COURSE OVERVIEW DE0100
Completion Design, Practices & Perforation (E-Learning Module)

Course Title
Completion Design, Practices & Perforation (E-Learning Module)

Course Reference
DE0100

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

This E-Learning is primarily designed for drilling, production and completion engineers and supervisors needing a practical understanding and an appreciation of completion design, practices and perforation.

It explains how completion configurations are varied to meet well objectives and to maximize well productivity. Design concepts and methods are presented together with downhole tools and their selection criteria.

Completion types and design for vertical, horizontal and multilateral wells, design and optimization of tubing based on tubing performance analysis (Inflow performance analysis, liquid and gas hold up during fluid flow and forces on tubing), downhole equipment, tubing accessories, wellhead equipment including sub sea completion.

Also, fluid flow through perforations and perforation techniques; communication tests; wireline operations; reservoir stimulation; and hydraulic fracture treatment design and optimization are extensively reviewed**.** Local case studies are also provided.

Course Objectives

After completing the course, the employee will:-

- Apply systematic techniques in completion design, practices and perforation
- Develop a high level completion strategy for wells in a variety of situations
- Select tubing, packers, and completion flow control equipment
- Appraise/design a suitable flow barrier strategy
- Make recommendations on installation and retrieval practices for tubing, packers, etc
- Identify key design features for horizontal, multilateral, HPHT wells, etc
- Select an appropriate intervention strategy/equipment
- Identify key features/applicability of the main sand control, fracpack and well stimulation options
- Assess/specify concerns/remedial measures for formation damage/ skin removal
- Develop and outline overall strategy for a completion program
- Optimize tubing dimensions for maximum production and estimate the pressure losses in tubing for different rock & fluid properties
- Use different subsurface completion equipments and accessories and select packers and packer settings
- Operate the well head equipments properly and calculate geometries and dimensions casing and tubing hangers
- Identify the different special consideration for horizontal and multilateral completions on wellbore, tubing and casing configuration
- Recognize the components of perforation of oil and gas wells such as completion fishing operations, well stimulation and fracturing, well testing, and well integrity
- Carryout the various procedures of communication tests
- Practice the process of wireline operations
- Discuss the elements of reservoir stimulation and increase the knowledge in understanding of stress and rock properties involved in the simulation techniques

Who Should Attend

This course covers systematic techniques and methodologies on completion design, practices and perforation for well and senior petroleum engineers, drilling and senior drilling supervisors, reservoir and senior reservoir engineers, geologists, production and completion engineers and supervisors needing a practical understanding and an appreciation of well completion design and operation, well stimulation and work over planning

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.

Course Fee

As per proposal

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 Contents

- Well Completion Design & Operation, Well Stimulation & Workover Planning
- Introduction
- Definitions
- What is Completion?
- What is Workover Operations?
- Well Maintenance
- Well Barriers
- Well Barriers Theory
- Barriers Theory
- Types of Barriers
- Mechanical
- Types of Barriers
- Mechanical Barriers Types
- Hydrostatic Barriers
- Barrier Classification
- Types of Barriers
- Surface Barrier
- Structural Barrier
- Geological Barrier

- Down Hole Barrier
- Hydrostatic Barriers
- Example Barrier Classifications
- Example Completion Barrier Envelopes
- Completion Barriers
- Well Integrity
- Definition of Well Integrity
- The Foundation of Well Integrity
- Why is Well Integrity Important?
- High Risk Well
- High Risk Wells
- Well Integrity Assurance Task Force
- Task Force Purpose and Scope
- Well Completion Types
- What is Completion?
- Introduction
- Well Design Considerations
- Generic Well Completion Design Process
- Factors Affecting - Well Completion & Workover Design
- Factors affecting the Well Completion Selection & Design
- Factors Affecting Well Completion & Workover Design
- Completed Oil Well
- Completion Classifications
- Types of Completion
- Completion Considerations
- Openhole Completions
- Well Completion Types
- Openhole Completions
- 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
- Mode of Production Flowing Artificial Lift
- Completions for Pumping Wells
- Application Range
- Typical Artificial Lift Application Range
- Number of Zones Completion
- Single String Flowing Well Completion
- Single Completion
- Single String Flowing Well Completion
- Multizone Completions
- Multiple Zones Completion Schematics
- Multi-Zone Completion
- Subsea Completion
- Multi-zone TFL Subsea Completion Schematic
- Gas Producer Completions
- Water Injection Completions
- Horizontal Water Injection Completions
- Course Recap
- Completion Equipment and Design Practices
- Tubing Selection
- Tubing
- Completion Design
- Tubing String Selection and Design Objectives
- Tubing Material
- Which Tubing Grade?
- Tubing Grade Examples
- Tubing Material
- Example of a Tubing-connection
- Tubing Selection Criteria - (Forces & Stresses -1)
- Example of API tubing specification

