TRAINING CATALOGUE · CATEGORY F

Process Engineering & Design

FEED deliverables, simulation, hydraulic and utility studies, exchangers, rotating equipment, P&ID practice and distillation - the engineering behind a plant that runs as designed.

7 COURSES

11 TRAINING DAYS

Practitioner-led training for the process industry

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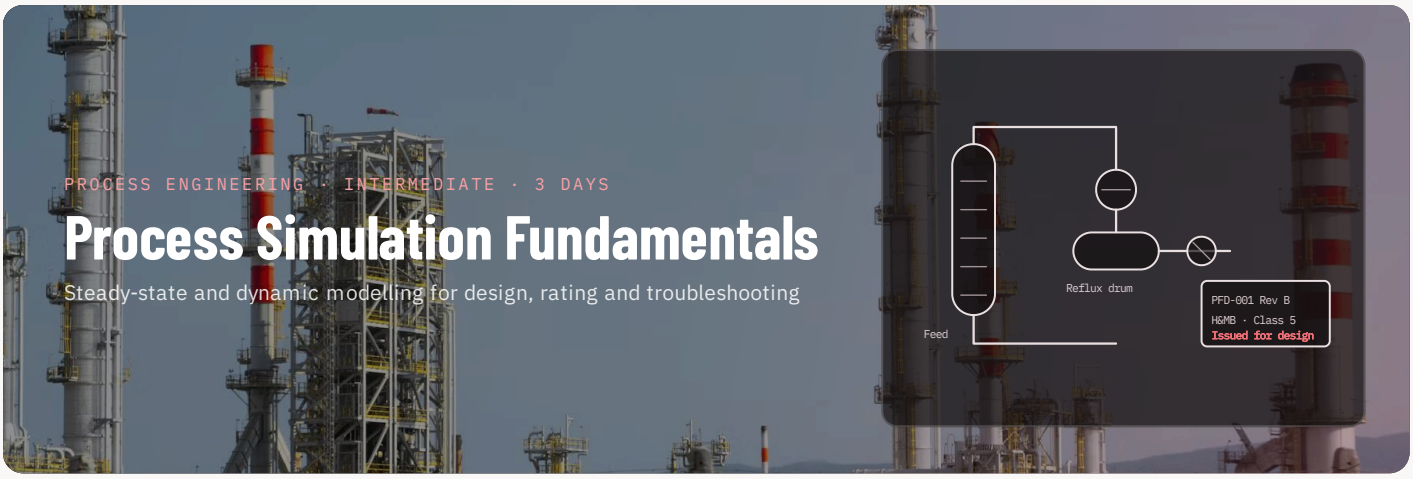
Category F · Process Engineering & Design

CODE	COURSE	DURATION	LEVEL	PRIMARY AUDIENCE
F · Process Engineering & Design				
TR-F01	**Process Simulation Fundamentals** Steady-state and dynamic modelling for design, rating and troubleshooting	3 days	Intermediate	Process engineers building or reviewing simulation models fo
TR-F02	**FEED and Basic Engineering Deliverables** What a process engineer must produce from concept to FEED, and how each deliverable is reviewed	2 days	Intermediate	Process and project engineers moving into front-end work
TR-F03	**Process Studies — Hydraulics, Utilities and Pinch** Line sizing, pump and control-valve hydraulics, utility balances and energy targeting for revamps and debottlenecking	2 days	Intermediate	Process engineers performing operability
TR-F04	**Heat Exchanger Design and Fouling Assessment** Thermal design, rating, TEMA selection and using plant data to track fouling and plan cleaning	1 day	Intermediate	Process and mechanical engineers specifying
TR-F05	**Compressor and Pump Selection and Operation** Machine types, performance curves, NPSH and surge, and the operating decisions that protect the machine	1 day	Intermediate	Process and rotating-equipment engineers
TR-F06	**P&ID Reading and Development (ISA 5.1)** Symbols, tagging and control narratives, and how a P&ID is built, revised and frozen	1 day	Foundation	Junior process
TR-F07	**Distillation Troubleshooting and Optimisation** Diagnosing flooding, weeping, maldistribution and control problems, and finding the energy and yield that a column is giving away	1 day	Advanced	Process and operations engineers responsible for distillatio



