COURSE OVERVIEW EE0069(AD4)-4D
HV Switchgear Maintenance

Course Title
HV Switchgear Maintenance

Course Reference
EE0069(AD4)-4D

Course Duration/Credits
Four days/2.4 CEUs/24 PDHs

Course Date/Venue

Session(s)	Date	Venue
1	March 04-07, 2024	Ajman Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE
2	June 10-13, 2024	Al Aziziya Hall, The Proud Hotel Al Khobar, KSA
3	September 09-12, 2024	Boardroom 1, Elite Byblos Hotel Al Barsha, Sheikh Zayed Road, Dubai, UAE
4	December 16-19, 2024	Club B, Ramada Plaza By Wyndham Istanbul City Center, Istanbul, Turkey

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

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

Abu Dhabi	**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
Al Khobar	**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.
Dubai	**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.
Istanbul	**US$ 5,000** 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 **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.

- 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:

Dr. Alaa Abdel Kerim, PhD, MSc, BSc, is a **Senior Electrical & Instrumentation Engineer** with over **35 years** of extensive experience in **ABB 11kV Distribution Switchgear**, **Operation & Maintenance of Rotork**, **Electrical Safety**, **HV Cable** Design, **Cable** Splicing & Termination, **Cable** Jointing Techniques, **High Voltage** Electrical Safety, **Electrical Drawing & Schematics**, **Electrical Power**, **Electrical Wiring**, Machines, **Transformers**, **Motors**, **Power Stations**, **Substation** Site Inspection, **HV/MV Cable Splicing**, **High Voltage Circuit Breaker** Inspection & Repair, **Cable & Over Head Power Line**, **High Voltage Power System** Safe Operation, High Voltage Safety, **High Voltage Transformers**, Safe Operation of **High Voltage & Low Voltage Power Systems**, **Fundamentals of Electricity**, **Electrical Standards**, Practical **High Voltage Safety Operating Procedures**, Modern Power System **Protective Relaying**, **Electrical & Control System** Testing, **Design**, **Commissioning**, **Operation** and **Maintenance** of **Switchgears**, **Transformers**, **Substations**, **Medium & High Voltage Equipment** and **Circuit Breakers**, **Electrical Motors & Variable Speed Drives**, **Power System** Equipment, **Distribution Network** System, **Electric Distribution System Equipment**, Practical Troubleshooting of **Electrical Equipment & Control Circuits**, **Electrical & Control System** Testing & Commissioning, **LV/MV/HV Circuit Breakers** Inspection & Maintenance, Electrical **Power Substation** Maintenance, **Power Stations**, **Uninterruptible Power Systems** (**UPS**), **Battery Chargers** and **AC** & **DC Transmission**, **DCS**, **PLC**, **SCADA**, **Siemens SIMATIC S7** Maintenance & Configuration, **Siemens Simatic S7 PLC**, **Siemens WINCC, Siemens SIMATIC & WinCC**, **Siemens**, PLC Simatic **S7-400/S7-300/S7-200**, **HM**I, **Automation System**, **Process Control & Instrumentation**, **Hydrocarbon**, **Level & Flow Measurements**, **Analytical Instrumentation**, **Find Control Elements**, **Control Loop Operation**, **Data Acquisition & Transmission**, **Electronics Technology**, **Power Systems Control**, **Power Systems Security**, **Power Transmissions**, **Power Generation**, **Electrical Substations** and **MV/LV Electrical System**.

During his career life, Dr. Alaa has been practically and academically involved in different **Power System** and **Instrumentation international companies** and **Universities** as a **Senior Professor** & **Consultant**, **Instrumentation Engineer** and **Electrical Engineer**. His recent practical applications experience includes the design, supply, installation, operation of full **DCS**, **SCADA**, **PLC**, **HMI Automation System** for **Sumid Line Petroleum**, **Siemens USA**, **AREVA USA** to name a few. His experience also includes electrical coordination, protection level adjustments and electrical testing.

