


EE273:
Substation Maintenance and Troubleshooting of Switchgears & SF6

Training Description:

This intensive training course is designed to provide participants with a detailed and up-to-date overview of GIS substation maintenance and troubleshooting. It focuses on what to do, when to do it and how to interpret the results from testing and maintenance. In additions, participants will be equipped with new or refreshed skills to ensure that electrical equipment and control systems which related to Electrical Substations plus identified faults or problems are repaired and the underlying causes are identified and eliminated to reduce further failures.

The course will also discuss the different substation types and purposes; the fundamentals of power system operation and primary substation equipment; the major components, construction and operation of power transformers and controls; the basic concepts of schematics and wiring diagrams; the construction and operation of voltage regulators, power circuit breakers, circuit switchers, reclosers, capacitor banks and metalclad switchgear; the types and applications of disconnect switches and power fuses; the principles of operation of instrument transformers, purpose and types of protective relay systems, purpose and ratings of battery systems, purpose and functions of SCADA; the purpose and applications of wave traps; the station power requirements of AC station power systems; and the communication systems and interfaces related to integrated/automated substation control.

During this interactive course, participants will learn the substation commissioning and its start-up procedures; the proper procedure for managing the maintenance of the substation assets; the principles of implementing elements of a PdM program; the maintenance process automation and information integration tools, PdM diagnostic tests and the condition assessment for data evaluation and cost benefit analysis; the proper diagnostic testing of insulating materials that can be tested, dissolved gas analysis (DGA) and the physical and chemical testing related to oil quality assessment; the concept of solid dielectric diagnostics; the proper procedure of sampling techniques and protocols related to the maintenance, grounding and safety of electrical power substations; and the proper procedure of breaker oil analysis (BOA); the purpose, grounding theory, types of test equipment, inspection and testing related to substation grounding; and the operation, maintenance and troubleshooting procedures.

Training Objectives:

By the end of the training, participants will be able to:

- ✓ Apply and gain an in-depth knowledge on GIS substation maintenance and troubleshooting
- ✓ Discuss the different substation types and purposes as well as the fundamentals of power system operation and primary substation equipment
- ✓ List the major components and illustrate the construction and operation of power transformers and controls
- ✓ Illustrate the basic concepts of schematics and wiring diagrams
- ✓ Recognize the construction and operation of voltage regulators, power circuit breakers, circuit switchers, reclosers, capacitor banks and metalclad switchgear
- ✓ Identify the types and applications of disconnect switches and power fuses
- ✓ Explain the principles of operation of instrument transformers, purpose and types of protective relay systems, purpose and ratings of battery systems, purpose and functions of SCADA as well as the purpose and applications of wave traps

- ✓ List the station power requirements of AC station power systems and explain the communication systems and interfaces related to integrated/automated substation control
- ✓ Employ substation commissioning and its start-up procedures and the proper procedure for managing the maintenance of the substation assets
- ✓ Discuss the principles of implementing elements of a PdM program
- ✓ Carryout maintenance pricess automation and information integration tools, PdM diagnostic tests, condition assessment for data evaluation and cost benefit analysis
- ✓ Implement proper diagnostic testing of insulating materials that can be tested, dissolved gas analysis (DGA) and the physical and chemical testing related to oil quality assessment
- ✓ Discuss the concept of solid dielectric diagnostics which include paper insulation and transformer life, assessing life expectancy, degree of polymerization and furfural tests
- ✓ Apply proper procedure of sampling techniques and protocols related to the maintenance, grounding and safety of electrical power substations
- ✓ Illustrate proper procedure of breaker oil analysis (BOA), tap-changer signature analysis (TASA), transformer condition assessment, sulfur hexafluoride (SF6) testing and transformer oil analyst (TOA)
- ✓ Explain the principles of substation safety by focusing on electrical hazards, transportation and storage, installation and commissioning, protective clothing and first-aid measures, etc.
- ✓ Determine the purpose, grounding theory, types of test equipment, inspection and testing related to substation grounding as well as operate, maintain and troubleshoot procedures

Training Designed for:

This course is intended for electrical engineers, electrical maintenance personnel, plant electricians, electrical contractors, power specialists, maintenance managers, consultants and technologists responsible for the design, construction, installation, inspection, operation, or maintenance of electrical systems, electrical technicians, inspectors, safety personnel and other employees responsible for the operation and maintenance of electrical electric power substations. This includes, industrial, utility or plant engineers, maintenance supervisors, schedulers or planners, senior installation or maintenance technicians, consulting engineers, electric utility engineers involved in engineering, maintenance or operations.

