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Practical

# POWER SYSTEMS PROTECTION

for Engineers & Technicians



## YOU WILL LEARN:

- The fundamentals of electrical power protection and applications
- The different fault types
- How to perform simple fault and design calculations
- Practical fundamentals of protection system components
- About relay settings
- How to increase your job satisfaction through informed decision making
- How to improve the safety of your site with the knowledge gained

## WHO SHOULD ATTEND:

- Electrical Engineers
- Project Engineers
- Design Engineers
- Instrumentation and Design Engineers
- Electrical Technicians
- Field Technicians
- Electricians
- Plant Operators



*Technology Training that Works*

## THE WORKSHOP

This workshop has been designed to give plant operators, electricians, field technicians and engineers a better appreciation of the role played by Power System Protection systems. An understanding of power systems along with correct management, will increase your plant efficiency and performance as well as increasing safety for all concerned. The workshop is designed to provide excellent understanding on both a theoretical and practical level.

The workshop starts at a basic level, to ease the engineer and technician into the perhaps forgotten art of studying, and provide a refresher to those who are more familiar with the basic topics covered. The workshop then moves onto more detailed applications.

The workshop features an introduction covering the need for protection, fault types and their effects, simple calculations of short circuit currents and system earthing. The workshop also includes some practical work, simple fault calculations, relay settings and the checking of a current transformer magnetisation curve.

## WORKSHOP OBJECTIVES

This is an intermediate level workshop ... at the end of the workshop you will have an excellent knowledge of the principles of protection. You will also have a better understanding of the possible problems likely to arise and know where to look for answers.

In addition you are introduced to the most interesting and "fun" part of electrical engineering to make your job more rewarding. Even those who claim to be protection experts have admitted to improving their knowledge after attending this workshop.

## ON-SITE TRAINING

- ✓ **SAVE** over 50% by having an IDC workshop presented at your premises.
- ✓ Customise the training to **YOUR** workplace.
- ✓ Have the training delivered when and where you need it.

Contact us for a **FREE** proposal.

## THE PROGRAM

### DAY ONE

#### NEED FOR PROTECTION

- Selectivity, stability, sensitivity, speed, reliability, dependability, security

#### FAULT TYPES & THEIR EFFECTS

- Active, incipient, passive, transient, asymmetrical
- Phase & earth faults

#### SIMPLE CALCULATION OF SHORT

#### CIRCUIT CURRENTS

- Revision of simple formulae
- Calculation of short circuit MVA & fault currents
- Worked examples

#### SYSTEM EARTHING

- Solid, impedance, touch potentials
- Effect of electric shock
- Earth leakage protection

#### PROTECTION SYSTEM COMPONENTS INCLUDING FUSES

- History, construction & characteristics
- Energy let through & applications

#### INSTRUMENT TRANSFORMERS

- Current transformers: construction, performance, specification, magnetisation curves
- Voltage transformers: types, accuracy, connections

#### CIRCUIT BREAKERS

- Purpose & duty, clearance times, types

#### TRIPPING BATTERIES

- Battery types, chargers, maintenance, D.C. circuitry

#### RELAYS

- Inverse definite minimum time (IDMT) relay
- Construction principles and setting
- Calculation of settings - practical examples
- New Era - modern numerical relays & future trends

#### PRACTICAL DEMONSTRATIONS

#### AND SESSIONS

- Including simple fault calculations and relay settings

## PRACTICAL SESSIONS

You will undertake a series of **six practical sessions**, ranging from elementary to advanced, based on the Power System Protection lecture material.

**You will undertake the following assignments:**

- Simple fault calculations
- Relay setting calculations
- Checking a current transformer magnetising curve
- Case Study 1 - Settings calculation
- Case Study 2 - Settings calculation
- Case Study 3 - Calculations and Layout

### DAY TWO

#### CO-ORDINATION BY TIME GRADING

- Problems in applying IDMT relays

#### LOW VOLTAGE NETWORKS

- Air & molded circuit breakers
- Construction and installation
- Protection tripping characteristics
- Selective co-ordination (current limiting, earth leakage protection, cascading)

#### PRINCIPLES OF UNIT PROTECTION

- Differential protection - basic principles

#### FEEDER PROTECTION

- Cables
- Pilot wire differential
- Overhead lines
- Distance protection (basic principles, characteristics, various schemes)

#### TRANSFORMER PROTECTION

- Phase shift, magnetising in-rush, inter-turn, core & tank faults
- Differential & restricted earth fault schemes
- Buchholz relay, oil & winding temperature
- Oil - testing & gas analysis

#### SWITCHGEAR (BUSBAR) PROTECTION

- Requirements, zones, types
- Frame leakage
- Reverse blocking
- High, medium & low impedance schemes

#### MOTOR PROTECTION

- Thermal overload, time constraints, early relays, starting & stalling conditions
- Unbalanced supply voltages, negative sequence currents, de-rating factors
- Phase faults protection
- Earth faults - core balance, residual stabilising resistors

#### GENERATOR PROTECTION

- Stator & rotor faults
- Overload & over-voltage
- Reverse power, unbalanced loading
- Loss of excitation and synchronism
- Typical protection scheme for industrial generators

#### OVERHEAD LINE PROTECTION

- Basic principles of the distance relay
- Tripping characteristics
- Application onto power lines
- Effect of load current & arc resistance
- Various schemes using power line carrier

#### MANAGEMENT OF PROTECTION

- Routine & annual testing, investigation and performance assessment, upgrading