COURSE OVERVIEW DE0159
Horizontal and Multilateral Wells: Completions and Stimulation (E-Learning Module)

Course Title
Horizontal and Multilateral Wells: Completions and Stimulation (E-Learning Module)

Course Reference
DE0159

Course Format & Compatibility
SCORM 1.2. Compatible with IE11, MS-Edge, Google Chrome, Windows, Linux, Unix, Android, IOS, iPadOS, macOS, iPhone, iPad & HarmonyOS (Huawei)

Course Duration
30 online contact hours
(3.0 CEUs/30 PDHs)

Course Description

Recent Advances in drilling and completion have resulted in a rapid increase in the number of horizontal and multilateral wells drilled each year around the world. A horizontal well, to some extent, is different from a vertical well because it requires an interdisciplinary interaction between various professionals, such as geologists, reservoir engineers, drilling engineers, production engineers, and completion engineers. A typical horizontal well project is different from a vertical well project because productivity of a well depends upon the well length. Moreover, the well length depends upon the drilling and completion techniques implemented.

Multilateral well technology is revolutionizing the way that reservoirs are accessed by wells. The ability to create wells with multiple branches that can target widely spaced reservoir compartments provides engineers unlimited options in optimizing economic extraction of oil and gas. Along with this opportunity comes the inherent complexity of these well architectures.

The type of well completion affects horizontal and multilateral well performance, and certain types of completions are possible only with certain types of drilling techniques. Thus, well length, the well's physical location in the reservoir, the tolerance in drilling location, and the type of completion that can be achieved, strongly depend upon the drilling method. Therefore, it is very important for reservoir engineers to understand different drilling techniques, their advantages and disadvantages. Similarly, drilling engineers, completion engineers, production engineers and geologists should also understand and appreciate the different factors that influence the performance of the horizontal and multilateral wells. Hence, cooperation and teamwork of different professionals is essential to ensure the successful horizontal and multilateral well project.

Successful multilateral and horizontal wells require new considerations, interdisciplinary planning, and special techniques. This intense course addresses the critical need for a proper understanding of all aspects of horizontal and multilateral design, completion and simulation that make these wells unique. It is designed for those planning or working with horizontal and multilateral wells and interested in effective use of the latest technology.

This E-Learning is designed to provide participants with an in-depth knowledge of the technology and processes of horizontal and multilateral well drilling and completion in a variety of environments for oil and gas exploration. It will cover drilling types, techniques, operation, calculations, equipment selections and planning for multilateral and horizontal wells. Specific problems associated with horizontal and multilateral drilling such as torque, drag, hole cleaning, logging, drill string component design, completion design and pay-zone-borehole connection will also be discussed.

Basic understanding of important reservoir characteristics, hole stability, formation damage, crucial zonal isolation, and hydraulic fracturing are just some of the critical issues addressed by this course. Hydraulic fracturing aspects of unconventional resources plays, including conductivity, proppant selection, and practices, are discussed. A combined practical and technical theme is employed, with emphasis on economy and efficiency in designing, completing, and producing horizontal and multilateral wells.

The course also analyzes the successes and failures of well integrity management from a series of real case studies in the oilfield and production facilities around the globe. During the course, the participants will review and discuss the requirements of operators and regulatory authorities for integrity assurance in wells and production facilities. They will also gain knowledge in the completion techniques and design of wells in increasingly complex field developments to ensure well integrity, failure-free and long-life production.

