

# DRILLING AND COMPLETION

# DRL016

## COURSE DESCRIPTION

This course provides in-depth information on the impact of workovers and completion design in maximizing field production and increasing recoverable reserves. It also emphasizes the importance of a team concept as a determining factor in operations success. Participants will gain a greater understanding of how to apply advanced technologies to designing and executing Completion and workover jobs, and how to select the best operations method to perform the task in the safest, most efficient manner.

## COURSE GOAL

To enhance the participants' knowledge, skills, and attitudes necessary to understand how to apply advanced technologies to designing and executing Completion and workover jobs.

## COURSE OBJECTIVES

By the end of this course, participant will be able to:

- Appraise/design a suitable flow barrier strategy and suitable intervention strategy
- Make recommendations on installation and retrieval practices for tubing, packers, etc. in different well types
- Identify key features/applicability of the main sand control, frac. pack and well stimulation options.

## WHO SHOULD ATTEND

Petroleum Engineers, Completion Engineers, drilling and senior drilling supervisors, reservoir and senior reservoir engineers, geologists, production and completion engineers and supervisors Foreman.

## COURSE DURATION

5 Working Days

## COURSE OUTLINES

### 1. Basis of Well Completion Engineering

- Grounds of Reservoir Geology and Reservoir Engineering
  - Types of Oil and Gas Reservoirs
  - Reservoir Fluid Properties
  - Reservoir Characteristics and Interlayer Differences

- Core Analysis Techniques
  - Requirements of Well Completion Engineering for Core Analysis
  - Contents and Applications of Core Analysis
- Reservoir Sensitivity to Fluid and Working Fluid Damage Evaluation
- Reservoir Stress Sensitivity Analysis
  - Stress Sensitivity Experiment Evaluation
  - Stress Sensitivity of Low-Permeability Sandstone Oil Reservoir
  - Stress Sensitivity of Tight Sands Gas Reservoir
  - Stress Sensitivity of Carbonatite Reservoir
- In situ Stress and Mechanical Parameters of Rock
  - Basic Conception of in situ Stress
  - Stress State of Borehole Wall Rock
  - Relationship between in situ Stress and Well Completion Engineering
  - Relationship between in situ Stress and Well Completion Engineering
- Technological Grounds of Petroleum Production Engineering

## 2. Well Completion Mode Selection

- Vertical, Slant, and Directional Well Completion
  - Perforated Completion
  - Liner Tieback Perforation Completion
  - Open Hole Completion
  - Slotted Liner Completion
  - Gravel Pack Completion
  - Other Sand Control Screen Completions
  - Chemical Sand Consolidation Well Completion
  - Fiber Complex Fine Silt Control Completion
  - Intelligent Well Completion
  - Monobore Well Completion
  - Underground Natural Gas Storage Well Completion

## 3. Selection and Determination of Tubing and Production Casing Sizes

- Overview
- Overview of Nodal Analysis
- Selection and Determination of Tubing and Production Casing Sizes for Flowing Wells
- Selection and Determination of Tubing and Production Casing Sizes for Gas Wells

- Selection and Determination of Tubing and Production Casing Sizes for Artificial Lift Wells
- Effects of Stimulation on Tubing and Production Casing Size Selection
- Selection and Determination of Tubing and Production Casing Sizes for Heavy Oil and High Pour-Point Oil Production Wells

#### 4. Completion and Perforating Fluids

- Functions of Drilling and Completion Fluid and Basic Requirements
  - Functions of Drilling and Completion Fluid
  - Features of Formation Damage of Drilling and Completion Fluid
  - Requirements of Reservoir Protection for Drilling and Completion Fluid
- Drilling and Completion Fluid Systems and Application
  - Aero-Based Drilling and Completion Fluid
  - Water-Based Type Drilling and Completion Fluid
  - Oil-Based Type Drilling and Completion Fluid
- Shield-Type Temporary Plugging Technique
  - Overview
  - Theoretical Basis of Shield-Type Temporary Plugging Technique of Modified Drilling Fluid
  - Reservoir Protecting Shield-Type Temporary Plugging Technique Program and Application Results
  - Development of Shield-Type Temporary Plugging Technique
- Drilling and Completion Fluid for a Complicated Reservoir
- Perforating Fluid
  - Formation Damage Mechanism of the Perforating Fluid
  - Design Principle of a Perforating Fluid System
  - Common Perforating Fluid Systems and Their Features
  - Requirements of Perforating Technology for Perforating Fluid

#### 5. Perforating

- Perforating Technology
  - Wireline Casing Gun Perforation
  - Tubing-Conveyed Perforation (TCP)
  - Wireline Modular Gun Perforation Technology
  - Tubing-Conveyed Perforation Combination Technology
  - Wireline Through-Tubing Perforation (TTP)
  - Extreme Overbalance Perforating Technology (Forward Shock)

- Horizontal Well Perforating Technology
- Oriented Perforating Technology
- Perforated Well Productivity Influencing Rule Analysis
  - Productivity Rule of Perforated Well of Sandstone Reservoir
  - Productivity Rule of Perforated Well of a Fractured Oil Reservoir
  - Productivity Rule of a Perforated Horizontal Well
  - Perforating Differential Pressure Design
  - Optimizing the Perforation Design

