

COURSE OVERVIEW EE0970-4D
Power System Blackouts, Restoration & Troubleshooting

Course Title

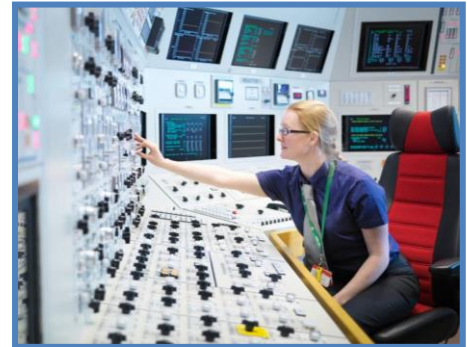
Power System Blackouts, Restoration & Troubleshooting

Course Reference

EE0970-4D

Course Duration/Credits

Four days/2.4 CEUs/24 PDHs



Course Date/Venue

Session(s)	Date	Venue
1	February 19-22, 2024	Club B Meeting Room, Ramada Plaza by Wyndham Istanbul City Center, Istanbul, Turkey
2	May 13-16, 2024	Boardroom 1, Elite Byblos Hotel Al Barsha, Sheikh Zayed Road, Dubai, UAE
3	August 12-15, 2024	Ajman Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi,
4	November 11-14, 2024	Al Aziziya Hall, The Proud Hotel Al Khobar, Al Khobar, KSA

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.

Power system loads continue to grow in size and complexity. Reliability expectations continue to rise. Power systems themselves become larger and more complex in response to growing load and customer expectations. Indeed, power systems have become more difficult to analyze and operate. Recent power system blackouts have heightened the concern for power system security and, therefore, reliability. Major blackouts of electric power systems in which many customers are left without power are rare events. However, the effects of blackouts, for instance, can be catastrophic. It has been observed that protective system failures are a contributing factor in a large proportion of these blackouts during system disturbances.

Nowadays, power systems are operating with lower and lower security margins. This is due to the prioritization of the electricity market deregulation, the load consumption increase, the difficulties to build new facilities such as transmission lines and large power plants, etc.



Consequently, the vulnerability of power systems becomes a very important issue and the probability of large blackout tends to increase, as confirmed by the various incidents experienced in the past. Therefore, mastering the knowledge of different topics related to blackout inception and power system instability has become essential for researchers and engineers involved in power system planning, operation and control.

This course is designed to help power system professionals, planners and engineers gain ground on the power system blackout and restoration. This course provides an up-to-date description of the restoration methodologies and implementation strategies practiced internationally. Participants will learn how to identify precursors for blackouts and will practice the steps necessary to prevent them from occurring. The course will focus on mechanisms of blackouts, instability phenomena, modelling and analysis tools, preventive and curative measures and finally service restoration.

Course Objectives

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

- Apply and gain a comprehensive knowledge on restoration and troubleshooting of power system blackouts
- Determine the blackout concerns and review recent blackouts, its causes and lessons learned from these incidents
- Identify the various instability mechanisms and transients and analyze the cold inrush current effects on blackout
- Recognize the role of induction motors in triggering blackouts
- Evaluate the functions of angle and voltage stability control in power system blackouts and become acquainted with the process of assessing security margins with respect to voltage instability
- Implement the blackout preventive measures and identify the process of wide-area monitoring and control
- Discuss the power system restoration including the analytical tools for power system restoration, system operations challenges, protection relays issues during restoration and the heuristic approaches to distribution system restoration
- Determine the special considerations in system restoration such as black start capabilities, tie line utilization during power system restoration and the usage of HVDC links in power system restoration
- Employ the new approaches in power system restoration namely knowledge-based systems, real time considerations, MARS, etc
- Use a structured approach on system restoration planning in consideration to the tools, guidelines, techniques and procedures for system restoration plan implementation

Who Should Attend

This course provides an overview of all significant aspects and considerations of power system blackouts restoration and troubleshooting for power system analysts and engineers, including generation and transmission planners, protection engineers, ISO/RTO technical staff and operations supervisors. Others who will benefit include power developers and marketers, power exchange personnel, regulatory staff and economic and management consultants.




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:-


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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 **2.4 CEUs** (Continuing Education Units) or **24 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.

