COURSE OVERVIEW EE0069(AD4)
High Voltage Switchgears

Course Title
High Voltage Switchgears

Course Date/Venue
Session 1: June 15-19, 2025/Crowne Meeting Room, Crowne Plaza Al Khobar, KSA
Session 2: September 14-18, 2025/ Boardroom 1, Elite Byblos Hotel Al Barsha, Sheikh Zayed Road, Dubai, UAE

3.0 CEUs (30 PDHs) AWARD

Course Reference
EE0069(AD4)

Course Duration/Credits
Five days/3.0 CEUs/30 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 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 and 132 KV cables. 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 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.

This course provides invaluable information to those who wish to understand the role of acceptance testing, commissioning and start-up of circuit breakers, switchgears and 132 KV cables. The importance of planning and preparation for the project, from engineering to commissioning and start-up, will be emphasized. This course deals with safety considerations and testing and start-up procedures for the major components of substation and particularly the switchgears and the 132 KV cables.

By reviewing electrical testing specifications developed by NETA, ANSI IEC 62337 and NEC 2011 participants can create a commissioning program designed to meet their facility's needs. It will also help them decide what can be done by in-house personnel and what is best left to an accredited electrical maintenance professional. The course will provide the delegates with a solid understanding of theory and standards.

Course Objectives

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

- Apply and gain an in-depth knowledge on technical information of HV switching technology GIS
- Discuss high voltage gas-insulated switchgear and describe possible faults on SF6-insulated switchgear with their causes and parameterization of GIS design
- Identify the different types of switchgears and low voltage switchboards, distribution boards and MCCs
- Recognize short circuit rating of a switchgear, routine checks required for HV switchgear and the required frequency of these checks
- Describe HV switching, list the qualifications needed before being authorized for switching the typical tests that are done on an existing high voltage circuit breaker and why they are done
- Identify the differences between contactor, breaker and isolating switches as well as safety measures before and after high voltage test has been made on a bus bar
- Explain potential hazards and the requirements of a design data sheet for switchgear equipment
- List the different types of protection used for switchgear and differentiate normal and essential switchboards and the factors that determine the short circuit rating of the switchgear
- Discuss thermal short circuit rating, breaking capacity, and the advantages and disadvantages between vacuum and SF6 breakers
- Describe the effect of switching resistive, capacitive and inductive loads
- Explain the arc extinction process in different types of circuit breakers and the requirements for switching LV and MV switchgears
- Use a schematic diagram to explain in detail the control and power circuits and explain in detail the function and operation of each major component
- Describe a change to the schematic diagram for a modification to suit the process requirements including timer, limit switch using a practical example

- Modify starter control circuit including timer and switch and explain the modification and requirements and the FAT requirements for testing of switchgear
- Perform sizing calculations for switchgear equipment and explain required data input and results
- Replace shunt trip coil in HV circuit breaker and measure the circuit breaker main contacts resistance using appropriate tool
- Illustrate HV circuit breaker closing/tripping circuits using schematic diagram, replace the defective control plug in and prepare a requisition and analyze the technical bids

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, sample video clips of the instructor's actual lectures & practical sessions during the course conveniently saved in a **Tablet PC**.*

Who Should Attend

This course provides a basic overview of all significant aspects and considerations of HV switchgear maintenance for expert and advance who are involved in HV switchgear maintenance.

Training Methodology

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

30% Lectures
20% Workshops & Work Presentations
30% Case Studies & Practical Exercises
20% Software, Simulators & 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$ 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.

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 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.

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. Herman Eksten, PE, PgDiP, is a **Senior Electrical Engineer** with over **40 years** of extensive experience within the **Petrochemical**, **Oil & Gas** and **Power** industries specializing in **Electrical Safety**, Certified **HV Electrical Safety**, **Low Voltage Electrical Safety**, **Electrical Circuits**: Series and Parallel Connection, **Electrical Faults & Protective Devices**, Risk Control Methods, **LOTO – Breakers** Operation in Electricity Substation, **LOTO** Principles and Procedures, **Arc Flash Risk Assessment**, Safety in **Power Electronic Equipment & Lasers**, **Circuit Breakers & Switchgears**, **Switchgear Assets Management**, **Circuit Breakers Control Circuits**, **Substation Maintenance** Techniques, **High Voltage Operation, Electrical Protection**, **Overhead Lines & Substation**, **Power Supply**, **High Voltage Substation**, **Electrical Protection Design**, **Earthing & Lightning Protection Design, Underground Equipment**, **Distribution Network Maintenance & Construction**, **Transformers Operation & Maintenance**, **Electric Power System, Power Plant Management**, **Substation Commissioning & Troubleshooting**, **Cable Splicing & Termination, Electrical Installation & Maintenance**, **Power Generation Operation & Control, Switchgear Life Assessment**, **Structured Cabling, Electric Power System, Power System Stability, Power System Planning & Economics**, **Power Flow** Analysis, **Combined Cycle Power Plant**, **UPS & Battery System, Variable Speed Drives,** and **HV Motors & Transformers**. He is currently the **Lead Electrical Engineer** of **SNC-LAVALIN** wherein he is responsible for basic designs and successful implementation of electrical engineering to plant overhead lines and substations.

