COURSE OVERVIEW EE0275
Power System Protection & Relaying
Electrical Protection Systems

Course Title
Power System Protection & Relaying: *Electrical Protection Systems*

Course Reference
EE0275

Course Duration/Credits
Five days/3.0 CEUs/30 PDHs

Course Date/Venue

Session(s)	Date	Venue
1	February 18-22, 2024	Kizkulesi, Crown Plaza Istanbul Asia Hotels & Convention Center, Istanbul, Turkey
2	March 03-07, 2024	Oryx Meeting Room, Doubletree By Hilton Doha-Al Sadd, Doha, Qatar

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 delegates with detailed and up-to-date overview of power system protection and relaying. It covers the various faults, their effects and calculations including the effect of faults on equipment; and the earthing system and standard requirement.

The course will also discuss the protection devices and technology including history, construction and principles of protection relays; the IED's and fuses; the instrument transformers, current and voltage transformers as well as types, construction, performance, specification and applications; the tripping devices of circuit breakers; the mechanism of electric arc breakdown; and the principles & calculation of settings for grading and protection coordination.

Overhead lines and feeder protection including the common types of faults and causes; the proper procedure for transformer protection related to restricted Buchholz relay, overpressure, oil and winding temperature; the proper procedure for motor protection; various electrical and mechanical faults; the various generator data requirements; the types of faults, excitation fault protection and mechanical fault protection; the miscellaneous protection including voltage and frequency protections, bus bar protection; and the circuit breaker failure protection will also be discussed during the course.

Course Objectives

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

- Apply and gain systematic techniques in power system protection and relaying
- Identify various faults, their effects and calculations including the effect of faults on equipment
- Recognize earthing system and standard requirement
- Explain protection devices and technology including history, construction and principles of protection relays
- Describe IED's and fuses covering the main protection and back-up protection
- Discuss instrument transformers including current and voltage transformers as well as types, construction, performance, specification and applications
- Review tripping devices of circuit breakers and illustrate the mechanism of electric arc breakdown
- Explain the principles & calculation of settings for grading and protection coordination & cite practical examples
- Analyse overhead lines and feeder protection including the common types of faults and causes
- Implement the proper procedure for transformer protection related to restricted Buchholz relay, overpressure, oil and winding temperature
- Apply the proper procedure for motor protection by analyzing motor data requirements as well as identifying various electrical and mechanical faults
- List the various generator data requirements, types of faults, excitation fault protection and mechanical fault protection
- Identify miscellaneous protection including voltage and frequency protections, bus bar protection and circuit breaker failure protection
- Employ protection relay management and practice simulator

Who Should Attend

This course provides a complete and up-to-date overview of the power system protection and relaying for engineers and other technical staff who are involved in the protection and relaying of various power systems, equipment and networks.

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.

Accommodation

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

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

Istanbul	**US$ 6,000** per Delegate + **VAT**. This rate includes Participants Pack (Folder, Manual, Hand-outs, etc.), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.
Doha	**US$ 6,000** per Delegate. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