Course Objectives

After completing the course, the employee will:-

- Apply a comprehensive knowledge on the latest techniques of drilling and completion of horizontal and multilateral wells and deal with the major concerns related to well integrity
- Successfully design and optimize horizontal and multilateral well completions
- Engineer wells, taking into account limitations imposed by well bore stability and borehole friction
- Determine the appropriate zonal isolation methods for horizontal and multilateral wells
- Perform hydraulic fracturing of horizontal wells
- Design damage removal, stimulation, and workover operations
- Design and optimize horizontal and multilateral well completions
- Take into account limitations imposed by well bore stability and borehole friction
- Determine appropriate zonal isolation methods for horizontal and multilaterals wells
- Perform hydraulic fracturing of horizontal wells
- Design damage removal, simulation, and workover operations
- Design horizontal and multilateral wells in a professional manner including drilling method selection, precompletion & completion design, planning, surveying and drilling fluid selection
- Explain the horizontal and multilateral drilling method using the turbodrills and perform measurement while drilling (MWD)
- Evaluate well formation using logging, sampling & coring and understand the various techniques of horizontal and multilateral well control & completion
- Solve the major drilling problems in horizontal and multilateral wells and know how to deal with well productivity and integrity
- Develop a proper well integrity management program and review the requirements of operators and regulatory authorities for integrity assurance in horizontal and multilateral wells and production facilities

Who Should Attend

This course provides a complete and up-to-date overview of the completions and stimulation of horizontal and multilateral wells for drilling engineers, reservoir engineers, geologists, production and completion engineers and supervisors.

Course Certificate(s)
Internationally recognized certificates will be issued to all participants of the course.

Certificate Accreditations
Certificates are accredited by the following international accreditation organizations: -

- USA International Association for Continuing Education and Training (IACET)

  Haward Technology is an Authorized Training Provider by the International Association for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, VA 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 1-2013 Standard** which is widely recognized as the standard of good practice internationally. As a result of our Authorized Provider membership status, Haward Technology is authorized to offer IACET CEUs for its programs that qualify under the **ANSI/IACET 1-2013 Standard**.

  Haward Technology's courses meet the professional certification and continuing education requirements for participants seeking **Continuing Education Units** (CEUs) in accordance with the rules & regulations of the International Association for Continuing Education & Training (IACET). IACET is an international authority that evaluates programs according to strict, research-based criteria and guidelines. The CEU is an internationally accepted uniform unit of measurement in qualified courses of continuing education.

  Haward Technology Middle East will award **3.0 CEUs** (Continuing Education Units) or **30 PDHs** (Professional Development Hours) for participants who completed the total tuition hours of this program. One CEU is equivalent to ten Professional Development Hours (PDHs) or ten contact hours of the participation in and completion of Haward Technology programs. A permanent record of a participant's involvement and awarding of CEU will be maintained by Haward Technology. Haward Technology will provide a copy of the participant's CEU and PDH Transcript of Records upon request.

- British Accreditation Council (BAC)

  Haward Technology is accredited by the **British Accreditation Council** for **Independent Further and Higher Education** as an **International Centre**. BAC is the British accrediting body responsible for setting standards within independent further and higher education sector in the UK and overseas. As a BAC-accredited international centre, Haward Technology meets all of the international higher education criteria and standards set by BAC.

Training Methodology

This Trainee-centered course includes the following training methodologies:-

- Talking presentation Slides (ppt with audio)
- Simulation & Animation
- Exercises
- Videos
- Case Studies
- Gamification (learning through games)
- Quizzes, Pre-test & Post-test

Every section/module of the course ends up with a Quiz which must be passed by the trainee in order to move to the next section/module. A Post-test at the end of the course must be passed in order to get the online accredited certificate.

Course Fee

As per proposal

Course Contents

- Smart Drilling
- General
- Limitations Of Horizontal Wells
- Application of Horizontal Drilling
- Horizontal Drilling Techniques
- Types Horizontal
- Ultra Short Radius
- Short Radius
- Medium Radius
- Long Radius
- Completion Techniques
- Factors Affecting Inflow Performance
- Horizontal Well Skin Damage
- Effective Wellbore Radius
- Horizontal Well Design
- Well Design Consideration

- BHA Performance Considerations
- Dogleg Severity Limit
- Horizontal Well Path Design
- Short Radius Wells (SRW)
- Medium Radius wells (MRW)
- Long Radius Wells (LRW)
- Well Profile Design Considerations
- Single Curve Design
- Design Equation
- Well Planning
- Conclusion
- Case History - Long Radius Horizontal Well
- Building BHA
- Results
- Course Recap
- Reservoir Characteristics
- Formation Damage
- Background
- Formation Porosity
- What is Porosity “Φ” ?
- Formation Porosity
- Formation Permeability
- Rock Properties
- Capillary Pressure
- Effect Grain Size in Permeability
- Oil Reservoirs
- Traps General –Structural Trap Example
- Stratigraphic Traps Example
- Causes of Low Productivity Wells
- Skin Effect
- Reservoir Model of Skin Effect
- Reservoir Pressure Profile
- The Cost-Impact of Formation Damage on Well Production

