

HP-HT Drilling Operations

Well Design, Engineering and Operations



⏄ Duration/Dates of Course

5 Days (or at client request)

⏄ Overview

Pressure (HP) (>10,000 psi) and High Temperature (HT) (>300 °F) conditions are becoming more High routine drilling targets worldwide in the pursuit of deep gas reserves. This course delivers a comprehensive review of HP HT well design, engineering and drilling requirements. The content emphasis in this course/workshop is placed on current regulatory and standard operating principles of HP HT - right from a well's concept phase, through pre-planning, rig and equipment selection, the basis of well design, detailed design, engineering, offset study, and final drilling of the critical HP HT transition and reservoir zones. The challenges of geological risks and uncertainty with drilling fluids, cement design, equipment assurance and drilling problem prevention, solving and decision making, all require special attention. The course draws on several HP HT case studies from different drilling environments in conjunction with instructor led facilitation, use of multi-media files and most importantly individual and group led engagement sessions.

⏄ Target Participants

The course targets any member of a project team: geo-scientists, engineers, technical, non-technical personnel at all levels. It also includes everyone involved in the design, construction, engineering, implementation and the drilling of HP HT wells. This course embraces drilling engineers with or without experience.

Pre-requisites: Basic knowledge and understanding of HP HT well's, 2-3 years' involvement in drilling projects in an operating, support or services role preferred but not essential.

⏄ Purpose

Equip a multi-disciplinary team to manage and control the drilling hazards and risks that exist in HP HT wells. This course also delivers a participative, practical program where individual and teamwork skills are developed to meet the HP HT drilling challenges presented.

⏄ Goals and Objectives

- Create an environment for a multi-disciplinary team to practically challenge HP HT standards, instruction, well integrity practices and develop new concepts to well safety and performance.
- Identify and eliminate the drilling hazards and risks within HP HT wells to as low as practicable.
- How to translate and sustain HP HT drilling case-study findings, success and failure learnings into future drilling projects.

⏄ Course Take Away

- Awareness of key issues that exist in HP HT 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 skilfully control HP HT 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 HP HT drilling applications.

Course Summary

HP-HT Drilling Operations



Session	Day 1	Day 2	Day 3	Day 4	Day 5
09:15 to 10:15	Course Introductions Pre-course assessment (30mins)	HP HT well design Geology, Geo-science Casing design Case study ref.	Situational problems in HP HT wells (1)	HP HT well control assurance	HP HT adaptive technologies. <i>Media Files, Case study ref.</i>
15 mins	Break				
10:30 to 12:00	HP HT Essentials & differences <i>Case study ref.</i>	HP HT Pressure /well stability fundamentals. Challenges, problems and difficulties <i>Case study ref.</i>	Situational problems in HP HT wells (2)	HP HT primary and secondary well control methods <i>Case study ref.</i>	Post-course assessment (60mins) <i>Course feedback Final questions</i>
12:00 to 13:00	Lunch Break				
13:00 to 14:15	HP HT Well's, rig and drilling eqpt essentials. <i>Case study ref.</i>	HP HT Drilling Ops readiness, transition/res zone drilling <i>Case study ref.</i>	HP HT - Well Management & Loss of Control Failure (45mins video) + Discussion	HP HT situational well control problems and solutions <i>Case study ref.</i>	<i>Parking lot HP HT questions & answers session</i>
15 mins	Break				
14:30 to 16:00	HP HT problems <i>Group exercises</i>	Transition and reservoir drilling <i>Group exercises</i>	Situational drilling problems <i>Group Exercises</i>	HP HT well control <i>Group Exercises</i>	

Course Details

HP-HT Drilling Operations



Day 1

Introduction to HP HT drilling Operations

HP HT Definition, classification, challenges, essentials and differences:

- Definitions, classifications, industry growth
- Technical challenges and knowledge gaps
- Origins and characteristics of HP HT
- Why HP HT is different to normal drilling

Debrief: Assuring safe and efficient HP HT drilling

Well construction, design, drilling rigs equipment and HP HT operating systems

- Well construction, planning, design issues:
 - Well equipment quality, material and failure issues
 - Hazards and concerns
 - Complicating factors
 - Well integrity, casing design and tubular selection
 - Well equipment response and preventing HP HT failures.
- Rig, well equipment, integrity, concerns:
 - HP HT well control layout
 - Rig, equipment audits, assurance
 - BOP equipment and component details
 - Cement (kill) pumps, cement manifold, and hook up details
 - Surface well control equipment, mud gas separators, de-gassers
 - Rig instrumentation
 - HP drilling components and well-kill facility
 - Downhole tools and equipment

Debrief: HP HT rig and associated well equipment

HP HT Group Exercise

- Hazard within HP HT drilling operations
- Generate a priority list of project specific drilling hazards

