2024 GAS LIFT WORKSHOP

Gaslift Optimization Strategies for Enhanced Productivity in Ageing Brown Fields.

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The Shell Petroleum Development Company (SPDC)

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Agenda

- Introduction
- Field X Overview
- Painting the Picture
- Production Decline Issue
- Campaign outcome
- Gains from the opportunities
- Lowlights and Learnings
- Recommendation
- Conclusion.
- Q & A

Introduction

- The introduction and optimization of gas lift systems in oil wells is a crucial process to enhance the recovery of hydrocarbons and extend the well life.
- When brown fields and assets in late life are considered within the context of Wells Reservoir and Facility Management (WRFM), the utility of gaslift systems has been proven to be beyond marginal.
- In the Niger Delta, it is not uncommon to find development/producer wells situated in brown fields assets that have produced for more than forty (40) years.
- Over the extensive production life of these wells, the propensity for vertical lift issues associated with higher watercut and/or reservoir pressure depletion increases, and ultimately results in well productivity decline.
- Gas lift is essential in achieving and sustaining improved recovery from mature wells.

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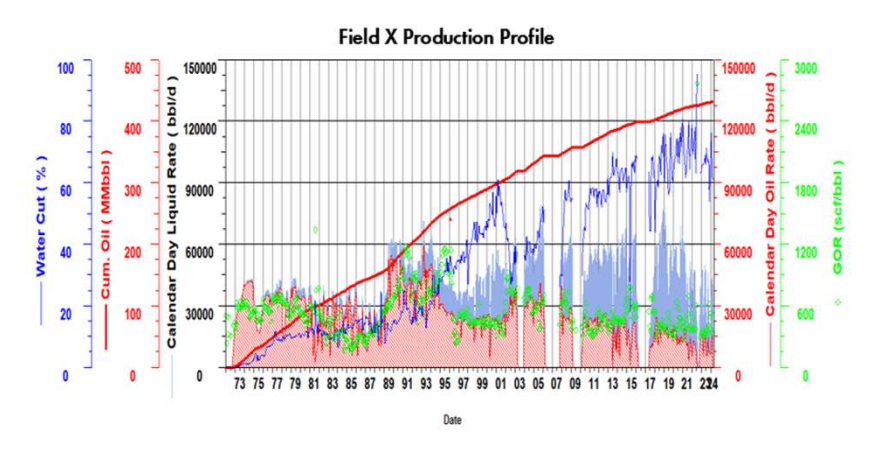
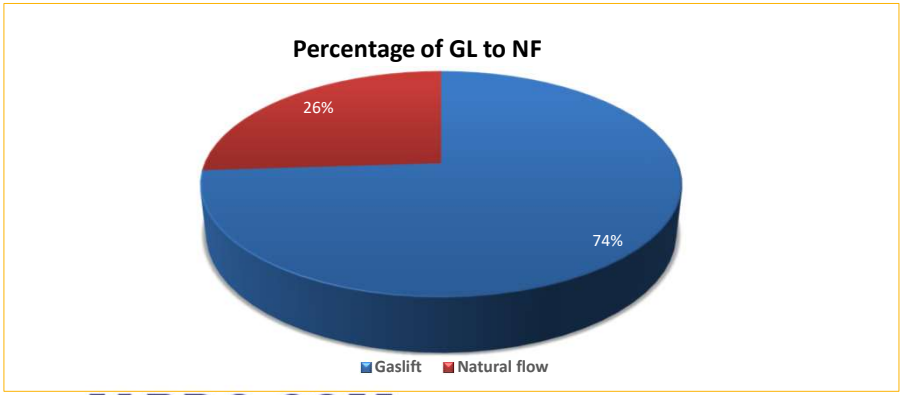
Field X Overview

- Field X, an onshore oil producing asset situated in the Niger Delta was discovered in the 1960's.
- The Field Development Plan established the need for artificial lift in Field X, and gas lift was selected as the preferred artificial lift method for all the wells.
- Oil production commenced in the early 1970's.
- 57 wells were drilled and completed in this field.
- It has produced a total of about 430 MMstb of oil since it came onstream with peak production of 55 kbbl/d in 1993.
- Over the years, oil production has declined with increasing watercut.
- Gas lift has been essential in improving recovery from this field.





