Advanced Process Control and Instrumentation Best Practices Training Course



Ref: #ACE9079

Course Introduction / Overview:

This course provides a comprehensive exploration of Advanced Process Control (APC) and instrumentation, essential for optimizing industrial processes for efficiency, safety, and profitability. In today's competitive landscape, moving beyond basic regulatory control is no longer an option but a necessity. This program delves into the sophisticated techniques that drive modern industrial automation, from advanced regulatory strategies to the powerful capabilities of Model Predictive Control (MPC). As detailed by renowned academic Thomas E. Marlin in his seminal work, "Process Control: Designing Processes and Control Systems for Dynamic Performance," a deep understanding of both control theory and its practical instrumentation is crucial for success. Participants will gain a holistic perspective, bridging the gap between theoretical principles and real-world application. BIG BEN Training Center has designed this curriculum to empower professionals with the skills to design, implement, and maintain robust control systems, troubleshoot complex issues, and leverage data for continuous process improvement, ensuring their operations remain at the forefront of technological advancement and operational excellence.

Target Audience / This training course is suitable for:

- Process Control Engineers.
- Instrumentation and Control Technicians.
- Automation Engineers.
- Chemical and Process Engineers.
- Operations Managers and Supervisors.
- Plant Engineers and Managers.
- Electrical Engineers working in industrial settings.
- Project Engineers involved in control system upgrades.
- Maintenance Planners and Supervisors.
- Technical professionals seeking to enhance their knowledge of process control.

Target Sectors and Industries:

- Oil and Gas.
- Petrochemicals and Refining.
- Chemical Manufacturing.
- Power Generation and Utilities.
- Water and Wastewater Treatment.
- Pharmaceuticals and Biotechnology.
- Food and Beverage Processing.
- Pulp and Paper.
- Mining and Metals.
- Governmental bodies and public sector utilities.

Target Organizations Departments:

- Engineering.
- Operations.
- Maintenance and Reliability.
- Process Safety Management.
- Production.
- Automation and Control.
- Technical Services.
- Research and Development.
- Quality Assurance and Control.
- Project Management.

Course Offerings:

By the end of this course, the participants will have able to:

- Analyze and tune PID control loops using various established methods for optimal performance.
- Design and implement advanced regulatory control strategies, including cascade, feedforward, and ratio control.
- Grasp the fundamental principles and industrial applications of Model Predictive Control (MPC).
- Evaluate and select appropriate instrumentation for measuring pressure, temperature, flow, and level.
- Interpret P&ID diagrams to understand process flow and control system architecture.
- Understand the architecture and functionality of Distributed Control Systems (DCS) and PLCs.
- Develop effective alarm management strategies based on industry standards like ISA-18.2.
- Apply fundamental principles of Safety Instrumented Systems (SIS) for process safety.
- Troubleshoot common issues in control loops and instrumentation systems systematically.
- Assess control system performance and identify opportunities for optimization.

Course Methodology:

The training methodology at BIG BEN Training Center is designed to be highly interactive and participant-centered, ensuring a deep and practical understanding of advanced process control and instrumentation. We move beyond traditional lectures by integrating a blended learning approach that includes detailed presentations, real-world case studies from diverse industries, and collaborative group discussions. Participants will engage in practical exercises and simulated problem-solving scenarios that mirror the challenges they face in their own operational environments. This hands-on approach reinforces theoretical concepts and builds practical troubleshooting skills. Our expert instructors facilitate an open learning atmosphere, encouraging participants to share their experiences and ask questions. Continuous feedback is provided throughout the sessions to ensure concepts are thoroughly understood. The course structure promotes teamwork and knowledge sharing, allowing attendees to learn not only from the instructor but also from the diverse experiences of their peers, creating a rich and dynamic learning environment.

Course Agenda (Course Units):

Unit One: Fundamentals of Process Control and Instrumentation

- Introduction to Process Control and its objectives.
- Understanding Process and Instrumentation Diagrams (P&IDs).
- Fundamentals of PID (Proportional-Integral-Derivative) control.
- Controller modes and tuning basics.
- Principles of pressure and level measurement technologies.
- Principles of temperature and flow measurement technologies.
- Introduction to final control elements, including control valves.

Unit Two: Advanced Regulatory Control Strategies

- Cascade control system design and implementation.
- Feedforward control for disturbance rejection.
- Ratio control for blending and combustion applications.
- Split-range and selective control strategies.
- Advanced PID tuning techniques (Ziegler-Nichols, Cohen-Coon).
- Control valve characteristics, sizing, and selection.
- Troubleshooting and optimizing complex regulatory control loops.

Unit Three: Model Predictive Control (MPC) and Multivariable Systems

- Limitations of single-loop control and the need for multivariable control.
- Introduction to Model Predictive Control (MPC) concepts.
- Developing process models for MPC applications.
- Understanding the role of constraints and optimization in MPC.
- Benefits and challenges of implementing MPC.
- Overview of Real-Time Optimization (RTO) systems.
- Case studies of MPC in refining and chemical industries.

Unit Four: Digital Control Systems and Industrial Communication

- Architecture of Distributed Control Systems (DCS).
- Role and application of Programmable Logic Controllers (PLCs).
- Supervisory Control and Data Acquisition (SCADA) systems.
- Human-Machine Interface (HMI) design principles.
- Digital communication protocols (HART, Foundation Fieldbus, Profibus).
- Introduction to industrial network cybersecurity.
- Smart instrumentation and its diagnostic capabilities.

Unit Five: Process Safety, Optimization, and System Management

- Introduction to Safety Instrumented Systems (SIS) and Safety Integrity Levels (SIL).
- Alarm management principles and the ISA-18.2 standard.
- Control loop performance monitoring and diagnostics.
- Systematic troubleshooting of control system failures.
- Documentation and management of change for control systems.
- Data analytics and its role in process optimization.
- Course review and capstone discussion on integrated control strategies.

FAQ:

Qualifications required for registering to this course?

There are no requirements.

How long is each daily session, and what is the total number of training hours for the course?

This training course spans five days, with daily sessions ranging between 4 to 5 hours, including breaks and interactive activities, bringing the total duration to 20 - 25 training hours.

Something to think about:

As automation and AI become more integrated, how might the role of the human process control engineer evolve from a hands-on operator to a strategic system supervisor, and what new skills will be paramount for ensuring both safety and efficiency?

What unique qualities does this course offer compared to other courses?

This course distinguishes itself by providing a holistic and integrated perspective that bridges the critical gap between advanced control theory and the practical realities of industrial instrumentation. While many programs focus on either control strategies or hardware in isolation, this curriculum weaves them together, demonstrating how instrumentation performance directly impacts the effectiveness of advanced algorithms like Model Predictive Control (MPC). We move beyond a purely academic discussion to focus on the practical implementation, tuning, and troubleshooting of these systems in real-world scenarios. The curriculum is uniquely structured to build knowledge progressively, starting from fundamental PID control and advancing to complex multivariable and model-based strategies. Furthermore, it incorporates essential, contemporary topics such as process safety management through SIS, effective alarm management based on industry standards, and an introduction to industrial cybersecurity, which are often overlooked. The emphasis on case studies and systematic problem-solving equips participants not just with knowledge, but with the critical thinking skills needed to enhance operational efficiency and safety in their own facilities.