FIRST TIME in Asia!

COMBINED CYCLE GAS TURBINE PERFORMANCE
Implementing a successful performance evaluation strategy for a Combined Cycle Gas Turbine Power Plant

06 - 10 MARCH 2017, KUALA LUMPUR, MALAYSIA

TOPICS COVERED

- Performance Test Calculations
- Power Output/Heat Rate Calculations
- Correction Factors
- Performance Monitoring
- Performance Diagnostics
- Performance Improvements
- Combined Cycle GT Plant Overview
- Performance Terms and Definitions
- Brayton Cycle
- Rankine Cycle
- Combined Cycle
- Performance Test Objectives
- Uncertainty Analysis

Expert Course Faculty Leader

Colin Campbell
20 years experience in the Gas Turbine and Power Generation Industry
About This Training Course

To provide attendees with a detailed understanding of the calculations required to evaluate the performance of a Combined Cycle Gas Turbine (CCGT) Power Plant. Provide an understanding of the requirements as regards implementing a successful performance evaluation strategy for a Combined Cycle Gas Turbine Power Plant

Key Learnings

- Performance Test Calculations
- Power Output/Heat Rate Calculations
- Correction Factors
- Performance Monitoring
- Performance Diagnostics
- Performance Improvements
- Combined Cycle GT Plant Overview
- Performance Terms and Definitions
- Brayton Cycle
- Rankine Cycle
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- Performance Test Objectives
- Uncertainty Analysis

Who Should Attend

This course would be ideal for any engineer requiring an understanding of the thermodynamic calculations required to assess the performance of a CCGT Power Plant. Attendees would be encouraged to bring their own plant data for discussion during the course.

Unique Features with powerEDGE Training

- Pre-Course Questionnaire to help us focus on your learning objectives
- Detailed Course & Reference Manual for Continuous Learning and Sharing
- Practical Exercises & Case Examples to better understand the principles
- Limited class size to ensure One-to-One Interactivity
- Assessment at the end of the course to help you develop a Personal Action Plan

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.
5 Day Course Outline

DAY 1
Introduction

Combined Cycle GT Plant Overview
- Gas Turbine (Frame 9, 13E2)
- Steam Turbine
- Boiler Components

Performance Terms and Definitions
- Units and Terminology, Conversion factors
- Power Output (Gross and Net)
- Heat Rate (Gross and Net)
- Energy inputs
- Efficiency
- System Losses

DAY 2
Performance Theory

Brayton Cycle
- Theoretical Brayton Cycle
- Practical Brayton Cycle
- Practical Exercises

Rankine Cycle
- Steam Cycle (Steam Table and Enthalpy)
- Practical Exercises
- Steam Turbine Power Output and Efficiency

Combined Cycle
- Heat Balance Diagrams

DAY 3
Performance Test Objectives
- Necessity for Performance Testing
- Test Preparations
- Conducting the Test
- Evaluation of Test Data

Uncertainty Analysis
- Necessity for Uncertainty Analysis
- Bias Uncertainty
- Random Uncertainty

DAY 4
Performance Test Calculations

Power Output/Heat Rate Calculations

Correction Factors
- Pressure
- Temperature
- Humidity
- Power factor
- Altitude
- Pressure Drops
- Boiler steam flow
- Condenser vacuum
- Frequency

Practical Exercise using Correction Factors
Simple Cycle/Combined Cycle Performance Calculations

DAY 5
Performance Monitoring

Performance Diagnostics
- Identifying lost performance
- Locating the cause
- Remedial action

Performance Improvements
- Increase Mass Flow (steam, water injection)
- Air intake cooling (Evaporative Chillers)
- Increase Firing Temperature (Component Upgrade Options)
- Reducing Leakage and Improving Cooling

Course Review and Feedback
Your Expert Course Faculty

Colin has over 20 years experience in the Gas Turbine and Power Generation Industry. Having graduated from Glasgow University with a Degree in Electrical and Electronic Engineering, Colin joined John Brown Engineering (JBE) as a Controls Engineer in 1993. At this time JBE was a licensee for GE Gas Turbines and project managed the installation and commissioning of many types of GE Gas Turbine both in simple cycle and combined cycle configurations. Colin was involved in many aspects of this work including commissioning support, field service and technical training.

He spent several weeks in the US working with GE to learn the MK V Speedtronic Control System and quickly became an expert in all versions of the Speedtronic Control System. This expertise has been maintained by attending further training courses in MK VI and MK VIe Speedtronic Control Systems.

Specialising in technical training he went onto manage a technical training business for a Masood Group Company before joining his current employer Masood John Brown (MJB). During this time he developed the business to cover all types of rotating equipment and assisted in the development and delivery of detailed technical training programmes covering subject areas including Combined Cycle Gas Turbine Performance, Gas Turbine Technology and Steam Turbine Operations & Maintenance.

