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# Integrated Artificial Lift Excellence: Technologies, Operations, and the Digital Future

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# Integrated Artificial Lift Excellence: Technologies, Operations, and the Digital Future



## Maximizing Production in Offshore Brownfields Through Retrofit Deep Gas Lift (RDGL): Screening, Design, Deployment, and Field Performance

Zafuan Noor/Nor Sharifah Omar/Ruben Leong/Teoh Yee Wei - Jadestone Energy (Malaysia) Pte. Ltd.

Zayful Hasrin/M Izzuddin – PETRONAS Carigali Sdn. Bhd.





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## Presentation Outline

- Screening Process
- RDGL Concept
- Nodal Analysis
- Solution & Deployment Method
- Well Diagram
- Post Job Performance
- Conclusions & Value Creation



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# Screening Process

## History:

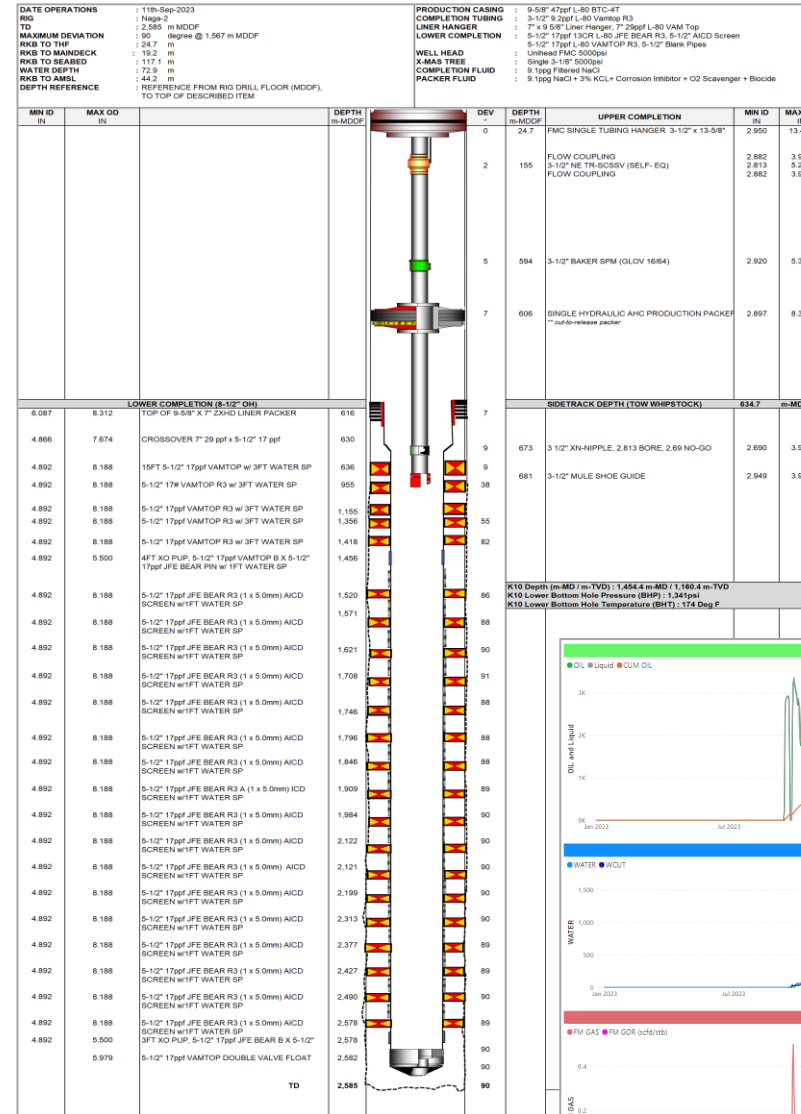
- Well XY was completed in 2023 as Side Track #3.
- The gas lift/orifice depth is relatively shallow (<600 m MDDF) due to shallow sidetrack design during infill drilling.
- Initially, the well produced over 3,000 bpd of liquids with zero water cut after full unloading.
- Pre DGL installation:
  - Oil Rate: ~ 440 bpd /Liquid Rate: ~2000 bpd
  - Water Cut: 78%

## Objective:

- To deepen GL injection past EOT (681 m MDDF) for better production rate.

## Challenges:

- Injection string selection to offset frictional pressure loss of deeper GL.
- Cost effective solution to deepen the gas lift.
- Minimize POB.
- Short time frame for completion of work in Q4 2025 before monsoon season.





