

PetroSkills®

2016 Gas Processing Training Guide



OGCI®

John M. Campbell

RDC



Gas Processing

Course Progression Matrix

The Gas Processing Progression covers equipment and processes primarily focused on the handling of natural gas and its associated liquids. The wellhead is the starting point, ending with delivery of the processed gas, meeting the required specifications, into a sales gas or reinjection pipeline. Recovered natural gas liquids (NGLs), again meeting the required specifications, are delivered to an export point — either a pipeline or storage facility. The NGL may be fractionated into individual specification products or sold as a mix for fractionation elsewhere. Waste by-products are disposed of in accordance with the applicable regulatory requirements. Main topics covered include fundamentals, natural gas characterization, phase behavior, vapor-liquid equilibrium, basic thermodynamics, and water-hydrocarbon behavior, as well as all the key equipment to process natural gas.

PetroSkills | John M. Campbell training delivers competency-based training, in these and other areas, at progressive levels to provide the skills necessary to successfully support the operation of oil and gas production processes.

The following instructors have been selected and approved by the PetroSkills Curriculum Network:

DR. FRANK ASHFORD	MR. ROBERT FANNING	MR. JAMES LANGER	MRS. KINDRA SNOW-McGREGOR
MR. JAN BLUM	MR. JOSH GILAD	MR. HARVEY MALINO	MR. KEN SOURISSEAU
MR. ROBERT BOMBARDIERI	MR. GERARD HAGEMAN	MR. YUV MEHRA	MR. PAUL VERRILL
MR. MARK BOTHAMLEY	MR. MALCOLM HARRISON	MR. JOHN MORGAN	MR. COLIN WATSON
MR. JOHN BOURDON	MR. BOB HUBBARD	DR. MAHMOOD MOSHFEGHIAN	MR. DAVID WEEKS
MR. AJEY CHANDRA	MR. FRANK JARRETT	MR. ELMO NASATO	MR. PETER WILLIAMS
MR. BILL DOKIANOS	MR. DALE KRAUS	DR. JAY RAJANI	MR. WES WRIGHT

	Gas Processing	General Courses	Process Safety
SPECIALIZED		CO ₂ SURFACE FACILITIES – PF-81 (PAGE 5)	
INTERMEDIATE	GAS TREATING AND SULFUR RECOVERY – G-6 (PAGE 3)	SEPARATION EQUIPMENT - SELECTION & SIZING – PF-42 (PAGE 4)	
	ADVANCED APPLICATIONS IN GAS PROCESSING – G-5 (PAGE 3)	TROUBLESHOOTING OIL & GAS PROCESSING FACILITIES – PF-49 (PAGE 5)	
	ONSHORE GAS GATHERING SYSTEMS – PF-45 (PAGE 5)	FUNDAMENTALS OF PUMP AND COMPRESSOR SYSTEMS – ME-44 (PAGE 6)	RELIEF AND FLARE SYSTEMS – PF-44 (PAGE 5)
FOUNDATION	GAS CONDITIONING AND PROCESSING - LNG EMPHASIS – G-4 LNG (PAGE 2)	INSTRUMENTATION, CONTROLS AND ELECTRICAL SYSTEMS FOR FACILITIES ENGINEERS – ICE-21 (PAGE 6)	RISK BASED PROCESS SAFETY MANAGEMENT – HS45 (PAGE 4)
	GAS CONDITIONING AND PROCESSING – G-4 (PAGE 2)	PROCESS UTILITY SYSTEMS – PF-47 (PAGE 4)	PROCESS SAFETY ENGINEERING – PS-4 (PAGE 3)
BASIC	LNG SHORT COURSE: TECHNOLOGY & THE LNG CHAIN – G-29 (PAGE 2)		FUNDAMENTALS OF PROCESS SAFETY – PS-2 (PAGE 3)
	OVERVIEW OF GAS PROCESSING – G-2 (PAGE 1)		
	OVERVIEW OF THE NATURAL GAS BUSINESS AND BASICS OF GAS PROCESSING – G-1 (SEE WEBSITE)		
	INTRODUCTION TO OIL AND GAS PRODUCTION FACILITIES – PF-2 (PAGE 4)		

Overview of Gas Processing – G-2

BASIC

G-2 is a versatile overview of the gas conditioning and processing industry. This course is designed for a broad audience and is participative and interactive, utilizing basic technical exercises and terminology to communicate key learning points. This course does not cover the technology and engineering principles in depth, and is only recommended for those needing an overview of the industry and common processes and equipment used.

DESIGNED FOR

As a wide ranging overview, it is suitable for interested parties, such as geologists, reservoir engineers, line managers, and sales or business development staff; related specialists like environmental staff, operational staff, and shift foremen; those new to the industry, such as entry-level (1-2 year) engineers; or anyone interested in a general, technically-oriented overview of the gas processing industry.

YOU WILL LEARN

- An overview of natural gas and world energy trends
- Natural gas sources, makeup, properties, specifications, and related oil and gas terminology
- Markets and uses for NGL, LPG, ethane, propane, and butane
- Options for various basic gas conditioning and processing steps, including treating, dehydration, liquid extraction, and product fractionation
- Summary of gas processing costs, commercial and contract issues in liquids extraction
- How gas is transported and sold
- Review of gas measurement and common measurement devices
- Key pieces of equipment used in natural gas production and processing facilities
- Overview of related specialty processes, such as LNG, nitrogen rejection, and helium recovery, plus sulfur recovery and acid gas reinjection

