

CLASSROOM TRAINING

COMMISSIONING OF ELECTRICAL EQUIPMENT:

PREPARATION, PLANNING, PRE-COMMISSIONING CHECKS AND TESTS, COMMISSIONING SCHEDULE, DETAILED COMMISSIONING PROCEDURES FOR TRANSFORMERS, SWITCHGEAR, INDUCTION AND SYNCHRONOUS MOTORS, AND GENERATORS, COMMISSIONING CODES, INSTRUMENTATION, TRIAL RUN OF EACH EQUIPMENT, SAFETY AND PRECAUTIONS, SAFETY RULES CLEARANCE CERTIFICATES, PROCEDURE FOR THE CONTROL AND HANDLING OF DEFECTS, COMMISSIONING REPORTS

*5 full day training, 7 hours per session
(total 35 hours)*

GLOBAL LEADER IN POWER & UTILITIES TRAINING



COURSE OVERVIEW

This 5 full-day course provides a comprehensive understanding of all the commissioning and start-up activities of all electrical equipment including transformers, switchgear, induction and synchronous motors, generators and auxiliaries. All commissioning activities are covered in detail in this course. This includes all the commissioning procedures and documents, purpose of commissioning, responsibilities, system description, documentation, testing and commissioning schedules, test reports, safety, certification, and plant completion report. The course provides also a thorough understanding of all the commissioning requirements for transformers, switchgear, induction and synchronous motors and, generator and auxiliaries including its switchgear equipment, switchgear, and transformers.

All the stages of the commissioning procedure are covered in-depth in this course. This includes preparation – planning various activities, pre-commissioning checks and tests, typical commissioning schedule, detailed tests and commissioning procedures for every type of transformers, switchgear, induction and synchronous motors, and generators and auxiliary systems, instrumentation, trial run of the equipment, safety and precautions, commissioning of electrical systems, Safety Rules Clearance Certificates, procedure for the control and handling of defects, Commissioning Reports.

This course is a MUST for anyone who is involved in the pre-commissioning or commissioning of any electrical equipment because it provides detailed pre-commissioning checks and tests and detailed tests and commissioning procedures for every electrical equipment. In addition, the course provides in-depth coverage of all preparation, planning activities, commissioning schedules, trial run of each electrical equipment, safety and precautions, Safety Rules Clearance Certificates, Procedures for handling defects, and Commissioning Reports.

Course Level	Basic or Foundation
Maximum Number of Participants	20



COURSE LEARNING OUTCOMES

- **Pre-Commissioning Checks and Tests, Detailed Tests and Commissioning Procedures and Instructions for all Electrical Equipment:** Gain a thorough understanding of all pre-commissioning checks and tests, and all commissioning procedures and instructions for all electrical equipment
- **Commissioning Procedures, Documents, and Certification of Electrical Equipment:** Discover the benefits of the Commissioning Management System of electrical equipment including all commissioning procedures and documents, purpose of commissioning, responsibilities, system description, documentation, testing and commissioning schedules, test reports, safety, equipment certification, and commissioning completion report
- **Commissioning Procedures for Transformers:** Learn about the commissioning procedures for transformers including functional checks, pre-commissioning tests, commissioning tests, and records.
- **Commissioning Procedures for Switchgear Assemblies:** Gain a thorough understanding of all the commissioning procedures for switchgear assemblies including substation commissioning, electrical testing, code requirements, safety rules, grounding and shorting, high power testing, NETA acceptance testing procedures, test values analysis, and commissioning forms
- **Commissioning Procedures for Generator and Auxiliaries:** Discover all the commissioning procedures for generator and auxiliaries including generator, seal oil system, hydrogen gas system, stator water system, rolling and payment of generator
- **Commissioning Procedures and Instructions for Generator Electrical Equipment:** Learn about all the commissioning procedures and instructions for generator electrical equipment including switchyard equipment, switchgear, transformers, and motors
- **Code Requirements for Commissioning Electrical Equipment and Systems:** Learn about the code requirements for commissioning transformers, switchgear, inductions and synchronous motors, and generators and auxiliaries

WHO SHOULD ATTEND

- Engineers of all disciplines
- Managers
- Technicians
- Maintenance personnel
- Other technical individuals

TRAINING METHODOLOGY

The instructor relies on a highly interactive training method to enhance the learning process. This method ensures that all the delegates gain a complete understanding of all the topics covered. The training environment is highly stimulating, challenging, and effective because the participants will learn by case studies which will allow them to apply the material taught to their own organization.