During his career life, Mr. Eksten held various positions such as the **Lead Electrical Engineer**, **Operations Manager**, **Project Engineer**, **Technical Specialist**, **Customer Executive**, **District Manager**, **Electrical Protection Specialist**, **High-Voltage Operator** and **Apprentice Electrician** for FOX Consulting, UHDE (ThyssenKrupp Engineering), TWP Projects/Consulting (EPMC-Mining), ISKHUS Power, Rural Maintenance (PTY) Energia de Mocambique Lda., Vigeo (PTY) Ltd and ESKOM.

Mr. Eksten is a **Registered Professional Engineering Technologist** and has a Postgraduate Diploma in Management Development Programme and a National Higher Diploma (NHD) in Electrical Power Engineering. Further, he is a **Certified Instructor/Trainer**, a Senior member of the South African Institute Electrical Engineers (**SAIEE**) and holds a Certificate of Registration Membership Scheme from the Engineering Council of South Africa (**ESCA**). He has further delivered numerous trainings, courses, seminars, workshops 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

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Switchgear Terminology & Definitions of HV Switching Devices***
0930 – 0945	*Break*
0945 – 1100	***Voltage & Short Circuit Levels***
1100 – 1230	***Arc Quenching Principles for Air, Oil, Vacuum & SF6 Insulation Mediums***
1230 – 1245	*Break*
1245 – 1420	***Basic Operating Principles & Purpose of HV Switching Devices*** *Circuit Breakers (Air, Oil, Vacuum and SF6) • Disconnectors • Switch and Switch-Disconnector • Earthing Switches • Contactors • Fuses • IS Limiters • Surge Arresters • Instrument Transformers*
1420 – 1430	***Recap***
1430	*Lunch & End of Day One*

Day 2

0730 – 0900	***Typical Configurations of HV Switchgear*** *Standard Electrical Symbols for Switching Devices • Criteria for Busbar System Selection • Single, Double and Transfer Busbar • Unit Substation*
0900 – 0915	*Break*
0915 – 1100	***HV Switchgear Design*** *Metal-enclosed/Metal-clad • Fixed/Withdrawable • Gas Insulate Switchgear (GIS)*
1100 – 1230	***Location & Identification of Components (Theory)***
1230 – 1245	*Break*
1245 – 1420	***Location & Identification of Components (Practical)***
1420 – 1430	***Recap***
1430	*Lunch & End of Day Two*

Day 3

0730 – 0900	***HV Switchgear Arrangements*** *Incomers and Feeders • Bus Sections and Bus Couplers • T-Off • Metering • Special Arrangements • Typical Primary and Secondary Distribution Arrangement*
0900 - 0915	*Break*
0915 – 1100	***Aspects of Good & Bad Installations*** *Requirements for Indoor Switchgear Design • Requirements for Switchgear • Accessible to the Public • Special Requirements for GIS Installations • Protection Against the Effects of Arc Faults*
1100 – 1230	***Safety Considerations*** *Protection Against Direct and Indirect Contact • Safety Considerations during Maintenance • Qualified and Authorised Person • Work Permits*

1230 – 1245	*Break*
1245 – 1420	***Racking In & Out of Service (Theory & Practical)*** *Switching ● Isolating ● Testing ● Earthing ● Reinstating the Circuit ● Checklist for Operating Switchgear ● Remote Racking*
1420 – 1430	***Recap***
1430	*Lunch & End of Day Three*

Day 4

0730 – 0900	***Life Extension of HV Switchgear Equipment*** *Typical Problems and Means of Eradicating Them ● Corona and Its Manifestations*
0900 – 0915	*Break*
0915 – 1100	***Life Extension of HV Switchgear Equipment (cont'd)*** *Tracking Phenomenon and How to Cease It ● Use of Infrared Thermography and Ultraviolet Imaging*
1100 – 1230	***HV Switchgear & Circuit Breakers Maintenance*** *Scheduling ● Guidelines for Switchgear Maintenance*
1230 – 1245	*Break*
1245 – 1420	***HV Switchgear & Circuit Breakers Maintenance (cont'd)*** *General Maintenance Procedures for MV Switchgear ● Circuit Breaker Testing*
1420 – 1430	***Recap***
1430	*Lunch & End of Day Four*

