THERMAL POWER PLANT PERFORMANCE TESTING

Major Equipment Performance Testing, Boilers, Turbines, Condensers, Pumps, Fans, Test Methodology and Code Requirements, Equipment Efficiency, Heat Rate Calculations, Correction Factors

30 JULY – 1 AUGUST 2018, KUALA LUMPUR, MALAYSIA

Topics Covered

- Thermal Plant Performance Testing
- Performance Test Methodology and Code Requirements
- Performance Test Preparatory Work and Instrumentation
- Equipment Efficiency Calculations
- Calculating the Heat Rate of CFB and Pulverized Coal Boiler Power Plants
- Benefits of Lowering Heat Rate

Expert Course Faculty Leader

Philip Kiameh

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". Philip has also written 5 books for working engineers from which three have been published by McGraw-Hill, New York.
THERMAL POWER PLANT PERFORMANCE TESTING
30 JULY – 01 AUGUST 2018, KUALA LUMPUR, MALAYSIA

Course Overview
This seminar provides detailed description of all the performance testing methods for all thermal power plant equipment including boilers, turbines, condensers, pumps, fans, deaerators, and feedwater heaters. The methodology, and code requirements for the performance tests for all thermal power plant equipment will be covered thoroughly in this seminar. The preparatory work and instrumentation required for each test will be described in detail in this seminar. The efficiency calculations for all the equipment used in circulating fluidized-bed (CFB) boiler and pulverized coal boiler power plants will be covered in-depth in this seminar. All the processes, operational and maintenance activities, capital projects, technical options, potential initiatives and incentives to implement upgrades/repairs for increasing the power plant equipment efficiency will also be covered in detail. This seminar will also provide a thorough explanation of CFB and pulverized coal boiler technology including hydrodynamics, combustion, emissions, design considerations, gas-solid separators, design of CFB and pulverized coal boiler components, management of solid residues, materials, stoichiometric calculations, and model for sulfur capture. The operation, maintenance, testing, and refurbishment options of all the equipment and systems used in CFB and pulverized coal power plants will be covered in detail including, boilers, superheaters, reheaters, turbines, condensers, feedwater heaters, deaerators, pumps, compressors, fans, electric generators, instrumentation and control systems, and governing systems, etc. All the factors which affect CFB and pulverized coal boiler power plant efficiency and emissions will be explained thoroughly. All the methods used to calculate the heat rate of CFB and pulverized coal power plants will be covered in detail. All the areas in CFB and pulverized coal boiler power plants where efficiency loss can occur will be explained. This seminar will also provide up-dated information in respect to the following methods used to improve CFB boiler and pulverized coal boiler power plant heat rate:

- Optimizing the Combustion Process and Sootblowing
- Controlling the Steam Temperature
- Recovering Moisture from Boiler Flue Gas
- Performing Steam Turbine Maintenance
- Lowering Condenser Back Pressure
- Pre-drying High Moisture Coal and Reducing Stack Temperature