COURSE CONTENT

Natural gas and world energy trends • The role of gas processing in the natural gas value chain • Technical engineering principles (common conversions, gas density, phase behavior) • Gas sweetening • Gas hydrates and dehydration • Gas conditioning (dew point control) and NGL extraction • Stabilization and fractionation concepts and facilities • Gas processing key equipment and support systems (heat transfer, compression, pipelines and gathering systems, and measurement) • Specialty processes in gas processing (LNG, nitrogen rejection and helium recovery, sulfur recovery, and acid gas reinjection)

2016 Schedule and Tuition / 3 Days

HOUSTON, US	23-25 AUG	US\$2995
KUALA LUMPUR, MY	29 NOV-1 DEC	US\$3675
LONDON, UK	11-13 APR	US\$3475+VAT
PERTH, AUSTRALIA	15-17 JUN	US\$4150+GST
PITTSBURGH, US	7-9 NOV	US\$3025



Gas Conditioning and Processing – G-4 Campbell Gas Course®

FOUNDATION

The Campbell Gas Course® has been the standard of the industry for more than 46 years. Over 36,500 engineers have attended our G-4 program, considered by many to be the most practical and comprehensive course in the oil and gas industry. Both hands-on methods and computer-aided analysis are used to examine sensitivities of technical decisions. To enhance the learning process, about 30 problems will be assigned, reviewed, and discussed throughout the course. Problems will be solved individually and in teams.

DESIGNED FOR

Production and processing personnel involved with natural gas and associated liquids, to acquaint or reacquaint themselves with gas conditioning and processing unit operations. This course is for facilities engineers, process engineers, senior operations personnel, field supervisors, and engineers who select, design, install, evaluate, or operate gas processing plants and related facilities. A broad approach is taken with the topics.

YOU WILL LEARN

- Application of gas engineering and technology in facilities and gas plants
- Important specifications for gas, NGL, and condensate
- About the selection and evaluation of processes used to dehydrate natural gas, meet hydrocarbon dewpoint specifications, and extract NGLs
- How to apply physical/thermodynamic property correlations and principles to the operation, design, and evaluation of gas processing facilities
- Practical equipment sizing methods for major process equipment
- To evaluate technical validity of discussions related to gas processing
- To recognize and develop solutions for operating problem examples and control issues in gas processing facilities

COURSE CONTENT

- Gas processing systems
- Physical properties of hydrocarbons
- Terminology and nomenclature
- Qualitative phase behavior
- Vapor-liquid equilibrium
- Water-hydrocarbon phase behavior, hydrates, etc.
- Basic thermodynamics and application of energy balances
- Process control and instrumentation
- Relief and flare systems
- Fluid hydraulics; two-phase flow
- Separation equipment
- Heat transfer equipment
- Pumps
- Compressors and drivers
- Refrigeration in gas conditioning and NGL extraction facilities
- Fractionation
- Glycol dehydration; TEG
- Adsorption dehydration and hydrocarbon removal
- Gas treating and sulfur recovery

2016 Schedule and Tuition / 10 Days

ABERDEEN, UK	4-15 APR	US\$9620+VAT
	12-23 SEP	US\$9620+VAT
BRISBANE, AUSTRALIA	5-16 DEC	US\$9720+GST
DENVER, US	13-24 JUN	US\$8670
DOHA, QATAR	8-19 MAY	US\$9620
DUBAI, UAE	6-17 NOV	US\$9620
HOUSTON, US	18-29 APR	US\$8760
	11-22 JUL	US\$8760
	24 OCT-4 NOV	US\$8760
KUALA LUMPUR, MY	8-19 AUG	US\$9720
	10-21 OCT	US\$9720
LONDON, UK	1-12 FEB	US\$9620+VAT
	20 JUN-1 JUL	US\$9620+VAT
	3-14 OCT	US\$9620+VAT
	5-16 DEC	US\$9620+VAT
PERTH, AUSTRALIA	1-12 AUG	US\$9720+GST
PITTSBURGH, US	1-12 AUG	US\$8670
STAVANGER, NORWAY	7-18 MAR	US\$9620
	7-18 NOV	US\$9620

Gas Conditioning and Processing – LNG Emphasis – G-4 LNG

FOUNDATION

This is the LNG-industry version of our popular G-4 course, with expanded coverage of refrigeration and LNG technologies. The course includes in-depth information on basic LNG gas conditioning and processing. In addition, instructors will explain the LNG supply chain that consists of four main links—natural gas exploration and production, liquefaction, shipping, receiving, and distribution. The course covers relevant details of both the mixed refrigerant (APCI) and cascade (ConocoPhillips) processes in LNG liquefaction. New liquefaction processes are addressed, such as mixed fluid cascade and dual nitrogen refrigeration cycles. Versions of this course have been taught in many of the world's base-load and peak-shaving LNG plants, such as Australia, Indonesia, Malaysia, Norway, Qatar, UK, and West Indies.

DESIGNED FOR

Personnel involved with natural gas processing and LNG production, as well as anyone interested in a solid technical understanding of the principles of an LNG plant.

YOU WILL LEARN

- The basics of LNG gas conditioning and processing
- Selection and evaluation processes used to dehydrate natural gas, remove heavy components and other contaminants, and extract NGLs for LNG plants
- Physical/thermodynamic property correlations and principles, including heating values, etc. as applied to gas processing facilities and LNG plants
- Fundamentals of propane, propane-precooled, mixed refrigerants, and cascade systems used in LNG plants
- Key points in other LNG liquefaction technologies
- How to perform and review equipment sizing for major process equipment
- Solutions to operating problems and control issues in LNG and gas processing facilities

COURSE CONTENT

Basic gas technology principles • Terminology and nomenclature • Physical properties of hydrocarbons • Qualitative phase behavior • Vapor-liquid equilibrium • Water-hydrocarbon system behavior, hydrates, etc. • Thermodynamics of LNG processes • Separation equipment • Gas treatment, CO₂ and H₂S removal • Dehydration of natural gas (TEG and Molecular Sieve) • Heat transfer and exchangers • Pumps and compressors • Refrigeration systems • LNG liquefaction technologies • Fractionation • Other facilities topics relevant to LNG • Course summary and overview

