COURSE OVERVIEW EE1126
Switchgear Theory and Practical

Course Title
Switchgear Theory and Practical

Course Date/Venue
October 19-23, 2025/Meeting Plus 9, City Centre Rotana, Doha, Qatar

Course Reference
EE1126

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 provide participants with a detailed and up-to-date overview of Switchgear Theory and Practical. It covers the fundamentals of switchgear, components of switchgear assemblies, types of circuit breakers and the electrical power system; the standards and regulations, safety in switchgear operations, principles of protection, control and interlocking mechanisms and current and voltage transformers in switchgear; the protection relays and trip units, busbar design and compartmentalization, auxiliary systems in switchgear and switchgear installation guidelines.

During this interactive course, participants will learn the factory acceptance testing (FAT), site acceptance testing (SAT) and commissioning, insulation resistance and dielectric testing, primary and secondary injection testing, thermal imaging and condition monitoring; the preventive and predictive maintenance, common faults and troubleshooting, breaker maintenance and overhaul, aging switchgear risk management, retrofitting and modernization and documentation and maintenance records; the advanced protection coordination, arc flash analysis and mitigation and the digital switchgear and smart grids.

Course Objectives

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

- Apply and gain an in-depth knowledge on switchgear (theory and practical)
- Discuss the fundamentals of switchgear, components of switchgear assemblies, types of circuit breakers and the electrical power system
- Recognize standards and regulations, safety in switchgear operations, principles of protection, control and interlocking mechanisms and current and voltage transformers in switchgear
- Determine protection relays and trip units, busbar design and compartmentalization, auxiliary systems in switchgear and switchgear installation guidelines
- Carryout factory acceptance testing (FAT), site acceptance testing (SAT) and commissioning, insulation resistance and dielectric testing, primary and secondary injection testing, thermal imaging and condition monitoring
- Explain preventive and predictive maintenance, common faults and troubleshooting and breaker maintenance and overhaul
- Employ aging switchgear risk management, retrofitting and modernization and documentation and maintenance records
- Identify advanced protection coordination, arc flash analysis and mitigation and the digital switchgear and smart grids

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 theory and practical for electrical engineers, plant engineers , facility engineers , maintenance technicians and electricians, and other utility company personnel.

Accommodation

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

Course Fee

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.

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

Haward's certificates are accredited by the following international accreditation organizations:

- British Accreditation Council (BAC)

  Haward Technology is accredited by the **British Accreditation Council** for **Independent Further and Higher Education** as an **International Centre**. Haward's certificates are internationally recognized and accredited by the British Accreditation Council (BAC). 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.

- 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.

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.

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, 19th of October 2025***

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Fundamentals of Switchgear*** *Definition and Role in Electrical Networks • Classification: LV, MV, HV Switchgear • Primary Functions: Control, Protection, Isolation • Indoor versus Outdoor Switchgear*
0930 - 0945	*Break*
0945 – 1045	***Components of Switchgear Assemblies*** *Circuit Breakers, Disconnectors, Fuses • Current and Voltage Transformers (CTs & VTs) • Relays and Control Panels • Busbars, Enclosures and Interlocks*
1045 - 1145	***Types of Circuit Breakers*** *Air Circuit Breakers (ACB) • Vacuum Circuit Breakers (VCB) • SF6 Circuit Breakers • Miniature (MCB) and Molded Case Breakers (MCCB)*
1145 - 1230	***Electrical Power System Overview*** *Power Generation to Distribution Pathway • Load Centers and Substations • Role of Switchgear in Protection Coordination • Single-Line Diagram Interpretation*
1230 – 1245	*Break*
1245 – 1330	***Standards and Regulations*** *IEC, IEEE, ANSI and NEMA Switchgear Standards • IEC 62271, 60947, 61439 Standards Overview • OSHA, NFPA 70E Electrical Safety Relevance • Certification and Labeling Requirements*
1330 - 1420	***Safety in Switchgear Operations*** *Arc Flash Hazards and PPE Requirements • Lockout/Tagout Procedures (LOTO) • Safe Switching Practices • Risk Assessments and Safety Signage*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day One*

