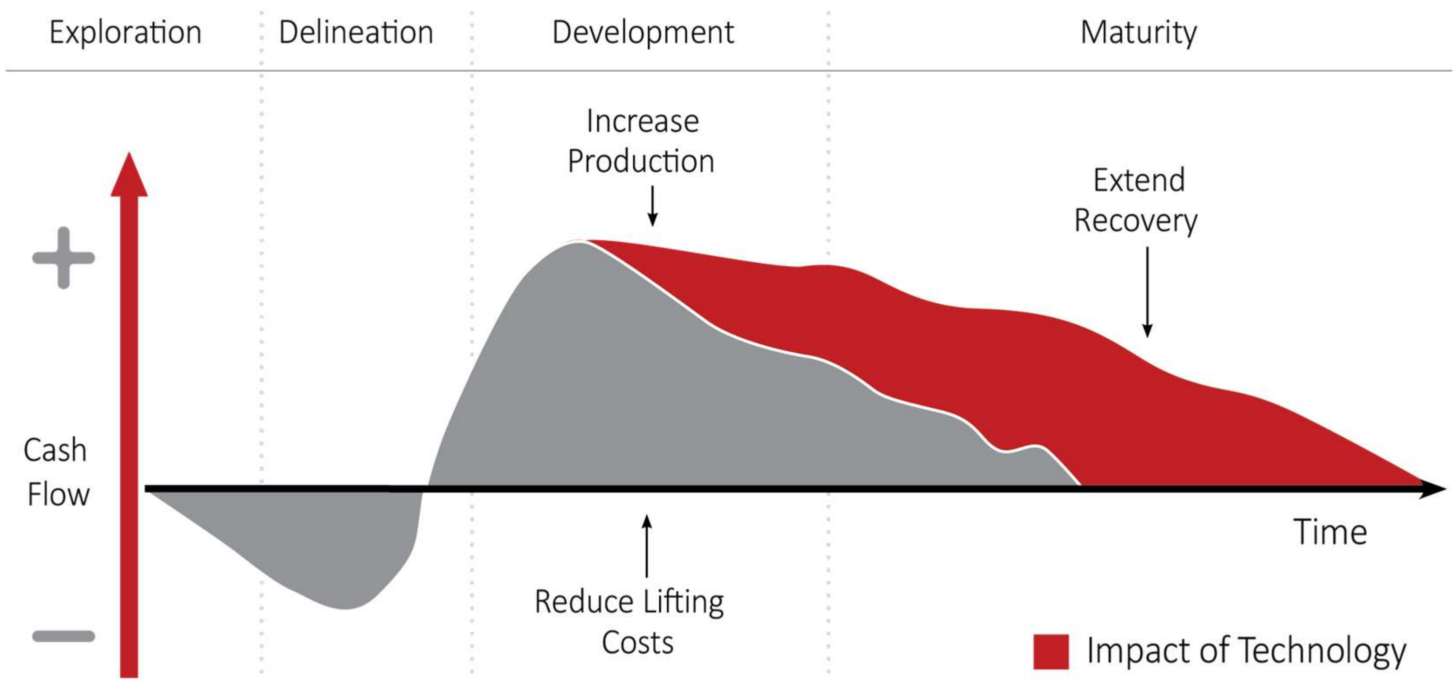
- Where is it used?
- Retrofit Deep Gas Lift System and Equipment
- Components and Benefits of DGL System
- How is Retrofit Deep Gas Lift System installed?
- Customer Pain-points and Pre-job Considerations
- Case Study
- Operational Challenges and Lessons Learned
- Results
- Conclusion

Introduction



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Customer Challenges

- Inability to enhance the production from existing wells
- Avoid expensive workovers to redesign gas lift wells
- Limited surface foot-print at offshore production jacket
- Augment incremental oil gain to maximize the recovery from field

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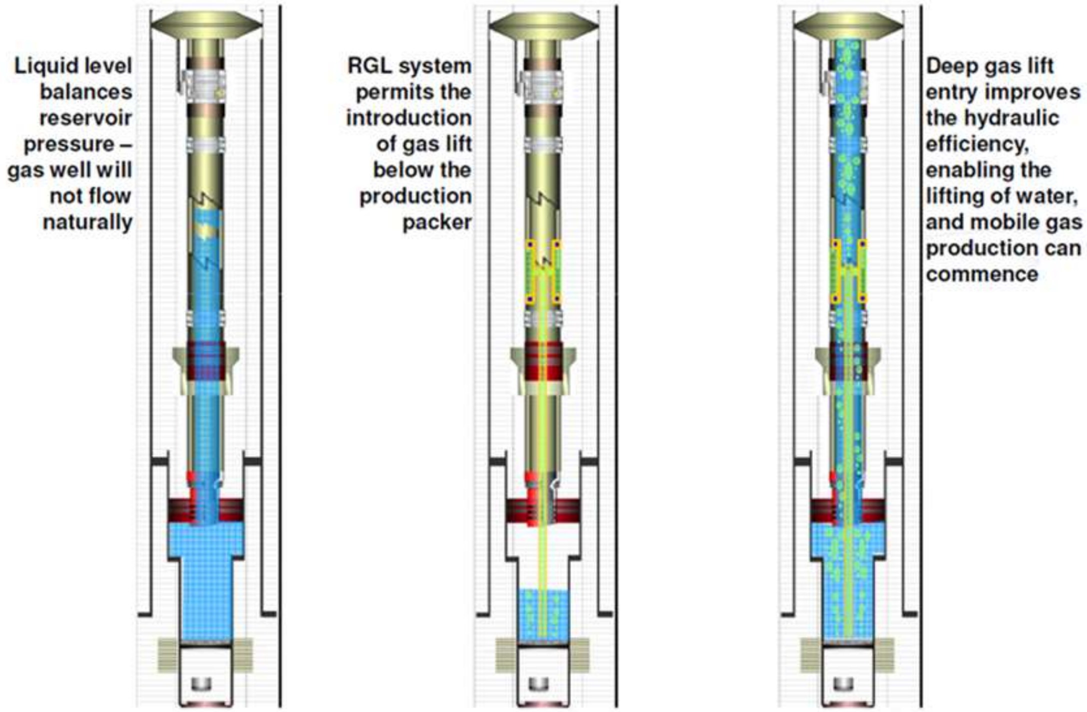
Design Concept of Retrofit Deep-Gas Lift System