2016 Schedule and Tuition / 10 Days

DOHA, QATAR	4-15 DEC	US\$9620
HOUSTON, US	6-17 JUN	US\$8760
PERTH, AUSTRALIA	9-20 MAY	US\$9720+GST

LNG Short Course: Technology and the LNG Chain – G-29

BASIC

This LNG Short Course is designed for participants requiring moderate technical coverage, coupled with information on LNG commerce and all parts of the LNG Value Chain. Over five days, the course covers technical LNG basics and facility operation topics, plus technical, design, and commercial issues. Selected exercises and syndicates are used to reinforce the main topics of LNG trade and technology. In-house versions are available with either increased technical and operational emphasis or increased project and development emphasis.

DESIGNED FOR

Commercial and managerial staff looking for a concise overview; engineers new to the LNG industry; operations supervision staff and senior plant personnel; specialists looking to broaden their general knowledge of LNG; and staff involved in LNG commerce and interested in LNG technical fundamentals.

YOU WILL LEARN

- What is LNG, why it is produced, and what is the current status of the industry
- LNG facilities world-wide
- The LNG chain and impact of contractual issues on LNG plant design and operation; LNG pricing
- A survey of commercial and contractual issues
- Project costs, feasibility, development, and issues
- Some technical fundamentals of gas processing, such as molecular weight, heating value, Wobbe Index, vapor pressure, multi-component mixtures, thermodynamics
- Refrigeration: single and multi-component refrigeration cycles
- Technologies used in the production of LNG for base-load and small scale production, issues relating to technology selection, and operation
- Main equipment used in the production of LNG: heat exchangers, compressors and drivers used for LNG, pumps, and turbo expanders
- To apply knowledge of LNG gas pretreatment, drying, and refrigeration
- About LNG storage, shipping, and terminals, sizing basis, and small scale tanks
- Types of LNG carriers, marine management issues, and LNG transfer
- LNG importing, regasification of LNG and distribution to consumers, basis for sizing, technology selection, and energy integration
- New developments: development of off-shore LNG operations to regasification and liquefaction; coal seam gas project issues
- Site selection and HSSE considerations

COURSE CONTENT

What LNG is and where it comes from • Physical properties of LNG • Vapor-liquid equilibrium behavior of LNG and refrigerants • Gas pre-treatment • Heat exchangers • Refrigeration • Rotating machinery • Liquefaction processes • LNG storage • LNG shipping • LNG importing

2016 Schedule and Tuition / 5 Days

BAKERSFIELD, US	28 NOV-2 DEC	US\$4110
HOUSTON, US	12-16 SEP	US\$4150
LONDON, UK	16-20 MAY	US\$4780+VAT
PERTH, AUSTRALIA	15-19 AUG	US\$5600+GST



Advanced Applications in Gas Processing – G-5

INTERMEDIATE

This full five day course covers sweet gas processing and NGL extraction, using a commercial simulator to perform calculations. A basic working knowledge of the commercial process simulation package used (generally UNISIM) is suggested to achieve the course learning objectives. Volumes 1 and 2 of the John M. Campbell textbooks, *Gas Conditioning and Processing*, are the basis for the material presented, coupled with a comprehensive exercise based on a typical gas processing facility (can be applied to onshore or offshore facilities). The exercise is developed in stages as the material is covered. Participants will develop a process simulation that includes a dew point control process, a mechanical refrigeration process with economizers, hydrate inhibition using MEG, and NGL liquid product stabilization with recycle.

DESIGNED FOR

Engineers that require in-depth training on natural gas processing and NGL recovery processes, with emphasis on the use and benefits of a simulation package.

YOU WILL LEARN

- To determine the water content and hydrate formation conditions for gas streams using both a commercial process simulator and hand calculation methods
- Techniques to inhibit hydrate formation, including injection of equilibrium inhibitors such as methanol and MEG
- Preliminary design and evaluation of TEG dehydration processes using quick hand calculations
- Process design used to control the hydrocarbon dew point of sales gas streams by removing NGLs using mechanical refrigeration processes
- Various techniques to optimize mechanical refrigeration systems
- How to use the process simulator to evaluate the impact that pressure and temperature changes have on the sizing of process equipment and levels of NGL recovery
- How to use short-cut distillation calculations to provide input to rigorous distillation simulations in order to obtain consistent convergence
- Which thermodynamic property correlations are appropriate for various gas processing systems
- Limitations associated with commercial simulation packages and how the results can be quickly checked for relative accuracy

COURSE CONTENT

Physical properties of hydrocarbons • Qualitative phase behavior • Vapor-liquid equilibrium • Water-hydrocarbon equilibrium • Basic thermodynamic concepts • Separation equipment • Heat transfer • Pumps • Compressors • Refrigeration • Fractionation/distillation • Glycol dehydration • Adsorption dehydration

2016 Schedule and Tuition / 5 Days

DUBAI, UAE	4-8 DEC	US\$5490*
HOUSTON, US	17-21 OCT	US\$4700*

* plus computer charge

Gas Treating and Sulfur Recovery – G-6

INTERMEDIATE

This course emphasizes process selection, practical operating issues, technical fundamentals, and integration of the sweetening facilities into the overall scheme of gas processing. Sulfur recovery and tail gas processes are also covered, including standard Claus configurations, SuperClaus®, EuroClaus®, SCOT®, etc. Special design and operation topics, such as trace sulfur compound handling and the importance of H₂S:CO₂ ratio, are covered as well. Related topics reviewed during the course include liquid product treating, corrosion, materials selection, and NACE requirements.

