COURSE OVERVIEW EE1131
MV ACB & HV Technology

Course Title
MV ACB & HV Technology

Course Date/Venue
June 16-20, 2025/Glasshouse Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE

Course Reference
EE1131

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 MV ACB & HV Technology. It covers the electrical power systems, medium voltage air circuit breakers, high voltage (HV) technology and switchgear components and functions; the IEC and IEEE standards for MV and HV equipment, testing and certification requirements, environmental and safety regulations and compliance and auditing processes; the safety protocols in MV and HV systems, construction and components of MV ACB, operating principles and protection schemes using MV ACB; and the routine inspection procedures, contact resistance measurement, insulation resistance testing and timing and functional tests.

Further, the course will also discuss the common issues and troubleshooting including HV circuit breakers, SF_6 circuit breakers, vacuum circuit breakers and oil and air-blast circuit breakers; the switchgear configurations and standards and testing for HV equipment; the design considerations for HV systems and protection and control in HV systems; and the maintenance strategies for HV equipment and safety practices in HV operations.

During this interactive course, participants will learn the environmental impact and sustainability covering SF_6 gas management and alternatives, recycling and disposal of HV equipment, energy efficiency measures and regulatory compliance and reporting; the integration of MV and HV systems, testing and commissioning procedures and digitalization and smart grid integration; the emerging technologies in MV and HV systems covering vacuum interrupters for HV applications, solid-state circuit breakers, eco-friendly insulating gases and advanced diagnostics and analytics; and the regulatory and compliance updates covering recent changes in standards, impact on equipment design and operation, compliance strategies and future regulatory trends.

Course Objectives

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

- Apply and gain an in-depth knowledge on medium voltage air circuit breakers and high voltage technology
- Discuss electrical power systems, medium voltage air circuit breakers, high voltage (HV) technology and switchgear components and functions
- Review IEC and IEEE standards for MV and HV equipment, testing and certification requirements, environmental and safety regulations and compliance and auditing processes
- Recognize safety protocols in MV and HV systems, construction and components of MV ACB, operating principles and protection schemes using MV ACB
- Apply routine inspection procedures, contact resistance measurement, insulation resistance testing and timing and functional tests
- Identify common issues and troubleshooting including HV circuit breakers, SF_6 circuit breakers, vacuum circuit breakers and oil and air-blast circuit breakers
- Carryout switchgear configurations and discuss standards and testing for HV equipment
- Explain design considerations for HV systems and protection and control in HV systems as well as apply maintenance strategies for HV equipment and safety practices in HV operations
- Discuss environmental impact and sustainability covering SF_6 gas management and alternatives, recycling and disposal of HV equipment, energy efficiency measures and regulatory compliance and reporting
- Apply integration of MV and HV systems, testing and commissioning procedures and digitalization and smart grid integration
- Recognize the emerging technologies in MV and HV systems covering vacuum interrupters for HV applications, solid-state circuit breakers, eco-friendly insulating gases and advanced diagnostics and analytics
- Review regulatory and compliance updates covering recent changes in standards, impact on equipment design and operation, compliance strategies and future regulatory trends

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 MV ACB & HV technology for electrical engineers, maintenance engineers & technicians, substation operators & technicians, project engineers / managers, commissioning engineers, supervisors & team leaders, health & safety professionals, procurement / asset management personnel, utility & industrial plant engineers 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. Ken Steel is a **Senior Electrical & Instrumentation Engineer** with over **30 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.

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: Monday, 16th of June 2025

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Introduction to Electrical Power Systems*** *Overview of Power Generation, Transmission and Distribution • Voltage Classifications: LV, MV, HV, EHV • Importance of Switchgear in Power Systems • Basic Components: Transformers, Circuit Breakers, Isolators*
0930 – 0945	*Break*
0945 – 1030	***Medium Voltage Air Circuit Breakers (MV ACB)*** *Definition and Applications • Operating Principles • Comparison with Other Breaker Types • Advantages and Limitations*
1030 – 1130	***High Voltage (HV) Technology Overview*** *Definition and Voltage Ranges • Applications in Power Systems • Challenges in HV Systems • Safety Considerations*
1130 – 1215	***Switchgear Components & Functions*** *Circuit Breakers • Disconnectors and Isolators • Earthing Switches • Instrument Transformers*
1215 – 1230	*Break*
1230 – 1330	***Standards & Regulations*** *IEC and IEEE Standards for MV and HV Equipment • Testing and Certification Requirements • Environmental and Safety Regulations • Compliance and Auditing Processes*

