

# **Petrochemical DCS**

## *COURSE CONTENT*

### **GET IN TOUCH**



Multisoft Systems  
B - 125, Sector - 2, Noida



(+91) 9810-306-956



[info@multosoftsystems.com](mailto:info@multosoftsystems.com)



[www.multosoftsystems.com](http://www.multosoftsystems.com)

## **About Multisoft**

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## **About Course**

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Petrochemical DCS Training by Multisoft Systems focuses on the application of Distributed Control Systems for monitoring, controlling, and coordinating petrochemical plant processes. The course connects DCS engineering concepts with practical process applications, covering instrumentation, controller and I/O architecture, PID and advanced control strategies, HMI, alarms, interlocks, sequences, system integration, diagnostics, and cybersecurity. Participants also explore control requirements associated with major petrochemical units and equipment, helping them gain an application-oriented understanding of DCS engineering and plant operations.

## Module 1: Introduction to Petrochemical Plants and DCS

- ✓ Overview of the petrochemical industry
- ✓ Petrochemical plant structure and operating environment
- ✓ Major feedstocks and petrochemical products
- ✓ Overview of upstream, midstream, refining, and petrochemical operations
- ✓ Process units commonly found in petrochemical complexes
- ✓ Role of automation in continuous process industries
- ✓ Evolution from conventional control systems to DCS
- ✓ Distributed Control System fundamentals
- ✓ DCS versus PLC, SCADA, and SIS
- ✓ Role of DCS throughout the plant lifecycle
- ✓ Typical petrochemical control-room environment

## Module 2: Petrochemical Processes and Process Control Fundamentals

- ✓ Fundamentals of continuous process operations
- ✓ Process variables in petrochemical plants
  - a) Flow
  - b) Pressure
  - c) Temperature
  - d) Level
  - e) Composition
- ✓ Process dynamics and response characteristics
- ✓ Measurement, manipulated, and controlled variables
- ✓ Open-loop and closed-loop control

- ✓ Feedback control principles
- ✓ Process disturbances and control response
- ✓ Understanding P&IDs from a control perspective
- ✓ Control-loop identification
- ✓ Control valve fundamentals
- ✓ Fail-safe philosophy
- ✓ Introduction to process control narratives

## **Module 3: DCS Architecture for Petrochemical Facilities**

- ✓ DCS functional architecture
- ✓ System hierarchy and distribution concepts
- ✓ Engineering workstation
- ✓ Operator workstation
- ✓ Process controllers
- ✓ Application and system servers
- ✓ I/O subsystems
- ✓ Communication infrastructure
- ✓ Historian and information servers
- ✓ Redundant system architecture
- ✓ Controller redundancy
- ✓ Server and network redundancy
- ✓ Power supply considerations
- ✓ System availability and reliability
- ✓ Control-room and field architecture
- ✓ Overview of large-scale petrochemical DCS architecture

## Module 4: DCS Hardware, Controllers, I/O and System Infrastructure

- ✓ DCS hardware components
- ✓ Controller architecture
- ✓ Processor and memory fundamentals
- ✓ Controller execution cycles
- ✓ Local and remote I/O
- ✓ Analog input and output modules
- ✓ Digital input and output modules
- ✓ Pulse and specialized I/O
- ✓ Signal isolation
- ✓ I/O channel configuration
- ✓ Marshalling concepts
- ✓ Conventional and electronic marshalling
- ✓ Cabinet architecture
- ✓ System power supplies
- ✓ UPS considerations
- ✓ Redundant hardware configurations
- ✓ Hardware diagnostics
- ✓ Controller loading and capacity considerations

## Module 5: Field Instrumentation and DCS Integration

- ✓ Overview of petrochemical instrumentation
- ✓ Pressure transmitters
- ✓ Temperature measurement

