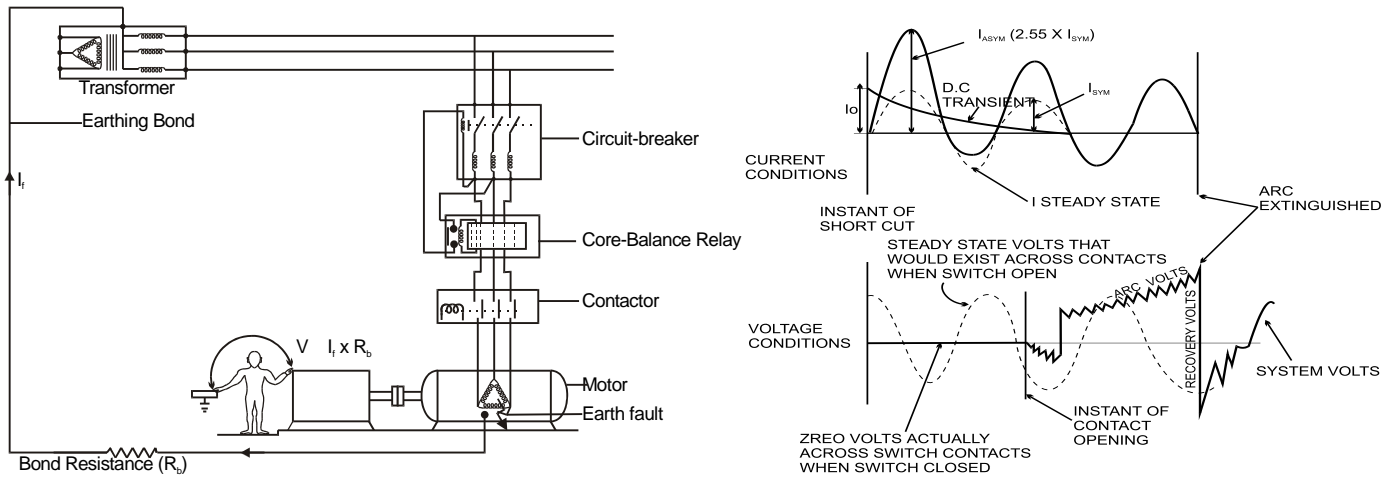




Technology Training that Works

# Electrical Power System Fundamentals for Non-Electrical Engineers



## 4 hour live, practical online course

### YOU WILL LEARN:

- The basics of electrical power engineering
- Basic electrical design rules
- Practical steps in selection, installation and commissioning of electrical systems
- How to work more effectively with electrical engineering professionals

### WHAT'S INCLUDED?

- Four 50 minute live, practical sessions with your instructor and attendees
- The full technical eBook manual for "Electrical Power System Fundamentals for Non-Electrical Engineers" which includes course slides, cases studies, calculations and practical exercises
- Four hours of additional in-depth video sessions covering many additional areas – yours to keep and watch any time you want



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## THE COURSE

This course will focus on the building blocks of electrical engineering, the fundamentals of electrical design and integrating electrical engineering know-how into the other disciplines within an organisation. Unnecessary theory will be minimised and you will focus on best practice over the duration of the course.

The course will begin by reviewing basic electrical circuits and electrical laws. You will then be exposed to the basic principles of electrical generation, transmission and distribution. Electrical distribution will then be covered in considerably more detail.

The interesting area of electrical measurements, as applied to single phase and three phase systems, will then be reviewed. You will be exposed to earthing with a strong focus on safety issues. Transformers will then be examined with an emphasis on power transformers as used in the electrical distribution industry. The session will be concluded with coverage of power system components in terms of isolators, fuses and circuit breakers.

The next session will commence with an examination of AC and DC motors. The power hungry topic of electrical heating and cooling in industry is then examined. The impact, especially in the modern world of power electronics, is discussed with a demonstration of the possible unpleasant harmonics arising from using this powerful technology. This then smoothly leads into the topic of dealing with power quality. The last three major topics are electrical power system protection, electrical safety and customer installations. The penultimate topic of great interest to executive management in a company (and indeed municipalities and governments) is load forecasting.

The course is concluded with modern developments such as substation automation, the smart grid, industrial data communications and the still controversial topic of carbon trading.

## ONLINE COURSE PRESENTER



**Behrouz Ghorbanian - BSc, MSc, MIEAust**

Behrouz has completed degree courses in Telecommunications and Electrical Engineering overseas. He also completed his studies in Electrical Utility Engineering at Curtin University in 2004.

Behrouz started his career in the oil and gas industry where his role got him involved in the maintenance and repair of electronic and navigational marine equipment (VHF and SSB radios, Sat Nav, engine control panels etc). He then moved to the power industry and was involved in the design, installation, and commissioning of substations mainly for consultancies and utilities. He has also established a good reputation in teaching power system protection over his long term services lecturing at Curtin University, and also over the period he worked as a Protection Engineer in New Zealand.

Over the past years, Behrouz has been involved in many major projects across Australia (Port Hedland, Barrow Island, Tamar Valley, Karratha, and Newman for example). His most recent experience is related to cost estimation and risk assessment of major substation projects with a special focus on the secondary systems (Protection, COMMS, SCADA). He has also worked as an Engineering Manager and Senior Project Engineer on major copper mine projects overseas.

Behrouz has also gained good knowledge in substation design, HV cables sizing and installation, transmission system design, earthing system design and applications, and power system protection design and applications.



