



## **Protection of Electric Power Systems**

### **5-Day Training Program**

#### **INTRODUCTION**

The Protective Relay Application Seminar will provide personnel with an understanding of protective relay applications for medium and high voltage AC systems, and associated equipment. Using actual case studies, trainees will become familiar with concepts that will aid them in expanding or updating an existing system, designing a new system or in troubleshooting. Practical approaches rather than strict theoretical concepts are highlighted. Familiarity with basic short circuit and coordination fundamentals is required for attending this seminar.

#### **WORKSHOP OBJECTIVES**

The course presents an introduction to subject of protection of power systems. All Principles are presented and various applications are discussed. Protection engineers should benefit from the course as new applications (e.g. use of Artificial Intelligence in protection) are also presented.

#### **WHO SHOULD ATTEND**

Electrical Engineers and technicians should benefit from this course. Also practicing power engineers who work in electrical distribution should update and refresh their knowledge by attending this course.

#### **PROGRAM**

##### **Day 1**

#### **INTRODUCTION TO PROTECTION ENGINEERING**

- ✚ Short Circuit Calculations
- ✚ System Arrangements
- ✚ Coordination Fundamentals
- ✚ NEC Requirements
- ✚ Overview of Relaying Concepts
- ✚ Phasor Fundamentals
- ✚ Relaying Principles

#### **POWER SYSTEM GROUNDING**

- ✚ Symmetrical Components



- ✦ Ungrounded
- ✦ Solidly Grounded Systems

Systems

- ✦ Line to Ground Fault Calculations
- ✦ Low Resistance Grounded Systems
- ✦ High Resistance Grounded Systems
- ✦ Reactance Grounded Systems
- ✦ Ground Fault Detection and Protection

## **Day 2**

### **CURRENT TRANSFORMERS**

- ✦ Types of Current Transformers
- ✦ CT Connections
- ✦ Accuracy Class
- ✦ Application Examples

### **LINE PROTECTION**

- ✦ Fuse Protection
- ✦ Overcurrent Protection
- ✦ Tie-line Protection
- ✦ Reclosers
- ✦ Coordinating Reclosers with Fuses
- ✦ Pilot Wire Protection
- ✦ Distance Relaying
- ✦ Application Examples

## **Day 3**

### **GENERATOR PROTECTION**

- ✦ Generator Capability Curves
- ✦ Generator Decrement Curves
- ✦ Short Circuit Protection
- ✦ Generator Differential Protection
- ✦ Unbalance Relays
- ✦ Loss of Field Relays

### **INTERCONNECTING GENERATORS WITH A UTILITY**

- ✦ Interface Problems
- ✦ Synchronization



- ✚ Harmonics
- ✚ Grounding
  
- ✚ Directional Power Relays

## **Day 4**

### **MOTOR PROTECTION**

- ✚ Motor Characteristics
- ✚ Motor Inrush
- ✚ Overload Protection
- ✚ Short Circuit Protection using Instantaneous Devices
- ✚ Motor Differential Protection
- ✚ In-class Exercises
- ✚ Under-voltage Protection
- ✚ Induction Versus Synchronous Motors
- ✚ Voltage Unbalance Protection
- ✚ Current Unbalance Protection
- ✚ Determining Settings for Some Popular Motor Protection Relays

### **BUSBAR PROTECTION**

- ✚ Current Balance Schemes
- ✚ Differential Protection Schemes
- ✚ High Impedance Busbar Protection

## **Day 5**

### **TRANSFORMER PROTECTION**

- ✚ Transformer Withstand Capability
- ✚ Transformer Inrush
- ✚ Overcurrent Protection
- ✚ Instantaneous Protection
- ✚ Transformer Differential Protection
- ✚ Transformer Differential Protection
- ✚ Harmonic Restraint Units
- ✚ IN-RUSH CURRENT AND HARMONICS
- ✚ MODERN TRENDS IN PROTECTIVE SCHEMES OF POWER SYSTEMS, USE OF COMPUTERS AND NEUTRAL NETWORKS