COURSE OVERVIEW EE1175

Oscillatory Stability & Power System Stability (PSS) Tuning

Course Title
Oscillatory Stability & Power System Stability (PSS) Tuning

Course Date/Venue
October 19-23, 2026/Glasshouse Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE

3.0 CEUs (30 PDHs) AWARD

Course Reference
EE1175

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 Oscillatory Stability & Power System Stability (PSS) Tuning. It covers the power system stability, basics of synchronous machine dynamics and types of oscillations in power systems; the small-signal stability analysis, damping in power systems and power system stabilizers (PSS); the generator and excitation system modeling and state-space modeling of power systems; the eigenvalue analysis, frequency domain analysis, time-domain simulation and measurement of oscillations; the PSS structure and components and PSS design objectives; and the classical PSS design methods.

During this interactive course, participants will learn the multi-machine system considerations, PSS types and configurations and limitations of conventional PSS; the optimization-based PSS tuning and robust control approaches and adaptive and intelligent PSS; the wide-area damping control (WADC), interaction with other controllers and practical tuning considerations; the on-site testing procedures and signal validation; and the performance verification and troubleshooting issues.

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 oscillatory stability and power system stability (PSS) tuning
- Discuss power system stability, basics of synchronous machine dynamics and types of oscillations in power systems
- Carryout small-signal stability analysis, damping in power systems and power system stabilizers (PSS)
- Recognize generator and excitation system modeling and state-space modeling of power systems
- Apply eigenvalue analysis, frequency domain analysis, time-domain simulation and measurement of oscillations
- Explain PSS structure and components, PSS design objectives and classical PSS design methods
- Discuss multi-machine system considerations, PSS types and configurations and limitations of conventional PSS
- Interpret optimization-based PSS tuning and discuss robust control approaches and adaptive and intelligent PSS
- Recognize wide-area damping control (WADC), interaction with other controllers and practical tuning considerations
- Apply on-site testing procedures, signal validation, performance verification and troubleshooting issues

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 oscillatory stability and power system stability (PSS) tuning for power system and electrical engineers, grid stability and control engineers, power plant and utility engineers, protection and control engineers, generator and excitation system engineers, transmission system operators and control center personnel, commissioning and testing engineers, power system planning and reliability specialists, operations and maintenance engineers in generation facilities, professionals involved in oscillation analysis, small-signal stability and power system stabilizer (PSS) tuning.

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 Telepherm 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

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.

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, 19th of October 2026

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Introduction to Power System Stability*** *Definition and Classification of Stability • Rotor Angle, Voltage, and Frequency Stability • Importance in Modern Grids • Historical Blackout Examples*
0930 – 0945	*Break*
0945 – 1030	***Basics of Synchronous Machine Dynamics*** *Swing Equation and Rotor Dynamics • Inertia and Damping Concepts • Mechanical versus Electrical Torque • Small-Signal versus Transient Behavior*
1030 – 1130	***Types of Oscillations in Power Systems*** *Local Modes (Intra-Plant Oscillations) • Inter-Area Oscillations • Control Mode Oscillations • Forced Oscillations*
1130 – 1215	***Small-Signal Stability Analysis*** *Linearization of System Equations • State-Space Representation • Eigenvalues and System Modes • Stability Criteria*
1215 – 1230	*Break*
1230 – 1330	***Damping in Power Systems*** *Natural Damping Sources • Negative Damping Effects • Role of Excitation Systems • Need for Supplementary Control*
1330 – 1420	***Basics of Power System Stabilizers (PSS)*** *Purpose and Function of PSS • Basic Operating Principle • Signals Used for Stabilization • Overview of PSS Types*
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, 20th of October 2026

