COURSE OVERVIEW EE0427
Electrical Power System Components

Course Title
Electrical Power System Components

Course Date/Venue
July 27-31, 2025/Tamra Meeting Room, Al Bandar Rotana Creek, Dubai, UAE

Course Reference
EE0427

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 Electrical Power Systems Components. It covers the electrical power systems, basic electrical quantities and concepts and power generation systems; the power system voltage levels and classifications; the one-line diagrams and system layout; and the generators and alternators, power transformers, high voltage switchgear, transmission lines, towers and substations.

Further, the course will also discuss the distribution transformers and RMUs, distribution panels and switchboards and circuit breakers and protective devices; the cables and conductors, energy meters and load management devices and power system protection; and the relays and protection schemes covering overcurrent, earth fault, differential, distance relays, numerical versus electromechanical relays, time-current characteristics and protection grading and setting.

During this interactive course, participants will learn the control systems and automation; the SCADA systems for electrical power, remote terminal units (RTUs) and PLCS, human-machine interface (HMI) and data acquisition and logging; the power quality monitoring, power factor correction, energy auditing tools and grounding and earthing systems; the load flow and system stability as well as power factor and reactive power compensation; and the system integration and interconnection, testing and commissioning procedures and operation and maintenance best practices.

Course Objectives

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

- Apply and gain a comprehensive knowledge on electrical power systems components
- Discuss electrical power systems, basic electrical quantities and concepts and power generation systems
- Recognize power system voltage levels and classifications as well as one-line diagrams and system layout
- Identify generators and alternators, power transformers, high voltage switchgear, transmission lines and towers and substations
- Describe distribution transformers and RMUs, distribution panels and switchboards and circuit breakers and protective devices
- Identify cables and conductors, energy meters and load management devices and power system protection
- Discuss relays and protection schemes covering overcurrent, earth fault, differential, distance relays, numerical versus electromechanical relays, time-current characteristics and protection grading and setting
- Interpret control systems and automation comprising of SCADA systems for electrical power, remote terminal units (RTUs) and PLCS, human-machine interface (HMI) and data acquisition and logging
- Carryout power quality monitoring, power factor correction, energy auditing tools and grounding and earthing systems
- Discuss load flow and system stability as well as power factor and reactive power compensation
- Apply system integration and interconnection, testing and commissioning procedures and operation and maintenance best practices

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 electrical power systems components for electrical engineers, design engineers, power systems engineers, maintenance engineers, electrical technicians, control room operators, maintenance supervisors, field service technicians, project engineers, installation supervisors, commissioning engineers, site 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

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)

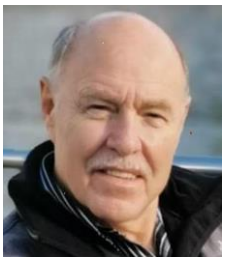
  Haward Technology is an Authorized Training Provider by the International Accreditors for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, VA 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 2018-1 Standard** 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. Fred Du Plessis is a **Senior Electrical Engineer** with over **30** years of extensive experience within the **Oil**, **Gas**, **Petrochemical**, **Refinery** & **Power** industries. His expertise widely covers in the areas of **Thermal Gas Power Generation**, **Power Station** Operations, **Power Generation Plant Outage** Management, **Power System** Analysis, **Power System** Generation & 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**, **High Voltage Electrical Safety**, **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**, 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, **VSD/VFD** Installations & Testing, **Electrical Panel Design**, **VSD/VFD Installations & Testing**, Instrument Installation and wiring, **AC/DC Supplies & Change Over Systems**, **AC & DC Winders** and VLF Testing, **Gas Turbines**, **Steam Turbine** with a **Station Generation**, **Project** Management & Project Controls, **Water Treatment & Reverse Osmosis** Plant Management and **Mechanical Maintenance** Management.

During Mr. Du Plessis's career life, he has gained his practical experience through several significant positions and dedication as the **Project Manager/Owner**, **Maintenance Manager**, **Project Excecution Manager**, **Commissioning & Operating Manager**, **Acting Operating Manager**, **Optimization/Commissioning Manager**, **Operating Support Manager**, **Operating Production/Shift Manager**, **Operations Lead Engineer**, **Electrical Engineer**, **Production/Maintenance Planner**, **Unit Shift Supervisor**, Principal **Plant Operator**, **Workshop & Maintenace Consultant**, Assistant **Electrical Supervisor**, Trainee **Motor Mechanic** and **Senior Instructor/Trainer** from various international **power station** companies like the Dunamis Energy, Peterhead Power Station, Lijaco Services, Eskom, Matla Power Station, Grootvlei Power Station, Ellisras Brick & Ceramic, Hlalisanani Mechanical Contractor, Matimba Power Station, Matimba Power Station, Eskom Kriel Power Station and Transvaal Provincial.