- ✓ Flow measurement technologies
- ✓ Level measurement
- ✓ Analytical instruments
- ✓ Control valves and actuators
- ✓ Positioners and valve feedback
- ✓ 4–20 mA signal integration
- ✓ Digital field communication
- ✓ HART fundamentals
- ✓ FOUNDATION Fieldbus overview
- ✓ Instrument signal conditioning
- ✓ Instrument ranges and engineering units
- ✓ Scaling and signal conversion
- ✓ Bad signal and instrument failure handling
- ✓ Smart instrumentation diagnostics
- ✓ Instrument loop interaction with DCS

## **Module 6: DCS Engineering, Configuration and Tag Management**

- ✓ DCS engineering workflow
- ✓ Project database concepts
- ✓ Plant hierarchy configuration
- ✓ Tag naming philosophy
- ✓ Instrument index and I/O database
- ✓ Point and tag creation
- ✓ Analog and digital point configuration

- ✓ Controller assignment
- ✓ I/O channel mapping
- ✓ Engineering units and ranges
- ✓ Alarm parameter configuration
- ✓ Control module configuration
- ✓ Function blocks
- ✓ Logic configuration
- ✓ Template-based engineering
- ✓ Bulk configuration concepts
- ✓ Configuration documentation
- ✓ Engineering change management
- ✓ Backup and version control principles

## **Module 7: Operator Stations, HMI and Process Graphics**

- ✓ Operator interface fundamentals
- ✓ HMI design philosophy
- ✓ Process overview displays
- ✓ Unit-level displays
- ✓ Equipment detail displays
- ✓ Faceplates
- ✓ Control-loop interaction
- ✓ Equipment status indication
- ✓ Dynamic process values
- ✓ Graphic symbols and objects
- ✓ Navigation hierarchy
- ✓ Alarm indication on graphics

- ✓ Trend integration
- ✓ Operator commands
- ✓ Setpoint and mode changes
- ✓ Manual and automatic operation
- ✓ High-performance HMI concepts
- ✓ Situational awareness
- ✓ Effective petrochemical control-room graphics

## Module 8: Regulatory and Advanced Process Control Strategies

- ✓ Regulatory control concepts
- ✓ PID control fundamentals
- ✓ Proportional, integral, and derivative actions
- ✓ Controller operating modes
- ✓ PID tuning concepts
- ✓ Flow control
- ✓ Pressure control
- ✓ Temperature control
- ✓ Level control
- ✓ Cascade control
- ✓ Ratio control
- ✓ Feedforward control
- ✓ Split-range control
- ✓ Override/selective control
- ✓ Constraint handling concepts

- ✓ Compressor control considerations
- ✓ Furnace combustion control concepts
- ✓ Distillation control strategies
- ✓ Reactor control concepts
- ✓ Introduction to Advanced Process Control (APC)
- ✓ DCS interaction with APC applications

## Module 9: Control of Major Petrochemical Process Units

- ✓ Control requirements of petrochemical process units
- ✓ Distillation column control
  - a) Pressure control
  - b) Reflux control
  - c) Reboiler control
  - d) Product quality considerations
- ✓ Reactor control
  - a) Temperature management
  - b) Pressure management
  - c) Feed control
- ✓ Furnace and heater control
- ✓ Heat exchanger control
- ✓ Compressor control
- ✓ Pump control and protection interface
- ✓ Separator and vessel control
- ✓ Storage tank control
- ✓ Utility system control
- ✓ Steam system considerations

- ✓ Cooling water systems
- ✓ Fuel gas systems
- ✓ Flare system monitoring
- ✓ Typical unit start-up and shutdown considerations

## Module 10: Alarm Management, Events, Trends and Historian

- ✓ Purpose of alarm systems
- ✓ Process alarms versus system alarms
- ✓ Alarm priority philosophy
- ✓ High and low alarms
- ✓ Deviation alarms
- ✓ Rate-of-change alarms
- ✓ Alarm acknowledgement
- ✓ Alarm suppression concepts
- ✓ Shelving and masking concepts
- ✓ Alarm flooding
- ✓ Nuisance alarms
- ✓ Alarm rationalization principles
- ✓ Sequence of Events (SOE)
- ✓ Event logging
- ✓ Real-time trends
- ✓ Historical trends
- ✓ Process historian fundamentals
- ✓ Historical data retrieval

