

# Work scope proposal for:

**Training Event:** Deepwater Drilling Fundamentals

*i.e. How to Plan, Design, Engineer and Drill Deepwater wells.*

**Date:** 4<sup>th</sup> – 16<sup>th</sup> August 2024.

**Venue:** On-line

**Client:** Public Course

**Training Provider:** Kingdom Drilling Services Ltd.

**Training Provider Contact:** Peter Aird. *C.Eng., C.Mar.Eng., F.I.Mar.E.S.T.*

*Email:* [kingdomdriller@outlook.com](mailto:kingdomdriller@outlook.com)

*Contact No: Mobile: +44 77 2870 9770*

*Home/Office +44 1592 771263*

## **Course Cost.**

First 6: participants £2,000pp,

Participants, 7 – 15, 9 £2,500pp.

**(Maximum 15 persons per course)**



# Deepwater Drilling Fundamentals,

How to Plan, Design, Engineer, and Drill Deepwater wells.

On line Course Outline, Week 1.



Monday	Tuesday	Wednesday	Thursday	Friday

DRILLING

TRAINING

# Deepwater Drilling Fundamentals,

How to Plan, Design, Engineer, and Drill Deepwater wells.

On-line Course Outline, Week 2.



Monday	Tuesday	Wednesday	Thursday	Friday

DRILLING

TRAINING

## Table of contents (Course Sessions).

### Deepwater Drilling Fundamentals

How to Plan, Design, Engineer, and Drill Deepwater wells

*Course Intro: Group session: Introductions, goals and objectives.*

#### **WEEK 1,**

##### **Day 1. Deepwater Differences and essentials. (4hrs instruction)**

- 1.1 Challenges and essential differences in deepwater. (Book chapters 1-5)
- 1.2 Rigs, equipment, and essential systems difference in deepwater. (Book Ch 1-5.)
- 1.3 Deepwater Metocean Environments. (book chapter 4)

*Deepwater Case study sessions and general exercise handouts.*

**Day 1 Debrief. Asynchronous Homework.**

##### **Day 2. Deepwater Differences and essentials. (4 hrs instruction)**

- 2.1 Geology and geoscience essentials and differences (Book chapter 2.)
- 2.2 Pressure management in deepwater environments. (Book Chapter 3.)

*Deepwater Case study sessions and general exercise handouts.*

**Day 2 Debrief. Asynchronous Homework.**

##### **Day 3 Managing & Planning Deepwater Projects. (4hrs instruction)**

Day 3 Projects, PD&E. Hazards (loss), risks and change.

- 3.1 Managing and Planning Deepwater Drilling Projects (Book Chapter 5,6,7,10,11)
- 3.2 Deepwater Hazards, risks, & loss control management. (Various chapters.)
- 3.3 Introduction to Latent Cause analysis (loss investigation).

*Deepwater Case study sessions and exercise (handouts).*

**Day 3 Debrief. Asynchronous Homework.**

##### **Day 4 Deepwater Well Engineering. (4hrs instruction)**

- 4.1 Deepwater well engineering. (Chapters 7-9)
- 4.2 Drilling Fluids PD&E (Supplementary material to be provided.)
- 4.3 Deepwater PD&E Cementing. (Supplementary material to be provided.)

*Case study sessions and exercise (handouts).*

**Day 4 Debrief. Asynchronous Homework.**

##### **Day 5 Deepwater Well Design. (4hrs instruction)**

- 5.1 Structural well design PD&E (Chapter 7)
- 5.2 Design case study and examples.

*Deepwater case study, class project group session/exercises*

**Day 5 Debrief. Asynchronous Homework.**

## WEEK TWO.

### Day 6 Deepwater Well Design. (4hrs instruction)

6.1 Deepwater casing design, PD&E (Chapter 8.)

6.2 Design case study examples.

*Deepwater casing design case study group session.*

**Day 6 Debrief. Asynchronous Homework.**

### Day 7 Deepwater Drilling Operations. (4hrs instruction)

7.1 Subsea capital equipment introduction. (Chapters 5, 14)

7.2 Marine riser PD&E (Chapter 14.)

*7.3 Deepwater Marine riser and subsea capital equipment group session  
Case study sessions and exercise handouts.*

