COURSE OVERVIEW EE0290
Electrical Power System Components - Part I

Course Title
Electrical Power System Components - Part I

Course Date/Venue
December 15-19, 2024/Al Aziziya Hall, The Proud Hotel Al Khobar, Al Khobar, KSA

Course Reference
EE0290

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.

Electric Power System has moved away from its regulated roots and is rushing headlong toward freewheeling competition, spurring more creative uses of energy and unprecedented advancements in plant efficiencies. Environmentalism has rushed forward too, ensuring that no power-generation technology is unscathed by demands for lower emissions and ecological impacts. Also, over the past decade, computer capability has skyrocketed in effectiveness and plummeted in cost, launching a mass invasion of control rooms by digital instrumentation. Changes such as these make today's powerplant a more diverse and more complex mix of technologies than ever before.

This course is designed to provide a good coverage of the generation, transformation, transmission, distribution and utilization of electric power and energy as well as the modeling, analysis, planning, design, monitoring and control of modern electric power systems. It will provide a contemporary overview of this far-reaching field as well as bringing together the core of knowledge from all of the many topics encompassed by the field.

The course is intended to give participants a working knowledge of the modern electric power systems operations from generation through transmission and distribution through wiring. Basic electrical terminology and concepts are discussed with regard to design, construction, operations and maintenance of power plants substations and transmission and distribution lines. The effects of the deregulation of electric power utilities are discussed with interesting examples. The basic concepts of fiber optics and other telecommunications systems used in the electric power industry are also presented.

Further, the course will introduce and explore a number of engineering and economic problems involved in planning, operating, and controlling power generation and transmission systems in electric utilities. The topics included serve as an effective means to introduce participants to advanced operations methods applied to practical electric power engineering problems. Some topics cover methods that are currently being applied in the control and operation of the modern electric power systems. However, in a 5-day course it is, of course, impossible to consider all the problems and "best practices" in this advanced field. We can only introduce the types of problems that arise, illustrate theoretical and practical approaches and point the participant the direction of seeking more information and developing advanced skills as they are required. As a matter of fact, this course covers a wide range of topics related to the design, operation and control of power systems that are usually treated separately. Various issues are treated in depth with analytical rigor and practical insight. The subject matter is presented in a very interesting and unique perspective. It combines, in a structured way, control theory, characteristics and modeling of individual elements and analysis of different aspects of modern electric power systems.

Course Objectives

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

- Apply systematic techniques on the design, analysis, planning, monitoring, control, maintenance and troubleshooting of electric power system including generation, transformation, transmission, distribution, substation and utilization
- Identify the modern power system components and explain their functions
- Discuss the concept of electric power generation including synchronous machinery, thermal generating plants and distributed utilities
- Explain the theory and principles of transformers and identify its various types as well as their features and functions
- Determine the transmission system structure, components and accessories and sag and tension of conductor
- Identify the different types of substations such as substation grounding, lightning and substation fire protection
- Employ the distribution system modeling and analysis and power system operation and control
- Describe electric power utilization including the metering of electric power and energy and load characterization and load modeling
- Employ the methodological process of power system analysis and simulation and identify fault analysis in power systems

- Discuss the principles of power system protection and power system transients including the protection of synchronous generators, digital relaying, lightning strokes, over voltages, switching surges and insulation coordination
- Implement the power system dynamics and stability with its methodological applications used in modern power system
- Carryout power system planning and reliability applied in power systems
- Discuss the power electronics and power quality and recognize their practical use in modern electric power system
- Use economic dispatch of thermal units including its methods of solution
- Identify the factors affecting power system security and determine the variables to be considered in the environmental controls of electric power systems

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 electric power system for electrical power managers, engineers, superintendents, supervisors, foremen and those who are involved in the design, engineering, operation, maintenance and control of the electric power system or those who are interested in obtaining a working knowledge of the modern electric power system.

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 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:-

- 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.

- 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.

