



COURSE OVERVIEW EE1180

Transient Stability & Voltage Stability in Transmission Networks

Course Title

Transient Stability & Voltage Stability in Transmission Networks

Course Date/Venue

November 02-06, 2026/Meeting Room, CUBES BUSINESS CENTER, Al Khazna Tower - 15th Floor - Al Najda Street - Al Danah - Zone 1, Abu Dhabi UAE

Course Reference

EE1180

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 Transient Stability & Voltage Stability in Transmission Networks. It covers the power system stability, basics of power system dynamics, swing equation and rotor dynamics; the power-angle relationship, types of disturbances in power systems and voltage stability; the concept of transient stability, equal area criterion (EAC) and fault analysis in stability studies; the numerical methods for stability analysis and multi-machine transient stability; and the factors affecting transient stability.

During this interactive course, participants will learn the fundamentals of voltage stability, PV and QV curves and reactive power compensation; the load modeling in voltage stability, voltage stability indices and voltage control strategies; the dynamic voltage stability, stability enhancement techniques and FACTS devices in stability improvement; the HVDC systems and stability, wide-area monitoring and control and stability-constrained operation; planning for stability in transmission networks; and the future trends in stability analysis.



Course Objectives/Outcomes & Benefits for the Participants

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

- Apply and gain an in-depth knowledge on transient stability and voltage stability in transmission networks
- Discuss power system stability, basics of power system dynamics and swing equation and rotor dynamics
- Recognize power-angle relationship, types of disturbances in power systems and voltage stability
- Explain the concept of transient stability, equal area criterion (EAC) and fault analysis in stability studies
- Apply numerical methods for stability analysis, multi-machine transient stability and factors affecting transient stability
- Discuss the fundamentals of voltage stability, PV and QV curves and reactive power compensation
- Illustrate load modeling in voltage stability, voltage stability indices and voltage control strategies
- Carryout dynamic voltage stability, stability enhancement techniques and FACTS devices in stability improvement
- Apply HVDC systems and stability, wide-area monitoring and control and stability-constrained operation
- Plan for stability in transmission networks and discuss the future trends in stability analysis

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 transient stability and voltage stability in transmission networks for power system and electrical engineers, transmission and grid planning engineers, protection and control engineers, system operation and load dispatch professionals, power plant and utility engineers, grid stability and reliability specialists, commissioning and testing engineers, energy management system (EMS) and SCADA professionals, regulatory and power system planning personnel, professionals involved in transient stability, voltage stability and secure transmission network performance.

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 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.

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. Ahmed El-Sayed, PhD, MSc, BSc, is a **Senior Electrical & Instrumentation Engineer** with over **30 years** of extensive experience in the **Oil, Gas, Power, Petroleum, Petrochemical and Water & Utilities**. He specializes in **Fire Fighting System Instrumentations, Fire Protection System, Fire & Gas Detection & Alarm System, Instrumentation Protection Devices Maintenance & Testing, Protection Devices Troubleshooting, Water Meter Calibration, Liquid & Gas Flowmetering & Meter Calibration, Testing & Calibration of Energy Meters, DCS & ESD System Architecture, Distributed Control System, DCS & SCADA, Distributed Control System (DCS) Selection & Troubleshooting, Advanced DCS Yokogawa, Yokogawa CENTUM VP DCS, Modern**

