Course Overview

Deepwater wells are amongst the most difficult and expensive to drill anywhere in the world. The Course Structure focuses upon the latest considerations and technologies which are now routinely being used on today’s difficult, costly and challenging deepwater wells so that both Engineering & Operations staff are aware of the advantages in using such considerations and technology. The Course also covers both successful and unsuccessful Case Histories in deepwater drilling from around the globe as reported by Operators, Drilling Contractors & Service / Supply Companies.

This course examines the difficulties, challenges and problems facing today’s deepwater drilling programme designers and personnel where wells are being drilled in increasingly difficult downhole and environmental conditions with ever increasing cost and legislation further contributing to design and operational pressures. Through offering potential and proven solutions to the problems facing today’s deepwater personnel, delegates will be able to maximise drilling safety, efficiency and hydrocarbon production whilst, at the same time, minimising cost and risk on these highly expensive and potentially very difficult wells.

Case histories referencing both successes and failures are referred to throughout the course to maximise the learning / experience transfer process and delegates will have the opportunity to both critique and examine recent deepwater well failures and successes drilled in different parts of the world to complete, through teamwork study, the knowledge-gain process. In order to climb the learning curve as expeditiously and effectively as possible, the course comprises five modules. Five modules are a more effective way of learning than one large module. They are all specifically designed to take personnel with existing offshore experience into the deepwater arena through the use of training material (text, examples, videos and calculations) and teamwork exercises such that personnel, at the end of these modules, know how to design and drill difficult deepwater wells with semi-submersible rigs and drillships safely, economically and optimally.

Emphasis is based upon a combination of theory, practise, planning and operations so that, by the end of the course, through teamwork exercises, delegates will be able to design their own deepwater drilling programme and be aware of the risks – and mitigations – involved. Actual case histories worldwide will be covered (through the referencing of Industry / SPE papers) so that delegates become familiar very quickly with the risks, dangers and remarkable successes which can be attributed to deepwater wells with both semi-submersible rigs and drill ships (up to and including the latest generation of vessel).

Course material is a combination of text, diagrams, videos, graphics, schematics and shown examples.

Aims & Objectives

By the end of the course, delegates will understand the key drivers behind successful Deepwater Drilling Optimisation so that their wells are successful. Delegates will also benefit from the successes – and failures – of deepwater wells worldwide and what can be done to maximise success and minimise failure. Consultancy services can be provided both before the course (e.g. certain wells / problems can be looked at), during the course (e.g. certain problems can be reviewed) or after the course (e.g. advice / well review) should delegates require.

Who Should Attend

This deepwater well engineering course has been specifically written for drilling personnel who are involved either directly or indirectly with well engineering / well construction and for those personnel who have an interest in deepwater drilling engineering but who might be from another discipline – such as completion, testing or production for example – whether office or offshore based.

Personnel from operators, drilling contractors, service providers, equipment suppliers and regulatory agencies will benefit from this course where a mix of management, planning, engineering and offshore considerations are blended to cover the whole mix of considerations which constitute the deepwater well engineering process, culminating in deepwater drilling programme review through teamwork exercises.
Your Dedicated Coach

Michael Gibson (PhD)

**Overview**

- Seasoned professional with 35 years’ worldwide experience on drill-ships, semi-submersibles, tender-assist units, platforms, jack-ups and land rigs.
- Extensive experience both onshore and offshore in engineering and operations for Operators and Drilling Contractors on exploration, appraisal & development wells.
- Extensive risk assessment, advisory, planning and rig-site work experience ranging from Drilling Engineer through to Drilling Supervisor, Superintendent & Drilling Manager.

**Training**

Training experience worldwide ranges across Operators, Drilling Contractors and Service Companies both in-house and public in the following areas:-

- HPHT
- Stuck Pipe Prevention & Fishing
- Deepwater Well Engineering
- Deepwater Operations
- Directional Drilling
- Horizontal & Multilateral Wells
- Accelerated Drilling Programmes for Drilling Contractors
- Graduate Drilling Engineering for Operators
- Optimised Drilling Practices
- Well Planning & Engineering
- Well Construction
- Well Control (Advanced, Understanding, Deepwater & HPHT)

**Consultancy**

Engineering & Operations Advisor to Operators, Drilling Contractors, Banks & Insurance Companies worldwide re Drilling & Field Development, Risk & Blowouts

- Hazard Analysis
- Offshore Operations
- Technical Advisor for HPHT Developments
- Well Control
- Technical Advisor for Deepwater Operations

**Project**

- Project Manager for HPHT Field Development; Standard Field Development
- Production Optimisation
- Risk Mitigation
- Brownfield Re-development
- Deepwater
- Well Control
- Management Systems

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MODULE 1: PRIOR TO DRILLING

1.0 WELCOME, INTRODUCTION & COURSE OVERVIEW

2.0 INDUSTRY DEFINITIONS OF DEEPWATER & ULTRA DEEPWATER

3.0 THE COMMONEST REASONS WHY DEEPWATER WELLS OVER-RUN IN TERMS OF COST / WHY THEY FAIL TO MEET THEIR OBJECTIVES

4.0 THE DEEPWATER ENVIRONMENT

4.1 The Environment

An introduction to the deeper water environment (i.e. deeper than standard semi-submersible rig water depth limitations) – what the key environmental considerations are, such as currents (current profiles from the sea-bed to surface will be discussed), waves, and combined current / wind / wave force loadings.

