

COURSE OVERVIEW EE0060

LV/MV/HV Circuit Breakers and Switchgear

Specification, Design, Operation, Inspection, Testing, Maintenance, Repair & Troubleshooting

Course Title

LV/MV/HV Circuit Breakers and Switchgear: *Specification, Design, Operation, Inspection, Testing, Maintenance, Repair & Troubleshooting*



Course Date/Venue

February 09-13, 2025/Zafaran Meeting Room, The Tower Plaza Hotel, Dubai, UAE

Course Reference

EE0060

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.



This course is designed to update participants with the latest development of Circuit Breakers and to present some of the more common and updated aspects of low, medium and high voltage switchgear maintenance. It must be understood that there is an incredible variety of equipment used on low, medium and high voltage switchgear today. Switchgears play an important role in the protection, distribution and control of electrical power in manufacturing or power plant and in a utility distribution system. Negligent maintenance practices can lead to power system inefficiency and loss of system reliability.



An older plant may have switchgear that was built in the forties in the older areas and modern switchgear in other areas as the plant was upgraded. This course will present maintenance problems to the maintenance manager and technician. Newer plants will probably have modern equipment of a limited variety and manufacture. It is these similarities that will be covered in the course.

Course Objectives

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

- Specify, design, operate, inspect, test, maintain, repair and troubleshoot circuit breakers and switchgears
- Apply an in-depth knowledge and skills on LV/MV/HV circuit breakers and switchgears
- Describe the switchgear details such as ratings, degree of protection, service conditions and ancillary equipment
- Explain switchgear asset management including CBM and RCM process, tripping devices, maintenance and testing
- Apply load and fault calculation to decide the task of protection system and the operating conditions of power system
- Explain circuit breaker control circuits, types and application of protective relays, structure of control circuits and the use and application of current and voltage transformers
- Discuss circuit breaker characteristics in relation to protection control circuits, selectivity, sensitivity and speed of the control circuits
- Recognize the value of earthing system to protection control circuits and the power system protection as well as fault clearance and power system redundancy through control system application
- Identify the various switchgear diagnostic techniques and employ the different types of substation circuit breaker techniques and determine the switchgear vital equipment including batteries condition and monitoring, relay applications for basic and complex busbar arrangements and zone selection logic
- Employ the substation maintenance techniques and discuss their description, structures, features and functions
- Apply the switchgear maintenance practices and improve maintenance and repair procedures
- Carryout maintenance work orders including their process development, procedures and problems encountered
- Introduce computerized maintenance management systems (CMMS) and recognize its importance in circuit breakers design, inspection, maintenance, repair and troubleshooting

Exclusive Smart Training Kit - H-STK®



Participants of this course will receive the exclusive “Howard Smart Training Kit” (H-STK®). The H-STK® consists of a comprehensive set of technical content which includes **electronic version** of the course materials conveniently saved in a **Tablet PC**.

Who Should Attend


This course provides an overview of all significant aspects and considerations of Circuit Breakers and Switchgears for engineers and other technical staff who need a sound understanding of Low, Medium and High Voltage Switchgear and Circuit Breaker specification, design, operation, inspection, testing, maintenance, repair and troubleshooting.

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: -

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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.

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USA International Association for Continuing Education and Training (IACET)

Haward Technology is an Authorized Training Provider by the International Association for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, Virginia 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 1-2013 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 1-2013 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 Association 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.

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. Pan Marave, PE, MSc, BEng, is a **Senior Electrical & Instrumentation Engineer** with over **40 years** of extensive experience in **Oil, Gas, Petrochemical, Refinery & Power** industries. His expertise includes **Circuit Breaker, HV Switchgear Maintenance, HV/LV Electrical Authorisation, Basic Electricity, Electrical & Special Hazards, Personnel Protection, HV/LV Equipment, Motor Controllers, Electrical Switching Practices, Emergency Planning, Safety Management, Safety Instrumented Systems (SIS), Safety Integrity Level (SIL), Emergency Shutdown (ESD); DCS, SCADA & PLC; Measurement (Flow, Temperature, Pressure); Process Analyzers & Analytical Instrumentation; Process Control, Instrumentation & Safeguarding; Process Controller, Control Loop & Valve Tuning; Industrial Distribution Systems; Industrial Control & Control Systems, Power Systems Protection & Relaying; Earthing, Bonding, Grounding, Lightning & Surge Protection; Electric Power Substation & Systems; Electrical Engineering Principles; Motor Control Circuit; Electrical Fault Analysis; Electrical Networks & Distribution Cables; Circuit Breakers, Switchgears, Transformers, Hazardous Areas Classification and Detailed Engineering Drawings, Codes & Standards**. Furthermore, he is also well-versed in Microprocessors Structure, Lead Auditor (**ISO 9000:2000**), **ISO 9002**, Quality Assurance, and Projects & Contracts Management.