Mr. Du Plessis has a **Bachelor's** (with Honours) degree in **Operations Management**. Further, he holds certification in Red & Silver Seal Accreditation Power Generation – (ESETA), a SAMTRAC & NOSA **Auditor** – (NOSA), a **Certified Instructor/Trainer** and has further delivered various trainings, seminars, conferences, workshops and courses globally.

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.

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 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: ***Sunday, 27th of July 2025***

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Overview of Electrical Power Systems*** *Power Generation, Transmission, & Distribution Stages • Grid versus Standalone Systems (e.g., Microgrids) • AC versus DC Systems • Energy Flow from Source to Load*
0930 – 0945	*Break*
0945 – 1030	***Basic Electrical Quantities & Concepts*** *Voltage, Current, Power, & Energy • Power Factor: Significance & Correction • Single-Phase versus Three-Phase Systems • Frequency & Harmonics in Power Systems*
1030 – 1130	***Power Generation Systems*** *Thermal Power Generation (Coal, Gas, Nuclear) • Renewable Generation (Solar, Wind, Hydro) • Diesel & Gas Generator Sets • Synchronous Generator Operation*
1130 – 1215	***Power System Voltage Levels & Classifications*** *Low Voltage (LV), Medium Voltage (MV), High Voltage (HV) • Utility Distribution Voltage Classifications • Nominal versus Operating Voltage • Standardized Voltage Levels (IEC, ANSI)*
1215 – 1230	*Break*
1230 – 1330	***One-Line Diagrams & System Layout*** *Understanding Electrical One-Line Diagrams • Representation of Components: Switches, Breakers, Relays • Busbar Configurations • Drawing Symbols & Legends*

1330 – 1420	***Workshop: Power System Mapping*** *Identify & Draw a Simplified Power System • Label Generation, Transmission, & Load Components • Use Standard Symbols • Present Group Diagrams for Peer Review*
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, 28th of July 2025***

0730 – 0830	***Generators & Alternators*** *Working Principles of Synchronous Generators • Excitation Systems (Static & Brushless) • Generator Protection (Reverse Power, Over/Under Voltage) • Generator Synchronization*
0830 – 0930	***Power Transformers*** *Core Types & Winding Configurations • Tap Changers (OLTC & NLTC) • Transformer Cooling Methods (ONAN, ONAF, OFAF) • Transformer Protection (Buchholz, Differential)*
0930 – 0945	*Break*
0945 – 1100	***High Voltage Switchgear*** *Types: AIS, GIS, Hybrid • Components: Circuit Breakers, Isolators, CTs, PTs • Operating Mechanisms (Spring, Hydraulic, Pneumatic) • Gas Insulation (SF_6): Properties & Safety*
1100 – 1215	***Transmission Lines & Towers*** *Overhead versus Underground Lines • Conductor Types (ACSR, AAAC, XLPE Cables) • Sag & Tension in Conductors • Line Insulators & Clearances*
1215 – 1230	*Break*
1230 – 1330	***Substations*** *Types: Distribution, Transmission, Switching • Main Components: Busbars, Transformers, Switchgear • Single Bus, Double Bus, Ring Bus Layouts • Substation Automation & SCADA Integration*
1330 – 1420	***Workshop: Identify Generation & Transmission Components*** *Use One-Line Diagrams & Photos • Match Symbols to Physical Components • Create a Simplified Generator-Transformer Station Layout • Group Presentation & Walkthrough*
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, 29th of July 2025***

0730 – 0830	***Distribution Transformers & RMUs*** *Pole-Mounted versus Pad-Mounted Transformers • Rating & Impedance Concepts • RMUs: Components & Operation • Surge Protection & Lightning Arresters*
0830 – 0930	***Distribution Panels & Switchboards*** *LV Switchboards & MCCs • Busbar Arrangements & Compartmentalization • Switchgear Interlocking & Safety • Arc Flash Prevention Features*