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Retrofit Deep-Gas Lift System

WHERE IS IT USED?

BELOW PRODUCTION PACKERS

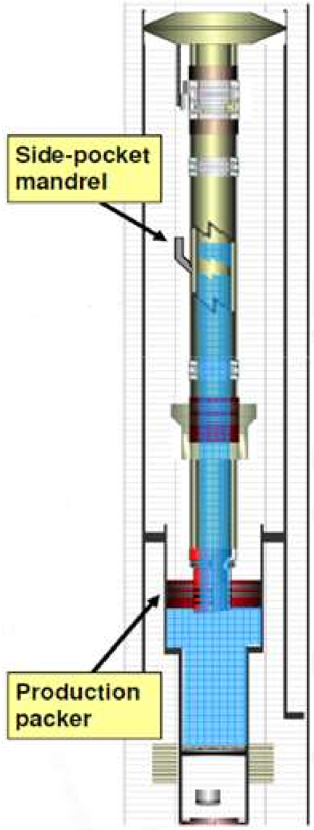
Conventionally lift gas is introduced in wells through side pocket mandrels. However, these mandrels cannot be extended below the production packer. DGL instead can be installed at any depth across the well.

GAS WELLS

Installing gas lift mandrels in gas wells is less common since gas tends to flow naturally. At a later stage artificial means for reducing the fluid column to lift the production gas may be required.

