GAS LIFT DESIGN & PRODUCTION OPTIMISATION Course

Detailed Course Contents

Monday (Gas Lift Design A)

Morning (08:30 – 12:30)

Introductions – venue / instructor / attendees / course overview

1. Introduction to Gas Lift
    a. How Gas Lift Works
        i. Basic System Components
        ii. Basic Gas Lift Equipment
        iii. The unloading process
        iv. Continuous operation
        v. Production performance variability
        vi. Comparison with other artificial lift technologies
    b. Valve Opening Equations
    c. Production Pressure Effect and R values
    d. Valve Closing Equations
    e. Spread

2. Working with Gas
    a. Using PROSPER, build a model of a gas lift gas supply line for a subsea well and use this to examine PVT relationships for gas and their impact on flow line pressure loss
        i. Derivation of Gas Deviation Factor using compositional analysis, charts and pseudo reduced pressures & temperatures vs. PROSPER PVT module

Afternoon (13:30 – 17:30)

3. Conceptual Gas Lift Design
    a. Well Performance Modelling
        a. Open a pre-built natural flow oil well PROSPER model and use this to examine the impact of gas lift.
        b. Phase Behaviour of Hydrocarbon Fluids
            i. General Description of Black Oil, Dry Gas, Condensate etc.
            ii. Black Oil Models
                1. use of Standing Charts to get PVT parameters
                2. tuning of standard PVT correlations to match lab data
                3. importance of viscosity data at lower temperatures
            iii. Selection of the right PVT parameters for well performance modelling (single flash vs. differential vs. multi-stage separator tests)
            iv. Importance of correct water gravity
            v. Difference between separator gas and gas lift gas PVT properties
        c. Examine life of well the natural flow production performance using:
            a. Sensitivity to Reservoir Pressure
            b. Sensitivity to Water Cut
        d. Examine impact of Gas Lift
            i. Gas Lift Input Data
                a. Gas Gravity

   b. Fixed Depth of Injection
   c. Optimal Depth of Injection
      i. Gas Gravity
      ii. Casing Pressure
      iii. DP across valve
   d. Valve depths specified
   e. Safety Equipment
ii. Output Data Sensitivity Analysis (Life of Well Issues)
   a. Optimal Gas Injection Rate
   b. Max Depth & Range of Depths of Injection achievable in different circumstances
   c. Casing Pressure required for stable max depth of injection.

Tuesday (Gas Lift Design B)

Morning (08:30 – 12:30)

1. Detailed Gas Lift Design
   a. 3 Basic rules
      i. Never risk being unable to unload from the top mandrel
      ii. You only have one opportunity to space mandrels
      iii. Operation pressures rarely match design pressures
   b. Overview of alternative Design techniques
      i. Brief Review of Design Literature.
      ii. API Documents
         1. Spec 11V1; RPs 11V2,5,6,7 & 8
         2. API Vocational Training Manual
      iii. "Technology of Artificial Lift" by Kermit Brown
      iv. SPE Petroleum Engineer's Handbook
2. Step by Step Graphical Design
   a. Gathering the required data
      i. Tubing Head Pressure – is it fixed?
      ii. Casing Head Pressure – what value?
      iii. Gas Lift Gas Gravity
      iv. Gas Lift Gas Injection gradient
      v. Load Fluid Gradient
      vi. Shut-in Reservoir Pressure
      vii. Production Pressure gradient –which one?
      viii. Temperature gradients
      ix. Design Safety Factors
   b. Progress the Design
      i. Determine Mandrel Depth
      ii. Size the valve port
      iii. Set the dome pressure
      iv. Set the TRO pressure
      v. Determine the next mandrel depth etc.

3. Compare Graphical Design with Software Design
   a. Using Conceptual Design well model, progress to Detailed Gas Lift Design within PROSPER
   b. Examine PROSPER Valve Design Options
   c. Complete valve specification and compare with hand calculations
   d. Examine sensitivity of the design to changed production conditions using "Quicklook for Gaslift" within PROSPER.

e. Enter Graphical Design output into PROSPER, and examine sensitivity of the design to changed production conditions using "Quicklook for Gaslift" within PROSPER.

Afternoon (13:30 – 17:30)

4. Gas Lift Optimisation & Troubleshooting
    a. Production Monitoring
        i. Network & Subsea Gas Lift Well Optimisation
        ii. Gas Injection distribution system pressure losses
        iii. Common flowline pressure losses (Tree pressure not fixed)
        iv. Well Testing
    b. Flowing Gradient Surveys
        i. Simultaneous Well Testing
        ii. "Anti-blowup" gradient survey tools
    b. Troubleshooting case study
    c. Distributed Temperature Sensing
    c. Tubing & Annulus PDHG

5. Gas Lift Well Integrity & Alternative Gas Lift Equipment
    a. Casing Design
        i. ID
        ii. Thread seal
        iii. Collapse rating & wear down-rating
        iv. Top of cement
    b. Wellhead Design
        i. Casing & Tubing Hanger thread and seal
        ii. Gas lift point of entry & ESD valve location
    c. Tubing Equipment
        i. Basic Equipment
            1. Valve (Injection pressure operated)
            2. Mandrel
            3. Kick-over tools
            4. Annular Safety Valve / VR plug valves
        ii. Optional Equipment
            1. Alternative Valve types & purposes
                a. Alternative configurations
                b. Spring valves
                c. High Pressure Valves
                d. Electric Valves
            2. Equalising dummies
            3. Annulus Pressure PDHG / DTS
    d. Retro-fit Gas lift equipment
        i. Punched holes
        ii. Straddle arrangements
    e. Construction Monitoring
        i. Well Integrity Management
        ii. MAASP
        iii. Modern Echometer technology

END OF COURSE