COURSE OVERVIEW EE0050
HV/MV Substation Design, Installation, Commissioning, Testing, Operation, Control & Maintenance

Course Title

HV/MV Substation Design, Installation, Commissioning, Testing, Operation, Control & Maintenance

Course Date/Venue

November 03-07, 2024/Club B Meeting Room, Ramada Plaza by Wyndham Istanbul City Center, Istanbul, Turkey

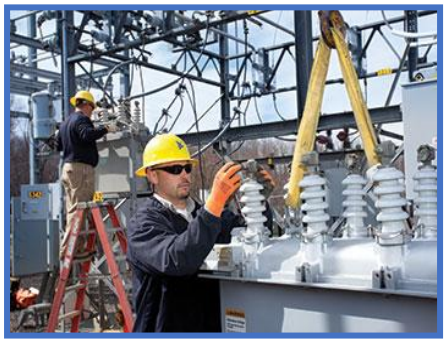
Course Reference

EE0050

Course Duration/Credits

Five days/3.0 CEUs/30 PDHs

Course Description



This practical and highly-interactive course includes real-life case studies and exercises where participants will be engaged in a series of interactive small groups and class workshops.

The electric power substation, whether generating station or transmission and distribution, remains one of the most challenging and exciting fields of electric power engineering. Recent technological developments have had tremendous impact on all aspects of substation design, operation, maintenance, safety, and grounding, testing and troubleshooting. A substation is a high – voltage electric system facility. It is used to switch generators, equipment, and circuits or lines in and out of a system. It is also used to change AC voltages from one level to another, and/or change alternating current to direct current or direct current to alternating current. Some substations are small with little more than a transformer and associated switches.

Others are very large with several transformers and dozens of switches and other equipment. Substations generally contain one or more transformers, and have switching, protection and control equipment. In a large substation, circuits breakers are used to interrupt any short-circuit or overload currents that may occur on the network. Smaller distribution stations may use Autoreclosers or even fuses for protection of branch circuits.

A typical substation will contain line termination structures, high-voltage switchgear, one or more power transformers, low voltage switchgear, surge protection, controls, and metering. Other devices such as power factor correction capacitors and voltage regulators may also be located at substation.

This course will introduce you to the equipment that makes up an electric substation. It will explain how each type of equipment operates and guide you through the control and wiring diagrams that control equipment operation. At this course you will learn about the latest diagnostic testing techniques for assessing the condition of substation equipment such as transformers, circuit breakers, load tap changers, switches, and associated equipment. Knowledge of equipment condition allows you to target your maintenance efforts to reduce equipment failures and improve substation reliability. The course will show you how to apply predictive diagnostic testing to reduce equipment failures and extend equipment life.

Applying predictive maintenance (PdM) methods can reduce your costs and improve the performance of your maintenance program. This course will show you methods and case studies that illustrate how to incorporate these new methods and testing techniques to improve reliability and optimize your existing maintenance program. You will study the latest testing technologies and how to apply them to determine the condition of oil and gas insulated transformers, circuit breakers, and other electrical equipment. Learn how these modern techniques allow determination of equipment condition without taking the equipment out of service.

Electrical substation safety is an important issue in utility networks as well as large industrial installations and requires adequate attention in the stages of system planning, design, installation, operation and maintenance. A number of serious accidents including fatalities occur every year in industrial establishments due to accidents involving electricity, resulting in huge financial losses and wasted man-hours. In this course, we will take a look at the theoretical aspects of safety as well as the practical and statutory issues.

Good substation grounding is very important for effective relaying and insulation of equipment; but the safety of the personnel is the governing criterion in the design of substation grounding. It usually consists of a bare wire grid, lain in the ground; all equipment grounding points, tanks, support structures, fences, shielding wires and poles, and so forth, are securely connected to it. The grounding resistance is reduced enough that a fault from high voltage to ground does not create such high potential gradients on the ground, and from the structures to ground, to present a safety hazard. Good overhead shielding is also essential for outdoor substations, so as to virtually eliminate the possibility of lighting directly string the equipment. Shielding is provided by overhead ground wires stretched across the substation or tall grounded poles. This course will discuss how to maintain, test, and inspect a proper grounding system for the electrical power substation.