Dr. Alaa has a **PhD** degree in **Electrical Engineering** from the **Technical University of Gdansk**, **Poland** and has **Master** and **Bachelor** degrees in **Electrical Machine & Power Engineering** from **Cairo University** and **Helwan University**, respectively. Further, he is a **Certified Instructor/Trainer** and delivered numerous trainings and workshops worldwide.

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***
0900 – 0915	*Break*
0915 – 1100	***Voltage and 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*

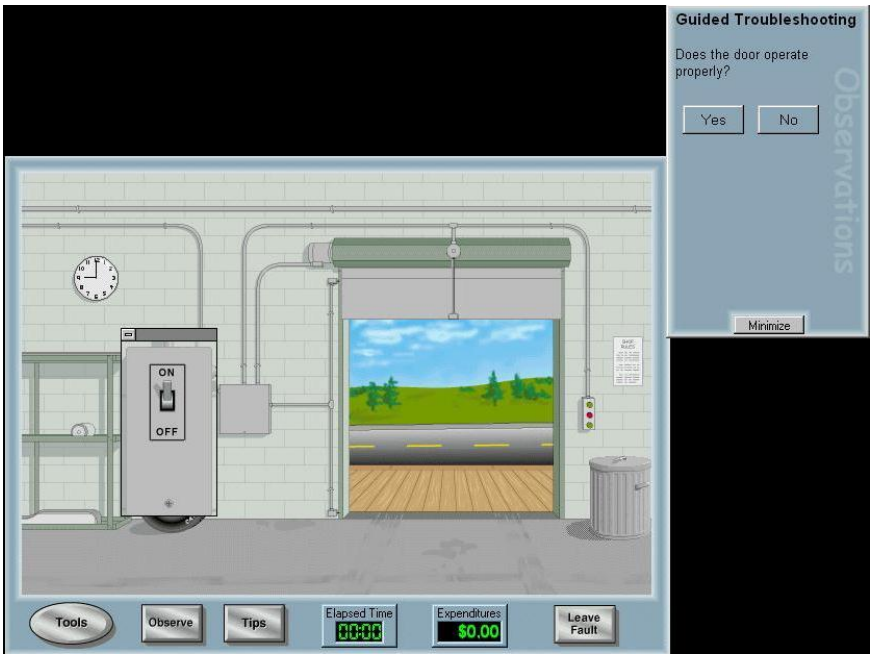
1245 – 1420	***Racking In & Out of Service (Theory and Practical)*** *Switching ● Isolating ● Testing ● Earthing ● Reinstating the Circuit ● Checklist for Operating Switchgear ● Remote Racking*
1420 – 1430	***Recap***
1430	*Lunch & End of Day Three*

