Analysis of Modern Power Systems: Stability, Quality, & FACTS Training Course

Ref: #ERE3178

Course Introduction / Overview:

The "Analysis of Modern Power Systems: Stability, Quality, & FACTS" training course is a comprehensive program offered by BIG BEN Training Center. It is designed to equip professionals with the knowledge to manage the complexities of today's electrical networks. The course focuses on three critical aspects of modern grids: stability, power quality, and Flexible AC Transmission Systems (FACTS). A key academic reference for this field is the book "Power System Stability and Control" by Prabha Kundur, which provides foundational principles for understanding grid dynamics. We will explore a range of topics, including the impact of distributed generation on system stability, the identification and mitigation of power quality issues like voltage sags and harmonics, and the application of FACTS devices to enhance power flow control. Participants will learn how to analyze the dynamic behavior of power systems, diagnose common grid disturbances, and apply modern solutions to ensure reliable and efficient operation. This course covers everything from transient stability and voltage stability to power factor correction and harmonic filtering. The curriculum is meticulously designed to bridge theory and practice, providing professionals with the skills needed to address the challenges of integrating new technologies while maintaining grid integrity. This training is essential for anyone working to optimize performance and ensure the resilience of modern electrical power systems.

Target Audience / This training course is suitable for:

- Power system engineers and planners.
- Grid operators and dispatchers.
- Electrical engineers.
- Researchers and academics in the power sector.
- Consultants specializing in grid studies.
- Technical managers in electric utilities.
- Government agencies and regulatory personnel.
- Professionals involved in power quality audits.

Target Sectors and Industries:

- Electric utilities and power companies.
- Transmission system operators.
- Renewable energy generation.
- Heavy industries and large commercial consumers.
- Energy consulting firms.
- Government and regulatory bodies.
- Research and development institutions.
- Manufacturing of power equipment.

Target Organizations Departments:

- Grid planning and analysis departments.
- Operations and control centers.
- Engineering and design departments.
- Research and development departments.
- Technical services and maintenance.
- Asset management.
- System studies and protection.
- Regulatory compliance departments.

Course Offerings:

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

- Analyze power system stability and its various forms.
- Evaluate the impact of disturbances on grid stability.
- Assess and improve power quality parameters.
- Identify and mitigate voltage sags and swells.
- Design solutions for harmonic filtering and reactive power compensation.
- Understand the functionality and application of FACTS devices.
- Model and simulate power system dynamics.
- Apply practical solutions to enhance power transfer capability.
- Implement control strategies to maintain system security.
- Diagnose common power system problems and propose effective solutions.

Course Methodology:

This training course uses a project-based and interactive approach to ensure a deep understanding of modern power systems. The methodology combines expert-led presentations with a strong focus on practical application. Participants will engage in case studies that simulate real-world scenarios, such as a large-scale power outage or a severe power quality issue at a facility. We will use system modeling and simulation software to demonstrate how different factors affect power system stability and quality. These exercises allow participants to test various solutions and observe their impact in a controlled environment. The program encourages teamwork and group discussions, which help professionals share experiences and learn from diverse perspectives. We will also incorporate a series of interactive sessions where participants can apply what they have learned to solve complex problems, such as designing a FACTS device for a specific grid enhancement. The course includes continuous feedback and Q&A sessions, ensuring all participants can master the material. This hands-on, practical approach, offered by BIG BEN Training Center, ensures that participants are not only familiar with the concepts but also have the skills to apply them confidently in their professional roles.

Course Agenda (Course Units):

Unit One: Power System Stability Fundamentals

- Introduction to power system stability.
- Types of stability: transient, voltage, and rotor angle.
- Impact of power system faults and disturbances.
- Synchronous machine modeling and dynamics.
- Small-signal and large-signal stability analysis.
- Factors affecting stability.
- Case study: analyzing a blackout event.

Unit Two: Power Quality Assessment and Mitigation

- Introduction to power quality (PQ).
- Common PQ issues: voltage sags, swells, and harmonics.
- Causes of power quality problems.
- Power quality standards and regulations.
- Harmonic analysis and filtering techniques.
- Power factor correction.
- Measurement and monitoring of power quality.

Unit Three: Principles of Flexible AC Transmission Systems (FACTS)

- Introduction to FACTS controllers.
- Series and shunt compensation principles.
- Static VAR compensator (SVC) and its applications.
- Thyristor controlled series capacitors (TCSC).
- Static synchronous compensator (STATCOM).
- Unified power flow controller (UPFC).
- Role of FACTS in power flow control and stability.

Unit Four: Modeling and Simulation of Modern Power Systems

- Overview of power system modeling.
- Dynamic and transient stability studies.
- Power flow and short-circuit analysis.
- Simulation tools for power system analysis.
- Modeling of FACTS devices and their controls.
- Interpreting simulation results.
- Practical examples using modeling software.

Unit Five: Solutions for Grid Resilience and Future Trends

- Integrating renewable energy and its impact on stability.
- Advanced control systems for grid stability.
- Role of energy storage in power systems.
- Future of FACTS technology.
- Cybersecurity for modern power grids.
- Resilience planning for critical infrastructure.
- Final case study: designing a solution for grid stability using FACTS.

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:

In what ways will the increasing decentralization of power generation and the rise of demand-side management transform the traditional role of FACTS devices and power quality solutions in maintaining grid stability?

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

This training course stands out by bringing together three crucial and interconnected topics: power system stability, power quality, and Flexible AC Transmission Systems (FACTS). While other courses may focus on just one of these areas, this program provides a holistic view of the challenges and solutions in modern power grids. The curriculum is meticulously structured to connect the theoretical principles of grid dynamics with the practical application of FACTS devices to solve real-world problems. Participants will not only learn about stability concepts, but also how specific power quality issues, such as harmonics, can impact stability. The course also goes beyond theory by using a project-based methodology. Participants will gain practical experience in modeling, simulation, and analysis, which are essential skills for diagnosing and solving complex grid problems. The training is also forward-looking, covering topics like the role of renewable energy and energy storage in affecting system dynamics. This comprehensive, integrated, and practical approach ensures that professionals will leave the course with a deep understanding and the ability to apply their knowledge to enhance the performance, reliability, and resilience of any electrical power system.