Training Program:

DAY ONE:

- ❖ Pre-Test
- ❖ Introduction
- ❖ Substation Types and Purposes
  - Fundamentals of Power System Operation, Primary Substation Equipment
- ❖ Switchgear
  - Low Voltage, MV Metal Clad Switchgears, Motor Control Centers (MCC)
  - EHV Gas Insulated Switchgears (GIS), Advantages and Applications
  - Construction and Operation, Protection and Control
- ❖ Circuit Breaker Maintenance
  - Function of Circuit Breakers, ARC Phenomena and Circuit Interruption
  - Modern Vacuum Distribution Switchgears, Maintenance Frequencies
  - Inspection and Testing, Troubleshooting

DAY TWO:

- Circuit Breaker Maintenance (cont'd)
  - Checking the Closing Coil & Tripping Coils, CB Timing Test
  - Measuring the Contact Resistance, SF6 Dew-point & Purity Test
- Managing the Maintenance of Your Substation Assets
  - Identifying your Maintenance Goals
  - Maintenance Philosophies, Strategies and Definitions
  - Financial Savings of PdM and Maintenance Optimization
  - Key Options for Optimizing your Maintenance Process
  - Real time Winding Hot Spot Temperature Sensors for Power Transformers and other High Voltage Assets
  - Winding Hot Spot Temperature Measurement for Distribution Transformers
  - Infrared Thermal Imaging System in Real Time through Image Data for Remote Substation Monitoring and Security

DAY THREE:

- Implementing the Elements of PdM Program
  - Why Establish an Electrical Preventive Maintenance Program?
  - What is PdM Program and its Benefits?
  - How to Plan and Develop an Electrical Maintenance Program
  - Test Equipment Overview
  - PdM Program Elements and Diagnostic Technologies
  - Converting PdM Information to Action
  - Key Elements for a PDM Implementation Program, PdM Roles and Responsibilities
- PdM Diagnostic Tests
  - What they are and What they are Designed to Detect
  - Partial Discharge and Ultrasonic Noise Analysis, Vibration Analysis
  - Sound and Measuring Sound Levels, Infrared Imaging
  - Insulating Oil Quality, Physical Inspections

DAY FOUR:

- Diagnostic Testing of Insulating Materials
  - Insulating Materials as an Indicator of Equipment Condition
  - Types of Insulating Materials that can be Tested
  - Physical and Chemical Testing Fundamentals
  - The Chemistry of Insulating Materials Breakdown
- Dissolved Gas Analysis (DGA)
  - Dissolved Gas in Mineral-Based Insulating Fluids, Electrical and Thermal Faults
  - Dissolved Gas as an Indicator of Equipment Condition
  - Testing Transformers, LTC and OCBs
- Practical Sessions
  - This hands-on and includes real-life case studies and exercises

DAY FIVE:

- Oil Quality Assessment
  - Physical and Chemical Testing
  - Influence of Temperature, Oxidation and Contamination

- Dielectric Breakdown Voltage, Acidity, Interfacial Tension, Power Factor
- Oxidation Inhibitors

❖ Solid Dielectric Diagnostics
- Paper Insulation and transformer Life, Assessing Life Expectancy
- Degree of Polymerization and Furfural Tests
- Effects of Acidity, Moisture and Heat on Life Expectancy SF6 Gas Properties
- Sf6 Metal Enclosed Switchgear
- SF6 Apparatus and Components
- SF6 Circuit Breakers
- Insulation Coordination and Overvoltage Protection
- Handling, Maintenance, Inspection and Testing
- SF6 Troubleshooting

❖ Sulfur Hexafluoride (SF6) Testing
- Condition Monitoring without Internal Inspections, SF6 Gas Analysis
- Non-Instructive Testing of Arcing Contacts and Teflon Arcing Chamber Condition
- Safety and Environmental Concerns

❖ Course Conclusion
❖ Post-Test And Evaluation

Training Requirement:

"**Hand's on practical sessions, equipment** and **software** will be applied during the course if required and as per the client's request."

Please note that the above topics can be amended as per client's learning needs and objectives. Further, it should be forwarded to us a month prior to the course dates.

Training Methodology:

This interactive training course includes the following training methodologies as a percentage of the total tuition hours:

- 30% Lectures, Concepts, Role Play
- 70% Workshops & Work Presentations, Techniques, Based on Case Studies & Practical Exercises, Software & General Discussions
- Pre and Post Test

Training Certificate(s):

Internationally recognized certificate(s) will be issued to each participant who completed the course.

Training Fees:

As per the course location - This rate includes participant's manual, hand-outs, buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Note: The 5% VAT (Value Added Tax), will be effective starting 01st of January 2018 as per the new regulation from the UAE Government. The VAT applies for all quotation both for local and abroad.

Training Timings:

Daily Timings:

07:45 - 08:00	Morning Coffee / Tea
08:00 - 10:00	First Session
10:00 - 10:20	Recess (Coffee/Tea/Snacks)
10:20 - 12:20	Second Session
12:20 - 13:30	Recess (Prayer Break & Lunch)
13:30 - 15:00	Last Session

For training registrations or in-house enquiries, please contact:

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Training & Career Development Department