Day 2: ***Monday, 20th of October 2025***

0730 – 0830	***Principles of Protection*** *Overcurrent and Short Circuit Protection • Earth Fault and Differential Protection • Protection Zones and Relaying Logic • Selectivity and Coordination*
0830 – 0930	***Control & Interlocking Mechanisms*** *Mechanical and Electrical Interlocks • Manual versus Motorized Control Systems • Synchronization Controls and Breaker Failure Interlocks • PLC-Based Switchgear Automation*
0930 - 0945	*Break*
0945 – 1130	***Current & Voltage Transformers in Switchgear*** *CT/VT Role in Metering and Protection • Polarity, Burden and Class Accuracy • Installation and Testing Best Practices • CT Saturation and VT Voltage Ratios*

1130 - 1230	***Protection Relays & Trip Units*** *Electromechanical versus Digital Relays • Time-Current Characteristic Curves • Relay Setting Calculation and Programming • Coordination with Upstream/Downstream Devices*
1230 - 1245	*Break*
1245 - 1330	***Busbar Design & Compartmentalization*** *Single and Double Busbar Systems • Busbar Ratings, Spacing, and Support • Thermal and Dynamic Stress Considerations • Switchgear Compartment Arrangement*
1330 - 1420	***Auxiliary Systems in Switchgear*** *Heater Circuits and Anti-Condensation Systems • DC Supply Systems and UPS • Indication Lamps, Alarms and Mimic Diagrams • Panel Wiring and Terminal Blocks*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Two*

Day 3: ***Tuesday, 21st of October 2025***

0730 – 0830	***Switchgear Installation Guidelines*** *Foundation and Mounting Requirements • Cabling Practices and Terminations • Environmental Conditions (Temperature, Humidity, Ingress Protection) • Clearance and Accessibility*
0830 – 0930	***Factory Acceptance Testing (FAT)*** *Visual and Dimensional Checks • Functional Testing of Breakers and Relays • Primary/Secondary Injection Testing • FAT Documentation and Checklists*
0930 - 0945	*Break*
0945 – 1130	***Site Acceptance Testing (SAT) & Commissioning*** *Pre-Energization Checks • Cable Insulation and Continuity Tests • Relay Settings Validation • Energization and Operational Tests*
1130 - 1230	***Insulation Resistance & Dielectric Testing*** *Megger Insulation Resistance Testing • Polarization Index Measurement • Dielectric Withstand Testing (HiPot) • Test Voltage Levels and Safety Precautions*
1230 - 1245	*Break*
1245 - 1330	***Primary & Secondary Injection Testing*** *Purpose of Injection Testing • Test Equipment Setup and Connection • Contact Resistance and Trip Curve Validation • Interpretation of Test Results*
1330 - 1420	***Thermal Imaging & Condition Monitoring*** *IR Scanning for Hotspots and Loose Connections • Vibration and Partial Discharge Analysis • Online Monitoring Devices • Reporting and Trend Analysis*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Three*