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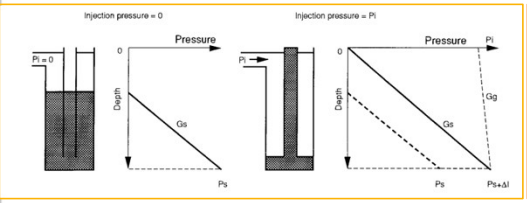
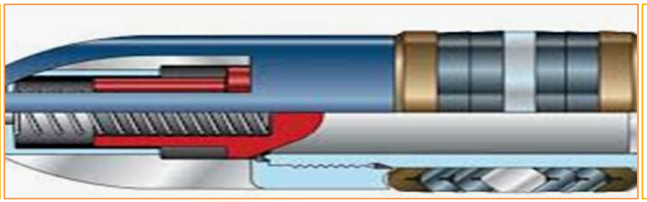
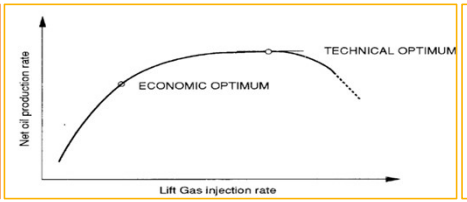
Painting the Picture

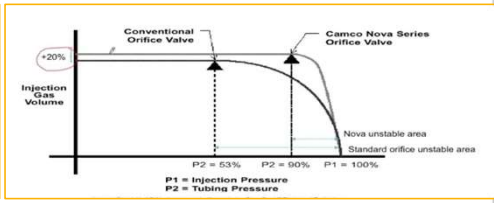
- 64% percent of the total production comes from gas lifted wells, so gas lift optimization is a major focus area.
- Routine surveillance identified that 8 wells were producing below potential: 5 wells are gas lifted, and 3 wells are naturally flowing.
- After detailed integrated subsurface review of the production performance of these wells, the following issues were highlighted as responsible for sub-optimal production:
    - Lift Gas sharing issues
    - Gas Cycling
    - Liquid loading.

The value driver for this campaign is to improve oil production in the short term by providing the ability to kick off wells on gas lift and to optimize production from existing gas lifted wells.









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Well 1S Production Issues: Lift Gas sharing & cycling

Background:

- Well 1 is a dual string oil producer, with both strings on gaslift.
- The Short string (X1S) has been producing sub-optimally due to lift gas sharing issues.
- The orifice is currently on the first mandrel (1751ftah), and this was based on the early to mid-life gas lift design.

Surveillance & Findings:

- The gas lift cycling suggests that the orifice valve depth is shallower than the fluid level in the tubing.
- Confirmed fluid level in tubing (2321ftah) during the 2020 Static Gradient Survey and concluded that the injection depth is sub-optimal.

Optimization Opportunity:

- Lower the orifice depth to achieve deeper gas lift and install venturi orifice valve.
- Replace dummy valves with gas lift valves for unloading.

Standard Orifice | Venturi Orifice

The venturi valve flow regime virtually eliminates any effect of tubing pressure on the gas injection rate and stabilizes the gas injection pressure. Venturi valves achieve critical flow with a pressure drop of 10% or less, while conventional orifice valves require an approximately 40% pressure drop.

N/B: ftah- feet along hole depth

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Well 2 Production Issues: Gas cycling

Background:

- Observed gas cycling in September 2019 and has been producing intermittently since then.
- The orifice is currently on the 1st mandrel, and this was based on the early to mid-life gas lift design of the conduit.

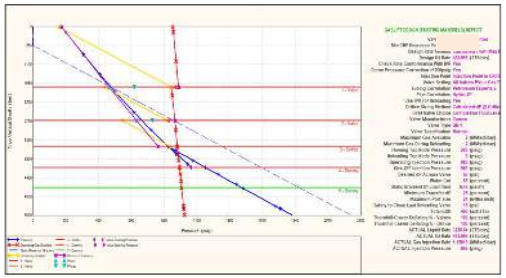
Surveillance & Findings:

- The gas lift cycling suggests that the orifice valve depth is shallower than the fluid level in the tubing.

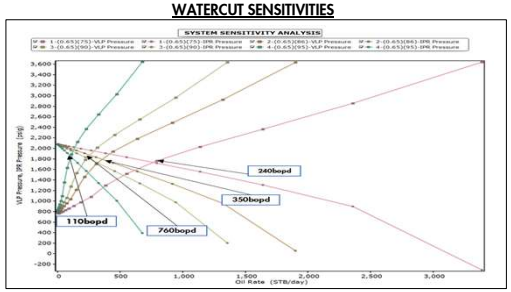
Optimization Opportunity:

- Lower the orifice depth to achieve deeper gas lift.
- Replace dummy valves with gas lift valves for unloading.
- Re-establish continuous rather than intermittent production from this well.

