Drilling & Well Control COURSES

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BIT SELECTION

Instructor: Dr. Ferda AKGUN
Duration: 5 Days

For: Engineers and managers, rig supervisors with good math skills and operations superintendents responsible for drilling offshore wells or other purposefully deviated wells

Conducted For:

- ADMA-OPCO, Dec 18-22, 2004, Abu Dhabi, UAE

On average drill bits contribute less then ten percent of total drilling cost. However types of bits to be used and conditions at which they are going to be operated can have significant effect on drilling time, consequently on total drilling cost. The largest manufacturer of drill bits makes 34 types and 33 sizes and many more on request. With more than three hundred slides and illustrations you will learn and develop a systematic way on how to select the most suitable bit for your own case by employing modern techniques and analyzing previous bit records from your own field.

You will master your skills by working out problems assigned for your group, participating in interpretations and discussions after each group activity. Throughout the course you will be given five problems for hands on training.

DAY 1-Introduction to drill bits & Diamond Bits

Rock Bit Terminology
Rock Failure Models
General Types of Drill Bits
Drag (Fish tail) bits and limitations (only briefly)
Polycrystalline Diamond (PCD) Bits
Roller Cutter Bit
Factors to consider when planning a bit program
Available bits
Bit evaluation
Geology
Offset well data
Hole and casing program
Diamond Bits
Components
Diamond Drilling Technology
Planning for Diamond Bit Usage: Economical evaluation
IADC Classification of Diamond Bits
PRACTICAL SESSION
General guidelines to diamond bit selection
General guidelines to diamond bit usage in the field
How to predict diamond bit performance and performance evaluation
What should we look for on rating diamond bit dullness
Field experience with diamond bits
The future

DAY 2-Roller Cone Bits & Dull Bit Grading

Basic components of Roller Cone Bits
IADC classification of roller cone bits
Practical session
Cutting structure (Milled tooth bits & Carbide insert bits)
Formation Hardness
Design features
Friction bearings bits
Planning the bit selection program
Cost analysis
Guidelines on field usage of roller cone bits
Operating conditions of roller cone bits
Field performance of roller cone bits
Guidelines when running insert bits
The future
Dull bit grading system
Guidelines to teeth grading-insert bits
Guidelines to bearing grading
Grading Gauge wear

DAY 3-4-Bit Operation

Factors Affecting Tooth Wear and Bearing Wear
Factors Affecting Penetration Rate (PR)
Bit type and PR
Formation Characteristics and PR
Drilling Fluid Properties and PR
Mathematical Modeling of PR
PR models for Diamond Bits
PR models for Rolling Cutter Bits
Optimum Operating Conditions for an efficient Bit Run
Selection of BHA
Prevention of Accidental Bit Damage
Optimum Bit Weight (WOBopt) and Rotary Speed (RPMopt)
Selecting WOBopt & RPMopt based on a graphical technique using data from previous bit runs
Selecting WOBopt & RPMopt based on Bourgoyne &Young PR model by using data from previous bit runs
Selecting WOBopt & RPMopt based on Galle & Wood PR model by using data from previous bit runs
PRACTICAL SESSION
Estimating Optimum Bit Life
Terminating a Bit Run
PRACTICAL SESSION

DAY 5-Bit Performance analysis & Drill Bit Hydraulics

Drill off tests and test procedures
Bit performance prediction based on Drill off tests
Diagnosing bit balling
Diagnosing inadequate cleaning the bit
PRACTICAL SESSION
Bit hydraulics
Drag bit hydraulics and hydraulic lift
Optimizing bit hydraulics by maximizing bit hydraulics horse power
Optimizing bit hydraulics by Maximizing jet bit impact force
PRACTICAL SESSION
Bit record remarks

Upsides/downsides of using commercial software for bit selection.

1. PRACTICAL SESSION
   In this activity, each participant will be assigned a separate IADC drill bit code. They will be asked to determine type of the bit it represents, as well as features of formations for which it can be suitable to use.
2. PRACTICAL SESSION
   The graphical interpretation technique will be practiced to determine the optimum weight on bit and optimum rotary speed. A set of hypothetical drilling record will be given by the instructor. However, the participants are encouraged to bring their own field records.
3. PRACTICAL SESSION
   In this activity, Galle and Woods analytical method will be practiced to determine the optimum operating parameters for a given bit based on previous drill bit records. Participants will be asked to determine the optimum weight on bit and the rotary speed to achieve minimum cost drilling.
4. PRACTICAL SESSION
   Participants will be given a set of data from a real drill off test. They are expected to construct a chart of 'rate of penetration 'versus 'bit weight'. They then, will analyze the chart to diagnose whether or not there is any bit balling problem and any need for improvement in bit hydraulics.
5. PRACTICAL SESSION
   Participants will determine the optimum jet bit nozzle size (s) to maximize bit hydraulics horse power. For this problem they will be given a hypothetical pump pressure versus circulation rate data.

WELL PLANNING AND DRILLING OPTIMIZATION

Instructor: Dr. Ferda AKGUN
Duration: 5 Days

For: Drilling engineers, toolpushers, drillers, company representatives & service company personnel

Conducted for:

- PT Exspan/Nusantara, Sep, 2001, Jakarta, INDONESIA
- ZADCO, Feb 2002, Abu Dhabi, UAE
- Kuwait Petroleum Company, Sep 2002, KUWAIT
- Karachaganak Petroleum Operating, Aug 2003, Aksai, KAZAKHSTAN
- PUT, Feb 19-25, Tehran, IRAN

This is a comprehensive course on drilling with topics covering from the planning stages of a drilling well, to selecting optimum operating conditions to achieve 'cost effective' as well as, safe drilling practices. The instructor will list the stages of planning, explain each one of them, show example cases, and finally, will let the students work on sample cases. A number of popular industry software packages will also be used to demonstrate the concepts explained during lectures. The students will have hands-on experience with these software packages. However, dangerous assumptions inherent in these software packages will also be explained.

DAY 1-Introduction to Drilling Engineering

Why 'Drilling an oil well' is not simply 'creating a hole.'
Rotary Drilling Process
API Recommendations on Bit, Hole and Casing Sizes
BASIC COMPONENTS OF A DRILLING RIG
Rig Power System
Rig power requirements
Fuel consumption, engine power, block speeds and efficiency
Hoisting and Power System
Components
Making a connections and Making a Trip
Line sizes, breaking strengths and line load capacity
Cut and Slip Programs
Derrick loads
PRACTICAL SESSION
Circulating System
Components
Duplex and Triplex pumps
Pump horse power, pressure and output
Hole fill up
PRACTICAL SESSION
Rotary system
Swivel, Kelly, Rotary Drive, Drill Pipes and Drill Collars
Internal and External Upset pipes and Tool Joints
Margin of Over Pull
Drill collars and Weight on Bit
PRACTICAL SESSION
Drill Bits
IADC Classification
Drill bit selection
Optimum run time and cost per foot
Optimum WOB and Rotary Speed
PRACTICAL SESSION
Well Control System
Equipment used in well control
Shut in drill pipe and casing pressures and identifying kick type
Kick circulation with driller's and engineers method.
PRACTICAL SESSION

DAY 2-DF Rheology & Hydraulics

Rheology
Shear Stress and Shear Rate
Newtonian and Non-Newtonian Fluids
Plastic Viscosity, Apparent Viscosity
Rotational Fann VG viscometer and Plastic Viscosity
Predicting Parasitic Pressure Losses
Bingham Plastic and Power Law Flow Models
Laminar and Turbulent Flows
Annular and Pipe Flows
PRACTICAL SESSION 6
Bingham's Drilling Efficiency Diagram
Optimizing Drilling Fluids Hydraulics
Drilling rate vs. Bit hydraulics HP
Maximizing BHHP and/or Impact force
Optimizing with field method
PRACTICAL SESSION

DAY 3-Pressure, Fracture Gradients and Casing Setting Depth

Formation Pore Pressure Prediction
Formation pore pressure prediction prior to drilling
Formation pore pressure during drilling and d-exponent interpretation
PRACTICAL SESSION
Formation Fracture Gradient and Leak off test
Ben Eaton's data-Poisson's ratio, overburden stress and Formation Fracture Gradient
Formation integrity (leak-off) test
PRACTICAL SESSION
Casing Setting Depth Planning
Preparing a mud program by considering pore pressures and formation fracture strengths
Kick Tolerance Criteria and designing Casing Setting Depths
Estimating the required number of intermediate casings
API Casing sizes and bit sizes for a given production string size.
PRACTICAL SESSION

DAY 3&4-Oil Field Tubular Design

Casing Types and Casing Grade Design
Estimating borehole stresses (axial and bending, internal yield and collapse) for a given bore hole geometry, pore pressure gradient and mud program.
Estimating casing strengths (biaxial) for available casings

Comparing borehole stresses with available casing strengths and planning minimum cost casing program (A software package will be used for illustration purposes).