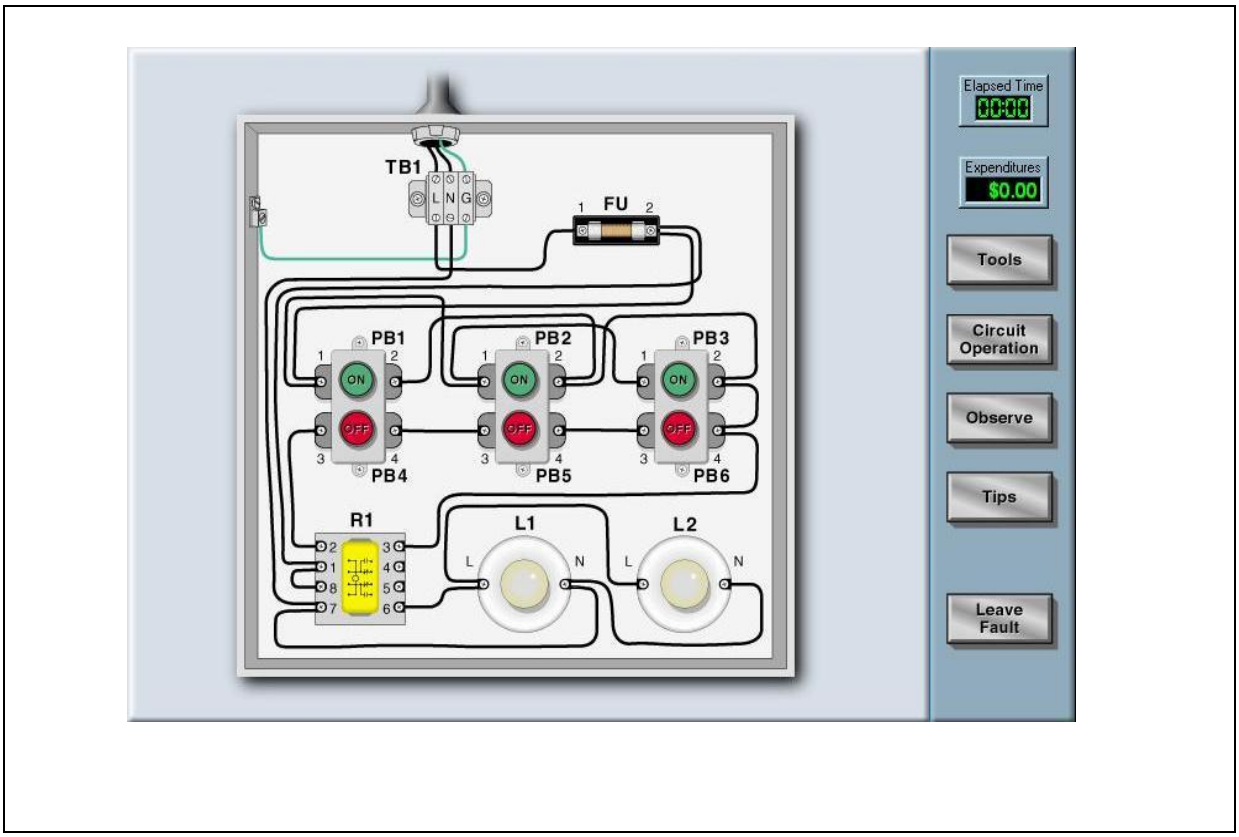
Day 4:	Wednesday, 22nd of October 2025
0730 – 0830	***Preventive & Predictive Maintenance*** *Maintenance Schedules (Daily, Monthly, Annual) • Cleaning, Lubrication, and Functional Testing • Infrared Thermography and Acoustic Detection • Condition-Based versus Time-Based Maintenance*
0830 – 0930	***Common Faults & Troubleshooting*** *Failure to Open/Close, Tripping without Cause • Overheating, Arcing and Insulation Breakdown • Panel Wiring Issues • Root Cause Analysis Methods*
0930 - 0945	*Break*
0945 – 1130	***Breaker Maintenance & Overhaul*** *Disassembly and Inspection Procedures • Contact Wear and Arc Chute Cleaning • Spring Charging and Mechanism Checks • Reassembly and Test Run*
1130 - 1230	***Aging Switchgear Risk Management*** *Indicators of Switchgear End-of-Life • Cost-Benefit of Repair versus Replacement • Arc-Flash Risk in Aging Switchgear • Upgrading Insulation and Control Components*
1230 - 1245	*Break*
1245 - 1330	***Retrofitting & Modernization*** *Replacing Outdated Relays with Digital Versions • Adding Motor Operators to Manual Gear • Busbar Reinforcement and Enclosure Upgrades • Arc Flash Detection and Mitigation Systems*
1330 - 1420	***Documentation & Maintenance Records*** *Inspection and Test Records • Logbook and Service Reports • QR Code Tagging and Digital Asset Management • Maintenance Planning Using CMMS Tools*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Four*

