



## Training Program:

**Power Systems Protective & Maintenance With  
Inspection, Repairs And Alterations**

[www.btsconsultant.com](http://www.btsconsultant.com)

## Introduction:

Power system protection is an essential component of all forms of electrical power systems. In practice, protective relaying is directly associated with security of supply, the reduction of damage to faulted plant, cost of energy and, most importantly, all aspects of safety. The subject is unique in requiring knowledge of all topics broadly classified under the title of electrical power engineering, including generation, utilization, maintenance and the transmission of electrical power. As a consequence it enhances an engineer's working knowledge and becomes an important asset for power system planning, operation and management.

## Who Should Attend?

This course is specially designed for (protection, operation, maintenance, testing electrical power) Engineers dealing with specification, installation, inspection, maintenance and commissioning of electrical plant

## Methodology

This interactive Training will be highly interactive, with opportunities to advance your opinions and ideas and will include;

- Lectures
- Workshop & Work Presentation
- Case Studies and Practical Exercise
- Videos and General Discussions

## Accreditation:

**BTS** attendance certificate will be issued to all attendees completing a minimum of 80% of the total course duration.

## Course Objectives:

**This course is designed to enable participants to:**

- The need for protection
- An overview of power system fault analysis
- Protection fundamentals
- Relay transducers, both current and future
- System grounding principles
- Overcurrent earth fault protection
- Coordination principles
- Transformer protection
- Generator protection
- Bus protection
- Motor protection
- Line and feeder protection

# Course Outline

## Fundamentals and Fault Analysis

- Introduction to power system protection
- Power system fault analysis
- Phase faults
- Earth faults
- Manual calculation
- Use of software
- Case study
- Protection fundamentals
- Definitions and terminology
- Unit and non-unit systems
- Wrap up session

## Transducers and Overcurrent Schemes

- Transducers
- Current transformer (CT) equivalent circuit
- CT specification
- CT errors
- CT characteristics

- Effect of CT burden
- Overcurrent relays of control systems
- The modern relay and functions provided
- Characteristics
- Directional schemes
- High and low set instantaneous relays
- Application to earth faults
- Principles of coordination
- Case studies and tutorials
- Wrap up session

### **Unit Protection 1**

- Transformer protection
- Typical transformer faults
- Protection of small transformers
- Biased differential
- High impedance differential
- Restricted earth leakage
- Buchholz and winding temperature
- Additional earth fault

- Use of earthing transformer
- Relay settings for modern multi-functional relays
- Generator and generator unit
- Schematic layout of plant
- Generator grounding principles
- Generator earth fault
- Differential schemes
- Discussions and wrap up session

## **Unit Protection 2**

- Generator protection continued
- Asynchronous running
- Negative phase sequence
- Over and under voltage
- Over and under frequency
- Reverse power
- Excitation
- Motor protection
- Motor protection principles
- Thermal considerations

- Frequent starting
- Locked rotor
- Phase imbalance
- Single phasing
- Phase short circuit
- Earth fault
- Undercurrent
- Setting of multifunctional relays
- Wrap up session

### **Bus and Circuit Protection**

- Busbar protection
- Principles of operation
- High impedance selective schemes
- Tutorial
- Distance protection
- Principles of operation
- Characteristics
- Arcing faults
- Faults close to relay location

- Causes of inaccuracy of measurement
- Teed feeders
- Practical study
- Final session
- Supervised tutorials
- Group discussion