Short Circuit Analysis

4 Days, 2.8 CEUs

All electrical systems are susceptible to short circuits and the abnormal current levels they create. The ability to accurately predict these current levels is essential for equipment selection, protection, and evaluation. The results of short circuit studies are also used in predicting incident energy (arc flash hazard levels), and completing a comprehensive protective device coordination study.

This course is intended for engineers, supervisors, electricians, and technicians that are involved in equipment selection/evaluation and protection of industrial and utility power systems. The student should have basic knowledge of power system equipment and mathematics.

Pre-Requisites

Student must bring a laptop and have full administration rights to install software, to complete the class labs. Laptop must have Windows XP/Vista/7/8, 600+ MHz processor, 4+GB hard drive space, 1+GB RAM, a CD-ROM drive. IPads and tablets without CD-ROM or USB ports are not acceptable.

Lab and Classroom Attire

AVO Training Institute is committed to the personal safety of each participant and require long pants and ANSI rated “safety-toe” work shoes for lab activities. Lecture courses may involve a tour of a work or shop area and for this reason open-toe shoes and shorts are not considered appropriate attire for the classroom.

Learning Objectives

To receive 2.8 CEUs, participants must attend 4 days of class (28 contact hours) and attain a minimum grade of 80% on the final exam. Upon completion of this course the participant will demonstrate that he/she is able to:

- Describe the types of studies performed on power systems.
- Summarize the purpose and methods used when performing a short circuit analysis.
- Perform mathematical operations on vectors, phasors, complex numbers, matrices, and explain their application in the performance of a short circuit analysis.
- Utilize mathematical tools to perform short circuit analysis.
- Recognize the basic types of power system short circuits, and their configuration.
- Use leading engineering software to create a power system model and to calculate short circuit currents based on fault models.

SCOPE

Day 1* (7 contact hours)

I. Introduction to Short-Circuit Analysis (4 hrs)
   A. Types of Power System Studies
      1. Short Circuit Analysis
      2. Load Flow
      3. Stability
      4. Motor Starting
      5. Harmonic Analysis
      6. Switching Transients
      7. Reliability
      8. Cable Ampacity Analysis
      9. Ground Mat Analysis
      10. Protective Device Coordination

AM Break

   B. SCA – Method and Purpose
   C. SCA Examples
   D. Standards Std141, Std 242, Std 399, C37 Series
   E. Computer Methods

Lunch

II. Mathematics Review (3 hrs)
   A. Vectors and Phasors
      1. Vector Addition
      2. Vector Subtraction
      3. Vector Multiplication
      4. Vector Division

PM Break

      5. Phasors
   B. Complex Numbers
   C. Matrices

*Class scheduling times may vary based on discussions and size of class

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SCOPE (cont'd)

Day 2 (7 contact hours)

III. Power Engineer's Tools (4 hrs)
- A. The Per Unit System
- B. Symmetrical Components
  - 1. Basic Concept

AM Break
  - 2. Formulas
  - 3. Application to Power Systems
- C. Sample Problems

Lunch

IV. Types and Characteristics of Power Systems Short Circuit (3 hrs)
- A. Types and Magnitudes of Short Circuits
  - 1. Three Phase Fault
  - 2. Two Phase Fault
  - 3. Two Phase to Ground Fault

PM Break
  - 4. Single Phase to Ground Fault
  - 5. Relative Magnitudes of the Four Short Circuits
  - 6. Phasors
- B. Characteristics of Short Circuits
- C. Including AC and DC Decrements

Day 3 (7 contact hours)

V. Power System Impedance Networks (2.5 hrs)
- A. Equipment Impedance Equivalent Circuits
- B. System Sequence Networks
- C. Impedance Network Interconnections
- D. Simplifying Assumptions for SCA

AM Break
- E. Transferring Fault Currents across DeltaWye and Wye Delta Transformer Winding

VI. Circuit Analysis Methods (1.5 hrs)
- A. Required Data
- B. Preparation of a Single Line Diagram
- C. Preparation of an Impedance Diagram

Lunch

VI. Circuit Analysis Methods (cont'd) (1 hr)
- D. Point to Point Short Circuit Calculations
- E. ANSI Methods
- F. Computer Methods and Techniques

VII. Software Exercise (2 hrs)
- A. Load SKM PTW Software

PM Break
- B. Present PTW Basic Procedures
- C. Part I – Hands On SCA (Fault Study) using SKM PTW Software

Day 4 (7 contact hours)

VII. Software Exercise (cont'd) (6 hrs)
- D. Part II - Complete PRW Fault Study

AM Break
- D. Part II - Complete PRW Fault Study (cont'd)

Lunch
- D. Part II - Complete PRW Fault Study (cont'd)

PM Break

VIII. Conclusion (1 hr)
- A. Review
- B. Final Exam

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