

COURSE OVERVIEW EE0076(AL4)-4D
LV/MV/HV Switchgear Operation & Maintenance

Course Title

LV/MV/HV Switchgear Operation & Maintenance

Course Date/Venue

Session 1: July 15-18, 2024/Al Aziziya Hall, The Proud Hotel Al Khobar, Al Khobar, KSA
 Session 2: October 14-17, 2024/Boardroom 1, Elite Byblos Hotel Al Barsha, Sheikh Zayed Road, Dubai, UAE

Course Reference

EE0076(AL4)-4D

Course Duration/Credits

Four days/2.4 CEUs/24 PDHs



Course Description



This practical and highly-interactive course includes various practical sessions and exercises. Theory learnt will be applied using our state-of-the-art simulators.



This course is designed to provide delegates with detailed and up-to-date overview of switchgear. It covers operation and maintenance of LV/MV/HV switchgear up to 220kV. It includes in-depth discussion on operation, troubleshooting, repair and maintenance, safe isolation and deisolation of switchgear of low, medium and high voltage systems up to 220kV.



The course will describe voltage convention classifications, switchgear components and their function, the protection system for generator, transformer and motor including switchgear construction, ground fault relay system and the three basic types of low and medium voltage circuit breaker contacts.

Safe operation, isolation, deisolation, inspection, maintenance and troubleshooting of LV/MV/HV switchgear will also be carried out during the course.

Course Objectives

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

- Operate and maintain LV/MV/HV switchgear in a professional manner
- List the voltage convention classifications
- Describe switchgear components and their function
- Explain the protection system for generator, transformer and motor
- Identify switchgear construction, ground fault relay system and the three basic types of low and medium voltage circuit breaker contacts
- Employ safe operation, isolation, deisolation, inspection, maintenance and troubleshooting of LV/MV/HV switchgear

Exclusive Smart Training Kit - H-STK®



Participants of this course will receive the exclusive “Haward 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 switchgear for power operation and maintenance management employees who are involved in the operation, troubleshooting, repair, maintenance, safe isolation and deisolation of low, medium and high voltage switchgears.

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.

Accommodation

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

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 accreditation by the following international accreditation organizations:

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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 **2.4 CEUs** (Continuing Education Units) or **24 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.

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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.

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. Anouar Dhifallah, MSc, BSc, is a Senior Electrical Engineer with over 20 years of extensive experience within the Oil, Gas, Petrochemical, Refinery & Power industries. His expertise widely covers in the areas of MV Substation Maintenance, HV/MV Cable Splicing, Cable & Over Head Power Line, HV/MV Switchgear, HV Cable Design, Cable Splicing & Termination, Cable Jointing Techniques, LV & MV Switchgears & Circuit Breakers, HV/LV Equipment, High Voltage Electrical Safety, LV & HV Electrical System, HV Equipment Inspection & Maintenance, HV Switchgear Operation & Maintenance, LV Distribution Switchgear & Equipment, Electrical Safety, Electrical Maintenance, Inspection, Testing & Risk Assessment, Electrical Generator Protection, Electrical Generator Testing & Maintenance, Programmable Logic Controller (PLC), Distribution Control System (DCS), Temperature, Flow & Level Measurement, Pneumatic & Hydraulic Technologies, Substation Automation Systems & Application, Testing & Maintenance of Electrical Substations, Electrical Substation 33/11KV Design, Electrical Power Substation Maintenance, Substation Quality Control & Site Inspection, Electrical Forecasting Techniques, Transformer Maintenance & Testing, Electrical Quality Control & Site Inspection, Electrical Installation Works Designs & Supervision, Electrical Equipment Inspection, Testing & Troubleshooting, Lighting Installation Design, Electric Distribution System, Load Forecasting Methods, Transmission & Distribution Analysis, Circuit Breakers Inspection & Maintenance, Protective Relaying, Electrical & Control System, Switchgears, Transformers, Medium & High Voltage Equipment, Circuit Breakers, Cable & Overhead Line Troubleshooting & Maintenance, High Voltage Circuit Breaker Inspection & Repair, High Voltage Power System, Electrical Standards, Electrical Drawing & Schematics, Voltage Distribution, Power Distribution, Filters, Automation System, Electrical Variable Speed Drives, Power Systems, Power Generation, Diesel Generators, Power Stations, Uninterruptible Power Systems (UPS), Battery Chargers, AC & DC Transmission, CCTV Installation, Data & Fire Alarm System, Security Systems, Evacuation Systems and Electrical Motors & Variable Speed Drives, Renewable Energy and Installation & Control of Electrical and Electronic devices.