## 6. Well Completion Tubing String

- Oil Well Completion Tubing String
  - Separate-Layer Production Tubing String
  - Sucker-Rod Pumping Well Production Tubing String
  - Electrical Submersible Pump Well Production Tubing String
  - Downhole Screw Pump Well Production System
  - Jet Pump Well Production Tubing String
  - Gas Lift Production Tubing String
  - Hydraulic Piston Pump Well Production Tubing String
  - Separate-Layer Production Tubing String with Oil- and Gas Expandable Openhole Packers and Screens
- Gas Well Completion Tubing String
  - Gas Production Well Tubing String
  - Tubing-Conveyed Perforating Gas Production Well Tubing String
  - Water-Drainage Gas-Production Tubing String
- Separate-Layer Water Injection String
  - Fixed Water Distribution String
  - Hollow Water Distribution Strings
  - Eccentric Water Distribution Strings
- Heavy Oil Production Tubing String
  - Conventional Steam Injection Tubing String
  - Sealing and Separate-Layer Steam Injection String
  - Nitrogen Heat-Insulation Cleanup Tubing String
  - Heavy Oil Huff-and-Puff and Pumping Tubing String
  - SAGD Production Tubing String
  - Heavy-Oil Sand Clean-out Cold-Flow Production Tubing String
  - Hollow-Sucker-Rod Through-Pump Electric Heating Production Tubing String
  - Production Tubing String of Combined Jet Pump and Oil Well Pump

- Completion Tubing String Safety System
  - Subsurface Safety Valve
  - Matching Surface Safety Valve System
- Tubing String Mechanics
  - Status Models of Tubing String
  - Helical Inflexion State Analysis of Tubing String
  - Basic Models for Calculating the Deformation of Tubing String
  - Strength Analysis of Tubing String
- Tubing Stress Analysis
  - Purpose of Stress Analysis
  - Stress Loads
  - Safety Factors and Design Factors
  - Load Cases
  - Completion Equipment and Connections
- Materials Selection
  - Metals
  - Metallurgy & Corrosion
  - Elastomers and Plastics
  - Protective Coatings

## 7. Workover Operations

- Workover definition and description
- Workover Types
  - Safety Workover (SWO)
  - Long term suspension (LTS)
  - Plug and Abandonment (P&A)
  - Production enhancement (PE)

## 8. Workover Feasibility Studies

## 9. Well Problems Analysis

- Reservoir Problems
  - Reservoir management
  - Productivity/injectivity
- Completion Problems
  - Equipments

- Lift considerations
- Wellbore Problems
  - Mechanical failure
  - Modification or Redesign
  - Abandon

## 10. Formation Damage

- What is formation Damage?
- Damage Characterization
- Damage Quantification
- Formation Damage Components
- Formation Damage Mechanism

## 11. Sand Control

- Sand Formation Properties and Geology
- Why Sand is Produced?
- Why Sand Control Production?
- Erosion
- Sand Bridging
- Casing Failures
- What causes Sand Production?
- Drilling and Completion Requirements
- Fluid Selection
- Solids Free Fluids
- Polymers Bridging Material
- Perforating
- Perforating Damage
- Gravel Control
- Gravel and Screen Selection
- Gravel Sizing
- Slot Sizing
- Inside Gravel Packing
- Open Hole Gravel Packing
- Placement Methods
- Hole Enlargement

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- Carrier Fluid Concept
- Chemical Consolidation
- Consolidated Packs
- Expandable Screens
- Expandable Screens and Borehole Interactions
- Expansion Methods
- Open Hole Gravel Packs (OHGPs)
- Cased Hole Gravel and Frac Packs
- Choosing the appropriate method of Sand Control

## 12. Measures for Putting a Well into Production

- Preparations before Putting a Well into Production
  - Drifting
  - Drifting by Using Drift Diameter Gauge.
  - Drifting by Using Lead Stamp
  - Casing Scraping
  - Well-Flushing
- Main Measures for Putting the Well into Production
  - Physical and Chemical Blocking Removal
  - Acting Mechanisms and Applicable Ranges of the Main Measures for Putting a Well into Production
- Physical and Chemical Blocking Removal
  - Chemical Blocking Removal
  - Physical Blocking Removal
- Hydraulic Fracturing for Putting a Well Into Production
  - Hydraulic Fracturing of Sandstone Reservoirs
  - Hydraulic Fracturing for Carbonatite Reservoir
- Acidizing for Putting a Well Into Production
  - Principle and Classification of Acidizing
  - Principle of Increasing Productivity by Acidizing
  - Matrix Acidizing for Sandstone Reservoir
  - Real-Time Monitoring and Effectiveness Appraisal of Acidizing.
  - Matrix Acidizing for Carbonatite Reservoir
- High-Energy Gas Fracturing for Putting a Well Into Production
  - Mechanism of High-Energy Gas Fracturing

- Conditions of Generating Fractures.
- Cracking Initiation Mechanism.
- Self-Propping of Fractures.
- Effects of High-Energy Gas Fracturing
- Types of High-Energy Gas Fracturing and Suitability
- High-Energy Gas Fracturing Design
- Combined High-Energy Gas Fracturing and Perforating
- Flowing Back
  - Flowing Back by Displaced Flow
  - Conventional One-Step Displaced Flow Method.
  - Two-Step Displaced Flow Method.
  - Flowing Back by Swabbing
  - Flowing Back by Gas Lift
  - Conventional Gas-Lift Unloading.
  - Multistage Gas-Lift Valve Unloading.
  - Coiled-Tubing Gas-Lift Unloading.
  - Nitrogen Gas Gas-Lift Unloading.
  - Flowing Back by Aerated Water
  - Flowing Back by Foam

### 13. Coiled Tubing

- Coiled Tubing Completions
  - Definition
  - CT Completions History/Evolution
  - Benefits of Coiled Tubing Completions
  - Types of Coiled Tubing Completion
  - Applications and Candidates
  - Constraints of Coiled Tubing Completions
- Coiled Tubing Completion Design and Planning
  - CT Completion Design Factors
  - CT Completion Application Design
- Coiled Tubing Completion Components and Equipment
- Coiled Tubing Completion Case Histories
- Primary & Remedial Cementing