GASLIFT DESIGN



WATERCUT SENSITIVITIES

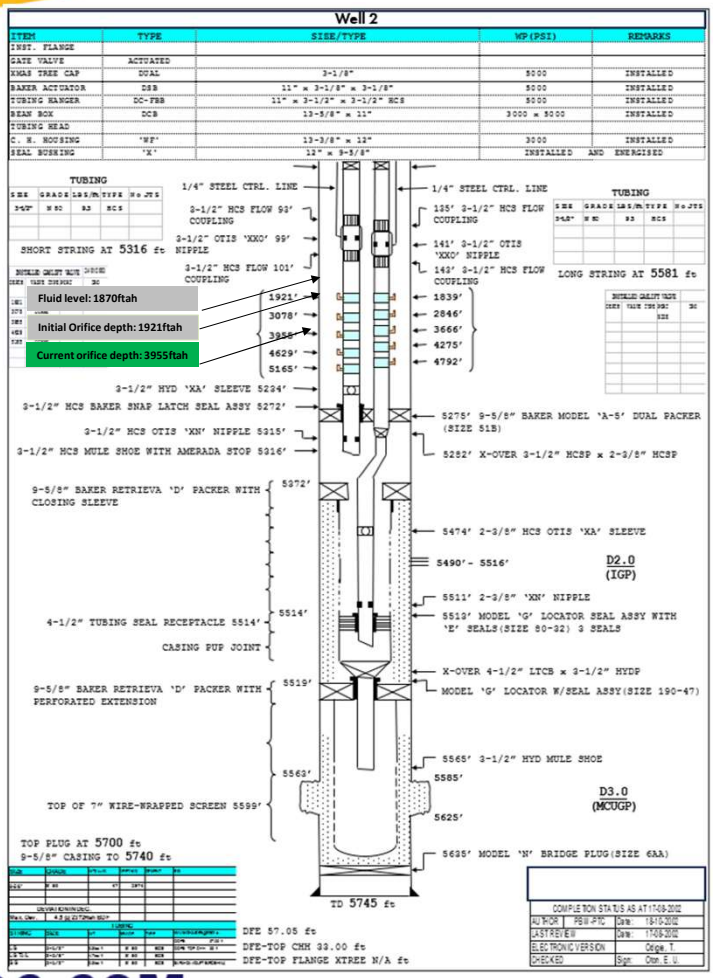


INITIAL GLV DESIGN PARAMETERS

No.	Depth (ftah)	Valve Type	Port size (/64")	TRO (psi)
1	1921	Orifice	N/A	N/A
2	3078	Dummy	N/A	N/A
3	3955	Dummy	N/A	N/A
4	4629	Dummy	N/A	N/A
5	5165	Dummy	N/A	N/A

NEW GLV DESIGN PARAMETERS

No.	Depth (ftah)	Valve Type	Port size (/64")	TRO (psi)	PVo (psi)	PVc (psi)
1	1921	Valve	8	825	941	919
2	3078	Valve	16	880	916	865
3	3955	Orifice	22	N/A	N/A	N/A
4	4629	Dummy	N/A	N/A	N/A	N/A
5	5165	Dummy	N/A	N/A	N/A	N/A



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Well 3 Production Issues: Intermittent Productivity

Background:

- Well 3 was single string completion producing on natural flow.
- The inability of this well to sustain flow is due to prevailing liquid loading (TVD >4000ft, and high BSW).

Surveillance & Findings:

- Nodal analysis indicated that production could be sustained and optimized through gas lift injection.

Optimization Opportunity:

- Lay gas lift line to Well 3.
- Install gas lift valves in existing mandrels.
- Establish continuous gas lift and return well to continuous production.