DESIGNED FOR

Production and processing personnel involved with natural gas treating and sulfur recovery, requiring an understanding of the principles of these process operations. This course is for facilities engineers, process engineers, operations personnel, and field supervisors, as well as others who select, design, install, evaluate, or operate gas sweetening and sulfur recovery facilities.

YOU WILL LEARN

- Evaluation and selection of processes to remove acid gases (H₂S, CO₂, COS, CS₂, mercaptans, etc.) from gas and NGLs
- The advantages and disadvantages of available gas treating technology and processes
- How to estimate solvent circulation rates, energy requirements, and equipment sizes
- To recognize and evaluate solutions to common operating and technical problems
- Sulfur recovery technologies, including an overview of the Claus Sulfur process
- How to select among the proper sulfur recovery process given differing process conditions
- Tail gas cleanup

COURSE CONTENT

Fundamentals of sour gas processing, sweetening, etc. • Overview of gas treating and sulfur recovery, terminology • Gas specifications and process selection criteria • Generic and specialty amine treating • Common operating and technical problems • Proprietary amine solvents, such as Sulfinol® and Flexsorb® • Carbonate processes • Physical absorption processes, e.g. Selexol • Metallurgical issues (corrosion) • Other technologies and new developments • Selective treating, acid gas enrichment • Solid bed and non-regenerable treating; scavengers • Liquid product treating • Sulfur recovery processes • Tail gas clean-up (SCOT-type, CBA, and others) • Acid gas injection • Membranes • Emerging and new technologies • Course workshop and summary

2016 Schedule and Tuition / 5 Days

DOHA, QATAR	6-10 NOV	US\$5490
HOUSTON, US	4-8 APR	US\$4460
LONDON, UK	3-7 OCT	US\$1510+VAT

Fundamentals of Process Safety – PS-2

FOUNDATION

The course will cover the fundamentals of process safety for all staff levels of processing facilities in the upstream and downstream oil, gas, and petrochemical industry. To identify how different disciplines and roles can have an impact on process safety performance, there is a rolling case study (Project COLEX) throughout the course that involves the installation of a separator vessel, and the process safety considerations and implications are explored and discussed at the various stages, from design to full operation.

DESIGNED FOR

The course will benefit all staff associated with the operation, maintenance, and governance in production and processing facilities and is relevant to roles, including senior management, project and engineering support teams, HSE support, supervisors, and operator and maintenance technicians. It provides an understanding of the design basis and essentials for safe operations, without addressing the more detailed calculation aspects covered in Process Safety Engineering – PS-4.

YOU WILL LEARN HOW TO

- Identify the systems and processes required to create process safety in a high hazard installation
- Identify and choose appropriate techniques and tools to qualitatively assess process hazards
- Determine appropriate risk reduction strategies and identify effective risk reduction measures to prevent, control, and mitigate process safety risk
- Recognize and develop systems to manage process safety in operations through operating procedures and operating limits, ensuring plant integrity through maintenance and inspection
- Use a management of change process to minimize risk of change
- Identify and monitor key performance measures and verifications to maintain and improve safety performance

COURSE CONTENT

Business context for process safety • Risk assessment [hazard identification, hazard scenarios, consequence and likelihood analysis, and risk analysis and tools and techniques] • Risk reduction measures (barriers) [types and hierarchy of risk reduction measures (barriers)] • Management of process safety in operations [operating procedures, design and operating limits, human factors, inspection and maintenance, and emergency response] • Management of change • Learning from previous incidents and near misses • Self-verification and measurement • Process safety key performance indicators • Management review and auditing • Process safety leadership [governance and culture]

2016 Schedule and Tuition / 5 Days

HOUSTON, US	20-24 JUN	US\$4150
KUALA LUMPUR, MY	25-29 JUL	US\$5460
LONDON, UK	5-9 DEC	US\$4780+VAT

Process Safety Engineering – PS-4

FOUNDATION

This course provides an overview of process safety engineering fundamentals for hydrocarbon processing facilities, with emphasis on the upstream oil and gas sector. The focus of this course is on the engineering/design aspects of Process Safety Management. Frequent reference will be made to historical incidents and recurring problem areas. Techniques for analyzing and mitigating process safety hazards applicable to oil and gas processing will also be reviewed. Integration of the concepts covered to achieve a measured approach to Process Safety Engineering is a key aim of this course as well. Exercises and group projects will be utilized to emphasize the key learning points.

DESIGNED FOR

Facilities, process, and design engineers, as well as new safety/loss prevention engineers who require an overview of Process Safety Engineering.

YOU WILL LEARN

- Types of equipment and process systems that have historically been problematic in the Upstream – Midstream oil and gas industry
- Basics of risk analysis
- Thinking in terms of "Inherently Safer Design"
- Most common process hazard analysis methods and where they are used
- "Layers of Protection" concept—what the different layers are and how they are applied
- Detection and mitigation methods for different types of hazards

COURSE CONTENT

Historical incidents and problem areas • Risk analysis basics • Process hazards analysis techniques - overview • Layers of protection • Inherently safer design • Hazards associated with process fluids • Leakage and dispersion of hydrocarbon releases • Combustion behavior of hydrocarbons • Sources of ignition • Hazards associated with specific plant systems • Plant layout and equipment spacing • Pressure relief and disposal systems • Corrosion and materials selection • Process monitoring and control • Safety instrumented systems • Fire protection principles • Explosion protection

2016 Schedule and Tuition / 5 Days

BRISBANE, AUSTRALIA	5-9 SEP	US\$6350+GST
CALGARY, CANADA	25-29 JUL	US\$4350+GST
DUBAI, UAE	11-15 DEC	US\$5490
HOUSTON, US	12-16 SEP	US\$4350
LONDON, UK	9-13 MAY	US\$5060+VAT
	17-21 OCT	US\$5060+VAT
PERTH, AUSTRALIA	4-8 APR	US\$6350+GST

Risk Based Process Safety Management

– HS45

FOUNDATION

This course introduces process safety management in the oil and gas industry, the elements and benefits of process safety management systems, and tools for implementing and managing a system. In this course the participant will learn to use tools and techniques for managing process safety. The Center for Chemical Process Safety's (CCPS) book titled "Guidelines for Risk Based Process Safety" or "RBPS Guidelines" will be the text for this course. Participant centered exercises and selected case studies will be used to build on the concepts that CCPS advocates for risk based process safety.

