# Oilfield Production Consultants

*Subsurface engineering, geosciences and production engineering experts*

# Training Course Catalogue
2018

ISO 9001:2008

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# INTRODUCTION TO OPC

Established in 1988, Oilfield Production Consultants (OPC) is a global technical services consultancy providing fully integrated geosciences, subsurface engineering, production technology, reservoir surveillance and management expertise to NOCs, IOCs and Independents in the oil and gas exploration and production industry.

OPC has offices in London, Aberdeen, Stavanger, Atyrau, Astana, Doha, Lagos, Basra and Houston having staff, consultants and software technology deployed in-house at OPC and externally at our clients' offices and well sites.

OPC is ISO 9001:2008 certified, guaranteeing a quality product. OPC is certified by the London and New York Stock Exchanges as a "competent entity" under their Listing Rules.

OPC **Technical Services** (TS) provides the following expertise;

- Seismic-to-simulation field development modelling
- Regional and near-field prospect evaluation
- Integrated reservoir modelling and multi-disciplinary studies
- Reservoir engineering
- Reservoir surveillance and management
- CPR's, asset and reserves evaluations
- Well test planning, design, supervision and analysis
- Specialist pressure transient analysis

OPC **Technical Training Services** (TTS) has been developed to support company's gain the highest return from their human capital. We have taken a specific focus on regions in which there is an appetite to train and develop the national workforce. OPC provide high quality training and educational courses on a wide range of topics within the oil and gas industry. All of our training programmes are hosted and delivered by experienced and industry-recognised tutors, many of whom regularly lecture in collaboration with leading institutions such as the SPE, Imperial College, London and the Institut Français du Petrole.

The majority of our training is delivered through bespoke courses developed to meet the specific requirements of an individual client and the specific training needs of their personnel. Training is delivered at the client's location or at a suitable off-site training centre. It is frequently supported by additional mentoring and ongoing support for the client's staff.

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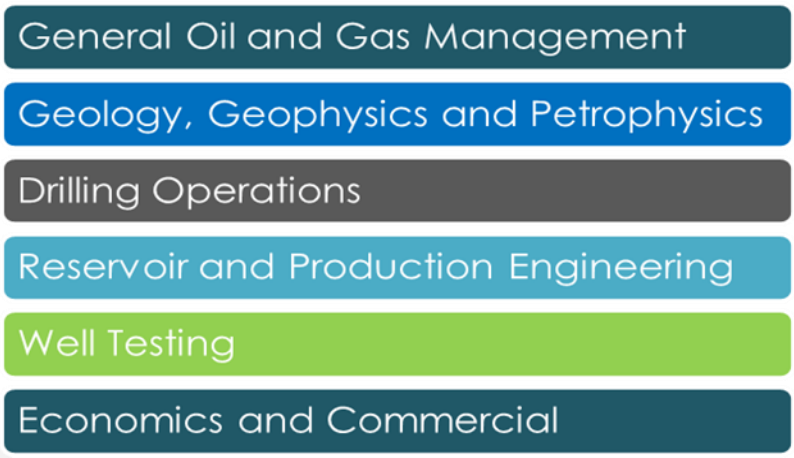
Training disciplines include but are not limited to:




OPC TTS also provide competency based training analysis for oil and gas organisations with an identified skills gap. OPC provide a full Gap Analysis that will identify areas where improvements and change can be made to deliver a positive long term return on investment in human capital.

OPC analysis will typically cover:

- Current training and development systems, training methodology, policies, approaches and techniques
- Current training provision by external training companies
- Training resources including CBT Materials, Courses / Curriculum, OJT Programmes, Instructors, Vocational Training Centres (VTC's), Institutes and Schools and Vendor Training
- Retention strategies
- Recruitment strategy of new students/employees
- Competency standards

OPCs website http://www.opc.co.uk gives further information on its services.

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# TRAINING SERVICES

OPC is a recognised provider of training, mentoring and coaching services (classroom and on job training OJT) in all our areas of competence. Training courses are generally tailored to our client's specific requirements and can be delivered onsite and offsite.

OPC is delivering training in countries where nationalisation programmes require companies to employ a high ratio of local nationals to expatriates to enable sustainable economic growth. Our specialist expertise is deployed in support of national employee development programmes to enable employers to meet Government targets.

Our current range of courses includes:

| General Management | Days |
|---|---|
| "Petroleum Explored" - An Introduction to E&P | 1 |
| Introduction to Data Management | 5 |
| The Digital Oilfield | 2 |
| E&PD Contracts (Policy, Process, Monitoring & Assessment) | 5 |

| Geology, Geophysics and Petrophysics | Days |
|---|---|
| Introduction to Petroleum Geology | 5 |
| Fundamentals of Applied Petrophysics | 5 |
| Cased Hole Logging & Production Log Evaluation | 5 |
| Seismic Interpretation | 10 |
| AVO and Seismic Inversion | 5 |
| Rock Physics & Petrophysics for Seismic Interpretation | 5 |
| SCAL: Programing, Design, Implementation, QC & Evaluation | 5 |
| Integration of Core & Log Data | 5 |

| Drilling Operations | Days |
|---|---|
| Introduction to Drilling & Completions Operations | 5 |
| Fundamentals of Well Control | 5 |
| Casing Cementing - Current Leading Practice & New Techniques | 5 |
| Advanced Well Cementing | 5 |
| Advanced Drilling Practices | 5 |
| Advanced Drilling & Completion Technique | 3 |

| Reservoir and Production Engineering | Days |
|---|---|
| Practical Well Test Interpretation | 3 |
| Advanced Well Test Interpretation | 3 |
| Reservoir Characterisation | 5 |
| Reservoir Surveillance – Effective Use of Permanent Downhole Pressure Data | 2 |
| Integrated Reservoir Management | 5 |
| Basic Reservoir Engineering for Production Operations Staff | 5 |
| Advanced Hydraulic Fracturing | 5 |
| Fractured Reservoirs | 5 |
| Evaluation and Developing Heavy Oil Resources | 5 |
| Reservoir Engineering Workshop | 10 |
| Dynamic Reservoir Simulation | 10 |
| Fluid Properties & Phase Behaviour (PVT) | 5 |
| Advanced EOR/IOR | 5 |
| Enhanced Oil Recovery Fundamentals | 5 |
| Evaluation and Management of Fractured Reservoirs | 5 |

| Economics & Commercial | Days |
|---|---|
| Introduction to International Petroleum Economics | 3 |
| Petroleum Economics & Risk Analysis | 5 |
| Front End Loading for E&P Projects (FID) | 5 |
| O&G Contracts Agreements | 4 |

| Field Development Planning (FDP) | Days |
|---|---|
| Field Development Planning (FDP) - Subsurface | 3 |
| Field Development Planning (FDP) - Subsurface & Facilities | 5 |

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**Duration** 1 day
**Code** GM/PE/01

# "Petroleum Explored" An Introduction to E&P



## Course Objectives

To give newcomers to the industry an appreciation of how the E&P business operates. This course will describe:

- How the industry has reached where it is today
- What the jargon means
- How the different technical and commercial experts combine to efficiently exploit oil and gas reservoirs
- What can we expect in the future

## Who Should Attend?

The course will be suitable for all staff who have just joined the industry and to existing employees who would like to better understand how their specialist role contributes to the company's development and growth.

## Course Outline

### Welcome to the Oil & Gas Industry

- What's so special about oil & gas?
- In basic terms, what does it do?
- What are you talking about? Here's some basic jargon
- How has it got to where it is now?
- What's coming up for the rest of the day?

### How Do we Find Oil & Gas?

- Where do O&G come from?
- How do they end up in reservoirs?
- So how do we know where it is?
- How much is there?
- Are you sure?

### We've Found it, so What Can we Do with it Now?

- How can we get it out of the ground?
- How can we prove it's all there?
- What can we do to recover as much as possible?

### What Shall we Build?

- What processing facilities do we need?
- What's different about offshore?
- What factors control the design?
- How do you manage the construction project?

### So Who Gets to Make all the Money?

- Whose oil is it?
- What's it worth – supply & demand?
- Can we afford to develop our fields?
- How do we choose the best projects?
- Did somebody mention risk?

### How Do we Go about Selling our Oil & Gas?

- When will we run out of oil?
- How much more have we found?
- So how can we get some more?
- Can't we use something else?
- What about global warming?
- Let's go for renewables then, shall we?

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**Duration** 5 days
**Code** GM/IDM/02

# Introduction to Data Management



## Course Objectives

To identify the core data types used in the E&P industry and how to maximise the value of the available information within an effective data management framework.

## Who Should Attend?

Any asset team members from junior to management level gaining an in-depth understanding to workflow optimization and data management.

## Course Outline

### Introductions and Ice Breaker

- What is data and why is it an asset?
- Data types in the E&P industry
- Group exercise on data types
- Use of data standards in E&P
- WITSML demonstration
- Data management best practices
- Data models and databases

### Data Management

- Understanding business value
- Group exercise on business value
- Common data management issues and challenges
- Working group discussions and presentations on data management challenges

### The Value of Data Management

- Group exercise “What is data management?” with feedback presentations
- Why is data management important?
- Video on data management importance
- Understanding data as an asset and treating it appropriately

### Data Management Framework

- Defining a data management framework
- Working group discussions on the important elements to support the data management framework with feedback presentations
- An example high level data management framework

### Data Management Challenges

- Learning objectives for day 5
- Data management challenges: governance, quality, security and system of record
- Working group discussions on orchestrating the data management challenges with feedback presentations
- Data management – putting it all together

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# The Digital Oilfield

**Duration** 2 days
**Code** GM/DO/03



## Course Objectives

To review the current use of IT applications in the oil & gas industry and how they can be extended & combined into an integrated management system.

## Who Should Attend?

Any asset team members from junior to management level gaining an in-depth understanding to workflow optimization and data management.

## Course Outline

Day 1

- What is a digital oilfield?
- The upstream digital oilfield
- Current applications in the subsurface
- Well production – drilling & completions
- Production operations
- Pipelines & export
- Digital oilfield data

Day 2

- Engaging the workforce
- Workflow design
- The IT foundation of the digital oilfield
- Getting into action
- Hopes for the future

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**Duration** 5 days
**Code** GM/EPD/04

# E&PD Contracts (Policy, Process, Monitoring & Assessment)



## Course Objectives

To learn the philosophy, evolution, and fundamentals of international petroleum contracts and have an opportunity to see how each of these actually works

## Who Should Attend?

For senior staff who are involved in E&PD contracts to gain an in-depth understanding of the workflow optimization of international petroleum contracts. Contract Policy, Process, Initiating, Planning, Tendering and Bid Evaluation, Negotiation, Execution, Monitoring and closing.

## Course Outline

Day 1
- Introduction
- Ownership of Oil & Gas in situ
- Contracts in general
- Petroleum E&PD contracts
- Review of day's lessons

Day 2
- Contracting Objectives
- Tendering for E&PD contracts
- Concessions
- Production sharing contracts
- Review of days lessons

Day 3
- Analysis of an E&PD contract (1)
- Review of day's lessons

Day 4
- Analysis of an E&PD contract (2)
- Review of day's lessons

Day 5
- Negotiating Skills
- Ethics and E&PD contracting
- Simulation exercise
- Closing review

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**Duration** 5 days
**Code** GGP/IPG/01

# Introduction to Petroleum Geology

## Course Objectives

To provide participants with an understanding of how oil and gas reservoirs have been formed and how, with limited sub-surface information, reservoir size can be estimated.

## Who Should Attend?

The course is designed for explorationists and managers with limited experience and operations staff who have not had significant geological training.