PROCESS ENGINEERING · INTERMEDIATE · 3 DAYS

Process Simulation Fundamentals

Steady-state and dynamic modelling for design, rating and troubleshooting

DURATION	LEVEL	FORMAT	LANGUAGE	MAX. PARTICIPANTS
3 days	Intermediate	On-site classroom · virtual instructor-led	English	16

50 % hands-on modelling

4 unit-operation case studies

1 dynamic scenario

Overview

A simulation is only useful when its assumptions are understood. The course builds thermodynamic judgement first — property packages, binary interaction, convergence — then applies it to columns, exchangers, compressors and flow networks, and finishes with dynamic modelling for relief loads, start-up and control studies.

Learning outcomes

- Select property packages and validate them against plant data
- Build and converge flowsheets with recycles and specifications
- Rate columns, exchangers and compressors against real operating cases
- Use models for relief-load estimation and operability checks
- Set up a dynamic model and run a transient scenario
- Document the model basis for hand-over and reuse

Who should attend

Process engineers building or reviewing simulation models for design, revamp, relief and operability studies

Course outline

DAY 1

Thermodynamics for engineers · equations of state and activity models · component and pseudo-component definition · flowsheet building and convergence

DAY 2

Distillation design and rating · heat exchanger rating and fouling · compressors and hydraulics · case studies and sensitivity · data reconciliation

DAY 3

Dynamic simulation basics · controller and valve modelling · relief and depressuring cases · start-up scenario · model documentation and QA

Standards referenced

GPSA Engineering Data Book · API 521 · DIPPR / NIST data · TEMA / API 660

Tools & exercises

Exercises on the client's simulator of choice; digital-twin basis for ProcessVision

What's included

- ✓ Course manual and slide pack
- ✓ Software access for the course
- ✓ Post-course Q&A with the instructor
- ✓ Exercise and case-study pack
- ✓ Competency quiz and certificate
- ✓ Templates used in the exercises

PREREQUISITES
Chemical engineering degree; basic simulator exposure

CERTIFICATION
Certificate of completion

INSTRUCTORS
Practising engineers — TÜV HAZOP Leader, CCPSC and IEC 61511 Functional Safety certified — with 200+ years of cumulative plant experience.

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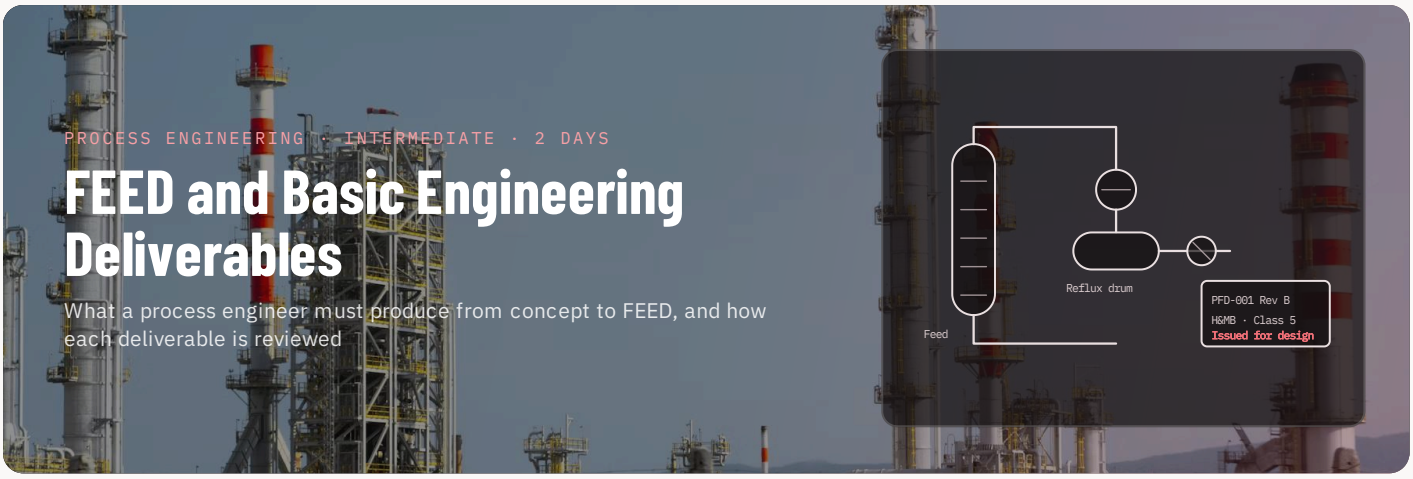

