COURSE OVERVIEW EE1133

Vacuum Circuit Breaker (VCB) Testing, Maintenance & Troubleshooting

Course Title
Vacuum Circuit Breaker (VCB) Testing, Maintenance & Troubleshooting

Course Date/Venue
August 17-21, 2025/Tamra Meeting Room, Al Bandar Rotana Creek, Dubai, UAE

Course Reference
EE1133

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 Vacuum Circuit Breaker (VCB) Testing, Maintenance & Troubleshooting. It covers the vacuum circuit breakers, including its advantages and limitations and common applications in power systems; the construction components, operational principles, types and classifications of VCBs; the installation and commissioning, safety standards and best practices; the testing standards, insulation resistance testing, contact resistance measurement, vacuum integrity testing and timing and travel analysis; the control wiring, testing trip and close coils and functionality of interlocks and indicators; the routine maintenance procedures and preventive maintenance techniques; and the mechanical component maintenance, electrical component maintenance and vacuum interrupter maintenance.

Further, the course will also discuss the impact of temperature and humidity, protection against dust and moisture, sealing and insulation integrity and mitigation of environmental risks; the common VCB faults and diagnostic techniques; the troubleshooting procedures and coordination with protection systems; recording fault incidents, maintaining troubleshooting logs and preparing incident reports; and recommendations for system improvements.

During this interactive course, participants will learn the safety protocols, PPE usage and hazard identification, emergency procedures and preparation of tools and equipment; operating insulation resistance testers, using micro-ohmmeters for contact resistance and timing test equipment setup and interpretation of test results; disassembling and inspecting VCB components and cleaning and lubrication procedures; and the adjustment of mechanical linkages and reassembly and functional testing.

Course Objectives

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

- Apply and gain an in-depth knowledge on vacuum circuit breaker (VCB) testing, maintenance and troubleshooting
- Discuss vacuum circuit breakers including its advantages and limitations and common applications in power systems
- Identify the construction, components, operational principles, types and classifications of VCBs
- Carryout installation and commissioning, safety standards and best practices
- Apply testing standards, insulation resistance testing, contact resistance measurement, vacuum integrity testing and timing and travel analysis
- Verify control wiring, test trip and close coils and identify functionality of interlocks and indicators
- Employ routine maintenance procedures, preventive maintenance techniques, mechanical component maintenance, electrical component maintenance and vacuum interrupter maintenance
- Recognize the impact of temperature and humidity, protection against dust and moisture, sealing and insulation integrity and mitigation of environmental risks
- Identify common VCB faults and apply diagnostic techniques, troubleshooting procedures and coordination with protection systems
- Record fault incidents, maintain troubleshooting logs, prepare incident reports and discuss recommendations for system improvements
- Review safety protocols and apply PPE usage and hazard identification, emergency procedures and preparation of tools and equipment
- Operate insulation resistance testers, use micro-ohmmeters for contact resistance and apply timing test equipment setup and interpretation of test results
- Disassemble and inspect VCB components as well as carryout cleaning and lubrication procedures
- Adjust mechanical linkages and apply reassembly and functional testing

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 vacuum circuit breaker (VCB) testing, maintenance and troubleshooting for electrical engineers, maintenance technicians and electricians, substation engineers, facility and plant engineers, power system protection engineers, supervisors and managers, utility and industrial electrical personnel and other technical staff.

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 **30 years** of extensive experience in **Oil**, **Gas**, **Petrochemical**, **Refinery** & **Power** industries. His expertise includes **Electrical Safety**, **Power System Equipment**, **Electrical Drawing**, **Transmission Networks**, **Substation**, **Cable & Over Head Line**, **Substation Automation Systems & Application**, **Distribution Networks**, **Circuit Breaker**, **HV Switchgear Maintenance**, **HV/LV Electrical** Authorisation, Basic **Electricity**, **Electrical & Special Hazards**, **Personnel Protection**, **HV/LV Equipment**, **Motor Controllers**, **Electrical Switching** Practices, Uninterruptible Power Supply (**UPS**), **UPS and Battery System**, Preventive Maintenance of **Battery Charger and UPS System**, **UPS, DC System & Battery Design**, **Operation, Maintenance & Troubleshooting**, **Emergency Planning**, **Safety Management**, Safety Instrumented Systems (**SIS**), Safety Integrity Level (**SIL**), Emergency Shutdown (**ESD**); **Electrical Installation**, Maintenance & Troubleshooting, **Electrical Inspection & Testing**, Electrical Measurements, Power Flow Analysis of **Electrical Power Systems**, Electrical Fundamentals, **Basic Electricity** & Electrical Codes, **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** degree 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.