PRACTICAL SESSION

Drill Collar Design

Drill-off tests and optimum weight on bit (WOB) and rotation per minute (RPM) (will be covered in detail during the lectures on 'optimization')

Neutral point concept and estimating drill collar lengths, as well as sizes to achieve the optimum WOB as a function of drilling depth.

Torque and Drag

Drill Pipe Design

Margin of over pull, surface and dogleg running load for a given bore hole geometry.

Designing minimum cost drill pipe string among the available drill pipes.

Bottom Hole Assemblies (BHA)

Major components and functions

Estimating side forces, reaction forces and stabilizers.

Designing BHA for build hold (slant and hang) and drop section of a given wellbore trajectory

PRACTICAL SESSION

DAY 5-Directional Drilling

Wellbore trajectory Planning

Types of wellbore trajectories and critical considerations in selecting the suitable trajectory.

Selection of critical points, such as: Kick-off, Build, Slant, Drop and Hang sections (A software will be used for illustration).

PRACTICAL SESSION

Surveying

Preparing a table of True Vertical Depth, North and East coordinates of planned trajectory, as well as inclination and direction angles for every feet of measured depth by three popular methods (A software will also be used).

PRACTICAL SESSION

1. PRACTICAL SESSION
   Participants will determine the tension on the drilling lines for a given drillstring weight and margin of overpull. Then, they will choose their drilling line sizes and determine the derrick loads.
2. PRACTICAL SESSION
   Participants will determine how many pump strokes will take a given volume of mud pill to a given hole and depth in the annulus. They will also be asked to estimate the time equivalent for a given pump factor.
3. PRACTICAL SESSION
   Maximum Axial Load, Hook Load and Margin of overpull concepts will be practiced with a problem session. The participants will be given a drill string weight and drill pipe yield strength, they then, will determine the maximum applicable tension in a vertical hole. They will see the effect of pipe grade on the maximum applicable pull in this practical session.
4. PRACTICAL SESSION
   In this session, based on Galle and Woods analytical method, the participants will determine the optimum weight on bit and rotary speed to achieve the minimum cost drilling. The bit and drilling data based on previous drilling records will be identified and given as an input for their problem case.
5. PRACTICAL SESSION
   a. Shut in DP and Casing pressures, as well as pit gain, mud and hole data will be given to participants for his pressure control practical session. Then, they will be asked to determine the pressure of the kicking formation, kick type and kill mud weight.
   b. In the second part, they will generate pressure and pit gain diagrams with one of the two popular kick circulation methods.
6. PRACTICAL SESSION
   The participants will work on an inclass problem, which involves in determining how much barite, Bentonite and water needed to meet given drilling fluid viscosity and density. They then, will work on estimating total system pressure losses by using one of the two flow models (Power law or Bingham Plastic)
7. PRACTICAL SESSION
   The participants will work on determining the optimum jet bit nozzle sizes needed to maximize bit hydraulics horse power (by using field method).
8. PRACTICAL SESSION
   Pore pressure prediction prior to drilling by using interval transit time from seismic will be practiced in this session. The participants will be assigned a table of depth vs. interval transit time data, then, they will determine the top of high pressure zone as well as the magnitude of the pressure by using two popular methods.
9. PRACTICAL SESSION
   The fracturing pressure of a formation can be determined by using overburden stress, poisons ratio and formation pore pressure by using Ben Eaton's method. This is exactly what the participants will do in this practical session. They will estimate the formation by formation fracture strengths at different depths by using Ben Eaton's method.
10. PRACTICAL SESSION
    Participants will be assigned a certain volume of methane kick and hole geometry. They will use the pore pressure gradient and fracture gradient diagrams which they produced in the previous two practical sessions (8 and 9) and come up with initially, a mud program, later, with casing setting depth. They will use Kick Tolerance criteria for the selection of casing setting depths.
11. PRACTICAL SESSION
    Participants will be assigned a casing grade and given a set of data representing combined loading (weight, dog-leg, inside and outside fluid densities, inside and outside casing pressures, etc). They will check if their casing is strong enough to support such loading. Their results will be compared with the computer solution developed by the instructor. The errors will be discussed.
12. PRACTICAL SESSION
    The bit side forces as a function of stabilizer position, hole inclination and weight on bit will be determined for a given drill collars. What configuration will drill building, dropping or holding wells will then be discussed. The current Jiazhi's analytical technique will be used for bit side force calculations. The shortcomings of this method will also be explained.
13. PRACTICAL SESSION
    Each participant will be given a set of data such as, wellhead location, target location, build up gradients and kick-off point, they will be asked to design a 2-D double build well. They then, will be asked to draw a section view of the planned well.
14. PRACTICAL SESSION
    Participants will be given a set of survey data such as, inclination, direction and measured depth at different survey points. They will be asked to determine North, East coordinates as well as True Vertical Depths by one of the popular survey techniques. They then, will be asked to draw plane view of the actual trajectory.

HORIZONTAL & MULTILATERAL WELLS: DRILLING AND COMPLETION

Instructor: Dr. Ferda AKGUN
Duration: 5 Days

For: Drilling and exploitation engineers and managers interested in workable techniques for successful horizontal wells, and the problems encountered

Conducted For:

- ADMA-OPCO, April, 2001, Abu Dhabi, UAE
- Kuwait Oil Company and Saudi Arabian Texaco (Joint operations), Nov, 2001, KUWAIT
- Karachaganak Petroleum Operating, Aug 2003, Aksai, KAZAKHSTAN
- KOC, Jan 2004, KUWAIT

This is a comprehensive course designed for petroleum engineers to familiarize with the benefits and design of horizontal and multilateral well technology. The topics selected for this course include almost all key details of drilling and completion of horizontal and multilateral wells, such as: planning, drilling, surveying, tubular selection, failure analysis, cutting transport, hole stability, cementing, centralizer spacing, etc. Participants will be asked to work on example designs prepared by the instructor during lectures. A number of popular industry software packages will be used and demonstrated. However, dangerous assumptions inherent in these software packages will also be explained.