# RDGL Concept

## Deepening Gas Lift (DGL)

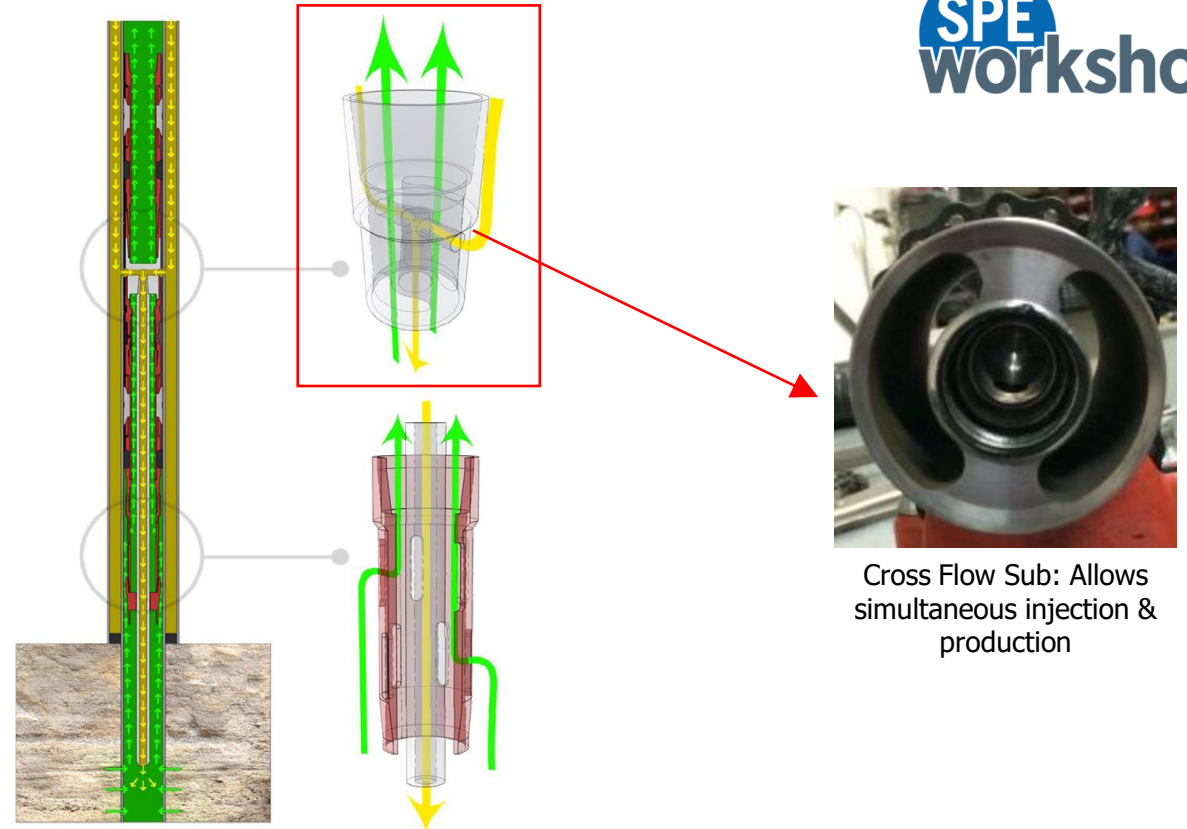
- system through a crossflow sub allows gas injection deeper in the well without a full workover, by redirecting gas from the annulus into the tubing at a deeper point.

## Injection Flow Path

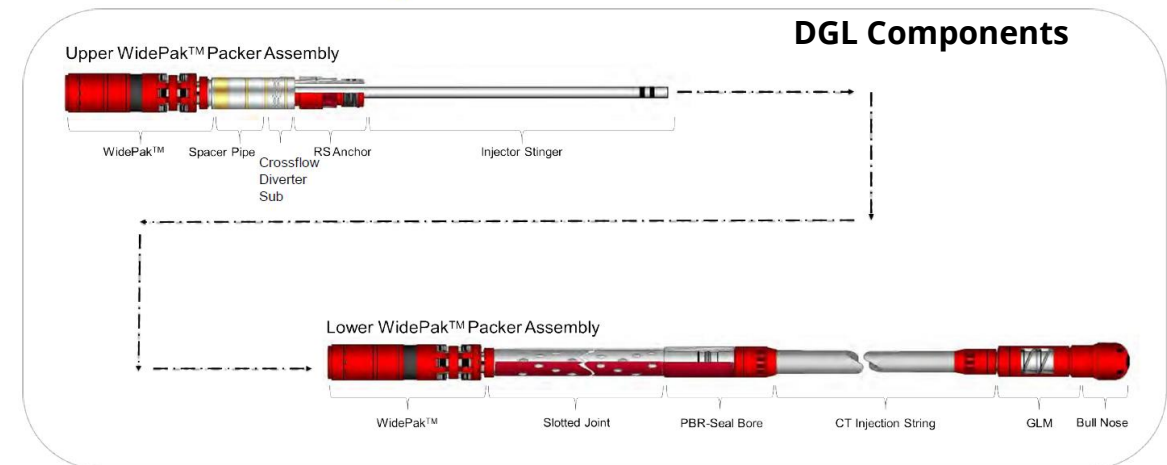
- Inject gas down casing annulus
- GL enters Straddle via SPM
- Into annular ports on cross flow sub & down stinger tube & injection string – CT or small pipe