Accommodation

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

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.

Course Program

The following program is planned for this course. However, the course instructor(s) may modify this program before or during the workshop for technical reasons with no prior notice to participants. Nevertheless, the course objectives will always be met:

Day 1: ***Sunday, 17th of August 2025***

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Introduction to Vacuum Circuit Breakers*** *Historical Development and Evolution of VCBs • Comparison with Other Circuit Breaker Types (e.g., SF_6, Air, Oil) • Advantages and Limitations of VCBs • Common Applications in Power Systems*
0930 – 0945	*Break*
0945 – 1030	***Construction & Components of VCBs*** *Vacuum Interrupter Design and Materials • Operating Mechanisms (Spring, Magnetic Actuator) • Arc Quenching Process in Vacuum • Insulation and Enclosure Materials*
1030 – 1130	***Operational Principles*** *Opening and Closing Sequences • Contact Movement and Arc Extinction • Dielectric Recovery in Vacuum • Current Interruption Capabilities*
1130 – 1215	***Types & Classifications*** *Indoor vs. Outdoor VCBs • Fixed vs. Withdrawable Designs • Voltage and Current Ratings • Standards and Classifications (IEC, ANSI)*
1215 – 1230	*Break*
1230 – 1330	***Installation & Commissioning*** *Site Preparation and Environmental Considerations • Mechanical and Electrical Installation Procedures • Pre-Commissioning Checks and Tests • Documentation and Record-Keeping*

1330 – 1420	***Safety Standards & Best Practices*** *Personal Protective Equipment (PPE) Requirements • Lockout/Tagout Procedures • Safe Handling of High-Voltage Equipment • Emergency Response Protocols*
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, 18th of August 2025

0730 – 0830	***Overview of Testing Standards*** *International Standards (IEC, IEEE) • Manufacturer Guidelines • Testing Intervals and Schedules • Test Documentation and Reporting*
0830 – 0930	***Insulation Resistance Testing*** *Purpose and Significance • Testing Equipment and Setup • Interpretation of Results • Factors Affecting Insulation Resistance*
0930 – 0945	*Break*
0945 – 1100	***Contact Resistance Measurement*** *Importance of Low Contact Resistance • Testing Methods (e.g., Micro-Ohmmeter) • Acceptable Resistance Values • Troubleshooting High Resistance Issues*
1100 – 1215	***Vacuum Integrity Testing*** *High-Potential (Hi-Pot) Testing Procedures • Leakage Current Measurement • Criteria for Pass/Fail • Safety Precautions During Testing*
1215 – 1230	*Break*
1230 – 1330	***Timing & Travel Analysis*** *Measurement of Opening and Closing Times • Assessment of Contact Travel and Bounce • Use of Oscillographs and Analyzers • Interpreting Timing Diagrams*
1330 – 1420	***Auxiliary Circuit Testing*** *Verification of Control Wiring • Testing of Trip and Close Coils • Functionality of Interlocks and Indicators • Simulation of Control Operations*
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, 19th of August 2025

0730 – 0830	***Routine Maintenance Procedures*** *Visual Inspections for Physical Damage • Cleaning of External and Internal Components • Lubrication of Moving Parts • Tightening of Electrical Connections*
0830 – 0930	***Preventive Maintenance Techniques*** *Scheduled Maintenance Planning • Condition-Based Maintenance Strategies • Use of Diagnostic Tools (e.g., Thermography) • Record-Keeping and Trend Analysis*
0930 – 0945	*Break*
0945 – 1100	***Mechanical Component Maintenance*** *Inspection of Operating Mechanisms • Adjustment of Springs and Linkages • Replacement of Worn Mechanical Parts • Testing of Mechanical Operations*

