College of Technology

Motors and Controls

Module # 5 Electrical Transmission, Distribution, and Protection

Document Intent:

The intent of this document is to provide an example of how a subject matter expert might teach Electrical Transmission, Distribution, and Protection. This approach is what Idaho State University College of Technology is using to teach its Energy Systems Instrumentation and Control curriculum for Electrical Transmission, Distribution, and Protection. The approach is based on a Systematic Approach to Training where training is developed and delivered in a two step process. This document depicts the two step approach with knowledge objectives being presented first followed by skill objectives. Step one teaches essential knowledge objectives to prepare students for the application of that knowledge. Step two is to let students apply what they have learned with actual hands on experiences in a controlled laboratory setting.

Examples used are equivalent to equipment and resources available to instructional staff members at Idaho State University.

Fundamentals of Electrical Transmission, Distribution, and Protection Introduction:

This module covers fundamental aspects of Electrical Transmission, Distribution, and Protection as essential knowledge necessary to perform work safely according to national and local standards on or around electrical power sources that are associated with motors and controls. Students will be taught the fundamentals of Electrical Transmission, Distribution, and Protection using classroom instruction, demonstration, and laboratory exercises to demonstrate knowledge and skill mastery of Electrical Transmission, Distribution, and Protection. Completion of this
module will allow students to demonstrate mastery of knowledge and skill objectives by completing a series of tasks demonstrating safe work practices on or around electrical power sources.

References

This document includes knowledge and skill sections with objectives, information, and examples of how Motors and Control could be taught in a vocational or industry setting. This document has been developed by Idaho State University’s College of Technology. Reference material used includes information from:


STEP ONE

Electrical Transmission, Distribution, and Protection Course

Knowledge Objectives

Knowledge Terminal Objective (KTO)

KTO 5.1. ANALYZE Electrical Transmission, Distribution & Protection systems to ensure adequate Protection Equipment exits for the safety of electrical workers.

Knowledge Enabling Objectives (KEO)

Knowledge Enabling Objectives (Chapters 7 & 11):

KEO 5.1. DESCRIBE what an electrical Power Distribution System consists of. (pg 290)

KEO 5.2. DESCRIBE how large amounts of power are generated using three phase systems. (pg 293)

KEO 5.3. DESCRIBE how substations serve as a source of voltage transformation along the distribution system. (pg-297)

KEO 5.4. DESCRIBE the three main sections of a typical substation. (pg-297-298)

KEO 5.5. DESCRIBE Switchboards are and how they are used in power distribution. (pg-298)

KEO 5.6. EXPLAIN how Panel-Boards and Branch Circuits distribute power. (pg 300-302)
Knowledge Enabling Objectives (Chapter 11):

**KEO 5.1.**  **DESCRIBE** what an electrical **Power Distribution System** consists of. (pg 290)

**KEO 5.2.**  **DESCRIBE** how large amounts of power are generated using three phase systems. (pg 293)

**KEO 5.3.**  **DESCRIBE** how substations serve as a source of voltage transformation along the distribution system. (pg-297)

**KEO 5.4.**  **DESCRIBE** the three main sections of a typical substation. (pg-297-298)

**KEO 5.5.**  **DESCRIBE** Switchboards are and how they are used in power distribution. (pg-298)

**KEO 5.6.**  **EXPLAIN** how Panel-Boards and Branch Circuits distribute power. (pg 300-302)

**KEO 5.7.**  **EXPALIN** the overall purpose for a Motor Control Center. (pg 301-304)

**KEO 5.8.**  **DESCRIBE** how Feeders and Bus-ways distribute power locally. (pg 305-305)

**KEO 5.9.**  **DESCRIBE** methods used to troubleshoot Fuses, Circuit Breakers, and Control Transformers. (pgs 306-309)
STEP TWO

Electrical Transmission, Distribution, and Protection

Skill/Performance Objectives

Skill Knowledge Introduction:

Below are the skill knowledge objectives. How these objectives are performed depend on equipment and laboratory resources available. With each skill objective it is assumed that a set of standard test equipment and tools be provided and safety procedures be implemented during each tasked being performed.

- Identify the IEEE protection devices using the appropriate device number
- Using appropriate test equipment, function test and calibrate the following:
  - Over current relays
  - Under Current relays
  - Phase differential relays
  - Reclose relays
  - Time over current relay
  - Reverse power relay
- Test the turns ratio of a transformer
- Verify proper operation of dead bus closure circuits
- Verify and correct if needed the operation of a synchronizing circuit