## Production Flow Path

- Production via injection string annulus
- Into straddle via slotted pup joints
- Up to cross flow sub via stinger tube / straddle annulus
- Through cross flow sub to surface via upper packer and existing completion



Cross Flow Sub: Allows simultaneous injection & production



DGL Components

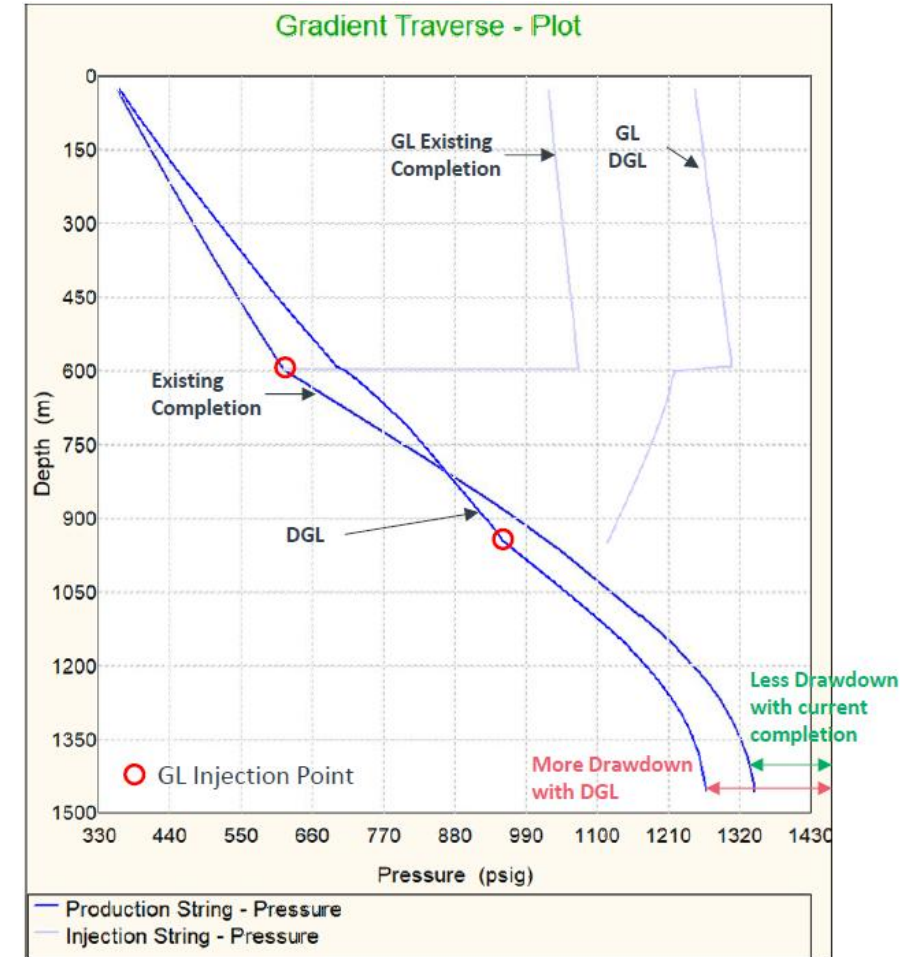


# Nodal Analysis

- FTHP: 360 psi
- Wcut: 74%
- GOR: 250 scf/stb

Nodal analysis showed the ability to deepen gas lift injection outweighs the frictional pressure loss and result in higher drawdown and oil gain.

Case	Optimum GL Inj Depth, m MD	GL Rate, mmscf/d	Liquid Rate, bbl/d	Inst. Oil Gain, bbl/d
Case 1: Current Completion	594	1.3	2084	-
Case 2: DGL with 1.9" Pipe (ID: 1.5)	950	1.3	3037	~200





