Advanced Process Control and Instrumentation for Energy Training Course

14 - 18 Dec 2026

Madrid

5900 € (Per Person)

Ref: #OG8556_98787

Course Introduction / Overview:

This comprehensive training course provides an in-depth exploration of advanced process control and instrumentation systems tailored specifically for the dynamic and demanding energy sector. In an industry where operational efficiency, safety, and regulatory compliance are paramount, mastering control systems is no longer an option but a necessity. This program is designed to bridge the gap between fundamental principles and the complex, real-world applications found in oil and gas facilities, power plants, and renewable energy operations. As detailed in seminal works like "Process Dynamics and Control" by Dale E. Seborg, the ability to effectively manage process variables directly impacts profitability and sustainability. Participants will delve into the architecture of modern control systems, including Distributed Control Systems (DCS) and Programmable Logic Controllers (PLC), and learn to implement advanced control strategies such as Model Predictive Control (MPC). BIG BEN Training Center has structured this course to empower professionals with the skills to optimize production, enhance safety through robust Safety Instrumented Systems (SIS), and troubleshoot complex instrumentation issues, ensuring they can contribute to a more reliable and efficient energy infrastructure.

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.
- Control Room Operators.
- Project Engineers involved in control system design.
- Maintenance and Reliability Professionals.
- Technical professionals seeking to specialize in industrial automation.

Target Sectors and Industries:

- Oil and Gas (Upstream, Midstream, and Downstream).
- Petrochemical and Refining Industries.
- Power Generation (Conventional and Nuclear).
- Renewable Energy Sector (Solar, Wind, and Geothermal).
- Chemical Manufacturing.
- Water and Wastewater Treatment Facilities.
- Governmental regulatory bodies and energy ministries.
- Heavy Industrial Manufacturing.

Target Organizations Departments:

- Operations and Production.
- Engineering and Design.
- Maintenance and Reliability.
- Process Safety Management.
- Automation and Control Systems.
- Technical Services.
- Project Management.
- Health, Safety, and Environment (HSE).
- Research and Development.

Course Offerings:

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

- Analyze and interpret Piping and Instrumentation Diagrams (P&IDs).
- Select appropriate measurement instruments for pressure, temperature, level, and flow.
- Calibrate and maintain key process control instrumentation.
- Implement and tune Proportional-Integral-Derivative (PID) control loops for optimal performance.
- Design and evaluate basic cascade, feedforward, and ratio control strategies.
- Understand the architecture and functionality of DCS, PLC, and SCADA systems.
- Apply principles of Advanced Process Control (APC) to optimize complex industrial processes.
- Identify the components and safety integrity levels (SIL) of a Safety Instrumented System (SIS).
- Develop effective alarm management strategies to enhance operator response.
- Assess and mitigate cybersecurity risks in industrial control systems.

Course Methodology:

The training methodology at BIG BEN Training Center is designed to foster a deep, practical understanding of advanced process control and instrumentation. This course moves beyond theoretical lectures to create an immersive and interactive learning environment. We utilize a blended approach that combines expert-led instruction with hands-on exercises, computer-based simulations of control loops, and detailed case studies drawn directly from the energy sector. Participants will engage in collaborative group workshops to analyze real-world control problems and design effective solutions. Interactive sessions encourage open dialogue, allowing attendees to share their unique operational challenges and gain insights from both the instructor and their peers. A significant portion of the course is dedicated to practical application, where participants will practice controller tuning techniques and evaluate system performance. Continuous feedback is provided throughout the training to ensure concepts are thoroughly understood and can be confidently applied in the workplace. This participant-centered approach ensures that learning is not only retained but is also immediately transferable to professional responsibilities.

Course Agenda (Course Units):

Unit One: Fundamentals of Process Control and Instrumentation

- Introduction to Process Control in the Energy Industry.
- Understanding Process Variables, Dynamics, and Control Loops.
- Interpreting Piping and Instrumentation Diagrams (P&IDs).
- Principles of Feedback and Feedforward Control Systems.
- Introduction to Process Modeling and Simulation.
- Standards and Symbology in Instrumentation (ISA Standards).
- Basic Controller Hardware and Software Components.

Unit Two: Measurement Technologies and Final Control Elements

- Principles of Pressure, Temperature, and Level Measurement.
- Flow Measurement Technologies for Liquids and Gases.
- Selection and Sizing of Sensors and Transmitters.
- Control Valve Characteristics, Sizing, and Selection.
- Understanding Actuators, Positioners, and Transducers.
- Calibration Procedures and Best Practices for Instrumentation.
- Troubleshooting Common Instrumentation Failures.

Unit Three: Core Control Strategies and Systems

- Proportional-Integral-Derivative (PID) Control Algorithm.
- Practical PID Controller Tuning Methods (Ziegler-Nichols and others).
- Advanced PID Control Enhancements.
- Implementing Cascade, Ratio, and Feedforward Control.
- Overview of Distributed Control Systems (DCS) Architecture.
- Introduction to Programmable Logic Controllers (PLC) and Ladder Logic.
- Supervisory Control and Data Acquisition (SCADA) Systems and HMI.

Unit Four: Advanced Process Control (APC) and Optimization

- Introduction to Advanced Process Control (APC) Concepts.
- Multivariable Control Challenges in the Energy Sector.
- Principles of Model Predictive Control (MPC).
- Application of APC in Distillation Columns, Reactors, and Furnaces.
- Process Optimization Techniques for Energy Efficiency.
- Real-Time Optimization (RTO) and its Role.
- Data Analytics and Statistical Process Control (SPC).

Unit Five: Safety, Cybersecurity, and Emerging Trends

- Introduction to Safety Instrumented Systems (SIS) and Functional Safety.
- Understanding Safety Integrity Levels (SIL) and IEC 61511.
- Alarm Management Philosophy and Rationalization.
- Cybersecurity for Industrial Control Systems (OT Security).
- Introduction to Industrial Communication Protocols (HART, Fieldbus).
- The Role of the Industrial Internet of Things (IIoT) in Process Control.
- Future Trends including Digital Twins and AI in Process Automation.

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:

Considering the increasing integration of operational technology (OT) with information technology (IT) in the energy sector, what new vulnerabilities and control challenges arise when a process control network is no longer fully isolated?

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

This training course distinguishes itself through its specialized focus on the unique and high-stakes environment of the energy sector. Unlike generic instrumentation programs, every module, case study, and practical example is directly relevant to the challenges faced in oil refineries, power generation facilities, and petrochemical plants. The curriculum meticulously balances foundational knowledge with an in-depth exploration of Advanced Process Control (APC) techniques like Model Predictive Control, which are critical for optimizing complex, multivariable processes common in energy production. Furthermore, the course places significant emphasis on the inseparable pillars of modern control systems, safety and cybersecurity. It dedicates substantial time to Safety Instrumented Systems (SIS) based on the IEC 61511 standard and addresses the growing threat of cyber-attacks on operational technology. This forward-looking approach ensures participants are prepared not only for today's operational demands but also for the future integration of IIoT, data analytics, and digital twin technologies. The focus is less on specific vendor tools and more on the universal principles and strategic thinking required to design, manage, and secure robust control systems, providing a deeper, more transferable skill set.