## Course Outline

### Reservoir Geology

- Fundamentals of petroleum geology
- Classification of reservoirs
- Controls on reservoir development
  - Depositional
  - Structural
- Introduction to the acquisition, processing and interpretation of seismic data
- Influences of geological characteristics on appraisal and development

### Reservoir Fluids

- Rock properties
  - Porosity
  - Permeability
  - Pore size distribution
  - Wettability
- Physical properties of liquids and gases
- PVT and phase behaviour
- Flow in porous media
- Multi-phase flow

### Estimating Hydrocarbon Volumes

- Basic principles of reserves & resources classification
- Deterministic and probabilistic approaches to calculating volumetrics
- Addressing the problems of uncertainty



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**Duration** 5 days
**Code** GGP/FAP/02

# Fundamentals of Applied Petrophysics

## Course Objectives

To give participants a good understanding of logging operations, the fundamentals of petrophysical relationships and how their work interacts with that of petroleum engineers.

## Who Should Attend?

The course will be suitable for geoscientists and engineers responsible for the day-to-day management of reservoirs.

## Course Outline

### Logging Operations
- Surface & downhole equipment
- Tool principles
- Log headers

### Lithology Determination
- Mud logs
- Gamma ray
- Spontaneous potential

### Quick-look Approach
- Pay calculation
- Cross-plots
- Archie equations
- Pickett plot

### Porosity
- Density, neutron, sonic
- Quality control
- Lithology & porosity
- Uncertainty

### Saturation
- Laterologs & induction logs
- Saturation determination & uncertainty

### Data Integration
- Zonation
- Contacts
- Uncertainty

### Pressure Data
- Tool physics
- Plotting & interpretation
- Gradients & FWL



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**Duration** 5 days
**Code** GGP/CHL/03

# Cased Hole Logging & Production Log Evaluation

## Course Objectives

To give participants a good understanding of the fundamentals of cased hole production logging.

## Who Should Attend?

The course is aimed at Persons who may be involved in the planning or supervision of Cased Hole logging operations or use the finished interpretation.

## Course Outline

### Introduction to Production Logging

- Reservoir monitoring
- Production logging measurement
- Application of production logging

### Fluid Dynamics & Properties

- Fluid flow fundamentals
- Fluid conversions

### Single Phase Measurements and Interpretation

- Single phase flow - overview
- Basic measurements
- Single phase flow – interpretation

### Two Phase Measurement and Interpretation

- Multiphase flow – overview
- Two-phase fluid mechanics
- Multiphase flow measurement tools
- Two-phase interpretation - main PL formulae

### Reservoir Monitoring Tools

- Saturation related problems
- Introduction to nuclear interactions
- Pulse neutron tools
- Pulse neutron interpretation

### Cement Evaluation

- Introduction
- Cement evaluation tools
- Cement evaluation interpretation

### Pipe Integrity

- Introduction
- Corrosion types
- Corrosion evaluation tools



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# Seismic Interpretation

**Duration** 10 days
**Code** GGP/SI/04

## Course Objectives

To give participants an understanding of seismic methods and the underlying geological concepts. The course members will learn:

- To integrate seismic data with other forms of exploration data
- Recognize structural and stratigraphic styles
- Interpret 2D and 3D seismic data-sets on paper and workstation
- To create seismic travel time maps from interpretation
- Create depth maps from velocity mapping and modelling

## Who Should Attend?

The course will be suitable for young geoscientists who have had only limited opportunities to develop their formal training. They will gain practical experience of seismic interpretation using real-life data-sets.

## Course Outline

Day 1
- Course introduction
- Methods & concepts in seismic acquisition and processing

Day 2
- Basic geological concepts
- Tying wells and exploration data to seismic data/ synthetics

Day 3
- Field excursion – seismic scale related to geological scale
- Interpretation of extensional and compressional features on 2D seismic data

Day 4
- Continue Interpretation of extensional and compressional features on 2D seismic data
- Interpretation of stratigraphic features on 2D seismic data

Day 5
- Summary of 2D interpretation lessons
- Interpretation of complete 2D & 3D datasets on workstation

Days 6 & 7
- Continue Interpretation of complete 2D & 3D datasets on workstation

Day 8
- Mapping in the time domain
- Velocity model determination and mapping

Day 9
- Depth mapping
- Description of "advanced methods" – seismic attributes, AVO, 4D

Day 10
- Interpretation pitfalls
- Review of course topics
- Discussion



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# AVO and Seismic Inversion

**Duration** 5 days
**Code** GGP/AVO/05

## Course Objectives

OPC offers a 5 day training course in AVO and Seismic inversion to build a thorough understanding of the techniques used transforming seismic reflection data into a quantitative rock-property description of a reservoir. The course will cover seismic inversion from post-stack, deterministic, random or geostatistical perspective.

## Who Should Attend?

The course is aimed at geoscientist's who aim to gain a better understanding and practical application of AVO and Seismic inversion.

## Course Outline

Day 1
- Different disciplines in reservoir characterisation
- Structural and stratigraphic interpretation
- Vertical Seismic Profiling (VSP)
- Seismic signal and data processing

Day 2
- Sequence stratigraphic interpretation
- Introduction to AVO and inversion methods
- Seismic attributes
- Case study and exercise

Day 3
- AVO and inversion
- Introduction to rock physics theory and applications
- Reservoir characterisation by seismic modelling

Day 4
- Introduction to log interpretation and seismic petrophysics
- Noise in seismic data interpretation
- Hydrocarbon indicators
- Case study and exercise

Day 5
- Time lapse seismic, monitoring and passive seismics
- Geo-statistical and neural network techniques
- Case studies and exercise



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**Duration** 5 days
**Code** GGP/RPP/06

# Rock Physics & Petrophysics for Seismic Interpretation

## Course Objectives

- Rock Physics vs Petrophysics, anisotropy, elastic properties, heterogeneous media
- Modulus e.g. Permeability-porosity relationship, critical porosity, dual porosity, Gassmann's equation
- Velocity-porosity relation for shales, shaly sand & carbonates, Vp & Vs, rock compressibility, elastic impedance, Reflection coefficient, AVO
- Pore pressure and effective stress, Biot theory, poroelasticity, Fracture gradient, stress modeling, stress sensitivity of shales & sands, sediment compaction
- Shale Anisotropy, Fractured reservoir, rock physics models for fractures, seismic characterisation of fractured reservoir, mapping of fracture corridors
- Borehole stability, Reservoir Geomechanics, 4D seismic monitoring and prediction of pressure and saturation through seismic data

## Course Outline

Day 1

- Introduction to Rock Physics and Petrophysics
- Pore pressure, in situ stress and geomechanical properties
- Porosity and permeability
- Sediment compaction and microstructure
- Estimation of min and max stress and tectonic strains

Day 2

- Fractured reservoirs
- Seismic (AVO) attributes
- Borehole and seismic methods, including VSP
- Mapping of fracture corridors in naturally fractured reservoirs
- Case story Kuwait fracture corridors

Day 3

- Seismic inversion fundamentals
- Lithology and fluid prediction
- Exercise fluid prediction from seismic
- Petrophysics and log interpretation
- Introduction to modern massive pre-stack data applications

Day 4

- Further on lithology and pore-fluid prediction from well and seismic data
- Exercises MATLAB with real input data
- Hybrid AVO/elastic inversion
- Case story integrated reservoir study
- 4D seismic monitoring

Day 5

- Statistical rock physics
- Exercise with MATLAB, estimate pdf
- Case stories of modern massive prestack data application
- Finding a balance between theory and the geoscientist´s toolbox



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**Duration** 5 days
**Code** GGP/SCAL/07

# SCAL: Programing, Design, Implementation, QC & Evaluation

## Course Objectives

- Design SCAL programs as per specific objectives
- QC data and eliminate non representative ones
- Understand the wettability and capillary pressure concepts and evaluate reported relative permeability curves
- Relate permeability results to rock types and make necessary adjustments and refinements
- Capillary Pressure Analysis and Rock Typing
- Determination of Residual Oil Saturation out of relative permeability curves
- Carry out a systematic review of a laboratory report and differentiate results that are clearly invalid from those that may be reliable

## Course Outline

### Introduction & Steady-State Technique

- Introduction
  - Business value of SCAL
  - Remaining vs. residual oil saturation
  - Wettability
  - Best Practice: need for interpretation-by-simulation
  - General overview of laboratory measurement techniques
- Steady-State Technique, Basics
  - Experimental set-up in the lab
  - Physics of the experiment
  - Horizontal vs. vertical
  - Automation of data gathering
- Steady-State Technique, Analytical interpretation with exercises in Excel
  - Data consistency
  - Design of the experiments, choices for fractional flow
- Steady-State Technique, Best Practice: interpretation-by-simulation, hands-on through exercises with the SCORES/DuMux simulator
  - Residual oil vs. remaining oil saturation
  - Impact of imbibition capillary pressure, oil end-effect
  - Impact of drainage capillary pressure, water end-effect

### Core Plug Preparation & UnSteady-State Technique

- Core plug preparation
  - Plug selection, using quantitative X-ray CT images
  - Cleaning
  - Establish initial water saturation
  - Ageing
- UnSteady-State (Welge) Technique, Basics
  - Experimental set-up in the lab
  - Physics of the experiment
  - Horizontal vs. vertical
  - Automation of data gathering
- UnSteady-State (Welge) Technique, Analytical interpretation with exercises in Excel
  - Analytical calculation of shock front saturation
  - JBN method
  - Corey parameter characterisation
- UnSteady-State (Welge) Technique, Best Practice: interpretation-by-simulation, hands-on through exercises with the SCORES/DuMux simulator
  - Effect of viscosity ratio
  - Impact of capillary forces
  - Capillary number and desaturation



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### Centrifuge Technique & SCAL Data Quality Assessment

- Centrifuge Technique, Basics
  - Experimental set-up in the lab
  - Physics of the experiment
  - Drainage vs. imbibition hardware
  - Automation of data gathering
- Centrifuge Technique, Analytical interpretation with exercises in Excel
  - Bond number
  - Hassler-Brunner analysis for multi-speed experiments
  - Hagoort analysis for single-speed experiments
- Centrifuge Technique, Best Practice: interpretation-by-simulation, hands-on through exercises with the SCORES/DuMux simulator
  - Effect of oil viscosity, characteristic time
  - Impact of water mobility in imbibition experiments
  - Impact of capillary forces
  - History matching multi- and single-speed experiments
- SCAL quality assessment
  - How to recognise bad data
  - Best Practice: verifying data consistency

### Porous Plate Technique, SCAL for Gas Flooding Experiments, Strengths and Weaknesses of each SCAL Technique

- Porous Plate Technique, Basics
  - Experimental set-up in the lab
  - Physics of the experiment
  - Capillary continuity
  - Multiple plugs vs. single plug equipment
  - Automation of data gathering
- Porous Plate Technique, Analytical interpretation with exercises in Excel
  - Recognising equilibrium
  - Characteristic time
- Porous Plate Technique, Best Practice: interpretation-by-simulation, hands-on through exercises with the SCORES/DuMux simulator
  - How to set-up simulations in the absence of data
  - Experimental design
  - Interpretation-by-simulation of capillary pressure and resistivity measurements
- SCAL for gas flooding experiments, Understand limitations of UnSteady-State and Steady-State techniques through exercises in Excel
  - Impact of shock front in drainage and imbibition mode in UnSteady-State experiments
  - Hagoort criterion for viscous fingering
- SCAL for gas flooding experiments, 3-phase relative permeabilities, spreading condition, centrifuge experiments for GOGD
- SCAL for gas flooding experiments, Best Practice: interpretation-by-simulation, hands-on through exercises with the SCORES/DuMux simulator
  - Impact of capillary pressure in flooding experiments
- Plenary discussion of strength and weaknesses of each SCAL measurement technique

