

SGD 4958 for
2
Participants
or More

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

26 – 30 NOVEMBER 2018, KUALA LUMPUR, MALAYSIA

Testimonials from Past Participants

“One of the best training seminar I have ever attended. The trainer is very well versed with the subject of topics covered, and very engaging throughout the whole course.” - Head of Electrical, Hengyuan Refining Company Berhad

“A very informative and useful course and a great refresher on the basics of electrical. Very enjoyable and the knowledge given is easily absorbed and easily understood.” - Commissioning Engineer, MISC Bhd

“The trainer gave detailed explanation on commissioning/testing method especially on transformer which I will definitely practice at work.” - Project Manager, Sarawak Energy Berhad

“Very informative course and well prepared, with a well versed trainer.” - Engineer, Tenaga Nasional Berhad

Expert Course Faculty Leader

The trainer has more than 32 years of practical engineering experience with Ontario Power Generation as an Engineering Supervisor and Training Manager, has conducted courses and seminars, to more than 4,000 working engineers and professionals who consistently ranked him as "Excellent" or "Very Good". He has also written 5 books for working engineers from which three have been published by McGraw-Hill, New York.

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Course Overview

This seminar 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 seminar. 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 seminar 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 seminar. 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 seminar 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 seminar 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 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

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.

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Who Should Attend

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

About Our Expert Course Trainer

The trainer has been a teacher at University of Toronto and Dalhousie University, Canada for more than 25 years. 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.

The trainer wrote 5 books for working engineers from which three have been published by McGraw-Hill, New York. Below is a list of the books authored by him:

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

The trainer has received the following awards:

1. The first "Excellence in Teaching" award offered by Poweredge Asia Training center, Singapore, December 2016
2. The first "Excellence in Teaching" award offered by the Professional Development Center at University of Toronto (May, 1996).
3. 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).
4. Awarded graduation "With Distinction" from Dalhousie University when completed Bachelor of Engineering degree (1983).
5. Entrance Scholarship to University of Ottawa (1984).
6. Natural Science and Engineering Research Counsel (NSERC) scholarship towards graduate studies – Master of Applied Science in Engineering (1984 – 1985).

The trainer performed research on power generation equipment with Atomic Energy of Canada Limited at their Chalk River and Whiteshell Nuclear Research Laboratories. He also has more than 32 years of practical engineering experience with Ontario Power Generation (OPG - formerly, Ontario Hydro - the largest electric utility in North America). He retired from OPG in November 2016.

While working at Ontario Hydro, he acted as a Training Manager, Engineering Supervisor, System Responsible Engineer and Design Engineer. During the period of time that the trainer 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 systems used in power stations.

The trainer 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.

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5 Day Course Outline

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

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

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- 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
- Acceptable Values for No Load Run Test Data: Phase Current, Phase voltage, percent Voltage Unbalance, Vibration Levels, Winding Temperature, Bearing Temperature, %N_s 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), % N_s 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

- 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
- 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

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	PER PARTICIPANT	2 PARTICIPANTS OR MORE	IN-HOUSE TRAINING
5 Day Programme	SGD 5,158 Per Participant	SGD 4,958 Per Participant	Guaranteed Minimum 40% Off Normal Price

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