0730 – 0830	***Generator & Excitation System Modeling*** *Synchronous Machine Models (Classical to Detailed) • AVR (Automatic Voltage Regulator) Models • Impact of Excitation on Stability • Modeling Simplifications*
0830 – 0930	***State-Space Modeling of Power Systems*** *Formulating State Variables • Linear System Representation • Matrix Formulation (A, B, C, D) • Interpretation of System Modes*
0930 – 0945	*Break*
0945 – 1100	***Eigenvalue Analysis*** *Real and Imaginary Parts of Eigenvalues • Damping Ratio and Frequency • Mode Shapes and Participation Factors • Identifying Critical Modes*
1100 – 1215	***Frequency Domain Analysis*** *Transfer Functions • Bode Plots • Gain and Phase Margins • Stability Assessment*
1215 – 1230	*Break*
1230 – 1330	***Time-Domain Simulation*** *Transient Response Analysis • Disturbance Scenarios • Oscillation Observation • Validation of Models*
1330 – 1420	***Measurement of Oscillations*** *PMU (Phasor Measurement Units) Basics • Wide Area Measurement Systems (WAMS) • Signal Processing Techniques • Real-Time Oscillation Detection*
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, 21st of October 2026

0730 – 0830	***PSS Structure & Components*** *Washout Filters • Lead-Lag Compensators • Gain Blocks • Input Signal Selection (Speed, Power, Frequency)*
0830 – 0930	***PSS Design Objectives*** *Improving Damping Ratios • Enhancing System Stability Margins • Avoiding Adverse Interactions • Robust Performance*
0930 – 0945	*Break*
0945 – 1100	***Classical PSS Design Methods*** *Phase Compensation Approach • Root Locus Method • Frequency Response Method • Parameter Selection*
1100 – 1215	***Multi-Machine System Considerations*** *Interaction Between Generators • Coordinated Tuning • Mode Observability • Decentralized versus Centralized Control*
1215 – 1230	*Break*
1230 – 1330	***PSS Types & Configurations*** *Conventional PSS (CPSS) • Dual-Input PSS • Multi-Band PSS • Adaptive PSS*

1330 – 1420	***Limitations of Conventional PSS*** *Sensitivity to Operating Conditions • Nonlinear System Effects • Limited Robustness • Need for Advanced Techniques*
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, 22nd of October 2026

0730 – 0830	***Optimization-Based PSS Tuning*** *Objective Functions (Damping Ratio, Eigenvalues) • Optimization Techniques (GA, PSO) • Parameter Tuning Strategies • Performance Evaluation*
0830 – 0930	***Robust Control Approaches*** *H-Infinity Control • Robust Stability Concepts • Handling Uncertainties • Controller Design Methods*
0930 – 0945	*Break*
0945 – 1100	***Adaptive & Intelligent PSS*** *Adaptive Control Techniques • Fuzzy Logic Controllers • Neural Network-Based PSS • Real-Time Tuning Approaches*
1100 – 1215	***Wide-Area Damping Control (WADC)*** *Concept of Wide-Area Control • Use of PMU Signals • Communication Delays • Control Coordination*
1215 – 1230	*Break*
1230 – 1330	***Interaction with Other Controllers*** *AVR and Governor Interactions • FACTS Devices (SVC, STATCOM) • HVDC Links • Coordinated Control Strategies*
1330 – 1420	***Practical Tuning Considerations*** *Site-Specific Tuning • Data Requirements • Testing and Validation • Field Implementation Challenges*
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*