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- Understanding main characteristics of each technique facilitates designing a lean and fit-for-purpose SCAL measurement program

### SCAL for EOR, Implementation of SCAL Data into Reservoir Model, and SCAL Master Measurement Program

- SCAL for EOR
  - Introduction into EOR techniques in the field
  - Understanding scope for EOR
  - Issues and design of SCAL experiments for Low salinity flooding, Thermal EOR, Chemical EOR
- Implementation of SCAL data into Reservoir Model
  - Model initialization
  - Primary recovery
  - Secondary recovery
  - Data for tertiary processes
- Plenary discussion on the design of a Master measurement program
  - At course close-out, a comprehensive hand-out will be distributed that serves as a Master SCAL measurement program for future use in the office

**Duration** 5 days
**Code** GGP/ICLD/08

# Integration of Core & Log Data

## Course Objectives

- Understand Lab Core measurements- RCAL and SCAL
- Determine reservoir properties from Log interpretation and compare it with core measurements and define rock types
- Determine Electrofacies and derive Poro-Perm Relation, well Test Analysis
- Integrate Core, Log and Test data for Reservoir Modeling

## Course Outline

Day 1

- Logging tools available to predict or measure reservoir properties
- Core analysis methods to measure reservoir properties (porosity, permeability, grain density and saturation)
- Electrical properties
- Log analysis

Day 2 & 3

- Log analysis, determine PHI, SW, lithology using deterministic and probabilistic methods
- Summaries
- Examples

Day 3 & 4

- Rock typing and hydraulic units
- Electrofacies and Lithofacies
- Permeability prediction
- Reservoir Rock properties from SCAL-Relative Permeability, Capillary Pressure, Wettability, Electrical properties
- Well Test Analysis, Integration with Petrophysical Analysis
- Examples

Day 5

- Uncertainty
- Monte Carlos sensitivity
- Conclusion



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**Duration** 5 days
**Code** DO/IDCO/01

# Introduction to Drilling & Completions Operations

## Course Objectives

The course covers the concepts under-pinning well control capability. It is important for those relatively new to drilling planning and operations to fully understand how wells are planned and put in place safely, in order to avoid well control incidents. The course combines theoretical and practical learning to cover topics including well design, well breakdown and well kill operations.

## Who Should Attend?

The course is designed for less experienced engineers and managers who are becoming increasingly responsible for well planning and design and drilling and also for relevant operations managers and technical support professionals.

## Course Outline

### Accessing Optimum Field in-fill Targets using Pilot Holes (aka Ratholing)

- Methods of identifying & defining optimum reservoir paths
- Planning of well paths to enable reaching these targets
- Designing the well casing configurations
- Considerations regarding vertical, deviated, step-out & horizontal wells
- Issues of new wells v re-use of existing wells with regard to defining objectives and making decisions on the options offered

### Multilaterals – Equipment and Methods of Casing

- Equipment options available to create multilateral wells
- Alternative casings that can be used as a mother bore and as laterals
- Applying the techniques in constructing a new well
- Issues of well integrity assurance

### Secondary Opening up of Producing Horizons

- Sidetracks and multilaterals
- Re-using an existing well options for using multi-lateral techniques
- Special equipment for creating openings & sidetracks from the existing well

### Well Completion

- The variety of well completion equipment available
- Selecting the right equipment
- Pros and cons of specific equipment use

### Completion Fluids (also known as Flush Fluids)

- Specification of well completion fluids
- Developing their precise purpose and duty
- Description of typical completion fluids



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**Duration** 5 days
**Code** DO/FWC/02

# Fundamentals of Well Control

## Course Objectives

The course covers the concepts under-pinning well control capability. It is important for those relatively new to drilling planning and operations to fully understand how wells are planned and put in place safely, in order to avoid well control incidents. The course combines theoretical and practical learning to cover topics including well design; well breakdown and well kill operations.

## Who Should Attend?

The course is designed for less experienced engineers and managers who are becoming increasingly responsible for well planning and design and drilling and also for relevant operations managers and technical support professionals.

## Course Outline

### Overview of Well Control

- Primary mechanism - adequate hydrostatic balance
- Requiring a secondary means – using BOP equipment
- Killing a well to correct matters and return to normal drilling operations
- Introduce well killing methods - drillers' method, wait and weight method, volumetric method, bullheading

### Well Formation Fracturing

- How and why it occurs
- Definition of fracture pressure
- Typical fracture pressures – globally and variation with depth
- Gas migration during shut-in (with & without influx expansion)
- What happens in an underground blow-out?
- Demonstration and analysis of why this has occurred
- Link to formation fracture gradient, mud weight and surface applied pressure
- How to avoid it happening during well control operations
- More on the well killing process

### Well Design – It's Objectives for Well Control

- Design method and criteria with regard to formation fracture
- Outline of casing design principles
- Staying with mud weights inside the pore pressure-fracture pressure envelope with depth Nominating safe limits for kick tolerance
- How leak-off test are carried out to properly determine formation fracture gradients
- How their results translate into limits of kick size for given mud weights to be used
- What are safe limits on most well hole sizes?

### Well Kill Operations

- Taking care to avoid down-hole formation fracture at casing shoe formation
- Good drilling practices
- Planning to ensure formation fracture does not occur
- Choice of kill method
- Proposed pressure schedule
- Operations and monitoring to avoid break-down during kill



Further information

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**Duration** 5 days
**Code** DO/CC/03

# Casing Cementing -
## Current Leading Practice & New Techniques

### Course Objectives

The course covers the fundamental concepts and calculations required to design cementing jobs and provide practical guidelines for understanding and controlling the operations to ensure that the work proceeds safely and efficiently. There will also be a discussion of the latest technological developments.

### Who Should Attend?

The course is designed for less experienced drilling engineers and managers who are becoming increasingly responsible for cementing operations and also safety and technical support staff.

### Course Outline

- Designing a cement job for casing
- Collecting the base input data
- Wellbore geometry for casing Jobs
- Determining hole size
- Cement volume calculations
- Methods of cement placement
- Types of cement
- Chemicals used in cementing – names, purposes
- Selecting cement weights
- Pump ability of cement
- Thickening times
- Cement chemicals calculations
- Advanced simulation of cementing Jobs
- Testing cement products beforehand
- Running the cement job
- Preparations
- Records whilst running
- Interpretation of pressures during the cement job
- Bumping the plug & pressure testing
- The differences in cementing a liner versus cementing casing
- To summarise techniques - the entire calculations for cement jobs for a well
- Recent innovations in cementing
- Specialist cementing equipment
- Cementing in wells using new technology such as expandable tubulars & swellable elastomers



Further information

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**Duration** 5 days
**Code** DO/AWC/04

# Advanced Well Cementing

## Course Objectives

The course covers the advanced practices in the latest cementing techniques. This course delves into the chemistry to address special cases as well as design a full cementing program for a real typical case.

## Who Should Attend?

Operational and Engineering personnel requiring practical and theoretical knowledge and the latest cementing techniques.

## Course Outline

The course will cover all of the topics shown below:

- Basic vs. advanced cementing
- Well Performance considerations and well cementing
- Chemistry and characterization of cements
- Cement additives and their functions
- Rheology of cement slurries
- Mud removal
- Cement/ formation interaction
- Speciality cements and systems
- Annular gas migration
- Cements for high temperature applications
- Cementing equipment and casing hardware
- Cement job design
- Primary cementing methods
- Secondary cementing methods
- Foamed cement
- Horizontal well cementing
- Cement job evaluation
- Laboratory testing of well cements
- Cementing calculations
- Casing and squeeze tool hydraulics
- Tuned light cementing system
- Rheology tuned cementing
- Right angle set cement



Further information

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**Duration** 5 days
**Code** DO/ADP/05

# Advanced Drilling Practices

## Course Objectives

- Drill a well cost effectively and maximize penetration rate
- Evaluate stuck pipe problems and avoid potential problems by optimizing hole cleaning and ROP
- Design, drill string and BOP/wellheads
- Design and implement bit and hydraulics programs
- Recognize and evaluate well control problems by effectively using Mud Logging principles and techniques

## Course Outline

Day 1
- Well Planning Basics
- Probabilistic Well Cost Estimation
- Risk Management Basics
- Risk Management Tools
- Overburden Drilling v Reservoir Drilling
- Getting the most from Service Co.

Day 2
- Stuck Pipe - Settled Solids
- Stuck Pipe - Differential
- Stuck Pipe - Others
- Fishing Tool & Methods
- Fishing Strategy
- Sidetracking & Casing Exits

Day 3
- Surface Wellheads
- Sub Sea Wellheads
- BOP & API 53C
- Drill String Design Basics
- Axial Force in Submerged Tubulars
- Drill String Inspection – DS-1
- Basic Casing Design

Day 4
- Bit Technology
- Drive Mechanisms, PDM, RSS
- Hydraulic Well Planning
- Hole Cleaning Basics
- Best Drilling and Tripping Practices

Day 5
- Classical Well Control (basic)
- Actual Well Control
- Considerations for Deepwater WC
- Consideration for HP/HT WC
- Deepwater Horizon and API 53C
- Advanced Kick Detection Systems
- Review and Q&A



Further information

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**Duration** 3 days
**Code** DO/ADC/06

# Advanced Drilling & Completion Technique

## Course Objectives

- Use of the Tools in the Tool Box to get wells "planned" correctly and then executed in the field
- Floating Drill String and employing new technologies to avoid getting stuck + Operations Handbook
  Investigating the success of the > 19,000 wells drilled UBD and the new way of drilling MMPD
- Utilizing the Service Companies to provide Slick Strings and getting the right drill bit for the job
  Surface Set Up to drill UBD/MMPD
- From planning right through to Execution = PERI (Planning Equipment Review and Implementation)
- Planning and working closely together with the Mud Logging Companies (Actually in the same Office 24/7) garners proven superior results and actually where working as a Performance Engineer for Offshore Operations, Shallow Water and Deep Water Development and Exploration wells
- Getting the Service Company involved in all Safety aspects of our ongoing operations and each engineer in the Operating Company becomes the Sponsor for that particular Service Company and again raises the Bar on Safety

## Course Outline

### Drilling the Well
- Drill a well cost effectively
- Evaluate Flat Time and Fix
- Look at all the Technologies and Methodologies available = Tools in the Toolbox including MMPD

### Avoiding Stuck Pipe
- Stuck Pipe Avoidance
- Lost Circulation challenges
- Lifting Capacity and using Pulsing Technologies
- Drilling Methods = MMUBD, MMPD and CTD

### Detailed Drill String Design
- Drill string design and surface components
- Slick strings – HWT and no DC's
- Drill Bit Selection
- Surface Set up for advanced Drilling Technologies

### BHA Design – Deviated, Horizontal, ML
- Design and implement bit and hydraulic programs
- Deviated Wells
- Horizontal Wells
- Multilateral Wells
- How to Complete?

### Different Completion Options
- Open Hole Completions
- Cased Hole Completions
- Slotted Liners
- Gravel Packs
- Stimulating
- HPHT Ops?

### Well Control and Mud Logging
- Recognize and evaluate WC problems by effectively using Mud Logging Co's
- GEOLOG and GEOSERVICES products
- Mud Logs and Wireline Logs
- Getting Pressures recorded properly

### Health Safety and Environment
- HSE
- Service Company Safety Meetings
- Documenting and Implementing
- All-important Follow Up



Further information

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**Duration** 3 days
**Code** RPE/PWTI/01

# Practical Well Test Interpretation

## Course Objectives

The course provides an understanding of the theory and practice of pressure transient analysis using analytical methods. Participants will gain:

- An understanding of the geological and fluid parameters which affect the results of pressure transient analysis.
- Skills to interpret pressure transient analysis data for permeability and the various components of skin
- Skills to evaluate reservoir geometry and connected volume using boundaries and mobility/storativity models
- Experience in analysing real sets of test data

The course materials and example datasets are not software specific thus can be used with any commercial software package. Use of the PIE well test software from WellTest Solutions (the software used by BP and Total among others worldwide) will be available for the course.