Throughout the course, participants will be challenged to think how their process safety management system can be enhanced and modified to meet the concepts of risk-based decision making. An individual action plan will be developed to apply the information from the course to the workplace.

DESIGNED FOR

HSE professionals, operations and maintenance technicians, engineers, supervisors and project managers requiring a basic foundation in developing and managing process safety. The more technical aspects of process safety engineering are covered in PS-4, Process Safety Engineering.

YOU WILL LEARN HOW TO

- Identify processes applicable to Process Safety Management (PSM) and describe relevant terms used
- Identify which standards are to be applied for managing process hazards
- Apply programs and tools for managing a PSM system
- Choose appropriate decision making methods and tools to identify process hazards
- Describe and use techniques available for control of hazards associated with process designs
- Describe the criteria and methods of selecting equipment and safe guarding controls
- Research and apply the performance parameters for the safety systems in operations
- Explain the role of all disciplines and their contribution to the management of potential HSE hazards

COURSE CONTENT

Process safety culture and competency • Compliance with standards • Understand hazards and risk • Operating procedures and safe work practices • Asset integrity and reliability • Management of change • Conduct of operations • Incident investigation (associated with plant failures) • Measurement and metrics • Management review and continuous improvement

2016 Schedule and Tuition / 5 Days

DUBAI, UAE	4-8 SEP	US\$5090
HOUSTON, US	18-22 APR	US\$4040
LONDON, UK	27 JUN-1 JUL	US\$4670+VAT

Introduction to Oil and Gas Production Facilities

– PF-2

BASIC

NEW

The scope of the discussion ranges from an overview of the oil and gas industry, hydrocarbon phase behavior characteristics, and different reservoir types, to product specifications and the processes used to meet these. Other facilities considerations are addressed, such as process safety and downstream processing that may impact the production facility selection and operation.

DESIGNED FOR

Those interested in an overview of production facilities, including subsurface professionals, line managers, sales or business development staff, environmental personnel, operational staff, and those new to the industry.

YOU WILL LEARN

- How the reservoir and product specifications influence the selection and design of the production facilities
- Quick "back of the envelope" calculations for equipment sizing and capacity
- Parameters that affect the design and specification of oil stabilization and dehydration equipment
- Awareness of the parameters that determine flowline/gathering system capacity
- The purpose of separators in a production facility and familiarity with the typical configurations
- Typical design parameters, operating envelopes, common operating problems of oil and gas production equipment, and the effect of changing feed conditions over the life of a field
- To describe oil dehydration/desalting process options and equipment
- Produced water treating options and the dependence on surface vs. subsurface, offshore vs. onshore disposal
- Compressor performance characteristics and how they affect production rates and facility throughput
- Gas dehydration process options, with a particular emphasis on glycol dehydration
- The principles of asset integrity and inherently safe design given the rate, composition, temperature, and pressure of the production stream
- About midstream facilities required downstream of the primary production facility to deliver saleable products to the market, and how these facilities are affected by production rates, composition, and production facility performance

COURSE CONTENT

Overview of oil and gas industry • Qualitative phase behavior and reservoirs • Hydrocarbon properties and terminology • Typical sales/disposal specs • Flowlines, piping, gathering systems • Production separation • Oil processing • Water injection systems (including pumps) • Gas handling – compression, dehydration • Measurement and storage • Utilities, process safety • Midstream facilities – gas processing, pipelines, LNG

2016 Schedule and Tuition / 3 Days

DENVER, US	12-14 SEP	US\$3025
HOUSTON, US	13-15 JUN	US\$2955
LONDON, UK	3-5 OCT	US\$2955
KUALA LUMPUR, MY	24-26 OCT	US\$3430+VAT
	7-9 NOV	US\$3550

Process Utility Systems

– PF-47

FOUNDATION

This five day course will provide an overview of the various utility systems, key selection considerations, and how they are integrated into onshore and offshore oil and gas facilities. Individuals will develop a basic understanding of the wide variety of utility systems and components, as well as how they integrate with process facilities and overall operation. System selection, relative costs, and other managerial decisions pertinent to utility operations are covered. Exercises are used to identify utility consumers, summarize utility requirements, consider high level utility systems options, and select the most energy efficient alternatives from an onshore and offshore perspective.

DESIGNED FOR

Facility engineers or engineers new to utility systems who are responsible for designing, operating, and maintaining utility systems in oil and gas processing and related facilities. Most operations and planning activities depend on a fundamental knowledge of utility systems. This important subject is frequently overlooked; however, it is vital to successful oil and gas operations. Attending this course will assist participants in developing a broad background in utility systems.