- Definitions
- Yield
- Yield Strength
- Tubing Selection Criteria - (Forces & Stresses - 2)
- Tubing Selection/Design Factors
- Tubing - Detailed Specification
- Tubing
- Key Message
- Tubing Burst
- Tubing Collapse
- Bending Stresses
- Couplings and Threads
- Well Completion
- Completion Accessory
- Packers
- What is the Packer?
- Why Run a Packer?
- Packers Applications
- Single Packer
- Dual Packer
- Packers-Mechanism
- Packer Types
- Retrievable Packers
- Permanent Packers
- Packer - Permanents Vs. Retrievable
- Inflatable Packers
- Tubing / Packer Forces and Movement
- Factors Causing Packer Forces or Tubing Movement
- Mechanical Forces
- Temperature or Thermal Effects
- Piston Force Effects
- Ballooning Effects
- Buckling Effects

- Slip and Seal Assembly
- Anchors
- Seating Nipples
- Landing Nipples
- Purposes of Seating Nipples
- Landing Nipple and Flow Coupling
- Selective Landing Nipples
- No-go Landing Nipples
- Sliding Sleeves
- Well Completion
- Circulation Device
- Sliding Sleeve Side Door – SSD
- Uses of Sliding Sleeves
- Side Pocket Mandrels
- Side Pocket mandrels (Courtesy of Camco, Houston)
- Anti-Erosion Device
- Blast Joints
- Flow Couplings
- Subsurface Safety Valves
- Flow-Controlled Safety Valves
- Surface-controlled Subsurface Safety Valves (SCSSSVs)
- SSSV Setting Depth
- Bottom-hole Chokes and Regulators
- Others
- Expansion Joint
- Completion Accessory Depth Rationalization
- Course Recap
- Perforation & Completion Design
- Wellbore Conditions While Perforating
- Overbalanced Perforating
- Shaped Charge Perforator
- The Perforation Process
- Factors Affecting Charge Performance

- Shaped Charge Components
- Perforating Techniques
- Reusable Hollow Carrier Gun
- Expendable Shaped Charge Gun
- Parameters Affecting Performance
- Pivot Gun
- Hollow Carrier
- Wire-line Expendable Guns
- Expendable Guns
- Initiation Systems
- Factors Affecting Perforating Efficiency
- Drilling and Perforating Damage
- Gravel Pack Screens
- Wellhead Pressure Control Equipment
- Charge Normalization
- Optimum Completion Design
- Productivity Ratio
- Formation Definitions
- Completion Design Procedure
- Classify Formation
- Determining Perforating Under-balance to Overcome Total Skin Damage
- Acoustic Data to Determine Δp
- Tubing Conveyed Perforating
- Applications of Wire Line Conveyed Perforating
- Firing Systems
- Gun Release
- Venting Devices
- Shot Detection
- Gun Positioning
- Dual Completions
- Standard Rod Pump Completions
- Perforation Cleaning
- Under-balance Perforating

- Perforation Washing
- Back-surging
- Artificial Lift
- Pressure Losses in Oil Production
- Main Types of Artificial Lift
- Gaslift
- Gas Lifted Well
- Kick-off (Continuous)
- Gas Lift
- Advantages
- Disadvantages
- Gas Lift is Preferred For
- Pumping
- Artificially Lifted Well – Downhole Pump
- Pumping - Best Applied When:
- Beam Pumping
- Conventional Beam Pump
- Pump Action
- Beam Pumping
- Advantages
- Disadvantages
- Electrical Submersible Pumps
- ESP with Y-Tool
- Hydraulic Pumping
- Jet Pumping
- Hydraulic Pumping
- Selection of Artificial Lift
- Summary
- Course Recap
- Formation Damage
- Formation Damage Impact
- Reservoir Pressure Profile
- Formation Damage Causes

