TECHNICAL EDUCATION ACADEMY

School of Engineering

COURSE PROGRAMME

000716

MECH071 - Compressor Anti-Surge Systems



Learn from the Best in the Business!

Course overview

Intermediate level

Why take this course

Compressor Anti-Surge Systems is a comprehensive training program designed to equip engineers, operators, and maintenance professionals with the knowledge and practical competencies required to ensure stable, safe, and efficient operation of centrifugal compressors. Surge is one of the most severe aerodynamic instabilities encountered in compression systems, capable of causing mechanical damage, process upsets, and costly unplanned downtime. This course explores the physics of surge, the dynamics of compressor operation, and the modern control strategies used to prevent surge across a wide range of operating conditions. Participants will learn how to interpret compressor performance curves, configure and tune anti-surge controllers, analyze real-time operational data, and apply troubleshooting and maintenance best practices. By the end of the program, participants will be able to confidently implement, operate, and optimize anti-surge systems to enhance reliability, extend equipment life, and improve overall plant performance.

Who it is for and how it helps

This course is designed for technical professionals who are involved in the operation, design, maintenance, or optimization of centrifugal compressor systems in oil & gas, petrochemical, power generation, and industrial process environments. It is especially valuable for:

• Operations & Production Personnel : Compressor operators, Control room panel operators, Shift supervisors and production coordinators. These participants gain a strong understanding of compressor dynamics, surge behavior, and how to operate anti-surge systems safely and effectively.

• Instrumentation, Electrical & Control System Engineers: Instrumentation engineers, Control & automation engineers, DCS/PLC/Mark VIe control engineers, E&I maintenance specialists.These professionals learn how anti-surge controllers work, how to tune and configure parameters, and how to diagnose control loop issues.

• Mechanical & Rotating Equipment Engineers: Mechanical engineers, Rotating equipment engineers, Machinery specialists. They benefit by understanding compressor operating envelopes, surge mechanisms, vibration risks, and system-level performance optimization.

• Maintenance & Reliability Personnel: Maintenance technicians, Reliability engineers, Condition monitoring specialists. Participants acquire maintenance, calibration, and troubleshooting skills for valves, sensors, and control systems.

• Process & Performance Engineers: Process engineers, System optimization engineers, Energy management engineers. These roles benefit from understanding how anti-surge control impacts system efficiency, throughput, and energy usage.

What you will learn

- Understand Compressor Surge and Its Consequences

Course overview — continued

- Interpret Compressor Maps and Operating Envelopes
- Configure and Tune Anti-Surge Controllers
- Operate Anti-Surge Systems in Real Time
- Troubleshoot Anti-Surge Control Problems
- Maintain and Calibrate Anti-Surge System Components
- Optimize Compressor Performance and Surge Margin

Curriculum

Modules 01–03

01 Fundamentals of Centrifugal Compressors

- Basic operating principles
- Compressor components and functions
- Pressure–flow characteristics
- Thermodynamic planes
- Performance and system resistance curves
- Relationship between flow, pressure, and operating point
- Surge line, stonewall line, and operating envelope
- Unsteady flow behavior
- Choking (Stonewall)
- Rotating stall
- Surge: causes, behavior, and consequences

02 Surge Phenomena & Anti-Surge Control Fundamentals

- Surge mechanisms in centrifugal compressors
- Effects of surge on equipment reliability and plant safety
- Economic and operational consequences
- Purpose and function of anti-surge systems
- Key principles of surge prevention
- Defining surge margin and control line
- Interpreting compressor maps
- Operating ranges and limits
- How anti-surge systems maintain stability across load conditions

03 Anti-Surge System Components & Implementation

- Controllers, sensors, transmitters, and valves
- System layout and integration with compressor control systems
- Inputs and outputs for anti-surge controllers
- Valve types (recycle, blow-off)
- Actuators, positioners, dynamics
- Valve selection criteria for surge protection

Curriculum

Modules 03–05 · Module 03 — continued

- PID control in anti-surge loops
- Cascade control structures
- Logic for different flow conditions and environments
- Shutdown and alarm philosophy
- Setting control limits and surge margins
- Defining control and protection lines
- Controller setup: gains, deadbands, response tuning
- Hands-on configuration exercises

04 Operation of Anti-Surge Control Systems

- Monitoring system performance using HMI/trending tools
- Key variables: flow, pressure, temperature, valve position
- Reading surge proximity and dynamic load behavior
- Understanding normal vs transient operation
- Main screen field descriptions
- Auto/manual control modes
- Status indicators and alarm interpretation
- Fine-tuning parameters for better stability
- Optimizing surge margin under varying loads
- Response adjustment during startups, shutdowns, and turndown
- Identifying oscillations, instability, and loop saturation
- Using diagnostics and logs
- Common operator errors and how to avoid them

05 Maintenance, Calibration & Reliability

- Routine inspection procedures
- Maintenance of control system hardware
- Best practices for anti-surge valves, sensors, and transmitters
- Calibrating pressure, flow, and temperature transmitters
- Verifying controller and loop performance
- Post-maintenance validation
- Identifying hardware failures

Curriculum

Modules 05–06 · Module 05 — continued

- Control loop malfunction analysis
- Valve response issues
- Diagnostic tools and advanced testing
- Software architecture in anti-surge systems
- Applying updates safely
- Use of simulation software for surge analysis

06 Load Sharing, Balancing & System Optimization

- Multi-compressor train interaction
- Control coordination between units
- Energy optimization strategies
- Handling extreme surge scenarios
- System-level interaction faults
- Dynamic response issues in complex plants
- Reducing energy consumption through optimized control
- Improving surge margins under variable demand
- Integrating anti-surge control with plant-wide automation

Pre-course requirements

- Participants should ideally have:
  - Basic understanding of industrial process operations
  - Familiarity with piping & instrumentation diagrams (P&IDs)
  - General knowledge of industrial automation, control systems, or rotating equipment

Participation and contacts

Joining the programme

Contact the Academy and quote course code 000716 to confirm dates, delivery format, prices and enrolment terms.

Training for your team

Tell us your business goals, the roles and number of participants, and your preferred dates and location. This will help us discuss the right training option.

Preparing for the programme

Read the pre-course requirements in this programme before enrolling.

Discuss your training needs

mail@tecedu.org
www.tecedu.academy

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