SIDE POCKET MIGHT BE THOUSANDS OF FEET AWAY FROM PERFORATIONS

PERFORATIONS



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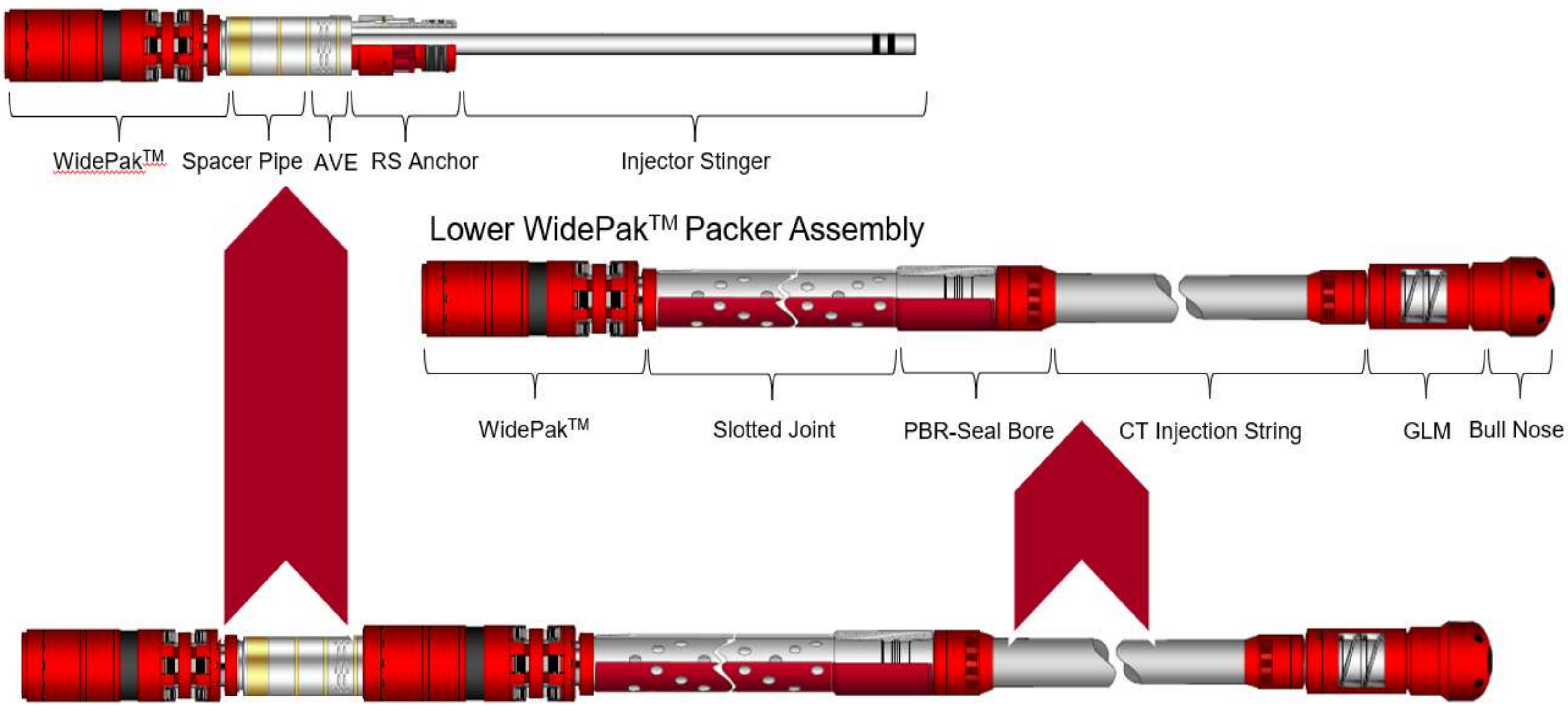
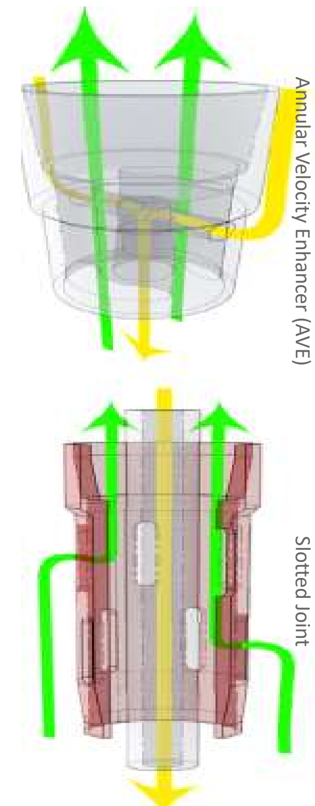
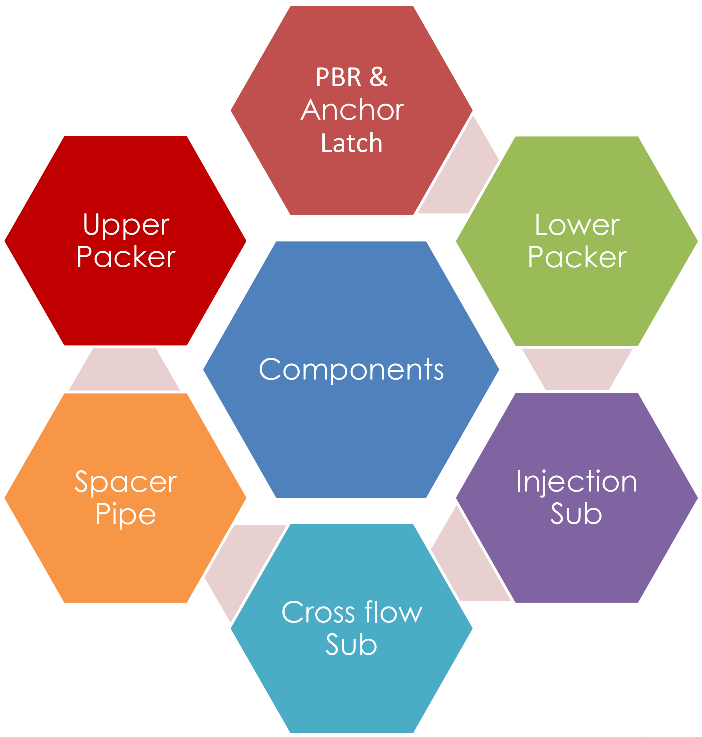
Retrofit Deep Gas Lift System and Equipment

