



# Advanced Process Control and Model Predictive Control (MPC) Training Course



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### Introduction:

Advanced process control and model predictive control MPC is a 5-day course for control, process and instrument engineering teams in refining, gas processing, petrochemicals and utilities that ends with an APC Opportunity Study and Distillation Controller Design. Many plants pay for multivariable controllers that drift into low uptime because step test models age, inferential qualities lose their laboratory bias and operators switch applications off when constraints are pushed without explanation. Nominees already maintain regulatory loops, and the course runs modelling builds on step test records, historian trends and column data. CoreConcept Training Center delivers this advanced process control course.

### Course Objectives:

- Quantify where regulatory PID control leaves variability and constraint margin on a process unit and size the APC benefit opportunity
- Design plant step tests and identify dynamic models for each manipulated and controlled variable pair, then validate them for control use
- Structure a model predictive controller with manipulated, controlled and disturbance variables, constraint limits, horizons and a steady-state economic optimiser
- Build and maintain inferential quality estimators calibrated against laboratory and analyzer results with a bias update routine
- Commission, tune and hand over a multivariable controller with an operator interface, training and acceptance criteria agreed with operations
- Measure APC service factor, constraint activity and realised benefits through a post-audit and a sustainment monitoring plan

### Target Audience:

- Control engineering teams responsible for designing and maintaining multivariable controllers on refinery, gas and petrochemical units
  - Process engineering teams responsible for unit constraints, product quality targets and economic operating points
  - Instrument and analyzer teams responsible for measurement quality behind APC and inferential estimators
  - Technical services teams responsible for performance monitoring and benefit tracking of control applications
  - Utility and power plant control teams responsible for boiler, steam header and compressor load control strategies
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## **Course Outline:**

### **Day 1: Regulatory Control Limits and APC Opportunity Assessment**

- Control Hierarchy From Regulatory Loops to Supervisory Optimisation
- Regulatory Layer Readiness Audit Before Multivariable Control
- Variability Reduction and Constraint Pushing Benefit Mechanism
- Advanced Regulatory Control Using Decoupling, Override and Adaptive Gain
- APC Opportunity Screening Matrix by Unit and Product Value

### **Day 2: Multivariable Control Concepts and Plant Model Identification**

- Process Interaction Analysis With Relative Gain Array
- Plant Step Test Plan With Move Sizes and Durations
- Pseudo-Random Binary Sequence Testing for Shorter Test Campaigns
- Finite Impulse Response and Parametric Model Identification Methods
- Model Validation Through Gain Checks and Prediction Error

### **Day 3: Model Predictive Controller Structure and Inferential Soft Sensors**

- Manipulated, Controlled and Disturbance Variable Selection Rules
- Prediction Horizon, Control Horizon and Receding Horizon Execution
- Steady-State Optimiser With Linear Programme Cost Settings
- Inferential Quality Estimator Built From Temperature and Pressure Data
- Laboratory Bias Update Logic and Estimator Drift Detection

### **Day 4: Controller Commissioning, Operator Acceptance and Benefit Sustainment**

- Offline Simulation Testing of Controller Response and Limits
- Move Suppression and Constraint Priority Tuning During Commissioning
- Operator Interface Displays and Limit Entry Procedures
- Benefit Post-Audit Comparing Baseline and Controlled Operation
- APC Service Factor and Model Degradation Monitoring Plan

### **Day 5: Modelling Build Distillation Column APC Case**

- Case Column Data Pack With Historian and Laboratory Records
  - Case Opportunity Study Using Variability and Constraint Analysis
  - Case Model Matrix From Supplied Step Test Responses
  - Case Controller Variable List, Limits and Optimiser Costs
  - APC Opportunity Study and Distillation Controller Design Completion
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## **Skills You Will Gain:**

- Control Performance Benchmarking
- Plant Test Design
- Dynamic Model Identification
- Multivariable Controller Configuration
- Soft Sensor Development
- Controller Commissioning
- APC Benefit Auditing
- Control Application Sustainment

## **Why Attend This Course:**

- Deliver an APC Opportunity Study and Distillation Controller Design to the control engineering lead and the unit process owner for approval
- Decide which units justify a multivariable controller and which need regulatory loop repairs first
- Avoid paying for controllers that operators switch off by planning acceptance, training and uptime monitoring from the start
- Share step test plans, model validation checks and post-audit templates with control and process colleagues

## **Conclusion:**

Back at work, the participant gives the control engineering lead and the unit process owner an APC Opportunity Study and Distillation Controller Design that sets the benefit case, step test plan, model matrix, variable list, constraint limits, inferential estimators and acceptance criteria for a unit. Management uses it to approve a controller project or regulatory repairs first, while operations agree limit handling and training. After the first months of controller service, the unit should review service factor, constraint activity, estimator bias and realised benefits against the study.

## **Frequently Asked Questions FAQ:**

### **What should participants know before the advanced process control and model predictive control course?**

Participants should already work with regulatory PID loops, process historians and unit operating targets. Bringing historian trends, step test records or a column process flow diagram from their own unit helps them apply the modelling builds to familiar equipment.

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## **How does advanced process control and model predictive control differ from a basic PID tuning or control system configuration course?**

It works above the regulatory layer: opportunity studies, plant model identification, multivariable controller design, inferential estimators, commissioning and benefit audits. PID tuning courses treat single loops, and control system configuration courses treat function blocks, networks and hardware; both appear here only as prerequisites.

## **Why do advanced process control and model predictive control applications lose service factor over time?**

Models age as feed, catalyst and equipment change, inferential estimators drift from laboratory results and limits are left too tight. Without monitoring of uptime, constraint activity and model error, operators lose trust and switch the controller off.

## **What do participants take back from the advanced process control and model predictive control course?**

Participants take back an APC Opportunity Study and Distillation Controller Design with a benefit estimate, a step test plan, a validated model matrix, a variable and limit list, optimiser costs, inferential estimator logic and a service factor monitoring plan.

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