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. Mike Tay, PhD, MSc, BSc, is a **Senior Electrical, Instrumentation & Communications Engineer** with over **40 years** of extensive experience. His expertise widely covers **Energy Industry**, **Global Warming**, **Hydroelectric & Geothermal Power**, **Biomass & Biogas**, **Four 'C's** of the Energy Transition, **Fifth Generation Heat**, **Protection Relay** Maintenance, Application & Testing, **System Analysis**, **Power System** Faults, **Protection Scheme** Components, Current & Voltage **Transformers**, **Power System** Neutral Grounding, **Feeder Overcurrent** Protection, **Electrical Protection** Systems, **Bus** Protection, **Motor** Protection, **Starting & Control**, **Transformer** Protection, **Generator** Protection, **Capacitor** Protection, **Numerical Relays**, **SCADA** Security, **ESD** System Analysis & Control, **Electrical** & **Instrumentation**, **Installation & Inspection**, **Custody** Measurement, **Loss Control** for Petroleum Products, **Process Control** & **Instrumentation**, **Fiber Optics** Access Network Planning, Safety Instrumented System (**SIS**), Safety Integrity Level (**SIL**), **PLC Design**, **Power System**, **Power Supply** Design Management, Basic **Electronics & Transformers**, **Diesel Generator**, **Electric Motors**, **Electrical** Fundamentals, Basic **Electricity** and **Electrical Codes**. Further, he is also well-versed in **Communications**, **Telecommunications**, **Mobile Protocols**, **4G LTE**, **GSM/UMTS**, **CMDA2000**, **WIMAX** Technology, **HSPA+**, **Alarm** Management System, **Computer Architecture**, **Logic & Microprocessor Design**, Embedded Systems Design plus **Computer Networking** with **CISCO**, **Network Communication**, **Industrial Digital Communication**, **Designing Telecommunications Distribution** System, **Electrical** Engineering, **WiMAX Broadband Wireless** System, TT Intranet & ADSL Network, TT Web & Voicemail, Off-site ATM Network, **IT** Maintenance, Say2000i, IP Phone, National Address & ID Automation, **Electricity Distribution** Network, **Customs** Network & Maintenance, **LAN** & **WAN Network**, **UYAP Network**, **Network Routing Protocols**, **Multicast Protocols**, **Network** Management Protocols, **Mobile** & **Wireless Networks** and **Digital Signal Processing**. Currently, he is the **Technical Advisor** of **Izmir Altek**.

During his career life, Dr. Tay worked with various companies such as the KOC Sistem, Meteksan Sistem, Altek BT, Yasar University, Dokuz Eylul University, METU and occupied significant positions like the **Aegean Region Manager**, **Group Leader**, **Technical Services Manager**, **Field Engineer**, **Research Assistant**, **Instructor**, **Technical Advisor** and the **Dr. Instructor**.

Dr. Tay has **PhD**, **Master** and **Bachelor** degrees in **Electrical & Electronic Engineering** from the **Dokuz Eylul University** and the **Middle East Technical University** (**METU**) respectively. Further, he is a **Certified Instructor/Trainer**, **Technical Trainer** (**Australia**), **Trainer** for **Data-Communication System** (**England & Canada**), a **Certified Internal Verifier/Assessor/Trainer** by the **Institute of Leadership & Management** (**ILM**), a **Certified CISCO** (CCSP, CCDA, CCNP, CCNA, CCNP) **Specialist**, a **Certified CISCO IP Telephony Design Specialist**, **CISCO Rich Media Communications Specialist**, **CISCO Security Solutions** & **Design Specialist** and **Information Systems Security** (**INFOSEC**) **Professional**. He has delivered and presented innumerable training courses and workshops worldwide.

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	**Basic Concepts** Introduction to the Topic ● Main Electric Parameters & Laws ● Standards & Regulations ● Standard Voltages
0930 - 0945	Break
0945 – 1100	**Faults, Their Effects & Calculations** Types of Faults & Causes ● Lightning, Switching Overvoltage & Use of Surge Arresters ● Safety, Safety Distances & the Dangers of Faults ● Short-circuit Faults (Phase & Earth Faults)
1115 - 1230	**Faults, Their Effects & Calculations (cont'd)** The Effect of Faults On Equipment (Thermal & Electromechanical Stress) ● Short-circuit Calculations ● Examples & Exercises
1230 - 1245	Break
1245 - 1420	**Earthing System & Standard Requirement** Solid, Impedance & Ungrounded Systems ● The Implications of Various Grounding Techniques on System Performance ● Earth Grid & Calculations ● Touch & Step Potentials ● Examples & Exercises
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

0730 – 0830	**Protection Devices & Technology** Introduction to Protection ● Simple Protection Devices ● Protection Relays (History; Construction & Principles of Operation; Modern Technology) ● Classification of Protection Relays & Codes
0830 - 0930	**Relays** Thermal Overload ● Induction Type & Microprocessors Relays ● Earth Fault ● Over Current ● Reverse Power ● Field Failure ● Shunt Trip, ● Earth Leakage Relays
0930 – 0945	Break
0945 – 1045	**IED's & Fuses** Main Protection & Back-up Protection ● Intelligent Electronic Devices (IED's) ● Fuses (Characteristics, Applications & Special Cares) ● Examples & Exercises
1045 – 1115	**Instrument Transformers** Current & Voltage Transformers ● Types, Construction, Performance, Specification & Applications
1115 - 1200	**Instrument Transformers (cont'd)** Magnetisation Curve & Characteristics (Ratio, Accuracy & Burden Power) ● Testing ● Examples

