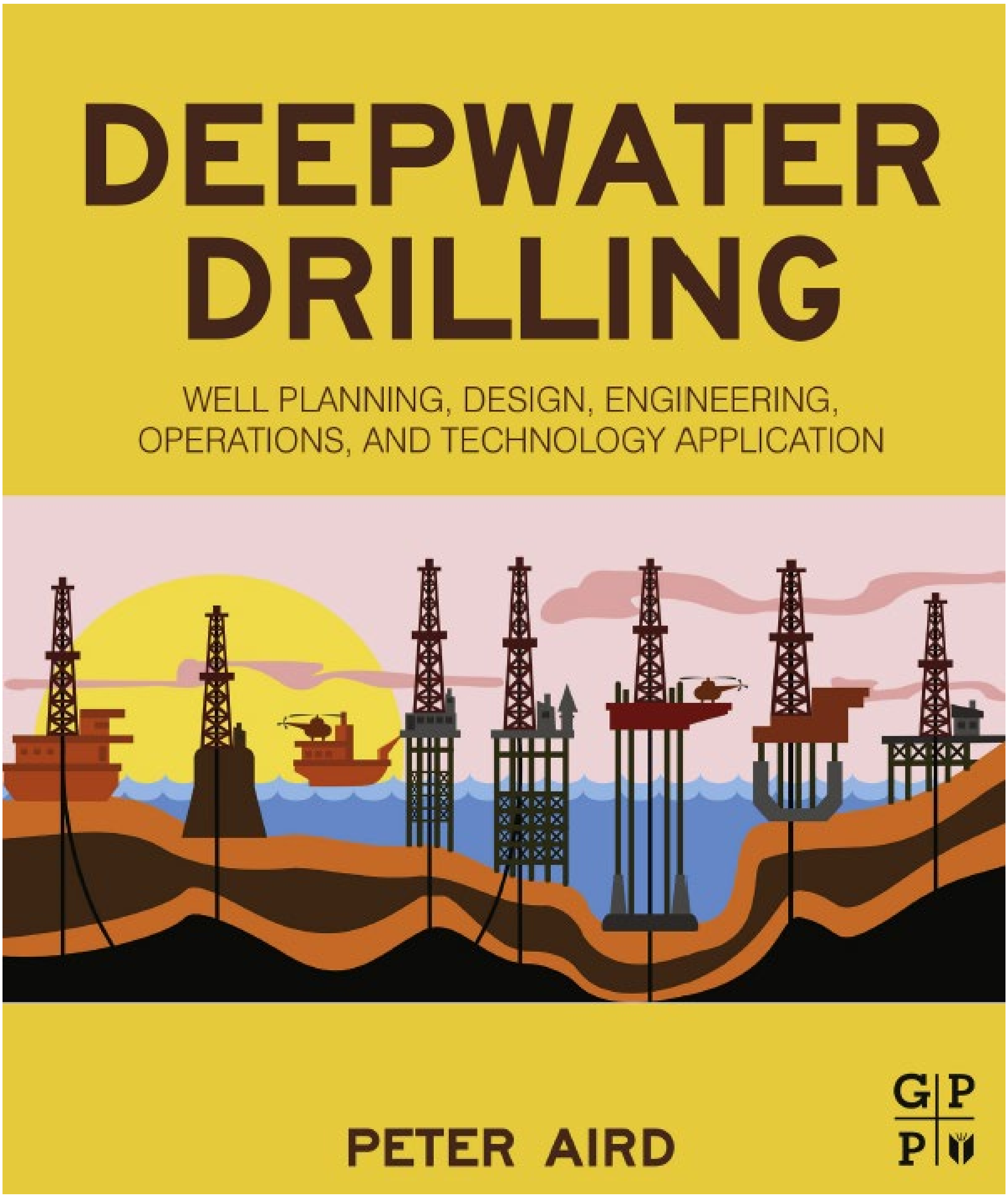


1st Edition Published December 2018.

https://www.elsevier.com/books/deepwater-drilling/aird/978-0-08-102282-5

This course has essentially been built and developed based on 2018 published book 'Deepwater drilling'.
That in itself was developed based on 20years of instructional delivery of deepwater courses in various guises.
We believe that this proven format shall evidently work to meet course purpose and intent. I.e. Learn about all specific of Deepwater drilling.