1330 – 1420	***Safety Protocols in MV & HV Systems*** *Personal Protective Equipment (PPE) • Lockout-Tagout (LOTO) Procedures • Arc Flash Hazards and Mitigation • Emergency Response Planning*
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: Tuesday, 17th of June 2025

0730 – 0830	***Construction & Components of MV ACB*** *Main Contacts and Arc Chutes • Operating Mechanisms • Trip Units and Protection Relays • Enclosures and Insulation Materials*
0830 – 0930	***Operating Principles of MV ACB*** *Arc Formation and Extinction • Current Interruption Process • Mechanical and Electrical Interlocks • Manual and Automatic Operations*
0930 – 0945	*Break*
0945 – 1100	***Protection Schemes Using MV ACB*** *Overcurrent Protection • Short-Circuit Protection • Earth Fault Protection • Coordination with Upstream and Downstream Devices*
1100 – 1215	***Maintenance & Testing of MV ACB*** *Routine Inspection Procedures • Contact Resistance Measurement • Insulation Resistance Testing • Timing and Functional Tests*
1215 – 1230	*Break*
1230 – 1330	***Common Issues & Troubleshooting*** *Contact Wear and Erosion • Mechanical Linkage Failures • Trip Unit Malfunctions • Overheating and Insulation Degradation*
1330 – 1420	***Case Studies & Practical Examples*** *Analysis of MV ACB Failures • Lessons Learned from Real Incidents • Best Practices in Maintenance • Improvement Strategies*
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: Wednesday, 18th of June 2025

0730 – 0830	***Overview of HV Circuit Breakers*** *Types: SF_6, Vacuum, Oil, Air-Blast • Applications and Selection Criteria • Comparison of Technologies • Environmental Considerations*
0830 – 0930	***SF_6 Circuit Breakers*** *Properties of SF_6 Gas • Arc Quenching Mechanism • Design and Construction • Handling and Environmental Impact*
0930 – 0945	*Break*
0945 – 1100	***Vacuum Circuit Breakers*** *Operating Principles • Advantages Over Other Types • Design Considerations • Applications in HV Systems*
1100 – 1215	***Oil & Air-Blast Circuit Breakers*** *Historical Development • Operating Mechanisms • Maintenance Requirements • Current Usage and Limitations*

1215 – 1230	Break
1230 – 1330	***Switchgear Configurations*** *Air-Insulated Switchgear (AIS) • Gas-Insulated Switchgear (GIS) • Hybrid Switchgear Systems • Selection Based on Application*
1330 – 1420	***Standards & Testing for HV Equipment*** *IEC 62271 Series • Type and Routine Tests • High-Voltage Testing Procedures • Certification Processes*
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: Thursday, 19th of June 2025

0730 – 0830	***Design Considerations for HV Systems*** *Insulation Coordination • Creepage and Clearance Distances • System Grounding Methods • Surge Protection Devices*
0830 – 0930	***Protection & Control in HV Systems*** *Differential Protection Schemes • Distance Protection • Breaker Failure Protection • Automation and Control Systems*
0930 – 0945	*Break*
0945 – 1100	***Maintenance Strategies for HV Equipment*** *Condition-Based Maintenance • Predictive Maintenance Techniques • Use of Diagnostic Tools • Maintenance Scheduling and Planning*
1100 – 1215	***Safety Practices in HV Operations*** *Risk Assessment Procedures • Safe Work Practices • Emergency Response Protocols • Training and Competency Requirements*
1215 – 1230	*Break*
1230 – 1330	***Environmental Impact & Sustainability*** *SF_6 Gas Management and Alternatives • Recycling and Disposal of HV Equipment • Energy Efficiency Measures • Regulatory Compliance and Reporting*
1330 – 1420	***Case Studies in HV System Failures*** *Analysis of Major Incidents • Root Cause Analysis Techniques • Preventive Measures • Lessons Learned and Best Practices*
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*