SPECIAL FEATURE

Each delegate will receive a copy of the following materials written by the instructor:

- “ELECTRICAL EQUIPMENT HANDBOOK” published by McGraw-Hill in 2003 (600 pages)
- ELECTRICAL EQUIPMENT COMMISSIONING MANUAL (includes practical information about all pre-commissioning checks and tests, typical commissioning schedule, detailed tests and commissioning procedures and instructions for all electrical equipment - 500 pages)



5 FULL-DAY COURSE OUTLINE

Soft copy course materials & Certification of Completion will be provided to registered participants.

Day 1:

Commissioning Management System, Commissioning of Power Transformers

- Commissioning Procedure and Documents: Purpose of Commissioning, Responsibilities, System Description, Organization, Working Parties, Test Teams, Documentation, Safety, Plant Certification, Plant Completion Report,
- Commissioning of Power Transformers: Introduction, Recording of salient parameters, Pre-commissioning Checks, General Checks, General Arrangement, Terminations, Perfection of Connections, Earthing, Control Cable Connections, Radiator, Main Conservator and OLTC Conservator, Bushing, Breather, Cooler Units, Fans and Pumps, Winding Temperature Indicator (WTI) and Oil Temperature Indicator, Bucholtz Relays, Magnetic Oil Level Gauge, Arcing Horn Gap, Tap Changer, General Inspection
- Functional Checks
- Pre-Commissioning Tests: Insulation Resistance Test, Selection of Insulation Tester, Factors Influencing IR Value, Steps for Measuring the IR, Minimum Value of IR, Influence of Temperature on IR, Interpretation of Insulation Resistance Value, Points to Note
- Dielectric Absorption and Polarization Index Tests: Instruments/Materials Required, Procedure for Test, Interpretation of Polarization Index and Dielectric Absorption Curve
- Two Voltage Test (Step Voltage Test), Measurement of Tan Delta, Transformer Ratio Test, Short Circuit Current Measurement, Measurement of Magnetizing Current, Test for Magnetic Balance, Phasor Group Test, Test for Transformer Oil, Sampling of Oil – General Precautions, Sampling Procedure, Evaluation of Test Results, Relay Tests
- Commissioning, Records
- Commissioning Switchgear Assemblies

Day 2:

Substation Commissioning, Commissioning of Power Transformers, Commissioning of Switchgear Assemblies

- Substation Commissioning: Introduction, Electrical Testing, Insulation Resistance Test, Example Calculation, Insulation Resistance Test Procedures
- AC Hipot Test, AC Hipot Test Procedure
- DC Hipot Test, DC Hipot Test Procedure
- Low Resistance Test, Low Resistance Test Procedure
- Safety Awareness and Practices
- Qualified Person, Qualifications of a Qualified Person, Recommended Practices
- A Brief Explanation of IEEE Standard 510-1983: Scope, Test Area and Safety Practice,
- Control and Measurement Circuits, Temporary Circuits
- Safety Rules, Safety Inspection
- Grounding and Shorting, Spacing,
- High Power Testing, General
- NETA Acceptance Testing Procedures: Visual and Mechanical Inspection, Electrical Tests
- Test Values Analysis: Visual and Mechanical, Electrical
- Test Set Operational Instruction Manual
- Switchgear Commissioning Test Forms
- Switchgear Inspection Check List Form
- Bus Section Resistance Test Form
- Bus Insulation Test Form
- References