# Solution and Deployment Method

## Solution

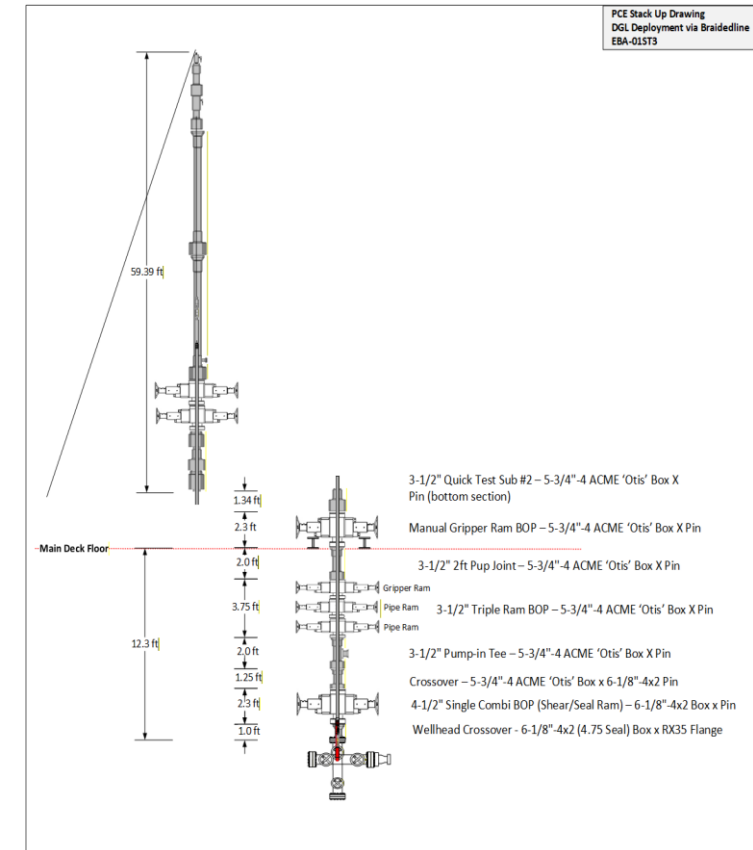
- Deepening Gas Lift System with 1.90" 3.65ppf NUE R2 Tubing.
- Customized Deployment BOP, Shear Seal BOP, Manual Gripper.
- Braided Line Package c/w Dual Drum Unit (7/32" Wire/0.125" Wire) with 80ft Wireline Mast.

## Phase 1 Scope of Work: Slickline (Completed 2 weeks prior BL ops)

- Scope involved tubing clearance and depth correlation, Calliper run, GLOV retrieval and casing clearance check run (past EOT till 6m below DGL injection point).

## Phase 2 Scope of Work: Braided Line

Run #	Scope
1	Depth Counter verification with 2.86" drift until TRSCSSV at 154.742m MDDF
2	Tubing Clearance Check (TCC) with 2.80" drift until XN- No Go at 673.194m MDDF
3	Dummy run with 2.725" Fluted No-Go and 3jt 1.90" R2 Blank Pipe until XN-No Go at 673.194m MDDF
4	Depth correlation run with 3" Kick Over Tool until SPM at 594.436m MDDF
5	Deployment of 37jt of 1.90" R2 blank pipe with bottom DGL BHA. Set Bottom Packer (COE) at 597.84m MDDF (3.4m below SPM). <i>Bottom DGL BHA to be deployed in live well condition via Deployment BOP</i>
6	Run 2.78" drift to tag Bottom Packer at 598.11m-MDDF
7	Run upper DGL BHA and set Top Packer at 592m-MDDF (2.4m above SPM)
8	Run 2.78" drift to tag Top Packer at 592m-MDDF





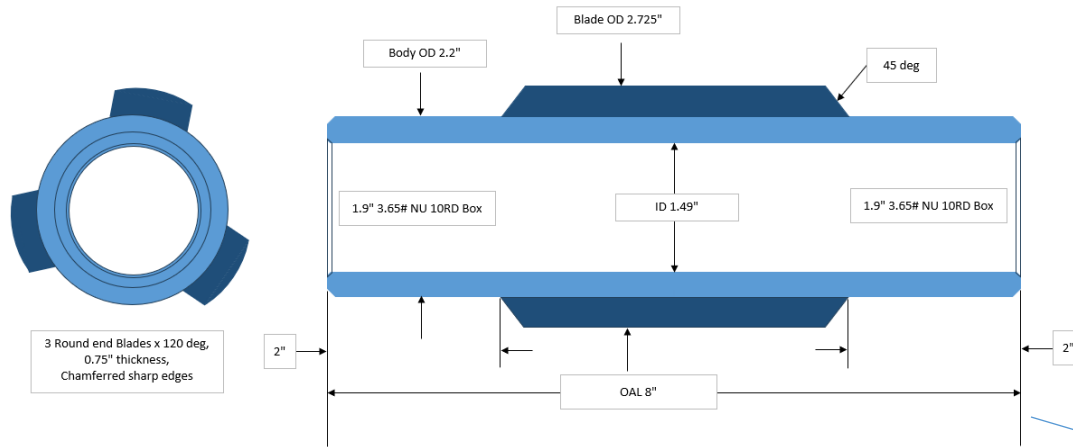
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# Lower DGL BHA Run

- Set 350m (37jts) of 1.90" R2 Blank Pipe + Lower DGL BHA



The 2.725" Fluted No-Go gives assurance of proper packer setting within the limited setting space from the SPM depth (6ft) and to minimize correlation error due to Braided line wire stretch.