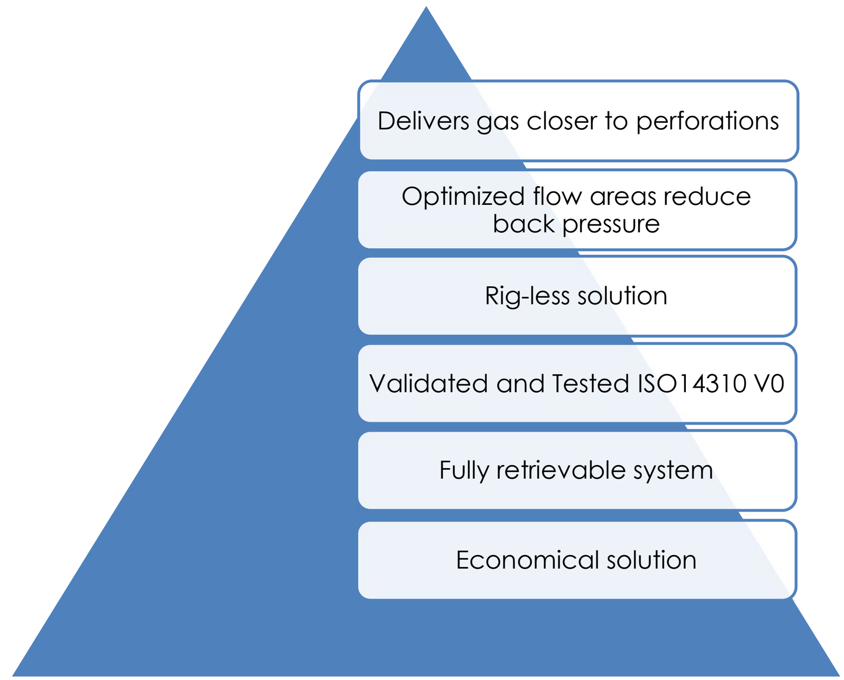
Upper WidePak™ Packer Assembly





Components and Benefits of DGL System





How Is Retrofit Deep Gas Lift System Installed?

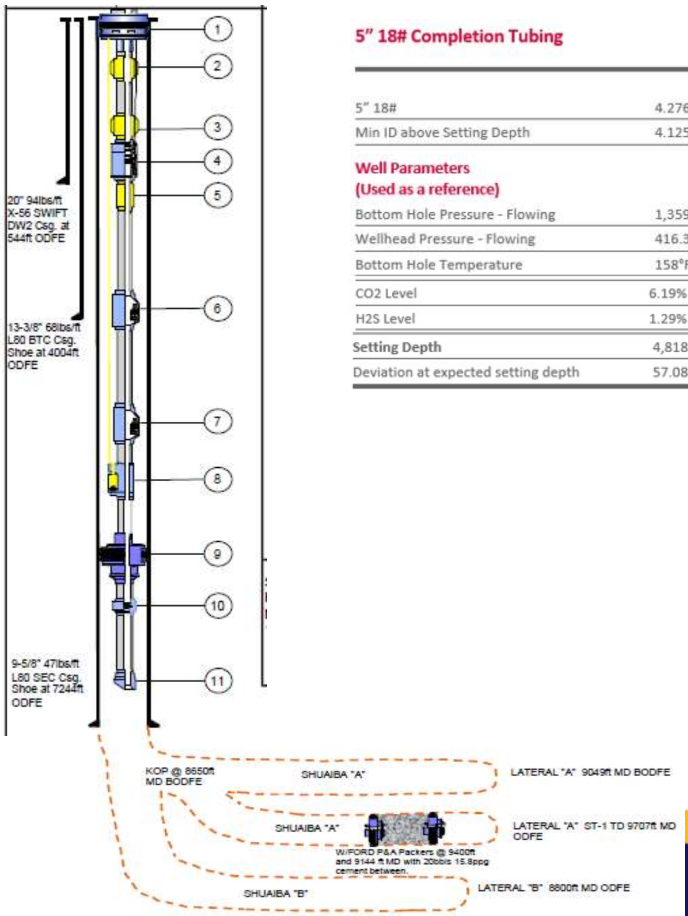
- DGL can be conveyed on:
  - Coiled Tubing
  - Threaded Pipe
  - E-Line
  - Braided Line
  - Slick Line

NOTE: Conveyance methods are determined by lengths, depths, weights, deviation, correlation etc.

Pre-job Considerations

- Gas Lift Modeling (WellFlo)
- Test all well control equipment for integrity.
- Perform integrity test on tubing and injection annulus.
- Utilize caliper logs to identify any severe wall loss at setting depth
- Drift runs to ensure DGL assembly can make it to depth.
- Depth Correlation options for lower packer
- Barrier requirements during installation and future recovery

