

SGD 2643 for
2
Participants
or More

UNINTERRUPTIBLE POWER SYSTEMS (UPS'S), **VARIABLE FREQUENCY DRIVES (VFD'S), AND INDUSTRIAL BATTERIES:**

Selection, Applications, Operation, Sizing, Diagnostic Testing, Troubleshooting, and Maintenance

26 – 27 MARCH 2018, KUALA LUMPUR, MALAYSIA

TOPICS COVERED

Power Electronics

Rectifiers and Pulse-Width Modulation Inverters

Variable Frequency Drives (VFD's)

Uninterruptible Power Systems (UPS's) Design

UPS Topologies for Large Critical Power Systems

Uninterruptible Power Systems (UPS's) Sizing

Troubleshooting and Maintenance of Industrial Batteries

Expert Course Faculty Leader



Philip Kiameh

Has more than 32 years of practical engineering experience with Ontario Power Generation and as a 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". Philip has also written 5 books for working engineers from which three have been published by McGraw-Hill, New York.

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Introduction

This seminar will provide a comprehensive understanding of the various types of uninterruptible power systems (UPS's), inverters, rectifiers, variable frequency drives (VFD's), and industrial batteries. This seminar will focus on maximizing the efficiency, reliability, and longevity of this type equipment by providing an understanding of the characteristics, selection criteria, common problems and repair techniques, preventive and predictive maintenance.

This seminar is a MUST for anyone who is involved in the selection, applications, or maintenance of uninterruptible power systems (UPS's), inverters, rectifiers, variable frequency drives (VFD's), and industrial batteries 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 uninterruptible power systems (UPS's), inverters, rectifiers, variable frequency drives (VFD's), and industrial batteries:

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

Who Should Attend

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

Seminar Outcome

- **Equipment Operation:** Gain a thorough understanding of the operating characteristics of uninterruptible power systems (UPS's), inverters, rectifiers, variable frequency drives (VFD's), and industrial batteries
- **Equipment Diagnostics and Inspection:** Learn in detail all the diagnostic techniques and inspections required of critical components of uninterruptible power systems (UPS's), inverters, rectifiers, variable frequency drives (VFD's), and industrial batteries
- **Equipment Testing:** Understand thoroughly all the tests required for the various types of uninterruptible power systems (UPS's), inverters, rectifiers, variable frequency drives (VFD's), and industrial batteries
- **Equipment Maintenance and Troubleshooting:** Determine all the maintenance and troubleshooting activities required to minimize the downtime and operating cost of uninterruptible power systems (UPS's), inverters, rectifiers, variable frequency drives (VFD's), and industrial batteries
- **Equipment Repair and Refurbishment:** Gain a detailed understanding of the various methods used to repair and refurbish uninterruptible power systems (UPS's), inverters, rectifiers, variable frequency drives (VFD's), and industrial batteries

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- **Efficiency, Reliability, and Longevity:** Learn the various methods used to maximize the efficiency, reliability, and longevity of uninterruptible power systems (UPS's), inverters, rectifiers, variable frequency drives (VFD's), and industrial batteries
- **Equipment Sizing:** Gain a detailed understanding of all the calculations and sizing techniques used for uninterruptible power systems (UPS's), inverters, rectifiers, variable frequency drives (VFD's), and industrial batteries
- **Design Features:** Understand all the design features that improve the efficiency and reliability of uninterruptible power systems (UPS's), inverters, rectifiers, variable frequency drives (VFD's), and industrial batteries
- **Equipment Selection:** Learn how to select uninterruptible power systems (UPS's), inverters, rectifiers, variable frequency drives (VFD's), and industrial batteries by using the performance characteristics and selection criteria that you will learn in this seminar
- **Equipment Enclosures and Sealing Methods** Learn about the various types of enclosures and sealing arrangements used for uninterruptible power systems (UPS's), inverters, rectifiers, variable frequency drives (VFD's), and industrial batteries
- **Equipment Commissioning:** Understand all the commissioning requirements for uninterruptible power systems (UPS's), inverters, rectifiers, variable frequency drives (VFD's), and industrial batteries
- **Equipment Codes and Standards:** Learn all the codes and standards applicable for uninterruptible power systems (UPS's), inverters, rectifiers, variable frequency drives (VFD's), and industrial batteries
- **Equipment Causes and Modes of Failure:** Understand the causes and modes of failure of uninterruptible power systems (UPS's), inverters, rectifiers, variable frequency drives (VFD's), and industrial batteries
- **System Design:** Learn all the requirements for designing different types of uninterruptible power systems (UPS's), inverters, rectifiers, variable frequency drives (VFD's), and industrial batteries

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.

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.

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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:

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).

Prof. Kiameh 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).

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.