He has delivered courses at locations all over the world and to management levels for companies such as British Petroleum, Saudi Electric, ARAMCO, Gasco, Adgas, RWE Npower and Shell. He has successfully project managed the delivery of technical training programmes for several large companies covering all aspects of Power Plant Operations and Maintenance.
OTHER AVAILABLE COURSES

4 Pillars of Transformer Condition
Advanced Project Finance for Power
Advanced Technical Report Writing & Presentation Skills
Advanced Turnaround Shutdown & Outage Management
Ancillary Services in Competitive Electricity
Asset Management for the Power Industry
Best Practice Renewable Energy Capital & Project Management
Biomass Power Generation
CFB Combustion for Boiler Operations
Clean Development Mechanism and Carbon Markets
Coal Contracts
Combined Cycle Power Plants Operation
Combined Heat & Power (CHP) and Co-Generation Plant Operations
Competency Management System for the Power Industry
Design & Operations of Circulating Fluidized Bed Boiler
Developing & Structuring Public-Private Partnership (PPP) for Infrastructure
Effective Tender Process Management for Power & Utilities
Electrical Hazop (eHazop) Studies for the Power Industry
Electricity Demand-Side Management
Electricity Industry Design
Electricity Network Planning
Electricity Retail Contracts
Electricity Theft
Electricity Trading Essentials
Energy Efficiency
EPC Contract Management for Power & Utilities
Essentials of Coal Markets and Trading
Essentials of Power Trading
Excitation Systems
Feed-In Tariffs for PV Systems
Finance for Non-Finance Professionals in Power & Utilities
Financial Modelling for Project Finance in Power & Utilities
Fitness-For-Service AP1 579 & High Energy Piping Life Management
Fundamentals of Geothermal Energy
Fundamentals of Power Generation
Gas & LNG Contract Negotiation
Gas Turbine Generator Selection, Operation & Maintenance
Gas Turbine Hot Gas Paths, Rotors & Failure Analysis
Gas Turbine Major Inspection & Overhaul
GE Gas Turbine Operations Simulation Based
HRSG Design, Operations & Understanding, Controlling of HRSG Damage
Mechanisms
HV Substation Design & Construction
IEC for Utilities
Integration of Distributed Generation
Introduction to Carbon Capture & Storage
Introduction to Clean Coal Technology
Introduction to Power Systems
Keeping Electrical Switchgear Safe
Leadership & Team Dynamics for Power & Utilities
LNG Fundamentals
LNG Markets & SPOT Trading
Maintenance Planning & Scheduling
Making IPP & Renewable Energy Projects Contract Frameworks Bankable
Managing Complex Projects for Power and Utilities Professionals
Medium Voltage & High Voltage Switchgear
Metallurgy for Engineers
Mechanical Engineering for Non-Mechanical Engineers
Mini Hydro Project Analysis
MKV Speedtronic Control System
MK VI Speedtronic Control System
Nuclear Energy Project Planning & Economics
Nuclear Power
Offshore Platforms Electrical Systems Design & Illustrations
Operations of Coal Fired Power Plants
Power Generation Commissioning, Operations & Maintenance
Power Generation Operation, Protection & Excitation Control
Power Plant Chemistry for Chemist & Chemical Engineers
Power Purchase Agreements
Process Control Methods
Programmatic CDM
Project Management for Power and Utilities
Relay Protection in Power Systems
Reliability Centered Maintenance Masterclass
Reliability Engineering
Renewable Energy Development & Investment
Renewable Energy Integration
Risk Based Inspection
Risk Management in Power Markets
Root Cause Analysis
Rotating Equipment Maintenance & Reliability Excellence
SCADA & Power Systems
Smart Grid
Solar Energy & Photovoltaic Power
Spare Parts Optimisation
Supercritical and Ultra-Supercritical Coal-Fired Power Plant
Technical Report Writing & Presentation Skills for Power & Utilities Professionals
Ultra Low NOx Gas Turbine Combustion
Uninterruptible Power Supply
Vibration Analysis & Condition Monitoring
Waste to Energy Plant Operations
Water Treatment and Corrosion Control for Steam Generation and Power Production
Writing Effective Standard Operating Procedures (SOP) for Power & Utilities Professionals & Engineers

www.poweredgeasia.com
Frequently Asked Questions (FAQs)