Day 4

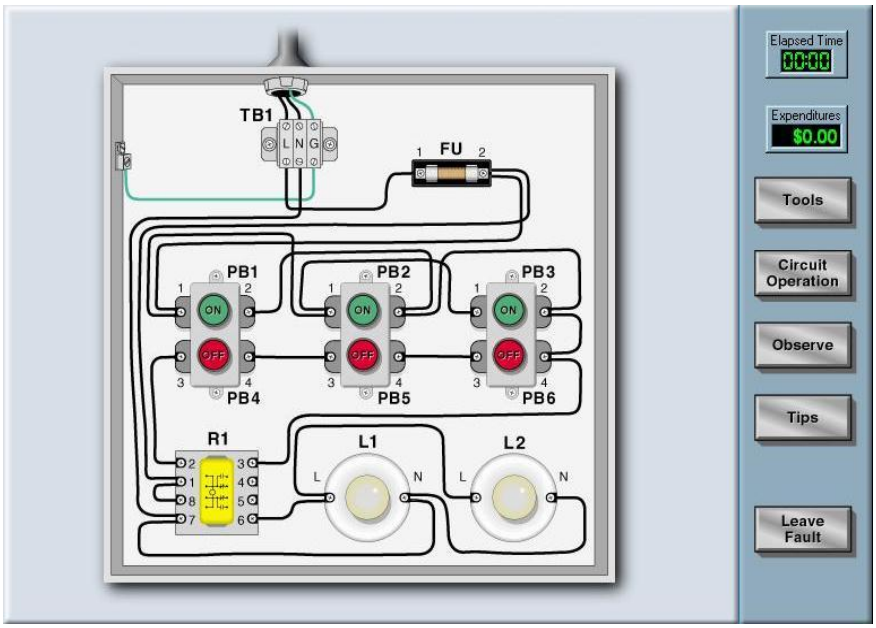
0730 – 0900	***Life Extension of HV Switchgear Equipment*** *Typical Problems and Means of Eradicating Them ● Corona and Its Manifestations • Tracking Phenomenon and How to Cease It ● Use of Infrared Thermography and Ultraviolet Imaging*
0900 – 0915	*Break*
0915 – 1100	***HV Switchgear & Circuit Breakers Maintenance*** *Scheduling ● Guidelines for Switchgear Maintenance • General Maintenance Procedures for MV Switchgear ● Circuit Breaker Testing*
1100 – 1230	***Interlocking*** *Purpose of Interlocking ● Standard Requirements for Interlock Design ● Types and Application of Interlocking Design*
1230 – 1245	*Break*
1245 – 1345	***Testing Interlocks (Practical)***
1345 – 1400	***Course Conclusion***
1400 – 1415	***POST-TEST***
1415 – 1430	*Presentation of Course Certificates*
1430	*Lunch & End of Course*

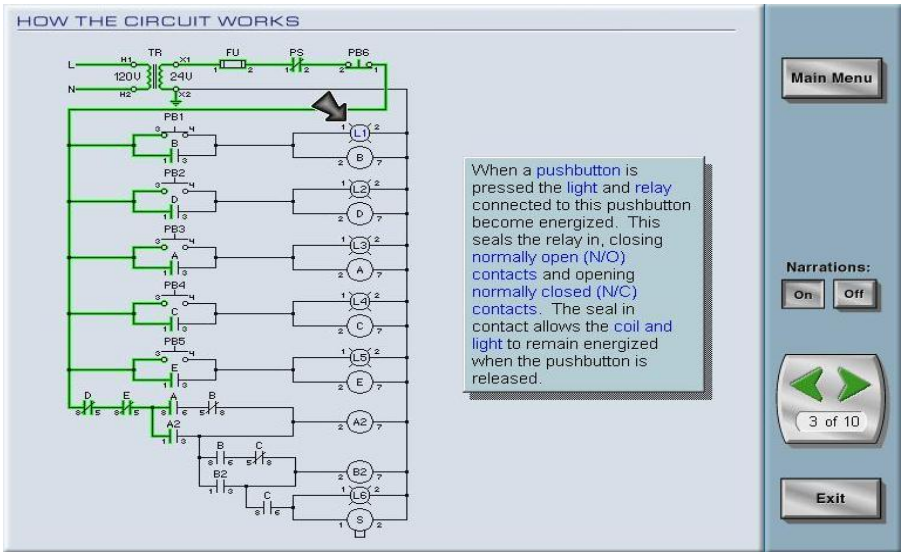
Simulators (Hands-on Practical Sessions)

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 "Haward Troubleshooting" and "Switchgear Simulator".