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2 Day Course Outline

Day 1 – Power Electronics, Rectifiers and Pulse-Width Modulation Inverters, Variable Frequency Drives (VFD's), Uninterruptible Power Systems (UPS's) Design, Equipment, Operation, Efficiency, Specifications, Modularity, Response to Power Quality Events, Monitoring, Testing, High-Efficiency Designs, UPS Topologies for Large Critical Power Systems, Smart UPS's

- Power electronics components, Insulated Gate Bipolar Transistor (IGBT), basic rectifier circuits, filtering rectifier output, pulse circuits, inverters, pulse-width modulated (PWM) inverters
- Variable Frequency Drives (VFD's), basic principles of AC variable Frequency (speed) drives (VSD's), inverters, parts of an inverter, pulse-width modulated inverters, input power converter (rectifier), DC link energy, output IGBT inverter, input sources for regeneration or dynamic slowdown, dynamic breaking, regeneration, PWM-2 considerations
- Transients, harmonics power factor and failures, thyristor failures and testing, AC drive application issues, AC power factor, AC input power changes with AC input voltage, IGBT switching transients, insulation voltage stress, motor winding voltage distribution, radiated electromagnetic interferences (EMI), cable terminating (matching) impedance, inverter output filter
- Cabling details for AC drives, motor, cable, and power system grounding, motor bearing currents, motor shaft grounding brush, reduce the stator to rotor capacitance value, use conductive grease in motor bearings, motor cable wiring practices
- Summary of application rules for AC drives, selection criteria of VSD's, variable process speed, compressors and pumps, motor starting.
- Regeneration, dynamometer, paper machine winder, dynamic breaking, maintenance, common failure modes, motor application guidelines
- UPS operation, mission time, standards, voltage regulation, harmonic distortion, soft-start, overload rating, advanced UPS design, output contactor, battery protection, efficiency, power factor derating, environmental conditions
- Input power converter (rectifier), inverter, static bypass, display and controls, battery disconnect breaker, battery system, maintenance bypass cabinet (MBC)
- Intersystem synchronization, parallel operation, unattended shutdown, remote UPS monitoring, software compatibility, factory inspection, testing of UPS, steady-state performance tests, dynamic performance tests, isolation tests, reliability tests
- UPS High-Efficiency Designs, UPS efficiency curve, no-load losses, proportional losses, square-law losses, Eco-mode, UPS topology, modularity, quantifying the effect of topology and modularity, economic advantage of high-efficiency UPS designs
- UPS Specifications, common mistakes made in UPS specifications
- Smart UPS's features, equipment, advantages, operation

- UPS topologies, Double-conversion topology, Delta Conversion topology, Rotary T UPS topology, passive standby
- UPS response to power quality events, line frequency variations, input voltage unbalance and single phasing, voltage waveform distortion at input, input switch commutation time, ITI (CBEMA) compliance of UPS topologies, tradeoff analysis

Day 2 – Uninterruptible Power Systems (UPS's) Sizing, Configurations, Regulations and Code Requirements, Options, Communication, Evaluation Parameters, Protection, Reliability, Installation, Commissioning, Maintenance, Power Problems, Disturbances, UPS Batteries, Troubleshooting and Maintenance of Industrial Batteries

- Commissioning of UPS, maintenance contracts, UPS maintenance, battery maintenance, UPS sizing, battery sizing, battery selection, space vector modulation technology, electromagnetic and radio frequency interference
- Power problems, disturbances in distribution system-power, requirements of sensitive loads, costs incurred by the quality of electrical power
- Solutions to power problems, in-built protection, filters, isolating transformers, voltage regulators, direct current power supplies, rotary solutions, static uninterruptible power systems
- UPS Regulations, UPS code requirements, Technical standards, safety, electromagnetic compatibility, performances, other standards, quality system certification
- UPS configurations, UPS double conversion operation, UPS double conversion operation with bypass, UPS line interactive operation
- Evaluation parameters, UPS electrical sizing, efficiency, input current harmonics, noise, dimensions and ease of maintenance, degree of protection, reliability parameters, batteries technology, UPS specifications
- UPS communication, local communication, remote communication
- UPS options, galvanic isolation transformer, additional autotransformer, solutions for input harmonic current reduction, other options
- Installation guidelines for medium and large UPS, power systems, circuit protection devices, branch circuit protection and discrimination, UPS output current limiting, neutral cable sizing, isolation of neutral, standby-generators, battery installation, UPS remote shutdown, UPS communication ports, non-linear loads
- Maintenance and services, mandatory service, pre-sale support, installation, commissioning, after-sales support, telemaintenance, customer training, services provided by manufacturers
- Discharge voltage characteristics, battery life, lead-acid batteries, installation and operation, placing the battery in service, charging the battery
- Modified constant-voltage method, taper method, two-rate method, constant-current method, maintenance, prevention of over-discharging, determination of battery condition, troubleshooting, repairs and maintenance of batteries
- Power station electrical systems and design requirements, safety requirements, shutdown and power trip, power plant outages and faults, UPS systems, DC systems

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	PER PARTICIPANT	2 PARTICIPANTS OR MORE	IN-HOUSE TRAINING
2 Day Programme	SGD 2,843 Per Participant	SGD 2,643 Per Participant	Guaranteed Minimum 40% Off Normal Price

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