Course Learning Outcomes

- Thermal Plant Performance Testing: Gain a thorough understanding of all the performance testing methods for all thermal power plant equipment including boilers, turbines, condensers, pumps, fans, deaerators, and feedwater heaters.
- Performance Test Methodology and Code Requirements: Understand the methodology, and code requirements for the performance tests of all thermal power plant equipment
- Performance Test Preparatory Work and Instrumentation: Learn about the preparatory work and instrumentation required for each equipment performance test in a thermal power plant
- Equipment Efficiency Calculations: Gain a thorough understanding of the efficiency calculations for all the equipment used in circulating fluidized-bed (CFB) boilers and pulverized coal boilers power plants
- Calculating the Heat Rate of CFB and Pulverized Coal Boiler Power Plants: Learn all the methods used to calculate the heat rate of CFB and pulverized coal boiler power plants
- Benefits of Lowering the Heat Rate of CFB and Pulverized Coal Boiler Power Plants: Understand all the benefits of lowering the heat rate of circulating fluidized-bed boiler coal power plants
- Methods Used to Improve CFB and Pulverized Coal Boiler Power Plants Heat Rate: Gain a thorough understanding of all the methods used to improve the heat rate of CFB and pulverized boiler coal power plants
- Processes, Operational and Maintenance Activities in CFB and Pulverized Coal Boiler Power Plants: Discover all the processes, operational and maintenance activities used to improve the heat rate of CFB and pulverized coal power plants
- Capital Projects Used to Improve the Heat Rate of CFB and Pulverized Coal Boiler Power Plants: Learn about all the capital projects used to improve the heat rate of CFB and pulverized coal power plants
- Technical Options for Improving the Heat Rate of CFB and Pulverized Coal Boiler Power Plants: Understand all the technical options used to improve the heat rate of CFB and pulverized coal boiler power plants
- Potential Initiatives and Incentives to Implement Upgrades/Repairs for Improving the Heat Rate of CFB and Pulverized Coal Bed Boiler Power Plants: Discover all the potential initiatives and incentives to implement upgrades/repairs for improving the heat rate of CFB and pulverized coal power plants
Factors Affecting CFB and Pulverized Coal Boiler Power Plants Efficiency and Emissions: Learn about all the factors which affect CFB and pulverized coal boiler power plants efficiency and emissions

Areas in CFB and Pulverized Coal Power Plants where Efficiency Loss Can Occur: Discover all the areas in CFB and pulverized coal power plants where efficiency loss can occur

Optimize the Operation of CFB and Pulverized Coal Power Plant Equipment and Systems to Improve the Plant Heat Rate: Understand all the techniques and methods used to optimize the operation of CFB and pulverized coal power plant equipment and systems to improve the plant heat rate

CFB and Pulverized Coal Power Plant Equipment and Systems: Learn about various types of CFB and pulverized coal power plant equipment and systems including: boilers, superheaters, reheaters, steam turbines, governing systems, deaerators, feedwater heaters, coal-handling equipment, transformers, generators and auxiliaries

Who Should Attend

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

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:

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).
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.
3 Day Course Outline

- Steam Power Plants
- Efficiency and Heat Rate
- Supercritical Plants
- Superheaters and Reheaters
- Economizers
- Steam Generator Control
- Feedwater-Level Control
- Steam-Pressure Control
- Steam-Temperature Control
- Turbine components
- Turbine controls
- Testing of Turbine blades
- Quality Assurance of Turbine Generator Components
- Assembly and testing of turbine components
- Turbine Types
- Turbine Control Systems
- Steam Turbine Maintenance
- Steam Generators, Heat Exchangers, and Condensers
- Power Station Performance Monitoring
- The Turbine Governing Systems
- Steam Chests and Valves
- Turbine Protective Devices
- Turbine Instrumentation
- Determine the boiler efficiency
- Combustion efficiency
- Fuel-To-Steam or Fuel-to-Water Efficiency
- ASME Power Test Code, PTC 4
- Fuel-to-steam efficiency
- Input-output method
- Heat Loss method
- Standard BTS-2000 test conditions

- Steam Turbine Performance Testing
- ASME PTC 6 Test (steam turbine testing)
- ASME PTC 6 Report
- ASME PTC 6.1 (alternative steam turbine test)
- ASME PTC 6S (Routine Performance Testing)
- DIN-1943 (steam turbine testing with allowances for measurement uncertainty, aging, etc)
- CIE/IEC 953-1 (steam turbine testing code)
- CIE/IEC 953-2 (steam turbine testing code)
- Station Instrument Testing
- Condenser Performance Test
- Thermal Performance Analysis of Variable Conditions in a Steam Power Plant
- Factors Affecting the Condenser Performance
- Condenser Overall Heat Transfer Coefficient
- Heat Transfer Society (HEI) formula
- Condenser Cleanliness Coefficients
- Condenser Correction Pressure
- Condenser Thermal Performance Analyses of Variable Conditions
- Boiler Feed Pump (BFP) Performance Assessment
- BFP Performance Testing
- Affinity Laws
- BFP Design Curves
- Pump Suction Head Calculation
- Suction Water Leg Correction
- Pump Discharge Head Calculation
- Water Density at Discharge Conditions, \( \rho_d \)
- Discharge Water Leg Correction, \( Z_d \)
- Velocity at Pump Discharge, \( V_d \)
- Total Dynamic Head Developed Calculation
- BFP Efficiency Calculation
- Performance Assessment of Forced Draft and Induced Draft Fans
- Purpose of the Performance Test
- Performance Tests Terms and Definitions
- Performance Standards
- British Standard, BS848
- Field Testing
- Instruction for Site Testing
- Location of Measurement Planes
- Location of The Flow Measurement Plane within the “Test length”
- Location of Pressure Measurement Plane
- Transverse Readings, Anemometer, Determination of Fan Pressure, Measurement of Static Pressure

