€TRAINING

Protection of Electrical Power Systems

Protection of Electrical Power Systems

Introduction:

Power system protection is an essential component of all forms of electrical power systems. In practice, protective relaying is directly associated with security of supply, the reduction of damage to the faulted plant, the cost of energy, and, most importantly, all aspects of safety. The training progrm focuses attention on the fundaments of the subject and illustrates the protection philosophies in common use by reference to the application of modern multi-functional microprocessor relays to practical situations illustrated by case studies.

Program Objectives:

At the end of this program, the participants will be able to:

- Understand the need for protection.
- Gain an overview of power system fault analysis.
- Learn about protection fundamentals.
- Explore relay transducers, both current and future.
- Understand system grounding principles.
- Study overcurrent and earth fault protection.
- Learn about coordination principles, transformer, generator, bus, motor, line, and feeder protection, as well as the principles of relay application.

Targeted Audience:

- Electrical/Plant Engineers.
- Supervisors.
- Technicians.
- Electricians with responsibility for the application.
- Commissioning and/or maintenance of electrical protective equipment used on the industrial electrical power system.

Program Outlines:

Unit 1:

Fundamentals and Fault Analysis:

- Introduction to power system protection, including power system fault analysis.
- Understanding phase and earth faults, along with manual calculation methods.
- Exploring the use of software for protection analysis.
- Delving into protection fundamentals, including definitions, terminology, and unit/non-unit systems.
- Concluding with a wrap-up session and a case study to reinforce concepts.

Unit 2:

Transducers and Overcurrent Schemes:

- Understanding transducers, including the current transformer CT equivalent circuit and specifications, as well as considerations for CT errors and characteristics, including the effect of CT burden.
- Exploring overcurrent relays of control systems, including modern relay functions, characteristics, directional schemes, and the use of high and low set instantaneous relays, particularly in application to earth faults.
- Studying principles of coordination, examining how relays are coordinated within a system to ensure optimal protection.
- Engaging in case studies and tutorials to apply learned concepts in practical scenarios.

Unit 3:

Unit Protection 1:

- Understanding transformer protection, including typical transformer faults and protection methods for small transformers, such as biased differential and high impedance differential schemes.
- Exploring additional protection mechanisms like restricted earth leakage, Buchholz and winding temperature monitoring, and addressing additional earth faults.
- Utilizing earthling transformers and configuring relay settings for modern multifunctional relays to enhance protection efficiency.
- Studying generator protection, including generator grounding principles, earth fault detection, and differential schemes.
- Concluding with discussions and a wrap-up session covering the schematic layout of the plant and reinforcing key concepts.

Unit 4:

Unit Protection 2:

- Continuing with generator protection, exploring issues such as asynchronous running, negative phase sequence, over and under-voltage, over and under frequency, reverse power, and excitation-related protection.
- Delving into motor protection principles, including considerations for thermal protection, frequent starting, locked rotor, phase imbalance, single phasing, phase short circuit, earth fault, and undercurrent protection.
- Understanding the settings of multifunctional relays to optimize motor protection and ensure efficient operation.
- Analyzing motor protection schemes to mitigate risks and maintain system integrity.
- Concluding with a comprehensive understanding of generator and motor protection principles, providing a robust framework for safeguarding power systems.

Unit 5:

Bus and Circuit Protection:

- Understanding busbar protection, including principles of operation and high impedance selective schemes, with a tutorial for practical application.
- Exploring distance protection, its principles of operation, characteristics, and considerations for arcing faults and faults close to relay locations.
- Analyzing causes of measurement inaccuracies and techniques for mitigating them within distance protection schemes.
- Studying teed feeders and their practical application in power system protection.
- Concluding with a practical study session to reinforce learning and apply concepts in real-world scenarios.