Presently, Mr. Marave is the **Technical Advisor** of **Chamber of Industry & Commerce** in Greece. Prior to this, he gained his thorough practical experience through several positions as the **Technical Instructor, Engineering Manager, Electronics & Instruments Head, Electrical, Electronics & Instruments Maintenance Superintendent, Assistant General Technical Manager** and **Engineering Supervisor** of various international companies such as the **Alumil Mylonas, Athens Papermill, Astropol** and the **Science Technical Education**.

Mr. Marave is a **Registered Professional Engineer** and has **Master's** and **Bachelor's** degrees in **Electrical Engineering** from the **Polytechnic Institute of New York** and **Pratt Institute of New York (USA)** respectively. Further, he is a **Certified Instructor/Trainer, a Certified Internal Verifier/Assessor/Trainer** by the **Institute of Leadership & Management (ILM)** and an active member of the **Technical Chamber** and the **Institute of Electrical and Electronics Engineer (IEEE)** in Greece. He has presented and delivered **numerous international** courses, conferences, trainings and workshops worldwide.

Course Fee

US\$ 5,500 per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

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 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, 09th of February 2025

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| 0730 – 0800 | Registration & Coffee |
| 0800 – 0815 | Welcome & Introduction |
| 0815 – 0830 | PRE-TEST |
| 0830 – 0930 | Introduction Voltage Convention • Fundamentals of Circuit Breakers • Types of Breakers, Construction • Ratings, Tripping Characteristics |
| 0930 – 0945 | Break |
| 0945 – 1100 | Switchgear in a Network Context Single Line • Utilization |
| 1100 – 1230 | Switchgear in Historical Perspective Oil Circuit Breakers • Air Blast CB • SF6 and Vacuum CB • Operating Mechanisms |
| 1230 – 1245 | Break |
| 1245 – 1420 | Switchgear Details Ratings Ur, Ik, Ip, Va • Degree of Protection • Service Conditions • Ancillary Equipment |
| 1420 – 1430 | Recap |
| 1430 | Lunch & End of Day One |

Day 2: Monday, 10th of February 2025

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| 0730 – 0930 | Switchgear Asset Management Equipment Register • CBM and RCM Process • Switchgear Diagnostic Techniques • Tripping Devices & Maintenance & Testing |
| 0930 – 0945 | Break |
| 0945 – 1100 | Circuit Breakers Control Circuits Philosophy, Types & Application of Protective Relays • Control System Structure, Instrument Transformers • Current & Voltage Transformers • Panels, Signalling, Interlocking |
| 1100 – 1230 | Circuit Breakers Control Circuits (cont'd) Typical Connection Diagrams • Primary & Back-up Relaying • Fault Calculation • System Earthing • Circuit Breakers Characteristics • Selectivity, Sensitivity, Speed • Reliability |
| 1230 – 1245 | Break |



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| 1245 – 1420 | Circuit Breakers Control Circuits (cont'd) Evaluation of Protection Relaying • Setting of Protection • Fault Clearance • Redundant Control Circuits |
| 1420 – 1430 | Recap |
| 1430 | Lunch & End of Day Two |

Day 3: Tuesday 11th of February 2025

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| 0730 – 0930 | Case Study Circuit Breaker Settings • Selectivity, Sensitivity, Speed |
| 0930 – 0945 | Break |
| 0945 – 1100 | Circuit Breaker Diagnostic Techniques Diagnostic Techniques |
| 1100 – 1230 | Switchgear Vital Equipments Batteries Condition and Monitoring • Discussions |
| 1230 – 1245 | Break |
| 1245 – 1420 | LV/MV/HV Substation Bus Arrangement, Incoming and Outgoing Circuits Automatic Switching During Normal or Abnormal Conditions, Bus Protection & Circuit Breaker System • Bus Differential & Breaker Failure Relay, Zone Selection Logic & CT Requirements |
| 1420 – 1430 | Recap |
| 1430 | Lunch & End of Day Three |

Day 4: Wednesday 12th of February 2025

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| 0730 – 0930 | Substation Maintenance Techniques Description • Structures • Fuses, Arresters, Switches • Substation Compound • Switchgear Maintenance Practices • Metal Clad Switchgear • Maintenance Details |
| 0930 – 0945 | Break |
| 0945 – 1100 | Substation Maintenance Techniques (cont'd) Metal Clad Switchgear Maintenance Details • Discussions |
| 1100 – 1230 | Substation Maintenance Techniques (cont'd) Maintenance & Repair Fundamentals |
| 1230 – 1245 | Break |
| 1245 – 1420 | Substation Maintenance Techniques (cont'd) Maintenance & Repair Procedures |
| 1420 – 1430 | Recap |
| 1430 | Lunch & End of Day Four |

