

DIRECTIONAL DRILLING

DRL004

COURSE OVERVIEW

This course builds a firm foundation in the principles and practices of directional drilling, calculations, and planning for directional and horizontal wells. Specific problems associated with directional/horizontal drilling such as torque, drag, hole cleaning, logging, and drill string component design are included.

Participants will receive instruction on planning and evaluating horizontal wells based on the objectives of the horizontal well. The basic applications and techniques for multi-lateral wells are covered in the course. Additionally, they will become familiar with the tools and techniques used in directional drilling such as survey instruments, bottomhole assemblies, motors, steerable motors, and steerable rotary systems. Participants will be able to predict wellbore path based on historical data and determine the requirements to hit the target.

COURSE OBJECTIVES

Upon successful completion of this course, participant will be able to:

- Make survey calculations.
- Interpret TVD, polar and rectangular coordinates, and vertical section.
- Interpret dogleg severity and the problems associated with dogleg severity.
- Plan a two-dimensional directional well.
- Plan horizontal wells based on the objectives of the well.
- Determine the best multi-lateral completion for an application.
- Determine declination and non-magnetic drilling collar selection.
- Apply the best survey instrument for the job.
- Directionally drill with rotary BHAs, jetting, whipstocks, motor, steerable motors, and rotary steerable systems.
- Drill horizontally underbalanced.
- Interpret torque and drag and determine what factors will affect the torque and drag.
- Determine cementing requirements for directional wells.

WHO SHOULD ATTEND

Drilling, production and operations engineers, field supervisors, toolpushers, managers, and technical support personnel.

COURSE DURATION

5 Working Days

COURSE OUTLINES

- 1. Pre course evaluation**
- 2. History and Applications of Directional Drilling**
 - Historical Background
 - Technology Advances
 - Applications of Directional Drilling
- 3. Fundamentals**
 - Petroleum Geology
 - Basic Concepts of Geology
 - The Sedimentary Cycle
 - Sedimentary Rock Types
 - Terrigenous Sediments
 - Pyroclastic Sediments
 - Carbonates Rocks
 - Evaporites
 - Structural Geology
 - Normal and Abnormal Formation Pressure
 - Algebra and Trigonometry
 - Exercise
- 4. Directional Well Planning**
 - Positioning and Coordinate Systems
 - Geographic Coordinates (Latitude and Longitude)
 - Ellipsoid
 - Geodetic Datum
 - Map Projection
 - Legal Coordinate Systems
 - Land Locations
 - Offshore Locations
 - Bottomhole Targets
 - Geological Requirements

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- Survey Calculation Methods
 - Definitions of Terms
 - Introduction
 - Tangential Method
 - Balanced Tangential
 - Average angle
 - Radius of Curvature
 - Vertical Projection
 - Horizontal Projection
 - Minimum Curvature
 - Dog-leg
 - Ratio Factor
 - Mercury
 - Relative accuracy of the different methods
 - Dog Leg Severity
- Basic Well Planning
 - Determining the Kick-Off Point
 - Determining Build and Drop Rates
 - Calculating the Trajectory
- Anticollision and Advanced Well Planning
 - Anti-Collision Considerations
 - Volumes of Uncertainty
 - Determining a "Lead Angle"
- Well Plan Maps
- Exercise

5. Survey Instruments

- Introduction.
- Magnetic Instrument Corrections
 - Magnetic Declination Correction
 - Non-Magnetic Drill Collar Selection
- Survey Instruments
 - Magnetic Survey Instrument
 - Electronic Survey Instruments
 - Steering Tool
 - Measurement While Drilling (MWD) Tool
 - Electronic Multi-Shot

- Gyroscopic Survey Tools
 - Conventional Gyro
 - Rate Integrating or North-Seeking Gyro
 - Ring Laser Gyro
 - Inertial Grade Gyro
- Accuracy of Survey Tools
- Orienting Tools
- Exercise

6. Methods of Deflecting a Wellbore

- Introduction
- Whipstock
- Jetting
- Rotary Bottomhole Assemblies
 - Building Assemblies
 - Dropping Assemblies
 - Holding Assemblies
- Downhole Motors
- Steerable Motor Assemblies
- Rotary Steerable Technology
- Exercise

7. Horizontal, Multilateral Drilling

- Introduction
- Types of Horizontal Wells
 - Ultra-Short Radius
 - Short Radius
 - Intermediate Radius
 - Medium Radius
 - Long Radius
- Logging High Angle and Horizontal Wells
 - Logging While Drilling
 - Pipe Conveyed Logging
 - Coiled Tubing Conveyed Logging
 - Wireline Tractor

- Hole Cleaning
 - Hole Cleaning Problems Associated with Inclination
 - Annular Velocity
 - Flow Regime and Viscosity
 - Drill Pipe Rotation and Reciprocation
 - Other Considerations
- Multilaterals
 - Multilateral Terminologies
 - Reasons for drilling multilaterals
 - Multilateral Classification system
- Exercise

8. Directional Drilling Operations

- BHA Weight
- Tool Handling
- Nudging
 - Nudging Techniques
- Orientation
 - Reactive Torque
 - Magnetic and Gravity Tool Face
 - Single Shot Kickoff/Correction Run/Oriented Sidetrack
- Correction Runs
- The Ouija Board
 - Ouija Board Calculations
 - How to Use the Ouija Board
 - Typical Uses of the Ouija Board
 - Estimating Dog Leg and Dog Leg Severity (DLS)
 - Deflection Tool Calculations
- Ragland Diagram
- Constant Rate of Turn to Target
- Constant Rate of Drop/Build to Target
- Open Hole Sidetracking
 - Cement Job
 - Bit Selection for Sidetrack
 - Open-Hole Sidetracking Procedure

- Jetting BHA for Sidetracking
- Low-Side Sidetracking
- Steerable PDM
- Turbodrill
- Open-Hole Whip-stock
- Cased Hole Sidetracking
- Exercise

9. Torque and Drag

- Introduction
- Simplified Torque and Drag Model
 - Factors that Affect Torque and Drag
 - Friction Coefficient
 - Directional Profile
 - String Weight
- Directional Drill String Design
 - Conventional Directional Well
 - High Angle or Horizontal Well
- Exercise

10. The Problem of Deviation and Doglegging in Rotary Boreholes

- Introduction
- Theories of Causes of Deviated Holes
- Categorizing Crooked Holes
- Methods Used to Control Deviation
- Doglegging in Rotary Boreholes
- A Unique Approach to Deviation

11. Post course evaluation.

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