COURSE OVERVIEW EE0031(SE2)
Electrical Maintenance Management, Failure Analysis & Troubleshooting

Course Title
Electrical Maintenance Management, Failure Analysis & Troubleshooting

Course Reference
EE0031(SE2)

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

Course Date/Venue

Session(s)	Date	Venue
1	May 04-08, 2025	Crowne Meeting Room, Crowne Plaza Al Khobar, Al khobar, KSA
2	August 03-07, 2025	Meeting Plus 9, City centre Rotana, Doha Qatar
3	November 03-07, 2025	Fujairah Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE

Course Description

This practical and highly-interactive course includes real-life case studies and exercises where participants will be engaged in a series of interactive small groups and class workshops.

This course is designed to provide participants with a detailed and up-to-date overview of electrical maintenance management, failure analysis and troubleshooting. It covers the purpose of preventive maintenance and problem-solving skills; the preventive, predictive and proactive maintenance; the failures, causes of failures and failure mode and effect analysis; the theory of troubleshooting and general analysis troubleshooting; and analyzing failures and the concepts of failure analysis and prevention.

During this interactive course, participants will learn the most common failures, failure mode and effect analysis (FMEA) process and failure prevention; the steps required for troubleshooting and following the troubleshooting safety precautions; the effect of electrical shock; the inspection, testing and troubleshooting electrical power transformer; the transformer troubleshooting, transformer oil troubleshooting, oil color troubleshooting and dielectric breakdown voltage troubleshooting; and the common failure of transformer, test result guide and recommended guide for transformer gas levels.

Course Objectives

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

- Apply and gain an in-depth knowledge on electrical maintenance management, failure analysis and troubleshooting
- Recognize the purpose of preventive maintenance and problem-solving skills
- Carryout preventive, predictive and proactive maintenance
- Define failures and causes of failures as well as describe the failure mode and effect analysis
- Discuss the theory of troubleshooting and general analysis troubleshooting
- Analyze failures and discuss the concepts of failure analysis and prevention
- Identify the most common failures and apply failure mode and effect analysis (FMEA) process and failure prevention
- List the steps required for troubleshooting and follow the troubleshooting safety precautions
- Recognize the effect of electrical shock as well as inspect, test and troubleshoot electrical power transformer
- Carryout transformer troubleshooting, transformer oil troubleshooting, oil color troubleshooting and dielectric breakdown voltage troubleshooting
- Identify the common failure of transformer, test result guide and recommended guide for transformer gas levels

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 maintenance management, failure analysis and troubleshooting for material planning department director, generation engineering expert, generation engineer, environmental protection engineer, trainer, transmission station maintenance technician and generation station electrician technician.

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:

- 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. Ken Steel is a **Senior Electrical & Instrumentation Engineer** with over **30 years** of extensive experience. His expertise widely covers **Energy Industry**, **Electrical Motors Testing**, **Heat Tracing** & Insulation Installation & Testing, **HV Terminations**, **High & Low Voltages** on Overhead Cranes, **HV/MV Cable Splicing**, **Cable & Over Head Power Line**, **HV/MV Switchgear, HV Cable** Design, **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, **Cable** Splicing & Termination, **High Voltage** Electrical Safety, **LV**, **MV & HV Cable** Installations & Properties, **LV Substation**, **MV & LV Cable**, **UPS Systems**, **MV & LV** Direct on Line Motor Drives, **MV & LV** VSD Motor Drives, **MV & LV** Soft Starter Motor Drives, **LV Two Speed Motor Drives**, Underground **Transformer Oil Containment Tank**, **Electrical & Instrumentation Construction** Installation, 1500KW, 1000KW, 1752KW **Diesel Power Plant Installation**, **110KV Overhead Line**, **110KV Outdoor Switchgear**, 110KV/10KV 6500KVA **Transformer**, **Transformer Substation**, 1600KVA 10KV/0.4KV & 2 Off 1000KVA **Diesel Generators**, 1600KVA 10KV/0.4KV & 1650KVA **Diesel Generator**, **110KV/35KV/10KV Substation**, 110KV/10KV **Transformers**,110KV & 2 Off 6KV **Overhead Lines**, 34.5KV,13.8KV ,4.16KV & 480V **Switchgear**, 4.16KV & 480V MCC, **Transformers & Motor Drives** Substations, **Diesel Driven Generators**, **Overhead Cranes**, **Overhead Cranes & HVAC Units**, **AC & DC Drives**, **Data Logger**, **Electrical, Instrumentation & Mechanical** Installation Maintenance, Slab Mills, Pre Heat Ovens, Hydraulic Shears, Stamping Machine, Gearboxes, Rollers, Pumps, Valves, Electro Magnets & Pump House Operation, Boilers Construction And Commissioning, Valve Calibration & Testing, Level Gauges, Pressure & Flow Transmitters Installation & Calibration, Pressure & Leak Testing of Boilers, Leak Testing, SMP, Elect, I&C, F&G, HVAC & Utility Services, Nitrogen Leak Test Operations, Steam Blowing Activities, SMP, Elect, I&C, F&G, HVAC & Utility Services, PTW Issue (PA/AC), Installation & Mechanical Piping and Hydro Testing & Leak Testing of Lines Installation.

