COURSE OVERVIEW EE0820
Different Type Relay for Generator

Course Title
Different Type Relay for Generator

Course Date/Venue
Session 1: June 23-27, 2025/Fujairah Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE
Session 2: December 07-11, 2025/Boardroom 1, Elite Byblos Hotel Al Barsha, Sheikh Zayed Road, Dubai, UAE

H-STK© INCLUDED

Course Reference
EE0820

3.0 CEUs (30 PDHs) AWARD

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.

Protection of low, medium and high voltage power systems requires an understanding of system faults and their detection, as well as their safe disconnection from the power system.

This course presents a comprehensive and systematic description of the concepts and principles of operation and application of protection schemes for various power system elements such as feeders, transformers, motors, buses, generators, etc.

The course begins with an overview of power system faults and the protection scheme requirements for the detection and coordinated clearance of these faults. Protection requirements for cogeneration and non-utility generation, and interconnection with the utility power system are covered in detail.

The course deals with protection systems from a practical perspective and includes important functional aspects such as testing and coordination of protection systems. It is specially designed for industries and utilities, which depend on proper system protection for operational efficiency and minimizing damage to equipment.

Course Objectives

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

- Apply systematic techniques in power system protective relaying and identify the different types of power system faults including their causes, effects and detection
- Determine the components of protection schemes including the application of Programmable Logic Controllers, circuit breakers, current and voltage transformers
- Describe the various types of current transformers & voltage transformers, application requirements of C.T.'s for protective relaying and accuracy classifications
- Discuss the power system neutral grounding for industrial plants and high-voltage substations, calculate ground-fault current and explain the reasons for limiting generator ground-fault current to a low value
- Illustrate the ground potential rise during power system faults which includes the hazards to individuals working in electrical substations, effects of ground-potential-rise (GPR), effects on telecommunications equipment, etc
- Apply the proper feeder overcurrent protection, protective relaying requirements for radial systems, relay setting criteria, load limitations and testing of overcurrent protection scheme
- Recognize the proper coordination of electrical protection systems, bus protection, motor protection, starting and control
- Explain the application of differential protection to transformers, winding temperature and oil temperature devices & analysis of transformer oil for dissolved gases in relation to transformer protection
- Implement the generator protection system including the differential protection, voltage controlled & voltage restrained overcurrent protection and testing of generator protection schemes
- Employ the appropriate methods of cogeneration & non-utility generation protection as well as transmission lines protection
- Demonstrate the application of static capacitors on power systems, description of protection schemes used and the testing of capacitor protection schemes in relation to capacitor protection
- Discuss new numerical relaying technology

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 system protective relaying techniques in the industrial, consulting and utility fields. Engineers, designers, supervisors and other technical staff who are involved in the design, regulatory inspection, operation and maintenance of power system protective relaying will benefit from the practical approach of this course. The course will also be very useful to those generally knowledgeable in protective relaying, but who may require a refresher or update.

Course Certificate(s)

Internationally recognized certificates will be issued to all participants of the course 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**. The 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 – 0845	***Introduction, Overview & Discussion of Objectives***
0845 – 0930	***Power System Faults*** *Different Types of Faults ● Incidence of Faults on Power System Equipment ● Effects of Power System Faults ● Causes of Power System Faults*
0930 – 0945	*Break*
0945 – 1130	***Power System Faults (cont'd)*** *Magnitude of Fault Current ● Detection of Faults ● Clearance of Faults ● Requirements of Protective Relaying Systems*
1130 – 1230	***Components of Protection Schemes*** *Fault Detecting Relays ● The Transition from Electro-mechanical Relays to Electronic and Digital Microprocessor-Based Relays ● Tripping Relays & Other Auxiliary Relays*
1230 – 1245	*Break*
1245 – 1330	***Components of Protection Schemes (cont'd)*** *The Application of Programmable Logic Controllers ● Circuit Breakers - Bulk-Oil, Air-Blast, Vacuum, SF_6 ● Current Transformers ● Voltage Transformers ● Modern Microprocessor-Based Relays - Review of Types Available*
1330 – 1420	***Current Transformers & Voltage Transformers*** *Various Types of C.T.'s V.T.'s & C.V.T.'s ● Theory and Characteristics of C.T.'s*
1420 - 1430	***Recap***
1430	*Lunch & End of Day One*