Deepwater drilling book

Description

Deepwater Drilling: Well Planning, Design, Engineering, Operations, and Technology Application presents necessary coverage on drilling engineering and well construction through the entire lifecycle process of deepwater wells. Authored by an expert with real-world experience, this book delivers illustrations and practical examples throughout to keep engineers up-to-speed and relevant in today’s offshore technology. Starting with pre-planning stages, this reference dives into the rig’s elaborate rig and equipment systems, including ROVs, rig inspection and auditing procedures. Moving on, critical drilling guidelines are covered, such as production casing, data acquisition and well control.

Final sections cover managed pressure drilling, top and surface hole ‘riserless’ drilling, and decommissioning. Containing practical guidance and test questions, this book presents a long-awaited resource for today’s offshore engineers and managers.

Key Features

1. Helps readers gain practical experience from an author with over 35 years of offshore field know-how.
2. Presents offshore drilling operational best practices and tactics on well integrity for the entire lifecycle of deepwater wells.
3. Covers operations and personnel, from emergency response management, to drilling program outlines.

Readership

- Drilling engineers, drilling company supervisors, petroleum engineers, offshore managers, and technicians

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

Details

No. of pages: 685
Language: English
Copyright: © Gulf Professional Publishing 2019
Published: 7th December 2018
Imprint: Gulf Professional Publishing
Paperback ISBN: 9780081022825.

Chapter 1, General Book, Abstract.

The first chapter introduces deepwater economics, purpose, goals, and objectives to explore, drill, discover, and develop oil and gas. It outlines why these projects are more complex, challenging, and cost intensive. The chapter introduces the three main component sections that make up this book. Section one chapter's focus on key and essential differentiators of deepwater from other offshore drilling projects. Section two chapters appraise project management, planning well design and engineering aspects. Section three evaluates current and future deepwater operational needs. This general introductory chapter further defines what is deepwater, its unique features, the tasks and operating environments to be managed and controlled to deliver outcomes and benefits desired using explicit examples from around the world, i.e. Brazil, West Africa, Gulf of Mexico, UK, and Norwegian Sea, India, SE Asia. Deepwater geology and geoscience fundamentals and some of the endemic problems and solutions are also highlighted to set the book's scene.

Chapter 2 Geology and geoscience, Abstract.

The importance and necessity of deepwater seismic technologies, site surveys, interpretation, analysis, and methods in conjunction with geology and geoscience principles to safely meet drilling challenges are presented. Shallow seabed, subsurface and deeper sedimentary hazards, and risk assessment features are also confronted to examine what are the central and unique subsurface problems that reside and how to address these. Fundamental features are weighed up and outlined in terms of what makes deepwater geological sedimentary environments so different, exclusive, and diverse, e.g., tectonics, climate, deposition, transportation, mass flow deposits, formation characteristics, and rock mechanics. The distinct hazard features of shallow and deeper sedimentary features are examined and detailed. The chapter concludes with a valuation of featured reservoir source rocks and trapping elements to consider in terms of source rock, sedimentology, trapping, origins, maturity, and migratory aspects. It attempts to validate why and how to successfully target, explore, and discover the "big oil" reservoirs and reasons why wells have yet to be drilled in the prospective deepwater subsurface environments that remain.

Keywords

Seismic technology, Deepwater geology, Deepwater geoscience
Shallow hazards, Deepwater sedimentary environments, Formation characteristics, Rock mechanics, Deepwater reservoirs, Source rocks.

Chapter 3, Pressure Management, Abstract

The chapter takes a multidisciplinary approach to peer review and assist this section to offer more assured methodologies to address the multiplicity of well pressure management issues that exist within all deepwater well pressure profiles. Emphasis is placed on front end loading, importance of preplanning, prediction studies, offset wells analysis and essential geo-mechanical and geo-technical work required. Sections overview all the fundamental prediction and detection aspects that must be comprehended, hazard and risk assessed prior to beginning each well's detailed planning design and engineering processes. Pressure implications in terms of normal, abnormal, subnormal, pore, fracture pressures, and well integrity tests are explained. In conjunction with how to predict pore, fracture and

overburden pressure gradients, safe drilling operational windows, where are the limits? Claystone/shale and other predictive methods used and applied today also are presented. Petro-physical elements of deepwater pressures are featured including aspects of cause and effect mechanisms (uplift, centroid, lateral transfer, buoyancy, lateral drainage, etc.). This first of its kind chapter closes with a generalized “how to assess and evaluate deepwater pressure systems” supported with illustrative case study examples from various deepwater operating regions.

Keywords

Deepwater pressure methods, Ultra deepwater, Pressure management, prediction, detection, Wellbore stability. Rock mechanics, Pore and fracture pressures, Drilling operating window. Deepwater overburden, Petrophysics Under-compaction theories.