1100 – 1215	***Electrical Component Maintenance*** *Checking Control Circuits and Relays • Testing of Auxiliary Contacts • Verification of Protection Schemes • Calibration of Control Devices*
1215 – 1230	*Break*
1230 – 1330	***Vacuum Interrupter Maintenance*** *Assessment of Contact Wear • Evaluation of Vacuum Bottle Condition • Criteria for Replacement • Handling and Disposal of Vacuum Interrupters*
1330 – 1420	***Environmental Considerations*** *Impact of Temperature and Humidity • Protection Against Dust and Moisture • Sealing and Insulation Integrity • Mitigation of Environmental Risks*
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, 20th of August 2025

0730 – 0830	***Common VCB Faults*** *Contact Wear and Erosion • Vacuum Loss or Degradation • Mechanical Linkage Failures • Control Circuit Malfunctions*
0830 – 0930	***Diagnostic Techniques*** *Use of Diagnostic Test Equipment • Analysis of Test Results • Identification of Fault Patterns • Root Cause Analysis Methods*
0930 – 0945	*Break*
0945 – 1100	***Troubleshooting Procedures*** *Systematic Approach to Fault Isolation • Step-by-Step Troubleshooting Guides • Use of Schematics and Wiring Diagrams • Verification of Corrective Actions*
1100 – 1215	***Case Studies & Practical Examples*** *Real-World Fault Scenarios • Lessons Learned from Past Incidents • Discussion of Troubleshooting Outcomes • Preventive Measures to Avoid Recurrence*
1215 – 1230	*Break*
1230 – 1330	***Coordination with Protection Systems*** *Interaction Between VCBs and Protective Relays • Coordination of Trip Settings • Impact of Protection Schemes on VCB Operation • Testing of Coordinated Protection Systems*
1330 – 1420	***Documentation & Reporting*** *Recording of Fault Incidents • Maintenance of Troubleshooting Logs • Preparation of Incident Reports • Recommendations for System Improvements*
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*