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## **WHO SHOULD ATTEND?**

- Administration staff
- Civil, mechanical, chemical, mining engineers, technologists and technicians
- Electrical contractors
- Finance, IT and accounting managers
- Human resources managers
- Managers who are involved with or work with staff and projects in electrical engineering
- Non-electrical engineers and technicians
- Non-electrical personnel who want to understand the broader picture
- Plant and facility engineers
- Procurement and buying staff
- Project managers
- Sales engineers

## **PRE-REQUISITES:**

No formal electrical education is required as everything is examined from a fundamentals and practical point of view. As such, this is certainly not an advanced course but one focusing on the fundamentals using basic maths to ensure you quickly understand the key concepts.

## **CONTENT SUMMARY**

### **INTRODUCTION**

*This is an intensive four (4) hour presentation; we will be emphasising sections marked in **BOLD** below. Full recordings will be provided for the lower intensity sessions (another four hours of video as detailed below) to review after the course.*

### **LIVE SESSION**

#### **SESSION ONE**

#### **OVERVIEW OF THE ELECTRIC POWER SYSTEMS**

- A brief historical perspective
- Overview of course

#### **BASIC CONCEPTS**

- Units and electrical quantities
- Voltage, current, resistance, power, energy, frequency
- Inductance and capacitance
- Ohm's law, rms and average values
- Single and three phase systems
- Power factor

#### *Pre-recording 1:*

##### – **ELECTRICAL GENERATION, TRANSMISSION AND DISTRIBUTION**

- |                               |                                   |
|-------------------------------|-----------------------------------|
| ○ Various forms of energy     | ○ Distribution                    |
| ○ Energy conversion           | ○ Power demand and tariffs        |
| ○ Modern power station        | ○ Power factor                    |
| ○ Coal-fired power plant      | ○ HVDC                            |
| ○ Hydro and nuclear           | ○ Power source                    |
| ○ Impact on environment       | ○ Typical electrical power system |
| ○ Solar, wind, geothermal     | ○ Electrical distribution systems |
| ○ Transmission of electricity | ○ Substations                     |



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- Step down transmission
- Distribution feeder circuits
- Switches and circuit breakers
- Industrial and residential customers
- Distribution substation
- Types – radial, loop, network
- Network reliability (outages/power interruptions)
- Power transformers and distribution boards

## **SESSION TWO**

### **ELECTRICAL MEASUREMENTS AND APPLICATIONS**

- Electrical parameters – W/VA/VAr
- Measuring
- Power and energy measurement
- Smart metering
- Measuring voltages, currents and resistance

### **TRANSFORMERS**

- Magnetic fields
- Electromagnetic fields
- Transformer operation
- Step down and step up
- Construction
- Single and polyphase transformers
- Cooling
- Oils and coolants
- Efficiency
- Tap changers
- Voltage regulation
- Earthing of transformers

### **ISOLATORS, FUSES AND CIRCUIT BREAKERS**

- Isolation
- Electrical faults
- Fuses
- Isolation, switching, tripping
- Circuit breakers
- Components of circuit breakers
- Medium voltage circuit breakers

#### *Pre-recording 2:*

- EARTHING
- Need for earthing
- Direct and indirect shocks
- Touch and step potential
- Types of earthing
- System and protective earthing
- Isolation
- Earth conductors and electrodes
- Measurement of earth resistance
- Lightning protection
- Bonding connection



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– ELECTRICAL ROTATING MACHINES – AC AND DC

- Basic principles
- Machines
- DC motor operation
- Speed, flux and armature voltage
- Speed control
- Single phase AC motors
- 3-phase induction motor
- Synchronous machines
- Torque versus speed
- Efficiency and power factor

**SESSION THREE**

**POWER SYSTEMS PROTECTION**

- Incipient and solid faults
- Need for protection
- Overloads
- Overvoltage and overcurrent
- Fuses, circuit breakers
- Relays
- Protection of equipment

*Pre-recording 3:*

– ELECTRICAL LIGHTING AND ILLUMINATION

- Incandescent lamps
- High intensity discharge lamps
- Mercury vapour
- Metal halide lamps
- Fluorescent lamps
- Compact fluorescent lamps
- LEDs
- Luminaire concepts
- Energy efficiency

– ELECTRICAL HEATING IN INDUSTRY

- Principles of heating
- Electrical heating
- Resistance heating
- Welding
- Electric arc furnaces
- Induction heating

– POWER ELECTRONICS AND APPLICATIONS

- Semi conductor devices
- Motor controllers
- Rectifiers
- AC motors and soft starting
- Variable speed drives



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## **SESSION FOUR**

### **ELECTRICAL SAFETY AND NATIONAL ELECTRICAL CODES**

#### **Key elements of National Electrical Codes (AS3000/NEC/CEC/SANS)**

- Electrical hazards
- Electrical shock
- Arc flash and burns
- Personal protective equipment
- Safety through better design and installation
- Work permits
- Authorisation personnel
- Training and first aid
- Legislation

### **POWER QUALITY**

- Power quality problems
- Voltage variations
- Overvoltage and undervoltages
- Voltage imbalances
- Voltage and frequency variations
- Interruptions and surges
- Lightning and harmonics
- Harmonic compensation

#### *Pre-recording 4:*

- CUSTOMER INSTALLATIONS
  - Metering and billing
  - Tariff structures
  - Connections
  
- THE ENTIRE ELECTRICAL PROJECT
  - Design rules
  - Specification
  - Procurement
  - Installation
  - Commissioning
  - Punchlist of defects
  - Contractual disputes
  - Certificate of compliance
  
- LOAD FORECASTING, PLANNING AND PROJECT EVALUATION
  - Load forecasting principles
  - Forward planning
  - Supply and demand side management
  - Evaluation of electrical projects



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– MODERN DEVELOPMENTS

- The smart grid
- Substation automation and industrial IT
- Data communications (including wireless)
- Cost of carbon/emissions trading

**SUMMARY, OPEN FORUM**

**CLOSING**