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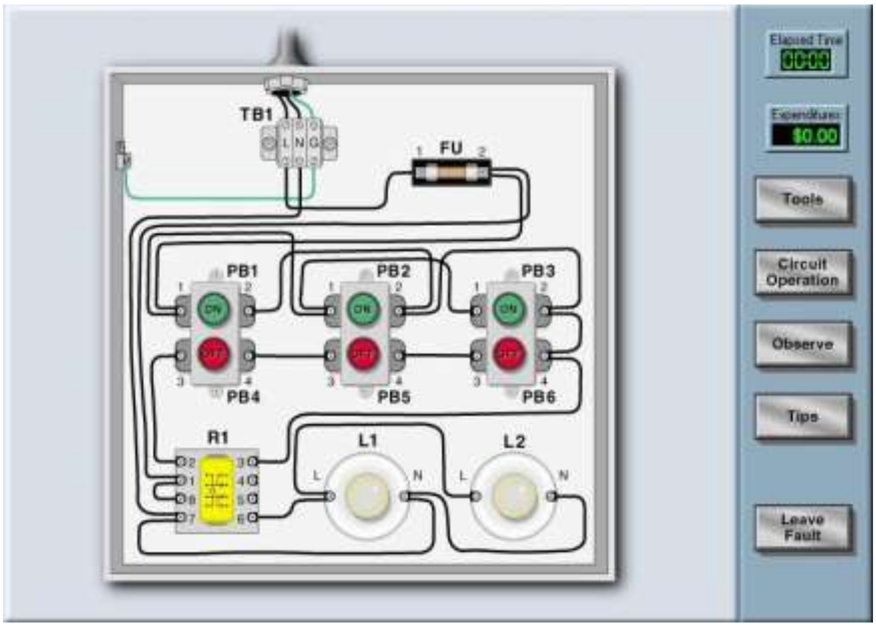
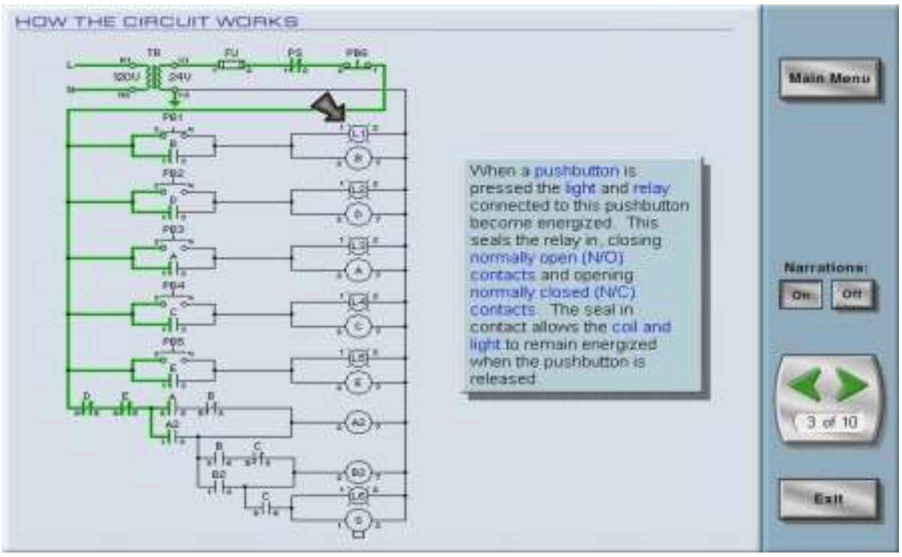
0730 – 0930	***Interlocking*** *Purpose of Interlocking ● Standard Requirements for Interlock Design ● Types and Application of Interlocking Design*
0930 – 0945	*Break*
0945 – 1100	***Testing Interlocks (Practical)***
1100 - 1230	***Testing Interlocks (Practical) (cont'd)***
1230 – 1245	*Break*
1245 – 1345	***Testing Interlocks (Practical) (cont'd)***
1345 – 1400	***Course Conclusion***
1400 – 1415	***POST-TEST***
1415 – 1430	*Presentation of Course Certificates*
1430	*Lunch & End of Course*

<u>Simulators (Hands-on Practical Sessions)</u>

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 "Switchgear Simulator", "GE Multilin Relay 469" and "GE Multilin Relay 750".





Troubleshooting Electrical Circuits V4.1 Simulator


SIEMENS

Switchgear Simulator

Switchgear Simulator

GE Multilin Relay 469 Simulator

GE Multilin Relay 750 Simulator

Course Coordinator

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