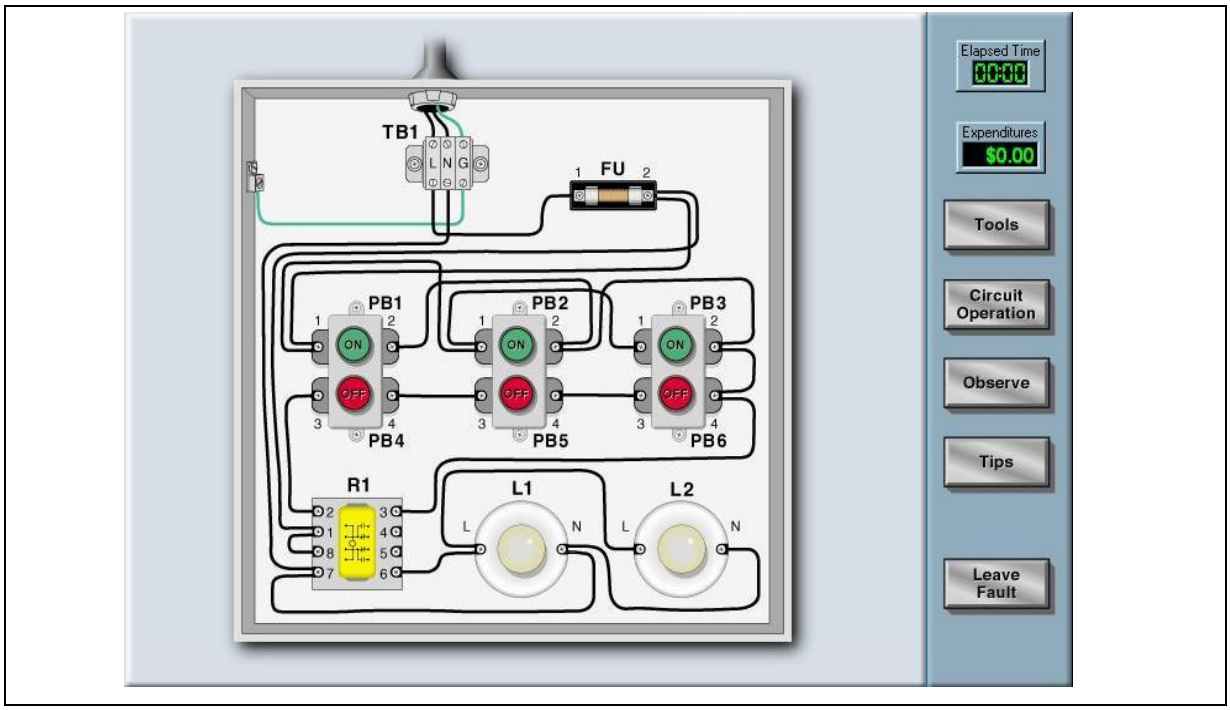
Day 5: Thursday, 21th of August 2025

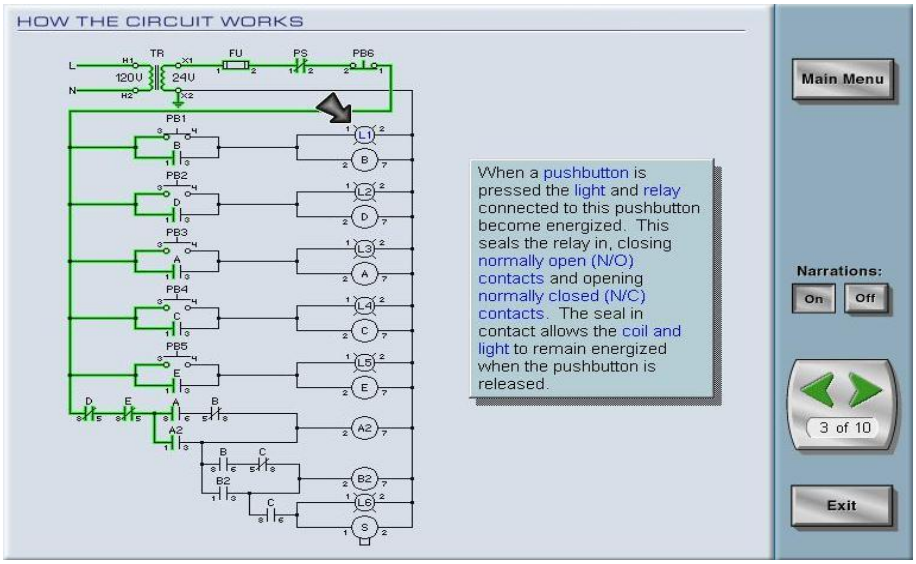
0730 – 0830	***Safety Briefing & Preparations*** *Review of Safety Protocols • PPE Usage and Hazard Identification • Emergency Procedures • Preparation of Tools and Equipment*
0830 – 0930	***Testing Equipment Demonstrations*** *Operation of Insulation Resistance Testers • Use of Micro-Ohmmeters for Contact Resistance • Timing Test Equipment Setup • Interpretation of Test Results*

0930 – 0945	*Break*
0945 – 1215	***Maintenance Activities*** *Disassembly and Inspection of VCB Components • Cleaning and Lubrication Procedures • Adjustment of Mechanical Linkages • Reassembly and Functional Testing*
1215 – 1230	*Break*
1230 – 1345	***Troubleshooting Exercises*** *Simulation of Common Faults • Application of Diagnostic Techniques • Implementation of Corrective Actions • Verification of Fault Resolution*
1345 – 1400	***Course Conclusion*** *Using this Course Overview, the Instructor(s) will Brief Participants about t Topics that were Covered During the Course*
1400 – 1415	***POST-TEST***
1415 – 1430	*Presentation of Course Certificates*
1430	*Lunch & End of Course*