Field X gaslift Skid

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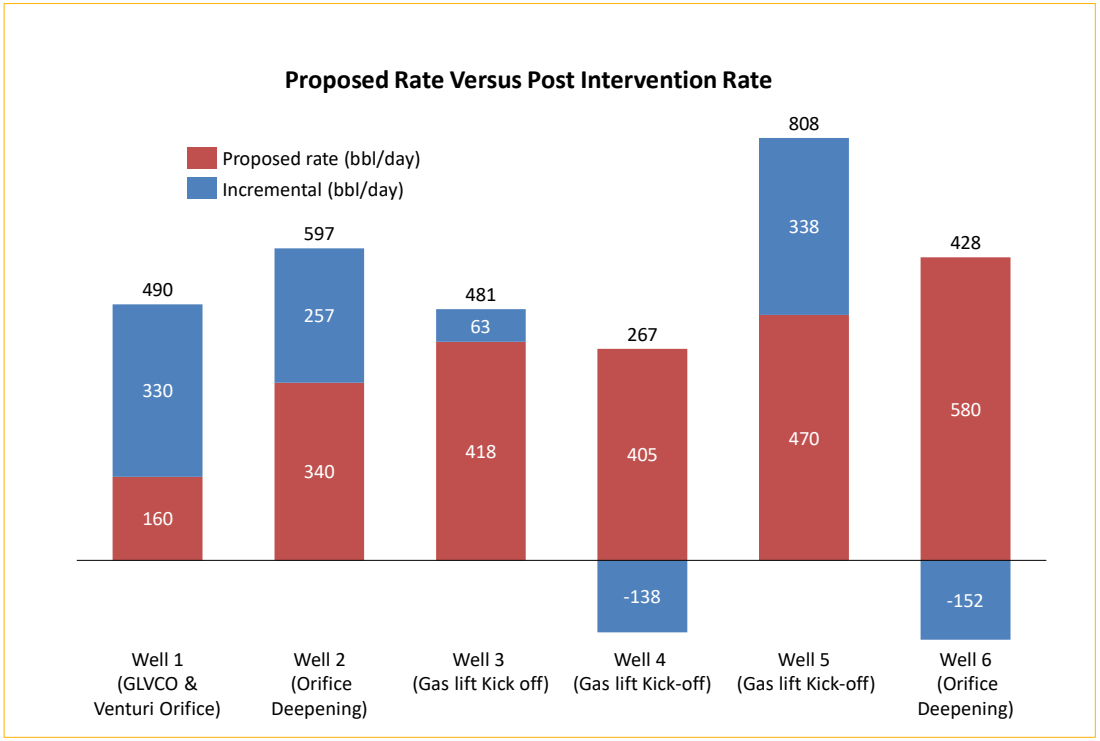
Gas lift Optimization Outcome



Summary of Results

- Well 1: Significant oil gain realized from lowering lift point and installing venturi orifice valve.
- Well 2: Significant oil gain realized from lowering lift point.
- Well 3: Slight increase in oil gain realized from gas lift kick off.
- Well 4: Gas lift kick-off was unsuccessful, hence proposed production was not met because of sand issues. ***Discussed further in slide 11.***
- Well 5: Significant oil gain realized from hooking up well to gas lift.
- Well 6: is producing lower than planned. Well constrained with a choke to flow within ambient valve's operating pressure.

Lowlights & Recovery Plan

Lowlights:

- Well 4 unsuccessful gaslift kick off:
  - Whilst retrieving the dummy from one of the mandrels, sand entered the well resulting in a HUD at 4632ftah.
  - Sand bailout operation was carried out for a while before the GLVCO intervention was eventually done.
  - Attempt to do so has been unsuccessful due to the sand issues.
  - The well is still flowing on natural flow on a much lower rate.
- Delayed startup of gas lift optimization candidates due to line pipe availability challenges & compressor constraints.

Recovery Plan:

- Carry out further troubleshooting on Well 4 and kick off on gas lift.
- Carry out drift run in the well to confirm the wellbore is free of any restriction.
- Repair/ replace Field X gas lift compressor to improve availability and sustain production.

Recommendations & Conclusion

- Gas lift installations and optimizations such as deepening the depth of injection and installation of venturi orifice for dual string producers have improved the performance of wells enhanced production in Field X.
- It is recommended to use venturi orifice valves to minimize interference between dual string gas lifted completions by eliminating the effect of tubing pressure on the gas injection rate and stabilizing the gas injection pressure.

Acknowledgement

- I acknowledge my Asset Manager, Dipo Ashafa, My PT TA1, Ufuoma Oghene, My Team Lead Faye de Haas and Steve Freeman for all the support and sponsorship.
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Onyinye Ekerenduh has worked in SPDC for 10 years across swamp, land and shallow water assets teams. She is a Seasoned Petroleum Engineer with award winning WRFM experience maximizing value from brownfield assets by continuous improvement, adopting learner's mindset for the optimization of the Wells, Reservoirs, and Facilities for exceptional performance, laser focus on effective well integrity management, adding reserves and enhancing production safely.

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Question Time

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