## Who Should Attend?

Engineers and Geoscientists who wish to obtain a basic understanding of well test interpretation and the skills required to use PIE.

The individuals attending the course should be able to develop their skills to a level where they will be able to do the analysis themselves and contribute knowledgeably to a department or asset that has some involvement in this area.

It would be useful to have had some previous exposure to well testing, well operations, or theory of reservoir engineering; but this is not vital.

## Course Outline

Day 1

- Overview of the development of well testing practice and theory
- The basics - obtaining good data, radius of investigation, the inverse problem, Type Curve models, Superposition
- Introduction to PIE - data loading exercise from a spreadsheet and ASCII file
- Gauge comparison
- The principles and importance of Superposition's and the rate history
- Analysis/diagnostic plots and the manipulation of them: Horner, Superposition and Log Log Derivative plots – straight line analysis with examples
- Well bore storage and skin – with examples

Day 2

- Flow regimes: radial flow, spherical flow, linear flow and bi-linear flow, pseudo steady state – what this means and why
- Type Curve models
- Examples to reinforce all of the above
- Examples to demonstrate all of the first day's theory in practice
- Boundaries and how this affects the pressure responses, plus how to analyse test data with boundaries
- Reservoir pressure and reservoir surveillance with examples
- Gas well testing with examples

Day 3

- Horizontal wells with examples
- Factors complicating well testing
- Test design
- Interpretation guidelines
- Recognising derivative shapes



Further information

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**Duration** 3 days
**Code** RPE/AWTI/02

# Advanced Well Test Interpretation

## Course Objectives

This course is more advanced and has thus incorporated more reservoir models for practical application. The aim is to equip attendees with an understanding of the theory and practice of pressure transient analysis using analytical methods and an understanding of the geological and fluid parameters which affect the results of pressure transient analysis.

The course will give you skills to interpret pressure transient analysis data for permeability and the various components of skin as well as evaluating reservoir geometry and connected volume using boundaries and mobility / storativity models. The practical element will give participants experience in analysing real sets of test data.

The course materials and example datasets are not software specific thus can be used with any commercial software package. Use of the PIE well test software from WellTest Solutions (the software used by BP and Total among others worldwide) will be available for the course.

## Who Should Attend?

The course will be suitable for junior to senior engineers aiming at getting an advanced perspective on well testing and its applications.

## Course Outline

Day 1

- Overview of the development of well testing practice and theory
- Introduction to PIE - data loading exercise from a spreadsheet and ASCII file and gauge comparison
- The principles of Superposition's and the rate history
- Analysis/diagnostic plots and the manipulation of them: Horner, Superposition and Log Log Derivative plots – straight line analysis with examples
- Well bore storage and skin – with examples, flow regimes: radial flow, spherical flow, linear flow and bi-linear flow, pseudo steady state – what this means and why
- Type Curve models and examples
- Boundary theory and practice with examples using PIE

Day 2

- Reservoir pressure and reservoir surveillance with examples
- Gas well testing with examples
- Horizontal wells with examples
- Factors complicating well testing and how this affects the pressure responses
- Managing anomalous data and analyses

Day 3

- Composite reservoirs: linear and radial
- Multi-well analysis set up and practice in PIE
- Double porosity with examples
- Double permeability with examples
- The principles and application of deconvolution with examples
- Managing the Inverse problem with what is known: testing hypotheses



Further information

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# Reservoir Characterisation

**Duration** 5 days
**Code** RPE/RC/03

## Course Objectives

To give participants an understanding of reservoir characterization as one of the core skills of their discipline, whereas the engineers will be able to build their cross-disciplinary awareness.

This course adopts a multi-disciplinary approach, which focuses on the importance of and the techniques for the integration of all available geophysical, geological and engineering data (seismic, log, core, test and production data).

The course emphasizes the multi- disciplinary nature of this process and the importance of using both static and dynamic data to help define the reservoir model and thereby optimize the development plan for the reservoir. The course makes extensive use of team exercises to practice data integration and case studies to highlight best practices in reservoir characterization.

## Who Should Attend?

This course is specifically designed for a mixed group of senior geoscientists and petroleum and reservoir engineers working in field development groups.

## Course Outline

### Objectives of Reservoir Characterization

- Identification of a reservoir model, which behaves as similar as possible to that of the actual reservoir
- Use of static and dynamic data interpretation models, and the integration of the models into a reservoir model
- Verification of the resulting reservoir model
- Need for consistency with all interpretation models
- Reservoir characterization - dynamic & iterative process
- Understand the non-uniqueness of the inverse problem in identifying a reservoir model and ways to reduce it
- Understand that reservoirs are more complex and uncertain than previously modelled

### Use all Available Data to

- Describe and model each reservoir unit
- Understand past & predict future reservoir performance
- Controls on fluid flow and hydrocarbon recovery

### Static Data that Describe the Reservoir

- 2D vs 3D modelling
- Concepts of 3D stochastic modelling
- Principles & use of geostatistics in uncertainty modelling ‘best practice’ approach to integration of reservoir data
- The link to reservoir simulation

### Use of Seismic and Log Data, Seismic and Sequence Stratigraphy, etc., to Determine

- Structural configuration and hydrocarbon distribution
- Reservoir architecture and reservoir continuity
- Determine lithofacies and permeability distributions
- Interpretation of facies assemblages, flow units visualization
- Structural modelling & property modelling
- Honouring heterogeneity & complexity

### The Cross-Discipline Dimensions

- Use of engineering data (test, production data) to confirm geological correlations/models
- Dynamic data that describes reservoir behaviour
- Team exercises in reservoir characterization
- Case histories & best practices



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**Duration** 2 days
**Code** RPE/RS/04

# Reservoir Surveillance -

## Effective Use of Permanent Downhole Pressure Data

## Course Objectives

To give participants a good understanding of the concepts and value of reservoir surveillance and to provide:

- Skills to interpret pressure transient analysis data using well test interpretation software
- An understanding of the theory & practice of pressure transient testing sufficient to differentiate between well and reservoir performance
- Techniques for monitoring average reservoir pressure in multi-well reservoirs
- Experience in working with and extracting useful information from real sets of permanent downhole pressure data and permanent downhole flowmeter data

## Who Should Attend?

The course will be suitable for any member of a technical or commercial team, from TA to Manager, where large quantities of downhole pressure data are being provided to the team on a regular basis.

## Course Outline

### Fundamentals of Well Testing and Pressure Transient Analysis

- Well & reservoir terminology and definitions
- Data required and information gained from well testing
- Well test interpretation methodology
- Pressure Transient Analysis theory

### Relevance of Input Data for Reservoir Surveillance

- Pressure data - where, when and how?
- Rate data - what should we use and how accurate is it?
- Fluid and rock data
- Interference testing and rate allocation using PTA models

### Superposition Theory

- Importance in analysing long production history data
- What production history should be used?
- Does it matter?

### The Plots (graphs) Used for Analysis and Why we don't Use Horner Plots

- Data plots
- Superposition
- Log-log plots

### What are we looking for in Reservoir Surveillance?

- What can we do with the data we get?
- Monitoring permeability and skin changes
- Average reservoir pressure and time to pseudo-steady state
- Techniques for determining average reservoir pressure

### Material Balance and Reservoir Modelling with Permanent Down-hole Gauges

- Validity of material balance in PTA modelling
- Use of material balance models to determine Volume of Investigation and Minimum Connected Volume
- Use of PTA material balance for reservoir models: GIIP / STOOIP and reserves
- Use of mobility and storativity differences for reservoir modelling

### So how does this Add Value?

- Practical case studies based on real data sets.



Further information

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**Duration** 5 days
**Code** RPE/IRM/05

# Integrated Reservoir Management

## Course Objectives

To give participants a good understanding of the concepts and the tools which can contribute to the reservoir management by making it a multi-disciplinary process?

## Who Should Attend?

The course will be suitable for petroleum and reservoir engineers and some experienced geo-scientists responsible for day-to-day management of reservoirs.

## Course Outline

### Introduction to "Reservoir Management"

- What do we mean by reservoir management?
- The sources and acquisition of reservoir data
- The "old" sequential approach
- The "new" integrated/ iterative way of reservoir management
- The primary importance of reservoir characterisation

### The Reservoir Management Process

- The objective – increasing the value of a hydrocarbon asset
- Possible targets – decreased risk, greater and earlier production, reduced costs, added flexibility
- Planning field developments
- Monitoring reservoir performance
- Evaluating results by comparisons of actual performance with predictions

### Understanding the Reservoir – the Technology Toolkit

- Review of popular systems for static and dynamic reservoir modelling
- The importance of applying the technology competently
- Integration of geological, geophysical and engineering data
- Reservoir characterization, describing the reservoir – the static model with static data
- Reservoir simulation, describing the reservoir's behaviour – the dynamic model with dynamic data
- Reservoir surveillance – monitoring performance and analysing the data

### Adding Economic Value

- Techniques to maximize economic recovery
- Minimising capital investment, operating costs and risk
- Economic impact of changes to operating plans
- How timing affects value



Further information

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**Duration** 5 days
**Code** RPE/BRE/06

# Basic Reservoir Engineering -
## For Production Operations Staff

## Course Objectives

To give participants an understanding of the practices and limitations of the methods and procedures employed by reservoir engineers. In addition to covering the subjects at a basic conceptual level, gas well testing, sampling and reservoir surveillance will be covered in considerable detail and with practical examples.

## Who Should Attend?

The course will be suitable for all technical and professional field operations staff and their managers.

## Course Outline

### Basic Petroleum Geology & Petrophysics

- Deposition, formation and trapping mechanisms
- Reservoir properties
- Production mechanisms & recovery methods
- Recovery factors and sweep efficiency
- Fluid flow - Darcy's Law, absolute and relative permeability
- Linear and radial flow
- Transient, pseudo-steady and steady state flow regimes
- Rock & fluid properties, phase behaviour
- Viscosity, compressibility, z factor, p2 and m (p) methods

### Evaluation and Recovery of Gas Reserves

- Determination of original gas-in-place – material balance, decline curve analysis, volumetrics
- Overview of dynamic reservoir analysis
- Gas reservoir drive mechanisms, gas recovery estimates

### Gas Flow in Well Bores and Pipelines

- Gas well bore and pipeline flow correlations
- Transient and pseudo-steady state IPR
- Nodal analysis applied to gas wells/ reservoirs

### Predicting Future Performance & Ultimate Recovery

- Forecasting methods & use and abuse of decline curves
- Well spacing in gas reservoirs
- Infill well drilling for reserves or offtake enhancement
- Comparison of reservoir simulation & analytical methods

### Gas Well Testing and Pressure Transient Analysis

- Basics of gas well testing
- The concepts of radius of investigation, flow after flow testing, Isochronal and modified isochronal testing
- Build-up testing
- Determination of – permeability, mechanical, geometrical and rate dependent skin
- Boundary and heterogeneity identification
- IPR determination with C/N and LIT methods
- Problems with liquid dropout in the wellbore during testing
- Build-up analysis of gas condensate reservoirs

### Importance of Taking Representative Fluid Samples

- Use of fluid samples in reservoir characterization
- Surface and subsurface sampling methods
- Importance of quality control in sampling
- Reservoir surveillance



Further information

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**Duration** 5 days
**Code** RPE/AHF/07

# Advanced Hydraulic Fracturing

## Course Objectives

The course is designed for engineers, supervisors, geoscientists, technologists and operations personnel. It will enable participants to gain a thorough insight into all practical aspects of Advanced Propped Hydrofrac Stimulation Technologies, which have proven successful in field applications worldwide.