5 FULL-DAY COURSE OUTLINE

Day 3

Commissioning of Motors

- Pre-Energization Requirements: Verification of Electrical Connections/Interlocks
- Verification of Mechanical Integrity, Lubrication System Checks
- Insulation Resistance (IR) and Polarization Index (PI) Checks: Megohmmeter, Induction Motors
- Motor Tests: Preparation for Test, Test Procedure Insulation Resistance, Synchronous Motors, Test Procedure, Bearing Insulation Resistance, High-Potential Test
- Air Gap Check
- Verification of Protective Relay Setpoints: Phase Rotation Test
- Energization Tests: No Load Run Test, Phase Current Balance, Voltage Balance, Vibration Level
- No Load Run Test: RTD Readings for Bearings and Stator Windings, Test Duration, Synchronous Motors, Phase Current Balance, Voltage Balance, Vibration Level, RTD Readings for Bearings and Stator Windings, Field Current, Power Factor and KVAR Control, Test Duration
- Load Run Test: Induction Motors, Verify Motor Alignment, Phase Current Balance, Voltage Balance, Vibration Level, RTD Readings for Bearings and Stator Windings, Voltage Dip on Start, Acceleration Time, Field Current, Power Factor and KVAR Control, Test Duration
- Evaluating The Results of Motor Commissioning For Acceptability or Unacceptability: Motor Commissioning Form
- Evaluating The Results of Induction Motor Commissioning: Example Evaluation
- Evaluating The Results of Synchronous Motor Commissioning: Example Evaluation
- Procedure and Acceptable Values for Evaluating The Results of Motor Commissioning Compiled from NEMA, and Established Engineering Practices: Procedure
- Acceptable Values for Pre-Energization Data: Inspection/Check of Electrical Connection/Interlocks, Inspection/Check of Mechanical Integrity, Inspection/Check of Lubrication System, Insulation Resistance Readings, Work Aid 1, Polarization Index, High Potential Test, Rotating Rectifier Diode Check, Air Gap Check, Inspection/Check of Protective Relays, Phase Rotation Test

Day 3 (Continued)

- Acceptable Values for No Load Run Test Data: Phase Current, Phase voltage, percent Voltage Unbalance, Vibration Levels, Winding Temperature, Bearing Temperature, %Ns When Excited, Exciter Field Current, Motor Field Current, Power Factor, Reactive Power
- Acceptable Values for Load Run Test Data: Inspection/Check of Motor Alignment, Phase Current, Phase Voltage, Percent Voltage Unbalance, Vibration Level, Winding Temperature, Bearing Temperature, Voltage Dip on Start (%), Acceleration Time (sec), % Ns When Excited, Exciter Field Current, Motor Field Current, Power Factor, Reactive Power (KVAR)
- Glossary

Day 4

Generator and Auxiliaries, Generator, Commissioning of Seal Oil System, Hydrogen Gas System

- Generator: Preliminary Checks of Resistance' Insulation Resistance, Ohmic Resistances, Generator Stator Winding, Generator Rotor Winding
- Seal Oil System: Equipment Inspection, Control Panels, AC Seal Oil Pump Motor Set, DC Seal Oil Pump Motor Set, Oil Injector, Induction Liquid Indicator, Seal Oil Coolers, Seal Oil Filters, Damper Tank, Differential Pressure Regulator, Pressure Oil Regulator, Exhaust Fan and Motor on The Drain Header, Exhaust Fan and Motor on Main Oil Tank, Commissioning of Seal Oil Starting Panel, Commissioning of Seal Oil Signaling Panel, Check with 200 V DC and AC Supplies, Trial Run of Seal Oil Pump Motors, DC Seal Oil Pump Motor, Trial Run of Exhaust Fans, Oil Flushing, Trial Run of AC Seal Oil Pump, Second Stage Flushing, Third Stage Flushing, Fourth Stage Flushing, Fifth Stage Flushing, Commissioning of The System

5 FULL-DAY COURSE OUTLINE

Day 4 (Continued)