Day 2

0730 – 0930	***C.T.'S & V.T.'S (cont'd)*** *Application Requirements of C.T.'s for Protective Relaying ● Accuracy Classifications ● Future Trends in C.T. Design using Optics ● Testing of C.T.'s and V.T.'s*
0930 – 0945	*Break*
0945 – 1130	***Power System Neutral Grounding*** *An Overview of Power System Neutral Grounding ● System Grounding as Found in Industrial Plants and High-Voltage Substations ● Ungrounded Systems ● Resistance Grounded Systems ● Reactor Grounded Systems ● Solid or Effectively Grounded Systems ● Resistance Grounded Systems in Industrial Plants ● Calculation of Ground-Fault Current ● Ground-Fault Detection on Resistance Grounded Systems ● Ground-Fault Detection on Ungrounded Systems ● Generator Neutral Grounding Methods, Equipment Selection ● Reasons for Limiting Generator Ground-Fault Current to a Low Value ● Neutral Grounding Transformers and Resistors ● Calculation of Generator Ground-Fault Current ● Sizing and Rating of Grounding Equipment*
1130 – 1230	***Ground Potential Rise During Power System Faults*** *Hazards to Individuals Working in Electrical Substations ● Substation Grounding System Fundamentals ● Step Voltage, Touch Voltage, Mesh Voltage ● Tolerable Limits of Body Currents During Power System Faults ● Calculation of Allowable Step and Touch Potentials ● Effects of Ground-Potential-Rise (GPR) ● Control of Excessive Ground-Potential-Rise ● Control of Voltage Gradients in High-Voltage Substations ● GPR and Transferred Voltages ● Effects on Telecommunications Equipment ● Corrective Measures ● Neutralizing Transformers for Telephone Circuits ● Optical Isolation Equipment for Telephone Circuits*
1230 – 1245	*Break*
1245 – 1420	***Feeder Overcurrent Protection*** *Protective Relaying Requirements for Radial Systems ● Elements of Feeder Protection Schemes ● High-Set, Low-Set and Inverse-Timed Elements ● Directional Overcurrent Relays ● Coordination with Other Devices and Fuses ● Various Types of Overcurrent Relays ● Electromechanical, Electronic & Digital Relays ● Relay Setting Criteria ● Load Limitations ● Testing of Overcurrent Protection Schemes ● Microprocessor-Based Feeder Overcurrent Protection Relays-Features, Applications and Testing*
1420 - 1430	***Recap***
1430	*Lunch & End of Day Two*

Day 3

0730 – 0930	***Coordination of Electrical Protection Systems*** *Fuse to Fuse ● Circuit Breaker to Fuse ● Fuse to Circuit Breaker ● Computer Software Packages for Protection Coordination Studies ● Auto-Reclosing of Circuit Breakers ● Back-Up Protection ● Limitation of Fault Current ● Selective Zones of Protection*
0930 – 0945	*Break*
0945 – 1130	***Bus Protection*** *Types of Bus Protection Schemes ● Basic Concept of Differential Protection ● Application to Various Bus Configurations ● Application of High Impedance Relays ● Relay Setting Criteria ● Testing of Bus Protection Schemes*

1130 – 1230	***Motor Protection, Starting & Control*** *Applicable Motor Standards ● Methods of Starting ● Differential Protection, Phase Unbalance, Overcurrent ● Ground Fault Protection ● Electrical Code Requirements ● Microprocessor-Based Motor Control & Protection Devices*
1230 – 1245	*Break*
1245 – 1420	***Transformer Protection*** *Overcurrent and Ground Fault Protection ● Application of Differential Protection to Transformers ● Gas Relays, Pressure and Gas Accumulation ● Restricted Earth Fault Protection Winding Temperature and Oil Temperature Devices ● Testing of Transformer Protection Schemes ● Modern Microprocessor-Based Multi-function Transformer Protection Relays-Functions Available, Applications and Testing ●Analysis of Transformer Oil for Dissolved Gases*
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

0730 – 0930	***Generator Protection*** *Differential Protection ● Reverse Power, Stator Ground, Out-of-Step, Loss of Field ●Field Ground, Overexcitation, Interturn, etc. ● Over-Frequency, Underfrequency, Overvoltage, Undervoltage ●Negative Phase Sequence, or Phase Unbalance ● Voltage Controlled & Voltage Restrained Overcurrent Protection*
0930 – 0945	*Break*
0945 – 1130	***Generator Protection (cont'd)*** *Generator Short-Circuit Current Decrement Curves ● Synchronizing Systems, Synchro-Check Relays ●Comparison of Electro-Mechanical & Electronic Relays ●Testing of Generator Protection Schemes ● Microprocessor-Based Multi-function Generator Protection Relays-Available Functions, Applications and Testing*
1130 – 1230	***Cogeneration & Non-Utility Generation Protection*** *Protection Requirements for Non-Utility Generating Stations ● Requirements for the Interconnection NUGS to Utility Power Systems ● Typical Protection Schemes for Non-Utility Generators ● Low-Cost Microprocessor-Based Multi-function Relays for Small Generators ● Breaker Failure Protection ● Testing of Utility Tie Protection Schemes*
1230 – 1245	*Break*
1245 – 1420	***Transmission Line Protection*** *Interconnected Systems with Two-Way Flow of Fault Current ● Distance or Impedance Protection Schemes ● Phase Comparison Protection Schemes ●Line Differential Protection Schemes Communication Channel Requirements Between Terminals ● Coordination and Transfer-Tripping Between Terminals ● Modern Microprocessor-Based Line Protection Relays-Available Relays, Features, Applications and Testing*
1420 - 1430	***Recap***
1430	*Lunch & End of Day Four*

Day 5

0730 – 0930	***Capacitor Protection*** *Application of Static Capacitors on Power Systems ● Description of Protection Schemes Used*
0930 – 0945	*Break*

0945 - 1100	***Capacitor Protection (cont'd)*** *Testing of Capacitor Protection Schemes ● Microprocessor-Based Capacitor Protection and Controls Relays*
1100 – 1230	***Numerical Relays*** *Fundamentals of Numerical Relaying ● Technological Improvements Supplied by Numerical Relays ● Hardware Architecture of Numerical Relays ● Digital Signal Processors ● Sample and Hold Circuit ● Simultaneous Sampling ● Non-simultaneous Sampling*
1230 – 1245	*Break*
1245 – 1345	***Numerical Relays (cont'd)*** *Relaying Hardware for Metering ● Optical Communications ● Optical Current Transformers ● Open System Relaying*
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 simulators "GE Multilin Relay 469" and "GE Multilin Relay 750".

GE Multilin Relay 469 Simulator

GE Multilin Relay 750 Simulator

Course Coordinator

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