DAY 1-Introduction

Definition of the terms used in directional drilling.
Directional versus deviated wells
When do we need to drill a directional well?
Classification of Directional wells and Slant, S-type and Double-Build wells
Classification of Horizontal wells and ultra short, short, medium and long radius wells
TAML Classification of Multilateral Wells, benefits and limitations of each
TWO and THREE DIMENSIONAL TRAJECTORY PLANNING and MONITORING OF DRILLED WELLS
Formulation of Measured Depth, True Vertical Depth and Departure at key points on a 2-D plan
Estimating True Vertical Depth equivalent of a given Measured Depth
Estimating Measured Depth equivalent of a given True Vertical Depth
Planning a 3-D borehole profile for target intersection and/or side tracking
PRACTICAL SESSION
Surveying a directional and deviated well
Survey tools and operational mechanisms
How to calculate North, East and True Vertical Depth of a given Measured Depth from Inclination and Azimuth (Tangential, ROC, Minimum Curvature Methods)
Right and Left hand walk
Producing Horizontal and Vertical hole profiles
Ellipse of uncertainty and error analysis
Toolface rotation
PRACTICAL SESSION

DAY 2-Tubular Design For Directional Wells

Drill String Design for Directional Wells
Casing Design for Directional Wells
Bottom Hole Assemblies (BHA) for Directional wells
Components of BHA for directional wells
Principles of BHA design
Bit side force and bit tilt
Estimation of side forces and bit tilt analytically
Modern methods (advantages)
PRACTICAL SESSION
Single, two and multi-stabilizer BHAs
Packed and Pendulum BHAs
Assemblies for dropping, holding and building wells
Deviation control
Selection of BHAs for horizontal and multilateral wells
Major considerations in designing BHAs for horizontal wells
How to avoid Sinusoidal or sneaking wells and maintain horizontal well stability
Other horizontal well problems related to BHA.
Tubular failures in directional and horizontal wells
Bending in dog legs and Lubinski's bending loads
PRACTICAL SESSION
Buckling of tubular in inclined wells and Paslay's critical bucking load
Hang up
Lock up
Torsional Buckling
Ovality and deformation of tubulars in severe doglegs
Combined loading and drill string failures while fishing and drilling horizontal wells
PRACTICAL SESSION

DAY 3-Directional and Horizontal Well Hole Problems

BoreholeStability
Reasons for mechanical and chemical instabilities
How to measure formation in-situ stresses
How to estimate rock strength (experimentally and empirically)
Tensile failure and loss of circulation
Compressive failure and hole enlargement
How to select mud weight and prevent borehole break outs and tensile failures
Stability in unconsolidated formations (formations with no cohesive strength)
Selection of optimum trajectory for geomechanical point of view
Hole Cleaning Problems
Transport ratio, solids concentration and annular flow rate in vertical holes
Directional and horizontal well hole cleaning-Hopkin's chart
Minimum flow rate required to prevent Cuttings bed formation in directional wells
Practical methods to get rid of cuttings bed formation
Optimizing drilling fluids Hydraulics for directional and horizontal wells

Torque and Drag (T&D) in directional wells
Estimating T&D Inclined but straight holes
Estimating T&D Dropping and Building wells
T&D while pulling out of the hole and while running in the hole
PRACTICAL SESSION with drilling toolbox software

DAY 4-LWD-MWD and Geosteering

Horizontal Well Placement And Geomechanical Considerations
Reasons for Geosteering
Fault, Dip Change, Heterogeneity, Fluid Type, Porosity, Lithology, Fractures, etc.
Field examples
Steerable Motors a Motor Sizes
GeoSteering Tool and Benefits
ROP Optimization with Dowhole RPM and DTOR, DWOB
Hard Rock Formation Indicators Drilling Into Reservoir Cap
Formation Evaluation using Logging While Drilling (LWD)
LWD tools and data transfer with pressure pulses and telemetry systems
Bit Resistivity measurements
Real time image
Resistivity and invasion effects
Polarization Horns
Lateral resistivity and RAB

DAY 5-Multilateral Lateral Technology

Limited Isolation/Access Multilateral System
Complete Multilateral System
Performance of ML systems
Limitations and challenges

1. PRACTICAL SESSION
   The participants will work on an inclass problem where they have to plan a two-dimensional horizontal well profile from a given location to a given target. The necessary critical data such as; build gradients, KOP, etc. will also be specified.
2. PRACTICAL SESSION
   The participants will work on a survey problem where they need to translate inclination, azimuth and measured depth to north, east and true vertical depth.
3. PRACTICAL SESSION
   Each participant will determine the bit side force for a given single stabilizer BHA and assigned weight on bit. They will learn how the same BHA can drill both building and dropping wells depending on the applied weight on bit.
4. PRACTICAL SESSION
   The participants will determine if a given drill string will be able to run through a severe dogleg without failure. They will determine dogleg and surface running loads and compare with the yield strength of the tubulars.
5. PRACTICAL SESSION
   The participants will check if they can apply a given combined loading (tension, torque, pressure and bending) to fish out a segment of pipe at an assigned depth. They will determine von Misses' general stress and compare with the strength of the tubulars.

DIRECTIONAL DRILLING TECHNOLOGY

Instructor: Dr. Ferda AKGUN
Duration: 5 Days

For: Engineers and managers, rig supervisors with good math skills and operations superintendents responsible for drilling offshore wells or other purposefully deviated wells

Conducted For:

- ARAMCO, June 24-28, 2006, Dhahran, Saudiarabia (awarded)
- ADMA-OPCO, Nov 2000, Abu Dhabi, UAE

This is a comprehensive course covering major engineering designs, evaluations and implementations of directional drilling. Engineering Methods covered during the lectures will be supplemented by sample problems. Popular industry software packages will be used to demonstrate some of the designs explained in the lectures. However, weaknesses of various software programs and/or dangerous assumptions inherent in these software packages will also be mentioned when necessary.

DAY 1-Introduction to Directional Drilling

Terminology used in Directional Drilling
When do we need to drill Directional Wells?
Types of Directional Wells
Slant Wells
S-Type Wells
Double Build or Horizontal Wells
Planning of a Directional Well
Two dimensional well planning
Selection of kick off point, build and drop gradients and calculation of slant angle
Measured Depth (MD), True Vertical Depth (TVD) and Departure (DEP)
Explicit equation of MD, TVD and DEP in build, hold and drop sections
Transforming MD to TVD and TVD to MD
PRACTICAL SESSION
Monitoring Directional Wells: North, East and TVD calculations
Survey measurements: Inclination and Azimuth at survey points
Surveying tools: Gyroscope and Tatco
Survey methods: Tangential, Radius of Curvature and Minimum Curvature Methods
PRACTICAL SESSION
3-DHole Planning
Tool face rotation
Plug back problems
Target intersection
PRACTICAL SESSION

DAY 2 & 3-Tubular Design for Directional Wells

Drill String Design for Directional Wells
Tension and Bending and Lubinski's Bending Stress formula
Surface and Dog-leg running loads
Maximum allowable dog leg severity
PRACTICAL SESSION
Casing Design for Directional Wells
Tension and Bending adjusted Body and Joint Strengths of casings
Tension and Compression adjusted internal yield strength of casings
Tension and Bending adjusted Casing Collapse strength
Effect of dog leg severity and tension on casing ovality
Effect of ovality on casing collapse pressure
PRACTICAL SESSION
Bottom Hole Assemblies (BHA) for Directional wells
Bit Side force and Tilt
Relations between bit side force and dropping, building and holding wells
Estimating Bit side force with Jiazhi's analytical technique
Estimating Bit side force and Bit tilt simultaneously with Finite Elements Techniques
Slick, one stabilizer, two stabilizer and multi stabilizer BHAs
PRACTICAL SESSION
Deviation Control and Deviation Control Charts

DAY 4-Tubular Failures In Directional Wells

Failures due to Bending and Drill Pipe Fatigue
Sinusoidal and Helical Buckling
Buckling by Rotational Drag
Torsional Buckling
Paslay's Critical Buckling Load in inclined holes
How to avoid buckling and 'lock-up' in directional wells
PRACTICAL SESSION
Ovality
Combined loading (axial tension, dog leg bending stress and pressure and torque) and von Misses' general stress formula (Failure at yield theory)
DP failures while fishing
Calculating maximum applicable pull for failure free fishing when drill pipes are subjected to tension, bending, torque and pressure simultaneously
PRACTICAL SESSION

DAY 5-Miscelleneous Important Topics

Torque and Drag Analysis and Maximum available weight on bit
Hole cleaning in Directional Wells and preventing 'cuttings bed' formation
Differential Sticking, Key-seats
Tie Point and Collision
Blowout well intersection
Correcting Doglegs-Correction Runs and Hole Opening
PRACTICAL SESSION

1. PRACTICAL SESSION
   Each participant will be given a set of data such as, wellhead location, target location, build up gradients and kick-off point, they will be asked to design a 2-D double build well. They then, will be asked to draw a section view of the planned well.
2. PRACTICAL SESSION
   Participants will be given a set of survey data such as, inclination, direction and measured depth at different survey points. They will be asked to determine North, East coordinates as well as True Vertical

Depths by one of the popular survey techniques. They then, will be asked to draw plane view of the actual trajectory.

