COURSE OVERVIEW EE0036
13.8 KV Switchgear Maintenance

Course Title
13.8 KV Switchgear Maintenance

Course Reference
EE0036

Course Duration/Credits
Five days/3.0 CEUs/30 PDHs

Course Date/Venue

Session(s)	Date	Venue
1	January 20-24, 2025	Ajman Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE
2	April 20-24, 2025	Al Khobar Meeting Room, Hilton Garden Inn, Al Khobar, KSA
3	July 20-24, 2025	Oryx Meeting Room, Double Tree by Hilton Al Saad, Doha, Qatar
4	October 05-09, 2025	Boardroom 1, Elite Byblos Hotel Al Barsha, Sheikh Zayed Road, Dubai, UAE

Course Description

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

Switchgear represents a significant capital investment in the electric power grid. The reliable performance of the 13.8 KV distribution switchgear within industries is a basic requirement for overall reliability of the plant. The trend now in switchgear maintenance is to move from the conventional approaches such as corrective maintenance and preventive maintenance to advanced strategies as well as risk-based maintenance and condition-based maintenance. This way, the service activity is no longer driven by predefined timeframes, observations and past experiences, but takes the actual condition of the equipment, the required reliability level and the life time extension expectation into account.

This course is designed to provide delegates with a detailed and up-to-date overview of the 13.8 KV switchgear maintenance. It covers the switchgear and the basic concepts of electrical engineering; the industrial switchgear; the CB design specification; the air, oil and modern vacuum circuit breakers and switchgear up to 13.8 KV; the switchgear lifespan practice and assessment; the switchgear diagnostics and maintenance; the switchgear operating tests; the switchgear inspection, maintenance and services; the general inspection technical procedure and the troubleshooting procedure of switchgear.

The course will give delegates the necessary information and skills required to maintain the 13.8 KV switchgear and an appreciation of the safety procedures associated with medium voltage electrical distribution. Also, it will provide participants with the practical and procedural aspects of safe working on electrical equipment and give the necessary guidance to carry out these duties to meet the requirements of the regulations and standards.

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 safe operation, isolation, deisolation, inspection, maintenance and troubleshooting of the 13.8 KV switchgears.

Course Objectives

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

- Apply systematic techniques on 13.8 KV switchgears maintenance
- Discuss switchgear and the basic concepts of electrical engineering
- Identify the industrial switchgear covering fuses, auto-reclosers, automatic sectionalizes, circuit breakers, isolator switches, load switches, relays, current transformers and voltage transformers
- Recognize the CB design specification based on short circuit current level, arc phenomena and circuit interruption
- Describe air circuit breakers and switchgear up to 13.8KV, oil circuit breakers and switchgear up to 13.8KV and modern vacuum CB and switchgear up to 13.8 KV
- Explain switchgear lifespan covering load effects, number of switching cycles, mechanical lifespan, electrical lifespan and ageing
- Carryout switchgear lifespan practice and assessment that includes electrical lifespan calculation, maintenance costs, spare parts availability, sustainability with existing fault conditions, risk assessment and cost benefit analysis
- Employ switchgear diagnostics and maintenance comprising of switchgear inspection, routing testing of switchgears, dielectric test on the main circuit and tests on auxiliary and control circuits
- Perform switchgear operating tests, tightness tests, condition-based maintenance (CBM), reliability centered maintenance (RCM) and asset register
- Illustrate switchgear inspection, maintenance and services and apply general inspection technical procedure, circuit breaker inspection on a daily, monthly and annual basis, disassembly, cleaning, tightening, testing procedure, direct testing, contact resistance test, insulation resistance test, test report and indirect testing
- Troubleshoot switchgear in a professional manner and identify the low insulation resistance and resistance between terminals of too high

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 covers a wide understanding and deeper appreciation of the 13.8 KV switchgears maintenance for electrical 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.

Accommodation

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

Course Fee

Abu Dhabi	**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.
Al Khobar	**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.
Doha	**US$ 6,000** per Delegate. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.
Dubai	**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.

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.