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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 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. Ehab Mohamed, BSc, CompEX, ETAP, is a Senior Electrical & Instrumentation Engineer with 30 years of extensive industrial experience within the Oil & Gas, Refinery, Petrochemical and Power industries. He specializes in Certified Cyber Security Practitioner, Power System Blackouts, Power System During Emergency and Blackouts, Electric Power System Operation, Electrical Transient Analysis Program (ETAP), Electrical Installation & Maintenance, Electrical Inspection & Testing, HV/LV Equipment, High Voltage Electrical Safety, LV & HV Electrical System, HV Equipment Inspection & Maintenance, HV Switchgear Operation & Maintenance, LV Distribution Switchgear & Equipment,

Substation Design & Commissioning, Substation Maintenance Techniques, Switchgear Operation & Maintenance, Circuit Breakers & Switchgears Inspection, Power System Control & Stability, Industrial UPS Systems & Battery Power Supplies, Power Generation & Transmission, Power System Protection & Relaying, Electric Power Calculation, Power Systems Protection, Distributed Control System (DCS) Applications & Troubleshooting, SCADA & Industrial Communication, Process Logic Controller (PLC), Load Flow Calculation, Cable Installation, Transformer Maintenance, Short Circuit & Protection Coordination, Harmonic Analysis Studies, Earthing & Grounding, Power Factor Correction, Power System Protection & Relaying, Electric Motors & Variable Speed Drives, Power Generation, Electrical Fault Detection & Remedies, Electrical Control Circuits & Equipment, Hazardous Area Classification, Electrical Hazards, Explosion Proof Ex Equipment, Hazardous Area Classification & Intrinsic Safety, Motor Testing & Maintenance, Modern Power System Protective Relaying, Generators and Transformer. Further, he is well-versed in Process Control & Instrumentation, Practical Industrial Data Communications & Telecommunications, Renewable Energy, Preventive Maintenance Management System, Condition-based Maintenance, Engines Oil Quality System, Root Cause Analysis (RCA), Computerized Maintenance Management System (CMMS) and Rig Modification Request (RMR) and is very skillful in various softwares like the Office 365, Outlook 365, Visio, ETAP, AutoCAD, RAMS, HRMS, Microsoft BI for Dashboard and Online Reports, Siemens TIA, ABB Drive, Wizard, Window, Composer Suite, SharePoint, NOV Rig Sense all versions, Cond Master Ruby for Condition Monitoring and OSIsoft Data Analytics. He is currently the Engineering Manager (Electrical & Controls) in Weatherford Drilling International.

During his career life, Mr. Ehab has gained his expertise and thorough practical experience and handling challenging positions such as being the **Engineering Manager, Product Manager, Acting Project Manager, Lead Operation Engineer, Plant Engineer, Electrical Project Engineer, Project Engineer, Field Support Engineer, Lead Electrical & Automation Engineer, Lead Electrical Engineer, Field Support Engineer, Application Engineer, Allen Bradley Rockwell Engineer, Lead Technical Assessor, Team Leader, Principal Teacher, Global Field Support Technician, Foreman, Technical Consultant, Technical Trainer and Staff Lecturer** for various companies such as the **Weatherford Drilling International Inc., Daleel Petroleum Company (DAPECO), NDSC Drilling Contractor, NOKHBA Energy, Abraj Drilling, American Standard Polymer and Acrylic Plant, Future Technologies Ltd, Industrial Technical College, Ministry of Higher Education and El-Masria Trading & Technical Services.**

Mr. Ehab has a **Bachelor degree in Electrical Engineering. Further, he is a Certified Instructor/Trainer, a Certified Internal Verifier/Assessor/Trainer by the Institute of Leadership of Management (ILM), a Certified CompEx Inspector & Installer, a Certified Allen Bradley Rockwell Engineer and a member of the Institution of Engineering & Technology (IET). Moreover, he holds a certification in Electrical Power Calculation (ETAP) and has delivered numerous trainings, courses, workshops, seminars 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

Istanbul	US\$ 5,000 per Delegate + VAT . This rate includes Participants Pack (Folder, Manual, Hand-outs, etc.), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.
Dubai	US\$ 4,500 per Delegate + VAT . This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.
Abu Dhabi	US\$ 4,500 per Delegate + VAT . This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.
Al Khobar	US\$ 4,500 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 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 – 0745	<i>Registration & Coffee</i>
0745 – 0800	<i>Welcome & Introduction</i>
0800 – 0815	PRE-TEST
0815 – 0930	Overview of Blackout Concerns
0930 – 0945	<i>Break</i>
0945 – 1030	Overview Blackout Causes
1030 – 1230	Review of Recent Blackouts, Causes & Lessons Learnt <i>Self-organizing Criticality & the Edge of Chaos</i>
1230 – 1245	<i>Break</i>
1245 – 1330	Instability Mechanisms & Transients
1330 – 1400	Cold Inrush Current Effects on Blackout
1400 – 1420	Induction Motors Role in Triggering Blackout
1420 – 1430	Recap
1430	<i>Lunch & End of Day One</i>