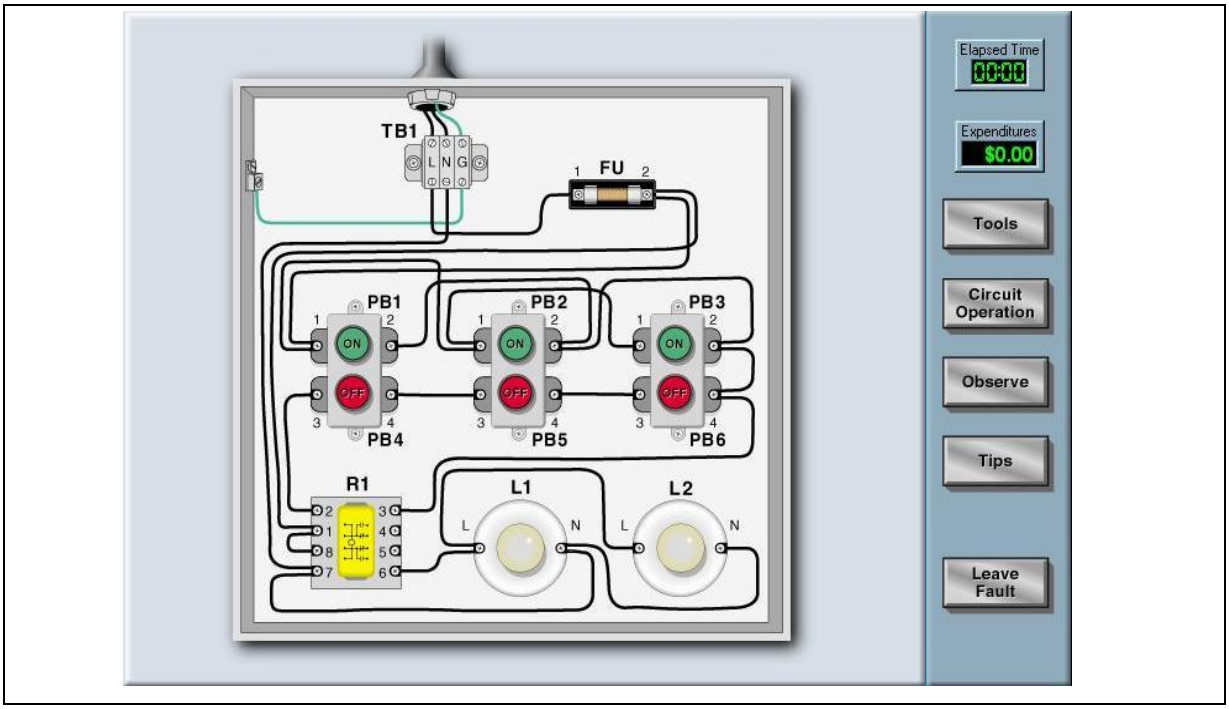
Day 5: Friday, 20th of June 2025

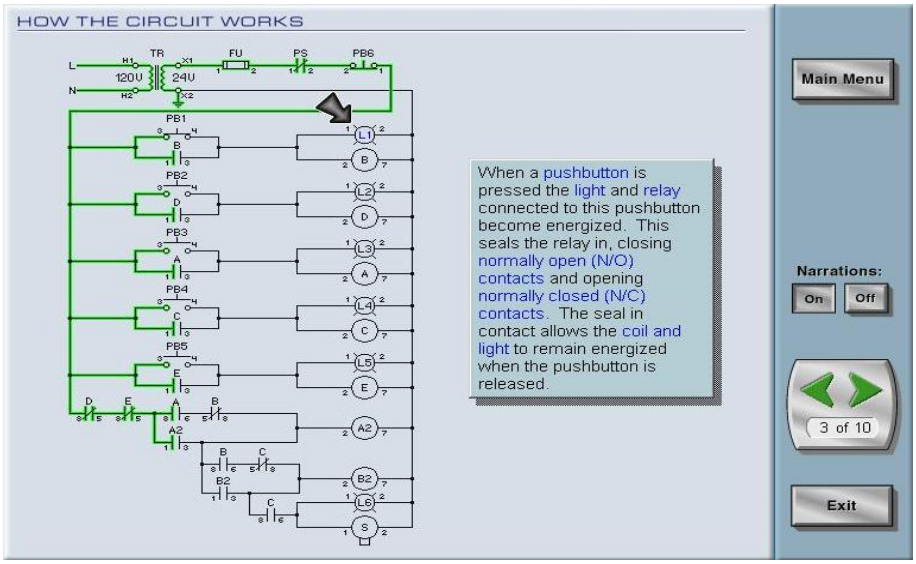
0730 – 0830	***Integration of MV & HV Systems*** *Interfacing Between MV and HV Equipment • Coordination of Protection Schemes • Communication Protocols • System Stability Considerations*
0830 – 0930	***Testing & Commissioning Procedures*** *Pre-Commissioning Checks • Functional and Performance Testing • Site Acceptance Tests • Documentation and Reporting*
0930 – 0945	*Break*