During Mr. Steel's career life, he has gained his practical experience through several significant positions and dedication as the **3GP PBF & Boilers SC Commission Support**, **SC Site Execution Superintendent**, **E&I Construction Superintendent**, **High Voltage Construction Supervisor**, **Control & Power Construction Supervisor**, **Electrical & Instrumentation Supervisor**, **Electrical Technician**, **Construction Support Electrical Engineer**, **E&I Engineer**, **Electrical/Instrumentation Site Supervisor**, **Q.A/Q.C Inspector**, **Electrical/ Instrumentation Technician**, **Maintenance Fitter Instrumentation Technician**, **Millwright**, **Apprentice Millwright** and **Senior Instructor/Lecturer** for Tengiz Chevron Oil Kazakhstan, Al Jubail Saudi Arabia, Escravos Delta state Nigeria, Lurgi S.A, SuD Chemie Sasol Catalysts, J C Groenewalds Construction (LTA), Tycon (Goodyear S.A.), Dragline Construction and Iscor Vanderbijlpark.

Mr. Steel has a **Diploma** in **Electronics Mechanic**. Further, he is a **Certified Instructor/Trainer** and delivered numerous trainings, courses, workshops, seminars and conferences internationally.

Course Fee

Al Khobar	**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
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
Abu Dhabi	**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

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	***Preventive Maintenance & Problem-Solving Skills*** *Troubleshooting (Run to Failure) • Preventive Maintenance Preventive Maintenance*
0930 - 0945	*Break*
0945 – 1100	***Preventive Maintenance & Problem-Solving Skills (cont'd)*** *Predictive Maintenance • Predictive Testing and Inspection (Vibration Monitoring & Analysis, Electrical Condition, Thermography: Infrared Thermography (IRT), Lubricant & Wear Particle Analysis, Passive (Airborne) Ultrasonic, Nondestructive Testing, NDT Techniques)*
1100 – 1230	***Preventive Maintenance & Problem-Solving Skills (cont'd)*** *Proactive Maintenance (Failed-Item Analysis, Reoccurrence Control) • Problem Solving Skills (Identify the Problem, Define the Main Elements of the Problem, Examine Possible Solutions, Act on Resolving Problem, Look for Lessons to Learn)*
1230 - 1245	*Break*
1245 – 1420	***Failure Analysis & Theory of Troubleshooting*** *Analyzing Failures • Concepts of Failure Analysis and Prevention • What is a Failure (A Good Definition of a Failure, Failure can be Defines on Several Different Levels) • Categories of Material Stressors (The Six Stressors: Mechanical, Chemical, Electromechanical, Thermal, Radiation, Electrical) • Why do Failures Happen? (The Most Common Reasons for Failures, Problem Solving is Rooted in the Scientific Method, Additional Tools Available to the Analyst)*
1420 – 1430	***Recap***
1430	*Lunch & End of Day One*

