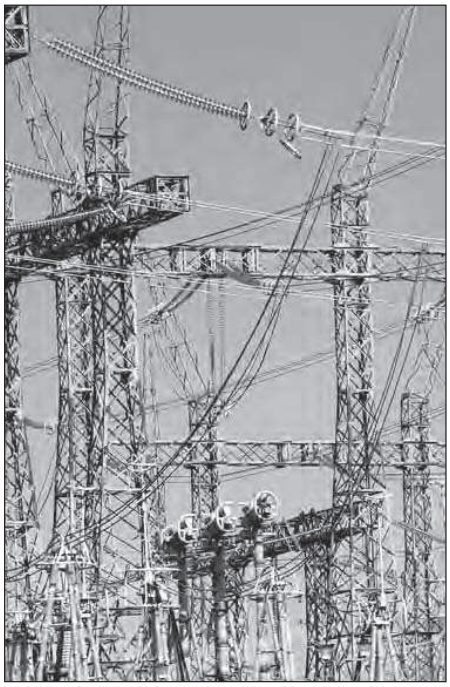
INSTALLING, PROGRAMMING AND COMMISSIONING OF POWER SYSTEM PROTECTION RELAYS AND HARDWARE



WHAT YOU WILL LEARN TO:

- Fundamentals of power system protection
- Key electrical system protection techniques including fault analysis
- How to calculate basic fault currents flowing in any part of your electrical system
- Key technologies and principles behind protective devices
- Architecture of the modern numerical (or microprocessor based) relay
- How to configure the various relays
- How to apply the modern relays to your distribution network
- How to assess and manage relay settings
- Typical problems and solutions with modern power system relays
- How to improve your electrical system protection against faults and other disturbances

WHO SHOULD ATTEND:

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

The Workshop

The continuity of the electrical power supply is very important to consumers especially in the industrial sector. Protection relays are used in power systems to maximise continuity of supply and are found in both small and large power systems from generation, through transmission, distribution and utilisation of the power. A good understanding of their application, operation and maintenance is critical for operating and maintenance personnel. In this course, you will gain a thorough understanding of the capabilities of power system protection relays and how they fit into the overall distribution network. The practical sessions covering the calculation of fault currents, selection of appropriate relays and relay coordination as well as hands-on practice in configuring and setting of some of the commonly used types of protection relays used in industry will give you an excellent understanding. Simulation software and real relays (but at safe voltages) will be used to give the course participants practical experience in setting up and configuring the various power parameters. Both electro-mechanical and microprocessor relays will be used to demonstrate the key configuration settings required and the major differences in the approach adopted between these two classes of relays.

The strengths and weaknesses of the latest microprocessor (or numerical) relays as compared to the older electromechanical relays will be outlined. You will also gain a solid appreciation of how the modern relay communicates not only to the central SCADA system but also between themselves resulting in a truly multifunctional system which includes protection, control and monitoring. Finally, you will gain a solid understanding of issues of reliability and security for the modern relay.

The Program

BASICS OF POWER SYSTEM PROTECTION

- Requirements of protection in an electrical system
  - Reliability, dependability, security
- Types of faults
- Evaluation of short circuit currents in a power system
- Exercises in fault calculations in simple circuits
- Earth faults and role of system earthing
- Characteristics of protective relaying
  - Sensitivity, selectivity, stability, speed
- Protection using fuses
- The protective relay/release and circuit breaker combination
- Instrument transformers and their application in protection systems

Practical session 1: Fault level calculations of typical power distribution networks

RELAYS AND THEIR DEVELOPMENT

- Types of protective relays (DMT and IDMT)
- Electromechanical static relays
- Microprocessor relays and numerical relays
- IDMT characteristics expressed as a mathematical function
- Comparison of electromechanical/static and numerical relays
  - Key features: flexibility/reliability/ communications/SCADA interface, cost, integrated protection and control

Practical session 2: Reconstructing different IDMTL characteristics using a spreadsheet graphical display

PROTECTION COORDINATION

- Need for coordination
- Time grading
- Current grading
- Application of time and current grading in power systems
- Grading using IDMTL characteristics
- Better grading through numerical relays

Practical session 3: Grading between IDMT/ DMT characteristics of current relays by using Excel spreadsheet

Practical session 4: Coordination between directing trip devices used in LV circuit breakers using typical software package

TYPICAL BLOCK DIAGRAM OF NUMERICAL PROTECTION RELAY

- Basic approach used in numerical protective relays
- Typical block diagram
- Hardware and software architecture of a numerical relay
- Importance of sampling interval in the operation of relay
- Examples of how waveform asymmetry and harmonic components are handled in numerical relays
- Extension of capabilities of relays in numerical design
- From individual protection relays to a complete protection management system
- Structure of the Intelligent Electronic Device (IED)
- Typical examples of the use of IEDs in functions other than protection
- Configuring substation automation using IEDs

Practical session 5: Designing a substation automation system architecture using IEDs

DIFFERENT TYPES OF NUMERICAL PROTECTION SYSTEMS AND PRINCIPLES

- Functional protection relays
- Equipment protection systems with multiple functions

Practical session 6: Designing the protection system of a typical HV/MV step-down substation with outgoing feeds to MV motors and MV switchboards and incoming transformer feeders and standby generator source

CONFIGURATION OF NUMERICAL RELAYS (Examples using industry standard protective relays)

- Setting approach in conventional relays
- Configuring numerical relays
- Configuration security through passwords
- Protection settings as a part of configuration
- Methods adopted for setting numerical relays
- Configuration exercises for typical relays/ simulation software

Practical session 7: Hands on configuration using the front keyboard of a typical single function numerical current relay

Practical session 8: Hands on configuration using a PC and configuration software with actual relays

COMMUNICATION ASPECTS OF NUMERICAL PROTECTION DEVICES

- Setting up a substation automation system using the communication capability of numerical relays
- Problems of compatibility between vendors
- DNP3 communication standard
- The new substation standard IEC 61850
- Logical grouping of functions
- Intercommunication using GOOSE
- Using IEC with Unified Modeling Language (UML)
- Example of substation automation system with IEDs compatible with IEC 61850

Practical session 9: Designing a wide area network protection system architecture by connecting the substation automation systems of different substations all using IEC 61850 compatible devices

SUMMARY, OPEN FORUM AND CLOSING

Practical Sessions

There will be at least nine practical sessions interspersed within the different theory sessions. These will enable participants to gain a practical feel of actual power systems and their protection system designs, plus substation automation and wide area protection architecture.