**Day 7 Debrief. Asynchronous Homework.**

### Day 8 Deepwater Drilling Operations. (4hrs instruction)

8.1. Deepwater riserless drilling PD&E essentials (Chapter 12)

8.2 Deepwater riserless drilling PD&E best practices (Chapter 13)

8.3 *Deepwater riserless drilling PD&E case study group session.*

*Case study sessions and exercise handouts.*

**Day 8 Debrief. Asynchronous Homework.**

### Day 9 Deepwater Drilling Operations. (4hrs instruction)

9.1 Post riser intermediate sections), PD&E Essentials. (Chapters 15-16)

9.2 Post riser Production sections, PD&E Essentials. (Chapters 15-16)

9.3 *Post riser PD&E cases study, group session.*

*Case study sessions and exercise handouts.*

**Day 9 Debrief. Asynchronous Homework.**

### Day 10 WCERP and Technology Application. (4hrs instruction)

10.1 Well Control & Emergency Response Plans (Chapters 10-11)

10.2 Deepwater technology applications (various extracts & supplements)

10.3 *Deepwater case study project group work.*

*Case study PD&E presentations.*

**Course Debrief feedback, questions, and answers. Course close out.**

TRAINING

# Kingdom Drilling Services

## *Charter of Inter-dependency*



# TRAINING

# DEEPWATER DRILLING

Well Planning, Design,  
Engineering, Operations, and  
Technology Application

---

PETER AIRD



Gulf Professional Publishing  
An imprint of Elsevier

TRAINING

## Table of contents.

### Part I. Deepwater General

1. Mission, Mission Statement
2. Deepwater Geology & Geoscience
3. Deepwater Pressure Management
4. Deepwater Metocean Environments
5. Deepwater: Essentials and Differences

### Part II. Deepwater Planning Design and Engineering

6. Deepwater Programs, Safety, and Loss Control
7. Deepwater Well Planning and Design
8. Deepwater Structural Design
9. Deepwater Well Design
10. Operating: Key Aspects of Deepwater Planning and Project Implementation

### Part III. Deepwater Drilling Operations

11. Readiness to Drill
12. Deepwater "Riserless" Drilling
13. Deepwater Riserless Best Practice
14. Deepwater Subsea BOP and Marine Drilling Riser
15. Deepwater Intermediate Wellbores and Pressure Detection
16. Production Wellbore Drilling and Well Control Assurance

**Appendix 1.** Organizational Learning

**Appendix 2.** Soil Classification and Testing

DRILLING  
TRAINING



# Contents

---

Foreword vii  
Author's Preface ix

## I

### DEEPWATER GENERAL

#### 1. Mission, Mission Statement

Mission 3  
A Guide to Deepwater Drilling 3  
Deepwater Drilling and Operating Environments 8  
References 15

#### 2. Deepwater Geology & Geoscience

Deepwater Geology & Geoscience 17  
Deepwater Geology Principles 34  
Deepwater Geological Characteristics/Environments 47  
Reference Standards 68  
References 68

#### 3. Deepwater Pressure Management

Claystone/Shale, Other Pressure Prediction Methods 84  
Other Pressure Mechanisms and Considerations 97  
Generalized Basis of Deepwater Pressure Systems 102  
Reference Standards 109  
References 109  
Further Reading 109

#### 4. Deepwater Metocean Environments

Deepwater Metocean Environments 111  
Deepwater, Metocean, Positioning, and Riser Management 145  
Metocean Lost Time Analysis 153  
Referenced Standards 163  
Reference 164  
Further Reading 164

#### 5. Deepwater: Essentials and Differences

Deepwater Portfolios, Programs, and Projects 165  
Key Business Drivers 168  
Essentials and Differences—Introduction 168  
Drilling Deepwater Wells 173  
Key and Essential Differences of Deepwater 178  
Nonconventional Floating Drilling 183  
Vessel Selection and Rig Utilization 188  
7th- and 8th-Generation Ultradeepwater Vessels 193  
Compensation and Tension Systems in Deepwater 198  
Subsea BOP and Associated Operating Equipment 203  
Station Keeping 215  
Supply Chain and Logistics 222  
Reference Standards 224  
References 224

## II

### DEEPWATER PLANNING DESIGN AND ENGINEERING

#### 6. Deepwater Programs, Safety, and Loss Control

Deepwater Programs and Projects 227  
Deepwater—Safety and Loss Control 242  
Reference Standards 255  
References 255

#### 7. Deepwater Well Planning and Design

Deepwater Well Planning 257  
Deepwater Well Design—Essentials 274  
Referenced Standards 283  
Specific References 283

TRAINING

## 8. Deepwater Structural Design

- Deepwater Structural String Design 285
- Structural Design Criteria 295
- Conductor and Conductor Anchor Node “CAN” Behavior 316
- Reference Standards 319
- Reference 319
- Further Reading 319