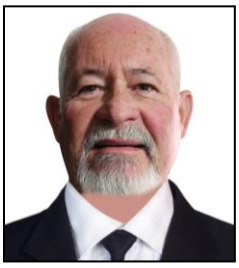
  Haward Technology Middle East will award **3.0 CEUs** (Continuing Education Units) or **30 PDHs** (Professional Development Hours) for participants who completed the total tuition hours of this program. One CEU is equivalent to ten Professional Development Hours (PDHs) or ten contact hours of the participation 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. Ken Steel is a **Senior Electrical & Instrumentation Engineer** with over **45 years** of extensive experience. His expertise widely covers **Electrical Motors Testing**, **Heat Tracing** & Insulation Installation & Testing, **HV Terminations**, **High & Low Voltages** on Overhead Cranes, **HV/MV Cable Splicing**, **Cable & Over Head Power Line**, **HV/MV Switchgear, HV Cable** Design, **Medium & High Voltage** Equipment, **High Voltage Circuit Breaker** Inspection & Repair, **High Voltage Power** System, **HV Equipment** Inspection & Maintenance, **HV Switchgear** Operation & Maintenance, Resin / **Heat Shrink & Cold Shrink** Joints, **HV/LV Equipment**, **LV & HV** Electrical System, **Cable** Splicing & Termination, **High Voltage** Electrical Safety, **LV**, **MV & HV Cable** Installations & Properties, **LV Substation**, **MV & LV Cable**, **UPS Systems**, **MV & LV** Direct on Line Motor Drives, **MV & LV** VSD Motor Drives, **MV & LV** Soft Starter Motor Drives, **LV Two Speed Motor Drives**, Underground **Transformer Oil Containment Tank**, **Electrical & Instrumentation Construction** Installation, 1500KW, 1000KW, 1752KW **Diesel Power Plant Installation**, **110KV Overhead Line**, **110KV Outdoor Switchgear**, 110KV/10KV 6500KVA **Transformer**, **Transformer Substation**, 1600KVA 10KV/0.4KV & 2 Off 1000KVA **Diesel Generators**, 1600KVA 10KV/0.4KV & 1650KVA **Diesel Generator**, **110KV/35KV/10KV Substation**, 110KV/10KV **Transformers**,110KV & 2 Off 6KV **Overhead Lines**, 34.5KV,13.8KV ,4.16KV & 480V **Switchgear**, 4.16KV & 480V MCC, **Transformers & Motor Drives** Substations, **Diesel Driven Generators**, **Overhead Cranes**, **Overhead Cranes & HVAC Units**, **AC & DC Drives**, **Data Logger**, **Electrical, Instrumentation & Mechanical** Installation Maintenance, Slab Mills, Pre Heat Ovens, Hydraulic Shears, Stamping Machine, Gearboxes, Rollers, Pumps, Valves, Electro Magnets & Pump House Operation, Boilers Construction And Commissioning, Valve Calibration & Testing, Level Gauges, Pressure & Flow Transmitters Installation & Calibration, Pressure & Leak Testing of Boilers, Leak Testing, SMP, Elect, I&C, F&G, HVAC & Utility Services, Nitrogen Leak Test Operations, Steam Blowing Activities, SMP, Elect, I&C, F&G, HVAC & Utility Services, PTW Issue (PA/AC), Installation & Mechanical Piping and Hydro Testing & Leak Testing of Lines Installation.

During Mr. Steel's career life, he has gained his practical experience through several significant positions and dedication as the **3GP PBF & Boilers SC Commission Support**, **SC Site Execution Superintendent**, **E&I Construction Superintendent**, **High Voltage Construction Supervisor**, **Control & Power Construction Supervisor**, **Electrical & Instrumentation Supervisor**, **Electrical Technician**, **Construction Support Electrical Engineer**, **E&I Engineer**, **Electrical/Instrumentation Site Supervisor**, **Q.A/Q.C Inspector**, **Electrical/ Instrumentation Technician**, **Maintenance Fitter Instrumentation Technician**, **Millwright**, **Apprentice Millwright** and **Senior Instructor/Lecturer** for Tengiz Chevron Oil Kazakhstan, Al Jubail Saudi Arabia, Escravos Delta state Nigeria, Lurgi S.A, SuD Chemie Sasol Catalysts, J C Groenewalds Construction (LTA), Tycon (Goodyear S.A.), Dragline Construction and Iscor Vanderbijlpark.