Course Objectives

Upon the successful completion of this course, each participant will be able to:-

- Design, install, commission, test, operate, control and maintain HV/MV substations in a professional manner
- Identify the various types of substations covering its parts, equipment and major components
- Recognize overcurrent protection for phase and earth faults as well as the recommended grading intervals
- Enumerate test requirements and component testing procedures
- Employ proper commissioning covering pre and cold commissioning, start-up, hot commissioning, start of production, performance test and acceptance of plant
- Carryout megger testing and substation grounding system
- Discuss the qualifications of testing organizational and personnel covering the division of responsibility and power system studies
- Perform testing procedures and basic calculations
- Illustrate medium voltage switchgear and oil circuit breakers
- Employ insulation testing and maintenance covering insulation-resistance meters and polarization of index

Who Should Attend

This course provides an overview of all significant aspects and considerations HV/MV substation for those who are involved in the design, installation, commissioning, maintenance, testing, control and operation of electrical substation equipment. This includes industrial, utility or plant engineers, maintenance supervisors, consulting engineers, electric utility engineers and other technical staff.

Training Methodology

All our Courses are including **Hands-on Practical Sessions** using equipment, State-of-the-Art Simulators, Drawings, Case Studies, Videos and Exercises. The courses include the following training methodologies as a percentage of the total tuition hours:-

30% Lectures
20% Practical Workshops & Work Presentations
30% Hands-on Practical Exercises & Case Studies
20% Simulators (Hardware & Software) & Videos

In an unlikely event, the course instructor may modify the above training methodology before or during the course for technical reasons.

Course Fee

US$ 6,000 per Delegate + **VAT**. This rate includes Participants Pack (Folder, Manual, Hand-outs, etc.), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Course Certificate(s)

Internationally recognized certificates will be issued to all participants of the course who completed a minimum of 80% of the total tuition hours.

Certificate Accreditations

Certificates are accredited by the following international accreditation organizations: -

- The International Accreditors for Continuing Education and Training (IACET - USA)

  Haward Technology is an Authorized Training Provider by the International Accreditors for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, VA 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 2018-1 Standard** which is widely recognized as the standard of good practice internationally. As a result of our Authorized Provider membership status, Haward Technology is authorized to offer IACET CEUs for its programs that qualify under the **ANSI/IACET 2018-1 Standard**.

  Haward Technology's courses meet the professional certification and continuing education requirements for participants seeking **Continuing Education Units** (CEUs) in accordance with the rules & regulations of the International Accreditors for Continuing Education & Training (IACET). IACET is an international authority that evaluates programs according to strict, research-based criteria and guidelines. The CEU is an internationally accepted uniform unit of measurement in qualified courses of continuing education.

  Haward Technology Middle East will award **3.0 CEUs** (Continuing Education Units) or **30 PDHs** (Professional Development Hours) for participants who completed the total tuition hours of this program. One CEU is equivalent to ten Professional Development Hours (PDHs) or ten contact hours of the participation in and completion of Haward Technology programs. A permanent record of a participant's involvement and awarding of CEU will be maintained by Haward Technology. Haward Technology will provide a copy of the participant's CEU and PDH Transcript of Records upon request.

- British Accreditation Council (BAC)

  Haward Technology is accredited by the **British Accreditation Council** for **Independent Further and Higher Education** as an **International Centre**. BAC is the British accrediting body responsible for setting standards within independent further and higher education sector in the UK and overseas. As a BAC-accredited international centre, Haward Technology meets all of the international higher education criteria and standards set by BAC.