YOU WILL LEARN

- To list the various options in selecting utility systems
- How to evaluate and select systems based on key criteria and considerations
- Key site selection considerations
- How to efficiently provide utilities
- Utilities management issues

COURSE CONTENT

Process heating systems: steam, hot oil, glycol, and water • Process cooling systems: indirect-cooling water, direct-seawater • Process drains – open and closed • Refrigeration • Power generation and distribution • Instrument/plant air and breathing air • Fresh and potable water • Fuel systems: natural gas, diesel • Firewater • Inert gas systems • Utilities energy considerations • Utilities management issues

Separation Equipment - Selection and Sizing

– PF-42

INTERMEDIATE

This course covers the different types of separation equipment typically encountered in oil and gas production facilities. Fractionation equipment and produced water treating equipment are not covered in this course. You will learn where the different types of separation equipment are used based on operating conditions and separation performance requirements. Frequent references will be made to real production facility process flow diagrams (PFDs). Typical operational problems and their solutions will also be discussed. Exercises requiring calculations are utilized throughout the course as well. Please be aware that due to overlap in content, it is not necessary to take the PF-42 course if you have already taken the PF-4 Oil Production and Processing Facilities course.

DESIGNED FOR

Process/Facilities engineers who need skills for design and troubleshooting of separators.

YOU WILL LEARN

- Different types of separation equipment utilized in the oil and gas industry and where they are used
- Separation performance capabilities of the different types of equipment
- How to size the different types of separation equipment
- How to troubleshoot and debottleneck separation equipment
- How to calculate the wall thickness and estimate the weight of separators
- Instrumentation and controls used on separation equipment

COURSE CONTENT

Fluid properties and phase behavior • Phase separation processes • Gas-liquid separation equipment: slug catchers, conventional separators (horizontal and vertical), scrubbers, compact separators, filter separators/coalescing filters • Separator internals: inlet devices, mist extractors, baffles, weirs, etc. • Emulsions • Oil-water separation equipment: conventional 3-phase separators and freewater knockouts, wash tanks • Oil treating and desalting equipment: mainly electrostatic coalescers • Liquid-liquid coalescing filters • Mechanical design aspects: pressure vessel codes, wall thickness and vessel weight estimation, material selection, relief requirements • Operational problems

2016 Schedule and Tuition / 5 Days

HOUSTON, US	19-23 SEP	US\$4150
-------------	-----------	----------

See website for dates and locations.

Relief and Flare Systems – PF-44

INTERMEDIATE

This intensive course provides a comprehensive overview of relief and flare systems for oil and gas processing facilities. The course begins with the need for pressure control/overpressure protection, continues with the key engineering and design aspects including code considerations, and concludes with selecting and defining the components of a relief and flare system. The material of the course is applicable to onshore field production facilities, pipelines, gas plants, terminals, and offshore production facilities.

DESIGNED FOR

Engineers and senior operating personnel responsible for designing, operating, and maintaining relief and flare systems in oil and gas facilities.

YOU WILL LEARN

- Purposes of relief and flare systems and their importance in safe operations
- Causes of overpressure and the ways to control/mitigate
- Defining the possible relief scenarios
- Commonly used pressure relieving devices, selection and sizing
- Determining set/relieving pressures to meet operational, safety, and code requirements
- Operational considerations of maintenance, testing, certification, and disposal of fluids
- Designing and operating relief and flare header systems considering fluid characteristics, service conditions, volumes, gas dispersion, and radiation
- Selection and sizing other key components of a relief/flare system

COURSE CONTENT

Overview of typical relief and flare systems and key components • Codes and standards as well as good practices typical in oil and gas facilities • Safety implications and causes of overpressure • Overpressure protection philosophy including source isolation and relief • Determination of relief requirements and defining set point pressures • Types, applications, and sizing of common relief devices • Blow-down/depressurizing – purpose and design/operational considerations • Design and specification considerations for relief valves and header systems, including fluid characteristics, services conditions, material selection, and header sizing • Environmental considerations • Radiation calculations and the impact of flare tip design • Selection and sizing of key components: knockout and seal drums, vent/flare stack, vent/flare tips, and flare ignition systems • Defining need and quantity of purge gas • Flare gas recovery, smokeless flaring, and purge gas conservation • Operational and troubleshooting tips

2016 Schedule and Tuition / 5 Days

ABERDEEN, UK	30 MAY-3 JUN	US\$4780+VAT
DOHA, QATAR	13-17 MAR	US\$5190
DUBAI, UAE	20-24 NOV	US\$5190
HOUSTON, US	3-7 OCT	US\$4150
KUALA LUMPUR, MY	7-11 NOV	US\$5460
LONDON, UK	24-28 OCT	US\$4780+VAT
PERTH, AUSTRALIA	15-19 AUG	US\$5600+GST

Onshore Gas Gathering Systems: Design and Operations – PF-45

INTERMEDIATE

This course deals with the design, operation, and optimization of onshore gas gathering systems and their associated field facilities, from the wellhead to the central gas processing facility. From a design perspective, the main variables that impact the flexibility and operational characteristics of an onshore gas gathering system will be discussed. Typical operating problems are covered including hydrates, multiphase flow issues, corrosion, declining well deliverability, etc. Exercises will be utilized throughout the course to emphasize the key learning points.

DESIGNED FOR

Production and facilities department engineers/senior operating personnel responsible for the design, operation and optimization of onshore gas gathering systems and their associated field facilities.