During Mr. Anouar’s career life, he has gained his practical experience through several significant positions and dedication as the **Electrical & Instrumentation Department Head, Technical Services Manager, Senior Electrical Engineer, Electrical Instructor and Instructor/Trainer** from various companies, colleges and institutes like the Technical School of Zarzis, Rancho Santiago College, Al Baha Technical College, **ARAMCO, PDO** and Tunisie Telecom Co.

Mr. Anouar has a **Master’s degree in Electronics & Telecommunication Engineering** and a **Bachelor’s degree in Electrical & Instrumentation Engineering**. Further, he is a **Certified Instructor/Trainer, a Certified Coach** from the International Coaching Federation (ICF) and delivered numerous trainings, courses, workshops, seminars and conferences internationally.

Course Fee

US\$ 4,500 per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

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

0730- 0800	<i>Registration & Coffee</i>
0800 - 0815	<i>Welcome & Introduction</i>
0815 - 0830	PRE-TEST
0830 - 0930	General Introduction <i>Electrical Engineering Basic Concepts • Three Phase Review & Per Unit • Voltage Levels • One Line & Three Line Diagram • Generation System Layout • Transmission System Layout • Substation System Layout • Distribution System Layout</i>
0930 - 0945	<i>Break</i>
0945 - 1045	Industrial Switchgear <i>Fuses • Auto-reclosers • Automatic Sectionalizer • Circuit Breakers • Isolator Switches • Load Switches • Relays • Current Transformers • Voltage Transformers</i>
1045 - 1130	CB Design Specification Based on Short Circuit Current Level <i>Per Unit System • Faults on Power Systems • Typical Protection System for Generator/Transformer/Motor • Transient Phenomena in Power System • Symmetrical Component Analysis of Three Phase Network</i>
1130 - 1230	CB Design Specification Based on Short Circuit Current Level (cont'd) <i>Network Connection for Various Fault Types • Current & Voltage Distribution in System Due to a Fault • Effect of System on Zero Sequence Quantities • Computer Programs Based Short Circuit Calculation</i>
1230 - 1245	<i>Break</i>
1245 - 1420	CB Design Specification Based on Arc Phenomena & Circuit Interruption <i>Arc Phenomena • Maintenance of the Arc • Properties of Arc • Arc Interruption Theory • Circuit Breaker Rating • Circuit Constants & Circuit Conditions • Conditions of Severity • Restriking Voltage Transient • Class A Ultra Fast Transients • Class B System Transients • Class C Low Transients • Transmission Line Transient • Switching Transients • Duties of Switchgear</i>
1420 - 1430	Recap
1430	<i>Lunch & End of Day One</i>

Day 2

0730 - 0930	LV Circuit Breakers & Switchgear <i>Low Voltage Molded Case Current Limiting Circuit Breakers • Low Voltage Molded Case Circuit Breakers with High Breaking Capacity • Insulated Case Circuit Breakers • Low Voltage Air Circuit Breakers</i>
0930 - 0945	<i>Break</i>



0945 - 1045	LV Circuit Breakers & Switchgear (cont'd) Low Voltage Circuit Breakers Specification • Low Voltage Circuit Breakers & Switchgear Safety Aspects • Low Voltage Circuit Breakers & Switchgear Safe Operation
1045 - 1130	Air Circuit Breakers & Switchgear up to 11.5kV Method of Increasing Arc Resistance • Plan Break Type • Magnetic Blow Out Type • Arc Splitter Type • Application • Construction & Operation • Axial Air CB • Blast Air CB
1130 - 1230	Oil Circuit Breakers & Switchgear 11.5kV Arc Rupture Under Oil • Advantages of Oil • Disadvantages of Oil • Plan Break Oil Circuit Breakers • Arc Control Circuit Oil Breakers • Minimum Oil Circuit Breakers • Construction & Operation
1230 - 1245	Break
1245 - 1420	Modern Vacuum CB & Switchgear 11.5kV Introduction • Advantages of Vacuum Interruption • Vacuum Contactors & Interrupters • The Vacuum Medium • The Vacuum Arc • Vacuum Arc Stability • Vacuum Break Down • Vacuum Switch Construction • Applications of Vacuum Circuit Breakers • Vacuum Circuit Breakers & Switchgear Safety Aspects • Vacuum Circuit Breakers & Switchgear Safe Operation
1420 - 1430	Recap
1430	Lunch & End of Day Two