Case Study

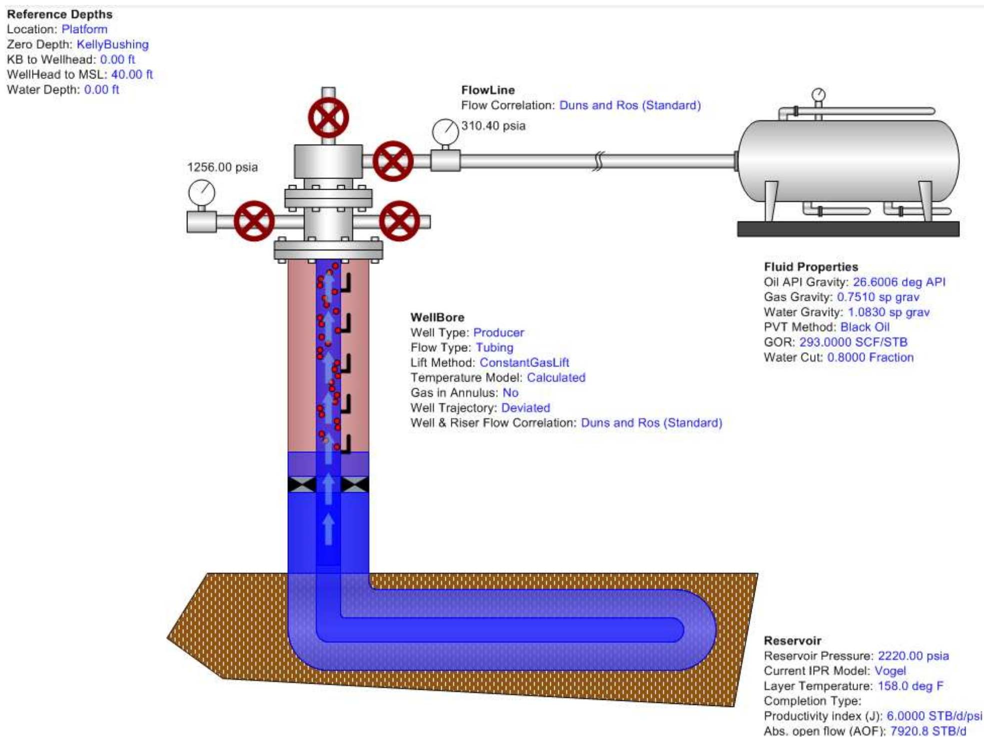


5" 18# Completion Tubing

5" 18#	4.276" ID (4.151" Drift)
Min ID above Setting Depth	4.125" @ 357.9ft

Well Parameters
(Used as a reference)

Bottom Hole Pressure - Flowing	1,359 psi
Wellhead Pressure - Flowing	416.3 psi
Bottom Hole Temperature	158°F
CO2 Level	6.19%
H2S Level	1.29%
Setting Depth	4,818ft (4,138.21ft TVD)
Deviation at expected setting depth	57.08°



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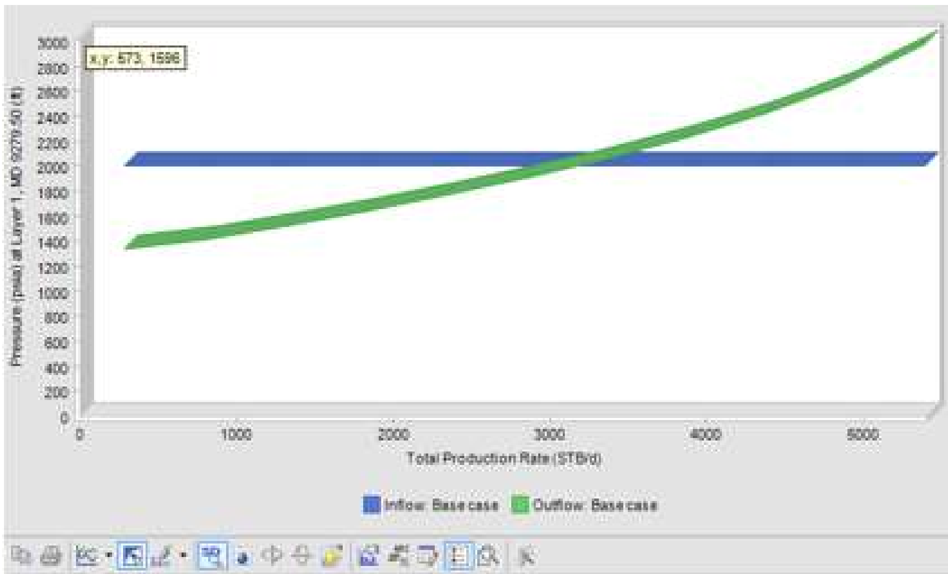
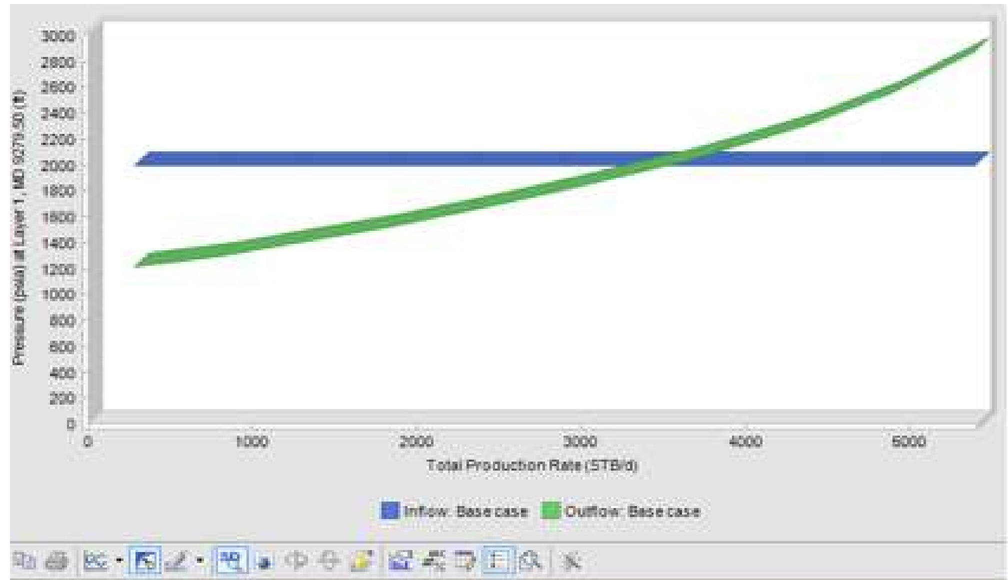
Case Study