A quick review of hydrofrac stimulation fundamentals will be presented at the very beginning; however, the trainees must have an understanding of the basic engineering principles and concepts.

## Who Should Attend?

The course is designed for engineers, supervisors, geoscientists, technologists and operations personnel.

## Course Outline

### Day 1: Data Gathering and Candidate Selection

- Data sources
- Input data required for 3D models
- Determine critical parameters
- Types of treatments
- Results of treatments
- Optimisation methodology

### Day 2: Fundamental & Critical Fracturing Concepts

- Fluid mechanics
- Rock mechanics
- Critical fracturing issues

### Day 3: Frac Design & Analysis

- Fluid selection considerations
- Proppant selection consideration
- Frac design with 3D model
- Benefits of real-time frac analysis
- Result of 3D models

### Day 4: Treatment Execution and Analysis

- MiniFrac design and execution
- MiniFrac analysis
- Rate Step-down test
- MiniFrac design and execution
- Post-treatment QAAC

### Day 5: Treatment Execution and Analysis

- Pre-job materials testing
- Pre-job QAAC
- Real-time QA/QC
- Real-time design methodology
- Post-job procedures



Further information

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# Fractured Reservoirs

**Duration** 5 days
**Code** RPE/FR/08

## Course Objectives

This course provides concepts, skills and understanding required for analysing fractured reservoirs. Geological concepts, fracture development process, behaviour of fractured reservoirs, engineering concepts and methods for evaluation and management of heterogeneous naturally-fractured reservoirs are presented.

Issues impacting fractured reservoir performance, including drive mechanisms, capillary forces, gravity, viscous effects and flow characteristics in matrix and fracture, well test analysis, integrated fractured reservoir study and reservoir simulation are discussed. Case studies and class exercises will be discussed.

## Who Should Attend?

Reservoir engineers, geologists, petrophysicists, geophysicists involved in multi-disciplinary subsurface projects related to evaluation, characterization and analysis of fractured reservoirs.

## Course Outline

- Introduction to fractured reservoirs
- Fractured reservoir geology
- Geological conditions of fracturing
- Quantitative evaluation of fracturing
- Characterization of natural fractures and fracture systems
- Basic parameters of fractures
- Statistical representations
- Physical properties of fractured rocks
- Porosities
- Permeabilities
- Compressibility
- Relative permeability
- Capillary pressure
- Logging in fractured reservoirs
- Fluid flow in fractured reservoir with double porosity
- Basic equations of flow
- Warren and Root model
- Other models
- Well flow and productivity
- Liquid flow
- Gas flow
- Analysis and interpretation of pressure transient tests in naturally-fractured reservoirs
- Drawdown test
- Build-up test
- Interference effects
- Type-curve analysis
- Fluid displacement in fractured reservoirs
- Displacement of oil by water
- Displacement of oil by gas
- Imbibition and drainage
- Production mechanisms
- Effects of natural fractures on reservoir permeability, drainage area and water flood
- Simulation of fractured reservoirs



Further information

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**Duration** 5 days
**Code** RPE/EDHO/09

# Evaluation and Developing Heavy Oil Resources

## Course Objectives

This course is largely designed for geoscientists or engineers with a need to advance their understanding of heavy oil – situ oil sands resources

- Evaluate and develop heave oil / oil sands resources.
- Understand the importance of heavy oil / oil sands resources in today's word energy market.
- Contrast heavy oil / oil sands resources as compared to conventional and other unconventional resources with aspect of.
- Understand the geology, critical attributes, and commerciality of the Canadian heavy oil / oil sands.
- Collect the appropriate data and evaluate the critical geologic and reservoir parameters of various types of heavy oil / oil sands.
- Recognize and evaluate the environmental challenges required to develop and produce heavy oil / oil sands resources.
- Understand the process and methodology to evaluate, select, plan, design, and implement a heavy oil / oil sands recovery.
- Become knowledgeable of the worldwide distribution and geologic setting of the more significant heavy oil resources.

## Who Should Attend?

The course will be suitable for Geoscience and engineering professionals

## Course Outline

Day 1
- Understand the importance of heavy oil/oil sands resources in today's world energy market.
- Oil sands (Bitumen)/heavy oil introduction and definitions

Day 2
- Collect the appropriate data and evaluate the critical geologic and reservoir parameters of various types of heavy oil/oil sands
- Recognize and evaluate the environmental challenges required to develop and produce heavy oil/oil sands resources
- Evaluate and develop heavy oil/oil sands resources

Day 3
- Evaluate and develop heavy oil/oil sands resources
- Heavy oil/in-situ oil sands recovery process overview –
- Non thermal field examples and development strategies
- Heavy oil/in-situ oil sands recovery process overview – Thermal
- Heavy oil/in-situ oil sands recovery process overview – Thermal field examples and development strategies

Day 4
- Evaluate and develop heavy oil/oil sands resources
- Heavy oil/in-situ oil sands recovery process overview – steam assisted gravity drainage (SAGD)
- Heavy oil/in-situ oil sands recovery process overview – steam assisted gravity drainage (SAGD) field examples and development strategies

Day 5
- Evaluate and develop heavy oil/oil sands resources
- Other commercial thermal in-situ technologies
- Other piloting recovery processes for heavy oil/oil sands recovery
- Reserves and resources booking practice of heavy oil/oil sands development
- Summary of process selection and methodology to evaluate and develop heavy oil/oil sands resources



Further information

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**Duration** 10 days
**Code** RPE/REW/10

# Reservoir Engineering Workshop

## Course Objectives

- Extended understanding of reservoir types, complexities and volumes
- Extended understanding of fluid contacts and reservoir pressures
- Extended understanding of reservoir drive mechanisms
- Extended understanding of rock and fluid properties, Test and RFT data
- Understanding well hydraulics and productivity
- Integrated understanding of uncertainties and their likely implications
- Understanding of the surface facilities issues and artificial lift operations
- Understand and apply basic petroleum economics
- Propose a development plan (from appraisal to abandonment)
- Advanced understanding of Fluid flow in reservoirs (drive and recover mechanisms)
- Advanced understanding of fluid properties, phase behavior (PVT), EOS and core analysis (conventional and special) for reservoir characterization
- Learn volumetric (OIP) and static and dynamic uncertainties and calculate reserves (material balance, decline curves) and uncertainty
- Run dynamic models/ reservoir simulation models. Conduct production forecasting as well as developing a good understanding of IOR/EOR methods including the evaluation of their application.

## Course Outline

### Day 1

- Evaluation of the Physical Properties of a Reservoir
- Reservoir geology, Geophysics and Hydrocarbon Accumulations
- Characterization of Reservoir Rocks
- Compressibility of Rock
- Averaging Porosity and Permeability Data
- Correlating Porosity and Permeability Data
- Reservoir Zonation
- Gross and net Thickness Determinations

### Day 2

- Evaluations of the Physical Properties of Reservoir Fluids
- Water Properties
- Gas Properties
- Oil Properties
- Surface-Tension-Wetability-Capillarity-Saturation
- Core Analysis
- Defining Fluid Contacts

### Day 3

- Well Pressure-Rate-Time Analysis
- Well Pressure-Time (WT) Volumetrics
- Well Rate-Time Volumetrics with DCA
- Flowing Material Balance Volumetrics
- Well Dynamic Behavior
- Well Performance Applications
- Well Logging and Analysis

### Day 4

- Static Reservoir Modelling
- Evaluation of Rock-Fluid Characteristic
  - Wettability Number and Contact Angle
  - Capillary Pressure Data
- Static Rock-Fluid Characteristics
- Dynamic Rock Fluid Characteristics
  - Construction of Relative Permeability
  - Averaging Relative Permeability Data
- Fluid properties
  - Fluid sampling
  - Fluid Samples Analysis
  - Use of the PVT Report
- Calculation of Fluid in Place
- Fluid in Place Uncertainties



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Day 5

- Dynamic Reservoir Modelling
- Classification of Hydrocarbon Reserves
- Computation of Reservoir Volume
- Gas Reservoir Volumetric methods
- Gas Condensate Reservoirs
- Undersaturated Reservoirs – Volumetric Methods
- Material Balance and Fluid Displacement
- Dynamic Well Performance
  - Well Trajectories
  - Inflow, Tubing, Well Performance and Artificial Lift

Day 6

- Reservoir Drive Mechanisms and Performance Predictions
- Calculations of Recovery from Gas Reservoir-No Water Drive
- Calculations of Recovery from Gas Reservoir-With Water Drive
- Calculations of Recovery from Gas Condensate Reservoirs-Volumetric Depletion
- Calculations of Recovery from Gas Condensate Reservoirs with Water Drive
- Calculation of Depletion Performance of Volatile Oil Reservoirs
- Estimation of Oil Recovery from Undersaturated Reservoirs
- Estimation of Recoveries for Saturated Reservoirs Solution Gas Drive
- Recovery Calculation for Gas Cap Drive
- Recovery Calculations Under Natural Water Drive
- Calculation of Recoveries under Simultaneous Solution Gas Drive, Gas Cap and Water Drive
- Determination of Water Influx-Infinite and Finite Aquifer
- Iterative Techniques for Estimating Water Influx
- Simultaneous Calculation of Initial Oil-in-Place and Water Influx

Day 7

- Immiscible Displacement Processes
- Recovery Calculations Using Frontal Advance Theory
- Description of Oil Recovery by Gas Displacements; Diffusive Flow with and without Gravity Drainage
- Pressure Maintenance by Pattern Gas Injection
- Pressure Maintenance by Crestal Gas Injection
- Determination of Oil Recovery by Water Injection (Segregated Flow)
- Determination of Oil Recovery by Gas Injection (Down-Dip Segregated Flow)
- Recovery Calculations by Water Injection in Stratified Media
- Calculation Performance in Layered, Patterned Water Floods- Craig, Geffen, Morse Method

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Day 8

- Improved Hydrocarbon Recovery
- Influence of Recovery Mechanisms on Residual Oil
- Miscible Displacement Mechanisms
- Miscible Flood Applications
- Chemical Flood Processes
- Heavy Oil Recovery
- Thermal Energy
- Reservoir Simulation

Day 9

- Field Appraisal Development
- Production Prognoses – Green Fields
- Green Field - Dynamic Reservoir Model Development
- Static and Dynamic Volumetrics
- Surface facilities
- Examples of Production Prognoses
- Risks Assessments
- Team Work Presentations-Green Fields

Day 10

- History Matching – Brown Fields
- Brown-Filed Model Development
- Examples of History Match
- Reservoir Monitoring and Production Forecasting
- Field Abandonment and Decommissioning
- Brown Field Modelling Economics
- Team Work Presentations-Brown Fields
- Course Summary

Further information

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# Dynamic Reservoir Simulation

**Duration** 10 days
**Code** RPE/DRS/11

## Course Objectives

- To know and understand fundamental concepts of Dynamic Reservoir
- To learn about the building of a reservoir simulation model (data gathering, data QC)
- To learn about carrying out a simple reservoir simulation study (data input, history matching and production forecast with a black-oil model)

## Course Outline

Day 1

- Reservoir Simulation Overview
- Structural Framework with faults and reservoir tops; Stratigraphy; Fluid contacts
- Rock Properties - Facies, Porosity, Compressibility, Core permeability
- Properties Distributions-Deterministic; Geostatistical; Seismic attributes
- Water saturation: Water saturation, Sw; Drainage capillary pressure vs. Sw
- Relative Permeability-End point scaling; Wettability
- Selected Exercises and Problems