- Drilling Fluid Damage
- Common Formation Damage Problems, Factors, and Mechanisms
- Injection Damage
- Production Damage
- Formation Damage Characterization
- Cause of Formation Damage
- Formation Damage Location
- Scale
- Solids/Particles Effects in Porous
- Drilling Damage
- Perforations
- Completion Fluids Damage
- Water Block Damage
- Damage Due to Production
- Damage Quantified through Skin Factor & Productivity Index
- Skin
- Radial Production and Skin (Darcy's Law)
- Geometric Skin - Flow through Perforation
- Geometric Skin – Partial Penetration
- Partial Penetration
- Geometric Skin – Deviated Wellbore
- Geometric Skin – Well with Hydraulic Fracture
- Completion Skin
- Gravel Pack
- Productivity Index
- Flow Efficiency
- Formation Damage
- Potential Sources of Formation
- Common Formation Damage Mechanisms
- Extraneous Materials
- Organic Deposition
- Mitigation Methods
- Treatment Fluids

- Sandstone Acidizing
- What is Well Stimulation?
- Well Stimulation
- Objectives of Acid Stimulation
- Stimulation Techniques
- Matrix Acidizing
- Chemical Stimulation Without Acid
- Mineral Acids
- Oil Well Stimulation
- Gas Wells
- Water Injection Wells
- Acid-Mutual Solvent Volume Requirements
- Mistakes Found in the Application of the Acid-Mutual Solvent Method
- Use of acids containing no hydrogen fluoride (HF)
- Use of diesel oil in the treatment of gas wells
- Omission of EGMBE from the mud acid treatment
- Lack of a regular acid preflush
- Inadequate acid volume
- Lack of immediate cleanup
- Fracturing the formation during treatment
- Carbonate Acidizing
- Matrix Stimulation
- Design of a Matrix Treatment
- Acid Fracturing
- Response of Carbonates to Acid Fracturing
- Matrix Stimulation
- Stoichiometry
- 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
- What is Hydraulic Fracturing?
- Hydraulic Fracturing Equipment
- Proppant
- Fracturing Fluids
- Cross Linked Gel with Proppant Sample
- Broken Sample
- Hydraulic Fracture Treatment Process
- Mini Frac or Data Frac Schedule
- Mini Frac or Data Frac Plot
- Main Frac Treatment Schedule
- Main Frac Treatment Plot
- Fracture Shape & Dimensions
- Hydraulic Fracture Treatment Process
- Functions of PAD & Flush
- Hydraulic Fracture Treatment Process
- PAD and Proppant
- Proppant Distribution
- Net Pressure
- Schematic of Net Pressure
- Measuring of Net Pressure
- Fracture Height
- Fracture Height vs. $P_{net}/ \Delta\sigma_{min}$ Ratio
- Fracture Half Length (X_f)
- Expressions in Hydraulic Frac
- Harsh Environment for Hydraulic Fracturing
- Why Some Treatments do not Work as Well as Expected?
- Proppant Settling

- Hydraulic Fracturing
- High Permeability Formations
- Hydraulic Fracturing
- Low Permeability Formation
- Ideal Reservoir Properties
- Design Parameters That We Can Control
- Measured or Estimated Parameters (Uncontrollable)
- Ideal Reservoir Properties
- Design Parameters That We Can Control
- Measured or Estimated Parameters (Uncontrollable)
- Scale Deposition
- Causes and Tendency of Scale
- Prediction and Identification of Scale
- Scale Removal
- Removal Methods
- Mechanical Removal Methods
- Chemical Removal Methods
- Inhibition of Scale with Organic Phosphates and Phosphonates
- Inhibiting Scale with Polymers
- Conclusions
- Scale Deposits
- Causes of Scaling
- Action to Solve Scale Problems
- Workover Planning & Problem Recognition
- What is a Workover?
- Workover Methods
- Reasons for Working Over a Well
- Service Unit Functions
- Workover Rigs Functions
- What is the Tools used for Well Analysis?
- Well Analysis Tools
- Characteristic of Problem Wells
- Water Control Problem Identification & Solutions - Problem Types

- Water Production Mechanisms
- Water Cut
- Well Analysis
- The Well Maintenance Requirements for a Completion
- Well Maintenance
- Workover Types
- Stimulation
- Workover Involving Drilling
- Workover Operations
- Summary of Common Problems & Workover Operations