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
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<tbody>
<tr>
<td>1. Does PowerEdge have other programmes than those listed?</td>
<td>We have more than 200 programmes that we are capable of running. All we need is for you to contact us and request for the preferred programme and we will able to develop it.</td>
</tr>
<tr>
<td>2. Where is PowerEdge based?</td>
<td>PowerEDGE is headquarted in Singapore but we run our training programmes in different venues around Asia.</td>
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<tr>
<td>3. What does PowerEdge do?</td>
<td>We are a Power &amp; Utilities Training Specialist.</td>
</tr>
<tr>
<td>4. Can this course be done in our city?</td>
<td>It absolutely can. Get in touch with us to request for a training programme to be carried out in your city.</td>
</tr>
<tr>
<td>5. Can you reduce the price of our preferred course?</td>
<td>While our price has been reduced before it is even launched, we are always happy to help you with further discounts.</td>
</tr>
<tr>
<td>6. Can you change the dates of the course?</td>
<td>If you have a special requested date, let us know and we will arrange another session for you.</td>
</tr>
<tr>
<td>7. Who are the companies that will be participating?</td>
<td>This varies from a diversity of Power Operators, Regulators, Financers, to Vendors in the Power &amp; Utilities industry.áticas.</td>
</tr>
<tr>
<td>8. Where is the venue for the course?</td>
<td>We usually engage a 4 to 5 star hotel meeting room to ensure the comfort of our participants.</td>
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<td>9. How many delegates should we expect for each course?</td>
<td>This varies from 15 to 20 participants. Class sizes are kept small to allow trainers to focus better on each participant.</td>
</tr>
<tr>
<td>10. What are the different payment modes?</td>
<td>We accept Visa/MasterCard, cheques, bank transfers and cash on site.</td>
</tr>
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<td>11. Is accommodation included when I sign up for a course?</td>
<td>Accommodation is not included in the course fee but we are always happy to advise on available accommodations.</td>
</tr>
<tr>
<td>12. Can I get a cheaper accommodation through PowerEdge?</td>
<td>We will be pleased to help you negotiate a better rate with hotels.</td>
</tr>
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<td>13. Is lunch provided during the course?</td>
<td>We provide lunch and 2 tea breaks every day during our training programmes.</td>
</tr>
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<td>14. Are the training materials included once I have signed up for a course?</td>
<td>Yes, training and course materials are included in the course fee.</td>
</tr>
<tr>
<td>15. Will there be a certificate for the course?</td>
<td>Yes, there will be a certificate of participation upon completion of a course.</td>
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<tr>
<td>16. Who are PowerEdge trainers?</td>
<td>They are expert consultants and practitioners with many years of experience in the subject matter that they deliver on.</td>
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<td>17. Are PowerEdge trainers competent?</td>
<td>We have received numerous favourable feedbacks on our trainers from past participants.</td>
</tr>
<tr>
<td>18. Can PowerEdge assist with Visa travel applications?</td>
<td>We can assist in advising you on the relevant procedure(s) and embassies/consulates that provide Visa for travel purposes.</td>
</tr>
<tr>
<td>19. Can we purchase training materials without attending a course?</td>
<td>Unfortunately this option is not available as training materials are specially developed for courses.</td>
</tr>
<tr>
<td>20. Can course content be tweaked to cater to our needs?</td>
<td>Of course! Just let us know your request and we will get the trainer to assist in carrying it out.</td>
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<table>
<thead>
<tr>
<th></th>
<th>PER PARTICIPANT</th>
<th>2 PARTICIPANTS OR MORE</th>
<th>IN-HOUSE TRAINING</th>
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<tbody>
<tr>
<td><strong>5 Day Programme</strong></td>
<td>SGD 4,900 Per Participant (*GST Exclusive)</td>
<td>SGD 4,600 Per Participant (*GST Exclusive)</td>
<td>Guaranteed Minimum 40% Off Normal Price</td>
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<tr>
<td></td>
<td>SGD 5,243 Per Participant (GST Inclusive)</td>
<td>SGD 4,922 Per Participant (GST Inclusive)</td>
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**ATTENDEE DETAILS**

Name ................................................................. Job title .................................................................
Tel ........................................ Department ............................................... Email .........................................................

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Tel ........................................ Department ............................................... Email .........................................................

**COMPANY DETAILS**

Organisation name ................................................ Industry .................................................................
Address ........................................................................................................................................
Postcode................................................................. Country .................................................................
Tel ........................................................................................................................................
Fax ........................................................................................................................................

**PAYMENT METHODS**
By Cheque/ Bank Draft: Make Payable to PowerEdge Pte Ltd.
By Telegraphic Transfer: Please quote AE1 with the remittance advice
Account Name: PowerEdge Pte Ltd.
Bank Code: 7339 Branch code: 468 Account Number: 686-253386-001 Swift Code: OCBGSGS
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.

**CANCELLATIONS & SUBSTITUTIONS**
You may substitute delegates at any time. POWEREDGE PTE LTD does not provide refunds for cancellations. For cancellations received in writing more than seven (7) days prior to the training course you will receive a 100% credit to be used at another POWEREDGE PTE LTD training course for up to one year from the date of issuance. For cancellations received seven (7) days or less prior to an event (including day 7), no credits will be issued. In the event that POWEREDGE PTE LTD cancels an event, delegate payments at the date of cancellation will be credited to a future POWEREDGE PTE LTD event. This credit will be available for up to one year from the date of issuance. In the event that POWEREDGE PTE LTD postpones an event, delegate payments at the postponement date will be credited towards the rescheduled date. If the delegate is unable to attend the rescheduled event, the delegate will receive a 100% credit.

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