4.2 Environmental Effects on Marine Vessels

How the environmental loadings referenced above affect / impact marine vessels, such as vessel movement in the lateral plane, vertical plane and intermediate planes – pitch, yaw and heave. The effects of these forces and movements upon vessel stability.

5.0 DRILLING VESSELS FOR DEEPWATER: RIG / DRILL-SHIP SELECTION

5.1 An Introduction to Semi-Submersible Rigs & Drill Ships & Their Usage

Capabilities of deepwater semi-submersible rigs.Capabilities of deepwater drillships. The key attributes – and differences – in their designs and capabilities. When semi-submersibles are typically used and when drill ships are typically used.

5.2 Semi-submersible Rig Stability & Station Keeping

The effects of current / wind / wave force loadings and shallow gas eruptions upon rig stability:– metacentric height, centre of gravity and survivability.

The Eirik Raude Deepwater Semi-submersible Rig
5.3 Drill Ship Stability & Station Keeping

An introduction to drill ship vessel design – how the different generations and classes of drill ships have been designed to cope with environmental loadings and water depth. A look at the different designs / classes of drill ship available, their design and functional characteristics, their capabilities and limitations. The effects of current / wind / wave force loadings and shallow gas eruptions upon drill ship stability.

6.0 PRIOR TO SPUDDING THE WELL

6.1 Sea-bed Surveys Prior to Spudding the Well

The use of vessels using sonar / side-scan sonar to acquire sea-bed data. The use of ROV’s and video cameras to survey the sea-bed. Grab samples. Core samples.

6.2 Shallow Gas Surveys Prior to Spudding the Well

The way in which shallow gas seismic data is acquired, what to look for and what the risks are.

6.3 Other Typical Deepwater Formation Issues

Methane gas seeps, mud volcanoes and weak formations.

6.4 The Problems Associated with Weak Formations

Why weak formations are such a problematic issue on deepwater wells – the effect on casing shoe strength and kick tolerance.

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**MODULE 2 : DRILLING UNIT 1**

1.0 **SPUDDING THE WELL : TOP HOLE & RUNNING THE CONDUCTOR**

1.1 Method 1 : Drilling

This section of the course looks at drilling the top-hole section to TD as opposed to washing and covers the benefits and disadvantages of such methodology. The problems of encountering weak formations are discussed and potential solutions are covered.

1.2 Method 2 : Washing the Top Hole Section

This section of the course looks at washing the conductor to section TD – the advantages and disadvantages – specifically where sea-bed formations are weak and drilling and cementing the conductor is not effective.

2.0 **DRILLING SURFACE HOLE**

The course now looks at the cases of exploration, appraisal and development wells with regard to drilling surface hole below the conductor. The case of drilling below the washed conductor is covered as is the case of drilling below the drilled and cemented conductor. The risk of shallow gas is covered and what a semi-submersible rig or drill ship should do if shallow gas is encountered. The surface casing string setting depth : The impact of typically weak formation upon casing shoe strength and kick tolerance.

3.0 **RUNNING THE SURFACE CASING STRING**

In all cases typically the surface casing string is cemented back to surface. Cement returns are seen at the sea-bed through exit ports in the wellhead assembly by the ROV. Once cemented in place (usually deeper than any shallow gas section) the 18¾” High Pressure Housing is exposed. The purposes of this housing are discussed for exploration, appraisal and development wells.

4.0 **SUBSEA DRILLING EQUIPMENT**

The following key items of subsea drilling equipment are covered in relative detail, such that functionality, design and service are covered – and understood – by the delegates.

4.1 **Subsea Wellheads**

Design and functionality, casing hangers, pack-off systems, set-down and rotation. The 30” Housing; the 18¾” High Pressure Housing (which connects to the H4 Connector); Subsequent casing string housing; sealing assemblies.

Videos will show how casing strings are landed and how the pack-offs are activated.

4.2 **Temporary and Permanent Guidebases**

Their design, functionality and operation.

4.3 **Subsea Templates**

Their design, functionality and operation.

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4.4 Subsea BOP Stack
This is, necessarily, a very detailed section, since subsea BOPE varies considerably from surface BOP stacks. Their design and functionality is covered – the 4 rams and 2 annular preventers – subsea hydraulics – and all ancillary equipment. When and how the BOP stack is run; how it lands and latches onto the 18¾” High Pressure Housing with the H4 Connector; how it is tested; use of overpull. The use of the “blue” and the “yellow” pod system. Hydraulic signals. MUX signals. Annular Preventers; Rams; Redundancy; Use of Acoustics / Deadman Emergency System.

