



NSI – Hydraulic Fracturing School

| | Introduction and Reservoir Engineering Aspects of Fracturing | Basic Fracture Design Variables | Fracturing Pressure Analysis | Fracturing Materials and Case History | Treatment Execution & Quality Control |
|--------|---|---------------------------------------|--|---------------------------------------|---|
| 1 Hour | Introduction | Fracture Geometry Computer Problem | "Big Problem" In Situ Stress Test Analysis | Proppants and Proppant Selection | Post-Frac Logs (& other diagnostics) |
| 1 Hour | Rock Stresses (Rock Mechanics Aspects of Hydraulic Fracturing) | Fracture Height and Modulus | Nolte-Smith Treating Pressure Analysis | Fluids and Fluid Selection | Treatment Execution |
| 1 Hour | | | "Big Problem" | Treatment Scheduling | |
| 1 Hour | Start "Big Problem" (Q 1 & 2) | "Big Problem" (Q 3, 4, & 5) | Pressure Decline Analysis | Computer Modeling | Case History Review |
| | Post-Frac Production Folds-of-Increase (Acid Frac Problem) | | | | |
| 1 Hour | Post-Frac Production Transient Flow & Economics | "Big Problem" (Q 6) | Net Pressure History Matching | Practical Session | |
| 1 Hour | | | | | Fluid Viscosity & Pump Rate |
| 1 Hour | Fracture Geometry Basics | In Situ Stress Tests | Fluid Efficiency Analysis | Work Complete Case History | |
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Course Schedule

5-Day Hydraulic Fracturing, NSI Technologies, Inc. - Tulsa , Oklahoma

Where possible the course is structured in one hour elements, with a short break following each hour. This gives approximately 7 "elements" for each class day (with the exception of Friday) or approximately 8 hours of "classroom" time each day.

DAY 1 -

- 1 hour - Introduction to Course and Brief History of Fracturing
- 1 hour - Steady-State and Pseudo-Radial Flow calculations for effect of fracturing on well performance
Problem
- 1 hour - Effect of Transient Flow (or Flush Production) on calculations
Problem
- 1 hour - Simple Economics for Fracture Optimization
Problem
- 1 hour - Fracture Geometry
- 1 hour - Computer modeling to emphasize important variables and the importance of fracture geometry "models"
- 1 hour - Discussion of computer exercise

DAY 2 -

- 1 hour - Rock Stresses and their control of fracture behavior
Problem
- 1.5 hours - Discussion of Fracture Height Prediction
Problem
- 0.5 hours - Discussion of Rock Modulus
- 1 hour - Fluid Loss
- 1.5 hours - Fracture Closure Stress, importance and measurement techniques
Problem
- 1.5 hours - Fracturing Pressure Analysis (Nolte-Smith Plot)
Problem

DAY 3 -

- 1.5 hours - Pressure decline analysis
Problem
- 1 hour - Computer Modeling (tying together frac pressure analysis/pressure decline analysis)
- 0.5 hours - Review effect of height growth on pressure analysis
- 1 hour - Post-Propped-Frac-Treatment Pressure Analysis
Problem
- 1 hour - "Efficiency" Analysis
- 1 hour - Design Examples (discussion of several examples showing use of pressure analysis to solve problems)
- 1 hour - Fluid Viscosity and Pump Rate
Problem

DAY 4 -

- 1 hour - Proppant Selection
- 1 hour - Fluid Selection
- 1.5 hours - Fluid Scheduling and Treatment Scheduling
Problem
- 0.5 hours - Discussion of Computer Modeling
- 3.0 hours - Fracture Design Problems

DAY 5 -

- 1 hour - Post-Frac Logging
- 2 hours - Treatment Execution/Quality Control
- 1 hour - Presentation of Design Problems