Day 2

0730 – 0930	Angle Stability Control
0930 – 0945	Break
0945 – 1115	Voltage Stability Control <i>Reactive Capability Limitation of Synchronous Machines • Optimizing Generator Reactive Power Resources</i>
1115 – 1230	Assessing Security Margins with Respect to Voltage Instability
1230 – 1245	Break
1245 – 1330	Blackout Preventive Measures - Overview
1330 – 1420	Wide-Area Monitoring & Control
1420 – 1430	Recap
1430	Lunch & End of Day Two

Day 3

0730 – 0830	Blackout Prevention by General & Network Voltage Control
0830 – 0930	Blackout Prevention by Compliance with Reliability Standards
0930 – 0945	Break
0945 – 1115	Blackout Prevention by Loads Voltage Stabilization <i>Static VAR Compensators • Voltage Stabilizers • AGC Implementation • Role of HVDC Systems in System Stability</i>
1115 – 1230	Restoration Overview <i>Power System Restoration-First Task Force Report • Analytical Tools for Power System Restoration-Conceptual Design • System Operations Challenge • Protection Relays Issues During Restoration • Overvoltage Control During Restoration • Effects of Cold Load Pickup at the Distribution Substation Transformer • Power System Restoration Issues • Asymmetry Issues in Power System Restoration • Steam Plant Startup & Control in System Restoration • A Framework for Power System Restoration Following a Major Power Failure • A Hierarchical Interactive Approach to Electric Power System Restoration • Heuristic Approaches to Distribution System Restoration</i>
1230 – 1245	Break
1245 – 1420	Special Considerations in System Restoration <i>Power System Restoration-The Second Task Force Report • System Restoration & Black Start Capabilities • Tie Line Utilization During Power System Restoration • Using HVDC Links in Power System Restoration</i>
1420 – 1430	Recap <i>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</i>
1430	Lunch & End of Day Three





Day 4

0730 – 0930	<p>New Approaches in Power System Restoration <i>Knowledge-Based Systems • Real Time Considerations • Guiding a Power System Restoration with an Expert System • Expert System Requirements for Power System Restoration • A New Algorithm for Service Restoration in Distribution Systems • MARS: Decision Support for Restoration after Local Disturbances</i></p>
0930 – 0945	<p><i>Break</i></p>
0945 – 1045	<p>Blackout & Restoration Training <i>Development of a Large-Scale Dispatcher Training Simulator & Results • Dispatcher Training Simulators-Lessons Learned • The Uses of an Operator Training Simulator for System Restoration • An Advanced Transportable Operator Training Simulator • Restoration Simulator Prepares Operators for Major Blackouts • Bulk Power System Restoration Training Techniques • Verification of an Advanced Power System Restoration Support System Using an Operator Training Simulator • Evaluating a Restoration Tool Using an Operator Training Simulator • System Restoration Guidelines: How to Set-up, Conduct & Evaluate a Drill</i></p>
1045 – 1230	<p>System Restoration Planning <i>Policies for Restoration of a Power System • Analytical Tool Requirements for Power System Restoration • System Restoration Plan Development for a Metropolitan Electric System • Role of Interactive & Control • Computers in the Development of a System Restoration Plan • System Restoration-Deploying the Plan • Power System Restoration Planning • A Systematic Method for Power System Restoration Planning • From Generic Restoration Actions to Specific Restoration Strategies • Estimating Restoration Duration</i></p>
1230 – 1245	<p><i>Break</i></p>
1245 – 1345	<p>Operators Perspective & Supporting Tools <i>Graphic Displays & Human Factors Engineering • Human Error Reduction Techniques • Risk Management Software</i></p>
1345 – 1400	<p>Course Conclusion <i>Using this Course Overview, the Instructor(s) will Brief Participants about the Course Topics that were Covered During the Course</i></p>
1400 – 1415	<p>POST-TEST</p>
1415 – 1430	<p><i>Presentation of Course Certificates</i></p>
1430	<p><i>Lunch & End of Course</i></p>





Practical Sessions

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



Course Coordinator

Kamel Ghanem, Tel: +971 2 30 91 714, Email: kamel@haward.org