BHA (schematic)	Item	Description	OD (in.)	ID (in.)	Length (ft.)	Weight (lbs)	Top Depth (FT)	Bottom (FT)	Top Depth (m)	Bottom (m)	Remark
	1	1-7/8" Rope Socket w/ Integral Swivel Bottom Conn: 1-7/8" QLS Female	1.875	N/A	0.500						
	2	Crossover, QLS to GRJ Top Conn: 1-7/8" QLS Male Bottom Conn: 1-7/8" GRJ Female	1.875	N/A	1.000						
	2	1-7/8" Swivel Joint Top Conn: 1-7/8" QLS Male Bottom Conn: 1-7/8" GRJ Female	1.875	N/A	1.100						
	4	1-7/8" Normal Stem (SR) Top Conn: 1-7/8" GRJ Male Bottom Conn: 1-7/8" GRJ Female	1.875	N/A	8.000						
	5	1-7/8" Knuckle Joint Top Conn: 1-7/8" GRJ Male Bottom Conn: 1-7/8" GRJ Female	1.875	N/A	1.100						
	6	1-7/8" Spang Jar Top Conn: 1-7/8" GRJ Male Bottom Conn: 1-7/8" GRJ Female	1.875	N/A	6.020						
	7	Crossover, GRJ to QLS Top Conn: 1-7/8" GRJ Male Bottom Conn: 1-7/8" QLS Female	1.875	N/A	1.000						
	8	1-7/8" Exit Sub Release Tool Top Conn: 1-7/8" QLS Male Bottom Conn: 1-7/8" QLS Female	1.875	N/A	4.31						
	9	Crossover, QLS to SR Top Conn: 1-7/8" QLS Male Bottom Conn: 1 1/16" SR Box	1.875	N/A	0.500						
	10	Non Explosive Setting Tool Top Conn: 1 1/16" SR Pin	2.125	N/A	4.17	37.4					
	11	Wireline Adapter Kit	2.72	N/A	0.505	8.8					
	12	Lower DGL Packer Top - COE = 2.825 R	2.72	1.81	5.430	33	1960.9	1966.3	567.7	599.3	COE @ 697.84m MDDF
	13	Slotted Joint Top Conn: 2.344" - 10 STUB ACME-3G Pin Bottom Conn: 2.903" - 10 STUB ACME Box	2.375	2.00	1.510	15.4	1966.3	1967.8	599.3	599.8	
	14	Gas Injection Tube PBR Top Conn: 2.063" - 10 STUB ACME Pin Bottom Conn: 2.903" WTS-8 Pin	2.39	1.50	0.750	22	1967.8	1968.6	599.8	600.0	
	15	Quick connect sub Top Conn: 2.063" WTS-8 Box Bottom Conn: 1.9" NUE Pin	2.5	1.00	2.190	6.6	1968.6	1970.8	600.0	600.7	
	16.A	Spacer Pipe (R2) Top Conn: 1.9" NUE Box Bottom Conn: 1.9" NUE Pin	1.9	1.49	219	799	1970.8	2189.6	600.7	607.4	79 x R2 1.90" Spacer Pipe Average 31ft per pipe
	16.B	Spacer Pipe (18ft) Top Conn: 1.9" NUE Box Bottom Conn: 1.9" NUE Pin	1.9	1.49	18	66	2189.6	2207.6	607.4	672.8	
	16.C	Spacer Pipe (12.88ft) + 2.725" Fluted No-Go (0.67ft) Top Conn: 1.9" NUE Box Bottom Conn: 1.9" NUE Pin	1.9	1.49	13	48	2207.6	2220.8	672.8	676.9	NN Hopper at 673.194m MDDF
	16.D	Spacer Pipe (R2) Top Conn: 1.9" NUE Box Bottom Conn: 1.9" NUE Pin	1.9	1.49	306	3308	2220.8	3127.0	676.9	953.1	294 X R2 1.90" Spacer Pipe Average 31ft per spacer
	17	Dual Flapper Check Valve Top Conn: 1.9" NUE Box Bottom Conn: 1.9" NUE Pin	2.2	0.91	1.120	7.7	3127.0	3128.2	953.1	953.4	
	18	Gas 8th Mandrel (PM-1) CW Check valve, orifice (CV-SO) : port size 20/64 Top Conn: 1.9" NUE Box Bottom Conn: 1.9" NUE Box	2.25	1.68	2.680	11	3128.2	3130.7	953.4	954.2	DGL Injection Point
	19	Bull Plug Top Conn: 1.9" NUE Pin	2.2	N/A	0.330	3.3	3130.7	3131.1	954.2	954.3	
					Overall BHA Length (ft.)	1,196.37					Verified by
					Overall BHA Length (m)	365.25					Date

Note: All dimensions are approximate until verified by Weatherford supervisor in the field prior to run in hole.