Day 2

- Reservoir Simulation Introduction - Drive Mechanisms and Material Balance
- Reservoir Modelling
- Numerical Model Construction-Finite-Difference Operations
- Flow Equations and Boundary Conditions
- Solution Methods for Systems of Linear Algebraic Equations
- Single Phase Flow Equations Solutions (Pressure and Flow-Steady State Pressure, Transient Pressure, Diffusion Equation; Flow Properties-REW, Upscaling)
- Selected Exercises and Problems

Day 3

- Two Phase Flow: Saturation, Capillary pressure, Gravity, End-point saturation, Relative permeability, Darcy flow, Buckley-Leverett
- Three Phase Flow: Black Oil Model-
- Pressure and fluid properties, Three phase relative permeabilities, Finite difference and initialization
- Multi-Component, Multi-Phase Flow: Black Oil; Compositional Simulation
- Special Topics in Reservoir Simulation
- Reservoir Simulation-minimum required data input
- Selected Exercises and Problems

Day 4

- Upscaling and Geologic Uncertainty-
- Upscaling to the Flow Model; Geologic Uncertainty
- Fluid Properties; Dynamic Data-RFT: MDT data, Well production history data, Tracer data
- Quality control of reallocated well production data
- Reservoir model building; Data popularization; Black Oil input data



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- Incorporating well trajectories with perforations
- Running the IMEX data set and Review simulation results
- Evaluate Volume in place calculations: Static vs. dynamic model; Flowing material Balance, FMB volume in place; P/Z volume calculations
- Reservoir Simulation Hands-on IMEX Tutorial; Selected Black Oil flow simulation exercises (IMEX-CMG)

Day 5

- Modelling of a reservoir aquifer: Modelling water influx, Infinite of Carter-Tracy and Finite aquifer of Fetkovich
- Approximate relations for water influx; Analysis of water drive
- Determination of the water breakthrough instant and breakthrough pressure
- Running selected exercises with aquifer, horizontal wells, and fault transmissibility
- Introduction to modelling of fluids with complex composition, using the cubic equation of state; miscible EOR Partial mixing, total mixing and multiple mixing
- Condensate recovery with water drive; Condensate recovery by dry gas recycling
- Selected Group-Problem Black Oil Simulation Exercises (IMEX-CMG)

Day 6

- Designing the reservoir model: Selecting Reservoir–Rock and Fluid Properties Data; Selecting grid and time step sizes; Selecting the numerical solution method
- Water injection (BO); Lean gas injection (BO); Water Alternating Gas, WAG injection
- Single vertical well studies (radial flow modelling)
- Well management
- Reservoir simulation with a complex well: a multifractured-horizontal well; a multilateral well
- Reservoir simulation risk assessments of production forecast (Green field)
- Selected Exercises CMG SW

Day 7

- Forecasting future production profiles
- Preparation of input data and Planning the prediction cases to be run
- Modelling structural elements in simulation - vertical and sloping faults, channels
- Mechanics of predictions: Well control, Facilities controls and constrains, Creating various prediction scenarios of infill drilling and injector placement
- Analysis of Simulation Results: Use of analytical methods to QC simulation output
- Selected Flow Simulation Exercises with CMG SW

Day 8

- History matching objectives, strategy and plans
- Choose and match selected performance parameters
- Considering a feedback loop with the geo-model
- Manual adjustments of matching parameters; Automatic history matching
- Reservoir flow simulation tracer studies (Brown field)
- Assessing quality of history match
- History Matching Examples with CMG SW

Day 9

- Sector modelling
- Structured and unstructured gridding approaches: Cartesian grids, Corner
- point grids, Voronoi grids
- Comparing Well-test match data to Sector model simulation data
- Quality Control, Review: Geology Review of key elements in static model; PVT questions to be answered before study; Investigate keys to good predictions
- including Uncertainty Analysis
- Selected Flow Simulation Exercises with CMG SW

Day 10

- Coupling Reservoir flow simulation to: Network simulation; Geomechanical flow model
- Reservoir simulation state of technology summary
- Group Problem Presentations
- Summary of the Dynamic Reservoir Simulation Course

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**Duration** 5 days
**Code** RPE/PVT/12

# Fluid Properties & Phase Behaviour (PVT)

## Course Objectives

- Critical properties of reservoir fluids
- PVT and phase behavior calculations
- Laboratory PVT Analysis

## Course Outline

Day 1

- Volumetric and Phase Behavior of Oil and Gas Systems
- Oil and Gas Properties and Correlations
- Classification of Reservoir Fluids
- PVT Fluid Sampling, Tests and Empirical Correlations (Black Oil, Natural Gas and Formation Water)
- Selected PVT Exercises

Day 2

- Criteria for Phase Equilibrium
- Cubic Equation of State
- Phase Behavior Calculations
- Fluid Characterization
- Selected PVT Exercises
- Quiz Sessions

Day 3

- Mechanisms of High Pressure Gas Displacements
- Experimental Studies
- Miscibility Conditions
- Interfacial Tensions
- Selected Exercises
- Sessions with Problems

Day 4

- Fluid Gradients
- Reservoir Compartmentalization
- Fluid Components Grouping
- Comparison of EOS
- Selected PVT Exercises
- Sessions with Problems

Day 5

- Tuning of EOS
- Dynamic Validation of Model
- Evaluation of Reservoir Fluids
- Group Problems Presentations
- Summary of Properties and Phase Behavior of Fluids



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# Advanced EOR/IOR

**Duration** 5 days
**Code** RPE/AEI/13

## Course Objectives

- EOR/IOR Physical Methods of Displacements
- EOR/IOR Screening Processes
- EOR/IOR Field Piloting Schemes
- EOR/IOR Practical Production Techniques

## Course Outline

Day 1
- Fundamentals of displacements
- Water - flood methods
- Gas - flood methods
- Chemical – flood methods
- Thermal flood methods
- Exercises with Questionnaires

Day 2
- Investigate feasibility of a given IOR/EOR scheme
- Screening of selected prospects for a gas / water flood displacements
- Screening of prospects for a thermal flooding
- Problem exercises

Day 3
- Review and learn selected piloting strategies Onshore
- Practical aspects of EOR pilots
- Operating guidelines and monitoring for piloting EOR
- Gas flood pilot case study (onshore)

Day 4
- Review and learn selected piloting strategies (offshore North Sea)
- Challenging aspects of EOR/IOR
- Selected offshore case study project
- Case study guidelines

Day 5
- Field scale reservoir characterization
- Inter well communication
- Flow rate analysis
- Case study presentations



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**Duration** 5 days
**Code** RPE/EORF/14

# Enhanced Oil Recovery Fundamentals

## Course Objectives

- Drive mechanisms and recovery factors for primary depletion and pressure maintenance with waterflood or immiscible gas injection
- Determine reasons and causes why recovery could be lower than expected
- Choose optimal methods for improving recovery for primary depletion, waterflood or immiscible gas injection
- Chose optimal methods of enhancing oil recovery beyond primary depletion, waterflood, or immiscible gas injection
- Understand mechanisms for enhanced oil recovery in various EOR techniques
- Understand the most important variables that control enhanced oil recovery in various EOR methods
- Screening criteria for selecting optimal EOR techniques
- Designing EOR processes - theoretical methods, lab tests, and field pilots
- Planning and implementing EOR processes using the appropriate empirical, analytical, and simulation tools
- Forecasting rate-time and recovery-time performance for various EOR methods and analysing the performance
- Assess risks for EOR performance and ways to mitigate these risks and minimize their impact on project economics

## Course Outline

Day 1

Reservoir life cycle and primary and secondary recovery and improved and enhanced oil recovery.

Primary Recovery

- Drive mechanisms
- Typical recovery factors
- Reasons for poor performance
- Methods to improve recovery
- Case Studies

Secondary Recovery

- Waterflood and immiscible gas injection
- Drive mechanisms
- Typical recovery factors
- Reasons for poor performance
- Methods to improve recovery
- Case Studies

Day 2

Improved Oil Recovery

- Recompletions
- Water shutoff
- Infill drilling
- Use of artificial lift
- Identification of bypassed oil
  - 4D seismic monitoring
- Field case studies

Day 3

Enhanced Oil Recovery Methods

- Miscible gas injection
  - Rich Gas
  - $CO_2$
- Thermal recovery methods
  - Steam flooding
  - CHOPS
  - SAGD
  - Insitu combustion
  - Mining
- Chemical flooding methods
  - Polymer flooding
  - Chemical (ASP) flooding

- Drive mechanisms and recovery factors for EOR processes
- Field Case Studies

Reservoir and Production Engineering

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Day 4

EOR Screening Criteria

- Examples and exercises

Designing EOR Processes

- Theoretical methods
- Laboratory measurements
- Field pilots
- Key variables
- Examples and exercises

Day 5

Planning and Implementation of EOR Processes

- Key factors for success
- Use of appropriate empirical, analytical and simulation tolls
- Practical considerations

- Forecasting EOR process performance and analyzing the performance
- Identify main risks to EOR performance
- Mitigate risks to minimize effect on EOR project economics
- Detailed Field Case Studies

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**Duration** 5 days
**Code** RPE/EMFR/15

# Evaluation and Management of Fractured Reservoirs

## Course Objectives

- To introduce and overview the technical issues and the best practice workflow to achieve solutions
- To introduce the principles of structural geology and rock mechanics required for fractured reservoir appraisal
- To describe the range of well-scale data sources available for reservoir appraisal, with their merits, limitations and applications
- To show how outcrop analogs can be used to support reservoir characterisation and modeling ('virtual field trip')
- To describe the methods and workflow for fractured reservoir modeling
- To overview fractured basement reservoir appraisal and development
- To overview in situ stress determination, geomechanics and drilling techniques in fractured reservoirs
- To review, summarise and discuss key learnings from the course

## Course Outline

Day 1

Session 1: Overview of Fractured Reservoirs

- Definitions, classifications of fractured reservoirs, examples worldwide
- Typical character of fractured reservoirs
- Technical issues in geology, geomechanics, engineering
- Overview of workflow and solutions in fractured reservoir appraisal and management

Session 2: Structure and Geomechanics Basics

- Basics of stress, strain and fracture mechanics
- Natural fracture types, geometries, flow character (open, sealed, partial)

Day 2

Session 2: Continued

- Fracture reactivation and critical shear, impact on reservoir quality
- Fracture attributes and impact on reservoir quality, fracture porosity review
- 3D Fracture distribution controls (fracture 'drivers')

Session 3: Data Sources and Techniques (Well-Scale)

- Static data sources for fractured reservoir appraisal and their merits, limitations, applications
- Exercises in image log interpretation for fractures

Day 3

Session 3: Continued

- Dynamic data sources for fractured reservoir appraisal and their merits, limitations, applications
- Geomechanics data sources for fractured reservoir appraisal and their merits, limitations, applications
- Exercises in well log data integration

Session 4: Outcrop Analogs

- Use of outcrop analogs for reservoir characterisation - virtual field trip to the fractured carbonate outcrops of Spain

Day 4

Session 5: Fracture Modeling

- Preparation of well data
- Fracture prediction methods at reservoir scale
- Static fracture modeling workflow
- Calibration with dynamic data
- Geomechanics models



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Session 6: Basement Reservoirs Introduction

- Basement charging mechanisms

Day 5

Session 6: Continued

- Basement reservoir examples, fracture and flow properties and reservoir quality
- Reservoir models and case histories

Session 7: In Situ Stress, Geomechanics and Drilling Issues

- Principles of in situ stress determination
- Stress models and critical shear appraisal of fracture k
- Wellbore stability techniques
- Drilling techniques in fractured rocks

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**Duration** 3 days
**Code** E&C/IIPE/01

# Introduction to International Petroleum Economics

## Course Objectives

To give participants a good understanding of the concepts and importance of petroleum economics and to demonstrate and develop the skills to:

- Build economic models and perform economic evaluations
- Identify, assess and manage uncertainties and risks
- Analyse the outcome of any E&P project investment

## Who Should Attend?

The course will be suitable for:

- Economists in the oil & gas industry
- Decision-makers responsible for approving and managing new investments
- New Ventures, Planning, Commercial and Financial managers
- Geoscience and engineering professionals

## Course Outline

### Petroleum Economics – An Overview

- What is it and why is it important?
- How does it relate to the rest of the company

### Fundamental Concepts

- What is petroleum economics
- Supply & demand – what controls product prices?
- It's all a matter of cash flow – revenues, costs, taxes
- Depreciation
- Looking to the future – dealing with historic costs
- The time value of money – discounting
- Economic parameters – NPV, IRR, CPI, Payback
- What do these parameters really mean?

