



Arabian Institute For Training

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# Generator Excitation Systems

## INTRODUCTION

- This Generator Excitation Systems training seminar has been developed for the participants to learn new skills associated with Generator systems and refresh their previous skills and training, to further advancement of knowledge.
- The successful operation of any Generating Systems ultimately depends on how well the inspection, testing, maintenance and troubleshooting functions are carried out. Well-developed procedures and planning will in the long run result in reduced costs, equipment down time, parts requirements and troubleshooting complexity.

This training seminar will highlight:

- Power Generator Systems
- Excitation Modes and Characteristics
- Voltage Control and Governors
- Generator Transformers
- Synchronization Techniques
- Generator Circuit Breakers
- Common Generator Faults
- Maintenance and Online Monitoring of Alternators
- Delegates are encouraged to participate by active involvement in group discussions, practical exercises and sharing experiences.

## OBJECTIVES

At the end of this training course, you will learn to:

- Elaborate on different types of power system generation
  - Discuss operations of the steam and gas turbines
  - Examine different types excitation systems
  - Explore different types of switch gear associated with generator systems
  - Identify automatic voltage regulating techniques and governors
  - Describe troubleshooting techniques and online monitoring
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## TRAINING METHODOLOGY

- In this Generator Excitation Systems training course, each participant will receive an electronic copy of the comprehensive training seminar notes. The presenter will outline and discuss the topics using computer displays and videos. This Electrical Engineering training course is designed to have an interactive format to maximize delegate participation. Questions and answers are encouraged throughout and at the daily sessions.
- Case studies and examples will be discussed in problem solving workshop sessions. This gives participants the opportunity to discuss with other delegates and the presenter their specific problems and appropriate solutions. Only minimum note taking is encouraged to ensure maximum delegate attention during this training course.

## ORGANISATIONAL IMPACT

Upon completion of the course the organizational impact would be:

- Current practices onsite can be reviewed (and changed) to bring the workplace up to current standards
- Engineers and Technicians can gain knowledge to apply in their individual work roles so that they can understand current procedures and practices, should their work role not be a fully 'hands-on' role
- Updating of technical skills and Standards from previous learning
- Technicians, Engineers and Managers will be able to apply current work practices, for compliance with legislation
- All candidates will be made aware of upcoming changes to practices and legislation, so that they can be pro-active in their work roles and implement the changes quickly and efficiently
- Candidates can progress onto further Power related training seminars, which can provide

## PERSONAL IMPACT

On successful completion of this training programme, delegates will be able to:

- Develop a systematic approach to the construction and operation of a turbo generator system
  - Maintain a continuing understanding of test equipment used for electrical inspection and servicing
  - Better understand the design, functionality of the excitation systems, automatic voltage regulator and governors
  - Understand the operations and component functions of a generator transformer
  - Utilize single-line diagrams and schematics for troubleshooting
  - Better understand standard work practices plus develop job plans, which assist in successful inspection and troubleshooting
  - Be aware of the importance of maintenance and safety
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## WHO SHOULD ATTEND?

This training programme is suitable to a wide range of professionals but will greatly benefit:

- Electrical Engineers
- Electrical Supervisors
- Electrical Technicians
- Electrical Project Engineers
- Electrical Power Engineers

## Course Outline

Definitions, Communications Protocols, Interpretation and Use of Drawings, Maintenance Planning and The Use of Test Equipment

- Generator Systems AC and DC Components
- Operation and Maintenance of Generator Systems
- Thermal Power Generation and Combine Cycle Power Plant
- Synchronous Machine Stator Construction and Characteristics
- Synchronous Machine Rotor Construction and Characteristics
- Instrumentation Associated with Generator Systems
- Single Line Diagrams
- IEC 61850 and GOOSE

The Methods of Generator Excitations and Importance of Reactive Power

- Functions and Construction of the Automatic Voltage Regulator (AVR)
- Digital Voltage Regulator for Generators
- Functions and Construction of the Governors
- Permanent Magnets Generators
- Over Fluxing and Types of Excitation Systems
- Self-excitation vs. Brushless
- Effects of Over & Under Excitation
- Reactive Power Relationship to Excitation

Economical and Mechanical Impacts on Over and Under Excitation Control Systems

- Control Systems for Excitation
  - Impact of Over & Under Excitation
  - Importance of The Capability Curve and P Q diagrams
  - Interpreting The Capability Curve
  - Capability Curve Software
  - Generator Stator Thermal Effects
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## The Generator Circuit Breaker ARC Extinction, Operation of Generator Step Up Transformer and Power Monitoring

- Generators Circuit Breaker Construction
- Vacuum and Gas Filled Generator Circuit Breakers Characteristics and Arc Extinction
- Construction of Power Transformers
- Generator Step Up Transformer (GSU)
- GSU Selection Criteria
- Power Monitoring
- Load Frequency Control
- Optimisation of Generator Output Related to Speed, Frequency and Excitation

## Common Generator Faults, Numerical Protection Relays Functionalities and Synchronisation

- Numerical Relay Functionalities Related to Generator Protection
- Generator Earth Fault Relays
- Causes of Phase Imbalance
- Synchronisation Generator Conditions and Merits
- Common Generator Problems
- Cooling of Generators
- Online Monitoring of Generators
- Wrap-up Session



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