

# VARIABLE SPEED DRIVES

## OPERATION, TROUBLESHOOTING AND MAINTENANCE

**ELC027**

### COURSE DESCRIPTION

It is estimated that variable speed drives and other rotating equipment consume about 50% of the total electrical energy consumed in the world today. The cost of maintaining variable speed devices can be a significant amount in the budget item of manufacturing and mining industries. This workshop gives you a thorough understanding of variable speed device's working, maintenance and failure modes and gives you the tools to maintain and troubleshoot variable speed devices. You will gain valuable insight into the selection of the protection necessary to ensure your devices are protected against fault conditions, so as to ensure reliability and long life. Typical applications of variable speed devices in mining, manufacturing, materials handling and process control are covered in detail.

### COURSE GOAL

To enhance the participants' knowledge, skills and abilities necessary to gain a fundamental understanding of the installation, operation and troubleshooting of variable speed devices.

### COURSE OBJECTIVES

By the end of this course, participant will be able to:

- Understand the fundamentals of motor technology.
- Understand the basic principles of rotating electric machines.
- Explain the principles of speed control.
- Understand efficiency, torque, inertia, horsepower/power factor.
- Explain torque-speed curves and how the motor produces torque
- Be familiar with motor theory, construction and maintenance.
- Be familiar with the three phase AC induction motors.
- Be familiar with protective devices of Ac motors.
- Speed control of AC motors.
- Understand variable speed drives or power electronic converters.
- Explain types, and designs of variable speed drives.
- Explain how to protection AC converters and motors.
- Understand control systems for AC variable speed drives.
- Select of AC converters for variable speed drive applications.
- Install and commission of AC variable speed drives.
- Be familiar with the new technologies and developments.

## WHO SHOULD ATTEND

- Electrical engineers.
- Maintenance technicians.
- Electrical supervisors.
- Engineering professionals.
- Project engineers.

## COURSE DURATION

5 Working Days

## COURSE OUTLINES

### 1. Fundamentals of Motor Technology

- Basic Principles of Rotating Electric Machines
- Fundamental Principles of Speed Control
- Efficiency, Torque, Inertia, Horsepower/Power Factor
- Torque-Speed Curves
- How the Motor Produces Torque?
- Types of Motors

### 2. AC Motor Theory, Construction and Maintenance

- Basic Construction and Physical Configuration, Windings
- Principles of Operation and Performance

### 3. Three Phase AC Induction Motors

- Components
- Theory of Operation
- Induction Motor Design
- Duty Cycles
- Insulation and Cooling Requirements
- Starting Methods
- Selecting Motors
- Maintenance of AC Machines
- Types of Faults, Fault Finding and Testing of AC Machines
- Testing Instrumentation

#### **4. Protection of Ac Motors**

- Protective Devices
  - Thermal Overload
  - Over Current / Overload
  - Under-Voltage / Over-Voltage
  - Under Frequency
  - Current Unbalance or Negative Phase Sequence
  - Earth Fault Protection
  - Pole Slip / Out of Step
  - Loss of Excitation - Over Fluxing
  - Stall Protection / Acceleration Time / Start Up Supervision (Time Between Starts / Starts Per Hour)
  - Voltage Controlled or Restrained Over Current
- Protection Settings

#### **5. Speed Control of AC Motors**

- Introduction to Variable Speed Drives or Power Electronic Converters
- Types, And Designs of Variable Speed Drives

#### **6. Protection of AC Converters and Motors**

- Frequency Converter Protection Circuits
- Protection Settings

#### **7. Control Systems for AC Variable Speed Drives**

- Control Theory of VSDS Explained

#### **8. The Selection of AC Converters for Variable Speed Drive Applications**

- Selection Procedure
- Nature of the Load
- Selection of Correct Size Motor and Converter

#### **9. Installation and Commissioning of AC Variable Speed Drives**

- General Installation and Environmental Requirements
- Electrical Connections and Earthing Requirements
- Control Wiring and Pre-Commissioning
- Commissioning Tests

#### **10. New Technologies and Developments**