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# Set Top DGL BHA

- Gas injection tube stung into and seal inside the PBR on the bottom DGL BHA (sting in length – 9.19ft)
- Top packer COE – 592m MDDF

BHA (schematic)	Item	Description	OD (in.)	ID (in.)	Length (ft.)	Weight (lbs)	Top Depth (FT)	Bottom (FT)	Top Depth (m)	Bottom (m)	Remark	
	1	1-7/8" Rope Socket w/ Integral Swivel Bottom Conn: 1-7/8" QLS Female	1.875	N/A	0.500							
	2	Crossover, QLS to GRJ Top Conn: 1-7/8" QLS Male Bottom Conn: 1-7/8" GRJ Female	1.875	N/A	1.000							
	2	1-7/8" Swivel Joint Top Conn: 1-7/8" GRJ Male Bottom Conn: 1-7/8" GRJ Female	1.875	N/A	1.100							
	4	1-7/8" Normal Stem (8ft) Top Conn: 1-7/8" GRJ Male Bottom Conn: 1-7/8" GRJ Female	1.875	N/A	8.000							
	5	1-7/8" Knuckle Joint Top Conn: 1-7/8" GRJ Male Bottom Conn: 1-7/8" GRJ Female	1.875	N/A	1.100							
	6	1-7/8" Spang Jar Top Conn: 1-7/8" GRJ Male Bottom Conn: 1-7/8" GRJ Female	1.875	N/A	6.020							
	7	Crossover, GRJ to QLS Top Conn: 1-7/8" GRJ Male Bottom Conn: 1-7/8" QLS Female	1.875	N/A	1.000							
	8	1-7/8" Exit Sub Release Tool Top Conn: 1-7/8" QLS Male Bottom Conn: 1-7/8" QLS Female	1.875	N/A	4.31							
	9	Crossover, QLS to SR Top Conn: 1-7/8" GRJ Male Bottom Conn: 1 1/16" SR Box	1.875	N/A	0.500							
	10	Non Explosive Setting Tool	2.125	N/A	4.17	37.4						
	11	Wireline Adapter Kit	2.72	N/A	0.997	8.8						
	11	Nipples Packer + 8" Extension 5,000 psi - V3 Set Force: 22,225 lb Release Force: 3,700 lb Bottom Conn: 2.344"-10 STUB ACME-3G Box Top - COE = 2,825 lb	2.72	1.81	3.610	33	1,940.3	1,943.9	591.4	592.5	COE @ 592m MDDF	
	12	Extension Pipe Top Conn: 2.344"-10 STUB ACME-3G Pin Bottom Conn: 2.344"-10 STUB ACME-3G Box	2.375	1.995	5.000	23	1,943.9	1,948.9	592.5	594.0		
	14	Extension Pipe Top Conn: 2.344"-10 STUB ACME-3G Pin Bottom Conn: 2.344"-10 STUB ACME-3G Pin	2.375	1.995	9.000	46	1,948.9	1,957.9	594.0	596.7		
	15	Crossflow Diverter Sub Top Conn: 2.344"-10 STUB ACME-3G Box Bottom Conn: 2.344"-10 STUB ACME-3G Pin	2.7	ported	0.560	4.4	1,957.9	1,958.4	596.7	596.9		
	16	272 Anchor Seal Assembly Top Conn: 2.344"-10 STUB ACME-3G Box Release force: 14,856lbs	2.72	1.74	1.580	11	1,958.4	1,960.0	596.9	597.4		
	17	Gas Injection Tube c/w DFCV CAL: 8.18" 1.5" Bonded Seal Assembly Top Conn: 1.063"-12 STUB ACME-2G Pin	1.64	0.62	9.190	11	(Sting in Length)				Seal inside PBR (Lower BHA)	
							Overall BHA Length (ft.)	57.63				Verified by
							Overall BHA Length (m)	17.57				Date

Note: All dimensions are approximate until verified by Weatherford supervisor in the field prior to run in hole.