Accommodation

Accommodation is not included in the course fees. However, any accommodation required can be arranged at the time of booking.

Course Instructor(s)

This course will be conducted by the following instructor(s). However, we have the right to change the course instructor(s) prior to the course date and inform participants accordingly:

Mr. Sherif Bayoumi, BSc, is a **Senior Electrical Engineer** with over **40 years** of extensive experience within **Oil**, **Gas**, **Petrochemical** and **Power** industries. His expertise widely covers **HV/LV Equipment**, **High Voltage Electrical Safety**, **LV & HV Electrical System**, **HV Equipments Inspection & Maintenance**, **HV Switchgear Operation & Maintenance**, **LV Distribution Switchgear & Equipment**, **Lock & Tag Out**, **Circuit Breakers & Switchgears**, **Electrical Systematics Troubleshooting**, **Electrical Distribution Systems & Control Circuits**, Electrical Parameters, **Symmetrical & Unsymmetrical Faults**, **Electrical Drawings**, **Relay Logic Circuits**, Test Requirements, Component Testing Procedures, Electrical & Control System, Troubleshooting **Transformers**, **Equipment** Troubleshooting, **System Grounding**, **Circuit Breakers**, **Protection Devices & Technology**, **Protection Relay**, **Solid State Relay**, Instrument **Transformers**, Grading & Protection Coordination, Electrical System & Equipment, **Generators**, **Gas Turbine**, Diesel Generators, **Power Transformers**, **AC & DC Motors**, **Substations**, **Switchgears & Distribution**, **Power System** Analysis, **Electrical Equipment Control Systems**, **Cables &** Domestic **Wiring**, **Overhead Transmission Lines**, **Electrical Safety**, **Electrical Protection**, **Batteries**, **Chargers & UPS**, Electrical Projects Handling, Electrical Measurements, Medium Voltage Switchgears (MVSG), Motor Control Centers (**MCC**), **Electrical Submersible Pumps** (**ESP**). He is also well-versed in **Preventive Maintenance**, Health, Safety & Environmental Management System (**HSEMS**), On-Shore & Off-Shore Electrical Installations, Engineering Studies, Water Desalination Units, **Induction Motors**, **Power Supply** Substations, Electro-mechanical Protection **Relays**, **Engineering Drawings**, **Industrial Power System Coordination**, **Machinery Vibration**, **Dynamic Balancing** Analysis, Material & Equipment Standard & Code System, Hazardous Area Classification, Safety Management System, Emergency Response, Permit to Work & Issuing Authority, Defensive Driving and Task Risk Assessment.

During Mr. Sherif's career life, he has occupied various key positions in several companies such as the **Electrical Maintenance Engineer**, **Senior Electrical Support Engineer**, **Lead Maintenance Electrical Engineer**, **Maintenance Electrical Engineer**, **Specialist Electrical Engineer** in **Abu Dhabi Company for Onshore Oil Operations** (**ADCO**), Gulf of Suez Petroleum Company (**GUPCO**) and West Desert Petroleum Company (**WEPCO**).

Mr. Sherif has a **Bachelor's** degree in **Electrical Power Engineering**. Further, he is a **Certified Instructor/Trainer** and has delivered numerous courses, trainings, workshops, seminars and conferences internationally.

Course Program

The following program is planned for this course. However, the course instructor(s) may modify this program before or during the course for technical reasons with no prior notice to participants. Nevertheless, the course objectives will always be met:

Day 1: Sunday, 15th of September 2024

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Types of Substations***
0930 – 0945	*Break*
0945 – 1030	***Substations Parts & Equipment***
1030 – 1100	***Major Components***
1100 – 1230	***Overcurrent Protection for Phase & Earth Faults***
1230 – 1245	*Break*
1245 – 1420	***Recommended Grading Intervals*** *Relay Connections ● Earth Fault Protection ● Overcurrent Protection (Relay Connections, Residual Voltage, Sensitive Wattmetric Protection) ● Transformers Function*
1420 – 1430	***Recap***
1430	*Lunch & End of Day One*