PROCESS ENGINEERING · INTERMEDIATE · 2 DAYS

FEED and Basic Engineering Deliverables

What a process engineer must produce from concept to FEED, and how each deliverable is reviewed

DURATION	LEVEL	FORMAT	LANGUAGE	MAX. PARTICIPANTS
2 days	Intermediate	On-site classroom · virtual instructor-led	English	16

30+ deliverables mapped to project phase

1 FEED package reviewed

4 estimate classes explained

Overview

A FEED package sets the cost, the schedule and most of the safety of the plant for the next thirty years, and the engineers writing it rarely get to see how it is used. This course walks the process deliverables in the order they are developed — design basis, simulation, PFDs, heat and material balances, equipment lists, data sheets, P&IDs, line lists, safeguarding — with the interfaces to other disciplines and the review gates each must pass. Participants review a real FEED package extract and produce a deficiency list.

Learning outcomes

- Define the scope and content of concept, pre-FEED and FEED phases and the estimate class each supports
- Write a design basis that fixes feed, product, utility and site conditions before simulation starts
- Develop PFDs, H&MB and utility summaries with a consistent numbering and revision system
- Produce process data sheets for vessels, exchangers, pumps and compressors that other disciplines can use
- Take P&IDs from IFD to IFH through HAZOP and design freeze
- Review a contractor's FEED package for completeness, consistency and safety content

Who should attend

Process and project engineers moving into front-end work; owner's engineers reviewing contractor FEED packages; discipline leads coordinating with process

Course outline

DAY 1

Project phases and stage gates · estimate classes (AACE 18R-97) and what process must deliver for each · design basis and process design criteria · simulation basis and case definition · PFDs, H&MB and stream tables (ISO 10628) · utility and effluent summaries · equipment list and sizing philosophy

DAY 2

Process data sheets by equipment type · P&ID development, revision control and hold management · line list, tie-in list, instrument index handover · relief and blowdown philosophy, hazardous area, safeguarding narratives · HAZOP, design review and technical-integrity gates · deliverable schedule and interfaces with piping, instrument and mechanical disciplines · workshop: FEED package review

Standards referenced

AACE 18R-97 · ISO 10628 · ISA-5.1 · API 521 · ASME B31.3 · IEC 61511

Tools & exercises

Review of an anonymised FEED package; templates for design basis, data sheets and deliverable register

What's included

- ✓ Course manual and slide pack
- ✓ Software access for the course
- ✓ Post-course Q&A with the instructor
- ✓ Exercise and case-study pack
- ✓ Competency quiz and certificate
- ✓ Templates used in the exercises

PREREQUISITES
Two or more years of process engineering experience

CERTIFICATION
Certificate of completion

INSTRUCTORS
Practising engineers — TÜV HAZOP Leader, CCPSC and IEC 61511 Functional Safety certified — with 200+ years of cumulative plant experience.

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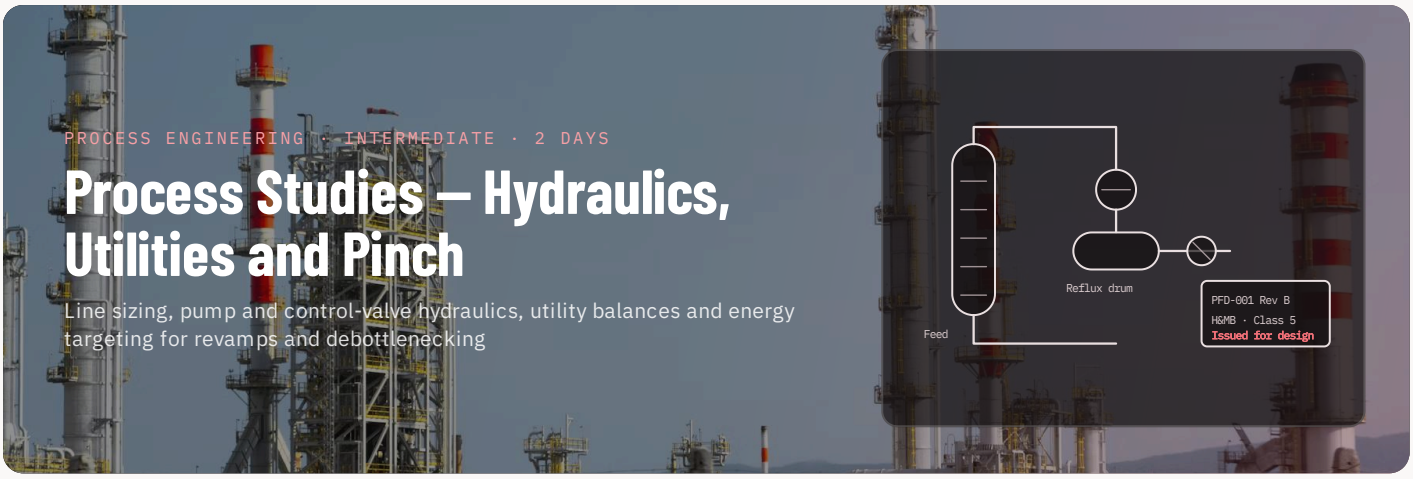