0930 – 0945	*Break*
0945 – 1100	***Circuit Breakers & Protective Devices*** *Types: ACB, MCCB, MCB, VCB • Selection Based on Voltage, Current, & Application • Breaking Capacity & Tripping Characteristics • Testing & Maintenance Requirements*
1100 – 1215	***Cables & Conductors*** *Types of Power Cables (LV/MV/HV) • Cable Insulation, Shielding, & Armoring • Cable Sizing Based on Load & Installation • Termination & Jointing Practices*
1215 – 1230	*Break*
1230 – 1330	***Energy Meters & Load Management Devices*** *Digital & Smart Metering • CT/VT Integration • Load Shedding & Demand-Side Management • Communication Protocols (Modbus, IEC 61850)*
1330 – 1420	***Workshop: Build a Distribution Network Model*** *Design a Basic LV Distribution Network • Select Breakers, Cables, & Transformer Ratings • Create Load Points & Metering Sections • Present to Group with Explanation*
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, 30th of July 2025

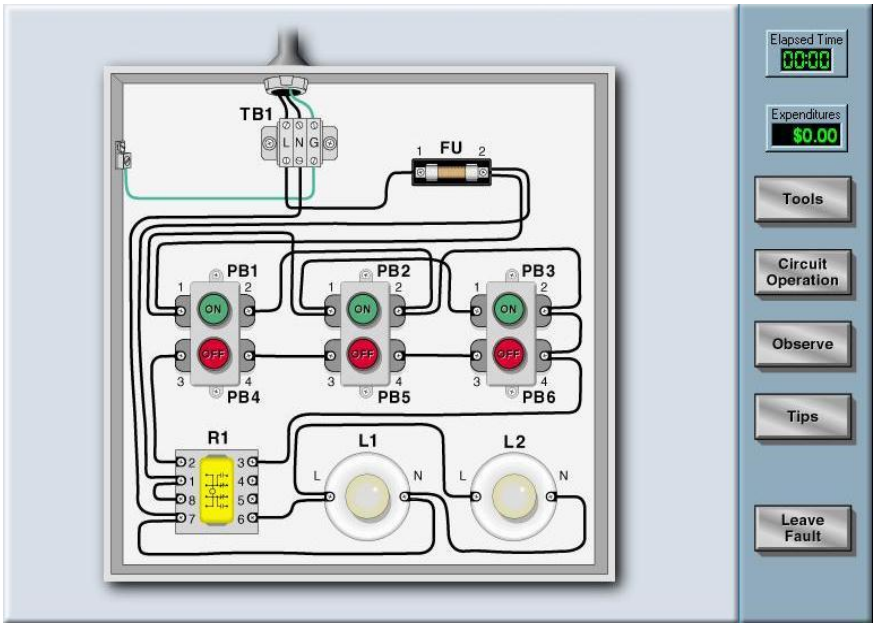
0730 – 0830	***Power System Protection Overview*** *Protection Zones & Principles • Selectivity, Reliability, Sensitivity • Backup & Primary Protection • Relay Coordination*
0830 – 0930	***Relays & Protection Schemes*** *Overcurrent, Earth Fault, Differential, Distance Relays • Numerical versus Electromechanical Relays • Time-Current Characteristics • Protection Grading & Setting*
0930 – 0945	*Break*
0945 – 1100	***Control Systems & Automation*** *SCADA Systems for Electrical Power • Remote Terminal Units (RTUs) & PLCs • Human-Machine Interface (HMI) • Data Acquisition & Logging*
1100 – 1215	***Power Quality Monitoring*** *Harmonics: Causes & Mitigation • Voltage Sags, Swells, Flicker • Power Factor Correction (Capacitor Banks, APFC) • Energy Auditing Tools*
1215 – 1230	*Break*
1230 – 1330	***Grounding & Earthing Systems*** *Earthing Methods (TT, TN, IT Systems) • Equipment Grounding versus System Grounding • Grounding Conductors & Rods • Step & Touch Voltage Considerations*
1330 – 1420	***Workshop: Design a Protection Scheme*** *Apply Relays to a Sample Substation Diagram • Calculate Relay Settings for Overcurrent Protection • Simulate a Fault & Analyze Trip Sequence • Discuss 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 Four*