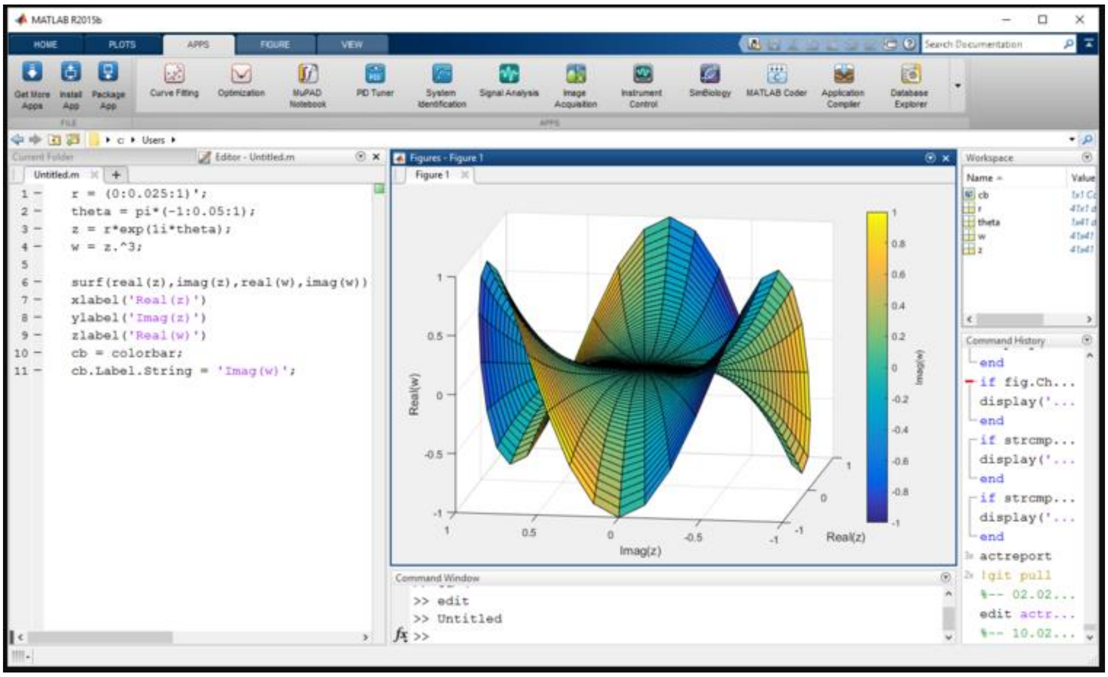
Day 5: Friday, 23rd of October 2026

0730 – 0830	***Software Tools for Stability Analysis*** *MATLAB/Simulink • DIgSILENT PowerFactory • PSS/E • Model Setup and Simulation*
0830 – 0930	***Case Studies of Oscillatory Instability*** *Inter-Area Oscillation Events • Poor Damping Scenarios • Root Cause Analysis • Lessons Learned*
0930 – 0945	*Break*
0945 – 1100	***PSS Tuning Case Studies*** *Single-Machine Infinite Bus System • Multi-Machine System Tuning • Comparison of Methods • Performance Improvements*
1100 – 1215	***Field Testing & Commissioning*** *On-Site Testing Procedures • Signal Validation • Performance Verification • Troubleshooting Issues*

