Training Program:

Modern Power System Protective Relaying

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Introduction:

Protection systems are installed to prevent faults from damaging electrical plant and to initiate isolation of faulted sections in order to maintain continuity of supply elsewhere on the system. Recent changes in technology together with changes in the manner in which Utilities and Industrial organizations operate, has greatly emphasized the development of integrated protection and control. Modern relays include facilities such as monitoring and recording capabilities, self-diagnostics and permit adjustment of setting by remote control. In short, the role of the modern protection relay is primarily to act in a fault situation but increasingly finds application in transmitting information in connection with the operation of the system. It is however the relay response to fault situations that forms the principal thrust of the current course. The program is ambitious but due regard will be given to the pace and uptake capabilities of the participants. Participants who bring laptop computers may make use of selected software for tutorial purposes.

Target Audience:

Engineers and senior technicians from Electrical Utilization Companies and Industrial organizations, Building and Services Professionals who have to deal with the aspects of electrical and industrial power systems protection, control and operation will also find the course beneficial. Participants need no specific requirements other than good understanding of electro technology and some relevant experience

Training Objectives:

At the end of this course, participants will learn about:

- The nature of different types of electrical faults and the effect these faults can have on company assets

- Understanding of electrical fault protection systems
- Practical solutions for specifying and operating protection systems
- Comprehensive understanding of principles and selection of protection relays and protection schemes
- The requirement for testing of relays and protection systems

Accreditation:

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

Daily Agenda:

Power System Fault Analysis

- Types of fault, Factors affecting fault severity
- Methods of fault calculation, Balanced faults
- Fault calculation procedure, Component representation
- Unbalanced faults, Symmetrical components
- Three-phase faults, Single-phase-earth faults
- More involved circuits and sequence diagrams
- Phase to phase faults, Phase-phase-ground faults
- Practical fault studies, Computer program FAULT

Transducers

- Current and voltage transformers
- General current transformer theory
- Current transformer characteristics
- Ratio error, Phase error, Short time factor
- Accuracy limit factor, Specification of current transformers
- Secondary rating, Secondary winding impedance
- Primary windings, Secondary current flow
- Current transformer response to system transients
- Harmonics during transients, Voltage transformers

Overcurrent Protection

- Relays, Co-ordination introduction
- Co-ordination fundamentals, Settings
- Discrimination period overall time interval
- Definite time over current relays
- Systems incorporating various voltage levels
- Directional over current systems
- High set over current relays, Problem of overreach
- Low voltage industrial system protection

Earth Fault Protection

- Sensitive earth fault relays, CT burdens for various fault types
- Equivalent circuit and secondary current flow
- Neutral earthing, Directional earth fault relays
- Interlocked over current
- Typical modular over current protection relay
- Multifunctional features and applications of modern microprocessor based overcurrent relays
- Typical relay data, Fuses, Applications
- Appendix A: Relay characteristic curves, Modular relays

Transformer Protection

- Failure and their causes, Small transformers
- Differential protection
- Current flows in transformers due to symmetrical and unsymmetrical faults
- Interposing current transformers, Neutral earthing transformer
- Biased systems, High impedance schemes
- Earth fault protection, Current transformer ratios and connections
- Restricted earth fault protection, Level of fault current
- Other fault types, Externally applied conditions

- Fault withstand levels, Magnetizing inrush
- Review of additional protection
- Protective schemes for various types of transformer
- Integrated multi-microprocessor overall protection
- Transformer feeders, Tripping schematics

Generator Protection

- Introduction, Generator operating under fault conditions
- Steady-state calculations, Generator earthing, High impedance earthing
- Differential protection, Generator transformers
- High impedance differential
- Generator unit protection excluding differential protection
- Overcurrent protection, Unbalanced load
- Asynchronous running, Balanced earth fault and neutral displacement
- Stator earth faults, Over-excitation protection
- Reverse power protection, Overvoltage protection
- Under frequency protection, Shaft current protection
- Rotor ground fault protection

Motor, Pilot Wire & Busbar Protection

Basic Principles of Distance Protection