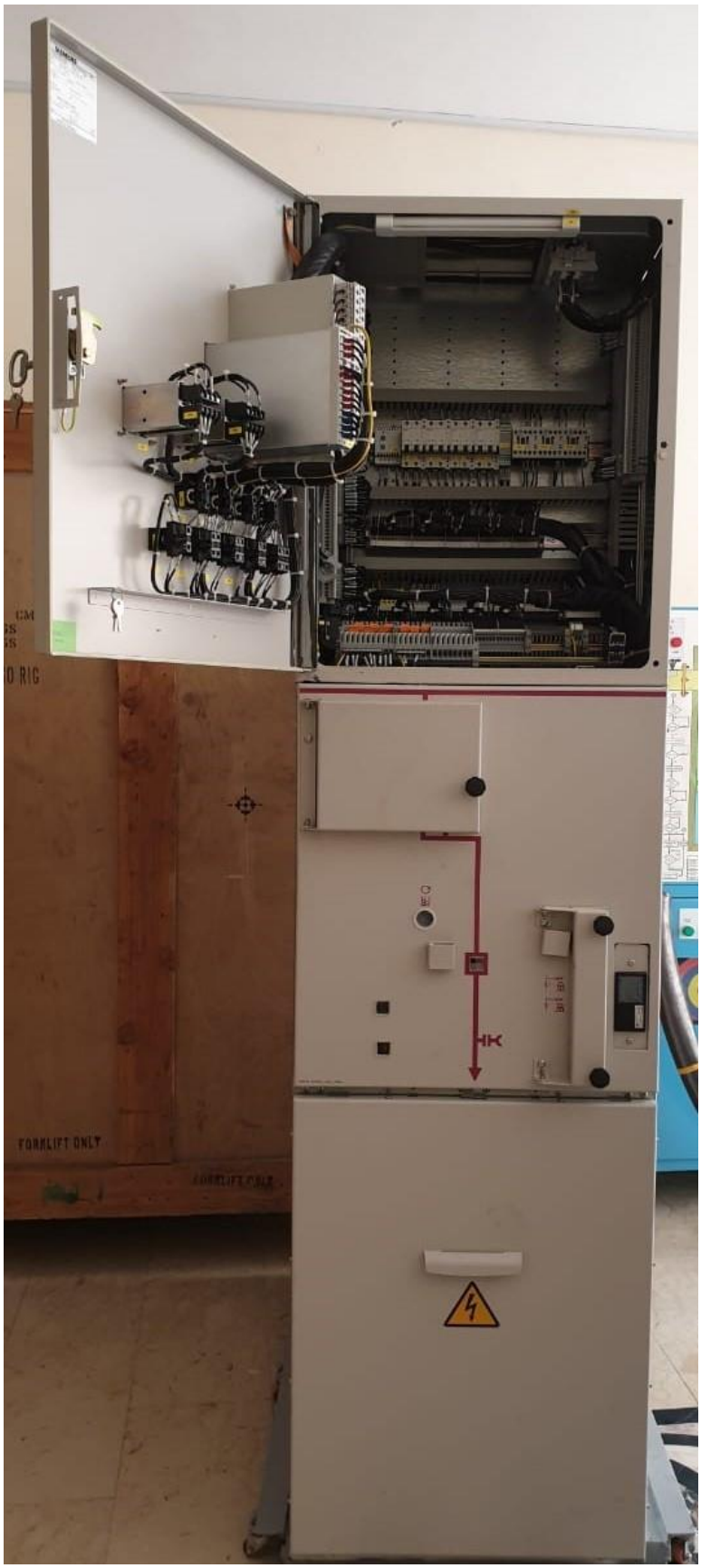


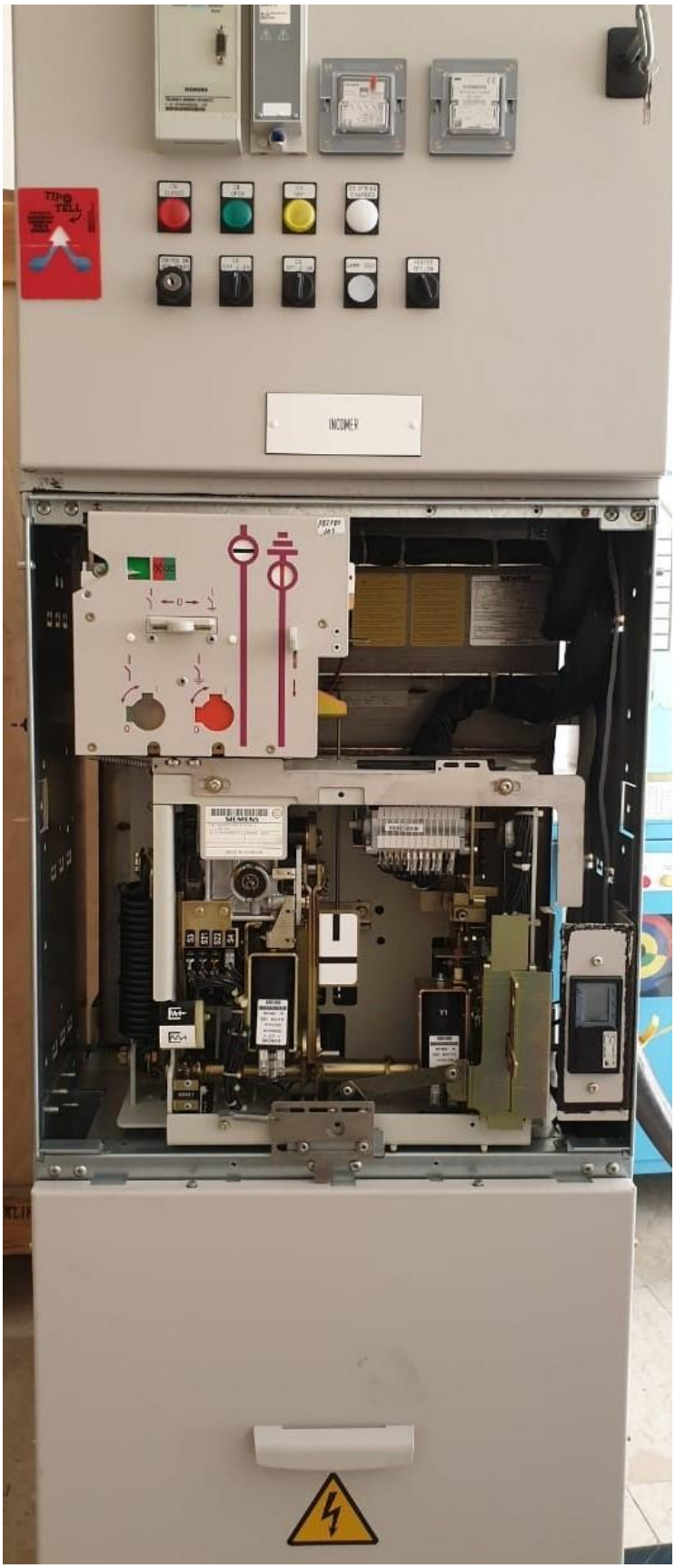
Troubleshooting Electrical Circuits V4.1 Simulator