### How do You Evaluate a Field Development?

- Oil & gas price assumptions and economic parameters
- Estimates of field production rates and cost data
- Introduction to international fiscal regimes – Concession, production sharing, service agreements
- Structure of a discounted cash flow model
- Interpreting the results

### Designing & Building a Discounted Cash Flow Model

- Differences and similarities between fiscal regimes
- Designing the portfolio model
- Modelling the different fiscal regimes

### Portfolio Modelling

- The ring-fence concept
- Designing the portfolio model

### Risk and Uncertainty

- Defining risks and uncertainties
- Methods of taking account of uncertainty
- Sensitivity analysis
- Expected monetary value & decision trees, risk analysis
- Other approaches – options theory & portfolio analysis

### Applications of Economic Evaluations

- Project ranking and portfolio management
- Funding of development projects
- Incremental project economics
- Basis of corporate planning
- Analysis of business development opportunities



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**Duration** 5 days
**Code** E&C/PE&RA/02

# Petroleum Economics & Risk Analysis

## Course Objectives

To give participants a good understanding of the concepts and importance of petroleum economics and to demonstrate and develop the skills to:

- Build economic models and perform economic evaluations.
- Identify, assess, quantify and manage uncertainties and risks.
- Analyse and forecast the outcome of any exploration, development or operations project.
- Rank projects and investigate economic robustness.

Covering these key areas:

- Introduction and exploration prospect evaluations
- Development project evaluations
- Risk management
- Applications of economic evaluations
- Case studies and group work

The exercises and group work will be dependent on information from the client and the participants' abilities.

## Who Should Attend?

The course will be suitable for Geologists, Geophysicists, Petrophysicists, Drilling Engineers, Reservoir Engineers, Production Engineers, Costs and Facilities Engineers, Development Planning Engineers, Commercial and Financial Analysts, Lawyers, Managers and any other professional staff involved in exploration and production in the oil industry.

## Course Outline

The exercises and group work will be dependent on information from the client and the participants' abilities. Below is a high level summary of the course agenda for each of the days:

### Introduction and Exploration Prospect Evaluations

- The purpose and importance of petroleum economics
- Basic concepts of economic evaluation and risk analysis
- Deterministic and probabilistic reserves estimations
- Risked reserves
- Expected monetary value and decision tree analysis

### Development Project Evaluations

- Discounted cash flow models
- Field development planning
- Building an economic model
- Production profiles and costs
- Fiscal regimes and taxes
- Results and profitability indicators

### Risk Management

- Defining risks and uncertainties
- Sensitivity analysis
- Technical risk management
- Commercial risk management

### Applications of Economic Evaluations

- Project ranking and portfolio management
- Funding of development projects
- Incremental project economics
- Developing models for any project

### Case Studies and Group Work

- Case studies of economic models from international projects
- Review of economic evaluations provided by the client
- Group work on building an economic model
- Group work on problem solving



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**Duration** 5 days
**Code** E&C/FID/04

# Front End Loading for E&P Projects (FID)

## Course Objectives

This course is largely designed for E&P multi discipline engineers.

This course discusses and reviews the framework and the interaction between all the various disciplines involved in the project stages up to the Final Investment Decisions (FID).

- To conduct Field Development Feasibility Studies
- To build and develop project options scenarios
- To define scope for project (Front End) estimates
- To identify uneconomic projects
- To produce project development plans

## Who Should Attend?

The course will be suitable for:

- Geologists
- Geophysicists
- Petroleum Engineers
- Reservoir Engineers
- Engineering professionals

## Course Outline

Day 1

- Capital projects; the characteristics of the front end versus the design and construction phases
- The importance of front end loading using project examples
- The range of influencing factors (including commercial, environmental, operational factors) and the project selection criteria

Day 2

- The value of data; when more is needed and the articulation of risk if it isn't available
- Overall project objectives and their influence on decision making
- The opportunity framing process and the importance of clear boundaries from the outset

Day 3

- Concept identification processes; the challenges and pitfalls
- The value of, assessment and selection of new technology
- The use and value of development analogues

Day 4

- Concept classification and evaluation
- Sensitivities and changes in the external environment
- Robust concept selection and assessment

Day 5

- Concept 'handover' and associated risks
- Documentation of the front end loading decisions and influencing factors
- Operational Feedback
- Summary

Economics & Commercial

Further information

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# O&G Contract Agreements

**Duration** 4 days
**Code** E&C/O&GCA/05

## Course Objectives

- Natural Resource development; why IOCs?, Division of revenues; contract elements, risk
- Classification of Fiscal Regimes; commercial elements to be considered
- Funding sources, finance issues, economic modeling, ancillary contract compliance elements
- Special considerations: Unitization and annual redetermination; Gas case; IOC/NOC future relationships

## Course Outline

Day 1

Introduction

- Course objectives and overview
- Agenda
- Expectations

Concept of Resource Development

Government as Mineral Rights Owner

- Mineral resource owner is usually the Government
- Financial creditworthiness of Government is highly dependent on amount of its petroleum reserves
- These form the basis of sovereign ability to access international finance markets for purposes of the funding of major national infrastructure projects

IOCs

- Valuation of most IOCs is heavily dependent on reserves under its control
- SEC requires explicit annual documentation of reserves as a condition of listing on the stock exchange
- Point of ownership transfer therefore is extremely important and must be clearly reflected in the contractual agreement

Ownership Transfer Point

- Usually at the wellhead in PSC and Royalty/Tax contracts
- No ownership transfer with service contracts

Role of the NOC in National Resource Development

- Increase Foreign Direct Investment
- Economic development of the country
- Conserve national risk capital
- Government control over national energy endowment
- Job provision and national market development
- Technology transfer and training
- Exploration for and development of its own national resource base
- Development of fields relinquished by IOCs as "marginally economic"
- Provision of advice to Ministry of Petroleum regarding fiscal and operational policy development; estimation of remaining petroleum reserves, future income flows and optimal rates of production
- Selection criteria for inviting IOCs to bid on forthcoming exploration rounds
- Selection, contracting and supervision of IOCs in the development of the national reserve base
- Drafting of environmental protection, production, health and safety regulations



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- Undertake economic analyses of proposals, creation of economic models, potential future basin discoveries
- Provision of technical input into National petroleum policy development

Role of IOC in Carrying out Host Government's Development Programs

- IOCs typically have the technology, capital and managerial strength to manage large exploration and development projects
- IOCs require access to petroleum reserves that can be rapidly discovered and exploited to the benefit of their shareholders
- These objectives are counter to those of the NOCs, as listed above
- The common ground is that both NOCs and IOCs desire the resources to be quickly and effectively developed for their mutual benefit
- To establish the ground rules of how these benefits are to be realized requires one of several forms of petroleum agreements

Division of Revenues

Government Take

- Bonuses
- Royalties
- Taxes and Profit Oil
- Government participation
- Rentals, etc.

Company Take

- Exploration costs
- Development costs
- Production costs
- Processing, transportation and marketing costs
- Abandonment and decommissioning costs

Contractual Elements

Work Commitment

- Signature bonus
- Seismic acquisition
- Drilling commitment

Fiscal Terms

- Royalties
- Cost Recovery (C/R)
- Profit Oil Split
- Taxes
- Government participation

Probability and Risk Assessment

- The Petroleum business is all about risk assessment and risk offset. The IOCs excel in this area.
- Areas of known reserves have very little technical risk of failure and accordingly the rewards should be modest

- For frontier areas, with little data, the risk of lack of discovery is very high, but the benefits of discovery and development are great; accordingly the rewards for taking these risks should also be high.
- As frontier areas become more developed, the risk of failure is reduced and it is logical to reduce the rewards proportionately.
- The negotiating of petroleum contracts therefore changes over time as petroleum basins mature and risk decreases
- To minimize the risk of failure, the IOCs specialize in highly sophisticated technology designed to maximize the potential to incur discoveries
- The cost of making use of this technology needs to be repaid, plus an agreed upon amount of profit, which is to be split with the state in the case of a PSC.
- These represent the elements of petroleum contract negotiation

Adjusting Contractual Work Commitment to Risk Assessment
- Risk sharing methodology
- Risk mitigation
- Managing time scale
- Relinquishment periods
- Conversion to Production License
- Abandonment and decommissioning

Day 2

Classification of Petroleum Fiscal Regimes
Royalty/Tax Systems (Concession)
- Signature bonus bidding
- Tax and Royalty to provide Government income flow
- Lack of contractual work program

Contractual-based Systems
Production Sharing Contracts (PSC)
- Management and control mechanisms are built in
- Cost recovery
- Profit oil sharing
- Bonuses, taxes and rentals
- Local content
- Stabilization clause
- Abandonment and decommissioning responsibilities
- Environmental remediation

Service Agreements
- Agreed upon work program
- Cost recovery
- Fee per barrel produced
- Lack of resource ownership; importance to IOCs

Joint Companies (Government and IOC Equal Owners)
- Ownership
- Management structure
- Annual work program and budget meetings

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Joint Ventures (Purpose-specific Partnerships)

- Purpose and structure of a joint venture
- Operator and Operating Committee of a JOA
- Main clauses of a JOA
- Legal document setting out rights and obligations of all partners in a petroleum venture

Commercial Issues

Managing Economics

- Construction of economic model during contract negotiations
- Annual work program review and budget proposal meetings

Accommodating Kuwaiti Policies and Contract Commitments

- Legal obligations and commitments are contained in the negotiated PSC
- PSC generally requires cabinet approval and has international legal standing that allows it to be taken to arbitration
- National policies and methodologies are the subject of separate Petroleum Regulations, approved by the Minister that set out how the host Government wishes contractual compliance to be performed
- Regulations are legal documents that set out requirements and timing for submission of reports, payments, Health, Safety and Environmental standards to be followed.

Project and Time Management Tools

- Quarterly, semi-annual and annual budget reviews
- VAR (Value at Risk)/RAIC (Responsible, Accountable, Consulted, Informed) system of project progress controls.
- Formal Project Management procedures

Pricing

- International market pricing e.g. Platts
- Responsibility for conducting of sales, administrative charges, quantity and quality control, etc.
- Negotiations for gas sales
  - BTU content
  - Delivery pressure, water content, etc.
  - Take or pay clauses, if required
- Domestic consumption allocation and pricing

Establishment of Commerciality, Marginal Economics and Failure Determinations

- Technical evaluation of recoverable reserves
- Economic valuation and estimates of return on investment
- Decision to develop or to relinquish
- Conversion of discovery area to Production License

Day 3

Sources of Funding

- Self-funded (internal source of funds)
- Contractor sourced funds
- External financial institutions
- Expected reserves as source of collateral
- Issues of control, management and repayment scheduling

Financial and Non-Financial Issues

Financing Oil Company and Government Shares

- IOC financing traditionally is through the parent company's financial strength; one of the criteria for being selected as contractor.
- Most common alternate action is to farm out a percentage interest in its holding to another company to help carry the financial load of development. Subject to Government approval.