Day 5: **Thursday, 31st of July 2025**

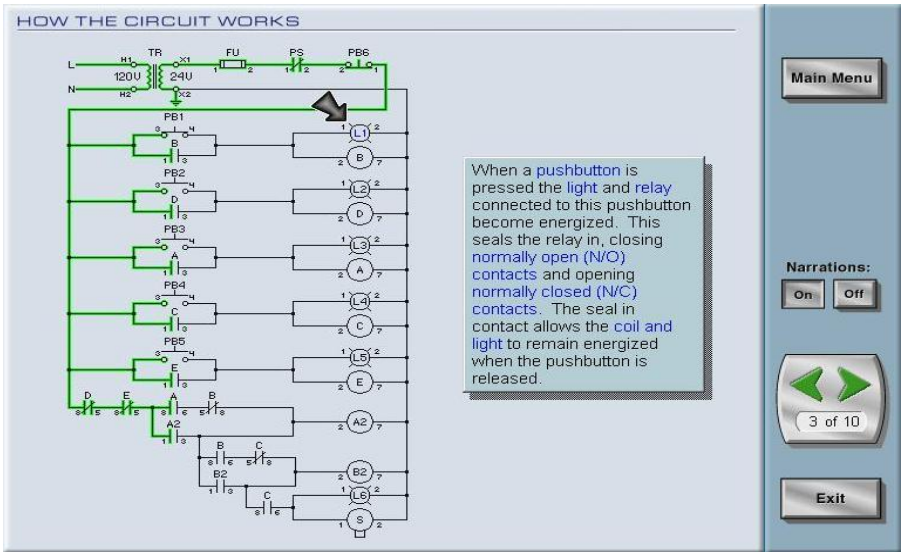
0730 – 0830	***Load Flow & System Stability*** *Load Flow Analysis Principles • Voltage Stability & Reactive Power Control • Generator/Load Balancing • Black Start Procedures*
0830 – 0930	***Power Factor & Reactive Power Compensation*** *Effects of Poor Power Factor • Capacitor Banks & Reactors • Synchronous Condensers • Real versus Reactive Power in System Design*
0930 – 0945	*Break*
0945 – 1040	***System Integration & Interconnection*** *Grid Connection Requirements • Islanded versus Grid-Tied Systems • Integration of Renewables • Power Purchase & Wheeling*
1040 – 1135	***Testing & Commissioning Procedures*** *Insulation Resistance Testing • CT/VT Ratio & Polarity Checks • Relay Testing & Functional Checks • Commissioning Reports & Certifications*
1135 - 1230	***Operation & Maintenance Best Practices*** *Preventive versus Predictive Maintenance • Thermography & Vibration Analysis • Shutdown/Startup Procedures • Common Failure Modes in Power Systems*
1230 – 1245	*Break*
1245 – 1345	***Capstone Workshop: Power System Simulation & Review*** *Simulate a Small Power Network (Generation to Load) • Identify Key Components, Protection, & Metering • Present Control & Maintenance Strategy*
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 “Haward Troubleshooting”, “Power World”, “GE Multilin Relay 469” and “GE Multilin Relay 750.

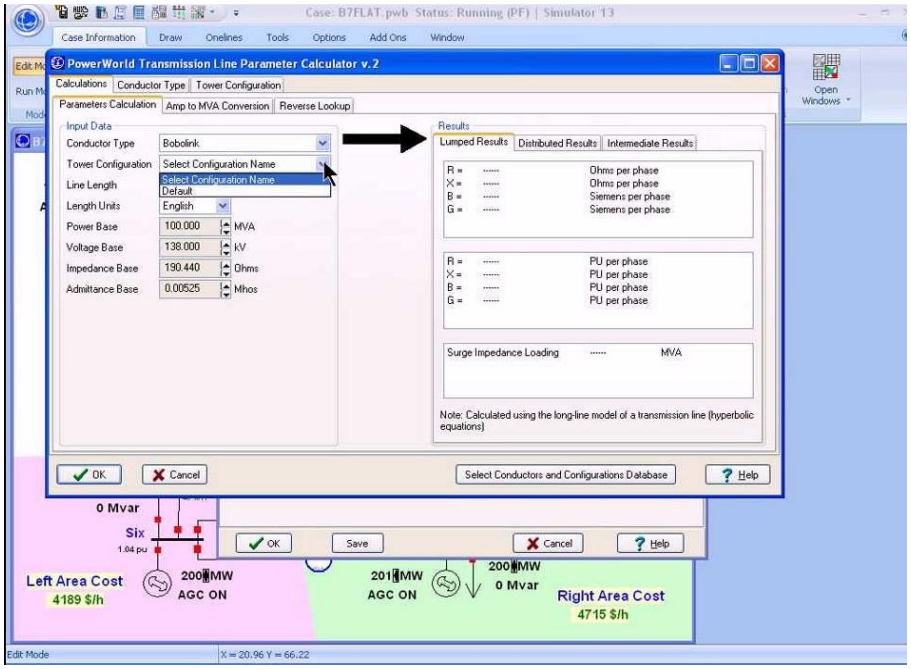


Basic Techniques



Basic Control Circuits

Motor Control Techniques



Power World Simulator

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