ENHANCING PRODUCTION PERFORMANCE OF DUAL COMPLETION GAS LIFTED WELLS USING NOVA VENTURI ORIFICE VALVE

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PRESENTATION OUTLINE

- Introduction
  - Business Opportunity/Challenge
- NOVA Venturi vs Conventional Orifice
- Field Production Performance
  - System and Field Challenges
- Candidate Screening Workflow
- Field Trial
- Results
- Conclusion
About 70% of SPDC Gas lift Wells are duals equipped with conventional orifice valves.

- Gas sharing
- Inability to produce both arms of dual concurrently.
- Optimisation challenges and observed well instability.
- Deferred production approximately 9000 bopd
Nova Orifice

- Requires 10% pressure drop across orifice to achieve critical flow
- Effect of variations in tubing flow regime on is negligible

Conventional Orifice

- Requires > 40% pressure drop across orifice to achieve critical flow
- Slight variations in tubing flow regime result in unsteady injection, instability and slugging
- Turbulent flow creating pressure losses
- Large sub critical flow regime
- Gas passage is dependent on downstream pressure (40-50%)
NOVA ORIFICE VENTURI GAS LIFT VALVES

- Replace conventional orifice
- Same number of moving parts as conventional orifice
- Exclusive computer generated flow profile
- Promotes a constant-flow gas injection rate
- Allows maximum gas passage with minimal differential across the Venturi.
- Compatible with the BK and R Series latches and will fit in any existing K or M Series side pocket mandrel.
NOVA ORIFICE VENTURI - BENEFITS

- Minimizes injected gas
- Increases well stability by allowing injection gas at critical flow velocities
- Maintains constant injection rate with constant injection pressure
- Maintains the deepest point of injection
- Excellent application in dual gas lift installation
SYSTEM AND FIELD CHALLENGES

- Lift Gas Metering
- Frequent compressor trips
- Inability to produce both arms of dual concurrently
- Well slugging
- Gas cycling
- Intermittent production
Data Acquisition
Critical data: THP, CHP, Well test data

Establish Instability
Fluctuation: THP, CHP, Liquid rate, lift gas rate, CHP, Well test data

Analyze cause of instability
Poor Design, Over sized orifice, over injection

STEP 1
Data Acquisition
Critical data: THP, CHP, Well test data

STEP 2
Establish Instability
Fluctuation: THP, CHP, Liquid rate, lift gas rate, CHP, Well test data

STEP 3
Analyze cause of instability
Poor Design, Over sized orifice, over injection

STEP 4
Gas lift Design – Nova
Preliminary design using existing FG and Pressure

STEP 5
Gas lift Design – Nova
Preliminary design using existing FG and Pressure

STEP 6
Field Execution
1. Acquire new FG/BHP
2. Optimize design
3. Carryout GLVCO

Establish Subcritical flow
Pt/Pc 0.6 - 0.9

CANDIDATE SCREENING WORKFLOW
June. 17 - 18, 2014
2014 EuALF
- Well was reported to have lift gas sharing issues.
- Both strings could not produce concurrently.
- Long string was produced preferential to the short string.
- Selected for NOVA pilot trial.
- Post nodal analysis and redesign, the Orifice depth for the long string was optimized from 4577 to 3626 ft. along hole.
- The orifice depth on the short string was optimized from 4107 to 3597 ft. along hole.
WELL 0001S PERFORMANCE - PRE AND POST NOVA DEPLOYMENT

Pre NOVA Installation

Post NOVA Installation
## RESULTS – WELL TEST

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<th>Date</th>
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<th>WC (%)</th>
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RESULTS – WELL 0001S

PRODUCTION PROFILE

Pre NOVATM installation  Post NOVATM installation

Cumulative Oil Produced (Mbbl)

Gas / Oil Ratio (Mcf/bbl)

Water Cut (%)

Time (Year)

OBGN008S:C9400A

Pre NOVA™ installation

Post NOVA™ installation

June. 17 - 18, 2014

2014 EuALF
KEY LEARNING AND RECOMMENDATIONS

- Instability can be caused by:
  - Poor gas lift design
  - Suboptimal lift gas injection
  - Low injection pressures
- Nova Venturi orifice valve can stabilize production
- Careful candidate screening is essential
- Venturi orifice must be sized for optimal lift gas injection
- Monitor THP and CHP trends to identify instability
CONCLUSION/GO FORWARD PLANS

- Nova orifice valve stabilized well production
- Venturi installation improved the efficiency of all 4 pilot wells
- About 700 bopd gain was recorded and sustained
- Standardise on Nova Venturi orifice
- Roll out in other fields.
Reserves: Our use of the term "reserves" in this presentation means SEC proved oil and gas reserves.

Resources: Our use of the term "resources" in this presentation includes quantities of oil and gas not yet classified as SEC proved oil and gas reserves. Resources are consistent with the Society of Petroleum Engineers 2P and 2C definitions.

Organic: Our use of the term Organic includes SEC proved oil and gas reserves excluding changes resulting from acquisitions, divestments and year-average pricing impact.

Resources plays: our use of the term ‘resources plays' refers to tight, shale and coal bed methane oil and gas acreage.

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June 2014
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