Mr. Steel has a **Diploma** in **Electronics Mechanic**. Further, he is a **Certified Instructor/Trainer** and delivered numerous trainings, courses, 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

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Introduction to Switchgear*** *Electrical Engineering Basic Concepts ● Three Phase Review and Per Unit ● Voltage Levels ● One Line and Three Line Diagram ● Generation System Layout ● Transmission System Layout ● Substation System Layout ● Distribution System Layout*
0930 – 0945	*Break*
0945 – 1100	***Industrial Switchgear*** *Fuses ● Auto-reclosers ● Automatic Sectionalizer ● Circuit Breakers ● Isolator Switches*
1100 – 1230	***Industrial Switchgear (cont'd)*** *Load Switches ● Relays ● Current Transformers ● Voltage Transformers*
1230 – 1245	*Break*
1245 – 1420	***CB Design Specification Based on Short Circuit Current Level*** *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*
1420 – 1430	***Recap***
1430	*Lunch & End of Day One*

Day 2

0730 – 0900	***CB Design Specification Based on Short Circuit Current Level (cont'd)*** *Network Connection for Various Fault Types ● Current and Voltage Distribution in System Due to a Fault ● Effect of System on Zero Sequence Quantities ● Computer Programs Based Short Circuit Calculation*
0900 – 0915	*Break*
0915 – 1100	***CB Design Specification Based on Arc Phenomena and Circuit Interruption*** *Arc Phenomena ● Maintenance of the Arc ● Properties of Arc ● Arc Interruption Theory ● Circuit Breaker Rating ● Circuit Constants and 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*
1100 – 1230	***Air Circuit Breakers & Switchgear up to 13.8 KV*** *Method of Increasing Arc Resistance ● Plan Break Type ● Magnetic Blow Out Type ● Arc Splitter Type*

1230 – 1245	Break
1245 – 1420	***Air Circuit Breakers & Switchgear up to 13.8 KV (cont'd)*** Application ● Construction and Operation ● Axial Air CB ● Blast Air CB
1420 – 1430	***Recap***
1430	Lunch & End of Day Two

Day 3

0730 – 0900	***Oil Circuit Breakers & Switchgear 13.8 KV*** 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 and Operation
0900 – 0915	Break
0915 – 1100	***Modern Vacuum CB and Switchgear 13.8 KV*** Introduction ● Advantages of Vacuum Interruption ● Vacuum Contactors and Interrupters ● The Vacuum Medium ● The Vacuum Arc ● Vacuum Arc Stability
1100 – 1230	***Modern Vacuum CB and Switchgear 13.8 KV (cont'd)*** Vacuum Break Down ● Vacuum Switch Construction ● Applications of Vacuum Circuit Breakers ● Vacuum Circuit Breakers & Switchgear Safety Aspects ● Vacuum Circuit Breakers & Switchgear Safe Operation
1230 – 1245	Break
1245 – 1420	***Switchgear Lifespan*** Load Effects ● Number of Switching Cycles ● Mechanical Lifespan ● Electrical Lifespan ● Ageing
1420 – 1430	***Recap***
1430	Lunch & End of Day Three

