

# Advanced Circuit Breakers Operation and Maintenance

## INTRODUCTION

- This Advanced Circuit Breaker Operations and Maintenance training seminar begins with the fundamental principles of arc extinction with progression of incorporating green gas resulting in the reduction of global warming potential and reduction of carbon footprint.
- Circuit breakers play an important role in the safe distribution of electrical power. The equipment needs to be operated, maintained and installed in a safe manner securing continuity of supply to consumers. Circuit switchers have been developed to overcome some of the limitations of fusing for substation power transformers. The method of arc extinction determines the types of circuit breaker.
- Hybrid circuit breakers, and state of the art high voltage circuit breakers incorporating alternatives to sulphur hexafluoride are the more efficient and safe for the environment. Higher ratings for high voltage vacuum circuit breaker are commonly installed today.

This training seminar will highlight:

- Electric power systems are designed to be as fault free as possible through appropriate network design, equipment design, proper installation and on-going maintenance
- The Circuit breaker and its associated fault detection equipment, protective relaying, is an extremely important device, through its role of clearing short-circuit currents, disconnecting faulty elements from the power network, and thus maintaining the overall integrity of the power network
- The characteristics of hybrid high voltage circuit breaker and operations
- The introduction of new types of green gas and clean air as the state of the art arc quenching medium in high voltage circuit breakers
- Minimising downtime by proper and systematic maintenance program

## OBJECTIVES

- This Advanced Circuit Breaker Operations and Maintenance training seminar covers all aspects of conventional methods of arc extinction of circuit breakers and the state of the art green gas incorporated in the Gas Insulated Switchgear (GIS) substations. This will result in the reduction of carbon footprint characteristics which include the outdoor live tank and dead tank circuit breakers.

At the end of this training seminar, participants will learn to:

- Appreciate the importance of preventive maintenance check and servicing of the various types of circuit breakers
- Determine safe operation of the gas insulated switchgear circuit breaker and its associated components
- Develop maintenance activities and maintaining system safety
- Understand the component functionalities of the gas and vacuum circuit breakers
- Explain methods of arc extinction for live tank and dead tank circuit breakers
- Recognise the importance of installing high voltage circuit breakers with green gas and clean air arc extinction designs

## TRAINING METHODOLOGY

- This Electrical Engineering course will expose participants to the new state of the art technologies in arc extinction for high voltage circuit breakers. Active participation between trainer and delegates and also among delegates will be carried out by discussing case studies, video clips and power point presentation. Open discussions among delegates will result in formulating solutions to maintenance issues of circuit breakers.

## ORGANISATIONAL IMPACT

Upon completion of the course, the organizational impact would be:

- An understanding for the need for routine inspection and maintenance
- Using selected videos and case studies to illustrate the material being discussed
- An emphasis to ensure material is appropriate to the organisations being represented with regards to the types of circuit breakers and switchgears are installed in their premises
- An awareness and understanding of the course objectives
- Safe working practices being stressed and risk management analysis are applied when the need arises
- Exposed to the state of the art circuit breakers availability

## PERSONAL IMPACT

On successful completion of this course, delegates will be able to understand:

- The construction, the arc extinguishing principles of different types of circuit breakers currently in use and the relevance to operations and maintenance
- The micro processor operation and impact on the fault clearing and tripping process
- Expand their knowledge on the new and mandatory arc extinction replacing the Sulphur hexafluoride (SF6) gas
- The operations of high voltage gas insulated switchgear (GIS) circuit breakers
- Circuit breakers and switchgear maintenance requirements and techniques
- Understand the components of the new generation outdoor high voltage circuit breakers

## WHO SHOULD ATTEND?

- The technicians and maintenance staff will be able to comprehend the types, construction, operations, function of circuit breakers. This will enable them to carry out effective maintenance activities and ensure safe operation of the electrical installation.

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

- Electrical Managers
- Electrical Engineers
- Maintenance Technicians
- Project Engineers
- HSE Professionals

## Course Outline

### Roles of Circuit Breakers under Fault Conditions

- Distinction between Load and Fault Current
- Sources of Short-circuit Current
- Introduction to Fault Calculations
- Symmetrical and Asymmetrical Faults
- Overview of Power System Categories and with Time Current Curves
- Importance of Instrument Transformers
- Types of Protection Systems with LSIG Characteristics
- The Role and Importance of the Circuit Breaker in Power Systems

## General Principles of Arc Extinction Air, Gas and Vacuum Circuit Breakers

- Air-Break or Air Circuit Breaker
- Performance Characteristics and Arc Chute Functions
- Vacuum Circuit Breaker Design and Construction
- High Voltage Live Tank and Dead Tank Vacuum Circuit Breaker
- Maintenance and Testing Requirements for VCB
- Gas Insulated Switchgear SF6 Circuit Breaker Construction and Operations
- Substation Layouts and Merits
- Digital Substation Circuit Breakers

## Eco Efficient Gas for New Generation Circuit Breakers as Alternative to Sulphur Hexafluoride (SF6)

- Hybrid High Voltage Circuit Breakers
- Green Gas for Grid or g3 alternative to SF6
- SF6 alternative Eco Efficient Gas
- Air Plus Insulation an alternative to SF6
- Fluoroketone alternative to SF6
- 8VN1 Clean Air Insulation
- Blue GIS VCB with Clean Air Technology
- Roles of Circuit Breakers and Substation Protection

## Operations and Maintenance of SF6 Gas Circuit Breaker

- Properties of SF6
- Principles of Arc Extinction
- Features of Construction
- Insulation Principles
- Gas Leak Problems
- Specific Supervision Requirements
- Circuit Power Factor Considerations
- Maintenance and Testing Requirements

## Circuit Breaker Specifications, Testing and Maintenance Programmes

- Importance and Relevance to Specifications
- Circuit Breaker Failure and the Effects on Power System Operation
- Circuit Breaker Inspection, Testing and Maintenance Program
- The Principles of Modern Substation Control Systems
- Power Circuit Breaker Maintenance