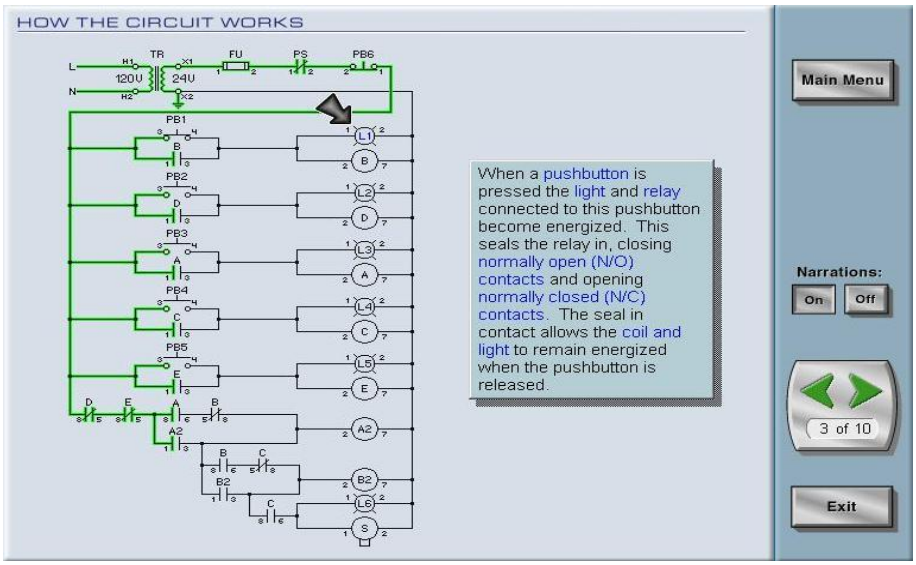
Day 5:	Thursday, 23rd of October 2025
0730 – 0830	***Advanced Protection Coordination*** *Time-Current Curve Plotting and Overlap Prevention • Selectivity Studies Using Software Tools • Coordination with Upstream Substations • Real-World Examples of Poor Coordination*
0830 – 0930	***Arc Flash Analysis & Mitigation*** *Arc Flash Hazard Calculation (IEEE 1584) • PPE Category Levels and Labeling • Arc-Resistant Switchgear Design • Fast Fault Detection Systems*
0930 - 0945	*Break*
0945 – 1100	***Digital Switchgear & Smart Grids*** *Integration with SCADA and Energy Management Systems • IEDs and IEC 61850 Communication • Remote Monitoring and Control • Digital Twin Concepts in Switchgear*
1100 – 1200	***Practical Workshop & Demonstrations*** *Live Breaker Racking and Interlock Checks • Relay Testing (Secondary Injection) • IR Camera Usage for Diagnostics • Hands-On Wiring of Protection Circuits*

1200 - 1215	*Break*
1215 – 1345	***Case Studies & Incident Reviews*** *Switchgear Failure Case Analysis • Arc Flash Accident Investigation • Human Error and Lessons Learned • Success Stories in Predictive Maintenance*
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*

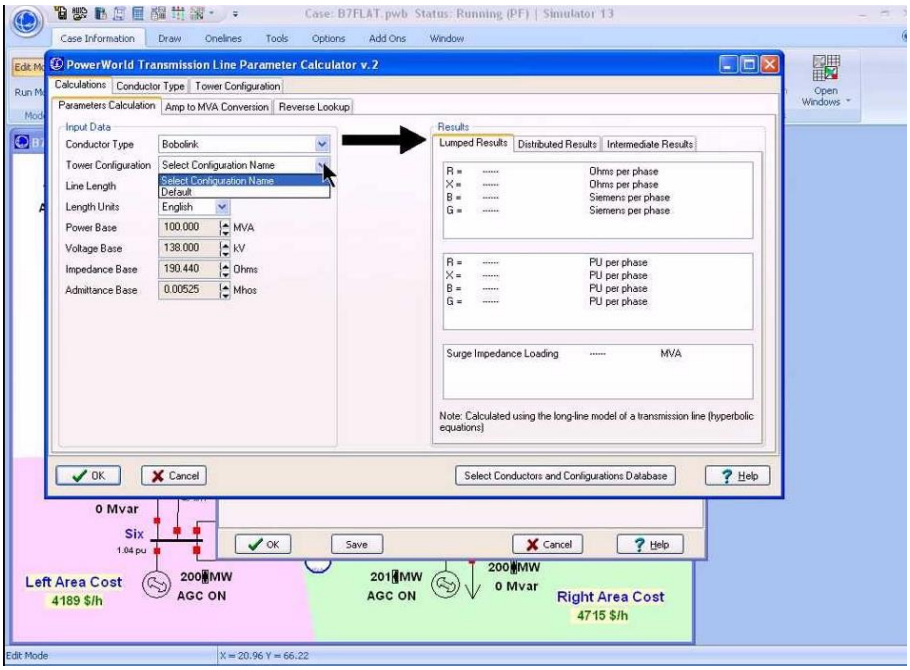
Simulator (Hands-on Practical Sessions)

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 simulator "Simutech Troubleshooting Electrical Circuits V4.1", Power World" and "ETAP software".