Day 2

0730 - 0930	***Failure Analysis & Theory of Troubleshooting (cont'd)*** *The Failure Mode and Effect Analysis (FMEA) Process (The Procedure) • Why is a Failure Investigation Performed (Nine Steps of a Failure Investigation) • Failure Analysis Procedures (The Basic Steps) • Accident Reconstruction • Types of Accident Reconstruction (Motor Vehicle, Aircraft, Structural, Electrical, Industrial, Mechanical, Construction, Fire Investigations) • Failure Prevention (Collection of Background Information of Failed Components, Preliminary Examination of Failed Components, Preservation, Cutting & Cleaning of the Sample, Assessing the Surface & Sub-surface Imperfections Using NDT, General Troubleshooting Theory, Gather Information, Ask Detailed Questions, Verify the Issue, Eliminate Third-party Products, Attempt to Recreate the Issue)*
0930 – 0945	*Break*
0945 – 1100	***Failure Analysis & Theory of Troubleshooting (cont'd)*** *Step Back and Ask More Questions (Try Quick Fixes, Use Appropriate Diagnostics, Use Additional Resources to Research the Issue, Escalate the Issue, Repair or Replace the Faulty Item, Verify your Repair by Testing the Equipment Thoroughly, Inform the User of What you have Done) • Six Step Problem Solving Model (Step 1: Define the Problem, Step 2: Define the Root Cause, Step 3: Develop Alternative Solutions, Step 4: Select a Solution, Step 5: Implement the Solution, Step 6: Evaluate the Outcome) • Drill Down Technique • Four Frame Model • Eight Disciplines of Problem (Team, Formation, Problem Description, Implementing Temporary Containment Actions, Defining Problem Root Causes, Developing Permanent Corrective Actions, Implementing Permanent Corrective Actions, Preventing Reoccurrences)*
1100 – 1230	***Case Studies: Case 1: Failure Analysis of Condensate Pump Shaft*** *Introduction • Visual Inspection after the Failure*
1230 – 1245	*Break*
1245 – 1345	***Case Studies: Case 1: Failure Analysis of Condensate Pump Shaft (cont'd)*** *Destructive Examination of the Shaft (Fractography, Metallography of the Fractured Area, Microstructure & Microhardness, Discussion, Conclusion)*
1345 - 1420	***Case Studies: Case 2: Failures of a Wire Rope on a Crane*** *Background (Visual Observations, Tensile Testing, Fractography, Summary & Conclusions, Recommendations)*
1420 – 1430	***Recap***
1430	*Lunch & End of Day Two*

Day 3

0730 - 0930	***Troubleshooting Principles*** *Troubleshooting Definition • Most Common Types of Failure • Steps Required for Troubleshooting (Step 1: Preparation, Step 2: Observation, Step 3: Define Problem, Step 4: Identify Possible Causes, Step 5: Determine Most Probable, Step 6: test & Repair, Step 7: Follow-up) • Troubleshooting Safety Precautions*
0930 – 0945	*Break*
0945 – 1100	***Troubleshooting Principles (cont'd)*** *Electrical Safety for Employee Workplaces (ANSI/NFPA 70E) • Basic to Electrical Accident • Testing of Electrical Circuit • Rubber Gloves for Electrical Work*

1100 – 1230	***Troubleshooting Principles (cont'd)*** *Low Voltage Tester • Medium and High-Voltage Detectors • Grounds - Personnel Protection • On-Site C.B Maintenance Safety*
1230 – 1245	*Break*
1245 – 1420	***Troubleshooting Principles (cont'd)*** *Racking in Precautions • Effects of Electrical Shock • Effects of 60-HZ Current on an Average Human*
1420 – 1430	***Recap***
1430	*Lunch & End of Day Three*

Day 4

0730 - 0930	***Transformer Troubleshooting Case Study*** *Failure of Transformer in Power Substation (Failure due to Lightning Discharged or Over voltages, Sustain Overloads, Inter-turn Short, Dead Short-Circuit, Buchholz Relay Tripping, Internal Flashover, Do's & Don'ts) • Common Failure of Transformer (Oil Leakage, Low Breakdown Voltage (BDV), Bushing Failure, Winding Failures, Oil Cooling System Failure, Low IR Value, Dehydrating Breather Material, Humming Sound, Conservator Oil Level, Buchholz Relay Alarm, Buchholz Relay Trip, Transformer Trip When Energizing, Abnormal Secondary Voltage or No Voltage, Pressure Relief Valve) • Transformer Oil Troubleshooting*
0930 – 0945	*Break*
0945 – 1100	***Transformer Troubleshooting Case Study (cont'd)*** *Oil Color Troubleshooting • General Guide • Dielectric Breakdown Voltage Troubleshooting • Analysis of the Breakdown Results*
1100 – 1230	***Transformer Troubleshooting Case Study (cont'd)*** *Test Result Guide • Water Content PPM (Part Per Million) • Interfacial Tension (IFT) Troubleshooting • Correlation Between IFT Vs Sludge Formation*
1230 – 1245	*Break*
1245 – 1420	***Transformer Troubleshooting Case Study (cont'd)*** *Acidity Neutralization Number (NN) (IFT-NN Relationship, Correlation between Acidity versus Sludge Formation in a Transformer Oil) • Loss Factor (Tan Delta) Troubleshooting • Limit of Results*
1420 – 1430	***Recap***
1430	*Lunch & End of Day Four*

