ABERDEEN DRILLING SCHOOL

In association with

SAIL

Consulting & Services

WELL ENGINEERING TRAINING FOR DRILLING ENGINEERS

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INTRODUCTION: ABERDEEN DRILLING SCHOOL AND LIBYA

Aberdeen Drilling School (ADS) is a global training company providing public courses and customised training in well control, specialist drilling, and well engineering. ADS is proud to work in partnership with **SAIL Consulting & Services (Libya)**. We have a long history of working successfully with Libya-based companies over a number of years. Clients and projects include:

Akakus Oil Operations	Optimised Drilling Practices
Mabruk Oil Operations	Drilling Technology & Well-Site Supervision
National Oil Wells Drilling & Workover Co. (NWD)	Advanced Drilling Technology
Shell Libya	High Pressure/High Temperature Wells Training & Rig-Site Coaching

WELL ENGINEERING TRAINING PROGRAMMES

These bespoke courses are designed to develop the technical skills of the Client's well engineers. With the support and encouragement of our specialist instructors, these courses aim to consolidate the participants' understanding of the principles of well engineering and enhance their ability to make informed and accurate decisions at the design, planning and execution stages of well operations. The information in this profile describes the aims, content, learning outcomes and unique features of ADS's Well Engineering training programmes.

TEAM-BASED WELL DESIGN PROJECT

A unique feature of Aberdeen Drilling School's Well Engineering programmes is the inclusion of a team-based well design project, with the participants working in teams and presenting their well design for approval.

The teams are supplied with a briefing document comprising a geological prognosis, pressure profiles, limited offset well data and a statement of requirements. Using this data, the teams will compile a simple well montage and outline programme, detailing their reasons for any selections made and based on the following criteria:

- Prepare a statement of objectives
- Identify drilling hazards and prepare a risk assessment and risk mitigation plan
- Design the casing and cementing programme
- Prepare an outline drilling fluids programme
- Design a suitable drillstring for each planned hole section
- Prepare a logging/geology evaluation programme consistent with the well objectives
- Advise a suitable completion design for the well
- Select a rig and prepare an AFE for presentation to the Drilling Manager

WELL ENGINEERING: TRAINING MODULES & LEARNING OUTCOMES

Module	Syllabus	Student Activity	Learning Outcomes
M1: Course introduction and objectives – expectations and outcomes	• Introduction to course and course project. • Teamwork and planning as key success factors	• Pre-course test • Team building exercise	1. Describe the objectives of the course and state personal objectives and outcomes from the course. 2. Describe the team attribute for effective well delivery.
M2: HSE considerations in well planning and design	• Role of the individual in managing HSE performance • Risk management systems and practices	• Case study	1. List the major HSE risks associated with drilling operations. 2. Describe an appropriate risk management approach to drilling operations using examples.
M3: Essential geology	• Basics of geology • Reservoir characterisation • Well objectives and data gathering	• Seismic interpretation exercise	1. Define the 4 essential attributes of a hydrocarbon reservoir. 2. Explain the process of oil and gas genesis. 3. List and evaluate the data collection needs and methods for an exploration well.
M4: Functions and operation of the rotary drilling rig	• Types of rig • Primary functions and rig equipment • Drillstring components and design • Drill bit design and function	• Drillstring design exercise	1. List the different types of rotary drilling rig and explain the basis for rig selection for a range of drilling applications 2. Describe the means by which the primary functions of a rotary drilling rig are achieved 3. List and describe a range of drillstring components and explain the function of each of the components
M4: Well planning	• Well planning processes • Understanding the technical limit • Drilling operations and drilling hazards • Well life cycle considerations • Determination of pore pressure and fracture pressure • Geomechanics	• Case study teamwork • Calculating fracture pressure – the effect of water depth • Simulation exercise – drilling hazards	1. Explain how the technical limit process can be applied to a drilling campaign 2. Calculate expected pore pressure and fracture gradient using a range of methodologies 3. Using examples explain how water depth effects fracture pressure 4. Give causes and reasons for lost circulation, stuck pipe and poor hole cleaning.

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M6: Drilling fluids	• Hole cleaning • Wellbore hydraulics • Drilling fluid selection • Solids control equipment selection • Sour gas	• Hole cleaning simulation exercise • ECD exercise • Sour gas exercise	1. Explain the principles underpinning optimum hole cleaning methods for vertical, high angle and horizontal wells 2. Describe and explain the advantages and disadvantages of different drilling fluid types 3. Analyse drilling fluid test parameters and describe what is happening giving solutions to any problems identified
M7: Wellbore pressures and well control principles	• Gas behaviour • Kick indicators and responses • Well control methods • Equipment selection • Relief well planning	• Case study • Kick control calculations exercise • Kick tolerance calculations • Relief well planning exercise	1. Describe at least three methods of killing a well 2. Prepare well control guidelines (outline) for use on an exploration well
M8: Casing design	• Casing seat selection • Kick tolerance • Casing design principles for collapse, burst and axial force • Temperature effects • Biaxial loads	• Casing seat selection exercise (kick tolerance) • Production casing load case exercise • Burst, collapse and axial load exercise	1. Recommend a casing design for an HPHT exploration well justifying the design using calculations and graphical methods 2. Explain how temperature effects casing design in an HPHT well
M9: Cementing operations	• Cement slurry design • Cement calculations • Liner cementing • Secondary cementing operations	• Cement programme exercise	1. Prepare a cementing programme suitable for the final casing string on an exploration well
M10: Directional drilling	• Deflection and measurement tools and methods • Directional well planning • Geosteering • Extended reach drilling	• Directional well plan • Tool selection	1. Describe the means by which a well can be drilled horizontally 2. List the means by which a well path can be monitored for various applications 3. Using the minimum radius of curvature method construct a deviated well plan 4. Explain why the margin tolerances in an ERD well are so much tighter than for a conventional horizontal well.