Day 3

0730 - 0930	DC Circuit Breakers & Switchgear Construction • Methods of Interruption • Application • Construction & Operation
0930 - 0945	Break
0945 - 1045	Modern SF6 CB & Switchgear up to 33kV Basic Features of SF6 Switchgear • Dielectric Properties of SF6 • Quenching Properties of SF6 • Construction of SF6 Switchgear • SF6 CB Types • Puffer Type SF6 Breakers
1045 - 1130	Modern SF6 CB & Switchgear up to 33kV (cont'd) Double Pressure System • Single Pressure Puffer-Piston System • Single Pressure Self Blast System • Improvement in SF6 Breakers for HV • SF6 Circuit Breakers & Switchgear Safety Aspects • SF6 Circuit Breakers & Switchgear Safe Operation
1130 - 1230	132kV GIS Basic Features of SF6 Switchgear 132kV GIS • Current Rating • Busbar & Connection Gas Chambers • Circuit Breakers & Operating Mechanism • Disconnectors & Earthing Switches • Interlocking, Auxiliary Switches & Contactors • Current Transformers & Voltage Transformers • Gas Handling Equipment • SF6 Circuit Breakers & Switchgear Safety Aspects • SF6 Circuit Breakers & Switchgear Safe Operation
1230 - 1245	Break



1245 - 1420	220kV GIS Basic Features of SF6 Switchgear 220kV GIS • Current Rating • Busbar & Connection Gas Chambers • Circuit Breakers & Operating Mechanism • Disconnectors & Earthing Switches • Interlocking, Auxiliary Switches & Contactors • Current Transformers & Voltage Transformers • Gas Handling Equipment • SF6 Circuit Breakers & Switchgear Safety Aspects • SF6 Circuit Breakers & Switchgear Safe Operation
1420 - 1430	Recap
1430	Lunch & End of Day Three

Day 4

0730 - 0930	Switchgear Inspection, Maintenance & Services Inspection • General Inspection Technical Procedure • Daily Inspection of Circuit Breakers • Monthly Inspection of Circuit Breakers • Annual Inspection of Circuit Breakers • Disassembly • Cleaning • Tightening • Lubrication • Equipment Used in Testing • Testing Procedure • Direct Testing • Contact Resistance Test • Insulation Resistance Test • Test Report • Indirect Testing
0930 - 0945	Break
0945 - 1045	Switchgear Control, Protection & Testing Switchgears Control Devices & Wiring • Switchgears Protection Devices & Wiring
1045 - 1130	Switchgear Control, Protection & Testing (cont'd) Testing Classification • Testing Laboratories • Description of a Simple Testing Station
1130 - 1230	Switchgear Troubleshooting Low Insulation Resistance (Below 2000 Mega-ohms) between Phase Terminal & Earthed Frame with Breaker Closed & Phase Terminals of a Pole • Resistance between Terminals of Pole too High (Above 100 Microhms) (15 Micro-ohm per Joint) Contact Unequal Contact Wipe & Travel in 3-pole Measured from Top Surface of Interrupter Flange & the Contact Lip by a Simple Rod with Breaker Open & Breaker Closed
1230 - 1245	Break
1245 - 1345	Switchgear Troubleshooting (cont'd) One of the Pole Does Not Close • Breaker Operation too Slow during Opening Timing from Trip Command to Contact Separation Instant too Large (60 ms instead of say 40 ms)
1345 - 1400	Course Conclusion Using this Course Overview, the Instructor(s) will Brief Participants about the Course Topics that were Covered During the Course
1400 - 1415	POST-TEST
1415 - 1430	Presentation of Course Certificates
1430	Lunch & End of Course



Simulators (Hands-on Practical Sessions)

Practical sessions will be organized during the course for delegates to practice the theory learnt. Delegates will be provided with an opportunity to carryout various exercises using our state-of-the-art “GE Multilin Relay 469” and “GE Multilin Relay 750” simulators.



GE Multilin Relay 469 Simulator



GE Multilin Relay 750 Simulator

Course Coordinator

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