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 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. William Hardi is a **Senior Electrical Engineer** with almost **35** years of extensive experience within the **Oil**, **Gas**, **Petrochemical**, **Refinery** & **Power** industries. His expertise widely covers in the areas of **Power System Analysis**, **Power System Generation and Distribution**, **Electric Power System** Design, Maintenance, Testing & Troubleshooting, **Transformer Protection**, **Transformer** Problem and Failure Investigations, **Power System Operation and Control**, Fault Analysis in **Power Systems**, **HV/MV Cable Splicing**, **Cable & Over Head Power Line**, **HV/MV Switchgear, HV Cable** Design, **Cable** Splicing & Termination, **High Voltage Electrical Safety**, **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**, **LV**, **MV & HV Cable** Installations & Properties, ORHVS for Responsible and Authorized Person **High Voltage Regulation**, **Transformers** Maintenance, inspections & repairs, Commissioning of **LV & HV Equipment**, Oil Purification and **High Voltage Maintenance**, HT Switch Gear -Testing, Safe Operating, Maintenance, Inspection & Repairs on **LV & HT Cables** - Testing (Pulse & Megger), Line Patrol in **Low Voltage & Distribution**, **Transmission**, **Operating Principles up to 132KV**, Abnormal Conditions & Exceptions, Commissioning & Testing, **Transformer Inspections & Repairs**, **Live Line Work up to 33KV**, **Basic Power System Protection**, **High Voltage** Operating Preparedness Phasing (**110V to 132KV**), **HV Operating & Fault** Finding (up to 132KV), Maintenance & Construction Supervision, Line Construction & Maintenance up to **132KV**, **VSD/VFD** Installations & Testing, **Electrical Panel Design**, **VSD/VFD Installations & Testing**, Instrument Installation and wiring, Programmable Logic Controller (**PLC**), **PLC for Process Control & Automation**, **ABB Drives and other PLC Starters**, **PLC** Starters – Commissioning & fault-finding, , **AC/DC Supplies & Change Over Systems**, **AC & DC Winders** and VLF Testing, Soft Starters – **VSD's** etc.,

During Mr. Hardi career life, he has gained his practical experience through several significant positions and dedication as the **Branch Manager**, **Maintenance Manager**, **Project Manager**, **Site Superintendent**, **Construction Supervisor**, **Shift Supervisor**, **Maintenance & Production Shift Supervisor**, **HT Specialist, Electrical & Instrumentation Supervisor**, **High Voltage Specialist & Commissioning Supervisor**, **Electrical Supervisor**, **Principal Technical Official**, **Winder & Conveyor Technician** and **Instructor/Trainer** from various companies, like the Armcoil Africa, JR Compressors, ELGER Electrical, Saaiplaas 3 Shaft, ESCOM and Target Mining.

Mr. Hardi is a **Qualified Electrician** certified by the Engineering Trades Training Board. Further, he is a **Certified Instructor/Trainer** and has delivered various trainings, seminars, conferences, workshops and courses globally.

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: Sunday, 15th of December 2024

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0900	***Overview of Modern Power System Components*** *Structure of the Electrical Power System • Generating Units (Synchronous Generators, Exciters and Automatic Voltage Regulators, Turbines and their Governing Systems) • Substations • Transmission and Distribution Network (Overhead Lines and Underground Cables, Transformers, Shut and Series Elements, Flexible AC Transmission Systems (FACTS)) • Protection*
0900 – 0915	*Break*
0915 – 1045	***Electric Power Generation*** *Hydroelectric Power Generation • Synchronous Machinery • Thermal Generating Plants • Distributed Utilities*
1045 – 1200	***Transformers*** *Theory and Principles • Power Transformers • Distribution Transformers • Underground Distribution Transformers • Dry Type Transformers • Instrument Transformers • Transformer Connections • Loading Power Transformers • Transformer Testing • Transformer Installation and Maintenance • Problem and Failure Investigations • On-line Monitoring of Liquid-Immersed Transformers*
1200 – 1215	*Break*
1215 – 1420	***Transmission System*** *Concept of Energy Transmission and Distribution • Transmission Line Structures • Insulators and Accessories • Transmission Line Construction and Maintenance • Insulated Power Cables for High Voltage Applications • Transmission Line Parameters • Sag and Tension of Conductor • Corona and Noise • Geomagnetic Disturbances and Impacts upon Power System Operation • Lightning Protection • Reactive Power Compensation*
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, 16th of December 2024

