MERCURY

Automatic Voltage Regulator and Adjustment

13 – 17 June 2027
Cairo (Egypt)



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Ref: 121354_1029118 **Date:** 13 – 17 June 2027 **Location:** Cairo (Egypt) **Fees:** 4000 Euro

Introduction

The Automatic Voltage Regulator and Adjustment course provides participants with a theoretical understanding of voltage regulation systems used in power generation and electrical networks. It explores how automatic voltage regulators maintain voltage stability, protect equipment, and enhance system reliability under varying operating conditions. It addresses fundamental principles, system components, and control mechanisms that govern voltage regulation in generators and power systems. Participants will examine adjustment methods, performance characteristics, and coordination with excitation systems. The program emphasizes fault conditions, stability issues, and operational challenges associated with voltage control. They will possess structured knowledge to analyze, evaluate, and optimize AVR performance in real-world electrical environments.

Targeted Groups

This Automatic Voltage Regulator and Adjustment training targets professionals seeking specialized knowledge and skills:

- Electrical engineers working in power generation facilities.
- Maintenance engineers are responsible for generator control systems.
- Power plant operators manage voltage stability.
- Technicians involved in excitation and control systems.
- Engineers in transmission and distribution utilities.
- Commissioning engineers for generators and alternators.
- Technical supervisors in industrial power plants.
- Professionals preparing for advanced power system roles.

Course Objectives

Participants will achieve the following objectives by completing the Automatic Voltage Regulator and Adjustment course:

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- Understand the purpose and role of automatic voltage regulators in power systems.
- Explain voltage control principles in synchronous generators.
- Identify key components and functional blocks of AVR systems.
- Analyze voltage regulation performance under steady-state conditions.
- Examine dynamic response during load changes and disturbances.
- Understand excitation systems and their interaction with AVRs.
- Interpret control modes and feedback mechanisms used in AVRs.
- Evaluate standard adjustment parameters and their impact on stability.
- Assess the effects of improper AVR settings on generator operation.
- Understand voltage droop, compensation, and reactive power sharing.
- Analyze system behavior during faults and abnormal conditions.
- Develop theoretical skills to optimize voltage regulation strategies.

Targeted Competencies

Participants will gain the following competencies during the program:

- Ability to explain AVR operating principles clearly.
- Competence in identifying AVR components and control loops.
- Skill in analyzing voltage regulation characteristics.
- Understanding of excitation system coordination.
- Ability to evaluate voltage stability issues theoretically.
- Knowledge of adjustment parameters and their effects.
- Competence in interpreting AVR performance curves.
- Awareness of protection and limitation functions.
- Ability to assess operational risks related to voltage control.

Studying Scenarios

In this training, participants will develop their skills through the analysis of the following scenarios:

- Generator voltage instability during sudden load variation.
- Improper AVR adjustment is causing hunting and oscillations.
- Reactive power imbalance between parallel generators.
- Voltage collapse due to excitation system limitations.
- AVR response during short-circuit and fault conditions.
- Coordination issues between AVR and power system stabilizers.

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Course Content

Unit 1: Fundamentals of Voltage Regulation

- Definition and purpose of voltage regulation in power systems.
- Importance of voltage stability for electrical equipment.
- Basic principles of synchronous generator voltage control.
- Relationship between excitation current and terminal voltage.
- Causes of voltage fluctuations in power networks.
- Role of automatic voltage regulators in modern power plants.

Unit 2: Automatic Voltage Regulator System Components

- Overview of AVR system architecture.
- Sensing and measurement elements for voltage detection.
- Error detection and comparison circuits.
- Amplification and control stages in AVR systems.
- Excitation system interfaces and power stages.
- Feedback paths and signal conditioning methods.
- Digital and analog AVR system distinctions.

Unit 3: AVR Operating Modes and Control Characteristics

- Manual and automatic control modes.
- Voltage control and reactive power control modes.
- Droop characteristics and load sharing concepts.
- Line drop compensation principles.
- Stability and transient response characteristics.
- Dynamic behavior during load changes.
- Control limits and saturation effects.

Unit 4: Adjustment and Tuning of Automatic Voltage Regulators

- Purpose of AVR adjustment and tuning.
- Voltage set-point selection and calibration.
- Gain adjustment and sensitivity control.
- Stability margins and damping considerations.
- Impact of adjustment on generator performance.
- Common adjustment errors and their consequences.
- Coordination with excitation and protection systems.
- Theoretical evaluation of tuning effectiveness.

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Unit 5: Performance Analysis, Faults, and Operational Challenges

- AVR performance under normal operating conditions.
- Behavior during short circuits and system faults.
- Limitation functions and protective features.
- Interaction with power system stabilizers.
- Voltage regulation challenges in parallel operation.
- Effects of system disturbances on voltage control.
- Analysis of instability and corrective strategies.
- Best practices for maintaining reliable voltage regulation.

Final Insights & Key Takeaways

Automatic voltage regulators play a critical role in ensuring voltage stability, system reliability, and efficient power generation. A strong theoretical understanding of AVR operation and adjustment enables professionals to analyze system behavior and support safe, stable electrical network performance.