Operating Pressure	Liquid Rate	Oil Rate	Water Rate	Formation Gas Rate	Injection Gas Rate	Water Cut	Produced GOR	Injection MD	Status
(psia)	(STB/d)	(STB/d)	(STB/d)	(MMSCF/d)	(MMSCF/d)	(Fraction)	(SCF/STB)	(ft)	
2000.00	3169.70	1109.40	2060.30	0.31	2.50	0.65	2533.68	4818.92	Stable

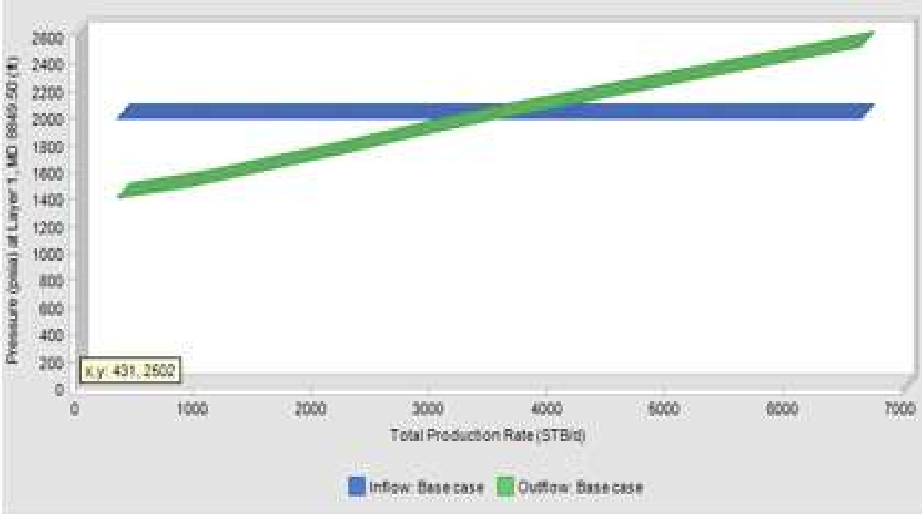
Figure:1 Initial Well Performance of Well A



Operating Pressure	Liquid Rate	Oil Rate	Water Rate	Formation Gas Rate	Injection Gas Rate	Water Cut	Produced GOR	Injection MD	Status
(psia)	(STB/d)	(STB/d)	(STB/d)	(MMSCF/d)	(MMSCF/d)	(Fraction)	(SCF/STB)	(ft)	
2000.00	3518.50	1231.50	2287.00	0.35	2.50	0.65	2310.30	6617.00	Stable

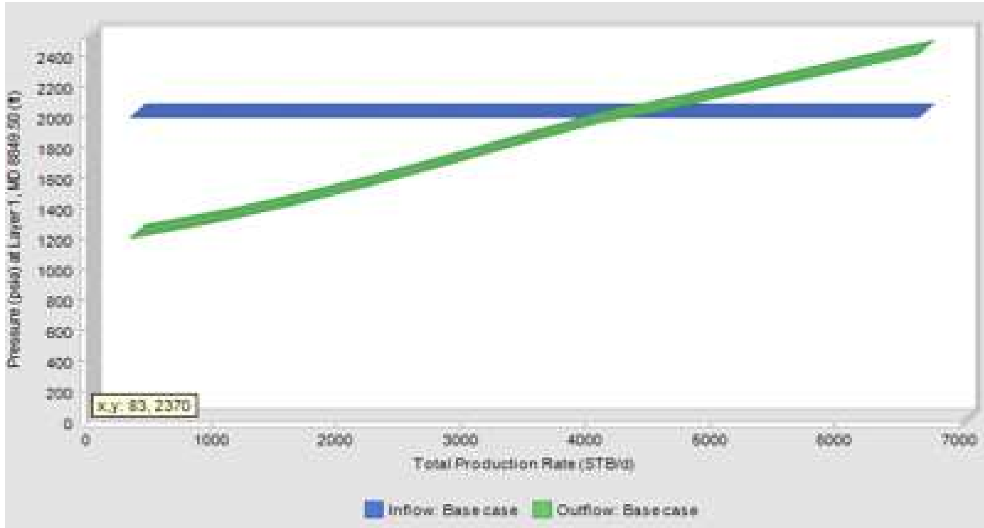
Figure:2 Final Well Performance of Well A using DGLS

Case Study



Operating Pressure	Liquid Rate	Oil Rate	Water Rate	Formation Gas Rate	Injection Gas Rate	Water Cut	Produced GOR	Injection MD	Status
(psia)	(STB/d)	(STB/d)	(STB/d)	(MMSCF/d)	(MMSCF/d)	(Fraction)	(SCF/STB)	(ft)	
2000.00	3552.50	1243.40	2309.10	0.35	2.50	0.65	2290.87	4146.50	Stable