Chapter 4 Metocean Conditions, Environments, Abstract

Metocean conditions, environments, problems, and challenges are examined and appraised. The diversity of all Metocean aerodynamic and hydrodynamic forces is presented and how these impact drilling operations. Hazards and risks are prioritized, analysed, and how these are to be acted upon to minimize operational loss and impact that can result. Facets of deepwater remoteness, water depth, winds, waves, tides, currents, solitons, ice, riser, time, and trouble-time management causes are emphasized. Environmental and ecosystems considerations are defined. A section condenses and considers all Metocean elements in the context of deepwater drilling and how all best fit to assure safe, trouble-free drilling, station keeping, riser management, operational plans, and emergency response events can result. A review of Metocean lost time analysis (supported by case studies) presenting evident elements concludes how teams can reduce and prevent Metocean loss in future deepwater projects.

Keywords

Deepwater Metocean forces, Deepwater waiting, Deepwater lost time, Deepwater station keeping, Riser management, Deepwater ice management, Deepwater emergency response, Unplanned disconnect, Deepwater drilling environments, Deepwater ecosystems

Chapter 5 Deepwater essentials, differences, Abstract.

Essential differences in comparison to shallow water offshore drilling are summarized. Variances of deepwater programs and projects are highlighted as a reminder to the key management metrics and business drivers to be controlled. How seismic technology progression has afforded operators to drive offshore projects to ultradeep water commercial success is emphasized through a summary of Brazil's deepwater geology and reservoir's characteristics. A short walk through of a deepwater well presents more evident differences. Project environments, practices, and technological differences are defined in comparison to the standard offshore norm. Vessel and rig utilization fitness for purpose are emphasized. A summary of rigs, drilling equipment, and systems and what are the future needs are appraised and valued. Key drilling operational focus areas of pipe and tubular handling, compensation, tensioning, subsea BOP, marine riser, wellheads, station keeping, systems, supply chain, and logistical needs for deepwater are summarized to conclude section 1 introduction.

Keywords

Deepwater essentials, Deepwater drilling differences, Deepwater drilling projects, Deepwater drivers, Drilling metrics, Deepwater rig utilization. Deepwater Brazil, Subsea BOP.

Chapter 6 Deepwater Programs, Safety, and Loss Control, Abstract.

Section 2 begins with an overview of deepwater current and future demands. Historical trends, past learnings, and a new norm are examined. Industry profile issues of human factors, intelligence traps, emotional intelligence, and imminent "big crew change," what drives success and gaps that exist are encompassed. How to manage successful programs are charted by simple project management essentials, with emphasis on what is of most value to drive deepwater drilling improvement and success. Key aspects of strategy, planning, communication, resources, people, standards, risk, change, and benchmark management and controls are scrutinized. To close, a holistic view of why and how organizations could SEE (safer, more effective, and efficient) outcomes benefits and results, as many other industries have proved, are deliberated. The chapter asserts that deepwater drilling can step change its competitiveness by addressing all operational safety defects, deficiencies, and failure to learn from things that go wrong, that evidently exists.

Keywords

Deepwater programs, loss control, project management, Drilling safety, Latent cause analysis, Deepwater accidents, incidents.

Chapter 7: Deepwater planning and design, Abstract.

Specifics of deepwater pre-well and detailed well planning are constructed and emphasized in this chapter. Several deepwater workflow process maps of detailed plans are provided as illustrative examples. Key planning learnings from case studies are summarized. Importance of and how to conduct an offset well study analysis is appraised. A summary overview of key deepwater specific elements of preplanning, organization, controls, and project delivery are analysed and evaluated. Key statements, conclusions, lessons learned, and the importance of a deepwater post well review are examined. The closing section introduces the fundamental and essential aspects of well design, methodology, classification and type, the purpose of design, and specific applications in deepwater. Deepwater well design and integrity features are overviewed, using several illustrative examples. Key deepwater design and construction objectives are highlighted to establish a framework for detailed design chapters to follow.

Keywords

Deepwater preplanning, well planning, Front end loading. Offset well analysis, Deepwater well engineering, well design, well integrity, Deepwater drilling engineering, Casing design.