3. PRACTICAL SESSION
A sidetracking case will be analyzed. The new course will be worked out for an off course wellbore. The participants will be selecting the optimum sidetrack depth in the old course. They will be determining the coordinates (N, E, TVD) of new path feet by feet.

4. PRACTICAL SESSION
In this practical problem session, a directional well with a known dogleg severity at a given depth will be given. Participants will select the minimum cost and safe drill pipe grade with in a given set of pipe alternatives such as: grade E, G and S.

5. PRACTICAL SESSION
Casing design for directional wells will be practices in this practical session and differences with a vertical well casing design will be stresses out. Participants will be assigned a Slant well. Then, they will be given a number of different grade available casings. They will work on how to determine dogleg-running loads by calculating bending stresses. They will determine the reduction in joint strengths due to doglegs and tension. There will be in-class discussion at the end. Some field failures will be discussed in the discussion session.

6. PRACTICAL SESSION
The bit side forces as a function of stabilizer position, hole inclination and weight on bit will be determined for a given drill collars. What configuration will drill building, dropping or holding wells will then be discussed. The current Jiazhi's analytical technique will be used for bit side force calculations. The shortcomings of this method will also be explained.

7. PRACTICAL SESSION
Participants will be given an inclined hole data as well as tubular dimensions, they then, will determine the maximum weight that can be put by avoiding bucking of the drill string. They will practice Paslay's buckling load equation and determine the maximum available weight on bit.

8. PRACTICAL SESSION
During fishing operations, oil field tubulars often, are subjected to tension, torque, bending and pressure loads simultaneously. The participants will learn how much load is too much during fishing by solving vonMisses's general stress equation. A number of field cases will be discusses during this practical session. These cases will actually be assigned to participants to work on.

9. PRACTICAL SESSION
   a. One of the common problems in drilling is differential sticking, the five popular methods to free a differentially stuck pipe will be explained and one field case will be analyzed in this practical session.
   b. In the second part of this practical session, participants will be assigned an inclined hole condition. They will be asked to determine the minimum required flow rate of mud to prevent 'cutting beds' formation by using Hopkin's chart and B.Tarr's inclined hole cleaning equations.

INTRODUCTION TO OIL & GAS INDUSTRY

Instructor: Dr. Ferda AKGUN
Duration: 3 Days

For: People who are new to petroleum industry and/or with limited background in this field.

This is a course is for people who are new to petroleum industry and/or with limited background in this field. It covers major aspects of petroleum engineering with special emphasize on drilling. The course is designed to familiarize the participants with as many topics as possible within given three days teaching time with reasonable level of information.

What Is Energy?
Global Picture of Energy
Conventional and Non-Conventional Energy Sources
Crude Oil
Origin
Energy Content of Crude Oil
Petroleum Products
Heating Value of a Fuel
Gaseous Fuels
Global Oil and Gas Production
Energy Forecasting and Demand
Exploration of Hydrocarbons
Drilling Technology
Why 'Drilling an oil well' is not just 'creating a hole.'
Introduction to Rotary Drilling Process
Oil Well Drilling Machinery and Basic components of a Drilling Rig
Power System
Rig power requirements
Fuel consumption, engine power, block speeds and efficiency
Hoisting and Power System
Components
Making a connections and Making a Trip
Line sizes, breaking strengths and line load capacity
Cut and Slip Programs
Derrick loads
Circulating System
Components
Drilling Fluid and its functions
Solids control and Solids Control equipment
Optimum solid concentration for minimum cost drilling
Pump types
Minimum required pump pressure and pressure losses.
Minimum Circulation Rate and Pump Stroke Per Minute
Hole fill up
Differential Sticking
Rotary system
Swivel, Kelly, Rotary Drive, Drill Pipes and Drill Collars
Internal and External Upset pipes and Tool Joints
Margin of Over Pull
Drill collars and Weight on Bit
Well Control System
Equipment used in well control
Shut in drill pipe and casing pressures and identifying kick type
Kick circulation with driller's and engineers method.
Well Monitoring System
Formation Pore Pressure Prediction and Mud Program
Casings and Running Casings in the hole
Why do we need them?
How to select correct casing shoe depths.
Casing types and grades
How to select proper casing grade for a given depth.
Cementing and Centralizer spacing
Drill Bits
Types and IADC classification
Hole sizes, casing sizes and bit sizes
Directional Drilling
Types of Directional wells
Surveying
Side Tracking
Petroleum Economics
Petroleum Production
Formation Evaluation

BASIC DRILLING FLUIDS

Instructor: Dr. Ferda AKGUN
Duration: 5 Days

For: Drilling engineers, toolpushers, drillers, company representatives and service company personnel

Conducted For:

- Kuwait Petroleum Company, Dec 2002, KUWAIT
- Karachaganak Petroleum Operating, Jul 2003, Aksai, KAZAKHSTAN

This course addresses the basic concepts of the latest developments in drilling fluids technology. The objective of the course is to get a better knowledge and experience of different mud systems and their applications. It is recommended for drilling operations staff and petroleum development division staff dealing directly with drilling operations.

DAY 1-Introduction

Nine basic functions of a drilling fluid (DF)
Physical and Chemical properties of DF
How to measure DF properties in the Laboratory
Density
Viscosity
Volume fractions of oil, water and solids
Sand content and Sieve Tests
Static and Dynamic filtration
Lubricity
Gel Strength
Chemical analysis and Corrosion Tests
Three Basic Classifications of DF
Water Base Drilling Fluids
Oil Base Drilling Fluids
Gas Base Drilling fluids
Drilling Fluid additives and Environmental concerns
Corrosion
Clay mineralogy
Clay Swelling Mechanisms
The electrostatic double layer and zeta potential
Particle Association: Gelation, Flocculation and Dispersion
How to prepare a Bentonite–Water system to meet the desired viscosity, density and volume
Yielding of clay and yield curves for various clays
Volume and Mass balance and systems of linear equations
Optimum solids concentration (minimum cost solids concentration)
PRACTICAL SESSION

DAY 2-DF Rheology & Hydraulics

Rheology
Shear Stress and Shear Rate
Newtonian and Non-Newtonian Fluids
Plastic Viscosity, Apparent Viscosity
Thixotropy
Rotational (Fann VG) viscometer and Plastic Viscosity
Predicting Parasitic Pressure Losses
Bingham Plastic and Power Law Flow Models
Laminar and Turbulent Flows
Annular and Pipe Flows
PRACTICAL SESSION
Optimizing drilling fluids Hydraulics
Drilling rate vs. Bit Hydraulics Horse Power (BHHP)
Maximizing BHHP and/or Impact force
Optimizing Bit Hydraulics with field method
PRACTICAL SESSION

DAY 3-DF Related Hole Problems

Shale Stability
Reasons for mechanical and chemical formation instabilities
How to measure formation in-situ stresses
How to estimate rock strength (experimentally and empirically)
Tensile failure, Circulation losses and practical methods
Compressive failure and hole enlargement
How to select mud weight and prevent borehole break outs and tensile failures
Stability in unconsolidated formations (formations with no cohesive strength)
PRACTICAL SESSION
Hole Cleaning Problems
Transport ratio, solids concentration and annular flow rate in vertical holes
Directional and horizontal well hole cleaning-Hopkin's chart
Minimum flow rate required to prevent Cuttings bed formation in directional wells
Recommended methods to remove cuttings bed formation
PRACTICAL SESSION
Hole Problems originating Drilling Fluids
Freeing differentially stuck pipe by reducing hydrostatic head
Bingham's drilling efficiency diagram and predicting Bit Balling
Surge and Swap pressure estimations
Equivalent Circulating Density
How to avoid kick while raising drill string depending on mud, hole and string properties
How to avoid fracture while lowering drill string depending on mud, hole and string properties
PRACTICAL SESSION
Torque and Drag (T&D) in directional wells
Estimating T&D Inclined but straight holes
Estimating T&D Dropping and Building wells
T&D while pulling out of the hole and while running in the hole
PRACTICAL SESSION with drilling toolbox software