0945 – 1100	***Digitalization & Smart Grid Integration*** *Intelligent Electronic Devices (IEDs) • SCADA Systems • Remote Monitoring and Control • Cybersecurity Considerations*
1100 – 1215	***Emerging Technologies in MV & HV Systems*** *Vacuum Interrupters for HV Applications • Solid-State Circuit Breakers • Eco-Friendly Insulating Gases • Advanced Diagnostics and Analytics*
1215 – 1230	*Break*
1230 – 1345	***Regulatory & Compliance Updates*** *Recent Changes in Standards • Impact on Equipment Design and Operation • Compliance Strategies • Future Regulatory Trends*
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*

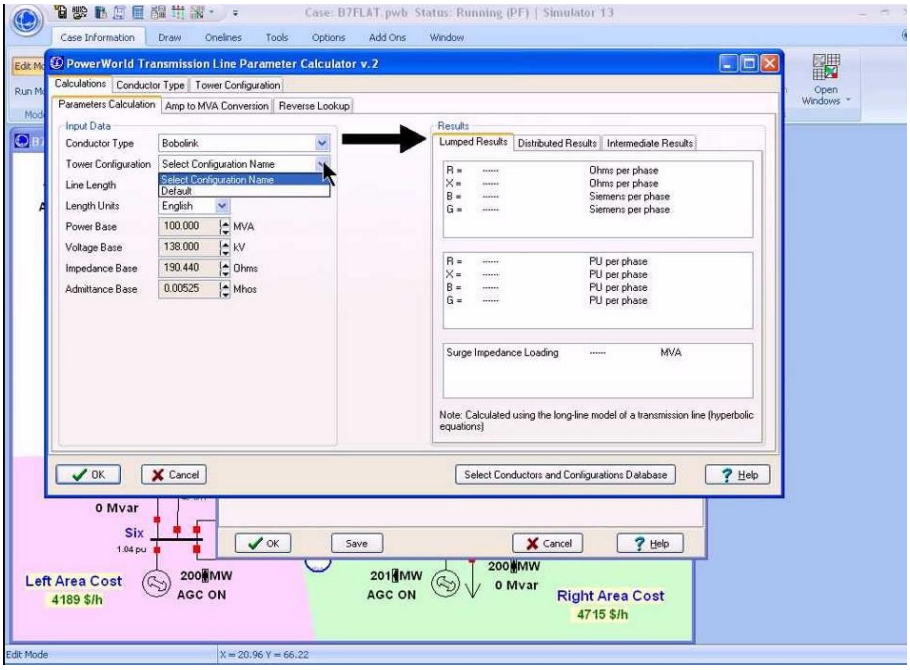
Simulator (Hands-on Practical Sessions)

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".

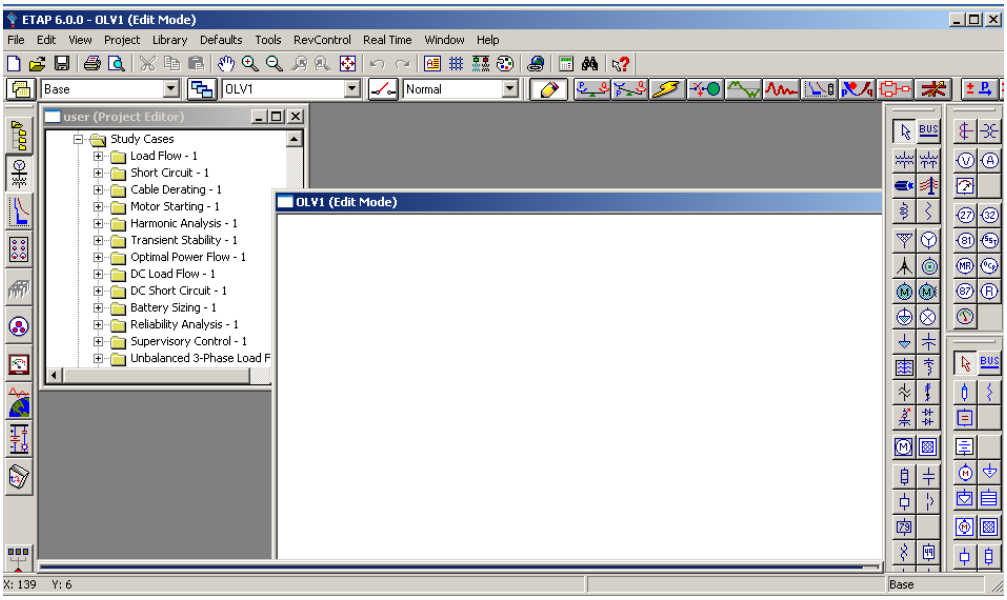




Simutech Troubleshooting Electrical Circuits V4.1



Power World Simulator



ETAP Software Simulator

GE Multilin Relay 469 Simulator

GE Multilin Relay 750 Simulator

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