Debrief: Review of Day 1

Day 2

HP HT Design, Engineering & Operations

Well Planning Design and Construction

- Planning and sequencing
 - Project management simplified
 - Well planning, basis of designs
 - Casing and tubular selection
- Well design, engineering issues, concerns:
 - Pressure management
 - Losses, kicks
 - Wellbore instability and differential sticking
- Gas behavior in HP HT drilling fluids:
 - Gas definitions, gas release, acceptable levels
 - Equivalent mud weight management
 - Understanding HP HT pressure effects
- Ideal gas laws and importance of compressibility factor 'Z':
 - PVT & density relationships
 - Gas behavior while drilling
 - Fluid diffusion
- Optimizing drilling and cement fluids
 - Fluid testing and monitoring
 - 'EMW' operating challenges
 - Temperatures and heat transfer effects
- HP HT case studies:
 - Well objectives & design considerations
 - Pressure, temperature profiles
 - Days vs depth, offset study, hazards and risk mitigation

Debrief: Well planning, design and construction

Wellbore Pressure and Stability Management

- Formation abnormal and subnormal pressures recap:
 - Effective pressure management
 - Pressure prediction and detection
- Wellbore stability fundamentals:
 - Claystone, mudstone and shale classification problems
 - Impact of poor decision making
 - Fracture gradient prediction, well integrity testing
- Benefits of pressure while drilling and advanced HP HT modelling

Debrief: Pressure and Stability management

Course Details

HP-HT Drilling Operations



Day 2 continued

HP HT Transition and reservoir zone drilling

- Why manage plans HP HT transition and reservoir zones?
 - Well integrity testing, assurance
 - Well monitoring equipment, detection, early warning systems
 - Transition, reservoir zones drilling
- Transition, reservoir zone well control
 - Managing geology and geoscience problems
 - Gas solubility, gas expansion and PVT effects in drilling fluids
 - Mud weight management (gelation, inertia and compressibility)
 - Pore pressure, wellbore instability detection.
 - Best practice
 - Finger printing, flow-back, Ballooning and super charging

Debrief: Transition and reservoir zone drilling

HP HT Group/Individual Exercises day 2

- EMW calculations
- Drilling and cementing fluids, temperature, solubility effects
- Gas behavior, surface handling
- Pore fracture and wellbore stability

Debrief: Review of Day 2

Day 3

HP HT Wells and Drilling Situational Problems

General HP HT situational drilling problems

- HP HT situational problems:
 - Operating loss and waste
 - Narrow operating windows
 - Loss circulation, wellbore instability
 - Overbalanced drilling
 - Real time vs modelling prediction
 - Drilling fluids (pressure and temperature effects)
 - Barite sag, solids loading and hole cleaning, swab and surge
 - Stuck pipe prevention

Debrief: HP HT situational drilling problems

Equipment assurance, failure prevention

- Prevention, quality control and assurance
- Surface and downhole equipment
- Life of well integrity and assurance

Other HP HT situational problems:

- Geological risks and uncertainties
- Formation damage
- QHSE and environment protection
- Logistics and supply chain
- Contingency, emergency
- Suspension and abandonment

Debrief: Well and drilling situational problems

Learning from Macondo's failure

- 45mins (investigative) video
- Review of findings
- Discussion

Debrief: Translating and sustaining learning

HP HT Group / Individual Exercises day 3

- Situational drilling problems exercises

Debrief: Review of Day 3

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Day 4

Day 4 Well Integrity, Well Control Assurance

Well control management and assurance

- Regulation, operating standards
- Roles, responsibilities of personnel
- QHSE, loss of control operations
Training and competency development
- Team work and communication
- Primary control, Early kick detection
- Finger printing
- Flow back, Supercharging, Bridging
- Best Practice checks to be performed
- Secondary control
 - Preparation and alertness
 - Pressure management
 - Kick, shut in procedures
 - Determining kick size
 - Cross flow, Secondary influxes
 - Tertiary control
 - Bull-heading, lubrication, volumetric killing (stripping)
 - Dynamic kill and other techniques underground flows
 - H2S, simulator training and exercises

HP HT Emergency and contingencies

- Emergency procedures
- Well kill continuation during loss of power
- Emergency cement plugs
- Insufficient casing shoe strength

Debrief: Well integrity, assurance and management

HP HT Group/Individual Exercises Day 4

- Secondary and tertiary well control exercise session

Debrief: Review of Day 4

Day 5

Day 5 HP HT Adaptive Drilling Technologies

HP HT Technology adaptation

- Optimizing well design
 - Expandable systems
- Wellbore strengthening
- Mono-bore wells
- Casing while drilling
- Managed pressure drilling
 - Simplified MPD, continuous circulation
 - Constant bottom hole pressure
 - Mud cap, pressurized mud cap drilling
 - Dual gradient drilling, Advanced MPD
- Other technology adaptors
 - HP HT tools advancement
 - LWD, SWD, RSS advancement
 - New drilling and cementing systems
 - Designer cement for HP HT wells
 - One trip, SMART completions
 - Enhanced seals and well integrity

Debrief: HP HT technology adaptation

Final close out discussions

- Parking lot re-visit,
- Final HP HT question and answer
- Open house discussion session

Debrief: HP HT parking lot, discussion session

Final Debrief: Review of Day 5