DAY 4- Solids Control & Formation Damage

Solids Control
Methods used to prevent the concentration of solids
Optimum solids concentration and penetration rate
Mechanical control (screening, mesh size)
Shale Shakers, Hydrocyclones, and Centrifuges
Cut point and cyclone sizing
Flocculation and Flocculants
Dilution and Volume calculations
PRACTICAL SESSION

DAY 5-Formation Damage and Well Productivity

Inflow Performance Relationship (IPR) curves
Filtration and near wellbore permeability alteration (Skin effect)
Impact of skin effect on IPR in vertical and horizontal wells
Filtration control methods
Bridging leak-off and spurt loss.
PRACTICAL SESSION

1. PRACTICAL SESSION
   The participants will work on an inclass problem which involves in determining how much barite, Bentonite and water needed to meet given drilling fluid viscosity and density.
2. PRACTICAL SESSION
   The participants will work on estimating total system pressure losses by using one of the two flow models (Power law or Bingham Plastic)
3. PRACTICAL SESSION
   The participants will work on determining the optimum jet bit nozzle sizes needed to maximize bit hydraulics horse power (by using field method).
4. PRACTICAL SESSION
   The participants will work on a given problem, which involves in determining the optimum mud density needed to prevent shale stability (by using empirical methods).
5. PRACTICAL SESSION
   The participants will work on a given problem, which involves in determining minimum flow rate needed to prevent cuttings bed formation as a function of hole inclination.
6. PRACTICAL SESSION
   The participants will assess how safe is a given tripping speed for a given hole and mud condition. In other words, they will estimate surge and swap pressures, calculate ECD and finally, compare with given formation fluid pressure and fracture strength.
7. PRACTICAL SESSION
   Practicing Torque and Drag estimations with Drilling Tool Box
8. PRACTICAL SESSION
   Predict the optimum solids concentration from a given drilling and mud data, practice dilution volume to achieve the required drilling fluid solids concentration and density.
9. PRACTICAL SESSION
   See the dramatic effect of permeability reduction on horizontal and vertical well productivities.

UNDERBALANCED DRILLING TECHNIQUE

Instructor: Dr. Ferda AKGUN
Duration: 5 Days

For: Engineers, managers, and field supervisors responsible for planning, implementing or analyzing the results of UBD.

Conducted For:

- ARAMCO, June 17-21, 2006, Dhahran, Saudiarabia (awarded)
- Karachaganak Petroleum Operating, Aug 2003, Aksai, KAZAKHSTAN
- ARAMCO, Sep 27-Oct 1, 2003, Dhahran, SAUDI ARABIA
- MAYANMAR PETROLEUM RESOURCES LTD., Jun 20-24, 2005, Yangon, MYANMAR
- ARAMCO, Sep 10-14, 2005, Dhahran, SAUDI ARABIA

This course is designed to introduce the basics and new developments in UBD Techniques for participants of different background, such as; engineers, geologists, and managers.
The materials covered during 5-days will help participants understand fundamentals of different UBD techniques, advantages and disadvantages of each method, operational conditions and constraints, which play important role in selecting the most suitable UBD technique. Up on completing this course, the participants are expected to be able to design, plan and run UBD operations.

Why Drill Underbalanced?
Benefits of UBD
Penetration Rate
Bit Life
Differential Sticking
Lost Circulation
Formation Evaluation
Formation Damage
Limitations to Underbalanced Drilling
Closed systems
Characterization of various techniques and methods
air,
nitrogen,
natural gas,
mist,
foam,
Mud-cap, flow, and coiled tubing UBD
Advantages and Disadvantages of various methods
Selecting an Appropriate Technique
Operational considerations and constraints
Technical Feasibility & Economic Analysis
Well Engineering
Casing Design
Completion Design
Directional Drilling
Special Considerations
Potential Applications
Safety in Underbalanced Drilling
New developments in UBD.

SOLIDS CONTROL IN DRILLING & WORKOVER FLUIDS

Instructor: Dr. Ferda AKGUN
Duration: 5 Days

For: Drilling engineers, completions engineers, rig supervisors, field supervisors, toolpushers, operations superintendents, managers, geologists, consultants, research and service company personnel

Conducted For:

- ARAMCO, Jun 2002, Dhahran, SAUDI ARABIA.
- ARAMCO, Feb 2003, Dhahran, SAUDI ARABIA
- Karachaganak Petroleum Operating, Jul 2003, Aksai, KAZAKHSTAN

Discover how critical is the control and disposal of solids and liquids in drilling, workover and completion operations. Indeed, you learn that this part of our technology is many times of critical importance to success. This takes on even more importance if the operation is taking place in environmentally sensitive areas, such as offshore, urban sites and public parks and forests. You obtain answers here that address the current problems associated with these concerns. You leave with all the options for dealing with these problems.

In 5 days, you learn the very best technology available to solve one of the most perplexing and expensive problems associated with rig operation.

Solids and Classification
Particle type
Particle Size
Liquids and liquid Content
Polymers
Oil
Problems associated with bad management of drilling fluid solids content
Lubricity and impact of friction coefficient on available WOB and drag loads
Filter cake and its impact on differential sticking of drill string
Static and Dynamic filtration and
Effect of Particle size and Shape on Cake Permeability and
Loss circulation
Weak bonding of cement
Uneconomically low penetration rates
Permeability impairment by particles from the Drilling mud
Methods used to prevent the concentration of solids
Mechanical Control
Screening and mesh size
Hydrocyclones, cut point, and cyclone sizing
Centrifuges
Settling and settling pits
Flocculation and Flocculants
Dilution and volume calculations
Solids Control for Unweighted Muds
Drilling fluid solids concentration and its effect on Penetration Rate
Optimum solids content for Minimum cost drilling
Solids Control for Weighted Muds
Centrifuge analysis
Solids Content Determination
Quality of Low-Gravity Solids
Washers
Storage
Closed Systems
Feasibility
Current Systems
Well Site Clean-Up Systems
Disposal
Environmental Concerns
Legal and Political Implications
Future Trends

TUBULAR DESIGN IN OIL WELLS & APPLICATIONS

Instructor: Dr. Ferda AKGUN
Duration: 3 Days

For: Engineers and managers, rig supervisors with good math skills and operations superintendents responsible for drilling offshore wells

This course is designed to give participants a full understanding of mechanisms behind drill pipe, drill collar and casing designs. Paricipants will master their ability to make appropriate designs and assess any tubular failure conditions by using drilling toolbox software in numerous practical sessions. This course is recommended for drilling engineers and technical personel of oil companies who may be involved in fishing activities.