Distributed Control System (DCS) & Process Instrumentation, Cyber Security of Industrial System, DCS System (Honeywell), DCS Experion System, DCS Siemens Teleperm XP, Relay Coordination Using ETAP Software, Power System Study on ETAP, ETAP-Power System Analysis, Flow Measurement Foundation, Hydrocarbon Measurement & Sampling, Gas Dosiers Preparation, Gas/Liquid Fuel Measurement, Instrumentation Measurement & Control System, Flow Measurement, Pressure Measurement, Level & Temperature Measurement, Measurement Devices & Control System, Instrumentation & Control Systems, Control System Orientation, Uninterruptible Power Supply (UPS) Battery Charger, Industrial UPS Systems Construction & Operation, Test Lead-Acid & Ni-cad Battery Systems, Hazards & Safe Work Practices, Transformer Operational Principles, Selection & Troubleshooting; HV & LV Transformers, Control Valves & Actuators, Electrical Safety, Protection Relay Application, Maintenance & Testing, NEC (National Electrical Code), NESC (National Electrical Safety Code), Electrical Safety, Electrical Hazards Assessment, Electrical Equipment, Personal Protective Equipment, Lock-Out & Tag-Out (LOTO), Confined Workspaces, Alerting Techniques, Electrical Transient Analysis Program (ETAP), Power Quality, Power Network, Power Distribution, Distribution Systems, Power Systems Control, Power Systems Security, Power Electronics, Electrical Substations, UPS & Battery System, Earthing & Grounding, Load Forecasting, Power Generation, Protective Systems, Electrical Generators, Power & Distribution Transformers, Electrical Motors, Switchgears, Transformers, AC & DC Drives, Variable Speed Drives & Generators, Generator Protection, GE Gas Turbines, PLC, SCADA, DCS, Process Control, Control Systems & Data Communications, Instrumentation, Automation, Valve Tuning, SIS, SIL, ESD, Alarm Management Systems, Energy Management System, Engine Management System, Bearing & Rotating Machine, Fieldbus Systems and Fiber Optics Technology. He is currently the **Systems Control Manager of **Siemens** where he is in-charge of Security & Control of Power **Transmission Distribution & High Voltage** Systems and he further takes part in the Load Records Evaluation & Transmission Services Pricing.**

During his career life, Dr. Ahmed has been actively involved in different Power System Activities including Roles in Power System Planning, Analysis, Engineering, **HV Substation Design**, Electrical Service Pricing, Evaluations & Tariffs, Project Management, Teaching and Consulting. His vast industrial experience was honed greatly when he joined many International and National Companies such as **Siemens, Electricity Authority** and **ACETO** industries as the **Instrumentation & Electrical Service Project Manager, Instrumentation & Control Engineer, Fire Protection Engineer, Energy Management Engineer, Department Head, Assistant Professor, Instrumentation & Control Instructor, Project Coordinator, Project Assistant and Managing Board Member** where he focused more on dealing with Technology Transfer, System Integration Process and Improving Localization. He was further greatly involved in manufacturing some of **Power System and Control & Instrumentation Components** such as Series of Digital Protection **Relays, MV VFD, PLC and SCADA** System with intelligent features.

Dr. Ahmed is well-versed in different electrical and instrumentation fields like **ETAP**, Load Management Concepts, **PLC Programming**, Installation, Operation and Troubleshooting, **AC Drives Theory**, Application and Troubleshooting, Industrial Power Systems Analysis, **AC & DC Motors**, Electric Motor **Protection, DCS SCADA, Control** and Maintenance Techniques, Industrial Intelligent Control System, **Power Quality Standards**, Power Generators and Voltage Regulators, Circuit Breaker and Switchgear Application and Testing Techniques, **Transformer** and **Switchgear** Application, Grounding for Industrial and Commercial Assets, Power Quality and **Harmonics, Protective Relays** (O/C Protection, Line Differential, Bus Bar Protection and **Breaker Failure Relay**) and Project Management Basics (PMB).

Dr. Ahmed has **PhD, Master's & Bachelor's** degree in **Electrical Engineering** from the **University of Wisconsin Madison, USA** and **Ain Shams University**, respectively. Further, he is a **Certified Instructor/Trainer**, a **Certified Internal Verifier/ Assessor/Trainer** by the **Institute of Leadership and Management (ILM)**, an active member of **IEEE** and **ISA** as well as numerous technical and scientific papers published internationally in the areas of Power Quality, Superconductive Magnetic Energy Storage, SMES role in Power Systems, Power System **Blackout** Analysis, and Intelligent Load Shedding Techniques for preventing Power System Blackouts, **HV Substation Automation** and Power System Stability.

Training Methodology

Our courses employ an interactive, learner-centred methodology that integrates theoretical knowledge with practical application. The training is delivered through a suitable combination of some or all of the following methods, selected according to the course content and learning objectives:

- Instructor-led presentations and facilitated discussions
- Practical workshops and participant presentations
- Hands-on exercises and real-world case studies
- Equipment demonstrations and technical drawings
- Hardware- and software-based simulations
- Gamification & Role Play in soft-skills courses only
- Virtual Reality (VR) and Augmented Reality (AR)
- Instructional videos and other relevant training resources

This blended approach encourages active participation, strengthens practical skills and supports the effective application of acquired knowledge in the workplace.