Day 4

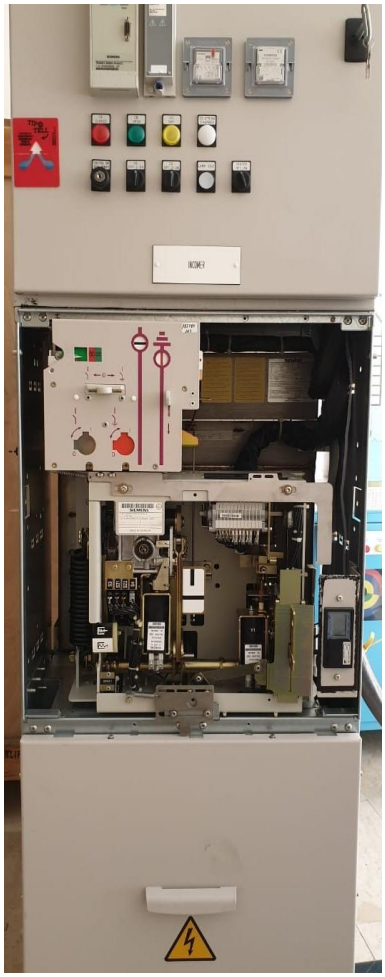
0730 – 0900	***Switchgear Lifespan Practice*** Electrical Lifespan Calculation Exercise
0900 – 0915	Break
0915 – 1100	***Switchgear Lifespan Assesment*** Maintenance Costs ● Spare Parts Availability ● Suitability with Existing Fault Conditions ● Risk Assessment ● Cost/Benefit Analysis
1100 – 1230	***Switchgear Diagnostics & Maintenance*** Switchgear Defects ● Switchgear Inspection ● Routine Testing of Switchgears ● Dielectric Test on the Main Circuit (Oil, Air, Vacuum & SF6 Type Devices) ● Tests on Auxiliary & Control Circuits
1230 – 1245	Break
1245 – 1420	***Switchgear Diagnostics & Maintenance (cont'd)*** Mechanical Operating Tests ● Tightness Test ● Condition Based Maintenance (CBM) ● Reliability Centred Maintenance (RCM) ● Asset Register
1420 – 1430	***Recap***
1430	Lunch & End of Day Four

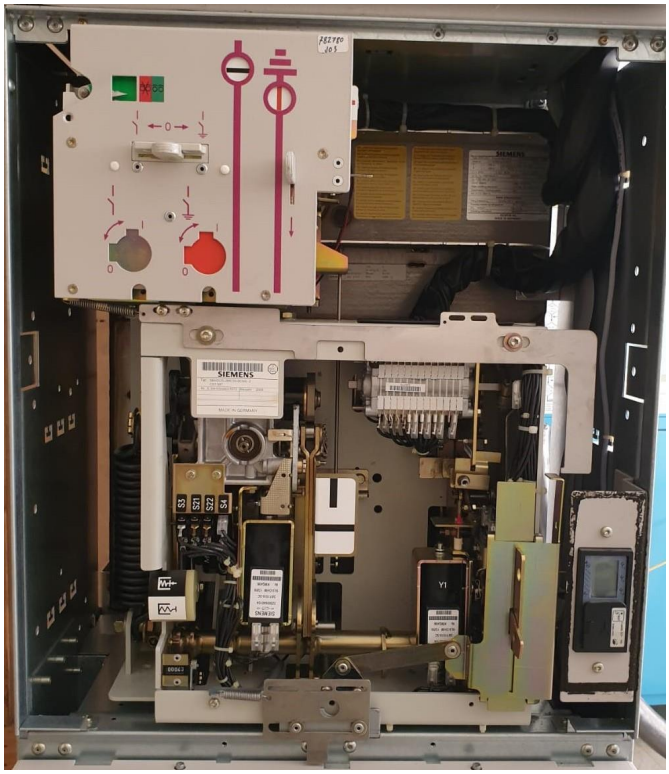
Day 5

0730 – 0900	***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*
0900 – 0915	*Break*
0915 – 1045	***Switchgear Inspection, Maintenance & Services (cont'd)*** *Cleaning ● Tightening ● Lubrication ● Equipment Used in Testing ● Testing Procedure ● Direct Testing ● Contact Resistance Test ● Insulation Resistance Test ● Test Report ● Indirect Testing*
1045 – 1215	***Switchgear Troubleshooting*** *Low Insulation Resistance (Below 2000 Mega-ohms) between Phase Terminal and 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 and Travel in 3-pole Measured from Top Surface of Interrupter Flange and the Contact Lip by a Simple Rod with Breaker Open and Breaker Closed*
1215 – 1230	*Break*
1230 – 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***
1400 – 1415	***POST-TEST***
1415 – 1430	*Presentation of Course Certificates*
1430	*Lunch & End of Course*