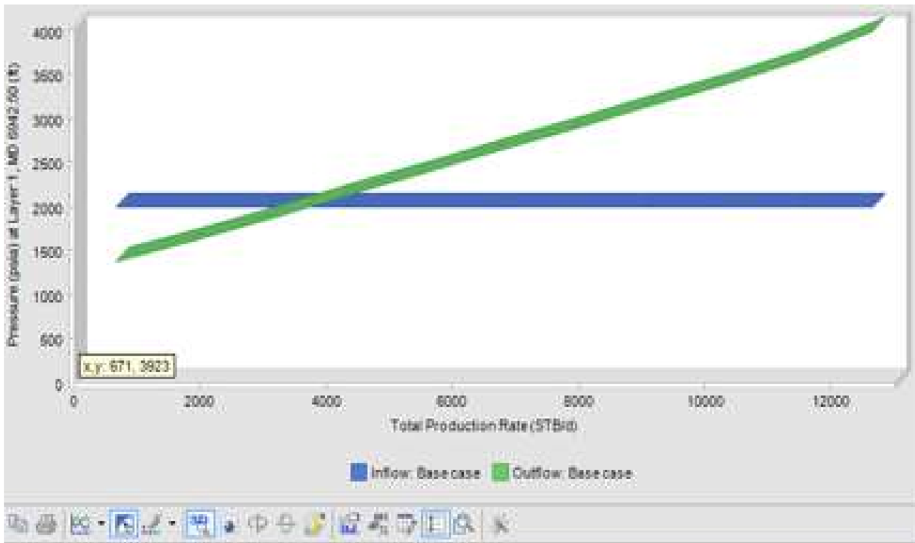
Figure:3 Initial Well Performance of Well B



Operating Pressure	Liquid Rate	Oil Rate	Water Rate	Formation Gas Rate	Injection Gas Rate	Water Cut	Produced GOR	Injection MD	Status
(psia)	(STB/d)	(STB/d)	(STB/d)	(MMSCF/d)	(MMSCF/d)	(Fraction)	(SCF/STB)	(ft)	
2000.00	4324.30	1513.50	2810.80	0.42	2.50	0.65	1932.00	7400.00	Stable

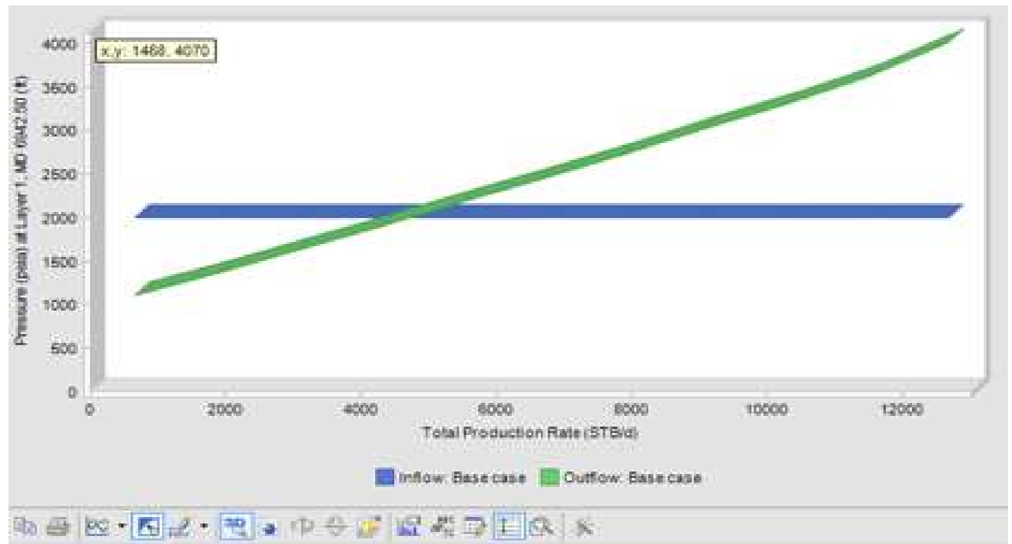
Figure:4 Final Well Performance of Well B using DGLS

Case Study



Operating Pressure	Liquid Rate	Oil Rate	Water Rate	Formation Gas Rate	Injection Gas Rate	Water Cut	Produced GOR	Injection MD	Status
(psia)	(STB/d)	(STB/d)	(STB/d)	(MMSCF/d)	(MMSCF/d)	(Fraction)	(SCF/STB)	(ft)	
2000.00	3715.50	743.10	2972.40	0.07	1.80	0.80	2511.28	3791.20	Stable

