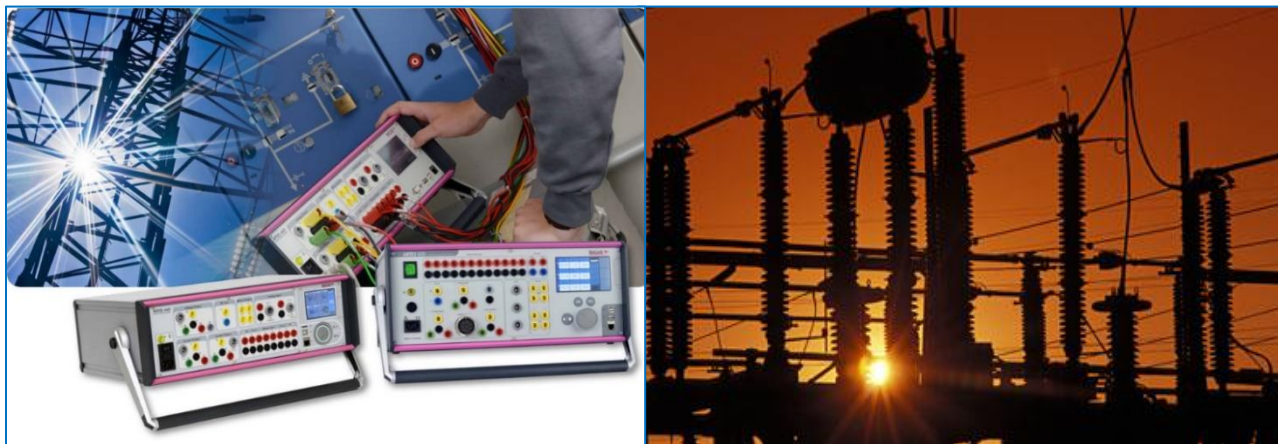




EE017: Modern Power System Protection & Relaying: *Electrical Protection System*

Training Description:

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.

This intensive training will highpoint:

- Power System Fault Analysis
- Current and Voltage transformers
- Over Current and Earth Fault Protection
- Pilot Wire and Distance Protection
- Transformer, Generator and Motor Protection
- Busbar Protection
- Protection Settings and Grading

Training Objectives:

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

- ✓ 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

Personal Impact:

- ✓ Understand the electrical characteristics of various electrical faults
- ✓ Identify different types of protection systems, understand the purpose of each type of protection system and identify the zone of protection for a given relay
- ✓ Recognize modern protective relays and understand their basic operation
- ✓ Appreciate the characteristics and importance of voltage transformers and current transformers in achieving dependable and accurate electrical protection systems
- ✓ Be familiar with the requirements for testing of protection systems

Organizational Impact:

- ✓ The course will allow delegates to interact and gain from shared experiences of others
- ✓ Carefully selected examples and case studies will be used to illustrate the material being discussed
- ✓ Emphasis will be given to ensure that the material is appropriate to the organizations represented
- ✓ Understand the concept of protection system discrimination and appreciate its importance in improving security of supply

- ✓ An awareness and understanding of the modern power system protective relays and understand their basic operation

Training Designed for:

This course is intended for all 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 Requirement:

"Hand's on practical sessions, equipment and software will be applied during the course if required and as per the client's request."

Contents can be adapted to your specific wishes. It is therefore possible to focus on specific modules of the training course as per client's learning needs and objectives. Further, it should be forwarded to us a month prior to the course dates.

Training Program:

DAY ONE:

- ❖ Course Introduction
- ❖ Introduction to Protection
 - Protection Role, Protection Objectives
 - Protection Requirements, Protection Basic Principles
 - Protection Types, Protection Function Codes
 - Relay Protection History, Numerical Protective Relays
- ❖ Power System Fault Analysis
 - Power System Basics
 - Faults in Power Systems
 - Type of Faults, Balanced & Unbalanced Faults
 - Fault Effects on the Power System
 - Fault Current, Factors Affecting a Fault
 - Power System Analysis, Short Circuit Calculation Method
 - Three-Phase Fault, Earth Fault, Two-Phase Fault
 - Open Circuit, Modeling Components
 - Short Circuit Calculation Procedure
 - SC Calculations by Computer Program

DAY TWO:

- ❖ Current and Voltage Transformers
 - Current Transformers Theory
 - Current Transformer Types, Current Transformer Rated Characteristics
 - Accuracy Class & CT Errors
 - CT Magnetizing Curve, CT Response to System Transients
 - Current Transformers Earthing, Current Transformer Connections

