COURSE OVERVIEW EE0092
Power System Analysis

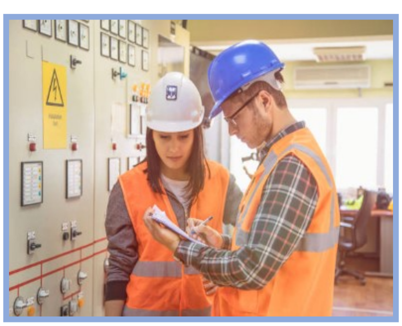
Course Title
Power System Analysis

Course Date/Venue
Session 1: May 04-08, 2025/Boardroom 1, Elite Byblos Hotel Al Barsha, Sheikh Zayed Road, Dubai, UAE
Session 2: October 06-10, 2025/Fujairah Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE

Course Reference
EE0092

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 provides recommended practices, methods and a reference tool for the analysis of industrial and commercial power systems. It covers a thorough analysis of the power system data required and the techniques most commonly used in computer-aided analysis in order to perform specific power system studies of short circuit, load flow, motor-starting, cable ampacity, stability, harmonic analysis, switching transient, reliability, ground mat, protective coordination, DC auxiliary power system and power system modeling.

At the conclusion of this course, the participants will be familiarized with the purpose for and techniques involved in power system studies including the principles involved in data acquisition in support of power system studies, the purpose of system studies during the design stage of power distribution systems and the purpose of system studies for existing power distribution systems as well as the advantages of power system analysis software in the design of complex modern power systems, the benefits and restraints associated with the critical analytical solution methods that are available or are the basis for valid techniques in solving power system problems.

Further, each participants will be able to apply and gain systematic techniques involved in modeling a power transformer, the techniques involved in modeling overhead power lines, the per unit system for expressing variables in power system calculation, the purpose for and the techniques involved in a transformer tap study including the critical aspects of a system load flow study and its use in power system design, the use of the load flow study to access power system performance and voltage profiles.

The course will describe the concept of Thevenin's equivalent as well as the purpose for and techniques involved in short circuit analysis, the purpose for and techniques involved in determining the DC component of fault current, the concept of and the techniques for power system modeling. It will explain how to model power system loads and their differences for power system calculations and studies, how to model generators in power system calculations and studies including the methods utilized by computer programs for power system analysis and the various factors affecting the results and accuracy of short circuit studies. It will discuss the salient principles, methodologies and computational procedures suggested by the North American IEEE and ANSI C37 standards in accordance with the international standard for short circuit calculations (IEC 60909, 1988) and the conceptual and computational deviations from C37 standards.

The course further covers the definition of stability, steady state stability, transient, and dynamic stability, the use of stability studies to determine load-shedding schemes and critical fault clearing times for setting protective relays, starting torque analysis for electric motors and the need for motor starting studies, the use of motor starting studies to determine power system performance, the use of motor starting studies to select the optimum starting method, the motor design requirements and the system design requirements to minimize the impact of motor starting on the entire power system including the use of motor starting studies to determine if a starting device is needed and its characteristics and ratings, the information required for performing motor starting studies and some common assumptions used in the absence of more precise data. It provides the concepts involved in studies of harmonic analysis of industrial and commercial power systems, the need for harmonic analysis and recognition of potential problems in power systems and the the required data for harmonic analysis, corrective measures that can be taken, and the benefits of using a computer as a tool for harmonic analysis.

The course is designed to apply the classical analytical methods used to solve switching transients, the typical circuit parameters used for transient studies, power system reliability assessment and evaluation methods based on probability theory including the use of reliability indexes for different system designs to evaluate the impact on service reliability and cost of changes in component reliability. It will employ the FMEA (failure mode and effects analysis) for power distribution systems including the solution of cable ampacity problems with computer software systems with emphasis on underground installations. Further, it will also identify the various items that affect cable ampacity, the primary purpose of a ground mat study, the theoretical background behind ground mat studies and its application in the design of ground mats by computer program as well as discuss the objective of a protective scheme in a power system, the application of computer and computer software to time-current coordination studies including the basics of coordination, the use of coordination software and the application of DC power system analysis.