- Effect of Skin on the IPR Curve
- Oil Viscosity "μo"
- Solution Gas-Oil Ratio "Rs"
- Reservoir Pressure < Oil Bubblepoint Pressure
- Productivity Index
- Flow Efficiency
- Reservoir Drive Mechanism
- Water Drive Main Producing Characteristics
- Gas Cap Drive Main Producing Characteristics
- Solution Gas Drive Main Producing Characteristics
- Completion Options and Aspects in Horizontal or High Deviated Sections
- Open Hole Completion
- Pre-Drilled or Slotted Liner
- Pre-Drilled or Slotted Liner with External Casing Packers
- Liner, Cemented and Perforated
- Open Hole With Pre-Drilled Liner & The Stand Alone Screen
- ECP'S- EXTERNAL CASING PACKERS
- CONTINUOUS MANDREL ECP
- PERFORATED SHOE
- Horizontal Completions
- Directional Down Hole Tools
- Mud Motor(DHM)
- Measurement While Drilling
- Drilling Mechanics Information
- Formation Properties
- Directional Surveying
- Surveying Guidelines
- Survey Tools
- Minimum Survey Program
- Survey Program For A Development well
- Survey Tool Selection
- Course Recap
- Drilling Fluids

- A- Objective of drilling fluids
- Drilling Fluid Composition
- Classification
- Disadvantages
- Dispersed Non-Inhibited fluid Formulation
- Non–Dispersed Non Inhibited
- Typical Formulation
- Oil Base Mud
- Advantages
- Course Recap
- Operations Integrity Management
- Steps of Program Implementation
- Management of Change MOC
- Definition of Well Integrity
- Factors affecting the Well Completion Selection & Design
- Completed Oil Well
- Completion Classifications
- Types of Completion
- Openhole Completions
- Well Completion Types
- Open Hole Completion Types
- Advantages of Openhole Completions
- Uncemented Liner Completions
- Screen/Pre-perforated Liner Completion
- Uncemented Liner Completions
- Perforated Liner Completion
- Cemented Liner Completion
- Cased Hole Completion Type
- Perforated Completions
- Completions for Pumping Wells
- Typical Artificial Lift Application Range
- Single String Flowing Well Completion
- Single Completion

- Single String Flowing Well Completion
- Multizone Completions
- Multi zone Completion Schematics
- Multi-Zone Completion
- Gas Producer Completions
- Completion Productivity
- Completion Productivity
- Oil Well Inflow Performance Relationship
- Pure Losses in Well System
- Inflow Performance Curve
- Outflow Performance Curve
- Nodal Analysis
- System Graph – Nodal Analysis
- Reservoir Pressure Drop
- Quantifying Well Flow Performance
- Reservoir Inflow
- Declining Oil Rate – Options?
- Improving Well Performance – Inflow
- Improving Well Performance – Outflow
- Nodal Analysis Basic Concepts
- COURSE RECAP
- Formation Damage Characterization & Prevention
- Risks Of Formation Damage
- Drilling Damage
- Perforation Damage
- Fluids Damage
- Sand Fill
- Maximizing Well Productivity
- Drilling Fluid Selection
- Perforating
- Selection And Treatment Of Completion Fluids
- Stimulation
- Key considerations in selecting stimulation method