Chapter 8: Deepwater structural design, Abstract

Deepwater structural design functions, verification, and analysis methods are reviewed. Industry standards for bending, axial and lateral loads as applied to deepwater structural strings are featured. Aspects of deepwater wellheads, subsea BOPs, stick up, inclination, and soil strength modelling below the sea flow are analysed and summarized. Design standards and installation methods are revised to evaluate all structural criteria and compliance to be adhered to. Worked methods and examples are provided throughout for axial, bending, collapse, tension, ratings, capacities, optimal lengths, setting depths, safety factors, and set-up time restoration effects based on soil classification and industry-recommended standards. Both jetted and grouted conductors are assessed, appraised, and included. A structural design summary is provided. The chapter closes with a section on conductor anchor node (CAN) behaviour, installation, set up and ultimate capacity evaluation as a deepwater structural design option.

Keywords

Deepwater structural design, well design, casing design, Deepwater conductor analysis, Conductor anchor node, soil classification, soil analysis, Deepwater axial, Bending loads.

Chapter 9: Deepwater Well design, Abstract.

Deepwater well casing and liner design verification, analysis, and responsibilities to be met are evaluated. Industry standards of maximum load designs are assessed. Design problems, complexities, and specific deepwater design issues are highlighted. Pressure management design issues then emphasized. A staged process from concept to a final base case design and contingencies is illustrated. Preliminary, detailed design, and other key aspects are addressed, notably shoe depth selection and maximum anticipated wellhead pressure (MAWP). MAWP assumptions as stated then supported with example calculation methods. Wellhead integrity and pressure testing are considered. External / internal design combined and fatigue loads in terms of deepwater are revised.

A STRESSCHECK deepwater design is presented to illustrate how load cases, safety, design factors inputs and outputs are used within a classic main deepwater well design. Chapter closes with advanced design aspects of salt loading, and trapped annular pressure build-up, if to be considered.

Keywords

Deepwater casing and liner design, concept design, casing design. Deepwater well design analysis, Maximum load design. Deepwater well integrity, STRESSCHECK Deepwater well design. Salt loading, Annular pressure buildup APB, Maximum allowable wellhead pressure MAWP, Deepwater design methods, Fatigue analysis.

Chapter 10: Operating: Key Aspects of Deepwater Planning and Project Implementation, Abstract.

Chapter validates wells compliance by utilizing the UK continental shelf offshore rules and regulations as an example. Features of licensing and legislation are presented to demonstrate what is needed to assure compliance of deepwater well planning construction, design and engineering standards and guidelines needs are met. Existing standards and recommendations for offshore projects provide a founding framework to work from. Aspects of well and rig safety cases are appraised. Use of an independent competent body to assure full compliance of all well verification standards, systems, and processes are stated. The application of hazard, risk, and change management integrated is measured. A section on well program management places emphasis of interface and bridging documents required between operator drilling contractor and key third parties. Leadership aspects of communication, monitoring, review, and auditing are included. Central features of emergency response plans, primacy, organizations, communications, notification, and action plans demanded are addressed.

Keywords
Offshore deepwater projects, Licensing and regulations, Well safety case, Rig safety case, Interface and bridging documents, Emergency response plans, Hazard, Risk and change management, Deepwater well programs, Deepwater well design construction and engineering, Well examination, Well verification, Independent competent body.

Chapter 11: Readiness to drill, Abstract.

Emphasis is placed on the importance of pre-planning and preparation. Planning checklists are provided to measure and appraise the effectiveness and efficiency of a well program's plans. Subsurface and well site survey pre-drilling work scope is covered. Assurances prior to and during a rig intake process are covered. Measures to be taken ensuring all resources, services, tools, equipment, standards, systems, and plans are verified and ready are outlined. Key operational aspects of the rig move, transit to arrival phase, establishing rig and well positioning and readiness to drill are stated. How to operate and execute a work program are reviewed. Operational features of pre-spud, quality, health, safety, environmental, preparedness and readiness to execute plans are emphasized. Aspects of notification, consent and well verification are covered. Operational emergency procedures and being ready *to act without delay* in terms of a worst case well release blowout, and/or oil spill emergency response readiness plans are featured and outlined.

Keywords
Deepwater pre-planning, Readiness to drill, Well-verification, Deepwater well control emergency response plans, Oil spill contingency plan, Blow out contingency, Relief well plan, Deepwater capping.

Chapter 12: Deepwater Riserless drilling, Abstract.