Course Objectives

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

- Apply and gain a comprehensive knowledge on power system analysis
- Analyze electrical system performance
- Carryout various applications of power system analysis including load flow, short-circuit, stability, motor-starting, harmonic, switching-transients, reliability, cable ampacity, ground mat, protective device and DC auxiliary
- Employ analytical procedures, methods and applications as well as system modeling, numerical solution techniques and computer systems
- Illustrate system representation, input data, solution methods, analysis, study sample and programs of load flow studies
- Discuss the scope, extent and requirements, system modeling and computational techniques, fault analysis according to industry standards, factors affecting the accuracy and computer solutions of short-circuit studies
- Recognize stability fundamentals, problems caused by instability, system disturbances that can cause instability, solutions to stability problems, system stability analysis and industrial power systems of stability studies
- Enumerate the need for motor-starting studies, recommendations, types of studies, data requirements, solution procedures and examples of motor-starting studies
- Describe the purpose of harmonic study, general theory, system modeling, example solutions, remedial measures and harmonic standards of harmonic analysis studies
- Identify switching transient studies including power system switching transients, field measurements and typical circuit parameters for transients studies and reliability studies which includes system reliability indexes, data needed for system reliability evaluations and method for system reliability evaluation
- Distinguish the difference among cable ampacity studies, ground mat studies and coordination studies
- Perform DC auxiliary power system analysis as well as the application of DC power system analysis, analytical procedures, system modeling, load flow/voltage drop studies, short circuit studies and international guidance on DC short-circuit calculations

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 power system analysis for electrical engineers, project managers, project engineers and other technical staff who are involved in the analysis, engineering and design of industrial and commercial power systems.

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

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**. 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. Herman Eksten, PE, PgDiP, is a **Senior Electrical Engineer** with over **40 years** of extensive experience **Oil**, **Gas**, **Petrochemical**, **Refinery** & **Power** industries and **Water & Utilities** specializing in **Electrical Safety**, Certified **HV Electrical Safety**, **Low Voltage Electrical Safety**, **Electrical Circuits**: Series and Parallel Connection, **Electrical Faults & Protective Devices**, **Renewable Energy Integration**, **Smart Grid** & **Renewable Integration**, **Renewable Energy** Storage Systems, **Renewable Energy** Economics & Finance, Risk Control Methods, **LOTO – Breakers** Operation in Electricity Substation, **LOTO** Principles and Procedures, **Arc Flash Risk Assessment**, Safety in **Power Electronic Equipment & Lasers**, **Circuit Breakers & Switchgears**, **Switchgear Assets Management**, **Circuit Breakers Control Circuits**, **Substation Maintenance** Techniques, **High Voltage Operation, Electrical Protection**, **Overhead Lines & Substation**, **Power Supply**, **High Voltage Substation**, **Electrical Protection Design**, **Earthing & Lightning Protection Design, Underground Equipment**, **Distribution Network Maintenance & Construction**, **Transformers Operation & Maintenance**, **Electric Power System, Power Plant Management**, **Substation Commissioning & Troubleshooting**, **Cable Splicing & Termination, Electrical Installation & Maintenance**, **Power Generation Operation & Control, Switchgear Life Assessment**, **Structured Cabling, Electric Power System, Power System Stability, Power System Planning & Economics**, **Power Flow** Analysis, **Combined Cycle Power Plant**, **UPS & Battery System, Variable Speed Drives,** and **HV Motors & Transformers**. He is currently the **Lead Electrical Engineer** of **SNC-LAVALIN** wherein he is responsible for basic designs and successful implementation of electrical engineering to plant overhead lines and substations.

During his career life, Mr. Eksten held various positions such as the **Lead Electrical Engineer**, **Operations Manager**, **Project Engineer**, **Technical Specialist**, **Customer Executive**, **District Manager**, **Electrical Protection Specialist**, **High-Voltage Operator** and **Apprentice Electrician** for FOX Consulting, UHDE (ThyssenKrupp Engineering), TWP Projects/Consulting (EPMC-Mining), ISKHUS Power, Rural Maintenance (PTY) Energia de Mocambique Lda., Vigeo (PTY) Ltd and ESKOM.