Learning Design & Customization

This course can be customized to the exact requirements of clients. Haward Technology is so proud of our huge capabilities in tailoring our courses to the training needs of our valued clients.

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, 02nd of November 2026

0730 – 0800	<i>Registration & Coffee</i>
0800 – 0815	<i>Welcome & Introduction</i>
0815 – 0830	PRE-TEST
0830 – 0930	Introduction to Power System Stability <i>Definition and Importance of Stability • Classification (Steady-State, Transient, Voltage Stability) • Impact on Grid Reliability • Historical Instability Events</i>
0930 – 0945	<i>Break</i>
0945 – 1030	Basics of Power System Dynamics <i>Dynamic versus Steady-State Behavior • Time Scales of Stability Phenomena • Disturbance Types (Faults, Switching, Load Changes) • System Response Characteristics</i>
1030 – 1130	Swing Equation & Rotor Dynamics <i>Concept of Rotor Angle Stability • Mechanical versus Electrical Power Balance • Inertia Constant and Damping • Interpretation of Rotor Motion</i>
1130 – 1215	Power-Angle Relationship <i>Power Transfer Equation • Stability Limit Concept • Effect of Transmission Reactance • Operating Point and Stability Margin</i>
1215 – 1230	<i>Break</i>
1230 – 1330	Types of Disturbances in Power Systems <i>Symmetrical and Unsymmetrical Faults • Line Outages and Switching Events • Generator Tripping • Load Variations</i>

1330 – 1420	Basics of Voltage Stability Definition and Importance • Short-Term versus Long-Term Voltage Stability • Causes of Voltage Collapse • Relationship with Reactive Power
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, 03rd of November 2026

0730 – 0830	Concept of Transient Stability Definition and Time Frame • Large Disturbance Response • Stability versus Instability Behavior • Critical Clearing Time (CCT)
0830 – 0930	Equal Area Criterion (EAC) Concept and Graphical Interpretation • Acceleration and Deceleration Areas • Stability Condition • Applications in Simple Systems
0930 – 0945	Break
0945 – 1100	Fault Analysis in Stability Studies Three-Phase Faults • Effect of Fault Location • Clearing Mechanisms • Post-Fault System Conditions
1100 – 1215	Numerical Methods for Stability Analysis Step-by-Step Integration Methods • Euler and Runge-Kutta Methods • Time-Domain Simulation Basics • Accuracy Considerations
1215 – 1230	Break
1230 – 1330	Multi-Machine Transient Stability System Modeling Complexities • Coherency of Generators • Inter-Area Dynamics • Stability Assessment Methods
1330 – 1420	Factors Affecting Transient Stability System Inertia • Fault Clearing Time • Transmission Line Parameters • Generator Excitation Systems
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, 04th of November 2026

0730 – 0830	Fundamentals of Voltage Stability Voltage Collapse Mechanisms • Load Characteristics • Reactive Power Balance • Static versus Dynamic Voltage Stability
0830 – 0930	PV & QV Curves Voltage versus Power (PV Curve) • Reactive Power versus Voltage (QV Curve) • Stability Margin Interpretation • Nose Curve Concept
0930 – 0945	Break
0945 – 1100	Reactive Power Compensation Shunt Capacitors and Reactors • Series Compensation • SVC and STATCOM Devices • Impact on Voltage Profile
1100 – 1215	Load Modeling in Voltage Stability Static Load Models (ZIP Model) • Dynamic Load Behavior • Voltage-Dependent Loads • Impact on System Stability
1215 – 1230	Break

1230 – 1330	Voltage Stability Indices <i>L-Index • Fast Voltage Stability Index (FVSI) • Line Stability Indices • Practical Applications</i>
1330 – 1420	Voltage Control Strategies <i>Generator Excitation Control • Transformer Tap Changers • Reactive Power Dispatch • Coordinated Voltage Control</i>
1420 – 1430	Recap <i>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</i>
1430	<i>Lunch & End of Day Three</i>

