Dynamic Simulation for Process Safety and Control Systems Training Course

28 Dec 2026 - 01 Jan 2027

Cape town

4600 € (Per Person)

Ref: #ACE1877_296256

Course Introduction / Overview:

This intensive training course provides a comprehensive exploration of dynamic simulation as a critical tool for enhancing process safety and optimizing control systems in modern industrial environments. In an era where operational margins are tight and safety regulations are increasingly stringent, moving beyond traditional steady-state analysis is no longer an option but a necessity. This course, offered by BIG BEN Training Center, bridges the gap between process engineering, safety management, and control system design. Participants will learn to build, run, and interpret dynamic models to predict plant behavior during transient conditions such as startups, shutdowns, and emergency scenarios. Drawing upon the foundational principles of process safety advocated by experts like Trevor Kletz, we will delve into practical applications for hazard identification, risk assessment, and the validation of safety instrumented systems (SIS). The curriculum is designed to be highly practical, referencing concepts from seminal texts like "Lees' Loss Prevention in the Process Industries" to ensure a robust theoretical and applied understanding. This program empowers professionals to proactively identify potential failures, design more resilient control strategies, and ultimately prevent catastrophic incidents, ensuring both operational excellence and the highest standards of safety.

Target Audience / This training course is suitable for:

- Process Safety Engineers.
- Control Systems and Automation Engineers.
- Chemical and Process Engineers.
- Instrumentation and Control Technicians.
- Plant and Operations Managers.
- HSE (Health, Safety, and Environment) Professionals.
- Technical Safety Specialists.
- Project Engineers involved in plant design and modification.
- Lead Operators and Shift Supervisors.
- Engineers in training and recent graduates in relevant fields.

Target Sectors and Industries:

- Oil and Gas (Upstream, Midstream, and Downstream).
- Petrochemicals and Refining.
- Chemical Manufacturing (including specialty and fine chemicals).
- Pharmaceutical and Biotechnology Industries.
- Power Generation and Utilities.
- Pulp and Paper Manufacturing.
- Food and Beverage Processing.
- Governmental bodies and regulatory agencies overseeing industrial safety.
- Engineering, Procurement, and Construction (EPC) companies.

Target Organizations Departments:

- Process Engineering and Design.
- Operations and Production.
- Health, Safety, and Environment (HSE).
- Control Systems and Automation.
- Maintenance and Reliability.
- Technical Safety and Loss Prevention.
- Research and Development (R&D).
- Project Management and Engineering.
- Asset Integrity Management.

Course Offerings:

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

- Develop and validate high-fidelity dynamic models of key process units.
- Analyze transient process behavior during startup, shutdown, and upset conditions.
- Utilize dynamic simulation for robust HAZOP and LOPA studies.
- Design, test, and verify Safety Instrumented Systems (SIS) and their logic.
- Optimize PID controller tuning and advanced process control strategies for safety.
- Model and size pressure relief systems and flare networks accurately.
- Evaluate the impact of human factors on process safety through simulation.
- Conduct quantitative risk assessments based on dynamic simulation outputs.
- Implement alarm management philosophies validated by dynamic scenarios.
- Create effective operator training simulators (OTS) for critical procedures.

Course Methodology:

The training methodology at BIG BEN Training Center is designed to be immersive, engaging, and highly practical, ensuring that participants can immediately apply their new skills in the workplace. This course moves beyond traditional lectures by integrating hands-on simulation workshops where participants will build and test their own models. We employ a blended learning approach that combines expert-led instruction with interactive group discussions, allowing for the exchange of ideas and experiences. A cornerstone of the program is the extensive use of real-world case studies, analyzing major industrial incidents to understand the role that dynamic events and control system failures played. Participants will work in teams on collaborative projects, simulating complex scenarios to design and validate safety measures. This fosters critical thinking and problem-solving skills. Continuous feedback is provided by the instructor throughout the sessions, and practical exercises are designed to reinforce theoretical concepts. The learning environment is structured to encourage active participation, ensuring a deep and lasting understanding of dynamic simulation for process safety and control.