## 9. Deepwater Well Design

- Well Design—Essentials 321
- Deepwater Design Methodology 333
- Standards Reference 369
- Design References 369

## 10. Operating: Key Aspects of Deepwater Planning and Project Implementation

- Regulations Project Standards and Guidelines 371
- Hazard, Risk, and Change Management in Deepwater Wells 379
- Well Programs and Safe Operations Management 388
- Emergency Response Planning 395
- Specific References 398

# III

## DEEPWATER DRILLING OPERATIONS

### 11. Readiness to Drill

- Deepwater Operational Planning 401
- Readiness to Drill 403
- Operational Emergency Procedures 416
- Reference Standards 438
- Specific References 438

### 12. Deepwater “Riserless” Drilling

- Geology, Geoscience, and Pressure Management 441
- Deepwater “Riserless Drilling” 457
- Industry Standard and Practices 458
- Riserless Barriers 464
- Standard Deepwater Loss 468
- Specific References 474

### 13. Deepwater Riserless Best Practice

- Top and Surface Hole Objectives 477
- Hazards and Risks 478
- Pilot Holes 494
- Foundation Conductor and Surface Casing Installation 494
- Drilling and Cementing Structural Casings 500
- Shallow Flow Cementing 504
- Reference Standards 505
- References 505

### 14. Deepwater Subsea BOP and Marine Drilling Riser

- Subsea BOP and Marine Drilling Riser 507
- Deepwater Marine Drilling Risers 520
- Reference Standards 561
- References 562

### 15. Deepwater Intermediate Wellbores and Pressure Detection

- Intermediate Section Objectives 563
- Operating Hazards 563
- Intermediate Section Operating Outline 564
- Intermediate Section Case Study and Worked Example 569
- Well Integrity and Barrier Requirements 578
- Pressure Detection Management—Post Riser Sections 582
- Reference Standards 596
- References 596

### 16. Production Wellbore Drilling and Well Control Assurance

- Drilling Deepwater Production Sections, Well Control Assurance 597
- Deepwater Well Control 611
- Reference Standards 640
- References 640

### Appendix 1: Organizational Learning 641

### Appendix 2: Soil Classification and Testing 643

### Index 659



## Authors Preface.

As a former Merchant Navy marine engineering officer, I became a trainee for Shell International, working through a drilling supervisors development program that I then served for both Shell and BP Internationally from 1986 to 1993. Thereafter, as a consultant. I was employed in the same role globally for various recognized companies, drilling frontier leading edge wells, many of which were

in deepwater. In 1998, I was approached and reluctantly agreed to develop industry first training materials for deepwater drilling and well engineering, confessing a lack of training skills, knowledge, and experience, but convinced a need for this training was and is today sorely needed.

Through the decades, I have since shared knowledge and experience gained by facilitating and delivering deepwater and other complex well design, drilling engineering, and operations training courses.

I felt similarly unprepared to write this book, even with the deepwater opportunities and experiences gained within drilling, well engineering, and operations specialist positions held, conducting leadership and consultancy support roles in multiple deepwater projects in recent years. Despite having produced numerous technical and operational documents.

I had absolutely no writing skills. But again, I saw the great need for a guide since, as the deepwater industry, technology, principles, and practices grow and change, so does the need for more discussion, sharing and distribution of knowledge from lessons learned and from things that go wrong.

The reason for this book is twofold. Foremost was this opportunity to continue one's self-education and development journey in all deepwater subject matters. That, through this process, has uncovered

and raised multiple aspects to what we as an industry know, don't know, and require more focus on, to assure deepwater programs, projects, technologies and best practices succeed, remain competitive, learn from the past, and deliver the *SEE (Safe, Effective, and Efficient)* outcomes and benefits desired.

Secondly, this is a first edition (and a time-constrained mission) to serve as a training, learning, and development vehicle for myself and others to collaborate, share, discuss, develop, and educate the next technological and digitized deepwater generation with the far wider skill set, knowledge, and experience demanded for field and project use.

To the many people through the decades who have evidently contributed to this deepwater drilling guide, we thank you deeply. More sincere thanks go to the sterling work of my editor, Carolyn Barta (without whom this book would never have resulted), illustrator Dianne Cook (of One Giant Leap), my well control guru and friend Bill Abel (Abel Engineering), Alexander Edwards (Ikon Geoscience), and Deiter Wijning (Huisman), and to my publisher, Elsevier, whose flexibility and extended deadlines have made this publication possible.

Enjoy, Peter Aird (The "Kingdom of Fife," Scotland, Driller