



*Your True Partner in Attaining
Professional Excellence*

Numerical Protection Relays

*- Applications, selection, setting
and testing*

Who Should Attend?

Technical personnel who are involved in the design, installation, operation and maintenance of protection systems for electricity networks, such as

- ◇ Power System Planners
- ◇ Power System Protection Engineers
- ◇ Field Technicians
- ◇ Circuitry and Automation Engineers
- ◇ Power System Managers and Technical Officers
- ◇ Communication Engineers
- ◇ Construction and Project Managers
- ◇ Power System O&M Engineers
- ◇ Power System Consultants

Numerical Protection Relays - Applications, selection, setting & testing

Course Overview

Numerical Relays are being increasingly used in transmission and distribution and industrial electricity networks. This course discusses the differences between static, digital and numerical relays and the advantages of numerical relays are presented and contrasted with electromechanical and static relays. Relay terminology, device functions, construction, operating principles and the selection of numerical relays will be presented.

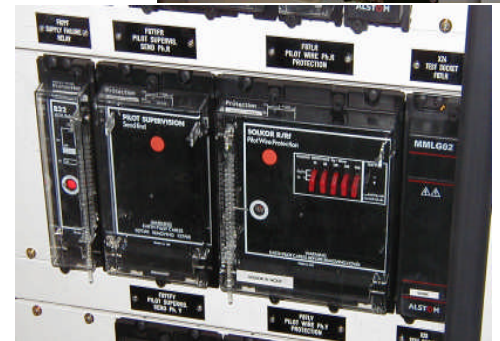
This course will also provide detailed implementation of power system protection using modern numerical relays. It will cover a typical system faults and their associated sequence currents. The analysed faults will be used to calculate the required relay settings for correct grading and clearance of faults. In addition, it will deal with the management of relay settings and firmware and to cover relay failure modes, fault analysis and relay testing as well.

Course Objectives

This course is specifically designed to provide a good understanding of applications and fundamental principles of numerical relay operations. It will assist technical personnel whose work involves them in the applications, selection, setting and testings of numerical relays.

By the end of the course, course participants will be able to:

- ✓ Understand the hardware construction of numerical relays
- ✓ Gain awareness of the software used for a range of relays.
- ✓ Know how to calculate bus, feeder, transformer, capacitor and reactor protection settings
- ✓ Understand time grading of protection relays
- ✓ Know how to configure numerical relays.
- ✓ Understand numerical relay failure modes
- ✓ Understand the testing requirements of numerical relays



Course Leader's Profile

Pranesh Pal, CPEng, MIEAust



Pranesh Pal has been involved in the design, installation and maintenance of power utility assets since 1991. He has been involved in the design, coordination and implementation of protection schemes associated with HV & EHV Transmission Systems since 1999.

Pranesh has held various positions relating to the design of protection schemes and has been the Senior Protection Design Engineer for Powerlink's southern region. Now in the role of Principal Engineer Protection Investigations, Pranesh provides specialist protection fault analysis services to support the Substation Design Teams, the Network Performance Group and the Field Services Groups within Powerlink. Pranesh has RPEQ registration with the Board of Professional Engineers Queensland. He is a Chartered Professional Engineer with Engineers Australia and is on their Professional Engineers' Register.

REGISTER NOW! Fax your registration form to (02) 9410 0030

COURSE CONTENTS



Day 1

- 1. Introduction to Protective Relays**
 - ◆ Required Inputs
 - ◆ Connection Details
 - ◆ Logic
 - ◆ Outputs
- 2. Protective Relaying**
 - ◆ Fault Discrimination
 - ◆ Fault Isolation
 - ◆ Speed of Operation
- 3. Advantages of Digital Relays**
 - ◆ Multiple Functionality
 - ◆ Accommodation of Complex functions
 - ◆ Self Checking
- 4. Disadvantages of Digital Relays**
 - ◆ Quick Obsolescence
 - ◆ Complexity
 - ◆ Configuration Management
- 5. Numerical Relay Description**
 - ◆ Differences between Digital and Numerical relays
- 6. Numerical Relay Construction and Operating Principles**
 - ◆ Signal Conditioning
 - ◆ Sampling Frequency
 - ◆ Isolation
 - ◆ A/D and Flash converters
 - ◆ Displays
 - ◆ HMI
- 7. Types of Relay Protection**
 - ◆ Over Current
 - ◆ Current Differential
 - ◆ Biased Differential
 - ◆ Distance
 - ◆ Over Voltage
- 8. Selection of Relays**
 - ◆ Protected Plant
 - ◆ System Configuration
 - ◆ Communication Requirements
 - ◆ Control Requirements
- 9. Relay Terminology**
 - ◆ Co-ordination
 - ◆ Characteristic Angle
 - ◆ Line angle
 - ◆ Mho and Quad
- 10. Device Functions**
 - ◆ ANSI Codes
- 11. Control Functions in Protective Relays**
 - ◆ Auto Reclose
 - ◆ Sync Check
 - ◆ Interlocks
 - ◆ Status Monitoring

Day 2

- 12. Selecting Relays**
 - ◆ Required Functionality
 - ◆ Speed of Operation
 - ◆ Control and Communications Requirement
 - ◆ In-house Expertise and Vendor Support
- 13. Relay Setting Software**
 - ◆ ABB Cap Tool
 - ◆ SEL AcSELerator
 - ◆ Siemens DIGSI
 - ◆ GE EnerVista UR Setup
- 14. Relay Settings for**
 - ◆ Feeder Protection
 - ◆ Transformer Protection
 - ◆ Capacitor Bank Protection
 - ◆ Reactor Protection
 - ◆ Bus Zone Protection
- 15. Relay Passwords**
 - ◆ Password Defaults and Recommendation
 - ◆ Management and Retrieval
- 16. Multiple Groups**
 - ◆ Requirements for Multiple Settings
 - ◆ Activation of Groups
 - ◆ Management of Active Groups
- 17. Management of Relay Settings & Firmware**
 - ◆ Relay Databases,
 - ◆ Tracking and Verifying Changes
 - ◆ Managing Permits, Load limits
 - ◆ Fault Correction Charts
- 18. DNP Communications**
 - ◆ Features and Benefits
 - ◆ Implementation Levels and Examples
- 19. Relay Maintenance**
 - ◆ Maintenance Frequency
 - ◆ Hazard Analysis, Isolation
 - ◆ Required Tests
- 20. Failure Modes**
 - ◆ Relay Component Failure
 - ◆ Relay Design, Accessory Failure
 - ◆ Setting or Co-ordination failure
 - ◆ Human Error, Force Majeure
- 21. Relay Self Diagnosis**
 - ◆ Software and Hardware Functions
 - ◆ Watchdog
- 22. Fault Analysis**
 - ◆ Event and Disturbance Records
 - ◆ Analysis Software
- 23. Testing and Commissioning Relays**
 - ◆ Type Testing
 - ◆ Commissioning Testing
 - ◆ Routine Maintenance Testing
 - ◆ Selecting Test Interval and Test Equipment
 - ◆ Determination of Inputs
 - ◆ Understanding CT configurations
 - ◆ Filtering of sequence currents
 - ◆ Expected Phase Currents
 - ◆ Expected Sequence Currents