0830 – 0900	***Substations*** *Gas Insulated Substations • Air Insulated Substations • High Voltage Switching Equipment • High Voltage Power Electronics Substations • Considerations in Applying Automation Systems to Electric Utility Substations • Substation Automation*
0900 – 0915	*Break*
0915 – 1045	***Substations (cont'd)*** *Oil Containment • Community Considerations • Animal Deterrents/Security • Substation Grounding • Grounding and Lightning • Seismic Considerations • Substation Fire Protection*

1045 – 1200	***Distribution Systems*** *Power System Loads • Distribution System Modeling and Analysis • Power System Operation and Control*
1200 – 1215	*Break*
1215 – 1420	***Electric Power Utilization*** *Metering of Electric Power and Energy • Basic Electric Power Utilization – Loads, Load Characterization and Load Modeling • Electric Power Utilization: Motors*
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, 17th of December 2024

0730 – 0900	***Power System Analysis and Simulation*** *The Per-Unit System • Symmetrical Components for Power System Analysis • Power Flow Analysis • Fault Analysis in Power Systems • Practical Examples*
0900 – 0915	*Break*
0915 – 1045	***Power System Analysis and Simulation (cont'd)*** *Modeling of Power System Using Computer Analysis Software • Load Flow Analysis • Short Circuit Analysis • Motor Starting • Practical Examples*
1045 – 1200	***Power System Protection*** *Basic Overview of System Protection • Instrument Transformers • Protection Relays • Time Grading Principles • Practical Examples*
1200 – 1215	*Break*
1215 – 1420	***Power System Protection (cont'd)*** *Unit Protection • Transformer Protection • The Protection of Synchronous Generators • Transmission Line Protection • Use of Oscillograph Records to Analyze System Performance*
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, 18th of December 2024

0730 – 0900	***Power System Transients*** *Characteristics of Lightning Strokes • Overvoltages Caused by Direct Lightning Strokes • Overvoltages Caused by Indirect Lightning Strokes • Switching Surges • Very Fast Transients • Transient Voltage Response of Coils and Windings • Transmission System Transients • Insulation Coordination*
0900 – 0915	*Break*
0915 – 1045	***Power System Dynamics and Stability*** *Power System Stability • Transient Stability • Small Signal Stability and Power System Oscillations • Voltage Stability • Direct Stability Methods*

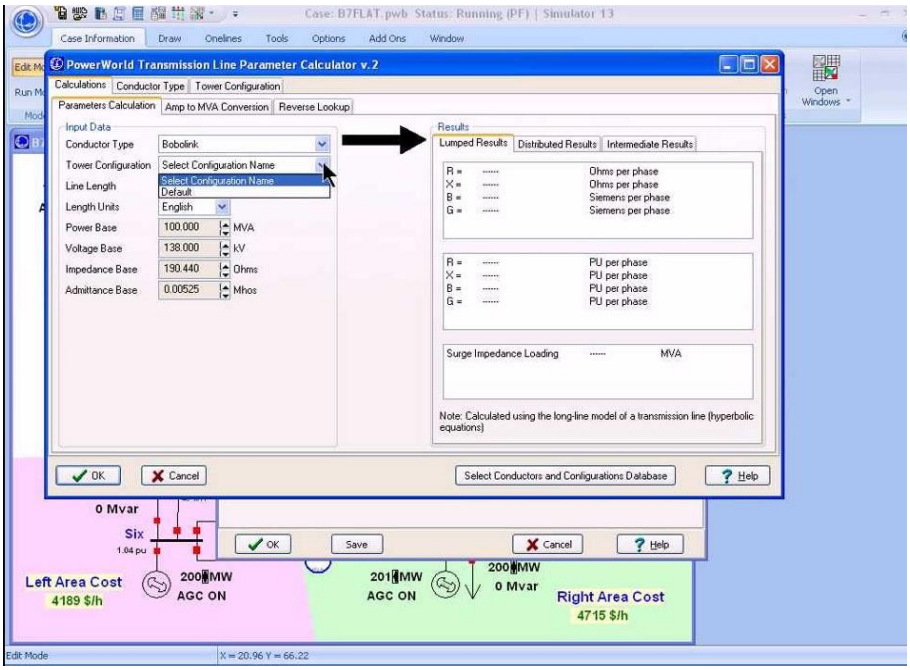
1045 – 1200	***Power System Planning (Reliability)*** *Planning • Short-Term Load and Price Forecasting with Artificial Neural Networks • Transmission Plan Evaluation – Assessment of System Reliability • Power System Planning • Power System Reliability*
1200 – 1215	*Break*
1215 – 1420	***Power Electronics*** *Power Semiconductors Devices • Uncontrolled and Controlled Rectifiers • Inverters • Active Filters for Power Conditioning • Fiber Optics*
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, 19th of December 2024