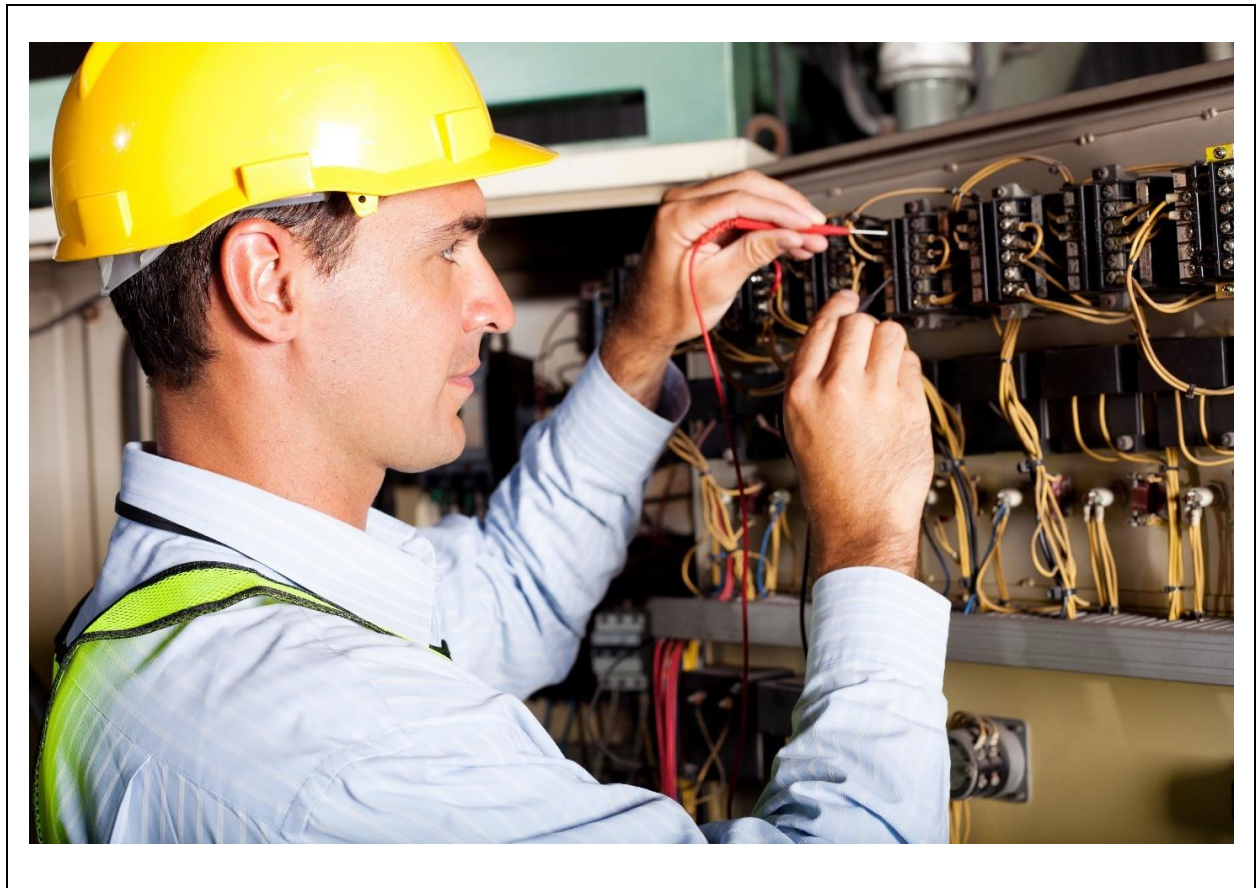
Day 5: Thursday 13th of February 2025

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| 0730 – 0930 | Maintenance Work Orders Maintenance & Repair Procedures (cont'd) |
| 0930 – 0945 | Break |
| 0945 – 1100 | Maintenance Work Orders (cont'd) Process Development • Procedures |
| 1100 – 1230 | Maintenance Work Orders (cont'd) Problems Encounters • Samples, Discussions |
| 1230 – 1245 | Break |

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| 1245 - 1345 | Fundamentals of Computerized Maintenance (CMMS) |
| 1345 - 1400 | Course Conclusion |
| 1400 - 1415 | POST-TEST |
| 1415 - 1430 | <i>Presentation of Course Certificates</i> |
| 1430 | <i>Lunch & End of Course</i> |

Practical Sessions

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



Course Coordinator

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