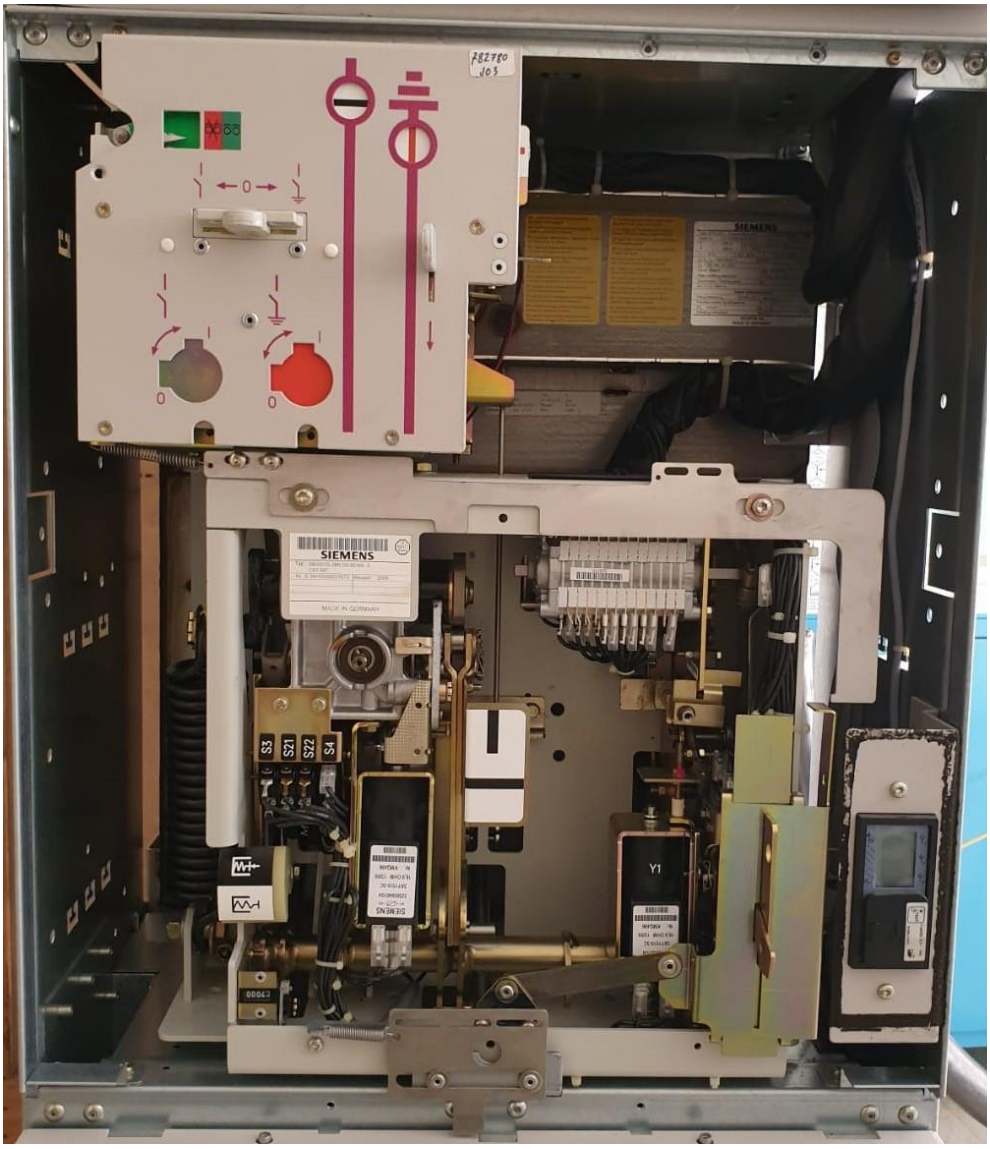

TB1
L N G
FU
PB1
PB2
PB3
PB4
PB5
PB6
ON
OFF
R1
L1
L2
Elapsed Time
00:00
Expenditures
$0.00
Tools
Circuit Operation
Observe
Tips
Leave Fault


HOW THE CIRCUIT WORKS
When a pushbutton is pressed the light and relay connected to this pushbutton become energized. This seals the relay in, closing normally open (N/O) contacts and opening normally closed (N/C) contacts. The seal in contact allows the coil and light to remain energized when the pushbutton is released.
Main Menu
Narrations:
On
Off
3 of 10
Exit


SIEMENS
Auftrags:78-2780 Pos.20
Feld-Nr./Typical: JZ04/J03


FORKLIFT ONLY


INCOMER



Switchgear Simulator

Course Coordinator

Kamel Ghanem, Tel: +971 2 30 91 714, Email: kamel@haward.org