Day 2: Monday, 16th of September 2024

0730 – 0830	***Test Requirements*** *Division of Responsibility ● Power System Studies ● Test Report ● Test Instrument Calibration*
0830 – 0930	***Component Testing Procedures*** *Test Equipment Used (Instrumentation & Control Systems in the Process Industry: Specific Phases & Milestone)*
0930 – 0945	*Break*
0945 – 1100	***Commissioning*** *Pre-commissioning ● Cold Commissioning ● Start-up ● Hot Commissioning ● Start of Production ● Performance Test ● Acceptance of Plant ● Process Industry*
1100 – 1230	***Commissioning (cont'd)*** *General Preparations before Acceptance of Plant ● Completion of Erection ● Mechanical Checks & Tests ● Testing Procedures ● Cables ● High Potential Testing ● Procedure*
1230 – 1245	*Break*
1245 – 1420	***Megger Test*** *Bucholtz Relay ● Temperature Relay's ● Transformer Ratio Test ● Transformer Vector Test ● Positive Sequence Impedance Test (Short Circuit Test) ● Restricted Earth Fault*
1420 – 1430	***Recap***
1430	*Lunch & End of Day Two*

Day 3: Tuesday, 17th of September 2024

0730 – 0930	***Substation Grounding Systems*** *Reasons for Substation Grounding System ● Substation Earthing Calculation ● The Layout of the Substation ● Principle of Substation Layouts*
0930 – 0945	*Break*
0945 – 1100	***Substation Grounding Systems (cont'd)*** *Components of a Substation ● Understanding Electrical Drawings ● The Schematic Diagram (Main & Circuit) ● Racking & Routing*
1100 – 1230	***Substation Grounding Systems (cont'd)*** *Installation Detail ● Panel Layout ● Other Electrical Documents ● Standardization of Symbols ● Sample Schemetics*
1230 – 1245	*Break*
1245 – 1420	***Qualifications of Testing Organizational & Personnel*** *Division of Responsibility ● Power System Studies*
1420 – 1430	***Recap***
1430	*Lunch & End of Day Three*

Day 4: Wednesday, 18th of September 2024

0730 – 0930	***Testing Procedures*** *Pressure Testing ● Procedure ● Substation Control & Automation ● Tapology & Functionality*
0930 – 0945	*Break*
0945 – 1100	***Testing Procedures (cont'd)*** *System Elements ● System Requirements ● Hardware Implementation*
1100 – 1230	***Testing Procedures (cont'd)*** *HMI-Based Tapology ● RTU-Based Tapology ● Decentralized Tapology ● Communication Methods*
1230 – 1245	*Break*
1245 – 1420	***Testing Procedures (cont'd)*** *Network Protocols ● Substation Automation Functionality ● System Configuration & Testing*
1420 – 1430	***Recap***
1430	*Lunch & End of Day Four*

Day 5: Thursday, 19th of September 2024

0730 – 0930	***Basic Fault Calculations*** *Need for Protection ● Faults, Types & Effects ● Simple Calculations of Short Circuits*
0930 – 0945	*Break*
0945 – 1100	***Medium Voltage Switchgear***
1100 – 1230	***Oil Circuit Breakers*** *Air Blast Circuit Breakers ● Operating Mechanisms ● SF6 & Vacuum Circuit Breakers ● SF6 Gas Analysis*
1230 – 1245	*Break*
1245 – 1345	***Insulation Testing & Maintenance*** *Insulation-Resistance Meters ● Polarization Index*
1345 – 1400	***Course Conclusion***
1400 – 1415	***POST-TEST***
1415 – 1430	*Presentation of Course Certificates*
1430	*Lunch & End of Course*

Practical Sessions

This practical and highly-interactive course includes real-life case studies and exercises:-

Course Coordinator

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