PROCESS ENGINEERING · INTERMEDIATE · 2 DAYS

Process Studies — Hydraulics, Utilities and Pinch

Line sizing, pump and control-valve hydraulics, utility balances and energy targeting for revamps and debottlenecking

DURATION	LEVEL	FORMAT	LANGUAGE	MAX. PARTICIPANTS
2 days	Intermediate	On-site classroom · virtual instructor-led	English	16

3 hydraulic networks solved by hand and by software

1 pinch analysis on a real unit

1 utility balance workshop

Overview

Most capacity and energy questions on an existing unit come down to a hydraulic calculation and a heat balance done properly. The course covers single-phase and two-phase line hydraulics, pump and control-valve system curves, steam and cooling-water balances and pinch analysis, always with the question of which constraint actually limits the unit. Exercises are worked by hand first so that software results can be checked.

Learning outcomes

- Size lines for liquid, gas and two-phase service using velocity, pressure-drop and erosion criteria
- Build a system curve, check NPSHa and control-valve authority, and find the true bottleneck
- Calculate steam, condensate, cooling-water and fuel balances and identify imbalances and losses
- Apply pinch analysis to set energy targets and screen heat-exchanger network modifications
- Structure a debottlenecking study from data gathering to option ranking
- Present hydraulic and energy results in a form that project and operations can act on

Who should attend

Process engineers performing operability, revamp and energy studies; plant engineers investigating capacity limits

Course outline

DAY 1

Line sizing criteria: velocity, pressure drop, erosional velocity (API RP 14E / ISO 13703) · friction factor and fittings (Crane TP-410) · compressible and two-phase flow methods · pump system curves, NPSH and control-valve authority · network solution and worked hydraulic cases · flare header and vent hydraulics overview

DAY 2

Steam, condensate and BFW balances · cooling water and fuel balance · utility losses and unaccounted-for streams · pinch analysis: composite curves, targets, cross-pinch heat transfer · HEN retrofit screening · debottlenecking study structure and option ranking · workshop on a participant unit

Standards referenced

API RP 14E / ISO 13703 · Crane TP-410 · GPSA Engineering Data Book · ASME B31.3 · API 521

Tools & exercises

Hand calculations and the client's simulator or hydraulic package of choice

What's included

- ✓ Course manual and slide pack
- ✓ Software access for the course
- ✓ Post-course Q&A with the instructor
- ✓ Exercise and case-study pack
- ✓ Competency quiz and certificate
- ✓ Templates used in the exercises

PREREQUISITES
Chemical engineering degree; basic fluid mechanics

CERTIFICATION
Certificate of completion

INSTRUCTORS
Practising engineers — TÜV HAZOP Leader, CCPSC and IEC 61511 Functional Safety certified — with 200+ years of cumulative plant experience.