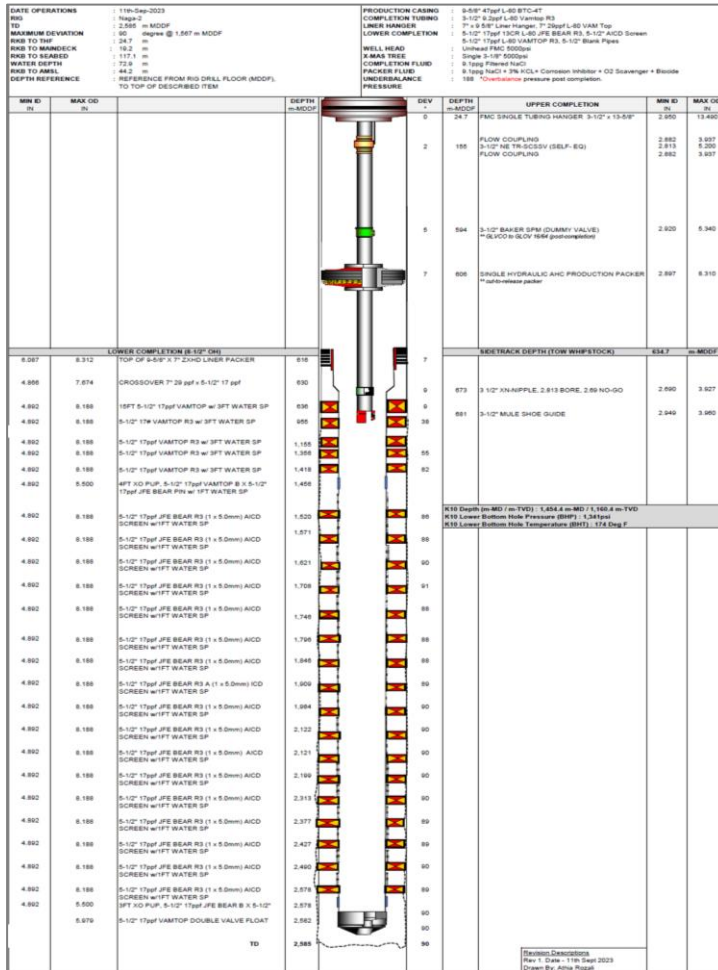
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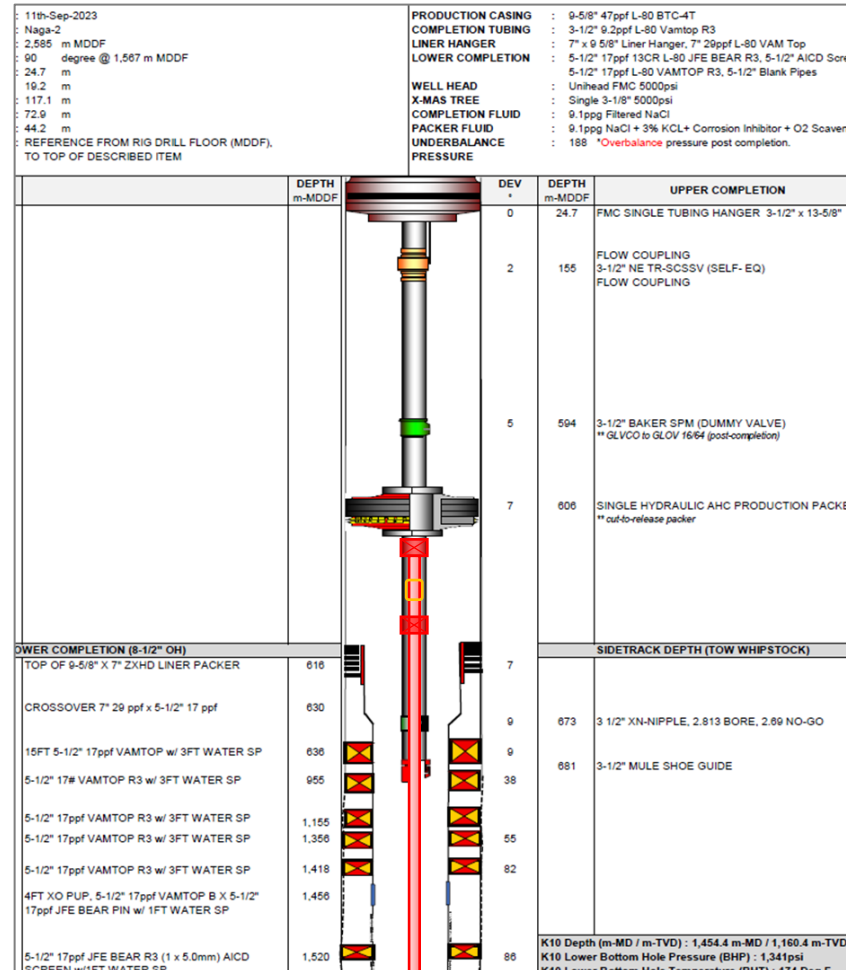