- Hydrogen Gas System: Equipment Inspection, Hydrogen Manifold, Carbon Dioxide Manifold, Hydrogen Gas Drier, Hydrogen Control Panel, hydrogen Cooling Water Pumps and Motors, Hydrogen Gas Coolers, Gas System Piping and Valves, Instrument, Gas Tightness Test of Generator with Gas and Seal Oil System, Requirements, Testing of CO2 Manifold Associated Elements and Piping, Testing of Gas Analyzer, Associated Elements and Piping, Final Gas Tightness test, Trial Run of Hydrogen Cooling Water Pump Motors, Trial Run of The Pumps, Charging Hydrogen Coolers, Conclusions

Day 5

Generator Stator Water System, Rolling and Dryout of Generator, Generator Electrical Equipment, Generator Switchgear, Generator Transformer, Commissioning Reports

- Stator Water System: Equipment Inspection, Stator Water Cooling Pumps and Motors, Water Coolers, Water Filter, Magnetic Filter, Expansion Tank, Water Jet Ejector, Stator Water System Piping and Valves, Gas Trap, Instruments, Commissioning of Stator Water Starting Panel, Checks with 220 V DC and AC Supplies, Trial Run of Stator Cooling Water Pump Motor, Flushing of Stator Cooling Water System, First Stage Flushing (By pass all equipment except filters), Second Stage Flushing (Cooler B included), Third Stage Flushing (Cooling A included), Fourth Stage Flushing (Magnetic filters included), Trial Run of Stator Water Pumps (5th stage flushing), Commissioning of The System (Final run)
- Rolling and Dryout of Generator: Requirements for rolling, Requirements for Dryout, Rolling (200/210 MW Turbines) BTPS/SSTPP, Checks During Rolling, Dryout Operation, Hydrogen Filling in The Generator
- Generator Electrical Equipment: Switchyard Equipment, 400 kV Air Blast Circuit Breaker, Pantograph Isolator, Horizontal Centre-Break Isolator, Current Transformers, Capacitor Voltage Transformer, Lightning Arrestor, Earthing Switch

Day 5 (Continued)

- Generator Switchgear: Description, Tests
- Generator Transformer: Description, Tests, HT Motor, Tests, Format and Guidance for Commissioning Reports, Safety Rules Clearance Certificate, Record of Initial Operation Certificate, Procedure for The Control & Handling of Defects, Stage I: Requirements for the Issue of Safety Clearance Certificate, Requirement for the Internal Takeover Certificate, Stage IV: Internal Final Contract Certificate Up to Guarantee Period

EXPERT COURSE FACULTY

Your specialist course leader has more than 32 years of practical engineering experience with Ontario Power Generation (OPG), one of the largest electric utility in North America. He was previously involved in research on power generation equipment with Atomic Energy of Canada Limited at their Chalk River and Whiteshell Nuclear Research Laboratories.

While working at OPG, he acted as a Training Manager, Engineering Supervisor, System Responsible Engineer and Design Engineer. During the period of time, he worked as a Field Engineer and Design Engineer, he was responsible for the operation, maintenance, diagnostics, and testing of gas turbines, steam turbines, generators, motors, transformers, inverters, valves, pumps, compressors, instrumentation and control systems. Further, his responsibilities included designing, engineering, diagnosing equipment problems and recommending solutions to repair deficiencies and improve system performance, supervising engineers, setting up preventive maintenance programs, writing Operating and Design Manuals, and commissioning new equipment.

Later, he worked as the manager of a section dedicated to providing training for the staff at the power stations. The training provided by him covered in detail the various equipment and system used in power stations.

In addition, he has taught courses and seminars to more than four thousand working engineers and professionals around the world, specifically Europe and North America. He has been consistently ranked as "Excellent" or "Very Good" by the delegates who attended his seminars and lectures.

He written 5 books for working engineers from which 3 have been published by McGraw-Hill, New York. Below is a list of the books authored by him;

- Power Generation Handbook: Gas Turbines, Steam Power Plants, Co-generation, and Combined Cycles, second edition, (800 pages), McGraw-Hill, New York, October 2011.
- Electrical Equipment Handbook (600 pages), McGraw-Hill, New York, March 2003.
- Power Plant Equipment Operation and Maintenance Guide (800 pages), McGraw-Hill, New York, January 2012.
- Industrial Instrumentation and Modern Control Systems (400 pages), Custom Publishing, University of Toronto, University of Toronto Custom Publishing (1999).
- Industrial Equipment (600 pages), Custom Publishing, University of Toronto, University of Toronto, University of Toronto Custom Publishing (1999).