Mechanics of Oil Field Tubular
Stress-Strain and Hooke's Law
Lame's radial and tangential stresses
Lubinski's bending stresses
Axial, Radial and Tangential Shears
Yield stress, vonMisses' stress
Critical Buckling Load
Drill Pipe design for Vertical and Directional Wells
DPs and DP grades
Maximum Axial Load and Margin of Over Pull
Casing Design
Bi-Axial Factor and Adjusted Yield Point
Collapse, Burst and Joint considerations
Dog Leg Running Loads and Surface Running Loads
Tubing Movement and Stress Calculations
Torque and Drag Predictions
Failure Analysis in Directional Wells
Bending
Buckling
Ovality
Combined loading and DP failures while fishing
Available Weight on bit
Stuck Point and Free Point

FUNDAMENTALS OF CASING DESIGN

Instructor: Dr. Ferda AKGUN
Duration: 5 Days

For: Engineers and managers, rig supervisors with good math skills and operations superintendents responsible for drilling offshore wells

DAY 1-Introduction

- Functions of Surface, Intermediate, and Production Casings
- Manufacturing of Casings
- Physical and Mechanical Properties of Casings
- Popular API casing and coupling dimensions
- Unit weight, nominal weight and buoyed weight
- Types of couplings (STC, LTC and Buttress)
- Popular API Grades
- Yield Strength and Ultimate Strength
- Young's Modulus and Poisson's ratio of steel
- Shear, Polar and Cross-sectional moment of inertia of casings

DAY 2-Setting Depth Design for Casing Strings

- Formation pressures and formation pore pressure predictions prior to drilling
- Base on Equivalent stress method
- Based on correlations (Pennabaker correlations)
- Formation fracture strength and fracture strength estimations
- Formation fracture strength estimation from pressure integrity tests (leak-off test)
- Formation fracture strength estimation based on empirical correlations (Ben Eaton's correlations.
- Preparing a mud program for a given pore pressure and fracture strength profile
- The concept of 'Kick Tolerance' and casing shoe selection to meet a specified Kick Tolerance
- Other factors which play important role in the selection of casing shoe depth (loss circulation, differential sticking, etc.)
- *PRACTICAL SESSION*

DAY 2&3-Casing Grade Design

- Why do casings fail in a given borehole environment?
- Principles of minimum cost and yet safe casing design.
- Introducing stress and strength concept.
- Axial stress acting on a casing segment in a hole and body strengths of different grade casings
- Axial stresses in a vertical well
- Axial stresses in a dogleg and Lubinski's bending stresses
- Dog-Leg Running Loads and Surface Running Loads
- Casing body strength calculations and API safety factor for axial strength criteria
- Collapse stress (pressure) and collapse strength of different grade casings
- Calculating anticipated wellbore pressures as a function of true vertical depth
- Introducing API's four recommended equations used to determine collapse strength of casings and how to select the appropriate equation for your case.
- Understanding the meaning of Bi-Axial and Tri-Axial design
- How to estimate adjusted Yield Strength of casings as a function of tension
- Calculating collapse strength of casing as a function of tension
- API's recommended safety factor for collapse
- Burst stress and Internal yield strength criteria
- How to estimate maximum anticipated internal pressure for a given formation pressure.
- Estimating burst stresses for a given depth by considering differential pressure
- API's three recommended equations for estimating internal yield resistance of casings and how to choose the appropriate equation for your case
- Internal yield pressure of the wall of the tube
- Internal yield strength of couplings
- Internal leak resistance of coupling
- Tension and compression effect on internal yield strength of casings (Bi-axial envelop)
- API's recommended safety factor for burst
- Joint stress and joint strength criteria
- Estimating joint strength for
- No bending case
- Bending with tension case
- API's recommended safety factor for joint
- How to design a minimum cost casing string from available casing grades by simultaneously considering all four design criteria
- Analytical method
- Graphical method
- Fundamentals behind Computer implementations of optimum casing design
- *PRACTICAL SESSION*

DAY 4&5-Special Considerations

- Failure of casings under combined loading
- General stress (von Misses's stress)
- Prediction of the combined loading conditions where failure is inevitable (i.e. simultaneous loading of tension, bending pressure, fluid density, rotation, etc.)
- Casing stress check for subsequent operations (swabbing, fracturing, etc)
- Buckling of casing and difficulties in running the casings in a given hole
- Sinusoidal Buckling and critical buckling load
- Helical buckling
- Ovality (deformation) of casings in a doglegs
- Reduction in diameter (Akgun and Mitchell charts)
- Reduction in collapse strength (Akgun and Mitchell charts)
- Bucking tendency and wellhead loads
- *PRACTICAL SESSION*

DAY-5 DIFFERENCES IN VERTICAL, HORIZONTAL AND MULTILATERAL WELL CASING DESIGNS-Open discussion and field cases

1. PRACTICAL SESSION
   The participants will work on a case where seismic interval transit time vs depth data will be given. They should be able to:
   a. Produce pore pressure versus depth profile
   b. Produce formation fracture strength versus depth profile (based on Ben Eaton correlations)
   c. Prepare a mud program, and finally
   d. Select casing points to satisfy a specified kick tolerance.
2. PRACTICAL SESSION
   The participants will work on a simplified case where each participant will select the minimum cost casing grade among the available casings for a specific casing depth assigned for him. Then, their selection will be analyzed with the program developed

by the instructor. If there are any errors made, they will be discussed.

3. PRACTICAL SESSION

   Each participant will be assigned a casing grade and given a set of data representing combined loading (weight, dog-leg, inside and outside fluid densities, inside and outside casing pressures, etc). They will check if their casing is strong enough to support such loading. Their results will be compared with the computer solution developed by the instructor. The errors will be discussed.

WELL CONTROL (Well CAP)

Instructor: Dave Price & Dr. Ferda Akgun
Duration: 5 Days

For: Drilling engineers, completions engineers, rig supervisors, field supervisors, toolpushers, operations superintendents, managers, and service company personnel.

This is an IADC certified well control course. It involves standard surface stack BOP and well control operations. The course can be conducted on-site,in-house as well as at the Petroleum Institute premises.

FORMATION PRESSURES
THE CONCEPT OF KICK TOLERANCE
CAUSE OF KICKS

Unintentional flow or “kick” from a formation
Failure to keep hole full
Swabbing effect of pulling pipe
Loss of circulation
Insufficient density of drilling fluid, brines, cement, etc.
Abnormally pressured formation
Lowering pipe too rapidly into the hole, i.e.: surge
Annular gas flow after cementing (i.e., cementing intermediate casing)
Intentional flow of “kick” from a formation
Failure to keep hole full
Swabbing effect of pulling pipe

KICK DETECTION

Kick Indicators
Gain in pit volume (rapid increase in fluid volume at the surface)
Increase in returning fluid-rate (with no pump stroke per minute increase)
Well flowing with pump shut down.
Hole not taking proper amount of fluid during trips.
Well control monitoring and alarm indicators
Warning signals that indicate a Kick Might be Occurring or About to Occur
Drilling Rate change
Tip, connection, and background gas change
Gas-cut mud
Water-cut mud or chloride concentration change
Decrease in circulating pressure or increase in pump stroke
Indications of Possible Increasing Formation Pressure
Cutting size and shape
Temperature change
Gas levels
Change in flow/mud properties of drilling fluid
Other Pore Pressure indicators
ROP increase
Importance of responding to kick indicators in a timely manner
Minimize: Kick size, Surface pressures, Lost operations time
Consequences of not responding
Distinguishing Kick Indicators/Warning Signals from other Occurrences (examples)
Loss/gains in pit volume
Drilling rate changes
Gas-cut mud

PRESSURE CONCEPTS AND CALCULATIONS
Types of Pressure
U-Tube concept and Hydrostatic column
Increase in returning fluid-rate (with no pump stroke per minute increase)
Formation gradient.
Hydrostatic pressure
Bottom Hole Pressure (BHP)
Differential Pressure (+/-)
Surface Pressure
Trapped” pressure
Casing shoe pressure
Surge and swab pressure
Hydrostatic pressure change due to loss of fluid level and fluids with different mud densities
Static and dynamic calculation of BHP
Fracture pressure (leak-off pressure) as defined by API RP 59
Calculations
Volume of tanks and pits
Volume of a cylinder as related to pump output
Displacement of open and closed pipe
Annular capacity per unit length
Annular volume
Hydrostatic pressure
Fracture pressure (as defined by API RP 59)
Formation pressure
Convert from pressure to equivalent fluid density
Kill Mud Weight
Circulation time
Bottoms up time for normal drilling
Total circulation time, including surface equipment
Surface to bit time
Bit to shoe time
Bottoms up stroke
Surface to bit strokes
Bit to shoe strokes
Total circulation strokes, including surface equipment
Pump output (look up from chart values only)
ECD based on given annular pressure drop data
Relationship between pump pressure and pump speed
Relationship between pump pressure and mud density
Maximum allowable surface pressure
Effect of water depth on formation strength calculation
Ideal Gas law (PV=K)
Weighting material required to increase density per volume
Volume increase due to increase in density
Volume to be bled off, corresponding to pressure increase (volumetric method)
Initial circulating pressure
Final circulating pressure
Riser volume and fluid required to displace
choke and kill line volumes
Choke and kill line strokes
Choke and kill line circulation time
Pressure drop per step
Conversion of pressure to an equivalent mud weight
Required mud weight
Equivalent circulating density (ECD)
Volume/Height Relationship and Effect on Pressure
Drop-In Pump Pressure as Fluid Density Increases during Well-Control Operations
Maximum Wellbore Pressure Limitations
Surface (e.g., wellhead, BOP, casing)
Subsurface (e.g., perforations, casing shoe, open hole formation)

PROCEDURES

Alarm Limits
High and low pit level
Return flow sensor
Trip tank level
Others (i.e., H_2S and flammable/explosive gas sensors)

Pre-recorded well control information
Standpipe pressure at slow pump rate.
Well configuration.
Fracture gradient.
Maximum safe casing pressure.