Mr. Eksten is a **Registered Professional Engineering Technologist** and has a Postgraduate Diploma in Management Development Programme and a National Higher Diploma (NHD) in Electrical Power Engineering. Further, he is a **Certified Instructor/Trainer**, a Senior member of the South African Institute Electrical Engineers (**SAIEE**) and holds a Certificate of Registration Membership Scheme from the Engineering Council of South Africa (**ESCA**). He has further delivered numerous trainings, courses, seminars, workshops 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.

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.

Accommodation

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

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

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Applications of Power System Analysis*** *Introduction • Load Flow Analysis • Short-circuit Analysis • Stability Analysis • Motor-starting Analysis • Harmonic Analysis*
0930 – 0945	*Break*
0945 – 1100	***Applications of Power System Analysis (cont'd)*** *Switching Transients Analysis • Reliability Analysis • Cable Ampacity Analysis • Ground Mat Analysis • Protective Device Coordination Analysis • DC Auxiliary Power System Analysis*
1100 – 1230	***Analytical Procedures*** *Definitions • Fundamentals • Methods • Applications*
1230 – 1245	*Break*
1245 – 1420	***System Modeling*** *Modeling • Review of Basics • Power Network Solution • Impedance Diagram • Extent of the Model • Models of Branch Elements • Power System Data Development • Models of Bus Elements*
1420 – 1430	***Recap***
1430	*Lunch & End of Day One*

Day 2

0730 – 0900	***Computer Solutions & Systems*** *Numerical Solution Techniques ● Computer Systems*
0900 – 0915	*Break*
0915 – 1100	***Load Flow Studies*** *System Representation ● Input Data ● Load Flow Solution Methods ● Load Flow Analysis ● Load Flow Study Example ● Load Flow Programs*
1100 – 1230	***Short-circuit Studies*** *Scope ● Extent and Requirements of Short-circuit Studies ● System Modeling and Computational Techniques*
1230 – 1245	*Break*
1245 – 1420	***Short-circuit Studies (cont'd)*** *Fault Analysis According to Industry Standards ● Factors Affecting the Accuracy of Short-circuit Studies ● Computer Solutions*
1420 – 1430	***Recap***
1430	*Lunch & End of Day Two*

Day 3

0730 – 0930	***Stability Studies*** *Stability Fundamentals ● Problems Caused by Instability ● System Disturbances that can Cause Instability*
0930 – 0945	*Break*
0945 – 1100	***Stability Studies (cont'd)*** *Solutions to Stability Problems ● System Stability Analysis ● Stability Studies of Industrial Power Systems ● Summary & Conclusions*
1100 – 1215	***Motor-starting Studies*** *Need for Motor-starting Studies ● Recommendations ● Types of Studies ● Data Requirements ● Solution Procedures and Examples*
1215 – 1230	*Break*
1230 – 1420	***Harmonic Analysis Studies*** *Background ● Purpose of Harmonic Study ● General Theory ● System Modeling ● Example Solutions ● Remedial Measures ● Harmonic Standards*
1420 – 1430	***Recap***
1430	*Lunch & End of Day Three*

