ELECTRICAL GENERATORS, EXCITATION SYSTEMS, AND GOVERNING SYSTEMS

Selection, Applications, Operation, Diagnostic Testing, Troubleshooting, Maintenance, and Refurbishment
11 – 15 DECEMBER 2017, KUALA LUMPUR, MALAYSIA

Expert Course Faculty Leader

Philip Kiameh

Has more than 30 years of practical engineering experience with Ontario Power Generation and as a Training Manager, has conduct courses and seminars, to more than 4,000 working engineers and professionals who consistently ranked him as "Excellent" or "Very Good". Philip has also wrote 5 books for working engineers from which three have been published by McGraw-Hill, New York.

Topics Covered

Synchronous Generators, Generator Stator and Rotor Construction

Generator Components, Auxiliaries and Excitation

Generator Main Connections, Generator Surveillance and Testing, Advanced Methods for Preventing Partial Discharge, Performance and Operation of Generators

Generator Inspection and Maintenance, Generator Rotor Reliability and Life Expectancy

SGD 4400 for 2 Participants or More
Introduction
This seminar will provide a comprehensive understanding of the various types of generators, exciters, automatic voltage regulators (AVR’s), governing systems, and protective systems. This seminar will focus on maximizing the efficiency, reliability, and longevity of this equipment by providing an understanding of the characteristics, selection criteria, common problems and repair techniques, preventive and predictive maintenance. The emphasis in this seminar is on inspection methods, diagnostic testing, troubleshooting, modern maintenance techniques, refurbishment, rewind and upgrade options, and advanced methods for preventing partial discharge and other failures.

This seminar is a MUST for anyone who is involved in the selection, applications, or maintenance of generators, exciters, automatic voltage regulators (AVR’s), and protective systems because it covers how this equipment operates, the latest maintenance techniques, and provides guidelines and rules that ensure the successful operation of this equipment. In addition, this seminar will cover in detail the basic design, operating characteristics, specification, selection criteria, advanced fault detection techniques, critical components and all preventive and predictive maintenance methods in order to increase reliability of the equipment and reduce the operation and maintenance cost.

This seminar will provide the following information for all types of generators, exciters, automatic voltage regulators (AVR’s), and protective systems:

- Basic Design
- Specification
- Selection Criteria
- Sizing Calculations
- Enclosures and Sealing Arrangements
- Codes and Standards
- Common Operational Problems
- All Diagnostics, Troubleshooting, Testing, and Maintenance

Seminar Outcomes

- **Equipment Operation**: Gain a thorough understanding of the operating characteristics of generators, exciters, automatic voltage regulators (AVR’s), and protective systems
- **Equipment Diagnostics and Inspection**: Learn in detail all the diagnostic techniques and inspections required of critical components of generators, exciters, automatic voltage regulators (AVR’s), and protective systems
- **Equipment Testing**: Understand thoroughly all the tests required for the various types of generators, exciters, automatic voltage regulators (AVR’s), and protective systems
- **Equipment Maintenance and Troubleshooting**: Determine all the maintenance and troubleshooting activities required to minimize the downtime and operating cost of generators, exciters, automatic voltage regulators (AVR’s), and protective systems
- **Equipment Repair and Refurbishment**: Gain a detailed understanding of the various methods used to repair and refurbish generators, exciters, automatic voltage regulators (AVR’s), and protective systems
- **Equipment Rewind and Upgrade Options**: Discover all options available to rewind and upgrade the generator rotor and stator to enhance the output and reduce downtime
- **Efficiency, Reliability, and Longevity**: Learn the various methods used to maximize the efficiency, reliability, and longevity of generators, exciters, automatic voltage regulators (AVR’s), and protective systems
- **Advanced Methods to Prevent Failure**: Gain a thorough understanding of all the methods used to prevent partial discharge, and other failures in generators, exciters, automatic voltage regulators (AVR’s), and protective systems
- **Equipment Sizing**: Gain a detailed understanding of all the calculations and sizing techniques used for generators, exciters, automatic voltage regulators (AVR’s), and protective systems
**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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This training course has a limited attendance for up to 20 participants only.

Sessions commence at 9am on all days, with short intervals at 10.30am and 3.30pm respectively. Refreshments will be provided in the short intervals. Lunch will be provided at 12:30pm for 1 hour. Sessions will end at 5pm on all days.
Your Expert Faculty

Philip Kiameh, M.A.Sc., B.Eng., D.Eng., P.Eng. (Canada) has been a teacher at University of Toronto and Dalhousie University, Canada for more than 25 years. In addition, Prof Kiameh has taught courses and seminars to more than four thousand working engineers and professionals around the world, specifically Europe and North America. Prof Kiameh has been consistently ranked as "Excellent" or "Very Good" by the delegates who attended his seminars and lectures.

Prof Kiameh 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 Prof Kiameh:


Prof. Kiameh has received the following awards:
1. The first "Excellence in Teaching" award offered by Poweredge Pte Ltd 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).

Prof. Kiameh 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). Prof. Kiameh retired from OPG in November 2016.

While working at Ontario Hydro, Prof. Kiameh acted as a Training Manager, Engineering Supervisor, System Responsible Engineer and Design Engineer. During the period of time that Prof Kiameh 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, Prof Kiameh worked as the manager of a section dedicated to providing training for the staff at the power stations. The training provided by Prof Kiameh covered in detail the various equipment and systems used in power stations.

