MERCURY

# Geomechanics and Wellbore Stability in Oil and Gas

7 – 11 July 2027
Paris (France)



Dubai - UAE: +971 4 450 5697
Istanbul - Türkiye: +90 539 599 1206
Amman - Jordan: +962 79 712 3347

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**Ref:** 121466_1039430 **Date:** 7 – 11 July 2027 **Location:** Paris (France) **Fees:** 6900 Euro

## Introduction

The Geomechanics and Wellbore Stability in Oil and Gas course provides a foundation for understanding subsurface mechanical behavior and its impact on drilling operations. It explores how rock mechanics, in-situ stress, and pore pressure influence wellbore integrity and drilling performance. Participants will gain insights into wellbore stability analysis, failure mechanisms, and practical mitigation strategies. The course bridges theoretical concepts and real-world oil and gas applications, emphasizing safe, cost-effective drilling practices. It also covers modern techniques in geomechanical modeling and stability prediction for complex reservoirs. Learners evaluate drilling risks and optimize well design in challenging geological environments.

## Targeted Groups

This Geomechanics and Wellbore Stability in Oil and Gas training targets professionals seeking knowledge and skills:

- Drilling engineers are involved in well planning.
- Petroleum engineers manage reservoir performance.
- Geologists are analyzing subsurface formations.
- Geomechanics specialists and analysts.
- Wellsite supervisors and drilling supervisors.
- Mud engineers are optimizing the design of drilling fluids.
- Completion engineers working on well integrity.
- Technical professionals in oilfield services.

## Course Objectives

Participants will achieve the following objectives by completing the Geomechanics and Wellbore Stability in Oil and Gas course:

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- Understand fundamental principles of rock mechanics in drilling.
- Identify in-situ stress regimes and their implications.
- Analyze the relationships between pore pressure and fracture pressure.
- Evaluate wellbore stability challenges in different formations.
- Apply geomechanical models for well planning.
- Interpret stress logs and formation strength data.
- Assess the impact of drilling fluid on borehole stability.
- Design safe mud weight windows for operations.
- Predict wellbore failure mechanisms and risks.
- Optimize drilling parameters for stability control.
- Integrate geomechanics into reservoir management strategies.
- Improve decision-making in complex drilling environments.

## Targeted Competencies

Participants will gain the following competencies during the Geomechanics and Wellbore Stability in Oil and Gas program:

- Ability to interpret geomechanical data accurately.
- Skills in wellbore stability analysis and prediction.
- Knowledge of stress distribution and rock behavior.
- Competence in selecting appropriate drilling fluid systems.
- Capability to design safe and efficient well trajectories.
- Understanding of formation pressure evaluation techniques.
- Ability to mitigate borehole collapse and fracturing risks.
- Skills in applying geomechanical software tools.
- Competence in integrating data from multiple sources.
- Improved analytical thinking in drilling operations.

## Studying Scenarios

In this Geomechanics and Wellbore Stability in Oil and Gas training, participants develop skills through the following scenarios:

- Evaluating wellbore collapse in shale formations.
- Designing mud weight programs for deep wells.
- Analyzing lost circulation and fracture gradients.
- Interpreting real-time drilling data for stability issues.
- Assessing stress changes during drilling operations.
- Planning wells in high-pressure, high-temperature reservoirs.

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# Course Content

## Unit 1: Fundamentals of Geomechanics in Oil and Gas

- Definition of geomechanics in drilling operations.
- Importance of geomechanics in the oil and gas industry.
- Overview of rock mechanics principles.
- Types of rocks and their mechanical properties.
- Stress and strain concepts in subsurface formations.
- Elastic and plastic deformation behavior.
- Introduction to in-situ stress and stress regimes.
- Relationship between geomechanics and wellbore stability.

## Unit 2: In-Situ Stress and Formation Pressure Analysis

- Types of in-situ stresses: vertical, horizontal, and shear.
- Methods for measuring subsurface stress.
- Pore pressure prediction techniques in drilling.
- Normal, abnormal, and overpressure conditions.
- Fracture pressure and its significance.
- Stress gradients and their impact on well design.
- Leak-off tests and formation integrity tests.
- Integration of pressure data into drilling plans.

## Unit 3: Wellbore Stability Analysis and Failure Mechanisms

- Definition and importance of wellbore stability analysis.
- Types of wellbore instability issues in drilling.
- Borehole collapse mechanisms in weak formations.
- Tensile failure and hydraulic fracturing effects.
- Shear failure and breakout formation.
- Time-dependent wellbore instability behavior.
- Impact of anisotropic formations on stability.
- Use of stability models in drilling optimization.

## Unit 4: Drilling Fluids and Mud Weight Optimization

- Role of drilling fluids in wellbore stability.
- Mud weight window determination for safe drilling.
- Effects of fluid density on formation stability.
- Interaction between drilling fluids and rock formations.
- Designing mud programs for different formations.
- Minimizing formation damage during drilling.
- Lost circulation and its impact on stability.
- Real-time monitoring of drilling fluid performance.

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## Unit 5: Advanced Applications and Geomechanical Modeling

- Introduction to geomechanical modeling techniques.
- 1D, 2D, and 3D geomechanical models.
- Data integration for accurate modeling.
- Well trajectory optimization using geomechanics.
- Stability analysis in deviated and horizontal wells.
- Applications in unconventional reservoirs.
- Risk assessment and mitigation strategies.
- Use of software tools for geomechanics analysis.

## Final Insights & Key Takeaways

Understanding geomechanics and wellbore stability is essential for minimizing drilling risks and optimizing operational efficiency in the oil and gas sector. Applying advanced stability analysis and modeling techniques enables safer well design and improved performance in complex geological conditions.