- IOC to sell off portion of its holding to a finance partner as means of raising capital. May incur Capital gains tax. Subject to Government approval.
- If Government has a working interest, the IOC as part of the original contract may carry its interest.

Working with Financial Institutions

- All financial institutions will require independent third party reserve determination to be used as collateral for any external financing
- Many banks specialize in petroleum project financing. Procedures are similar to other types of bank borrowing
- Smaller financial institutions are specialized in project corporatization and listing on one or more national financial security exchanges. Fees are large and subject to considerable regulatory compliance.
- Often, principal investors will require one or more seats on the Board of Directors or Management Committee. This means they have a meaningful voice in the project management.
- Reporting becomes voluminous and compliance is rigorous and often subject to public review
- In the event the NOC wishes to obtain external financing, they will likely be required to demonstrate that their industrial and financial metrics are equal to that of the IOCs likely through a form of benchmarking.

In Country Economic Issues Affecting the Contract

- The poorer the host country, the more important any petroleum project will be to its internal finances. This is both good and bad.
- In poor countries, project oversight is usually poorly undertaken and often is contracted out to an external development agency
- Particularly in times of low oil prices, the host country often looks to the IOC as a source of emergency financing or alternately, is unable to pay for its domestic product consumption, e.g. Egypt, South Sudan today.

- In these cases, contractual oversight by the host country becomes complicated as the IOC is not only the contractor, but one of the host's financers; a built in conflict of interest.
- In poor countries, the IOC at the onset of its project must provide missing infrastructure. This degrades all project economics and must be taken into account during contract negotiations.
- Relationships with nationals in areas surrounding operations are more problematical in poor countries where Central authority is not well managed in provincial areas.

Criteria used to Develop Lifetime of Model Economic Contract

- As part of the contract negotiation process, an economic model of the expected success case will have been made as a basis for determining profit sharing and cost recovery share.
- On discovery, a 3-D reservoir model should be established and maintained through development and depletion to determine:
  - Original Oil in Place
  - Annual depletion
  - Basic data for development of secondary recovery operations
  - Basic data for renegotiating contractual economic trigger points and when these changes should occur

Additional Contractual Commitments

- Employment
  - IOCs do not want expense of importing laborers or manual workers and expect to hire locals
  - Details of how selection and hiring of locals should be agreed upon during contract negotiation
  - Host Government should have IOC present a training program designed to bring local laborers up to semi-skilled and skilled levels in mechanics, welding, carpentering, plumbing, cooking and related subjects.
- Training
  - Host Government should insist on relevant vocational training for all staff employed by IOC and keep training records for each national staff member
  - All national staff wants to be trained abroad by IOC. This needs to be managed to insure such training is relevant to work to be undertaken; otherwise there is no value and it is quickly forgotten.
  - Apart from prestige, there is little near-term value in National staff obtaining MSc and PhD degrees abroad and this should be minimized.
- Purchase of domestic goods and services
  - List of agreed domestic goods and services to be agreed upon and included in original PSC contract
  - Subject of domestic goods and services purchases to be reviewed during annual work program and budget presentations for approval and/or modification
  - IOC training efforts of national staff in HSE compliance to count towards training obligation

- HSE compliance
  - IOC should have a training obligation to train all local employees in appropriate HSE skills
  - Host government to have contractual compliance inspectors on site, empowered to assess fines and mandatory remediation efforts.

Safety and Environmental Data

- Safety, Health and Environmental issues are very important, both to the contractor and to the nationals who live and work around the operational area.
- There are international HSE standards that apply to best oil field practices, but the Host Government should have Regulations with regulatory compliance agents in place.
- In the poorest countries, domestic goods and services requirements will generally involve catering, cooking and camp maintenance issues, the IOC should be granted training credits for training locals in these areas of work.
- An environmental base line should be established as part of the PSC contract prior to commencement of work, to serve as a benchmark during and after exploitation work has been completed.

Day 4

Special Considerations

Benefits of Unitization and Redetermination

- The Rule of Capture
- Why unitize a field
- Concept of a unit operator
- Role of the Government
- Need for basis for fair allocation of resource between various operators of the field
- Need for both IOC and Government to have yearly third-party independent redetermination of remaining reserves

Gas Contract Considerations

Processing

- Establishment parameters of “pipeline quality gas”
- Importance of BTU content
- Ownership and disposition of entrained liquids

Transportation

- Transit fees, use of gas for in-line compressors, metering
- Separate Pipeline Company or part of original contractual obligation to find and produce?

Sales Agreement

- Point of monetization (pipeline inlet, point of user offtake)
- Take or pay agreement clause?

Future Trends of the Roles of IOCs and NOCs

- The primary objective of the **NOCs** is to realize the full value of their hydrocarbon exports while achieving sustainable development through economic diversification

- Traditionally, **IOCs** objectives are to obtain equity participation in NOC-controlled projects, in order to book reserves and obtain a minimum rate of return for its shareholders. A quick monetization of resources is important.
- IOCs are generally more adept at financial management under conditions of low oil prices than are NOCs due to the competitive nature of the environments in which they work
- In spite of this diametric opposition of institutional objectives, it is quite possible that in return for IOCs offering:
  - Complex management packages
  - Upstream technical services
  - Technology management
  - Access to capital markets
  - Financial management
  - Personnel training
- Combined into one long-term offering, and with an acceptance of lower rate of return on invested capital, NOCs would find this to their advantage, especially in times of low oil prices.
- Additional benefits may be realized through the IOCs offering joint investment in research and development

Further information

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**Duration** 3 days
**Code** FDP/SUB/01

# Field Development Planning (FDP) - Subsurface

## Course Objectives

Through completion of the course, delegates will;

- Develop an understanding of the theory and practice of field development planning.
- Recognise the importance and benefits of integration of disciplines through working as a multi-disciplinary team.
- Identify uncertainty, its significance and explain the importance of assessing it realistically.
- Appraise the trade-off between cost and value of data and assess how to ensure that the optimum amount of data is collected.
- Describe and relate the importance of commercial goals to technical goals.
- Develop a multi-discipline appreciation and team building skills through the team exercises.

The course emphasises the importance of the sub-surface team (production profiles) working closely with the facilities team(s), in order to maximise the value of the project whilst managing risk.

Realistic field example(s) are used to demonstrate this; one for offshore, one for onshore, or both (on the five day course), with the delegates controlling the decision-making process to optimise the development. The examples illustrate the typical evolution of field understanding, with a mixture of predictable and less predictable data acquired.

## Who Should Attend?

Engineers, Geoscientists, Project and Asset managers and those involved in project economics who wish to gain a better of field development planning in order to maximise the value of asset development.

## Course Details

A three day course is sufficient to cover either onshore or offshore field development planning. To cover both, we recommend a five day course which will include an expanded section on facilities design. The actual course content will be tailored to meet the specific training needs of each customer.

The course is a mixture of taught material and practical exercises.

Further information

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## Course Outline

Day 1

- Introduction & Course overview
- Taught Material
  - Exploration and appraisal phase objectives
  - Collection and analysis of data, including proving of resources and reduction of uncertainty and risk, understanding the value of data
- Group Activity
  - Introduction to interactive case study (onshore or offshore case) and volumetric estimates

Day 2

- Taught Material
  - Introduction to facilities, onshore & offshore
  - Constructing a field development plan and workflow
  - Incorporating uncertainty management into the development plan
  - Building static models, dynamic models and forecasting
- Group Activity – Continuation of case study
  - Appraisal drilling programme and data acquisition as defined by participants
  - Preparation of development plans for chosen scenario
  - Teams present findings, uncertainty analysis, and preferred development scheme
- Taught Material
  - Comparison of teams' reservoir descriptions and volumetric estimates with "actual" case

Day 3

- Group Activity
  - Run basic economics on chosen development scheme and "actual" profiles
  - Assess different development options and test the impact of appraisal costs on overall field economics
  - Presentation of teams' development profiles (using digital model)
  - Summary of economics, including project abandonment
- Summary of Field Developments
  - How has uncertainty been dealt with, and how confident are we the optimum development scheme has been found

Approximately 70% of the course time will be spent on these practical exercises, which are highly interactive and intended to be challenging and a good basis for class discussion.

Day 4

- Additional case study onshore or offshore (optional)
  - Introduction to second interactive case study and volumetric estimates
  - Appraisal and drilling programmes, economic modelling
  - Preparation and presentation of development plans

Day 5

- Advanced facilities (optional)
  - What are the key facilities issues?
  - What are the key decisions, influencing factors
  - Balance between levels of definition and risks

Further information

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**Duration** 3 days
**Code** FDP/S&F/02

# Field Development Planning (FDP) - Subsurface & Facilities

## Course Objectives

Through completion of the course, delegates will;

- Develop an understanding of the theory and practice of field development planning.
- Recognise the importance and benefits of integration of disciplines through working as a multi-disciplinary team.
- Identify uncertainty, its significance and explain the importance of assessing it realistically.
- Appraise the trade-off between cost and value of data and assess how to ensure that the optimum amount of data is collected.
- Describe and relate the importance of commercial goals to technical goals.
- Develop a multi-discipline appreciation and team building skills through the team exercises.

The course emphasises the importance of the sub-surface team (production profiles) working closely with the facilities team(s), in order to maximise the value of the project whilst managing risk.

Realistic field example(s) are used to demonstrate this; one for offshore, one for onshore, or both (on the five day course), with the delegates controlling the decision-making process to optimise the development. The examples illustrate the typical evolution of field understanding, with a mixture of predictable and less predictable data acquired.

## Who Should Attend?

Engineers, Geoscientists, Project and Asset managers and those involved in project economics who wish to gain a better of field development planning in order to maximise the value of asset development.

## Course Details

A three day course is sufficient to cover either onshore or offshore field development planning. To cover both, we recommend a five day course which will include an expanded section on facilities design. The actual course content will be tailored to meet the specific training needs of each customer.

The course is a mixture of taught material and practical exercises.

Further information

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## Course Outline

Day 1

- Introduction & Course overview
- Taught Material
  - Exploration and appraisal phase objectives
  - Collection and analysis of data, including proving of resources and reduction of uncertainty and risk, understanding the value of data
- Group Activity
  - Introduction to interactive case study (onshore or offshore case) and volumetric estimates

Day 2

- Taught Material
  - Introduction to facilities, onshore & offshore
  - Constructing a field development plan and workflow
  - Incorporating uncertainty management into the development plan
  - Building static models, dynamic models and forecasting
- Group Activity – Continuation of case study
  - Appraisal drilling programme and data acquisition as defined by participants
  - Preparation of development plans for chosen scenario
  - Teams present findings, uncertainty analysis, and preferred development scheme
- Taught Material
  - Comparison of teams' reservoir descriptions and volumetric estimates with "actual" case

Day 3

- Group Activity
  - Run basic economics on chosen development scheme and "actual" profiles
  - Assess different development options and test the impact of appraisal costs on overall field economics
  - Presentation of teams' development profiles (using digital model)
  - Summary of economics, including project abandonment
- Summary of Field Developments
  - How has uncertainty been dealt with, and how confident are we the optimum development scheme has been found

Approximately 70% of the course time will be spent on these practical exercises, which are highly interactive and intended to be challenging and a good basis for class discussion.

Day 4

- Additional case study onshore or offshore (optional)
  - Introduction to second interactive case study and volumetric estimates
  - Appraisal and drilling programmes, economic modelling
  - Preparation and presentation of development plans

Day 5

- Advanced facilities (optional)
  - What are the key facilities issues?
  - What are the key decisions, influencing factors
  - Balance between levels of definition and risks

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# OPC Training Course Catalogue

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