Flow Checks
When drilling
When tripping

Shut-in
When drilling
When tripping
While running casing
While cementing
Wireline operations
During other rig activities
Verification of shut-in

Well Monitoring During Shut-in
Record keeping
Principles of bleeding volume from shut-in well
Determining shut-in DP pressure when using DP float
Gas, oil, or salt water kick differences on surface pressures
Situations in which DP shut-in pressure exceeds casing shut-in pressures
Maximum safe annulus pressure
Pressure between casing strings

Response to massive or total loss of circulation
During drilling, fill annulus with fluid in use
Notify supervisor immediately
Use of bridging materials (e.g., cement, gunk plugs, lost circulation material, etc.)
Elimination of overbalance.

Tripping
Procedures for keeping hole filled
Methods of measuring and recording hole-fill volumes
Wet trip calculations
Dry trip calculations
Slugs
Trip margin

Well Control Drills (Types and Frequency)
Pit drills
Trip drills
Personnel evacuation
Diverter drills as they relate to shallow gas hazards.

Formation Competency
Pressure integrity test (testing to a specific limit)
Leak-off test (testing to formation injectivity)
Interpret data from formation tests
Effect of fluid density change as applicable.
Preparing the well for leak-off testing

Stripping Operations
Line up for bleeding volume to stripping tank
Stripping procedure through BOP
Measurement of volume bled from the well
Calculations relating volumes and pressures to be bled for a given number of drillstring stands run into the hole
Stripping with/without volumetric control

Shallow gas hazards
Mechanisms and timing of events
Kill procedures
Pilot holes
During and after cementing conductor and surface casing
Setting barite or cement plugs.

GAS CHARACTERISTICS AND BEHAVIOR

Gas Types
Hydrocarbon
Toxic

Density
Gas
Gas and Mud Mixtures

Migration
If the well is left shut-in while gas is migrating
If the well is allowed to remain open with no control
If BHP is controlled

Expansion
While in well
Through surface equipment

Compressibility/Phase Behavior
Hydrocarbon gas can be either in a liquid or gaseous form when it enters the wellbore, depending on it's pressure and temperature.
Hydrocarbon gas entering as a liquid may not migrate nor expand until it is circulated up the wellbore.
Liquids can move down the annulus and come up the drillstring.

Solubility in Mud
Combinations of gas and liquid in which solubility issues may apply.
Gases dissolved in mud behave like liquids
Dissolved gases evolve out of mud at some point in the wellbore.

FLUIDS

Types of Drilling Fluids
Water based mud
Oil based mud (OBM), synthetic oil based mud (SOBM)
Cement
Completion fluids

Fluid property effects on pressure losses
Density
Viscosity
Changes in mud properties due to contamination by formation fluids

Fluid density measuring techniques
Mud balance
Pressurized mud balance

Mud properties following weight-up and dilution
Gel strengths
PV and YP

CONSTANT BHP WELL CONTROL METHODS

Objectives of well control methods
Circulate kick safety out of the well
Re-establish primary well control by restoring hydrostatic balance
Avoid additional kicks
Avoid excessive surface and downhole pressures so as not to induce an underground blowout

Principles of Constant BHP Methods
Well shut-in will stop influx when BHP equals formation pressure
Circulating out a kick with choke back pressure to keep BHP equal to or slightly greater than formation pressure
Bottom of the drillstring must be at the kicking formation (or bottom of the well) to effectively kill the kick and be able to resume normal operations.

Example Steps of a Constant BHP Well Control Method: Driller's or Wait & Weight
Well kill/control calculations and procedures
Organize the specific responsibilities of rig crew during well kill/control procedure.

Well Control Kill Sheets
Well control calculations
Maximum wellbore pressure limitations
Selection of kill rate for pump

Well Control Procedures
Procedure to bring pump on and off line and change pump speed while holding BHP constant using the choke
Initial Circulation Pressure
Choke adjustment during well kill procedure
Handling of problems during well control operations
Considerations if using a diverter

Other Well Control Methods
Volumetric, including lubricating/bleed
Bullheading
Reverse circulation during well testing/completion

Reasons for selecting specific well control methods

EQUIPMENT

Well Control Related Instrumentation
Fluid pit level indicator
Fluid return indicator
Pressure measuring equipment and locations
Mud pump/stroke counter
Mud balance and pressurized mud balance
Gas detection equipment
Drilling recorder
BOP Configuration
Components (API RP 53, latest edition)
Functions
Manifolds and piping
Standpipe
Choke
Valving
BOP stack
Drillstring
Choke manifold
Mud pump pressure relief
Auxiliary Well Control Equipment
Mud/Gas separator
Mud pits
Trip tank
Top drive systems
BOP Closing Unit-Function & Performance
Usable fluid volume test
Closing time test
Accumulator pressure
Adjustment of operating pressure
Operating functions
Testing/Completion Pressure Control Equipment
Packers
Lubricators
Christmas trees
Test trees
Testing/Completion Pressure Control Equipment
Maximum safe working pressure
General emphasis on quality maintenance practices
Emphasis on quality testing practices
Procedures for function and pressure testing all well control equipment.
Well Control Equipment Arrangements
General arrangements for BOP, valving, manifolds, and auxiliary equipment (applicable to both written and practical testing)

IWCF WELL CONTROL

Instructor: Dave Price & Dr. Ferda Akgun
Duration: 5 Days

For: Engineers, geologists and managers

This course is designed to provide participants with knowledge and skills covered in the International Well Control Forum syllabus. The course leads towards the award of an IWCF surface BOP stack certificate.

On completions of the course, participants will have the knowledge and skills required to sit the IWCF examination. Candidates will be issued IWCF certificate up on successfully passing written and practical assessments.

Formation pressures: Normal & abnormal
Causes of kicks
Warning signs
Kick indicators
Kick prevention
Circulating system
Pressure losses
Effect on bottom hole pressure
Annular pressure loss and equivalent circulating density
Slow circulating rates
Fracture pressures
Definitions
Leak off tests
Maximum allowable annular surface pressures
Kick tolerance
Shut in procedures
Shut in methods
Analysing data
Well control methods
Principles
Drillers method
Wait and weight
Volumetric and lubrication
Stripping
Kill sheets
Filling in a kill sheet
Gas behaviour
Boyles law
gas migration
- shut in well
- open well
Horizontal well control
Problems during well control operations
failures and complications
Well control equipment
stack configurations
diverter systems
annular preventers
ram preventers
associated equipment
control systems
Practical exercises
practical exercises on the DS500 well control and workover simulator.

ABOUT THE INSTRUCTORS

Dr. Ferda AKGUN

Is an associate professor at the Petroleum Institute Abu Dhabi

In his fifteen plus year career as an academic, he worked in several countries from North America to Australia. Participated in cutting edge research projects in respectable institutions. Consulted major oil companies and conducted numerous training courses for operators in the Middle East, Central and South-East Asia. Set up several drilling laboratories. Developed an IADC and IWCF accredited Well Control School under the PI banner. Authored more than 30 papers on new developments and technical issues in drilling engineering.