Day 4

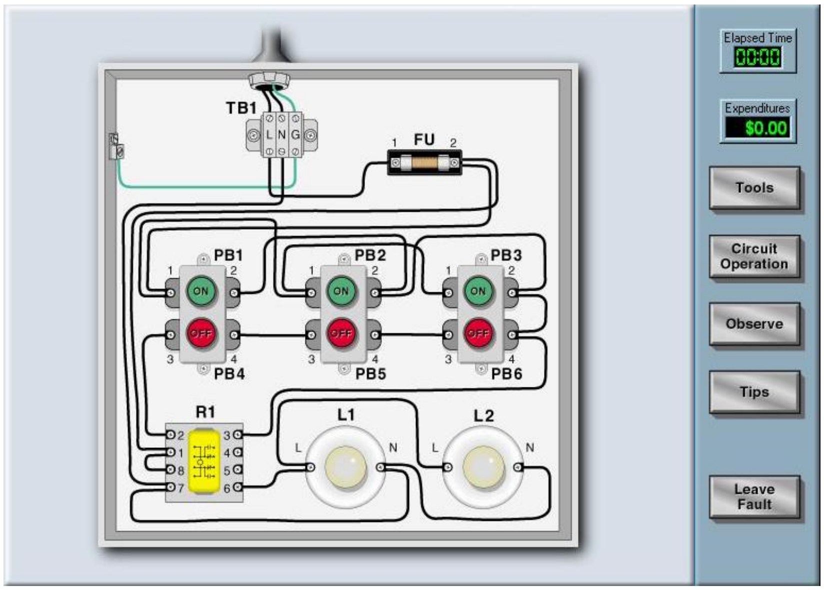
0730 – 0930	***Switching Transient Studies*** *Power System Switching Transients ● Switching Transient Studies*
0930 – 0945	*Break*
0945 – 1100	***Switching Transient Studies (cont'd)*** *Switching Transients-Field Measurements ● Typical Circuit Parameters for Transients Studies*
1100 – 1215	***Reliability Studies*** *Definitions ● System Reliability Indexes ● Data Needed for System Reliability Evaluations ● Method for System Reliability Evaluation*
1215 – 1230	*Break*
1230 – 1420	***Cable Ampacity Studies*** *Heat Flow Analysis ● Application of Computer Program ● Ampacity Adjustment Factors*
1420 – 1430	***Recap***
1430	*Lunch & End of Day Four*

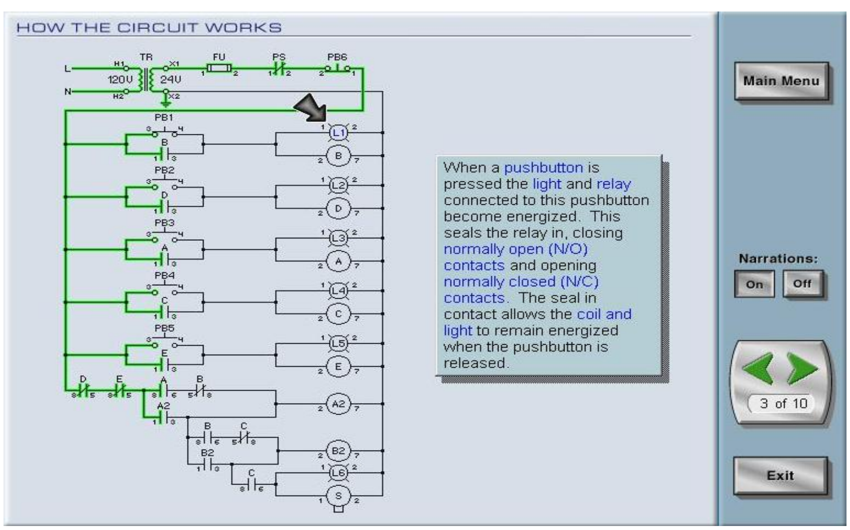
Day 5

0730 – 0930	***Ground Mat Studies*** *Justification for Ground Mat Studies ● Modeling the Human Body ● Traditional Analysis of the Ground Mat ● Advanced Grid Modeling ● Benchmark Problems ● Input/output Techniques*
0930 – 0945	*Break*
0945 – 1100	***Coordination Studies*** *Basics of Coordination ● Computer Programs for Coordination ● Common Structure for Computer Programs*
1100 – 1215	***Coordination Studies*** *How to Make Use of Coordination Software ● Verifying the Results ● Equipment Needs*
1215 – 1230	*Break*
1230 – 1345	***DC Auxiliary Power System Analysis*** *Application of DC Power System Analysis ● Analytical Procedures ● System Modeling ● Load Flow/voltage Drop Studies ● Short-circuit Studies ● International Guidance on DC Short-circuit Calculations*
1345 – 1400	***Course Conclusion***
1400 – 1415	***POST-TEST***
1415 – 1430	*Presentation of Course Certificates*
1430	*Lunch & End of Course*