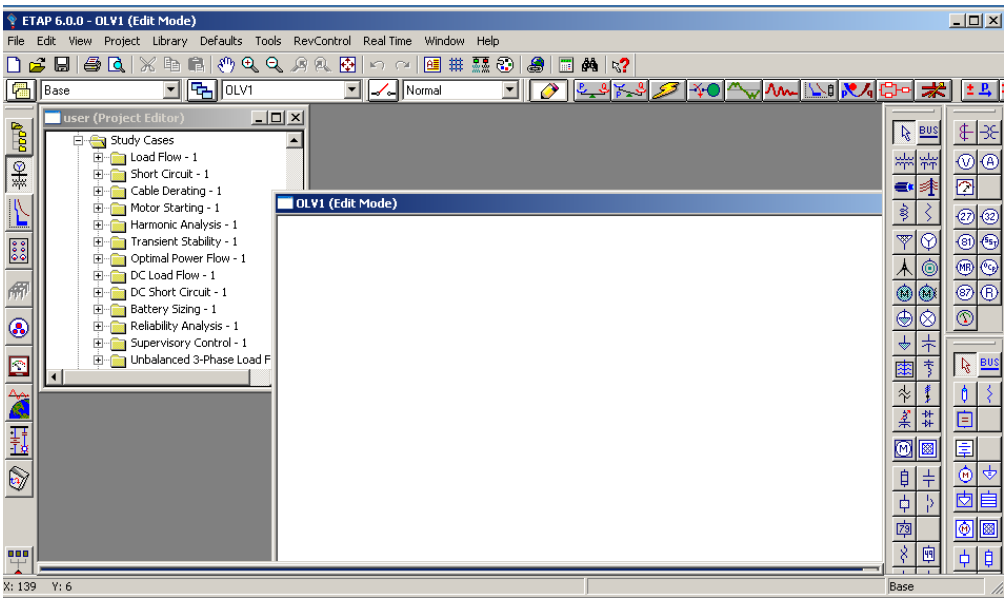




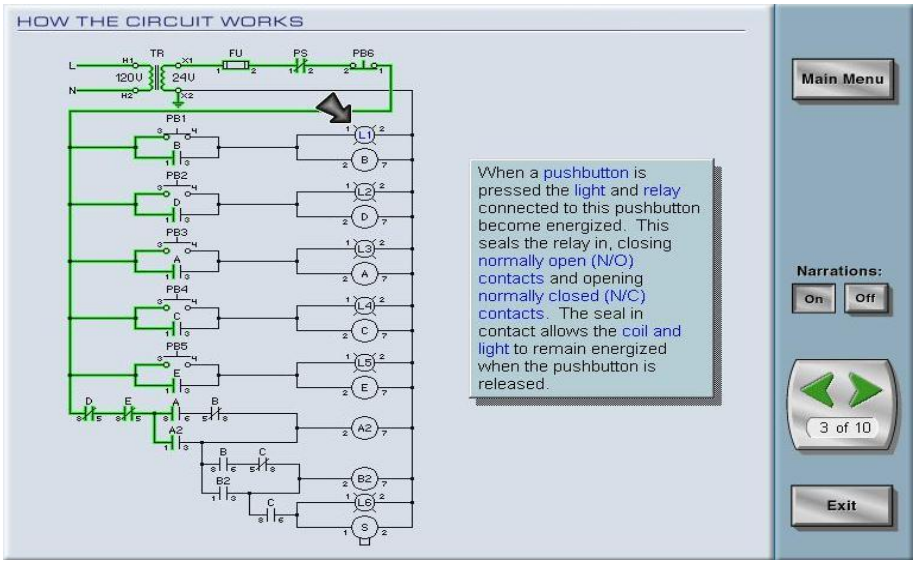
Simutech Troubleshooting Electrical Circuits V4.1