Day 4: Thursday, 05th of November 2026

0730 – 0830	Dynamic Voltage Stability <i>Time-Dependent Voltage Behavior • Role of Load Dynamics • Motor Loads and Stalling • Interaction with Frequency Stability</i>
0830 – 0930	Stability Enhancement Techniques <i>Fast Fault Clearing • High-Speed Relays • Improved System Design • Preventive Control Actions</i>
0930 – 0945	<i>Break</i>
0945 – 1100	FACTS Devices in Stability Improvement <i>SVC, STATCOM, TCSC, UPFC • Control of Power Flow • Voltage Support Capabilities • Impact on Transient Stability</i>
1100 – 1215	HVDC Systems & Stability <i>HVDC Links in AC Systems • Power Modulation • Stability Support Functions • Integration Challenges</i>
1215 – 1230	<i>Break</i>
1230 – 1330	Wide-Area Monitoring & Control <i>PMU Technology • Real-Time Monitoring • Oscillation Detection • Wide-Area Control Strategies</i>
1330 – 1420	Stability-Constrained Operation <i>Security-Constrained OPF • Preventive versus Corrective Control • Contingency Analysis • Operational Limits</i>
1420 – 1430	Recap <i>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</i>
1430	<i>Lunch & End of Day Four</i>

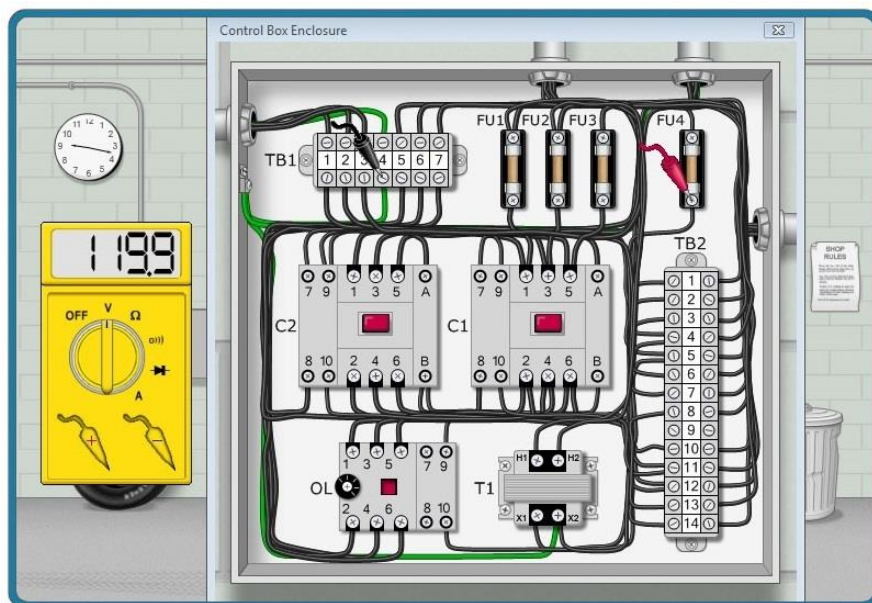
Day 5: Friday, 06th of November 2026

0730 – 0830	Software Tools for Stability Analysis <i>MATLAB/Simulink • DIgSILENT PowerFactory • PSS/E • Model Setup and Simulation</i>
0830 – 0930	Case Studies of Transient Instability <i>Major Blackout Events • Fault-Induced Instability • Root Cause Analysis • Lessons Learned</i>
0930 – 0945	<i>Break</i>
0945 – 1100	Case Studies of Voltage Collapse <i>Real-World Voltage Instability Cases • Reactive Power Deficiency Issues • System Recovery Challenges • Preventive Measures</i>