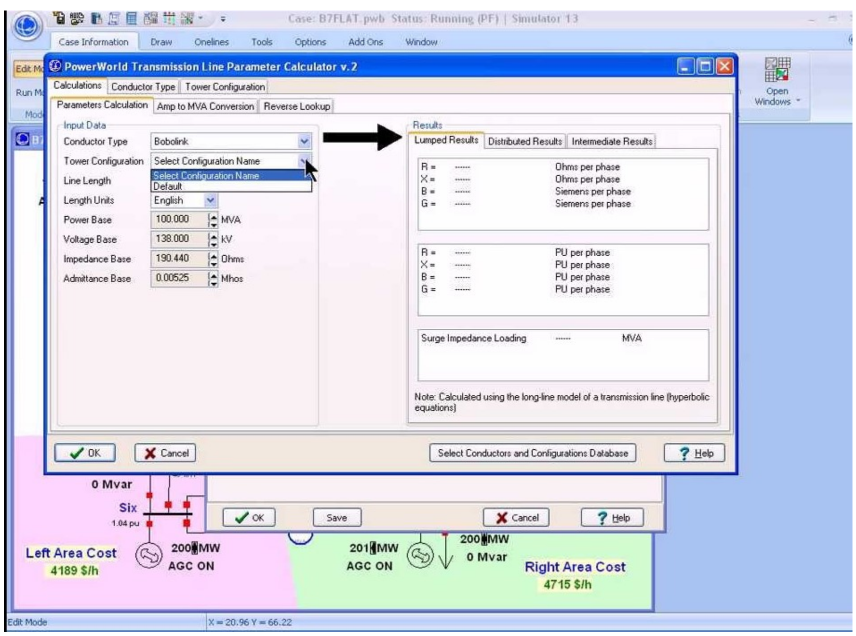
Simulator (Hands-on Practical Sessions)

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

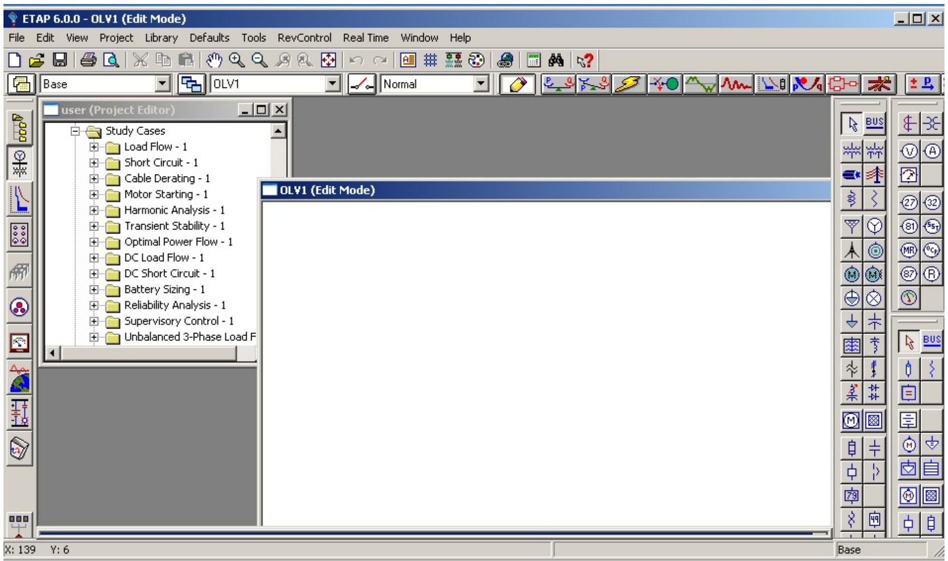




Troubleshooting Electrical Circuits V4.1 Simulator



Power World Simulator



ETAP Software Simulator

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