YOU WILL LEARN

- The impact of gathering system pressure on gas well deliverability
- The impact of produced fluids composition on gathering system design and operation
- How to evaluate field facility and gathering system configurations for different applications
- To recognize and develop solutions to operating problems with existing gas gathering systems

COURSE CONTENT

Gas well inflow performance and deliverability • Overview of gas well deliquification methods for low-rate, low pressure gas wells • Effect of gathering system/abandonment pressure on reserves recovery • Impact of produced fluids composition • Sweet/sour • CO₂ content • Rich/lean • Produced water • Hydrates and hydrate prevention • Dehydration • Heating • Chemical inhibition • Multiphase flow basics • Corrosion/materials selection • Gathering system layout • Wellsite/field facilities options • Provisions for future compression

2016 Schedule and Tuition / 5 Days

CALGARY, CANADA	20-24 JUN	US\$4110+GST
DENVER, US	22-26 AUG	US\$4160
HOUSTON, US	24-28 OCT	US\$4150
LONDON, UK	18-22 JUL	US\$4780+VAT
PITTSBURGH, US	15-19 FEB	US\$4160

Troubleshooting Oil and Gas Processing Facilities – PF-49

INTERMEDIATE

This course will cover how to establish and apply a general troubleshooting methodology as well as how to conduct process/equipment specific troubleshooting. Definitions of good/normal performance will be discussed for each process/equipment type covered. Data gathering, validation and utilization procedures will be discussed. Criteria to use when evaluating possible problem solutions will also be covered. Real-world exercises will be utilized throughout the class to reinforce the learning objectives. Both onshore and offshore facilities will be discussed. It is assumed that course participants have a solid understanding of how typical oil and gas production and processing facilities work, including the commonly used processes and equipment involved.

DESIGNED FOR

Process/Facilities engineers with 5-10 years of experience, facilities engineering team leaders/supervisors, and senior facilities operational personnel.

YOU WILL LEARN

- The difference between troubleshooting, optimization, and debottlenecking
- How to recognize trouble when it is occurring
- How to develop a methodical approach to troubleshooting
- To recognize how different components of a facility interact with each other, and the significance of these interactions
- How to gather, validate, and utilize the data needed for troubleshooting
- The criteria to be considered for identifying the best solution when several feasible solutions are available
- Typical causes of problems, and their solutions, for the main types of processes and equipment used in the upstream-midstream oil and gas industry

COURSE CONTENT

Troubleshooting methodology fundamentals and data reconciliation • Gas - Liquid separators • Reciprocating compressors • Amine gas sweetening • Glycol dehydration units • 3-phase separators • Centrifugal pumps • Oil treating • Produced water treating systems • Shell and tube heat exchangers • Centrifugal compressors • Molecular sieve dehydration units • NGL recovery processes

2016 Schedule and Tuition / 5 Days

ABERDEEN, UK	14-18 MAR	US\$4780+VAT
HOUSTON, US	9-13 MAY	US\$4150
LONDON, UK	15-19 AUG	US\$4780+VAT

CO₂ Surface Facilities

– PF-81

SPECIALIZED **FIELD TRIP**

This course emphasizes the effect of carbon dioxide on the selection and operation of equipment (separators, compressors, and dehydrators), as well as sweetening process equipment. This program, first introduced in 1985, assists those working with carbon dioxide or high carbon dioxide content natural gas. This course is particularly applicable to those persons who operate and/or design enhanced oil recovery (EOR) facilities using CO₂ as a miscible agent. Physical and thermodynamic property data for carbon dioxide/natural gas mixtures are discussed. Calculations are performed to illustrate principles and techniques. An extra day will be added to this course if a plant tour is available (Midland public course sessions, or in-house sessions only). The plant tour is optional.

DESIGNED FOR

Engineers and senior operating personnel involved with carbon dioxide/natural gas/CO₂ EOR systems.

YOU WILL LEARN

- What to expect over the life of a CO₂ EOR system
- Impact of CO₂ on the design and operation of oil production equipment
- Physical and thermodynamic properties of pure CO₂, and the impact of CO₂ in hydrocarbon mixtures
- Dehydrate high CO₂ - content gases
- Best practices to deal with Dense Phase pipelines, metering, flaring etc.
- How to pump and compress CO₂
- Using purification processes: membranes, Ryan-Holmes, amines, hot carbonate, etc.

COURSE CONTENT

Overview of CO₂ injection and process facilities • Heavy emphasis on CO₂ for enhanced oil recovery • Physical and thermodynamic properties of CO₂ and high CO₂ mixtures • Materials selection and design consideration in CO₂ systems • Process vessel specification • Pumps and compressors • Fluid flow and special pipeline design considerations such as the control of ductile fractures • Dehydration of CO₂ and CO₂-rich gases • General overview of processes to treat/recover CO₂

2016 Schedule and Tuition / 3 Days

DOHA, QATAR	20-22 MAR	US\$3675
MIDLAND, US †	14-17 NOV	US\$3420

† plant tour optional

Piping Systems - Mechanical Design and Specification – ME-41

INTERMEDIATE

This five day, foundation level course for engineers and piping system designers reviews the key areas associated with the design of piping systems for oil and gas facilities. The course is focused on four areas: codes and standards, pipe materials and manufacture, piping components, and piping layout and design. Applicable piping codes for oil and gas facilities (ISO, B31.3, B31.4, B31.8, etc.), pipe sizing calculations, pipe installation, and materials selection are an integral part of the course. The emphasis is on proper material selection and specification of piping systems.

DESIGNED FOR

This PetroSkills training course is ideal for mechanical, facilities, plant, or pipeline engineers and piping system designers who are involved in the design of in-plant piping systems for oil and gas facilities.

YOU WILL LEARN

- To apply piping system codes and standards
- About line sizing and layout of piping systems in various types of facilities
- How to specify proper components for process and utility applications
- To compare alternative materials of construction
- The process of steelmaking, pipe manufacturing, and material specifications
- Joining methods and inspection techniques
- Key considerations for flare and vent systems, including PSV sizing

COURSE CONTENT

Piping codes and standards (ANSI/ASME, API, ISO) • Pipe materials and manufacturing • Basic pipe stress analysis methods • Valves and actuators • Welding and non-destructive testing • Line sizing basics (single-phase and multiphase flow) • Pipe and valve material selection • Piping layout and design • Manifolds, headers, and flare/vent systems • Non-metallic piping systems • Operations and maintenance considerations of facilities and pipelines

Fundamentals of Pump and Compressor Systems – ME-44

INTERMEDIATE

This is an intensive five day course providing a comprehensive overview of pumps and compressor systems. The focus is on equipment selection; type, unit, and station configuration; and integration of these units in the process scheme and control strategy in upstream and midstream oil and gas facilities. The material of the course is applicable to field production facilities, pipelines, gas plants, and offshore systems.

