



# Principles of Hydraulic Fracturing & GOHFER Training (5 Days)

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# Principles of Hydraulic Fracturing / GOHFER Training (5 Day)



## Day 1: AM

### Introductions

#### Discussion - Fracturing: Objectives (G1)

- Goals of Stimulation
- How Do We Benchmark Well Performance?
- Why don't wells perform as expected after frac?

#### GOHFER Software – Introduction

##### Software Overview

- Installation
- License Access
- Convert Existing Project to GOHFER 3D

#### Discussion - Input Data for Fracture Design Models (G3-4)

- What Controls Created Fracture Geometry?
- Modeling In-Situ Stress States
- Effect of Pore Pressure on Stress
- Effects of ductile (plastic) behavior
- Other fracture containment mechanisms
- Processing full-wave sonic (Dipole) logs
- Deriving Synthetic Sonic Curves
- Log QC

## Day 1: PM

#### GOHFER Software – Vertical Well Class Example

##### Vertical Well Class Example – Actual Post Job

- LAS (Log Processing)
  - Input Data Requirements
  - Mechanical Property and Stress Profile Construction
- Geologic Section
  - Define wellbore segment(s) – treatment string / wellbore fluid
  - Define Grid Dimensions
- Treatment Design
  - Perforations
  - Actual Pump Schedule
- Engine Output Viewer
  - Output Grid Data

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Day 2: AM

**Discussion - Designing and Using Pre-Frac Injection Tests (G5-6)**

- Pre-Frac Injection/Falloff Tests
- Pre-Frac Step-Rate Injection Test
- Holistic pressure diagnostics
- Fluid Efficiency and Leakoff Coefficient during Closure
- Effects of Natural Fractures
- After-closure analysis and reservoir characterization

**GOHFER Software – Pressure Diagnostics**

**Pressure Diagnostics**

- Import Data / Analysis Input
  - Input File Preprocessor
- Pre-Falloff / Closure / After Closure Analysis

**GOHFER Software – Vertical Tight Gas Class Example History Match**

**Vertical Well Class Example – History Match**

- Pressure Matching Strategies
  - Matching Stresses (Pore pressure, Closure pressure, PZS) and leakoff
- Matching Frictional Effects (Pipe / perf / near wellbore)

**GOHFER Variable Sensitivity**

- Demonstration / discussion of individual input variables and their impact on the model

Day 2: PM

**Discussion - Predicting Final Fracture Conductivity, Cleanup and Production (G9)**

- Traditional Conductivity Estimates
- Polymer Concentration during Leakoff and Closure
- Degradation and Half Life of Various Breakers
- Proppant Crushing by Uneven Loading
- Non-Darcy Flow Mechanisms
- Relative permeability and Multiphase Flow
- Combined Effects of Multi-phase and Non-Darcy Flow
- Damage and Cleanup processes
- Case History: Created versus effective frac length

**GOHFER Software – Production**

**Vertical Well Class Example – Actual Post Job**

- Conductivity & Well Performance

**Class Exercise - Economic Optimization**

- Design / Production / Economic Optimization

**GOHFER Software – (GPA) GOHFER Production Analysis**

**GOHFER Production Analysis**

- Decline Analysis
- Type Curve Analysis

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**Day 3 AM**

**Discussion - Unconventional Reservoirs and Horizontal Well Stimulation (G10 & G11)**

- Selection of stimulation designs
- Transverse or Longitudinal fracs
- Achieving diversion and placement
- Treating pressures and breakdown efficiency

**GOHFER Software - Horizontal Transverse Shale Model & Production Example**

**Treatment / Reference Wells**

- 3D Surveys
- LAS (Shale / Carbonate Log Processing)

**Treatment Stage**

- Asymmetric modeling
- Longitudinal vs. Transverse Fractures
  - Building Geologic Structure
  - Offset Depletion
- Breakdown Pressure
- Fracture Orientation
  - Breakdown Gradient / Breakdown Angle

**Day 3: PM**

**GOHFER Software - Horizontal Transverse Shale Model & Production Example (cont.)**

**Treatment Design**

- Perforations
- Interference / Stress Shadowing
  - Single Transverse stage (multiple clusters)
  - Multiple Transverse stages (individual treatments)
- Stress Anisotropy
  - Ball Drop Transverse stages (single treatment / multiple stages)

**Engine Output Viewer**

- 3D Grid Output

**Production**

- Longitudinal / Transverse production parameters

**Day 4: AM**

**GOHFER 3D Software – Multi-Well Fully 3D GeoModel**

**3D Example 1 – Multi-Well Model w/ Reference Logs only (No Geologic Model)**

- Site & Well Location Entry
- Log Processing & Integration
- Grid Setup & Map View

**GOHFER 3D Software – Multi-Well Fully 3D GeoModel**

**3D Example 2 – Add 2D Surface Map to Previous Example**

- Grid Setup & Map View

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Day 4: PM

**GOHFER 3D Software – Multi-Well Fully 3D GeoModel**

**3D Example 3 – Add 3D Geologic Model to Previous Example**

- Create Core to Replace Reference LAS
- LAS Mapping from Core (Full 3D Distribution vs. Reference LAS (Layer Cake))
- Import Geologic Model / Requirements
- Offset Depletion / Well Bashing
- Zipper frac simulations

Day 5: AM

**Discussion - Proppant Transport & Screenout Behavior (G8)**

- Factors Affecting Proppant Transport
- Proppant Movement by Bulk Flow or “Convection”
- Proppant Bridging and Screenouts
- Proppant Holdup and Inefficient Transport
- Effects of Overflushing Frac Jobs

**Discussion - Fracturing Fluid Rheology and Leakoff (G7)**

- Fracturing Fluid Rheology
- Effect of Sand Addition on Frac Fluid Rheology
- Leakoff Modeling

**GOHFER Software**

**GOHFER Databases**

- Proppant Database
- Fluid Database
- Review proppant / fluid database inputs and functions
- How to add a fluid to the fluid database

**Reports**

- Report management/editing
- Adding images to reports

**Microseismic Class Example (optional)**

- Import Microseismic data into GOHFER

**Real-Time Data Acquisition Demonstration (optional)**

Day 5: PM

**Discussion - Modeling Fracture Geometry (G2)**

- Types of fracture design models
- Design models and their assumptions
- Effects of elastic coupling and shear
- Process zone mechanisms

**GOHFER Software**

- Individual Multi-Well Fully 3D GeoModel Class Exercise
- **Wrap Up - Summary and Conclusions**