- Collapse Loads
- Completion And Workover Fluids
- Basic Workover Fluid Functions
- Types Of Fluids
- Prepared Salt Water
- Optimum Completion Design
- Formation Definitions
- Completion Design Procedure
- Classify Formation
- Classify Formation
- Acidizing Techniques
- Matrix Stimulation
- Economic Formation Stimulation
- Stoichiometry
- Mineral Acids
- Organic Acids
- Acetic Acid
- Formic Acid
- Powdered Acids
- Acid Mixture
- Retarded Acid Systems
- Chemical Composition of Carbonates
- Classification and Origin of Carbonates
- Equilibrium Acid-Carbonate Reactions
- Matrix Stimulation of Carbonates
- Types of Acid stimulation
- Acid Reaction of Carbonates
- Acids used in Carbonate Acidizing
- Matrix Acidizing
- Acid Reactivity
- Organic Acids
- Matrix Acidizing
- Wormhole Penetration vs. Skin

- Injection Rates: Dissolution patterns
- Impact of Pump Rate and Temperature
- Wormhole Pattern from Radial Flow
- Matrix Acidizing
- Alternate Design Procedure For SS Acidizing
- Oil Well Stimulation
- Gas Wells
- Water Injection Wells
- Acid-Mutual Solvent Volume Requirements
- Mistakes
- Course Recap
- Hydraulic Fracturing Stimulation
- Four Steps of Treatment and Their Respective Functions
- Fracturing Treatment Selection
- Laboratory tests of formation samples for fracturing treatment guidelines
- Laboratory Tests Of Formation Samples For Fracturing Treatment Guidelines
- Laboratory Studies
- Porosity & Permeability Measurement
- Helium Porosimeter
- Description of tests and core needed
- X-Ray Diffraction
- Solubility Tests
- Thin Sections
- Description of tests and core needed
- Core Flow Tests
- Formation Properties Affecting the Orientation and Growth Pattern of Hydraulic Fractures
- Hydraulic Fracturing Fluids
- Storage and Mixing Requirements
- Course Recap
- Carbonate Acidizing
- Design of a Matrix Treatment
- Acid Fracturing
- Response of Carbonates to Acid Fracturing

- Matrix Stimulation
- Kinetics of HCl Reaction
- Key Factors in Carbonate Acidizing
- Wormhole Penetration vs. Skin
- Acid Reactivity
- Mineral Versus Organic Acids
- Injection Rates: Dissolution Patterns
- Impact of Pump Rate and Temperature
- Wormhole Pattern from Radial Flow
- Wormhole Growth for Various Rates
- Pore Level Model
- Placement
- Conclusions
- Course Recap
- Sandstone Acidizing
- Mineral Acids
- Oil Well Stimulation
- Acid-Mutual Solvent Volume Requirements
- Mistakes Found in the Application of the Acid-Mutual Solvent Method
- Paraffines & Asphaltenes
- Paraffines and Asphaltenes Characteristics
- Formation Damage
- Deposition Mitigation
- Paraffin and Asphaltene Removal
- Comparison of Horizontal and Fractured Vertical Wells
- Influence of Well Eccentricity
- Eccentricity
- Reservoirs W/ Water or Gas Coning
- Comparison of horizontal and fractured vertical wells
- Conventional Unconventional reservoirs
- Vertical Well Stimulation
- Multilateral Well
- New Tools

- Benefits of horizontal wells are:
- Disadvantages of horizontal wells are:
- Marginal Oil Wells
- Water Coning In Carbonate Reservoir
- Conclusions
- Horizontal and Multilateral Applications Overview
- Tight-gas formations
- Maximize Pay Zone
- Improve the productivity of wells in a fractured reservoir
- Rock Units that Benefit Most from Horizontal Drilling
- Relief well for well out of control
- Horizontal Drilling and Hydraulic Fracturing in Shales
- Multilateral drilling
- With Injection Of Co2
- Using Logs For Corrections In Drilling
- Real-Time Geosteering Takes Multilateral Wells
- Five Branch Multilateral Wells
- Multilateral Applications
- Logging For Horizontal Wells
- Logging
- The Transient Behavior Of Fluid Flow
- Ultrasonic Sensors For Monitoring Well Fluid Flow
- Extreme Production Logging In Long Horizontal Wells With High Flow Rates Using Downhole Tractors
- Extreme Logging With Tractors
- Multiphase Log. Horizontal
- Coil Tubing Logging
- Course Recap