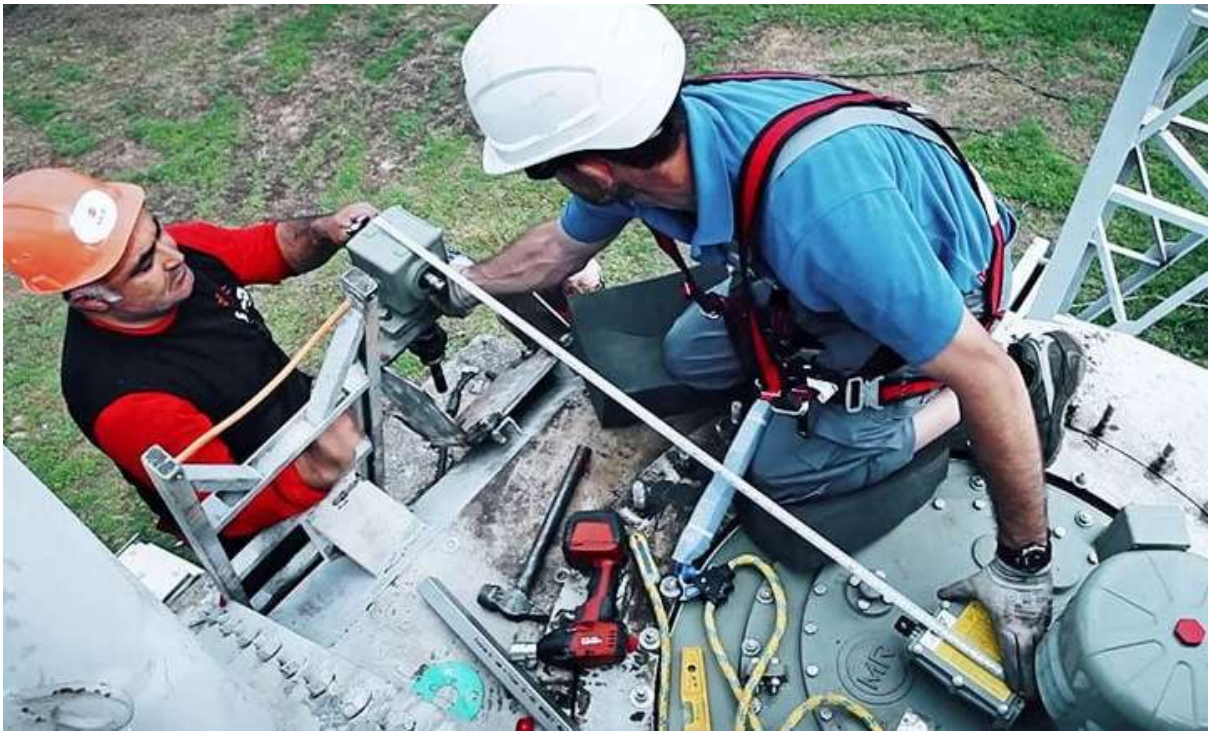
Day 5

0730 - 0930	***Transformer Troubleshooting Case Study (cont'd)*** *Dissolved Gas-In-Oil Analysis (DGA) • Thermal Degradation • Arcing*
0930 – 0945	*Break*
0945 – 1100	***Transformer Troubleshooting Case Study (cont'd)*** *Partial Discharge • Characteristics Gases:H2 • Guide for Interpretation of Gas in Oil*
1100 – 1230	***Transformer Troubleshooting Case Study (cont'd)*** *Gas Chromatograph • Interpreting Transformer Oil Test Data • Myers Index Number*

1230 – 1245	*Break*
1245 - 1345	***Transformer Troubleshooting Case Study (cont'd)*** *Definitions (Total Gas Content (TGC), Combustible Gas Content (CGC), N.D (not detected))* • *Recommended Guide for Transformer Gas Levels* • *Transformer Oil Troubleshooting Case Studies (Fault Case #1 (Diagnosis, Findings, Solution), Fault Case #2 (Diagnosis, Findings), Fault Case #3 (Diagnosis, Findings), Fault Case #4 (Diagnosis, Findings), Fault Case #5 (Diagnosis, Findings), Special Note, Rogers Ratio)*
1345 – 1400	***Course Conclusion***
1400 – 1415	***POST-TEST***
1415 – 1430	*Presentation of Course Certificates*
1430	*Lunch & End of Course*

Practical Sessions

This practical and highly-interactive course includes real-life case studies and exercises:-



Course Coordinator

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