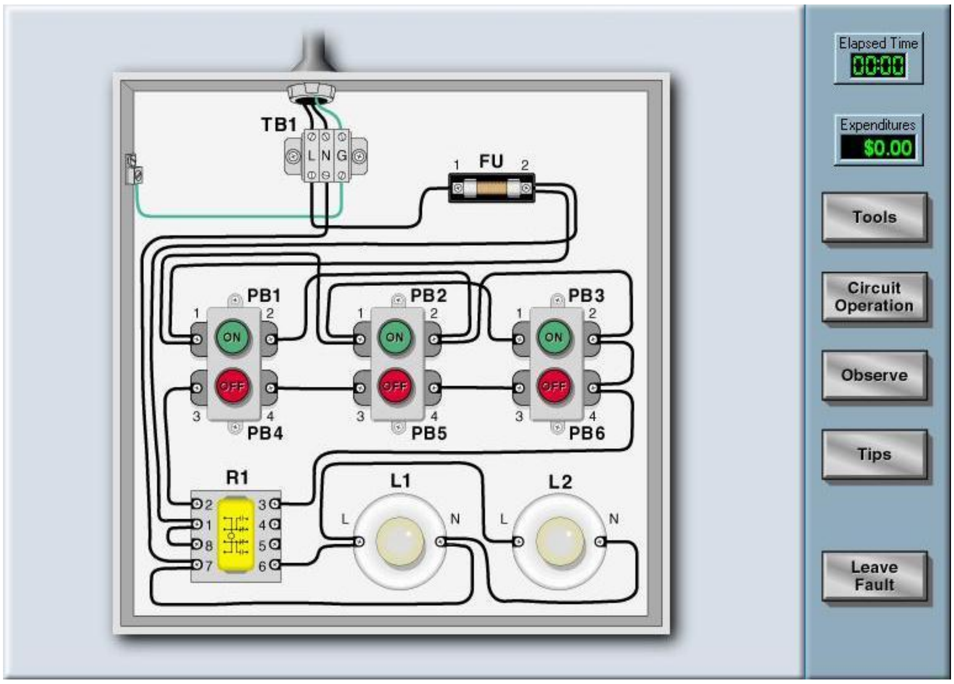
1215 – 1230	*Break*
1230 – 1300	***Future Trends in Stability Control*** *Grid with High Renewable Penetration • Reduced System Inertia • AI-Based Stability Control • Digital Twin Applications*
1300 - 1345	***Capstone Project & Evaluation*** *Modeling a Power System • Identifying Oscillatory Modes • Designing and Tuning PSS • 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 "MATLAB Simulator", "Simutech Troubleshooting Electrical Circuits V4.1", Power World" and "ETAP software".