- ✓ Using trends for process analysis
- ✓ Alarm and event analysis for troubleshooting

## **Module 11: Interlocks, Permissives, Sequence Control and SIS Interface**

- ✓ Difference between alarms, interlocks, and trips
- ✓ Permissive logic
- ✓ Interlock philosophy
- ✓ Equipment start/stop logic
- ✓ Motor and pump sequences
- ✓ Sequence control
- ✓ State-based control concepts
- ✓ Start-up sequences
- ✓ Shutdown sequences
- ✓ Cause-and-effect fundamentals
- ✓ Emergency shutdown concepts
- ✓ Introduction to Safety Instrumented Systems
- ✓ DCS and SIS functional separation
- ✓ DCS-SIS communication
- ✓ Safety status visualization on DCS
- ✓ Fire and gas system interface concepts
- ✓ Operational considerations for trip and reset logic

## Module 12: Industrial Communication Networks and System Integration

- ✓ DCS communication architecture
- ✓ Industrial Ethernet fundamentals
- ✓ Network topology
- ✓ Redundant communication networks
- ✓ Modbus RTU
- ✓ Modbus TCP/IP
- ✓ OPC concepts
- ✓ OPC UA overview
- ✓ HART communication
- ✓ FOUNDATION Fieldbus
- ✓ PROFIBUS overview
- ✓ Device integration concepts
- ✓ DCS and PLC integration
- ✓ DCS and SIS integration
- ✓ Package unit integration
- ✓ Analyzer system integration
- ✓ Electrical system interfaces
- ✓ Historian connectivity
- ✓ Plant information system integration
- ✓ Time synchronization concepts
- ✓ Network segmentation fundamentals

## Module 13: DCS Diagnostics, Troubleshooting, Maintenance and Cybersecurity

- ✓ DCS system health monitoring
- ✓ Controller diagnostics
- ✓ I/O diagnostics
- ✓ Communication diagnostics
- ✓ Server and workstation diagnostics
- ✓ Identifying field versus system faults
- ✓ Signal troubleshooting
- ✓ Controller communication failures
- ✓ I/O channel failure analysis
- ✓ Network fault identification
- ✓ Redundancy status monitoring
- ✓ System logs and diagnostic tools
- ✓ Preventive maintenance principles
- ✓ Configuration backup and restoration
- ✓ Patch and change management concepts
- ✓ DCS lifecycle considerations
- ✓ Industrial cybersecurity fundamentals
- ✓ Network segmentation
- ✓ User access and privilege management
- ✓ Secure engineering practices
- ✓ Cybersecurity considerations for petrochemical control systems

## Module 14: Petrochemical DCS Practical Exercises and Plant-Based Case Studies

- ✓ Reading petrochemical P&IDs
- ✓ Identifying DCS control loops
- ✓ Creating process tags
- ✓ Configuring analog and digital points
- ✓ Instrument range and scaling exercises
- ✓ Building basic PID loops
- ✓ Configuring cascade control
- ✓ Ratio control configuration exercise
- ✓ Interlock and permissive logic exercises
- ✓ Alarm configuration
- ✓ HMI graphic interpretation
- ✓ Trend analysis
- ✓ Process disturbance analysis
- ✓ Diagnosing instrument and I/O faults
- ✓ Troubleshooting communication issues
- ✓ Distillation column control case study
- ✓ Reactor control case study
- ✓ Furnace control scenario
- ✓ Compressor operation scenario
- ✓ Start-up and shutdown sequence analysis
- ✓ Integrated petrochemical DCS case study