Professor Philip Kiameh 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.
Day 1 – Synchronous Generators, Generator Stator and Rotor Construction

- Synchronous machines, physical description, pole pitch: electrical degrees, synchronous machine windings, field excitation, rotating rectifier excitation, series excitation, no-load and short-circuit values, torque tests, speed-torque characteristic, excitation of a synchronous machine, machine losses
- Synchronous generators, construction, speed of rotation of a synchronous generator, equivalent circuit of a synchronous generator, power and torque in a synchronous generator, synchronous generator operating alone, parallel operation of ac generators, frequency-power and voltage-reactive power characteristics, synchronous generator ratings, synchronous generator capability curves, short-time operation and service factor
- Generator stator construction, stator windings, stator insulation, forces on stator windings, stator endwinding support structure, generator rotor construction, rotor windings, rotor insulation, retaining rings, rotor endwinding structure

Day 2 – Generator Components, Auxiliaries and Excitation

- Generator components, auxiliaries and excitation, the rotor, rotor windings, rotor end rings, wedges and dampers, sliprings, brushgear and shaft grounding, fans, rotor and threading alignment, vibration, bearings and seals
- The stator, stator core, core frame, stator windings, end winding support, electrical connections and terminals, stator winding cooling components, hydrogen cooling components, stator casing
- Cooling systems, hydrogen cooling, hydrogen cooling systems, shaft seals and seal oil systems, thrust-type seal, journal-type seal, stator winding water cooling systems
- Excitation, AC excitation systems, exciter transient performance, pilot exciter, main exciter, exciter performance testing, pilot exciter protection, brushless excitation systems, rotating armature main exciter
- The voltage regulator, power system stabilizer, characteristics of generator exciter power systems (GEP), generator operation
- Governing Systems, Governor characteristics, subsidiary functions, acceleration feedback, unloading gear, governor speed reference, closed-loop control of turbine electrical load, overspeed testing, automatic run-up and loading systems, electronic governing, reheat relief valves, hydraulic fluid system, filtration

Day 3 – Generator Main Connections, Generator Surveillance and Testing, Advanced Methods for Preventing Partial Discharge, Performance and Operation of Generators

- Generator main connections, isolated phase bus bar circulatory currents, system description
- Inspection practices and methodology, site preparation, foreign material exclusion, experience and training, safety procedures – electrical clearances, inspection frequency, generator accessibility, inspection tools, inspection forms
- Generator surveillance and testing, generator operational checks (surveillance and monitoring), generator diagnostic testing, insulation resistance and polarization index, dc hipot test, ac tests for stator windings, synchronous machine rotor windings, partial discharge tests, mechanical tests
- Advanced methods for protecting the generator stator bars from partial discharge, causes of partial discharge, controlling partial discharge using antimony-doped tin oxide filler material, advanced methods for Preventing partial discharge in generator stator bars, modern US patents for preventing partial discharge
- Generator systems, condition monitoring, operation limitations, fault conditions

Day 4 – Generator Inspection and Maintenance, Generator Rotor Reliability and Life Expectancy

- Generator inspection and maintenance, on-load maintenance and monitoring, off-load maintenance, generator testing
- Generator operational problems, and refurbishment options, typical generator operational problems
- Generator rotor reliability and life expectancy, generator rotor refurbishment, generator rotor modifications, upgrades, and uprates

Day 5 – Generator Upgrades and Rewinds, Double Feed Generators, Power Station Electrical Systems and Design Requirements, Power Station Protective Systems, Frequently Asked Questions

- Generator upgrades and rewinds, rewinding for increased reliability, rewinding for increased output or efficiency, stator windings, rotor windings, impact on other components
- Stator windings, slot support system, end winding support, asphalt conversions, emergency situations, complete rewind, partial rewind, repair of bars, stator winding insulation, stator winding quality
- Field rewinds, overall design approach, component design, additional field considerations, field coil slot wedges, retaining rings, collector rings and bore copper, field winding quality, spare rotor
- Other generator equipment and auxiliaries, excitation equipment, removable cartridge brush holders, coolers, control cabinets, babbitted hydrogen seals, generator gas monitoring system and tagging compounds, air gap flux probe, shaft voltage monitor
- Double-feed generators, system configuration, equivalent circuit for the brushless double-fed machine, parameter extraction, generator operation, converter rating, machine control
- Bearings and Lubrication, Types of bearings, ball and roller bearings, thrust bearings, lubrication, viscosity of lubricants, greases, VI improved oils
- Used oil analysis, test description and significance, visual and sensory inspection, chemical and physical tests
- Vibration analysis, resonance, vibration instrumentation, vibration analysis, vibration causes, vibration severity
- Power station electrical systems, and design requirements, system requirements, electrical system description, system performance, unit start-up, synchronization, shutdown and power trip, power plant outages and faults, uninterruptible power supply systems, dc systems
- Power station protective systems, design criteria, generator protection, dc tripping systems
- Frequently asked questions

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| By Cheque  
Bank Draft: Make Payable to PowerEdge Pte Ltd.  
Account Name: PowerEdge Pte Ltd.  
Bank Address: 65 Chulia Street OCBC Centre, Singapore 049513  
All bank charges and payment in Singapore dollars (SGD) to be borne by payer. Please ensure that PowerEdge Pte Ltd receive the full invoiced amount. |

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