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PROCESS ENGINEERING · INTERMEDIATE · 1 DAY

Heat Exchanger Design and Fouling Assessment

Thermal design, rating, TEMA selection and using plant data to track fouling and plan cleaning

DURATION	LEVEL	FORMAT	LANGUAGE	MAX. PARTICIPANTS
1 day	Intermediate	On-site classroom · virtual instructor-led	English	16

6
exchanger rating cases

1
fouling-monitoring method with historian data

TEMA
types and their selection

Overview

Exchangers are specified once and then blamed for the next twenty years. This course covers enough thermal design to write a good data sheet and check a vendor's rating — LMTD, effectiveness, film coefficients, pressure drop, vibration — then turns to the operating question: how to calculate the fouling resistance from historian data, when to clean, and what the process can do to slow it down.

Learning outcomes

- Select the exchanger type and TEMA configuration for a given duty and fouling service
- Perform a rating calculation and check tube-side and shell-side pressure drop and velocities
- Review a vendor thermal design against API 660 / 661 and the process data sheet
- Calculate the actual overall coefficient and fouling resistance from plant data
- Set up a fouling-monitoring trend and a cleaning-interval economics calculation
- Diagnose common problems: temperature cross, vibration, maldistribution, tube leaks

Who should attend

Process and mechanical engineers specifying, rating or troubleshooting shell-and-tube, air-cooled and plate exchangers; energy and reliability engineers

Course outline

MORNING

Heat-transfer basics: LMTD, F factor, NTU-effectiveness · film coefficients and controlling resistance · shell-and-tube geometry and TEMA types · air-cooled exchangers and plate exchangers · process data sheet content · rating exercise and vendor design review (API 660 / 661)

AFTERNOON

Fouling mechanisms: crude preheat, cooling water, crystallisation, coking · calculating U and Rf from historian data · fouling-monitoring trends and cleaning-interval economics · mitigation: velocity, temperature, chemistry, design features · troubleshooting cases: cross, vibration, maldistribution, leaks · workshop on participants' exchangers

Standards referenced

TEMA · API 660 · API 661 · ASME BPVC Section VIII · HTRI / HTFS design practice

Tools & exercises

Rating exercises on the client's thermal design software; fouling trends from historian data

What's included

- ✓ Course manual and slide pack
- ✓ Software access for the course
- ✓ Post-course Q&A with the instructor
- ✓ Exercise and case-study pack
- ✓ Competency quiz and certificate
- ✓ Templates used in the exercises

PREREQUISITES
Chemical or mechanical engineering degree

CERTIFICATION
Certificate of completion

INSTRUCTORS
Practising engineers — TÜV HAZOP Leader, CCPSC and IEC 61511 Functional Safety certified — with 200+ years of cumulative plant experience.

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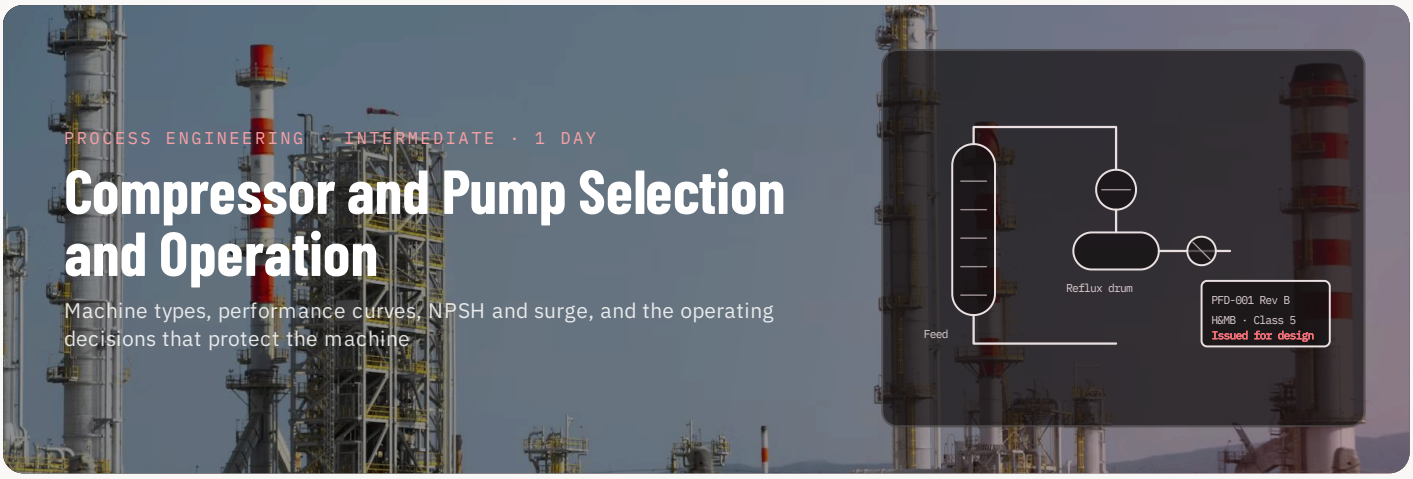