He is a recognized Well CAP insturctor and holds PhD in Petroleum Engineering from Colorado School of Mines .

TESTIMONIALS

Seminar Evaluation Summary

DIRECTIONAL DRILLING TECHNOLOGY

ADMA-OPCO

Abu Dhabi, U.A.E.

November 11-15, 2000

(In ascending order of experience level)

What is your overall impression of the conduct of the seminar and the value of the seminar to you and your company?

Participant Number **Response**

1. I learned very important information about the drilling field that will help me in the future. It is valuable for my company because this training allows engineers to fully understand the equations and criteria behind directional drilling.
2. The course was very informative and will help me in my job.
3. The course was very useful because it covered many things I need to know.
4. The seminar was very good.
5. The seminar was good and will be valuable to my company.
6. The conduct of the seminar was good. The course is valuable because I gained valuable information about the design of wells.
7. The course was directly related to my job and will help improve our field.
8. The course was related to my job and will help in the field.
9. The seminar was very useful for learning about theories behind directional drilling tools, including DP, BHA, DC, etc.

What was the most valuable part of the seminar? Why?

Participant Number **Response**

1. All parts of the seminar were valuable and essential.
2. The lecturer was excellent. Both his way of teaching and organizing the course material were valuable.
3. All of the material was useful.
4. BHA design and casing design were most valuable.
5. The most valuable parts of the seminar were drillpipe and casing design and how to calculate the strength of dip.
6. Casing design was very valuable.

7. All of the course was important because it was all relevant.
8. All of the seminar was valuable.
9. The most valuable part of the seminar was the section on the forces (pressure, stress, etc.) involved in drilling/running casing. This gives a good idea of what is happening behind the actual drilling operation.

What other topics should be included in seminars such as this?

A) Topics relating to this seminar?
B) Other complete seminar subjects?

Participant Number		Response
1.	A)	Horizontal drilling.
	B)	No Response.
2.	A)	Equipment.
	B)	No Response.
3.	A)	No Response.
	B)	No Response.
4.	A)	No Response.
	B)	No Response.
5.	A)	Horizontal drilling and multi-lateral drilling.
	B)	Well control and BHA selection.
6.	A)	No Response.
	B)	No Response.
7.	A)	Drilling fluid.
	B)	No Response.
8.	A)	Drilling fluid and mud selection.
	B)	No Response.
9.	A)	No Response.
	B)	No Response.

What, if anything, would you suggest doing differently in subsequent seminars of this nature?

Participant Number	Response
1.	No Response.
2.	More practice is needed.
3.	No Response.
4.	No Response.
5.	Use video tapes.
6.	No Response.
7.	Everything was good.
8.	Everything was OK.
9.	Increase the duration of the course.

Would you recommend this course to others in your company? If no, why not?

Participant Number	**Response**
1.	Yes, I would recommend it to all trainees on the drilling staff.
2.	I would recommend it to well, mud and cement engineers, as well as drilling supervisors.
3.	Yes, as a refresher to engineers.
4.	Yes.
5.	Yes.
6.	Yes, for drilling supervisors, well engineers, mud engineers, cementing engineers and technical personnel.
7.	Yes, it was a very good course.
8.	Yes, to all well and mud engineers.
9.	Yes.

Please give us your impression of the meeting facilities and any suggestions on how they can be improved.

Participant Number	**Response**
1.	There wasn't enough paper, but we managed.
2.	Everything was perfect.
3.	The facilities were just right.
4.	No Response.
5.	The facilities were good.
6.	No Response.
7.	The facilities were excellent.
8.	The facilities were excellent.
9.	The facilities were good.

Seminar Evaluation Summary

HORIZONTAL & MULTILATERAL WELLS: ANALYSIS & DESIGN

ADMA-OPCO

Abu Dhabi, U.A.E.

May 12-16, 2001

(In ascending order of experience level)

What is your overall impression of the conduct of the seminar and the value of the seminar to you and your company?

Participant Number **Response**

1. The seminar was of medium value to me and my company.
2. This was an excellent specialized course. It was especially needed since overall trends are moving toward horizontal drilling.
3. This course went into some basic theory. It was good for me, but some engineers need more practical courses.
4. This course was very useful for me and my company.
5. I got a very good understanding of basic engineering equations. Usually, we use software programs and get automatic results; now we can better understand how these results are derived.
6. It was a very good course, especially for well engineers, geologists and reservoir engineers.
7. It was a very good seminar and was valuable to my company.
8. This course was extremely useful to me as I am now in a position where I can correct some of the incorrect procedures currently being performed.
9. This was a great seminar. I now have a better understanding of designing and planning horizontal wells.

What was the most valuable part of the seminar? Why?

Participant Number **Response**

1. The most important parts of the seminar were horizontal well damage and skin effect because I experience these in my job.
2. Production was the most important part of the seminar because it will increase recovery, which is our ultimate goal.
3. Directional drilling was valuable because I have to evaluate the feasibility of a well workover from the reservoir engineering aspect.
4. The most valuable parts of the seminar were horizontal well hole cleaning, cementing, production and completions.
5. We knew some equations from SPE papers but may have missed some. This seminar collected all the important information in one book.
6. The most valuable parts of the course were tubular design, torque and drag, completion & stimulation and drill string failures.
7. The most important parts of the seminar were well design (trajectory), cementing operations and hole cleaning practices related to my job.

8. The most valuable parts of the seminar were the theoretical background and understanding how so many jobs are calculated in well planning and drilling.
9. Horizontal well completions and production stimulation were very important.

What other topics should be included in seminars such as this?

A) Topics relating to this seminar?
B) Other complete seminar subjects?

Participant Number		Response
1.	A)	Well testing.
	B)	Horizontal well workover.
2.	A)	Integrated disciplines such as geology.
	B)	No Response.
3.	A)	Practical methods to stimulate multilateral wells and evaluation of horizontal well, log, well test, etc.
	B)	No Response.
4	A)	No Response.
	B)	No Response.
5	A)	I think the topics were suitable for a 5-day course.
	B)	Completion design and engineering.
6	A)	Critical application in short radius and horizontal calculations and BHAs.
	B)	MWD, LWD in short radius.
7	A)	Acidizing and matrix stimulation and perforating techniques in horizontal wells.
	B)	MWD, LWD, CT applications.
8	A)	Geologic formations.
	B)	No Response.
9	A)	Economics and factors affecting productivity of the horizontal well.
	B)	Geosteering of horizontal wells.

What, if anything, would you suggest doing differently in subsequent seminars of this nature?

Participant
Number **Response**

1. Use more video tapes and slides.
2. The seminar was conducted in a professional manner.
3. No Response.
4. Allow a longer time period for the seminar.
5. No Response.
6. No Response.
7. It was fine.
8. No Response.
9. No Response.

Would you recommend this course to others in your company? If no, why not?

Participant Number	Response

1. Yes.
2. Yes, especially for drilling engineers.
3. I would recommend this course to junior reservoir/petroleum engineers because it provides a good understanding of the basics.
4. Yes, I would recommend this to most of the staff, especially petroleum, reservoir and drilling engineers.
5. Yes, I would recommend this course for drilling engineers.
6. I would recommend this course to cement, mud, petroleum, production, and directional engineers.
7. Yes, I would recommend this course because it was beneficial to my company.
8. Yes.
9. Yes.

Please give us your impression of the meeting facilities and any suggestions on how they can be improved.

Participant Number	Response

1. The facilities were okay.
2. They were good.
3. The facilities were very good.
4. The facilities were excellent.
5. The facilities were good. The manuals were important because they let the class follow along with the instructor and will be a great reference tool so we will not lose this information.
6. Include more instruction, quizzes, homework and software applications.
7. The facilities were very good.
8. The facilities were very good.
9. The facilities were good.
10. The facilities were good.