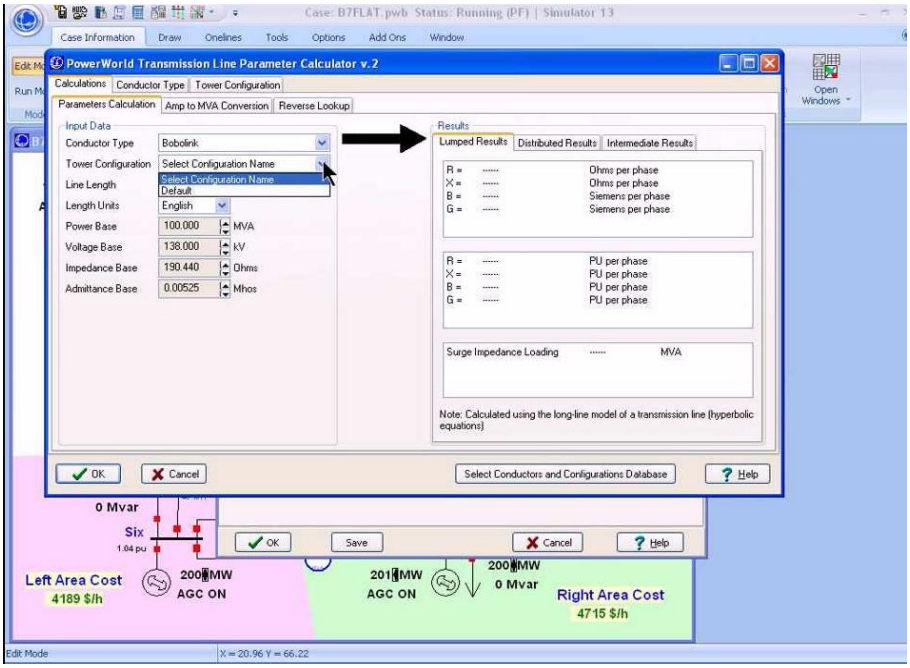
Simulator (Hands-on Practical Sessions)

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".

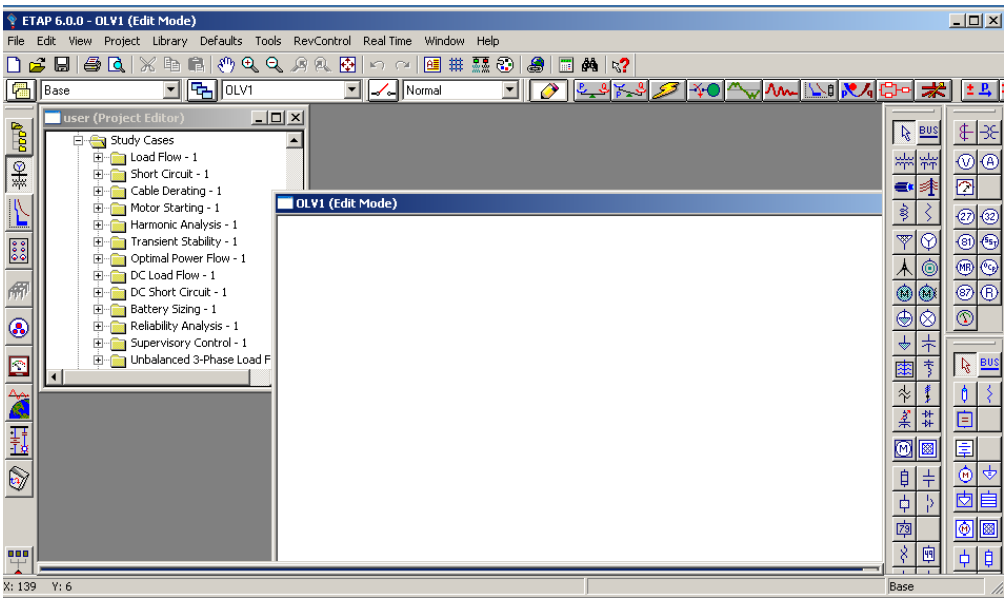




Simutech Troubleshooting Electrical Circuits V4.1



Power World Simulator



ETAP Software Simulator

GE Multilin Relay 469 Simulator

GE Multilin Relay 750 Simulator

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