Geology, geo-science and pressure management of "riserless drilling" in deepwater sedimentary environments are featured and defined. Boundary riserless drilling (of clay and sand) operating limits are determined and examined. The importance of pressure while drilling, its use and application is summarized and illustrated with a worked example. Shallow pressure prediction, detection, and operating facets of sedimentation rate and seismic are highlighted. A general guide to riserless drilling standards and best operating practices are provided. Two illustrative "pump and dump" case-study examples are included. Key and central aspects of deepwater dual gradient opportunities within the riserless drilling phases are presented. Components of well inclination, barrier control, and riserless drilling and tripping decision trees are featured. Specific lost time events from cases studies within the riserless sections are illustrated. Central waiting, equipment and wellbore lost time areas are appraised to conclude evident improvement areas.

Keywords
Deepwater riserless drilling, Deepwater geology and geoscience, Riserless drilling best practice, Pump and dump, Dual gradient drilling, Deepwater lost time, Deepwater pressure management, pressure while drilling.

Chapter 13: Deepwater Riserless best Practice, Abstract.

Deepwater riserless drilling and cementing operational practices are appraised, assessed, and addressed. Riserless sections objectives, followed by a summary of operating hazards and risks assessment and application are evaluated and concluded. Loss control strategies, avoidance, regulations, standards, and methods are examined in more detail. Shallow water flow, shallow gas and hydrate events, prediction detection and mitigation during operations are covered in more depth and detail. An ultradeep shallow gas pilot-hole case study is featured. Riserless drilling stuck pipe situations, conditions and preventative best practice elements are further presented. The chapter closes with a generalized operations sequence run through of the riserless sections from an initial penetration test, pilot hole, to main wellbore jetting, drilling ahead, tripping, casing and cementing riserless conductor and surface casing phases. General best practices, loss control prevention and mitigation methods are specified throughout.

Keywords
Deepwater riserless best practice, Riserless drilling hazards and risks Pilot hole, Deepwater cementing, Penetration test, Deepwater jetting, Deepwater conductor drilling, Deepwater surface casing drilling, Deepwater shallow water and gas flow, Shallow water flow cementing, Riserless stuck pipe prevention.

Chapter 14: Deepwater Subsea BOP and Marine Riser Operations, Abstract.

Deepwater subsea blowout preventers and marine riser operations are outlined. Reliability, planned maintenance, and failure prevention is stressed and defined for the critical system features. Core aspects of electrohydraulic, multiplex, and acoustic system are distinguished. Consideration to subsea pressure and temperature gauges, cold weather, cathodic protection, presence of subsalt formation, and remote-operated vehicle (ROV) work and intervention are highlighted. Preparation, deployment, and retrieval inclusive of a running, landing, and space-out guidelines of a deepwater SSBOP/riser onto a subsea wellhead are provided. Riser analysis operating and well integrity issues are further explained with each component appraised and assessed. Wellhead integration, riser design, size and specification are overviewed. Applying a deepwater data set, design factors, performance drivers, and operating limits are attended too with outcome results defined. Emergency disconnect sequencing, drift off, and recoil analysis conclude operational limits and best practices to employ.

Keywords

Deepwater subsea BOP, marine drilling riser, riser analysis, subsea and riser operations, Well specific operating guidelines, Subsea control systems, Deepwater multiplex systems, Electrohydraulic systems, acoustic systems, Emergency disconnect sequence, Drift-off, Drive-off analysis, Riser recoil.

Chapter 15: Deepwater Intermediate Wellbores and Pressure Detection, Abstract

Objectives, operating hazards and a generalized drilling guideline, diagnostic and trouble-shooting chart set the foundation for this chapter. A case study and worked example concludes key operating parameters to maintain well control and assurance. A casing and cementing guideline is similarly presented with a summary of section reporting obligations provided. Deepwater wells barriers are explained to be concluded via illustrated example barrier summaries. Pressure management features the important elements to be prioritized and acted upon. Pressure detection, cause and "loss of control" effects are appraised with best practices examined. The importance of pressure while drilling, metrics and value in conjunction with core features of insufficient or excessive EMW (equivalent mud weight) due to poor or inappropriate planning or execution concludes the assurances required to deliver the results desired. Preventative and best practice measures are discussed and outlined to close with a review of optimal casing setting depths, casing pressure tests supported by illustrated examples.

Keywords

Deepwater intermediate drilling, Deepwater drilling hazards, stuck pipe prevention, Well integrity, Deepwater casing and cementing, Deepwater barrier requirements, Pressure detection, Pressure while drilling, Equivalent mud weight, Pressure transition management, Critical zone drilling, Casing setting depths, pressure testing, Insufficient mud weight, Excessive mud weight, Deepwater lost circulation, kicks.