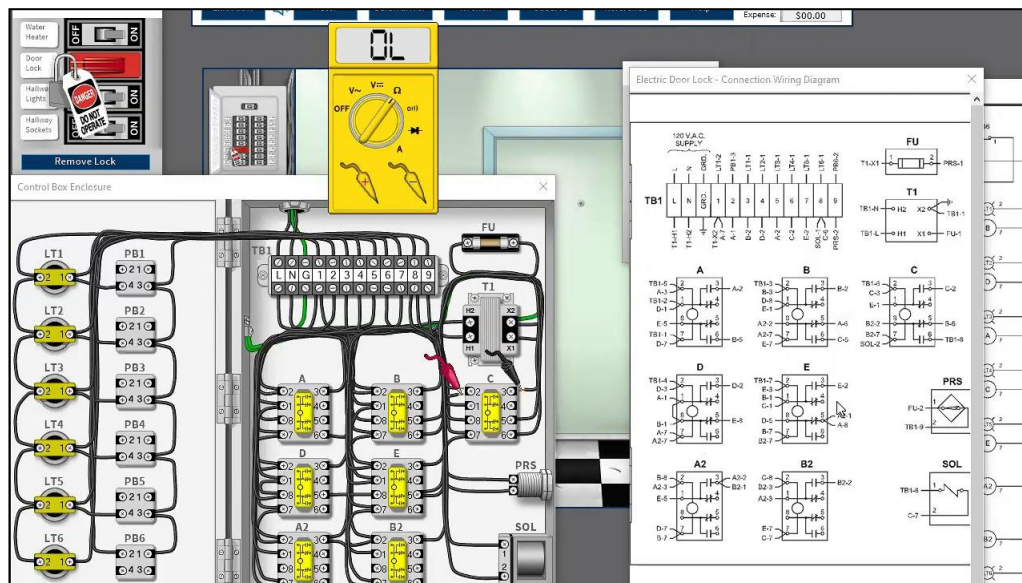
1100 – 1215	Planning for Stability in Transmission Networks Network Reinforcement • Reactive Power Planning • Contingency Planning • Long-Term Stability Considerations
1215 – 1230	Break
1230 – 1300	Future Trends in Stability Analysis High Renewable Penetration • Low Inertia Systems • AI-Based Stability Monitoring • Smart Grid Applications
1300 - 1345	Capstone Project & Evaluation Modeling a Transmission System • Performing Transient and Voltage Stability Analysis • Proposing Mitigation Measures • Presenting Results and Recommendations
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)

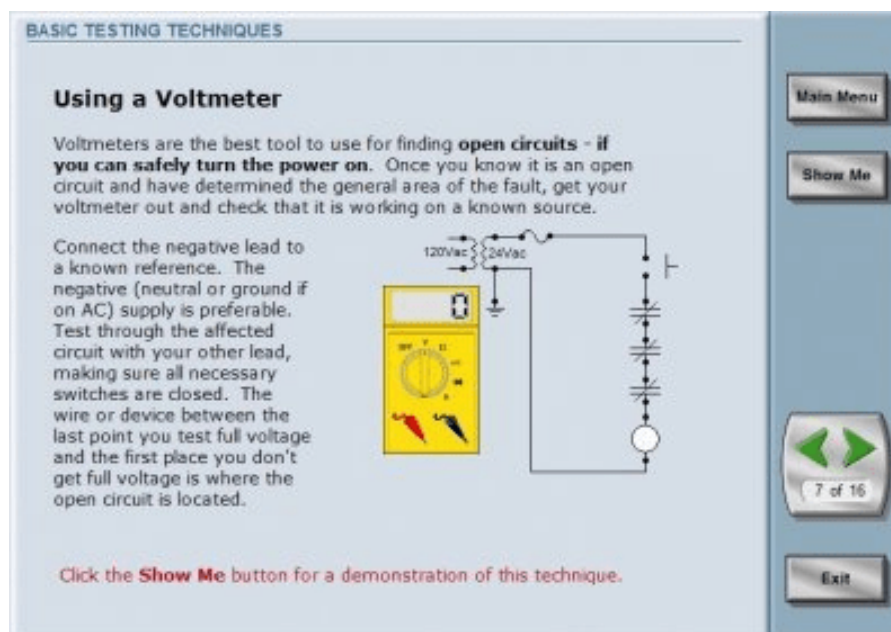
Practical sessions will be organized during the course for delegates to practice the theory learnt. Delegates will be provided with an opportunity to carryout various exercises using our state-of-the-art simulator “Troubleshooting Motor Control Circuits”, “Troubleshooting Basic Control Circuits”, “Troubleshooting Basic Techniques”, Power World” and “ETAP software”.