PROCESS ENGINEERING · INTERMEDIATE · 1 DAY

Compressor and Pump Selection and Operation

Machine types, performance curves, NPSH and surge, and the operating decisions that protect the machine.

DURATION	LEVEL	FORMAT	LANGUAGE	MAX. PARTICIPANTS
1 day	Intermediate	On-site classroom · virtual instructor-led	English	16

5 performance-curve exercises

2 surge and NPSH case studies

1 selection checklist per machine type

Overview

A pump or compressor is the one item of equipment where the process engineer's data sheet and the operator's actions interact every minute. The course covers selection between centrifugal, reciprocating and screw machines, reading performance curves, NPSH, minimum flow, surge and anti-surge control, and the process conditions — gas composition, suction pressure, parallel operation — that push machines outside their envelope.

Learning outcomes

- Select pump and compressor types for a duty from process conditions and turndown requirements
- Read and apply performance, head-capacity and surge curves to actual operating cases
- Calculate NPSHa and minimum-flow requirements and specify the protection needed
- Explain surge, anti-surge control and the effect of molecular-weight and suction changes
- Specify a machine using API 610 / 617 / 618 data sheets and recognise the key clauses
- Recognise operating problems — cavitation, recycle, parallel-machine instability — from trends

Who should attend

Process and rotating-equipment engineers, operations engineers and supervisors responsible for pumps and compressors; project engineers writing specifications

Course outline

MORNING

Pump types and selection · centrifugal pump curves, system curves, affinity laws · NPSH, cavitation and minimum flow · reciprocating and PD pumps · parallel and series operation · API 610 data sheet essentials · sealing and seal plans overview (API 682)

AFTERNOON

Compressor types: centrifugal, reciprocating, screw · head, polytropic efficiency and gas property effects · surge, stonewall and anti-surge control · performance-curve exercises and MW change case · API 617 / 618 specification essentials · operating and trending: start-up, load sharing, degradation · troubleshooting cases

Standards referenced

API 610 · API 617 · API 618 · API 682 · API 670 · GPSA Engineering Data Book

Tools & exercises

Curve and performance exercises worked by hand and in the client's simulator or vendor selection tool

What's included

- ✓ Course manual and slide pack
- ✓ Software access for the course
- ✓ Post-course Q&A with the instructor
- ✓ Exercise and case-study pack
- ✓ Competency quiz and certificate
- ✓ Templates used in the exercises

PREREQUISITES
Process or mechanical engineering background

CERTIFICATION
Certificate of completion

INSTRUCTORS
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PROCESS ENGINEERING · FOUNDATION · 1 DAY

P&ID Reading and Development (ISA 5.1)

Symbols, tagging and control narratives, and how a P&ID is built, revised and frozen

DURATION	LEVEL	FORMAT	LANGUAGE	MAX. PARTICIPANTS
1 day	Foundation	On-site classroom · virtual instructor-led	English	16

Your own P&IDs used in exercises

1 P&ID developed from a PFD

40+ symbols and tags decoded

Overview

The P&ID is the drawing every discipline, every HAZOP and every permit depends on, and it is also the one most people read only partly. The course covers ISA-5.1 symbols and identification, instrument and line tagging, control loops and interlocks as drawn, and typical site lead-sheet conventions, then has participants develop a P&ID from a PFD and mark up an existing one for a change so that they understand what a revision costs.