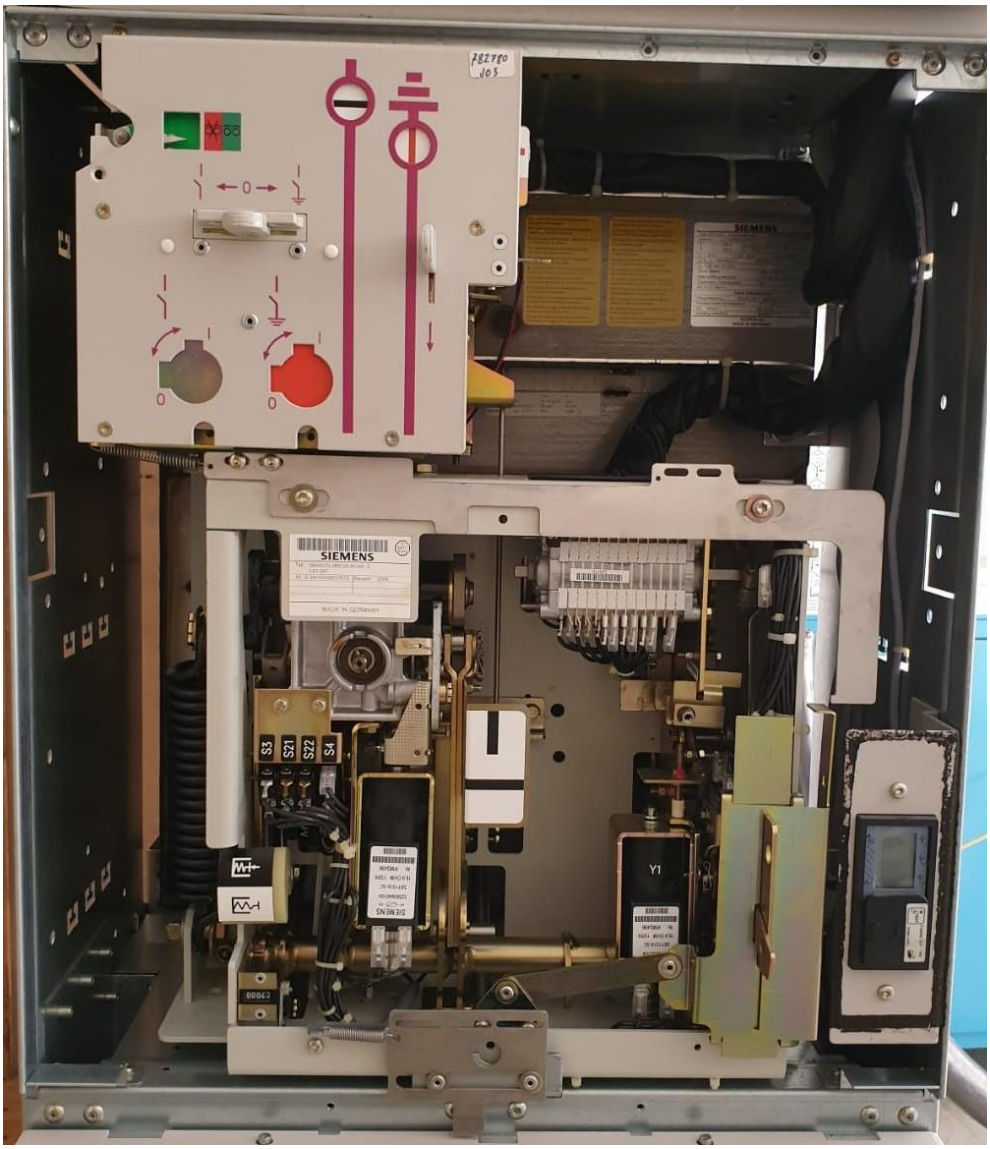
Simulators (Practical Sessions)

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 “Switchgear Simulator”, “GE Multilin Relay 469” and “GE Multilin Relay 750”.





Switchgear Simulator



Switchgear Simulator

GE Multilin Relay 469 Simulator

GE Multilin Relay 750 Simulator

Course Coordinator

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