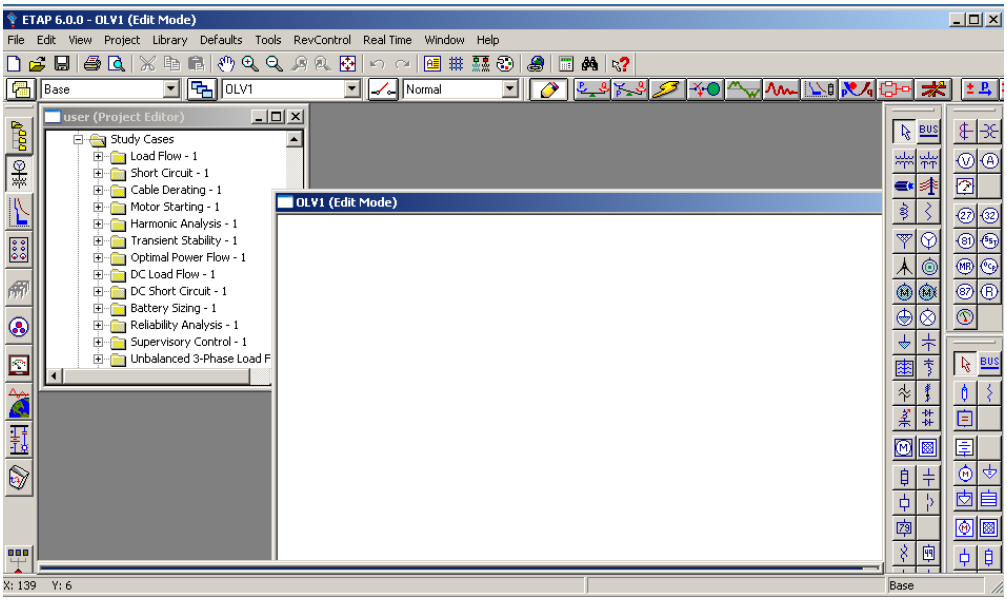
0730 – 0900	***Power Quality*** *Wiring and Grounding for Power Quality • Harmonics in Power Systems • Voltage Sags • Voltage Fluctuations and Lamp Flicker in Power Systems • Power Quality Monitoring*
0900 – 0915	*Break*
0915 – 1045	***Economic Dispatch of Thermal Units and Methods of Solution*** *The Economic Dispatch Problem • Thermal System Dispatching with Network Losses considered • The Lambda-Iteration Method • Gradient Methods of Economic Dispatch (Gradient Search, Economic Dispatch by Gradient Search) • Newton's Method • Economic Dispatch with Piecewise Linear Cost Functions • Economic Dispatch Using Dynamic Programming • Base Point and Participation Factors • Economic Dispatch Versus Unit Commitment*
1045 – 1200	***Power System Security*** *Factors Affecting Power System Security • Contingency Analysis: Detection of Network Problems (An Overview of Security Analysis, Linear Sensitivity Factors, AC Power Flow Methods, Contingency Selection, Concentric Relaxation, Bounding)*
1200 – 1215	*Break*
1215 – 1345	***Environmental Controls*** *Environmental Legislation and Regulation • Air Emission Controls (Electrostatic Precipitators, Fluidized-Bed Boilers, NOx Controls, Flue-Gas Treatment) • Water Emission Controls*
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*

Simulators (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 "Power World", "ETAP software" and "Switchgear Simulator".



Power World Simulator



ETAP Software Simulator

Course Coordinator

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