

HPHT WELL DESIGN AND OPERATION

DRL048

COURSE OVERVIEW

High Pressure (HP) (>10,000 psi) and High Temperature (HT) (>300°F) conditions are becoming more routine drilling targets worldwide in the pursuit of deep gas reserves. This course delivers a comprehensive review of HPHT well design, engineering and drilling requirements to help drilling engineering professionals understand the technologies, terminology, challenges, concepts, processes, and equipment used to drill High Pressure and High Temperature oil and gas wells. The course follows a typical HPHT operation and provides an understanding of the geological settings through well planning, drilling operations and well control challenges to the completion challenges in HPHT wells. Critical HPHT challenges are addressed in detail during the course. At the end of the course, the participants should understand the complexities associated with HPHT operations and will gain an understanding of issues that must be addressed when drilling HPHT wells.

COURSE OBJECTIVES

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

- Identify and eliminate the drilling hazards and risks within HPHT wells to as low as practicable.
- How to translate and sustain HPHT drilling case-study findings, success and failure learnings into future drilling projects.
- Awareness of key issues that exist in HPHT design, engineering and drilling operations.
- Increased proficiency with ability to address the key hazard and risks impacting HP HT drilling project delivery.
- Specific knowledge to skillfully control HPHT drilling problems as they arise, yet realize the importance of having necessary contingent mitigation in place for unexpected situations.
- Appreciate technical challenges and difficulties that exist, with new awareness to risk reducing and adaptive technologies being used and applied for specific HPHT drilling applications.

WHO SHOULD ATTEND

Drilling Engineers, completion engineers, exploration supervisors and managers concerned with HPHT well drilling.

COURSE DURATION

5 Working Days

COURSE OUTLINES

1. Pre course evaluation

2. High-Pressure, High-Temperature Well Construction and Challenges

- HPHT well Overview
- Defining the HPHT Environment
- Why are HPHT wells different?
- HPHT well locations worldwide
- Well planning
- Issues for HPHT Drilling
- Planning for Success

3. Pore & Wellbore Pressures and Stability Management

- Geological & Geophysical Aspects of Abnormal Pressures
- Pore Pressure predictions
- Wellbore Stability Fundamentals:
 - Mapping and Measurement of In-Situ Stresses and Fracture Pressure, well integrity testing
 - Predicting Stresses Around Borehole and Borehole Stability
 - Rock Mechanics Issues in HPHT Well
 - Claystone, Mudstone and Shale Classification Problems
 - Impact of poor decision making
- Drilling in Unusual Stress Regimes – Overpressured Zones

4. Well Design

- Casing design
 - Casing design specific to HPHT.
 - Casing Wear, H₂S and CO₂ Effects
 - Shoe Placement
 - HPHT Material Selection for HPHT Wells
- Rig, well equipment, integrity, concerns:
 - HPHT Well Control Layout
 - Rig, Equipment Audits, Assurance
 - BOP Equipment and Component Details
 - Cement (kill) Pumps, Cement Manifold, and Hook
 - Surface Well Control Equipment, Mud Gas Separators, De-gassers

- Rig Instrumentation
- HP Drilling Components and Well-Kill Facility
- Downhole Tools and Equipment
- Drill String Design in HPHT Well
 - Design, Operation, and Inspection
 - Designing to Prevent Overload Failure
 - Design for Fatigue Prevention
 - Design for Fatigue Buckling
 - Special Problems
 - Failure Analysis
- HPHT Drilling Fluids
 - Mechanism of Thermal Degradation
 - Aspects of Drilling Fluid Design, Rheology and Additives
 - Drilling Fluid Selection and HPHT Testing
 - Operational Considerations
 - Stable Flat Rheology Synthetic-Based Drilling Fluid System
- HPHT Well Cement
 - HTHP Cementing Considerations
 - Strength Stabilizing Additives
 - Slurry Integrity Additives
 - Flow through Unset Cement
 - Hydrostatic Pressure Loss
 - Gas Migration through Unset Cement
 - Losses of Overbalance Pressure

5. HPHT Well Control Management and Assurance

- Well Control Incident Rate for Normal Pressure versus Abnormal Pressure
- Human Factors Review for Offshore Blowouts During Drilling Completion Workover
- Common Difficulties
- Water versus Oil Based Muds
- Gas Behavior, Kicks And Control
- Gas Kick and Expansion Whilst Circulating Out
- Pressure At The Choke For A Sub-Sea Wellhead System
- Dispersed Kicks And Non-Dispersed Kicks
- Gas Migration Effects

- Kick Tolerance
 - Gas Solubility in OBM's- effects on kick behavior
 - Phases of Hydrocarbon Fluids
 - Phase Behavior
 - Gas Solubility
 - Drilled Gas And Kick Gas
 - Influx To Pit Gain Ratio
 - Rig equipment
 - Surface Gas Handling Capacities and Procedure for HPHT Wells
 - Introduction: Gas Expansion
 - The Choke Manifold and Choke
 - Mud-Gas Separators: Design, Capacities And Operation
 - Wellhead and Flowing Temperatures
 - Formation and Prevention of Hydrates
 - Steady Flow Energy Equation
 - Flow Regimes
 - Flow of Gases Through An Orifice
 - Flow Through a Choke
 - Flow of Gases Along Pipes: The Weymouth Formula
 - Drilling And Well Control Procedures For HPHT Well
 - Programs, Training & Communications Contents
 - Drilling And Well Control Procedures
 - H2S Procedures
 - Pressure Control System Equipment Inspection/Repair Procedures
 - Management and Control of Operations
 - Shut-In Procedures and Decision Trees
 - Volumetric Method of Well Control
 - Stripping
 - The Effects of Temperatures and Pressures on Muds
 - The Effects of Borehole Ballooning on Drilling Responses
 - Management of Operations
- 6. HPHT Well Completion**
- Well Completion Challenges
 - HPHT Completion Fluid Selection

- Review Brine Fluids & Properties
- Displacement of Drilling Fluid
- HPHT Completion Fluid Selection
- Brine Compatibility
- Fluid Loss Control
- Packer Fluids
- Formation Damage Concerns

7. Annular Pressure Build-Up (APB)

- APB Design and Evaluation Methods
- APB Failures
- APB Mitigation Options
- Worst Case Discharge (WCD)
- DWEP APB mitigation methods and applicability
- Wellhead Growth

8. HPHT Well testing Challenges

9. HPHT Adaptive Drilling Technologies

- HPHT Technology Adaptation
 - Optimizing Well Design
 - Expandable Systems
 - Wellbore Strengthening
 - Mono-Bore Wells
 - Casing While Drilling
 - HPHT tools advancement
- Managed Pressure Drilling
 - Simplified MPD, Continuous Circulation
 - Constant Bottom Hole Pressure
 - Mud cap, Pressurized Mud Cap Drilling
 - Dual Gradient Drilling, Advanced MPD

10. Post course evaluation.

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