High and Medium Voltage Substation Design, Testing and Maintenance Training

Description

Course Description

Substations play an important role in a power system network in maintaining the continuity of power supply and power quality to the industrial and commercial consumers. The high voltage substation comprises of switching equipment, transformers, reactors, var compensators, protection, control, automation and communication. A properly planned and designed substation is essential for the reliable operation of power system network.

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This course covers all aspects of high and medium voltage substation design including regulatory and environmental requirements, general design considerations, application of switching and power equipment, fault calculations, safe grounding design, protection/control, automation and communication, and maintenance considerations.

Course Objective

- To provide a practical understanding of planning, design, application and maintenance aspects of high and medium voltage substations for utility networks and industrial plants.

Course Outline

Industrial and Utility Substation

- Substation hardware
- Substation layout considerations
- Bus arrangements and bus design considerations

General Design Considerations

- Site selection and environment considerations
- Industrial and utility substations
- Safety, operating and maintenance considerations

- Typical single line diagrams

Fault Calculations

- Types of faults
- Symmetrical components
- Fault calculations, software

Application of Circuit Breakers

- Types of circuit breakers
- Classification of circuit breakers
- Breaker selection and ratings

Application of Circuit Breakers (continued)

- The ANSI C37 Standard and Guide
- Transient recovery voltage
- Out of phase switching
- Generator breakers

Substation Equipment

- Disconnect switch and circuit breakers
- Power transformers and reactors
- Instrument transformers, voltage and current
- Power and control cables
- Station battery

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Insulation Co-Ordination

- Principles of insulation co-ordination
- Classification of over voltages
- Surge arresters and choice of arrester ratingImpulse and switching surge overvoltages
- Standard insulation levels
- The concept of protective levels and protective margins
- Protective margins in insulation co-ordination

Harmonics in Utility and Industrial Systems

- Sources of harmonics
- The IEEE Std 519 on harmonics
- Harmonic analysis, filters
- Problems associated with variable frequency drives

Grounding Design Considerations

- The objectives of station grounding
- Safety considerations

- Step and touch voltages, ground potential rise
- Treatment of fence
- An example of substation grounding

GIS Application

- Review of GIS technology
- Layout and bus arrangement
- Handling of SF6 Gas
- Economics

Shunt Capacitor Application

- Capacitor arrangements and bank ratings
- \Capacitor and bank protection
- Harmonic resonance caused by shunt capacitors

Protection Metering and Control

- Review of relay applications, industrial and utility systems
- Transmission line protection
- Bus protection
- Transformer protection
- Medium voltage feeder protection

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Protection Metering and Control (continued)

- Measurements
- Integration and automation

Maintenance and Testing

- Maintenance and testing of substation equipment
- Introduction about the cables (history and construction of cables).
- Fault types, electrical characteristics of fault.
- Analyzing the fault.
- Principles of cable fault location.
- Cable testing systems and fault location.
- Cable line (tracing), and phase identification.