# Well Diagram

## Pre-DGL Installation



## Post-DGL Installation

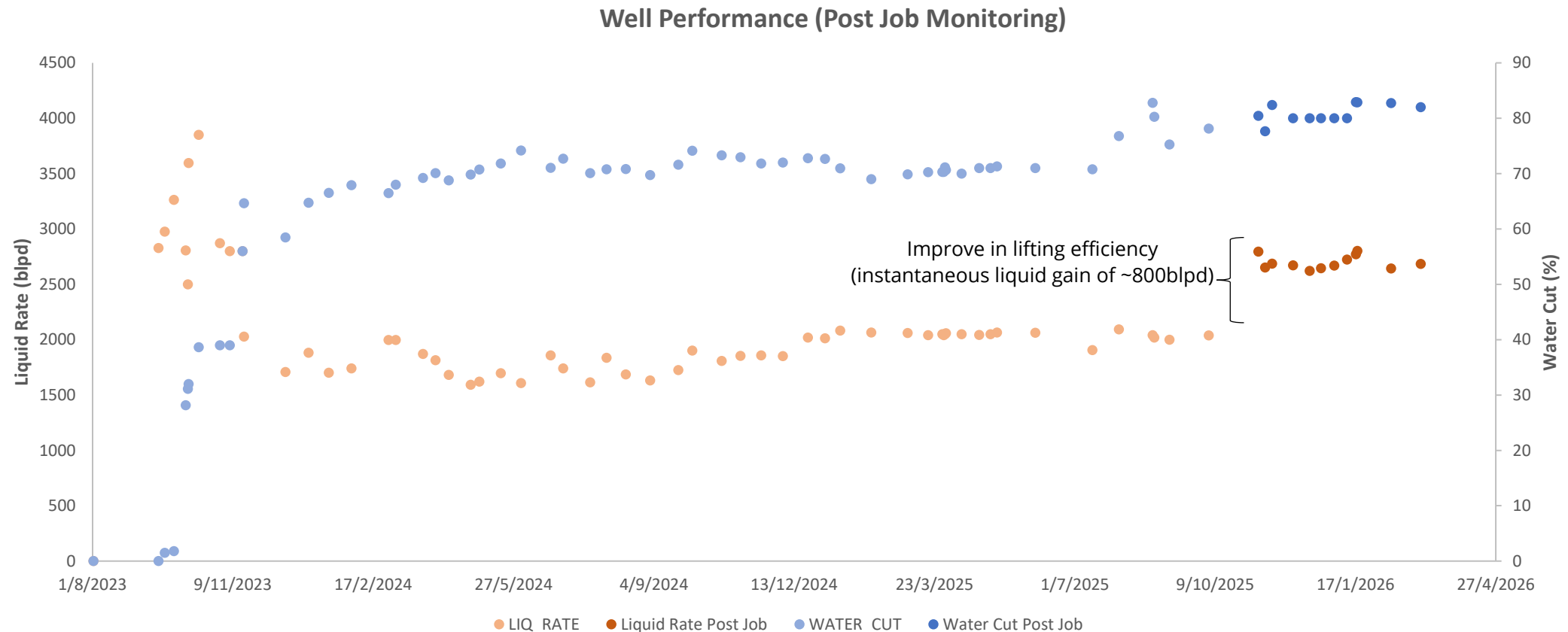


## Final Depth/ Placement

- Bottom packer COE: 597.84m MDDF
- Top packer COE: 592m MDDF
- PM-1 Gas Lift Mandrel: 954m MDDF
- \*Gas lift injection point deepen by 360m
- 1.90" R2 Base pipe used - 350m (37jts)
- Total BHA length - 362.67m

# Post Job Performance

- Successfully sustain oil production under increasing water cut trend.





# Conclusions & Value Creation

## Value Creation

- Successfully demonstrated an unconventional deployment of the DGL system via braided line - **First In The World for jointed pipe via braided line**
- Completed within **6.4 days** (excluding mob and demob).
- Fast track project delivery - **3 months**.
- Up to **70% cost savings** compared to conventional Coiled Tubing deployment while reducing manhours and cutting GHG.
- Optimized the gas lift performance by deepening the gas lift injection by another **~360m**.
- Minimize shut-in time for DGL operation – **5 days**

## Challenges

- Sourcing out equipment in short time frame.
- Encountered adverse weather condition during the DGL deployment, necessitating intermittent suspension of the operation.



**Zero** LTI /  
Injury



**14 Runs**  
Total Slickline &  
Braidedline



**0.3 Day**  
Total Wait on  
Weather



**~150 bopd**  
Instantaneous gain