Course Agenda (Course Units):

Unit One: Fundamentals of Dynamic Simulation and Process Safety

- Introduction to Dynamic vs. Steady-State Simulation.
- Core Principles of Process Safety Management (PSM).
- Thermodynamic Property Packages and Physical Data.
- Introduction to Process Modeling and Simulation Environments.
- Fundamentals of Hazard Identification (HAZID) and HAZOP.
- Governing Equations for Mass, Energy, and Momentum Balances.
- Building a Simple Dynamic Model: A CSTR Case Study.

Unit Two: Modeling Core Process Equipment and Reactions

- Dynamic Modeling of Heat Exchangers and Furnaces.
- Simulating Distillation Columns and Absorption Towers.
- Modeling Centrifugal and Positive Displacement Pumps and Compressors.
- Dynamic Behavior of Chemical Reactors (Batch, CSTR, PFR).
- Incorporating Reaction Kinetics and Heat of Reaction.
- Phase Equilibria and Multiphase Flow Dynamics.
- Validating Equipment Models against Plant Data.

Unit Three: Simulation of Process Control and Instrumentation

- Fundamentals of Feedback and Feedforward Control.
- Modeling and Tuning PID Controllers for Dynamic Performance.
- Simulating Control Valves, Sensors, and Transmitters.
- Implementing Advanced Process Control (APC) Strategies.
- Cascade, Ratio, and Split-Range Control Simulation.
- Developing and Testing Control Philosophies for Complex Processes.
- Analyzing Control Loop Interaction and Decoupling Strategies.

Unit Four: Advanced Safety Analysis with Dynamic Simulation

- Modeling Overpressure Scenarios and Emergency Depressurization.
- Dynamic Sizing and Validation of Pressure Relief Valves (PRVs).
- Simulating Flare and Vent System Dynamics.
- Quantitative Risk Assessment using Dynamic Simulation.
- Validating Safety Instrumented Systems (SIS) and Logic Solvers.
- Layer of Protection Analysis (LOPA) in a Dynamic Context.
- Simulating Emergency Shutdown (ESD) System Response.

Unit Five: Human Factors, Operator Training, and Advanced Applications

- Introduction to Operator Training Simulators (OTS).
- Developing Scenarios for Abnormal Situation Management.
- Dynamic Simulation for Alarm Management and Rationalization.
- Integrating Human Factors and Operator Response into Models.
- Procedure Validation for Startup, Shutdown, and Emergency Operations.
- Troubleshooting and Debottlenecking using Dynamic Models.
- Future Trends: Digital Twins for Process Safety and Operations.

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:

Beyond regulatory compliance, how can dynamic simulation be leveraged to foster a proactive and deeply ingrained safety culture within an organization, and what are the primary barriers to its widespread adoption?

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

This course distinguishes itself by holistically integrating the often-siloed disciplines of process control and process safety under the unifying framework of dynamic simulation. Unlike programs that focus on either control theory or safety regulations in isolation, this training provides a synergistic view, demonstrating how robust control strategies are fundamental to inherent safety and how safety systems must be designed with a deep understanding of process dynamics. Our approach is intensely practical, moving participants beyond theoretical knowledge to hands-on application through extensive simulation workshops. We emphasize the analysis of real-world industrial incidents, using dynamic simulation to deconstruct catastrophic failures and reveal critical lessons in prevention. Furthermore, the curriculum is forward-looking, dedicating significant attention to the development of Operator Training Simulators (OTS) and the integration of human factors—critical components for building resilient operational teams. By focusing on the "why" behind process behavior during transient conditions, the course equips professionals with the advanced analytical skills to not just meet safety standards, but to fundamentally design and operate safer, more reliable, and more efficient processes.