

# POWER GENERATION OPERATION, PROTECTION AND EXCITATION CONTROL

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27 Feb - 2 March 2012 Kuala Lumpur, Malaysia



Expert Course Faculty  
**Michael Kelly**

Organised By  
**powerEDGE®**



# POWER GENERATION OPERATION, PROTECTION AND EXCITATION CONTROL

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## Course Overview

This course is designed to give delegates an understanding of the factors to be considered within the area of power generation. The course covers generator theory, operation, protection and application, and troubleshooting. Different excitation systems, prime movers and generator earthing systems generator voltage and frequency control are included. In addition, condition monitoring and maintenance is also examined and explained.

## Course Learning Outcomes

- Explore the different prime movers used for generators
- How to control frequency and voltage
- Examine the earthing system for generators
- Explore different protection needed for generators
- Understand condition monitoring, data collection and routine maintenance for generators
- Develop an understanding of the factors with regard to load calculation, acceptance, rejection, shedding and sharing
- Gain knowledge of synchronisation methods and conditions
- Develop an understanding of power factor calculations and power factor correction
- Understand voltage drop and short circuit calculations
- Learn data collection techniques employed in major power generation equipment

## Who Should Attend

- Electrical engineers
- Plant engineers and instrument technicians
- Operations technicians
- Electrical maintenance technicians and supervisors
- Instrumentation and control system engineers

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## 5 Day Course Outline

### PRINCIPLES OF A.C. GENERATION

1. Principles of alternating and rotating
2. Magnetic fields
  - Peak, Rms and Mean Values
  - Vectors (or Phasors)
  - Faraday's Law of Electromagnetic Induction
  - A.C. Generators
- 3-Phase A.C. Generators
  - Star and Delta Connections
  - Drawing of Star- and Delta-Connected Apparatus

### I- GENERATOR CONSTRUCTION AND EXCITATION

1. General
  - Rotor construction
  - Insulation
  - Cooling
  - Excitation and voltage control
  - Insulated bearings
2. Generator Excitation and Voltage Control

### II- PRIME MOVERS

- Turbines

### DIESEL GENERATOR SETS

### III- GENERATORS EARTHING

1. Introduction
2. Equipment Earthing
3. System Earthing
4. Classification Of Supply / Installation System Earthing
  - Earthing via Neutral Earthing Compensator
  - Distribution Transformers
  - Zig Zag Transformers
  - Evaluation of Earthing methods

### IV- GENERATOR VOLTAGE AND FREQUENCY CONTROL

1. Reactive Power and Voltage Control
2. Voltage Control of Generator Loading At Synchronizing
3. Frequency Control of Generators Loading At Synchronizing

### V- GENERATOR OPERATION

1. Synchronising of Generators
2. Load Shedding
3. Power Factor

### VI- GENERATOR PROTECTION

- Generator Connections and Overview of Typical Protection
- Stator Phase-Fault Protection for All Size Generators
- Phase Protection for Small Generators That Do Not Use Differentials
- Phase-Fault Backup Protection (51v) Or (21)
- Stator Ground-Fault Protection Ground -Fault Protection for Single Medium Or Small Wye -Connected
- Ground -Fault Protection for Very Small , Solidly Grounded Generators
- Generator Off-Line Protection
- Reduced or Lost Excitation Protection (40)
  - ❖ Generator Protection for System Disturbances And Operational Hazards
  - ❖ Cogeneration and Non-Utility "Distributed" Generation Protection
  - ❖ Generator Operation under Contingency Conditions
  - ❖ Shaft Current
  - ❖ Typical Generator Protection Schemes of Various Ratings

### VII- CONDITION MONITORING AND DATA COLLECTION

- Introduction
- Approaches Based on Mathematical Models
- Reliability Centered Maintenance (RCM)
- Condition Based Maintenance (CBM)
- Partial Discharge
- Insulation Resistance Monitoring

### DC HI-POT TEST

- Maximum Allowable Test Voltage
- MEASURING INSULATION DEGRADATION
  - ❖ Capacitive Charging Current
  - ❖ Resistive Leakage Current
  - ❖ Energy Dissipated
- Insulation Power Factor
  - ❖ Insulation Power Factor Standards
  - ❖ Power Factor Test Sets
  - ❖ Outage for Scheduled Maintenance
  - ❖ On Line Measuring Partial Discharge Activity For Insulation

### THE ERA OF Intelligent Electronic Devices " IED " To collect Data

### VIII- Generator Maintenance

- Preventative Maintenance
  - ❖ Trouble Shooting
  - ❖ General Procedure
  - ❖ Generator Does Not Produce Voltage
  - ❖ Generator Produce Low Voltage
  - ❖ Generator Produce High Voltage
  - ❖ Generator Voltage Fluctuating
  - ❖ Fault analysis for Generator Control Circuit

Case Studies, Group Exercises, Group Discussions, Last Day Review & Assessments will be carried out.

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## Your Expert Faculty: Michael Kelly



Michael Kelly has over thirty five years experience in a technical capacity. Between 1983 and 1986 he worked for ABV Sweden/ Project 624 Iraq as an Electrical Test Engineer, and later as a Project Manager at F.G.Wilson Engineering ( a division of Caterpillar, USA) and in 1986 became Managing Director of MAK Engineering Services Ltd.

He possesses a BSC in Electrical Engineering and also a Full Technological Certificate in Electrical Engineering. He has travelled extensively and has been in Saudi Arabia, Iraq and Iran. Recently in addition to running his own consultancy, he has carried out many training courses for in Libya for CTS and in Abu Dhabi for GASCO and ADCO.

He has been delivering Instrumentation and Electrical courses in Oman and Saudi Arabia for various Oil and Power Companies. He has been delivering UPS and Power System Courses for PDOC and GNPOC in Sudan and involved in the tendering for Power System for Khartoum airport. He is a member of MIEIE, MFSB and the Londonderry Chamber of Commerce.

## You may also be interested in the following training courses:

January	Date	Level	Venue
Maintenance of Electrical Equipment in Oil & Gas Installations with Jim Wardhaugh	16 - 18	Basic	Kuala Lumpur
February	Date	Level	Venue
Introduction to Power Systems	20 - 24	Basic	Singapore
Reliability Centered Maintenance	27 Feb – 2 March	Basic - Intermediate	Kuala Lumpur
March	Date	Level	Venue
Fundamentals of Power Generation for Non-technical Professionals	26 - 28	Basic	Kuala Lumpur
Gas Turbine Operations – Simulator Based	26 – 30	Basic	Bangkok
Operations of Coal Fired Plants	26 – 30	Basic	Kuala Lumpur

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## REGISTRATION FORM

	Early Bird Ends 10 Jan 2012	Normal	Savings
5 Day Programme	SGD \$3799	SGD \$3999	SGD \$200

## 4 ways to Register

- Online: [www.poweredgeasia.com](http://www.poweredgeasia.com)
- Email: [info@poweredgeasia.com](mailto:info@poweredgeasia.com)
- Phone: (65) 6747 0775
- Fax: (65) 67478737

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## You may also be interested in

- ✓ Introduction To Clean Coal Technology
- ✓ Introduction to Power Systems
- ✓ LNG Fundamentals
- ✓ Fundamentals of Power Generation

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