

# Subsurface Production Operations and Artificial Lift Technologies

## INTRODUCTION

- This Subsurface Production Operations and Artificial Lift Technologies training course first provide an overview of well-performance evaluation leading to the determination of well conditions necessitating the application of artificial lift and stimulation operations. It will also give an overview of formation damage and the remediation techniques, covering all causes of the formation damage (during drilling, cementing, production).
- Then, the various types of artificial lift systems along with their selection criteria, will be presented. The theoretical and practical aspects of the most essential artificial lift methods will be covered. At the end of the training course, the participants will have a sound knowledge of the theory underlying each technique as well as a broad view of the relative advantages, disadvantages, niche of applications and limitations of each artificial lift system.

This training course will feature:

- Reservoir Performance: Inflow and Outflow Relationships
- Reservoir Properties Review - What properties most influence the effect of formation damage?
- Damage Mechanisms - How are sandstones and carbonates damaged, how do formation mineralogy and clay chemistry influence damage, what about scale, paraffin, etc.
- Damage Prevention - drilling completion, and production methods, drilling / completion fluid and additive selection
- Evaluation of Damage - production performance, pressure analysis review
- Damage Removal - acidizing materials and methods, non-acid approaches, such as wellbore washes, perforating techniques, and hydraulic fracturing to bypass damage, etc.
- Overview of the Artificial Lift Technologies
- Equipment and Accessories of the Artificial Lift Systems
- Artificial Lift Screening: Criteria for Selection of the Artificial Lift Systems
- Design of the Artificial Lift Systems
- Limitation and Advantages of the Artificial Lift Systems

## OBJECTIVES

By the end of this training course, participants will learn to:

- Apply and gain in-depth knowledge on subsurface production operations
- Discuss the inflow and outflow performances
- Make analysis & evaluation of formation damage and its effect on production performance
- Improve the technical background about formation damage in terms of causes, prevention and finding remedies & solutions
- Describe perforation methods, formation damage, matrix acidizing and hydraulic fracturing
- Apply and gain proper techniques on artificial lift systems and optimization technology
- Discuss gas lift systems, ESP systems, sucker rod pumping, jet pumps, hydraulic pumps and progressive cavity pumps
- Discuss criteria for artificial lift system selection and artificial lift screening methods
- Select the appropriate artificial lift system
- Compare systems to determine what system is most economically feasible
- Specify components and auxiliary equipment needed for each system
- Classify best practices available to extend the life of the equipment and installed lift systems
- Design system features that allow for gassy production, production with solids, viscous production, and for other harsh environments

## TRAINING METHODOLOGY

- This Subsurface Production Operations and Artificial Lift Technologies training course will utilize a variety of proven adult learning techniques to ensure maximum understanding, comprehension and retention of the information presented. This training course is designed as a blended environment of presentation, workshops, group work, practical exercises, field application/analysis and several industry videos showing all processes, and general discussions.

## ORGANISATIONAL IMPACT

The participants will get the knowledge that allows them to identify the theories behind the practical applications of the artificial lift technologies and stimulation operations. That will help to:

- Improve the performance at the workplace
- Enhance the integration between the technical and management team inside the company
- Apply the latest technologies for the oil and gas subsurface production operations (Artificial Lift Technologies and Stimulation Operations)
- Integrate between the activities of the upstream and downstream operations
- Apply the Interdisciplinary Synergistic approach to understand and solve the operational problems and troubleshooting
- Apply the proper techniques for the field's development projects

## **PERSONAL IMPACT**

By the end of this training course, delegates will be able to understand the concepts of the subsurface production operations and artificial lift techniques. They will be able to:

- Identify the reasons of the production decline from the oil wells (mechanical problems or formation damage problems)
- Understand the causes of the formation damage and select the proper ways to prevent and find remedies & solutions for such problems
- Be familiar with the stimulation operations and artificial lift techniques
- Understand the perforation methods, matrix acidizing and hydraulic fracturing techniques
- Understand the idea and concept behind each of the artificial lift techniques
- Select the suitable and proper artificial lift method for any specific well
- Use different ways to operate the oil wells efficiently and deal with the troubleshooting properly

