Maximize Efficiency of Coiled Tubing-Conveyed Perforation with Advanced Gun Deployment System and Real-Time Correlation in High-H2S/High-Pressure Wells

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OUTLINE

• Introduction
• Project challenges
• Appraisal
• Technology implementation
• Developed project approach
• Case study
• Conclusion
INTRODUCTION

- Oilfield located in Kazakhstan, Caspian basin
- Estimated Recoverable reserves 13 Bbls oil
- Worlds biggest oil discovery since 1968
- Project scope:
  - CT conveyed well perforation
  - Gun Deployment system
  - Commissioning – 14+3 wells
  - Handle possible H2S on surface
PROJECT CHALLENGES

• Reservoir Conditions
  - Hostile reservoir conditions: HP and Ultra High H2S 15-20%
  - NO fluid influx, H2S release or Well Flow allowed
  - BHP – above 10000 psi, WHP – 7500 psi

• Environment
  - Ambient Temperature vary –40 °C to +50 °C
  - Ultra shallow water, ice blocked in winter season,
  - 150 km remote from onshore, sensitive eco-system

• Unique Technology Requirements
  - 15K 5.125” H2S rated Surface equipment
  - Customized H2S rated perforation system
  - Emergency redundant downhole disconnection system
APPRAISAL

• Comprehensive risk analysis
  - High H2S concentration
  - Well Integrity, double barrier requirement
  - Chrome completion
  - Well depth and tortuosity
  - Well fluid influx and no-flow policy

• Technology challenges
  - Gun conveyance method analysis
  - Tool string selection and survivability after detonation
  - Precise real time depth control
  - Potential H2S handling at surface
  - Corrosion prevention and mitigation plan
  - Fishing contingencies
  - PCE configuration for perforation

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TECHNOLOGY IMPLEMENTATION

• Electric line enabled CT system
  - Electric line injected in CT
  - GR/CCL real time readings
  - Tension/Compression readings optional
  - Electrical disconnect device
  - Electrical detonator initiation

• Gun deployment system
  - New design H2S rated 5-1/8” 15000 psi deployment stack
  - H2S rated set of aligning connectors, swivels, adaptors for guns

• Perforation Tool string
  - Redundant disconnect system: electrical and mechanical
  - Shock resistant H2S-rated CT logging head
  - H2S-rated Shock absorbers
  - Rounded scallop HP guns, orienting featured
TECHNOLOGY IMPLEMENTATION - CONTINUE

• Advanced gun deployment system
  - Remotely connects / disconnect perforation connectors
  - Hold gun string weight
  - Able to work under pressure
  - 3 components connector: lock sleeve / slick joint / stinger
  - Sealed ballistic transfer
  - Set of aux components: retrieval / deployment ballistic / flow through
DEVELOPED PROJECT APPROACH

- PCE configuration design
  - Tailored for conveyance guns in double and trebles
  - Designed for 3 different rig and 2 rigless interventions
  - Fully compatible for all fishing scenarios
  - All contingency safety precautions included
  - New approach to “in scale” PCE space out design
TECHNICAL APPROACH - CONTINUE

CT software and hardware design
- CT force analysis
- CT logging head equipment selection
- WL cable and logging/perforation equipment selection

Perforation software and hardware design
- Dynamic underbalance effect and shock load
- Gun loading diagram design
- Gun OD, phasing, shot density, charges

Multi-service hardware design
- Working envelope vs shock load
- Shock absorbers and weak points set up
- Perforation fast gauge set up

CT, WL and perforation post-run data analysis
- CT Force analysis correction for upcoming runs
- Perforation fast gauge data analysis and shock simulation
- Tool string condition after POOH
CASE STUDY

• Well generic description
  – Oil producer
  – Carbonate formation
  – Chrome completion
  – Long deviated section
  – BHP above 11000 psi

• Perforation objectives
  – Dead well deployment of gun (17-20) string with CT
  – Convey to perforation interval (squeeze mode)
  – GR/CCL correlation
  – Overbalance perforation with DUB effect
  – POOH with maintained pressure
CASE STUDY - CONTINUE

• Acquisition job data analysis
  – Weight stability
  – Applied pressure during RIH/POOH
  – Speed limitations vs completion jewelry
  – Tool string gained weight after perforation
  – Cumulative metal fatigue and abrasion of CT

• CT post-run force analysis
  – Compared predicted and actual weigh readings
  – Adjustment of friction coefficients
  – Friction reducers / well fluid / CT pressure values
  – Upcoming runs simulations adjustment
CASE STUDY - CONTINUE

- Shock Analysis Correlation
  - Recover recorded pressure data
  - Compare Pressure during DUB
  - Adjust pressure and shock load simulation
  - Adjustment of upcoming runs

- Detonation Indication Verification
  - Pressure monitoring at surface and downhole
  - CT weight indicator readings
  - WL signal after detonator initiation
  - Physical impact and CT movement at surface
CONCLUSION

• Seamless integration of e-line-enabled CT perforation method with the advanced gun deployment system
• Perforation in controlled way with well integrity and influx management under anticipated operational parameters
• Reliability of electrical and mechanical disconnect combination in one tool string
• Service quality through developed design and execution systematic approach
• Proven solution for high H2S / high pressure environment
Thank you!

Questions?

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