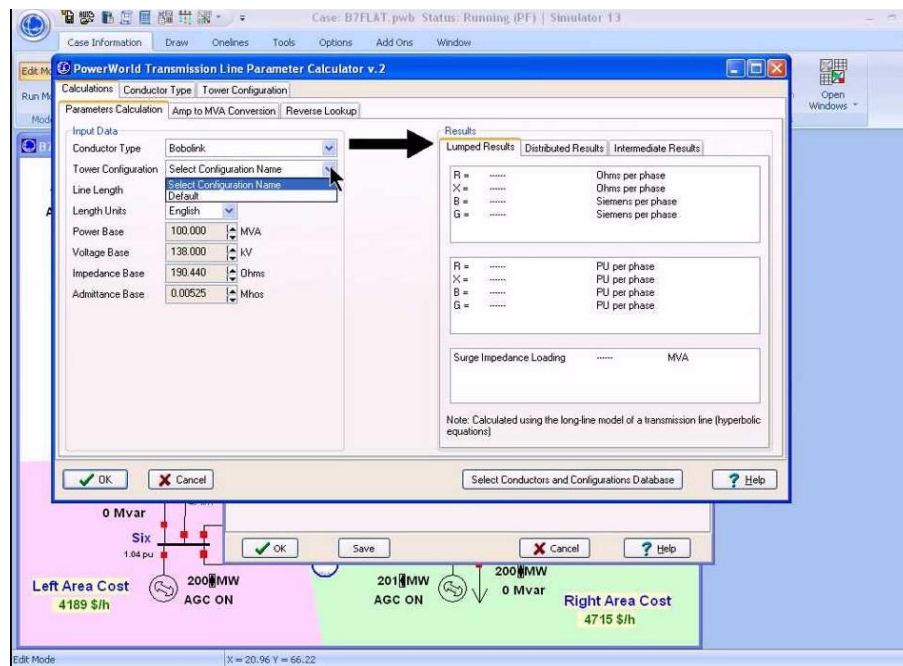
Troubleshooting Motor Control Circuits



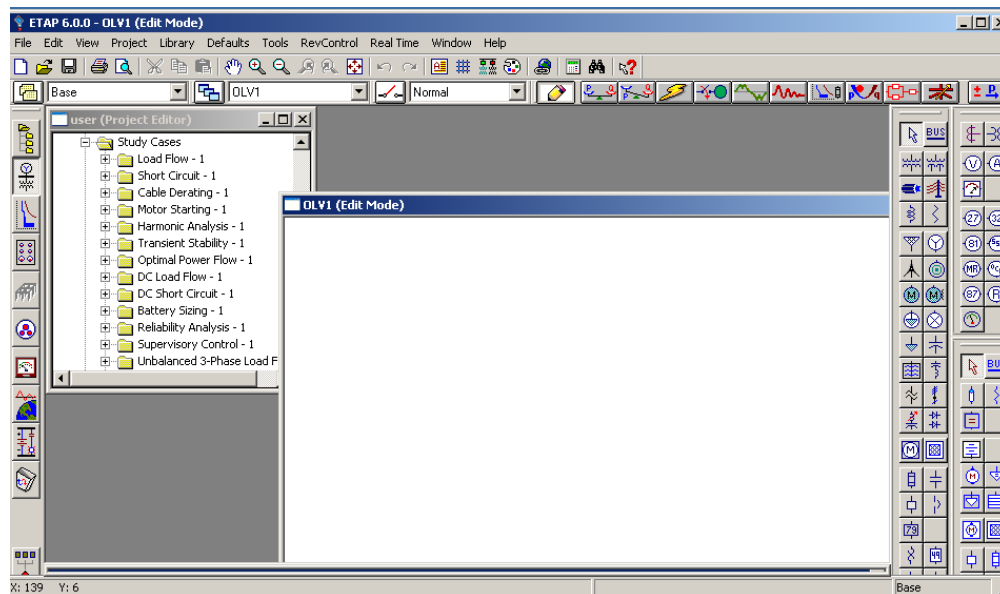
Troubleshooting Basic Control Circuits



Troubleshooting Basic Techniques



Power World Simulator



ETAP Software Simulator

Course Coordinator

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