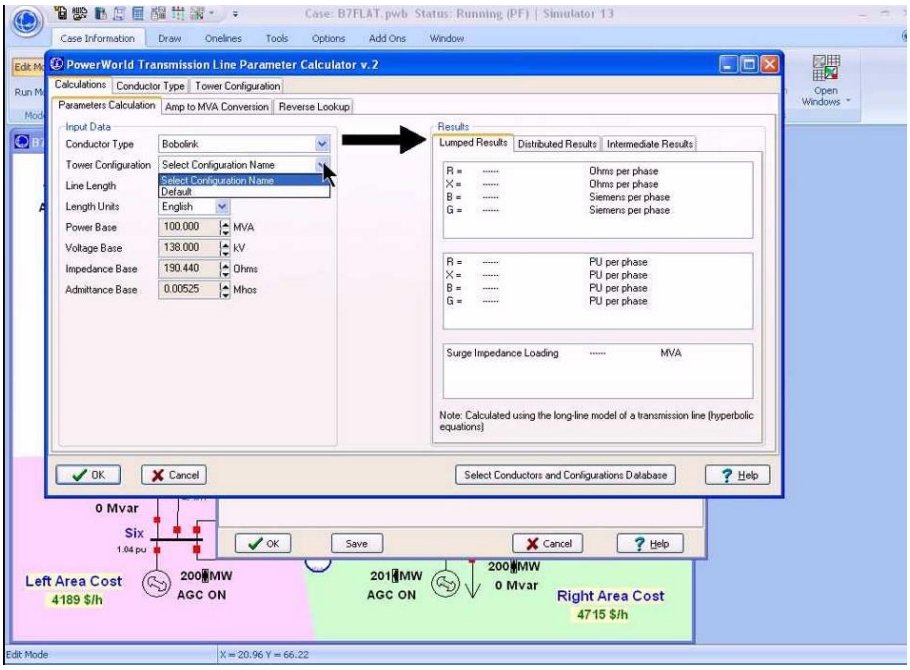
Power World Simulator



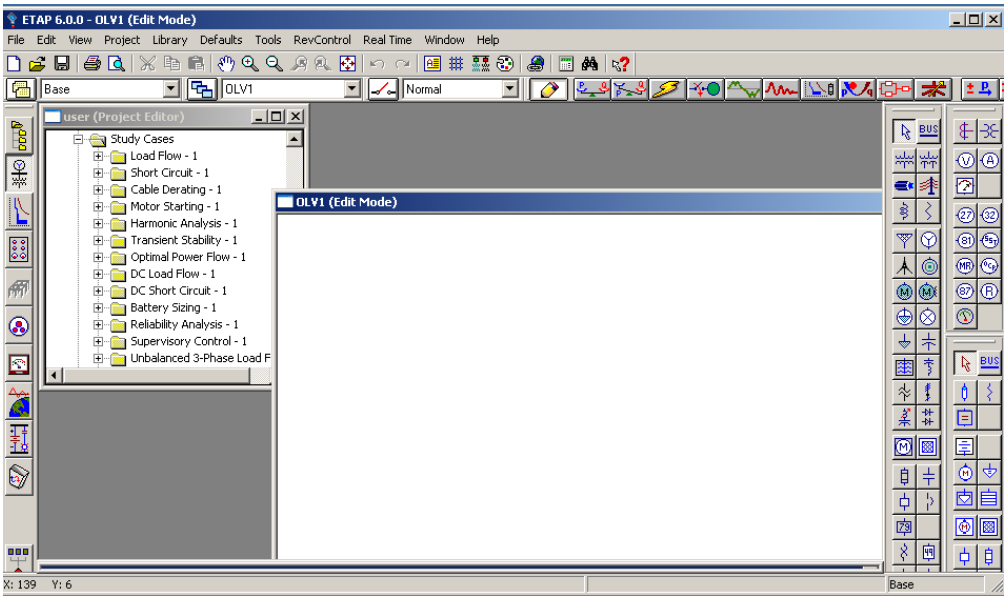
ETAP Software Simulator



Simutech Troubleshooting Electrical Circuits V4.1



Power World Simulator



ETAP Software Simulator

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