Furthermore, he has received the following awards:

- The first "Excellence in Teaching" award offered by PowerEdge, Singapore, in December 2016
- The first "Excellence in Teaching" award offered by the Professional Development Center at University of Toronto (May, 1996).
- The "Excellence in Teaching Award" in April 2007 offered by TUV Akademie (TUV Akademie is one of the largest Professional Development centre in world, it is based in Germany and the United Arab Emirates, and provides engineering training to engineers and managers across Europe and the Middle East).
- Awarded graduation "With Distinction" from Dalhousie University when completed Bachelor of Engineering degree (1983).

Lastly, he was awarded his Bachelor of Engineering Degree "with distinction" from Dalhousie University, Halifax, Nova Scotia, Canada. He also received a Master of Applied Science in Engineering (M.A.Sc.) from the University of Ottawa, Canada. He is also a member of the Association of Professional Engineers in the province of Ontario, Canada.

IN-HOUSE TRAINING SOLUTIONS

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- Programme and curriculum development refinement
- Strategic evaluation process to validate learnings' achieved with ROI
- Targeted and focused re-enforcement to ensure knowledge transfer

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OTHER RELATED TRAINING YOU CAN ATTEND:

Introduction to Power Systems

Maintenance of Steam and Gas Turbines: Diagnostic Testing, Troubleshooting, Maintenance, and Features Enhancing the Reliability and Maintainability of Steam and Gas Turbines

Industrial Instrumentation and Modern Control Systems

Design of Circulating Fluidized Bed Boilers

Commissioning and Start-up Activities of Coal Power Plants

Steam Turbine Technology: Selection, Applications, Operation, Inspection, Diagnostic Testing, Maintenance, Refurbishment, Performance Monitoring, Rotor Dynamic Analysis, and Computer Simulation of Steam Turbine Rotor Dynamics

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COMMISSIONING OF ELECTRICAL EQUIPMENT

REGISTRATION FORM

Name: _____ Job Title: _____ Department: _____
Telephone: _____ Email Address: _____
Preferred Course & Date: _____

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Telephone: _____ Email Address: _____
Preferred Course & Date: _____

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Telephone: _____ Email Address: _____
Preferred Course & Date: _____

Name: _____ Job Title: _____ Department: _____
Telephone: _____ Email Address: _____
Preferred Course & Date: _____

COMPANY DETAILS

Organization Name: _____ Industry: _____
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PAYMENT METHODS & POLICY

By cheque / bank draft: Only local cheque will be acceptable and cheque payable to Asia Edge Pte Ltd. Kindly ensure that your cheque is crossed 'Not Negotiable' and 'Account Payee Only'.

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Company UEN: 200710561C

By telegraphic transfer: Please quote the invoice number on the remittance advice.
Account name: Asia Edge Pte Ltd
Bank code: 7339 Branch code: 508 Account no: 508-762903-001 (SGD)
Bank code: 7339 Branch code: 665 Account no: 665-000774-301 (USD)
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Bank address: 65 Chulia Street OCBC Centre, Singapore 049513

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Payment is due in full at the time of registration. Full payment is mandatory for event attendee. By submitting this registration form, you have agreed to Asia Edge Pte Ltd's payment terms payment term mentioned.

* GST - exclusive price is only applicable for overseas corporate customers, subject to qualifying conditions.

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You may substitute delegates at any time before the event starts. Asia Edge Pte Ltd does not provide refunds for last minute cancellations. For cancellations received in writing more than 7 days or less prior to an event (including day 7), no credits will be issued.

In the event Asia Edge Pte Ltd cancels an event, delegate payments at the date of cancellation will be credited to a future Asia Edge Pte Ltd event. This credit will be available for up to 1 year from the date of issuance.

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