M11: Well completions and well servicing	• Data requirements • Completion types and equipment • Sand control and equipment selection • Well servicing	• Completions design exercise	1. Describe three types of completion giving examples and descriptions of the equipment used in each type for: zone isolation, sand control well control. 2. Describe the major components of three means of well intervention and explain how each method is used for at least two well servicing operations.
M12: Rig equipment, selection and contracting	• Specifying equipment needs • Rig upgrades • Contracting types • Calculating AFE	• AFE exercise	1. Prepare an AFE for an exploration well justifying the various expense items. 2. Describe how probability is used to prepare an AFE. 3. Prepare an outline specification for a rig suitable for exploration well drilling given outline well objectives.
M13: Drilling well on paper exercise	• Team well plan and implementation scenario exercise	• DWOP exercise	1. Demonstrate how a DWOP exercise can improve performance.

SAMPLE COURSE AGENDAS

The tables below are examples of course agendas for 3-week and 4-week drilling engineering training programmes that can be delivered to Aberdeen Drilling School's Clients. The duration and content of customised programmes can be fine-tuned and agreed with the Client.

3-Week Advanced Well Engineering Training

	Day	Morning	Afternoon
Week 1	1	Introduction and Team Project	The Importance of Teamwork
	2	Well Delivery Process	Budgeting and AFE generation
	3	Geology & rock properties	Static and dynamic pressures
	4	Casing Design	Casing Design
	5	Project work	Project Review and end of week test
Week 2	6	Cementing	Cementing
	7	Drillstring Design	Drillstring Design
	8	Drilling Fluids	Drilling Fluids
	9	Hydraulics	Drillbits
	10	Project work	Project Review and end of week test
Week 3	11	Directional Drilling	Directional Drilling
	12	Data Collection	Rig Selection
	13	Completions	Completions
	14	Drilling Hazards	Consolidation of Course learning, end of week test
	15	Project Preparation	Project Presentation

4-Week Advanced Well Engineering Training

	Day	Morning	Afternoon
Week 1	1	Introduction and Team Project	The Importance of Teamwork
	2	Well Delivery Process	Contract Management and AFE Preparation
	3	Rock Mechanics and Mud Weight Window	Well Lifecycle Planning
	4	Drilling Fluids	Drilling Fluids
	5	Project Work	Project Review and End of Week Test
Week 2	1	Casing Design	Casing Design
	2	Casing Design	Casing Design
	3	Cementing Design	Cementing Design
	4	Directional Drilling	Directional Drilling
	5	Borehole Surveying	Project Review and End of Week Test
Week 3	1	Well Control – Principles & Procedures	Well Control – Principles & Procedures
	2	Drilling Well Control (equipment)	Drilling Well Control (equipment)
	3	Advanced Well Control - Principles	Advanced Well Control - Principles
	4	Advanced Well Control (simulator session) Project Work	Advanced Well Control (simulator session) Project Work
	5	Hydraulics Optimisation	Project Review and End of Week Test
Week 4	1	Review of Project Status	Trend analysis and Data Collection
	2	Project Optimisation	Operations in an H_2S Environment
	3	Workover Operations	Workover Operations
	4	Drilling Optimisation and Best Practices	Drilling Optimisation and Best Practices
	5	Project Preparation	Project Review and End of Week Test

Well Engineering programmes may be adapted and extended by the inclusion of **international Well Control certification training (IWCF or IADC)** for Drilling and/or Well Intervention according to the Client’s requirements.

Simulation in Well Engineering Training

All delegates undertaking **IWCF and IADC Well Control** training at our facilities are taught and assessed on a DrillSIM-5000, full-size rig-floor drilling and well control simulator equipped with the latest graphic consoles, equipment and manifolds resembling those found on a drilling rig floor.

The rig-floor simulators also enhance our **Well Engineering** programmes, with the participants working alone or in small groups, drilling ADS-designed wells or wells based on the Client's own well parameters.

Simulator sample exercises

- Conventional well control with WBM or OBM
- Horizontal well control
- Stripping into the well under pressure
- Wells with high pressure and low permeability
- Wells slightly underbalance (P_{form} below dynamic BHP, above static BHP)
- Stuck pipe during tripping packed off
- Stuck pipe during tripping, jarring
- Stuck pipe during connection/survey, differential
- Hole cleaning issues during drilling, increasing torque and drag
- Ballooning during drilling
- Losses leading to kicks during drilling

Human Factors

The use of drilling simulators in conjunction with Team-Based Scenario Training can alert teams and individuals to weaknesses in non-technical skills and through changes in behaviour affecting drilling performance on the rig. The human factors that collectively lead to safety incidents and sub-optimal performance include:

- Situational awareness
- Communications
- Leadership
- Decision making

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