Chapter 16: Production Wellbore, Well Control Assurance, Abstract

Objectives, hazards, and generalized operating guidelines set the chapter. A worked example then directs key operating conclusions derived. Pressure management aspects of these sections are then examined. Well barrier use and implications are set and established. Deepwater well control lessons, kick detection and behaviour, essential features of flow checks, pit discipline, fingerprinting in critical zones, well control equipment, kicks in oil-based mud are evaluated. Deepwater fundamental well control principles are scoped with the prominent differences determined and evaluated. Well control assurance then focuses on a sequential review of 12 major elements that include aspects of gas, shut in and kills methods, equipment process, procedures, and well integrity testing. Well control assurance and pressure management improvements are then appraised to consider and conclude the most appropriate advanced ***conventional*** (flat rheology mud, wellbore strengthening) or ***nonconventional*** (dual gradient, managed pressure, casing drillings) methods to use.

Keywords

Deepwater production drilling, Well control assurance, Production casing and liners, Deepwater liner cementing, Deepwater well control, flow checks and fingerprinting, shut in and kill methods, gas migration, expansion and hydrates, Deepwater well integrity testing, Nonconventional drilling, Wellbore strengthening, Flat rheology mud, Dual gradient drilling, Managed pressure drilling, Casing while drilling.

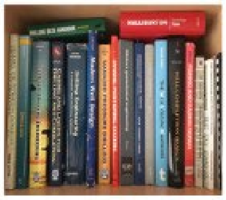
Appendix 1 - Organizational Learning

Appendix 2 – Soil Classification and testing.

Course Selected case studies used throughout. E.g.

1. **Early 90's exploration campaigns, UK, Canadian, Norwegian. Atlantic Margins.**
2. **Foinaven UK's 1st deepwater development 1996**
   4 wells delivered several months ahead of schedule
3. **Namibia DW 1996,**
4. **Falklands (6 wells) 1998**
   - **6 wells drilled 11 months ahead of schedule**
5. **Gjallar UDW Norway, well 1999**
   - **First UDW setting new benchmark.**
6. **Malaysia, Offshore wells**
7. **Norway, UDW wells**
8. **Faeroes, UK UDW wells 2001**
9. **India UDW Deepwater 2002-3**
10. **Indonesia UDW SBOP 2003-04**
    - **World first ESG.**
11. **Greenland 2009-10 (8wells)**
12. **North Africa, Morroco, Senengal.**
13. **India 2011-12 (15wells)**
    - **Doubled wells delivery.**
14. **Ivory, UDW Norway 2014/15**
    - **First UDW CAN run.**
    - **1st slender well setting new benchmark**
15. **Irish Atlantic Margins 2016/17**
16. **Plus, others from GOM, Brazil, Africa, reviewed that have SUCEEDED and FAILED**

Useful References and standards



- **Main source for this presentation**: Thanks to Christopher M. Barton, UH Petroleum Industry Expert Lecture Series, Petroleum Technology Program, October 29, 2014

1. **Deepwater drilling, well planning, design, engineering and technology application**
   1. Peter Aird November 2018
2. **API RP 96, Deepwater Well Design and Construction** 1st Edition March 2013,
3. **BIS, Guidelines for managing projects** November 2010.
4. **DNV-GL Practical Loss control Leadership**, 3rd Edition September 2015
5. **IADC Deepwater Well Control Guidelines** 1st Edition, October 1998.
   1. **Guidelines supplement**, 2nd October 2000 and **2nd Edition**, 2015.
6. **IADC Floating Drilling & Equipment Operations** 1st Edition 2015.
7. **IADC Surface BOP and Managed Pressure Drilling guidelines.**
8. **IOGP**, www.iogp.org Multiple offshore, standards, guidelines, documents and reports.
9. **Latent Cause analysis,** www.failsafe-network.com
10. **Norsok Standard D-101 Rev 4, June 2013:** "Well Integrity in drilling and completion operations".
11. **Oil and Gas UK, guidelines**
    1. **Well Life cycle integrity** guidelines, issue 3, 2016. **Abandonment of wells**, Issue 5 July 2015.
    2. **Guidelines for well-operators on well examination**, Issue 1, Nov 2011
    3. **Relief well planning for offshore wells**, issue 2, March 2013.

Useful Websites

Kingdom DRILLING TRAINING

- Http://www.offshore-mag.com/
- http://www.oilpro.com/
- http://www.offshore-technology.com/
- http://www.upstreamonline.com/
- http://www.ogjonline.com/
- http://www.rigzone.com/
- http://www.oilonline.com/