4.5 The H4 Connector
Their design, functionality and operation will be covered.

4.6 LMRP – Lower Marine Riser Package
Their design, functionality and operation will be covered. Why a 10 Degree limitation is required. Ball-joints and Flex-joints will be discussed.

4.7 The Riser System
Their design, functionality and operation will be covered. Essential riser maintenance. The two systems of joining riser joints together. Automated riser handling systems. Choke and Kill lines. The problems of long risers – fatigue, cleaning-out drilled cuttings (use of riser boost pumps), buoyancy, mud cooling etc.

4.8 Telescopic Joints / Slip Joints
Their design, functionality and operation will be covered with particular respect to how the system compensates for rig heave.

4.9 Riser Tensioner
The design, functionality and operation will be covered with particular respect to how the system applies tension to the riser.

5.0 Heave Compensator
The design, functionality and operation will be covered with particular respect to how the system compensates for rig heave. System charge pressure will also be discussed and video will be used to explain the principles.
1.0 DRILLING BELOW THE SURFACE CASING STRING: SUBSEA BOP STACK INSTALLED

Now that we have covered key subsea equipment and its landing and utilisation after drilling top hole and surface hole, we will look at drilling the subsequent (i.e. deeper) hole sections — 17¾” / 16”, 12¼”, 8¾” / 6” hole sections and study the problems associated with drilling these sections. This will be done in overview format, since the delegates will already be experienced in drilling (though perhaps in other areas).

One of the key areas in any drilling operation is, of course, well control. Surface stack personnel may not be aware of choke and kill line considerations, and how the choke line friction factor significantly affects what we see on the SICP Casing Pressure Gauge. This will be addressed in the next section, as will all items of equipment — design, functionality, operability and capability.

1.1 Key Drilling Issues — Potential Problems and Solutions

There are, potentially, many problems associated with deepwater drilling and the following areas / topics are discussed in appropriate detail.

1.2 The Problems Associated With Drilling Weak Formations — And Potential Solutions

The problems associated with weak / unconsolidated formations e.g. wellbore collapse, hole cleaning, poor casing shoe strength and kick tolerance etc. Potential solutions e.g. rock mechanics to determine minimum mud weight requirement; drilling fluids and chemistry / inhibition; minimum flow rates to determine optimal hole cleaning; the use of PWD to determine ECD; casing shoe setting depth; FIT as opposed to LOT; squeeze cementing; the use of expandables.

Using PWD to Monitor Surge Pressures

1.3 The Problems Associated With Drilling Deep Wells — And Potential Solutions

Cuttings transportation and the necessity of a riser boost pump; the effects of temperature changes upon the mud system; parasitic pressure losses; hydraulics; how to optimise drilling fluids selection; bit selection and economics; casing and cementation. Casing Setting Depths. Hydrates.

Hydrates Around H4 Connector, Offshore Angola
1.4 Introduction to Deepwater Well Control

One of the key areas in any drilling operation is, of course, well control. Surface stack personnel may not be aware of choke and kill line considerations, and how the choke line friction factor significantly affects what we see on the SICP Casing Pressure Gauge. This will be addressed in this section, as will all items of equipment – design, functionality, operability and capability.


1.5 Drilling to Well TD

Having covered subsea well control, videos will portray how the well is drilled to TD so that the delegates gain a good, full understanding of subsea drilling operations. A subsea drilling programme will be cross-referenced to maximise learning.

1.6 Emergency Operations whilst Drilling


1.0 EXAMINATION / REVIEW OF RECENT DEEPWATER DRILLING FAILURES AND SUCCESSES

This section of the course looks at recent failures and successes regarding both ends of the spectrum re deepwater drilling.

The first examination invites delegates to review the likely causes of a recent deepwater well failure which resulted in a catastrophe and the second examination invites delegates to review a recent deepwater well which was successful and to compare the differences and results between the two wells.

This is a teamwork exercise and the findings / results will “feed into” the final day of the course – a teamwork exercise where delegates are invited to partake in their own teamwork deepwater well design.

1.0 DEEPWATER WELL DESIGN TEAMWORK EXERCISE

During this final day of the course, delegates will work as teams to design, in outline, their own deepwater well and derive an outline drilling programme re their designed well so that the key objectives of maximum safety, maximum efficiency, maximum oil production and maximum profitability are attained.

It is expected that all of the course material will be utilised during the exercise and that the findings from the recent deepwater well failure and deepwater well success will be utilised.

A “key points overview” presentation will be given by the teams toward the end of the course to show that course learnings have been fully understood and assimilated.
IDEAS (Independent Drilling Engineering Associates) is a **thinking** company. It **focuses** its in-depth and holistic knowledge, breadth of experience and expertise onto operators, drilling contractors and service companies’ drilling engineering and related work requirements, to provide top quality fast turnaround bespoke work packages on either an ad-hoc or long term basis, 24 hrs per day / 365 days per year, worldwide.

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