- Protection Requirements on CT
- Voltage Transformers Theory, Voltage Transformer Types
- Voltage transformer rated characteristics
- VT accuracy & VT errors, Effects on VT Performance
- Voltage Transformers Earthing, Voltage Transformer Connections
- Optical Sensors Basics, Optical Sensors Principle
- Optical Sensors Characteristics
- ❖ **Power System Earthing**
 - Purpose of Earthing, System Earthing Types
 - Forming Neutral Point in Isolated Systems
- ❖ **Circuit Breakers**
 - Purpose of Circuit Breakers
 - Circuit Breaker Types (HV, MV, LV)
 - Circuit Breaker Tripping Characteristics
- ❖ **Overcurrent Protection**
 - OC Protection Principle of Operation
 - OC Protection Requirements, OC Protection Characteristics
 - Directional OC protection, OC Typical Data, OC Protection Applications
- ❖ **Earth Fault Protection**
 - EF Protection Principle of Operation
 - EF Protection Requirements, EF Protection Characteristics
 - EF Protection Typical Data, EF Protection Applications
 - Numerical Multifunctional OC & EF Relays

DAY THREE:

- ❖ **Feeder Protection**
 - Feeders in Power Systems, Pilot Wire Protection, Pilot Wire Protection Schematics
 - Pilot Wire Protection Characteristics
 - Feeder Differential Protection, Phase Angle Comparison
 - Optical Differential Protection, Communication Channels
 - Feeder Diff Protection Characteristics
 - Distance protection, Distance protection zones & characteristics
 - Distance protection schemes, Distance protection issues
 - Numerical distance protection
- ❖ **Transformer Protection**
 - Transformers in Power Systems, Transformer Faults & Current Flow
 - Magnetizing Inrush Current, Transformer Protection Requirements
 - Transformer Protection Concept, Transformer Differential Protection
 - Restricted Earth Fault Protection, HV/LV Connections Protection
 - HV overcurrent protection, LV overcurrent & earth fault protection
 - Neutral earth fault protection, Transformer Mechanical Protection
 - Transformer Tripping Circuits, Earthing Transformer Protection
 - Numerical Protection for Transformers, Transformer Feeders Protection
 - Ferro resonance, detection and mitigating measures

DAY FOUR:

❖ Generator Protection

- Generator Principle of Operation & Types
- Generator Earthing, Generator Connections
- Generator Faults, Generator Protection Requirements
- Generator Protection Concept, Generator Mechanical Protection
- Shaft Protection, Reverse Power Protection
- Pole Slipping Protection, Generator Differential Protection
- Stator Earth Fault Protection
- Overcurrent Protection, Stator Thermal Protection
- Rotor Earth Fault Protection, Over Excitation Protection
- Unbalanced Load Protection
- Overvoltage Protection, Undervoltage Protection
- Frequency Protection, Forward Power Protection
- Generator Protection Summary

❖ Motor Protection

- Motor Types, Motor Principle of Operation
- Motor Considerations and Imposed External Conditions
- Motor Faults, Motor Protection Requirements
- Motor Differential protection, Overcurrent protection
- Overload protection, Underload protection, Earth fault protection
- Under-voltage protection, Unbalanced protection
- Successive start protection, Speed variation protection
- Loss of supply protection, Out of synchronism protection
- Motor Protection Summary, Numerical Motor Protection

DAY FIVE:

❖ Busbar Protection

- Busbars in Power Systems, Busbar Protection Basics
- MV Busbar Protection, High Impedance BB Protection
- Low Impedance BB Protection
- Numerical BB Protection, Breaker Fail Protection

❖ Protection Settings

- Protection Settings Calculations
- General Principles for Protection Settings
- Relay Configuration File Example, Managing Protection Settings
- Overcurrent Protection Setting Calculations
- Transformer Differential Protection Setting Calculations
- Distance Protection Setting Calculations

❖ Protection Grading

- Protection Time-based Grading
- Current-based Grading, Logic-based Grading
- Case Study for Time Based Grading of OC Protection

❖ Course Conclusion

❖ Post-Assessment and Evaluation

Training Methodology:

This interactive training course includes the following training methodologies as a percentage of the total tuition hours:

- 30% Lectures, Concepts, Role Play
- 70% Workshops & Work Presentations, Techniques, Based on Case Studies & Practical Exercises, Gamification, Software & General Discussions
- Pre and Post Test

Training Certificate(s):

CMCT Internationally recognized certificate(s) will be issued to each participant who completed the course.

Training Fees:

TBA as per the course location - This rate includes participant's manual, hand-outs, buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Note: The 5% VAT (Value Added Tax), will be effective starting 01st of January 2018 as per the new regulation from the UAE Government. The VAT applies for all quotation both for local and abroad.

Training Timings:

Daily Timings:

07:45 - 08:00	Morning Coffee / Tea
08:00 - 10:00	First Session
10:00 - 10:20	Recess (Coffee/Tea/Snacks)
10:20 - 12:20	Second Session
12:20 - 13:00	Recess (Prayer Break & Lunch)
13:00 - 14:00	Last Session

For training registrations or in-house enquiries, please contact:

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