

Course No. 1352

Process Design Fundamentals

PROCESS ENGINEERING
INDUSTRIAL ENGINEERING, MAINTENANCE & OPERATIONS

DURATION

5 Days

DELIVERY

Classroom



Course Overview

The Process Design Fundamentals Training Course provides a practical and structured introduction to the principles, methods, and decisions that shape safe, efficient, reliable, and commercially sound process systems. The course enables participants to understand how process requirements are transformed into operating concepts, process flow schemes, equipment specifications, utility requirements, control strategies, and technical documentation.

Effective process design is essential for government entities, ministries, public sector organizations, oil and gas companies, utilities, manufacturing facilities, water and power operators, banks with critical infrastructure, and large corporations. Process design decisions influence production capacity, service reliability, safety, energy use, environmental performance, maintenance requirements, capital investment, and lifecycle asset value. A disciplined design approach helps organizations avoid avoidable constraints, unclear operating limits, inefficient equipment selection, and costly changes during later project stages.

This Process Design Fundamentals Training Course covers the process design lifecycle, from defining the design basis and process objectives to developing process flow diagrams, mass and energy balances, equipment requirements, utility needs, control concepts, and design reviews. Participants will learn how to assess process inputs, operating conditions, product or service requirements, safety considerations, performance targets, and technical assumptions before translating them into workable process solutions.

The course also examines the relationship between process design, process safety, asset reliability, maintainability, operability, energy efficiency, quality, procurement, construction, commissioning, and operations. Participants will gain insight into how design decisions affect the people who operate, maintain, inspect, and manage systems throughout their lifecycle.

Through technical discussions, practical exercises, and design-based case studies, participants will develop the capability to contribute more effectively to process design, modification, optimization, capacity expansion, and engineering review activities. The course supports executives and managers in making technically informed decisions while equipping engineers and specialists with practical tools for developing robust, fit-for-purpose process designs.

Objectives

- Analyze the role of process design in supporting operational performance, safety, quality, reliability, energy efficiency, compliance, and lifecycle asset value during the course.
- Assess process objectives, feed conditions, product specifications, capacity requirements, operating constraints, and stakeholder needs for selected process systems.
- Develop a structured design basis that defines scope, assumptions, design criteria, operating cases, performance targets, and technical boundaries.
- Apply mass and energy balance principles to evaluate material flows, energy requirements, utility demand, process losses, and preliminary equipment duties.
- Design basic process flow schemes that identify major process steps, equipment, streams, recycles, utilities, controls, and interfaces.
- Evaluate the selection of process equipment according to process duty, capacity, operating conditions, reliability, maintainability, safety, and energy considerations.
- Improve process design quality by identifying requirements for operability, accessibility, inspection, isolation, drainage, venting, cleaning, and maintenance.
- Strengthen process safety by integrating hazard identification, relief requirements, safeguarding, alarm philosophy, emergency response, and management of change into design decisions.
- Implement effective technical review practices for process flow diagrams, process descriptions, equipment data sheets, design calculations, and engineering assumptions.
- Assess the interaction between process design, piping, instrumentation, control systems, utilities, civil works, electrical systems, procurement, and project delivery.
- Align process design decisions with organizational objectives for capacity, cost, sustainability, operational resilience, risk management, and business continuity.
- Develop a time-bound action plan for applying process design fundamentals within the participant's organization.

Who Should Attend

The Process Design Fundamentals Training Course is designed for engineering managers, operations managers, production managers, project managers, maintenance managers, reliability managers, energy managers, utilities managers, asset managers, plant managers, facilities managers, and technical services leaders. It is particularly relevant for executives, directors, and decision makers responsible for capital investment, facility modifications, production capacity, operational performance, process safety, technical risk, energy use, and lifecycle cost management.

The course is suitable for process engineers, chemical engineers, production engineers, project engineers, design engineers, mechanical engineers, piping engineers, instrumentation and control engineers, electrical engineers, utilities engineers, energy engineers, maintenance engineers, reliability engineers, inspection engineers, integrity specialists, technical analysts, and engineering graduates. It supports professionals involved in conceptual design, feasibility studies, project development, process modification, equipment selection, capacity analysis, commissioning, operational troubleshooting, and engineering assurance.

Professionals in HSE, quality, procurement, supply chain, contract management, finance, risk management, internal audit, digital transformation, operational excellence, sustainability, and contractor management may also benefit where their responsibilities involve technical specifications, capital projects, engineering governance, equipment purchasing, regulatory requirements, environmental performance, or operational readiness. The course promotes informed collaboration between technical and business functions throughout project and asset lifecycles.