- Major Components of Coal Fired Power Plants
- Coal Fired Power Plant Performance
- Coal Fired Power Plant boiler hydrodynamics, combustion, emissions, design considerations, gas-solid separators
- Design for Boiler Components and Management of Solid Residues in Coal Fired Power Plants
- Materials, Characteristics of Solid Particles, Stoichiometric Calculations and Model for Sulfur Capture in Coal Fired Power Plant Boilers
- Net Power Generation Capacity
- Steam Cycle Heat Rate
- Design Parameters that Affect the Steam Cycle Heat Rate
- Boiler (Steam Generator) Efficiency
- Flue Gas Exit Temperature
- Flue Gas Desulfurization (FGD) Systems
- Environmental Issues Related with Coal Based Energy Conversion
- Air Pollution
- Environmental Control Systems
- Control Technologies for SO\textsubscript{x}, NO\textsubscript{x}, and Particulates
- Electrostatic Precipitators (ESP\textquotesingle)s
- Ash and Flue Gas Desulfurization (FGD) Sludge Disposal Systems
- Differences in Reported Efficiency Values
- Energy and Efficiency Losses
- Impact of Condenser-Operating Conditions on Efficiency
- Heat and Power Equivalence
- Efficiency Performance Assessment Periods

- Efficiency Standards and Monitoring
- Reporting Bases for Whole Plant efficiency
- International Energy Agency (IEA) Recommendations for Improving the Heat Rate in Coal Power Plants
- Calculating Heat Rate of Coal Fired Power Plants
- Benefits of Lowering the Heat Rate of Coal Fired Power Plants
- Efficiency and Systems of Coal Fired Power Plants
- Areas of a Coal Plant where Efficiency Loss Can Occur
- Assessing the Range and Applicability of Coal Power Plant Heat Rate Improvements
- Coal Power Plant Heat Rate Improvement – Methodologies, Capital and Maintenance Projects
- Coal Power Plant Heat Rate Improvement – Common Recommendations
- Fuel Savings and CO\textsubscript{2} Benefits
- Coal Power Plant Heat Rate Improvement – Fleetwide Assessment Case Study
- Steam Turbine Steam Path Modifications
- Coal Power Plant Heat Rate Improvement Program Guidelines
- Realized and Projected Heat Rate Improvements
- Efficiency Improvements to Reduce Greenhouse Gases (GHG)
- Existing Coal Power Plants Efficiency Improvements
- Key Technical Opportunities to Increase Thermal Efficiency
- Processes for Increasing the Plant Efficiency
- Operational and Maintenance Activities Used to Increase the Plant efficiency
- Capital Projects Used to Increase the Plant Efficiency
- Framework for Measuring and Sustaining Improvements
- Incentives for Existing Fleet to Implement Upgrades/Repairs for Increasing Plant
- Efficiency
- Improve the Heat Rate by Optimizing the Combustion Process and Sootblowing
- Improve the Heat Rate by Controlling the Steam Temperature
- Improve the Heat Rate by Recovering Moisture from Boiler Flue Gas
- Improve the Heat Rate by Performing Steam Turbine Maintenance
- Improve the Heat Rate by Lowering Condenser Back Pressure
- Improve Coal Power Plant Heat Rate by Pre-drying High Moisture Coal and Reducing Stack Temperature
ATTENDEE DETAILS

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COMPANY DETAILS

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<th>3 Day Programme</th>
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