MATLAB Simulator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Tools
Circuit Operation
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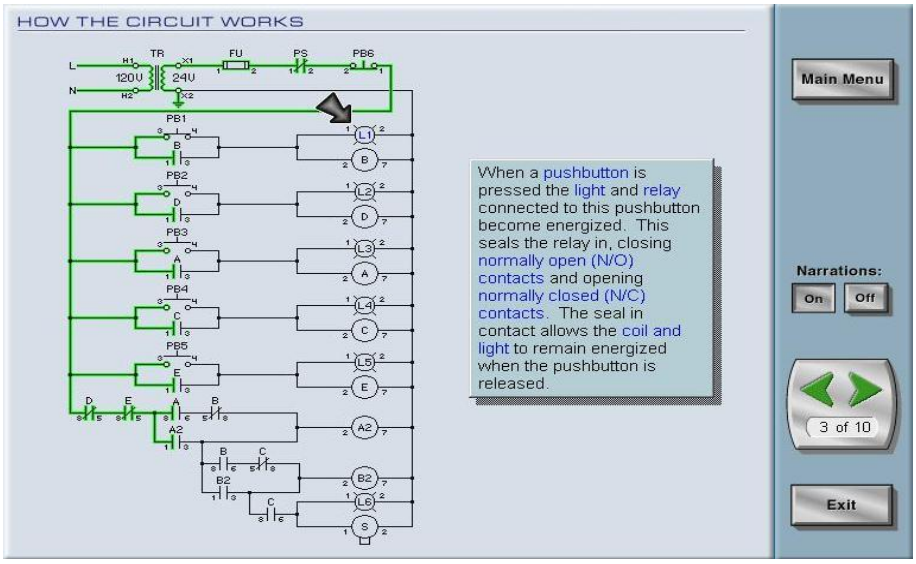
HOW THE CIRCUIT WORKS
When a pushbutton is pressed the light and relay connected to this pushbutton become energized. This seals the relay in, closing normally open (N/O) contacts and opening normally closed (N/C) contacts. The seal in contact allows the coil and light to remain energized when the pushbutton is released.
Main Menu
Narrations:
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3 of 10
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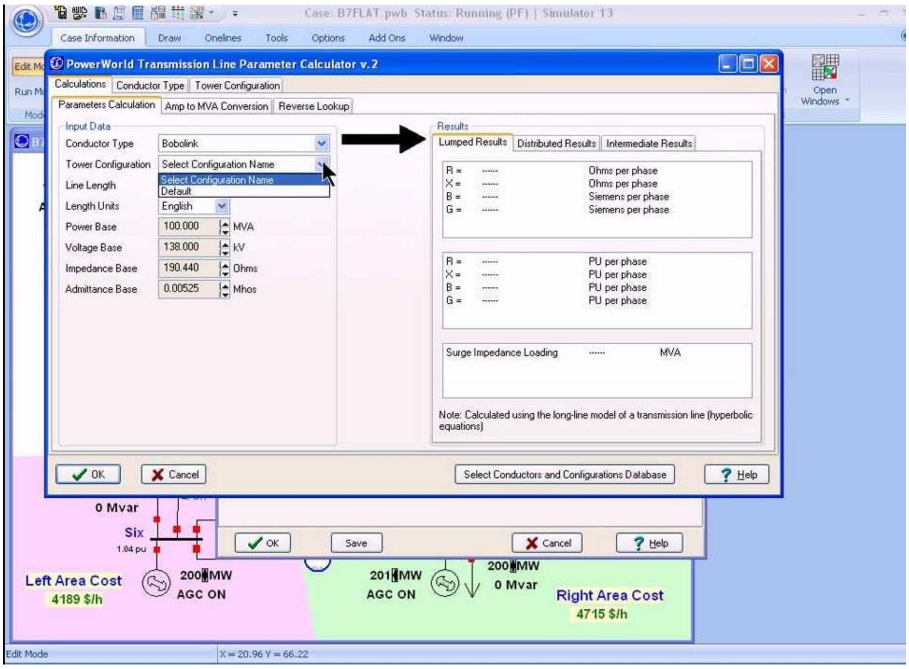
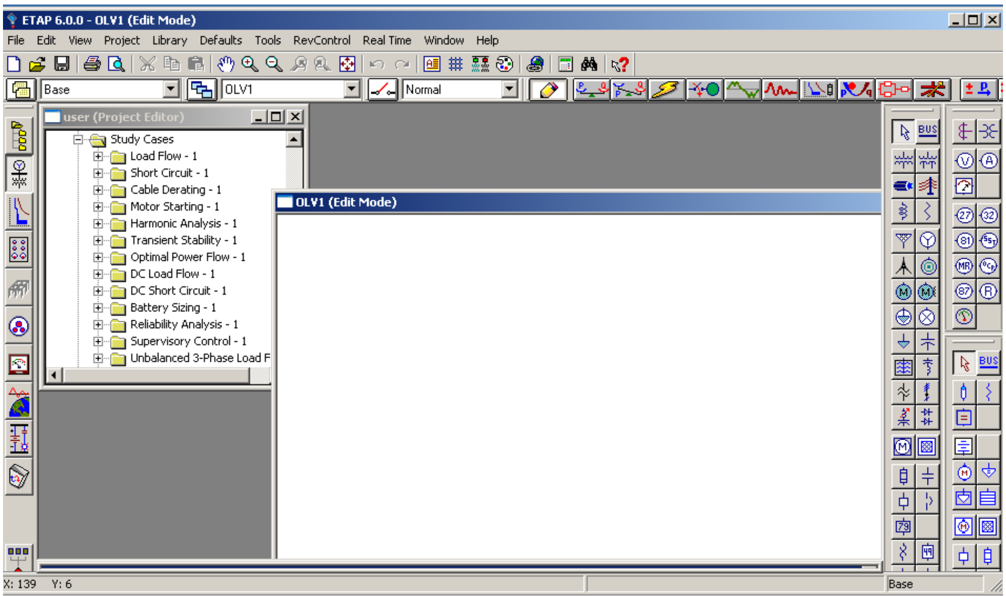
Simutech Troubleshooting Electrical Circuits V4.1



Power World Simulator



ETAP Software Simulator

Course Coordinator
Mari Nakintu, Tel: +971 2 30 91 714, Email: mari1@haward.org