## **WHO SHOULD ATTEND?**

This training course is suitable for a wide range of professionals but will greatly benefit:

- Petroleum and Production Engineers
- Completion, Reservoir and Drilling Engineers concerned with well performance & production enhancement facilities
- Supervisors, Field Operators and Technicians
- Other Company Staff involved in subsurface production operations
- Petroleum Engineers who are new to the profession
- Managers and Government Officials and others involved with the production systems
- Technical and Operations Staff from other disciplines, which require a cross-training to or a basic understanding of the subsurface production operations

## **Course Outline**

### **Reservoir Performance – Inflow and Outflow Relationships**

- Reservoir Performance: Wellbore and Reservoir Performance Overview
- Pressure Loss in the Wellbore
- Well Productivity
- Concepts of Productivity Index
- Inflow and Outflow Relationships

## Formation Damage

- Formation Damage
- Well Production Problems: Asphaltenes, Waxes, Hydrates, Inorganic, Scale Formation, Corrosion
- Drilling-induced Formation Damage
- Damage Mechanisms - How are sandstones and carbonates damaged, how do formation mineralogy and clay chemistry influence damage, what about scale, paraffin, etc.
- Formation Damage Causes
- Formation Damage caused by Completion and Workover Fluids: Damage during Perforating and Cementing
- Formation Damage caused by Fines Mitigation
- Formation Damage caused by Swelling Clays
- Formation Damage in Injection Wells
- Formation Damage resulting from Paraffins and Asphaltenes
- Formation Damage resulting from Emulsion and Sludge Formation
- Formation Damage resulting from Condensate Banking
- Formation Damage resulting from Gas Breakout
- Formation Damage resulting from Water Blocks,
- Formation Damage resulting from Wettability Alteration, Bacterial Plugging

## Stimulation Operations / Why and When do we need Artificial Lift?

- Damage Prevention
- Evaluation of Damage - Production Performance and Pressure Analysis Review
- Damage Removal: Two Basic Acidizing Treatments and Acidizing Materials and Methods
- Damage Removal by Chemical Solvents
- Acid Type and Concentration
- Evaluation of Acid Treatments
- Impact of Changing Well Conditions and Need for Artificial Lift
- Overview of Artificial Lift Technology: Sucker Rod Pump Design, Hydraulic Pump Design, Jet Pump, Gas Lift, Electric Submersible Pump (ESP)
- Application of Artificial Lift Technology and its Limitations
- Artificial Lift Screening Methods

## Sucker Rod Pumping and Gas Lift System

- Sucker Rod Pump Concept
- Limitations and Advantages of the Sucker Rod Pumping System
- Components of the Sucker Rod Pump
- Design of the Sucker Rod Pump
- Troubleshooting of the Sucker Rod Pump Systems
- Gas Lift Concept
- Gas Lift Types: Continuous and Intermittent Gas Lift
- Main Components of the Gas List System: Mandrels and Valves
- Gas Lift Design
- Effects of Temperature and Chokes
- Valve Spacing

## ESP System, Hydraulic & Jet Pumping and PCP systems

- Concept of the Electric Submersible Pump (ESP) System
- Equipment and Accessories of the ESP Systems
- ESP Design: Pump Performance Curves, Pump Intake Curves, Typical Problems, Installation, Troubleshooting - Best Practices for Installation and Maintenance
- Steps to Correctly Size an ESP System - Basic Sizing Principles for the Pump, Motor and Cable
- Importance of Correctly Matching Well Productivity to Pump Performance
- Use of Data to Diagnose Well / Equipment Problems
- Limitation and Advantages of the ESP System
- Concept of the Hydraulic Pumps
- Limitation and Advantages of the Hydraulic Pumps
- Concept of the Jet Pumping
- Limitation and Advantages of the Jet Pumps
- Concept of the Progressing Cavity Pump (PCP) Pumps
- Limitation and Advantages of the PCP Pumps
- Best Practices for Installation and Maintenance
- Criteria for Selection of Artificial Lift Systems and Artificial Lift Screening Methods