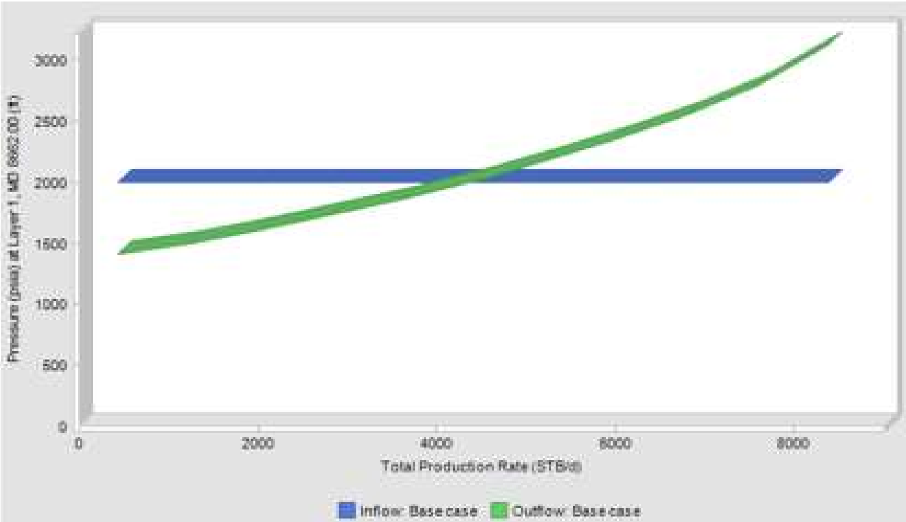
Figure:5 Initial Well Performance of Well C



Operating Pressure	Liquid Rate	Oil Rate	Water Rate	Formation Gas Rate	Injection Gas Rate	Water Cut	Produced GOR	Injection MD	Status
(psia)	(STB/d)	(STB/d)	(STB/d)	(MMSCF/d)	(MMSCF/d)	(Fraction)	(SCF/STB)	(ft)	
2000.00	4702.20	940.40	3761.70	0.08	1.80	0.80	2003.01	5516.70	Stable

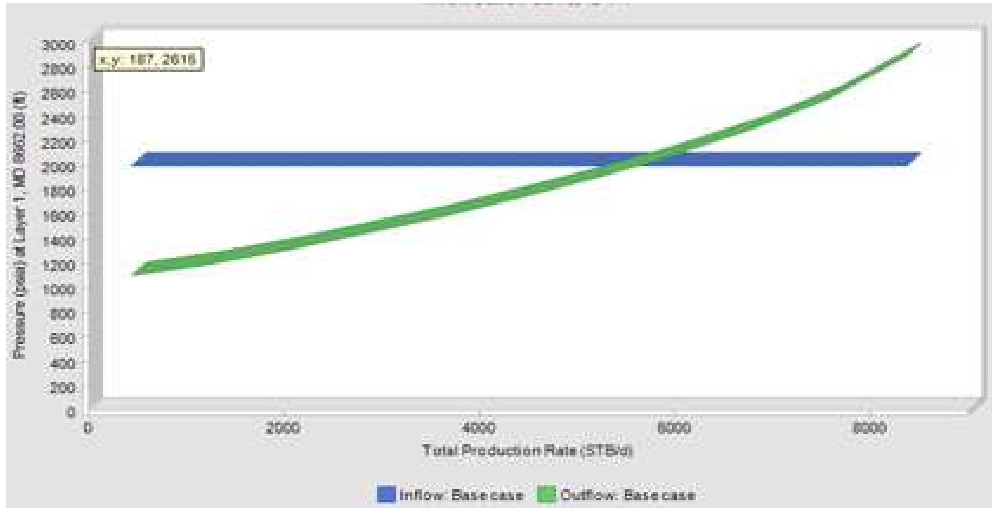
Figure:6 Final Well Performance of Well C using DGLS

Case Study



Operating Pressure	Liquid Rate	Oil Rate	Water Rate	Formation Gas Rate	Injection Gas Rate	Water Cut	Produced GOR	Injection MD	Status
(psia)	(STB/d)	(STB/d)	(STB/d)	(MMSCF/d)	(MMSCF/d)	(Fraction)	(SCF/STB)	(ft)	
2000.00	4355.60	871.10	3484.50	0.26	2.30	0.80	2933.28	3841.00	Stable

Figure:7 Initial Well Performance of Well D



Operating Pressure	Liquid Rate	Oil Rate	Water Rate	Formation Gas Rate	Injection Gas Rate	Water Cut	Produced GOR	Injection MD	Status
(psia)	(STB/d)	(STB/d)	(STB/d)	(MMSCF/d)	(MMSCF/d)	(Fraction)	(SCF/STB)	(ft)	
2000.00	5617.30	1123.50	4493.80	0.33	2.30	0.80	2340.24	6700.00	Stable

Figure:8 Final Well Performance of Well D using DGLS

Operational Challenges and Lessons Learned

- Space availability for the rig up of slickline unit and CT unit
- Evaluation of integrity of tubing and injection annulus
- Drift runs and scrapper runs are critical before deployment
- Depth correlation is critical for deployment of lower packer
- If a pump out plug is pre-installed, pressure is applied to the tubing to expel the pump out plug and allow the system to be tested.
- Switch gas lift supply and allow well back into production.
- Existing tubing integrity challenges can be converted into opportunities

Results

1+ mmscfd of gas is being over injected

Total 4 wells deployed with DGL

Minimal Downtime

Liquid production increased by 2000+ bpd

Quick Payback Time, High ROI

No HSE,

No NPT

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Conclusion

- Pilot project improved well performance
- Effective tool to overcome issues
- Cost-effective technology
- Enhancing and Recovering hydrocarbons are vital
- Integrated approach is required

Question Time

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