1200 - 1230	***Tripping Devices – Circuit Breakers*** *The Mechanism of Electric Arc Breakdown ● Types of Circuit Breakers & Applications (LV, MV & HV)*
1230 - 1245	*Break*
1245 - 1420	***Tripping Devices – Circuit Breakers (cont'd)*** *Main Characteristics ● Operating Mechanism, Tripping Circuits & Control Systems ● Examples*
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

0730 – 0930	***Grading & Protection Co-ordination*** *Principles ● Analysis in HV, MV and LV Networks (Transmission & Distribution Networks; Users' Networks) ● Calculation of Settings ● LV Approach (Typical Time-Current Curves & Selectivity of LV Circuit Breakers) ● Practical Examples*
0930 – 0945	*Break*
0945 – 1115	***Overhead Lines & Feeder Protection*** *Analysis in HV, MV & LV Networks (Transmission & Distribution Networks) – Common Types of Faults & Causes ● Distance Protection (Principle & Application) ● Line Differential Protection (Principle & Application) ● Overcurrent Protection ● Temporary Faults & Auto-Reclosing*
1115 - 1200	***Overhead Lines Protection (cont'd)*** *Practical Examples*
1200 - 1230	***Cable Protection*** *Common Types of Faults & Causes ● Differential Protection ● Overcurrent Protection (Thermal & Short-circuit*
1230 - 1245	*Break*
1245 - 1420	***Transformer Protection*** *Basic Theory of Transformers ● Types of Transformers & Applications*
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	***Transformer Protection (cont´d)*** *Main Electric Characteristics & Vector Group ● Built-on Protections (Buchholz Relay, Overpressure, Oil & Winding Temperature) ● Transformer Differential Protection (Principle & Application) ● Overcurrent Protection ● Practical Examples*
0930 – 0945	*Break*
0945 - 1130	***Motor Protection*** *Motor Data Requirements ● Common Types of Faults (Electrical & Mechanical) ● Motor Controllers & Starters ● Overcurrent (Phase-to Earth & Phase-to-Phase Short-circuit) & Thermal Overload Protection*

1130 - 1230	***Motor Protection (cont´d)*** *Negative Phase Sequence, Phase Unbalance & Phase Reversal Protections ● Bearing Temperature, Winding Temperature, Vibration & Blocked Rotor Protections ● Practical Examples & Exercises*
1230 - 1245	*Break*
1245 - 1420	***Generator Protection*** *Generator Data Requirements & Basic Theory ● Common Types of Faults (Electrical & Mechanical)*
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

0730 – 0830	***Generator Protection (cont'd)*** *Rotor & Stator Electric Faults Protection ● Excitation Fault Protection ●Voltage and Power (Reverse Power) Protections ● Overfrequency & Overspeed Protections ● Mechanical Faults Protection*
0830 - 0930	***Generator Protection (cont´d)*** *Practical Examples & Exercises*
0930 - 0945	*Break*
0945 - 1100	***Miscellaneous Protections*** *Voltage & Frequency Protections ● Bus Bar Protection ● Circuit Breaker Failure Protection ● Testing*
1100 - 1230	***Miscellaneous Protections (cont'd)*** *Single Phase Distribution Protections ● Three Phase Distribution Protections ● Circuit Diagrams for Protection Relays ● Protection Coordination Curves & Grading ● Testing of Relays ● Causes of Termination Heating & Preventive Measure ● Cause & Effect of Overload, Over Current, Short Circuit & Preventive Measures*
1230 – 1245	*Break*
1245 – 1345	***Protection Relay Management & Practice Simulator*** *Scheme Design ● SAT & FAT ● Commissioning ● Maintenance & Testing*
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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