Learning Outcomes

- Explain the process design lifecycle and its contribution to safe, efficient, reliable, and sustainable operational performance.
- Define process objectives, scope, design basis, assumptions, operating cases, constraints, and performance requirements for a selected system.
- Interpret and develop basic process flow schemes that show process steps, major equipment, streams, utilities, recycles, and operational interfaces.
- Apply preliminary mass and energy balances to estimate material flows, product recovery, energy demand, utility requirements, and process losses.
- Identify key design inputs, including feed composition, flow rate, pressure, temperature, product requirements, physical properties, and environmental conditions.
- Evaluate process equipment selection based on process duty, capacity, operability, maintainability, reliability, safety, energy efficiency, and lifecycle considerations.
- Recognize the purpose of process flow diagrams, P&IDs, process descriptions, equipment data sheets, line lists, and design calculations.
- Identify requirements for process control, instrumentation, alarms, safeguards, isolation, relief, drainage, venting, sampling, and emergency response.

- Assess how process design decisions affect construction, commissioning, operations, inspection, maintenance, asset integrity, and future modification.
- Participate effectively in design reviews, hazard studies, technical assurance activities, and management of change processes.
- Communicate process design assumptions, risks, technical requirements, and recommendations clearly to multidisciplinary stakeholders.
- Produce an initial process design improvement plan relevant to the participant's workplace or project environment.

Course Outline

DAY 01

Process Design Principles and the Design Lifecycle

- The purpose and value of process design in operational performance, safety, reliability, quality, energy efficiency, cost management, and asset lifecycle value.
- The process design lifecycle: concept development, feasibility, basic design, detailed design, procurement, construction, commissioning, operation, and modification.
- Process design roles, multidisciplinary interfaces, technical governance, decision rights, design assurance, and stakeholder engagement.
- Defining process objectives, capacity requirements, product or service specifications, operating context, constraints, risks, and success measures.

PRACTICAL APPLICATION OR DISCUSSION

Developing a high-level design basis for a selected facility, utility system, process modification, or operational improvement opportunity.

DAY 02

Process Data, Mass and Energy Balances, and Flow Development

- Design data requirements: feed composition, flow rate, pressure, temperature, physical properties, product requirements, environmental conditions, and utility availability.
- Process operating cases: normal, minimum, maximum, start-up, shutdown, upset, emergency, and future capacity conditions.

DAY 02 — CONTINUED

- Mass balance fundamentals: inputs, outputs, recycle streams, losses, accumulation, component balances, and recovery.
- Energy balance fundamentals: heating, cooling, phase change, heat duty, fuel, electricity, steam, refrigeration, and utility demand.

PRACTICAL APPLICATION OR DISCUSSION

Preparing a preliminary mass and energy balance and identifying major process streams and utility requirements.

DAY 03

Process Flow Diagrams, Equipment Selection, and Utility Systems

- Process Flow Diagrams and process descriptions: major equipment, stream numbering, process sequence, recycles, side streams, and operating relationships.
- Equipment selection principles for vessels, separators, heat exchangers, pumps, compressors, filters, tanks, reactors, distillation columns, and utility systems.
- Preliminary equipment sizing considerations: capacity, residence time, pressure, temperature, flow, duty, redundancy, materials, and operating margins.
- Utility design requirements: steam, cooling water, compressed air, electricity, fuel, refrigeration, heating, ventilation, and water systems.

PRACTICAL APPLICATION OR DISCUSSION

Developing a basic process flow scheme and identifying preliminary equipment and utility requirements.

DAY 04

Process Safety, Control, Operability, and Maintainability

- Integrating process safety into design: hazard identification, safe operating limits, safeguards, relief systems, emergency shutdown, containment, and fire and gas interfaces.
- Process control concepts: measurements, sensors, control loops, set points, alarms, interlocks, control valves, and operating procedures.

DAY 04 — CONTINUED

- Designing for operability: start-up, shutdown, process stability, abnormal conditions, operating flexibility, human factors, and control-room requirements.
- Designing for maintainability and asset integrity: access, isolation, drainage, venting, lifting, inspection, corrosion management, cleaning, spare parts, and equipment handover.

PRACTICAL APPLICATION OR DISCUSSION

Reviewing a process concept for safety, control, operability, and maintainability requirements.

DAY 05

Technical Reviews, Project Integration, and Process Design Implementation

- Process design deliverables: design basis documents, PFDs, P&IDs, equipment data sheets, process calculations, line lists, operating narratives, and technical specifications.
- Multidisciplinary design review, HAZOP preparation, value engineering, constructability, commissioning readiness, and operational handover.
- Managing design changes, assumptions, risks, deviations, approvals, contractor interfaces, and technical documentation.
- Linking process design with procurement, project controls, cost estimation, sustainability, environmental performance, maintenance planning, and continuous improvement.

FINAL WORKSHOP, ACTION PLAN, OR IMPLEMENTATION EXERCISE

Developing a 90-day Process Design Fundamentals action plan with priority systems, required data, design reviews, accountable owners, milestones, risk controls, and performance measures.

Register or Request More Information

Course page: <https://quest-training.com/courses/process-design-fundamentals>

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