DESIGNED FOR

Engineers, senior technicians, and system operators designing, operating, and maintaining pump and compressor systems in oil and gas facilities.

YOU WILL LEARN

- Selecting the appropriate integrated pump and compressors units (drivers, pumps, compressors, and auxiliary systems)
- Integrating the pump or compressor units with the upstream and downstream piping and process equipment
- Evaluating pump and compressor units and their drivers in multiple train configurations, parallel and series
- Identifying the key local and remote control elements of pumps and compressors as well as their drivers
- Defining the major life-cycle events, such as changes in flows, fluid composition, and operating conditions that can affect equipment selection and operating strategies
- Assessing the key pump hydraulics and compressor thermodynamics, and their effect on selection and operations
- Identifying significant operating conditioning monitoring parameters and troubleshooting techniques

COURSE CONTENT

Types of pumps, compressors, and drivers, and their common applications and range of operations • Evaluation and selection of pumps and compressors, and their drivers for long-term efficient operations • Unit and station configuration including multiple trains in series and/or parallel operations • Integration with upstream and downstream process equipment, local and remote control systems, and facilities utilities • Key auxiliary systems including monitoring equipment, heat exchangers, lube and seal systems, and fuel/power systems • Major design, installation, operating, troubleshooting, and maintenance considerations

2016 Schedule and Tuition / 5 Days

DENVER, US	25-29 JUL	US\$4160
DUBAI, UAE	13-17 NOV	US\$5190
HOUSTON, US	15-19 AUG	US\$4150
KUALA LUMPUR, MY	24-28 OCT	US\$5460
LONDON, UK	14-18 MAR	US\$4780+VAT
	22-26 AUG	US\$4780+VAT

Instrumentation, Controls and Electrical Systems for Facilities Engineers – ICE-21

FOUNDATION

This foundation-level course provides an overview of electrical systems, instrumentation, process control, and control/safety systems typically encountered in oil and gas facilities, such as: separation, gas dehydration, gas sweetening, NGL recovery, and associated facilities. The focus is to understand terminology, concepts, typical equipment configurations, control strategies, and common pitfalls in order to effectively manage and execute multi-discipline projects.

DESIGNED FOR

Process, chemical, and mechanical engineers, (i.e. non-instrumentation and non-electrical disciplines), as well as other professionals with little or no background in IC&E systems, in order to more effectively execute complete projects. Electrical and Instrumentation Engineers should consider IC-3 and E-3 for more in-depth coverage of alternate disciplines.

YOU WILL LEARN

- Fundamentals of electricity, such as: voltage, current, resistance, and power factor
- Electrical specifications, such as: voltage selection, load lists, and power
- One-line diagrams and components of power distribution, including: transformers, switchgear, MCCs, VFDs, and power distribution
- Infrastructure components, such as: cable, conduit, cable tray, and duct banks
- Classification of hazardous locations and equipment specifications
- Safety risks and mitigation strategies for power systems, including: short circuit and overcurrent protection, ground faults, shock hazards, and arc flash
- Fundamentals of control systems, sensors, controllers, and final elements
- Typical control strategies and configurations for common oil and gas process equipment, such as: separators, pumps, distillation towers, filters, contactors, compressors, heat exchangers, and fired heaters
- Key requirements for instrument specifications: accuracy, signal selection, pressure/temperature limits, material compatibility, installation considerations, capabilities and limits, and relative cost
- Basics of sizing criteria of shutdown and control valves
- Control system functions, limitations, and architectures, including: PLC, DCS, SIS, RTU, and SCADA; common networking systems, including: Ethernet, Modbus and Fieldbus

COURSE CONTENT

Fundamentals of electricity • Power distribution and motor control systems for oil and gas applications • Emergency power systems • Hazardous area classification for oil and gas applications • Electrical safety in industrial facilities • Control system fundamentals • Field measurement and control devices • Programmable electronic systems (PLC, DCS, SIS, SCADA) • Control system networking • Drawings and documentation for IE&C projects

2016 Schedule and Tuition / 5 Days

HOUSTON, US	19-23 SEP	US\$4150
KUALA LUMPUR, MY	5-9 SEP	US\$5460
LONDON, UK	25-29 APR	US\$4780+VAT

2016 Schedule and Tuition / 5 Days

DENVER, US	18-22 JUL	US\$4160
DUBAI, UAE	6-10 NOV	US\$5190
HOUSTON, US	15-19 FEB	US\$4150
	12-16 DEC	US\$4150
LONDON, UK	15-19 AUG	US\$4780+VAT



TO VIEW OUR COURSES IN OTHER DISCIPLINES, VISIT:

Subsurface

- Introductory/Multi-Discipline
- Geology
- Geophysics
- Petrophysics
- Reservoir Engineering
- Well Construction/Drilling
- Production & Completions Engineering
- Unconventional Resources
- Integrated - Heavy Oil
- Petroleum Data Management

Facilities

- Gas Processing
- Process Facilities
- Water & Corrosion
- Offshore
- Pipeline
- Instrumentation, Controls, & Electrical
- Mechanical
- Reliability Engineering
- Procurement/Supply Chain Management
- Refining

Operations & Maintenance

Health, Safety, Environment

Petroleum Business and Professional Development

- Petroleum Professional Development
- Petroleum Business
- Project Management