
SWITCHGEAR AND DISTRIBUTION SYSTEMS FOR ENGINEERS AND TECHNICIANS



WHAT YOU WILL LEARN:

- How to identify typical characteristics of an industrial distribution system
- Become familiar with the main components of an industrial distribution system
- Learn about the different types of distribution system equipment
- Cover aspects of electrical safety and power security

WHO SHOULD ATTEND:

This course is designed for personnel who want to understand the design and engineering principles involved in industrial distribution systems. Those who will benefit the most from this workshop include the following:

- Electrical engineers
- Project engineers
- Design engineers
- Instrumentation and design engineers
- Electrical technicians
- Field technicians
- Electricians
- Plant operators

The Workshop

Electrical supply is important in any industry. It is necessary to protect power distribution systems, equipment, motors, generators, etc. from dangerous fault conditions in an electrical supply. Hence, it is necessary to arrange the equipment so it can be switched ON or OFF under different conditions such as, no load or load conditions, or even under fault conditions. The collection of equipment used for switching and protecting purposes

in a power system is called switchgear. The most important element of good power system design is the proper selection of the distribution equipment.

The purpose of this workshop is to familiarise students with the basic concepts of a power distribution system, switchgear design and the principles of operation and applications of protection systems for the industrial electrical distribution systems.

The workshop provides an overview of the basics of industrial power distribution systems, the various components in the distribution systems, components of power system protection schemes and concludes with safety and maintenance aspects.

This workshop should be helpful for engineers and technicians in the field of electrical design or maintenance.

The Program

OVERVIEW

- Typical characteristics of an industrial distribution system
- Main components of an industrial distribution system
- Distribution system equipment
- Electrical safety and power security

COMMON DISTRIBUTION SYSTEM ALTERNATIVES

- Voltage classification
- Voltage levels in a distribution system
- Types of distribution - simple radial distribution, radial with redundant sources, radial with redundant feeds, primary loop type distribution
- Typical industrial distribution configuration
- Single and multiple incoming feeders
- Isolation arrangements
- Need for a transformer
- Imperatives of distribution without a transformer
- Voltage control in installations fed from transmission/sub-transmission circuits
- Outdoor vs. indoor arrangement

PLANNING OF POWER DISTRIBUTION SYSTEMS

- System planning - Why is it needed
- Approach
- Data needed for planning and collection of data
- Studies needed - load estimation, load flow (active and reactive), fault level, voltage profile, motor starting, harmonic power flow, relay coordination

IN-PLANT GENERATION REQUIREMENTS AND ALTERNATIVES

- Why in-plant generation?
- Engine generators as source of power
- Emergency power, standby power
- Integrating emergency sources with plant distribution
- Parallel operation of generator with external supply
- Points to note in parallel operation

TRANSFORMERS

- Basic theory
- Constructional features
- Cooling methods
- Voltage control
- Power Vs. distribution transformers
- Installation features
- Transformer protection
- Fire safety
- Troubleshooting

CIRCUIT BREAKER BASICS

- Function
- Historical development
- Principle of operation
- Major components
- Typical construction - HV circuits, MV circuits, LV circuits

MV DISTRIBUTION SWITCHGEAR

- Indoor and outdoor construction
- Comparison
- Metal clad switchgear basics
- Major components
- Safety features
- Protection

SELECTION OF CIRCUIT BREAKERS AND SWITCHGEAR AND THEIR RATINGS AND SPECIFICATIONS

- Standards
- Factors affecting circuit breaker selection
- Rated voltage
- Rated insulation level
- Rated short time withstand current
- Rated peak withstand current
- Symmetrical and asymmetrical rating
- Rated supply voltage of closing or opening devices
- Stored energy operation
- Locking and interlocking devices
- Enclosure degrees of protection

PROTECTION, PROTECTIVE RELAYS AND COORDINATION OF PROTECTION

- Need for protective apparatus
- Basic requirements of protection
- Basic components of protection
- Protection in distribution systems
- Protective relays for circuit breaker application
- Role of fuses in LV and MV distribution
- Protection integrated in LV devices
- Importance of settings and co-ordination of protective relays
- Time and current grading

POWER DELIVERY SYSTEMS - CABLES FOR POWER DISTRIBUTION

- Types and construction of cables
- Basic design and selection
- Insulating materials for LV and HV cables
- Accessories for cable installation
- Buried installation vs. open installation
- Fault detection of underground cable installations

DC SUPPLY EQUIPMENT FOR ELECTRICAL SWITCHGEAR

- Need for DC supply
- Possible alternatives to DC control
- Power source for DC supply
- Batteries-Basic principles and common types
- Battery sizing
- Battery charging
- Battery chargers-Principle and basic schemes
- Trip circuit supervision for circuit breakers
- Substation battery condition and monitoring
- Overcharging
- Measurement of contact resistance

SAFETY IN OPERATION AND MAINTENANCE OF CIRCUIT BREAKERS AND SWITCHGEAR

- Basics of electrical safety
- Electrical shock
- Touch and step potential (voltage)
- Direct and Indirect contact
- Role of electrical insulation in safety
- Avoiding electric shock-different approaches
- Earth leakage circuit breakers
- Earthing of power supply systems and its safety implications
- Role of earthing of equipment enclosures (protective earthing) in human safety
- Safety regulations and procedures

MAINTENANCE AND ASSET MANAGEMENT OF CIRCUIT BREAKERS AND SWITCHGEAR

- Asset Records
- Condition Based Maintenance (CBM)
- Reliability Centered Maintenance (RCM)
- Insulation deterioration
- Diagnostic techniques - Partial discharge, partial discharge - Transient Earth Voltage (TEV) monitoring, partial discharge testing by acoustic methods, Tan Delta testing, thermal imaging
- Problems that may be found during switchgear maintenance
- Defect management
- Examples of switchgear defects

SUMMARY, OPEN FORUM AND CLOSING