Learning outcomes

- Read instrument symbols, function identifiers and loop numbers to ISA-5.1 and the site lead sheet
- Trace process lines, utility connections, spec breaks and insulation classes from the line number
- Identify control loops, interlocks, relief devices and their set-points as drawn
- Develop a P&ID from a PFD, including valves, drains, vents and instrumentation needed for operation
- Mark up a P&ID for a change and follow it through MOC and as-built
- Spot common drawing errors and omissions before they reach a HAZOP

Who should attend

Junior process, instrument and project engineers; operators and supervisors moving into technical roles; maintenance planners and HAZOP scribes

Course outline

MORNING

Drawing hierarchy: BFD, PFD, P&ID, isometrics (ISO 10628) · ISA-5.1 symbols and identification letters · loop numbering, tag formats and lead sheets · line numbering, piping classes, spec breaks · valves, drains, vents, sample points, spectacle blinds · reading exercise on participants' own P&IDs

AFTERNOON

Control loops, cascades and split ranges as drawn · interlocks, SIS functions and cause-and-effect references · relief devices and set-points · P&ID development from a PFD workshop · revision control, holds, clouds and as-built · MOC mark-up exercise and common errors checklist

Standards referenced

ANSI/ISA-5.1 · ISA-5.3 · ISO 10628 · ISO 14617 · PIP PIC001 · ASME B31.3

Tools & exercises

Exercises on the site's own P&IDs and lead sheets; drawing templates provided

What's included

- ✓ Course manual and slide pack
- ✓ Exercise and case-study pack
- ✓ Software access for the course
- ✓ Competency quiz and certificate
- ✓ Post-course Q&A with the instructor
- ✓ Templates used in the exercises

PREREQUISITES
None

CERTIFICATION
Certificate of completion

INSTRUCTORS
Practising engineers — TÜV HAZOP Leader, CCPSC and IEC 61511 Functional Safety certified — with 200+ years of cumulative plant experience.

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PROCESS ENGINEERING · ADVANCED · 1 DAY

Distillation Troubleshooting and Optimisation

Diagnosing flooding, weeping, maldistribution and control problems, and finding the energy and yield that a column is giving away

DURATION	LEVEL	FORMAT	LANGUAGE	MAX. PARTICIPANTS
1 day	Advanced	On-site classroom · virtual instructor-led	English	16

8 troubleshooting cases from real columns

1 column rating on plant data

3 optimisation levers with economics

Overview

Columns rarely fail; they underperform, and the reasons are usually visible in pressure-drop, temperature-profile and reflux trends long before anyone opens the manway. Built around the Kister troubleshooting approach and FRI-based hydraulic guidance, the course teaches how to read a column from plant data, rate the internals against the current load, identify the operating limit, and then decide which of reflux, pressure, feed condition or product specification is worth changing.

Learning outcomes

- Interpret pressure drop, temperature profile and gamma-scan results to identify flooding, weeping, foaming and maldistribution
- Rate trays and packing hydraulically against the current load and set the real capacity limit
- Reconcile plant data with a simulation and estimate tray efficiency or HETP
- Diagnose control problems: pressure, temperature-control tray selection, reflux and reboiler interactions
- Quantify optimisation levers: reflux-to-minimum ratio, pressure minimisation, feed preheat and product give-away
- Prepare a turnaround inspection list and revamp options with a supporting case

Who should attend

Process and operations engineers responsible for distillation units; APC and control engineers supporting column control; unit supervisors

Course outline

MORNING

Column fundamentals refresher: stages, reflux, minimum reflux, pinch · tray and packing hydraulics: flooding, weeping, entrainment, pressure drop · reading a column from plant trends and gamma scans · common malfunctions and their signatures (Kister) · rating exercise on plant data

AFTERNOON

Data reconciliation and efficiency estimation · column control: pressure, temperature-tray selection, reflux and boil-up interaction · optimisation levers and economics: reflux, pressure, feed preheat, give-away · energy savings and constraint pushing · inspection and revamp options · troubleshooting cases workshop

Standards referenced

Kister, Distillation Troubleshooting and Distillation Operation
FRI design practices
GPSA Engineering Data Book
Perry's Chemical Engineers' Handbook
API RP 554

Tools & exercises

Exercises worked in the client's simulator with plant historian data; column monitoring examples from ProcessVision

What's included

- ✓ Course manual and slide pack
- ✓ Software access for the course
- ✓ Post-course Q&A with the instructor
- ✓ Exercise and case-study pack
- ✓ Competency quiz and certificate
- ✓ Templates used in the exercises

PREREQUISITES
Chemical engineering degree and experience with a distillation unit; TR-F01 helpful

CERTIFICATION
Certificate of completion

INSTRUCTORS
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