Training Agenda (5 days):

Artificial Lift Systems Modelling, Diagnosis and Optimisation

(using Prosper & GAP)

Date: *Location:*

Day 1 : Well systems overview

Introduction to integrated field modelling; interactions and dependencies

Fundamental concepts behind pressure loss in the wellbore
- gravity, friction and acceleration terms; slip and holdup, flow regimes, key parameters
- theory and use of multiphase flow correlations; selection recommendations
- practical applications in data measurement and validation; effect of viscosity and emulsions

Fluid characterisation methods
- oil composition; calculation of density and other fluid properties
- black oil correlations and compositional equations of state
- matching and validation techniques for oils (heavy, biodegraded, volatile)

Practical workshop session; introduction to commercial software (*Prosper*)
- building a naturally flowing well model; defining wellbore, fluid and inflow characteristics
- PVT matching; review and selection of available flow correlations
- validation and diagnosis of well performance

Day 2 : Inflow performance and introduction to artificial lift methods

Inflow performance modelling
- introduction and key concepts
- Vogel, Darcy, multi-layer, horizontal, fractured models etc.
- theory of skin and applications (vertical, deviated, partial penetration, damage)

Practical workshop session; inflow performance modelling and full system prediction
- building and matching inflow models; running sensitivities
- skin analysis and diagnosis; matching to production logs (PLT) and flowing gradient surveys
- combining with vertical lift performance curve to run system sensitivities (nodal analysis)

Introduction to artificial lift theory and concepts
- comparison and selection criteria; advantages and disadvantages of each method
- gas lift equipment, design procedure, key sensitivities, gas-lift performance curves
- ESP equipment and applications; design procedure, key sensitivities, using pump performance curves

Day 3 : Gas lift diagnosis and troubleshooting

Gas lift design and operation
- introduction, concepts and theory, equipment operation (valves, mandrels etc.)
- generation of multiphase flow pressure gradients; objective gradient
- design procedure, key sensitivities, gas lift performance curves

Practical workshop session; gas-lift well modelling and design
- building a gas-lift well model; key assumptions and data required
- matching flow correlations and inflow performance assumptions with test data
- design of gas-lift equipment

Gas lift diagnosis and troubleshooting
- diagnostic techniques, use of gradient traverse plot, troubleshooting
- field use of gas-lift surface performance curves and individual well optimisation
- effect of tubing head pressure, gas-injection rate (iGLR), casing head pressure
- generation of 4-variable lift curves for reservoir simulators

Practical workshop session; gas-lift diagnosis and troubleshooting
- analysing gas-lift systems with real field well data; data gathering and validation
- flowing gradient survey interpretation and matching
- determination of injection depth, orifice pressure drop etc.
- diagnosis of existing well problems and issues; recommendations for optimisation

…continued

Day 4 : ESP equipment, operations and troubleshooting

ESP theory, equipment, operations and design
- ESP equipment and applications; head generation and dependencies, impeller types and characteristics
- practical use of pump performance curves, conversion of head to pressure; use of gradient traverse plots
- consideration of gas, sand, high viscosity oils and emulsions on ESP performance

ESP troubleshooting & control settings for alarm/protection
- validation and diagnosis of well and ESP performance using gauge data
- setting up intelligent control systems to protect the ESP and well system
- review of examples and practice in determining corrective course of action

Practical workshop session; ESP well modelling and diagnosis
- building an ESP well model; key assumptions and data required
- matching flow correlations and inflow performance assumptions with test data
- design and sizing of ESP equipment; diagnosis of existing well problems and optimisation opportunities
- recommendations for setting alarms and trips for control and protection

Day 5 : Surface network modelling using GAP

Introduction to surface network modelling
- horizontal flow concepts and flow correlations
- well performance curves, interactions between wells and pipelines
- full field optimisation methods (natural flow, gas-lift and ESP wells)

Practical workshop session; building a field network model
- build simple field network model, linking to well models
- importing well performance curves, lift curves and inflow performance data
- matching flowline pressure loss; use for production allocation; adding constraints
- snapshot field prediction and optimisation; gas-lift gas and ESP power allocation techniques

Note: Each day will include practical workshop sessions illustrating the application of theory to well and artificial lift system models. Participants are encouraged to bring data and examples to interpret and analyse.

