COURSE OVERVIEW ME0033
Power Plant Performance, Efficiency & Optimization

Course Title
Power Plant Performance, Efficiency & Optimization

Course Reference
ME0033

Course Duration/Credits
Five days/3.0 CEUs/30 PDHs

Course Date/Venue

Session(s)	Date	Venue
1	July 27-31, 2025	Boardroom 1, Elite Byblos Hotel Al Barsha, Sheikh Zayed Road, Dubai, UAE
3	October 13-17, 2025	Ajman Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE
4	November 30-December 04, 2025	Oryx Meeting Room, Double Tree by Hilton Al Saad, Doha, Qatar

Course Description

This practical and highly-interactive course includes practical sessions and exercises. Theory learnt will be applied using our state-of-the-art simulators.

The efficient and optimum economic operation and planning of electric power generation systems have always occupied an important position in the electric power industry. Electricity-supply industry has moved away from its regulated roots and is rushing toward freewheeling competition, spurring more creative uses of energy and unprecedented advancements in plant efficiencies.

Power plants efficiency is very important in the economics of power generation. Optimizing efficiency requires that all power plant systems function at peak performance over long-term operation.

The performance of a power plant can be expressed through some common performance factors as heat rate (energy efficiency), thermal efficiency, capacity factors, load factor, economic efficiency and operational efficiency.

Typical performance and efficiency challenges that power plant operators face include:-

Combined Cycle Plant

- How much power loss and poor heat rate due to inefficient GT, HRSG, ST, Condensor, Cooling Tower?
- Are the calorific fuel measurements accurate for payment?
- What maintenance can be done to improve performance?
- How effective was that last GT compressor wash – was it worth the detergent cost and downtime?
- Is the HP Bypass valve passing?
- Is it necessary to clean the Condensor tubes?

Conventional Steam Plant

- How much power loss and poor heat rate due to inefficient Boiler, Feed Water heater, Air Heater, Economizer, Steam Turbine, Condensor, Cooling Water Pumps?
- What maintenance can be done to improve performance?
- How effective was that last Steam Turbine inspection overhaul?
- How much leakage is there in the Air Heater
- Is the Economizer section fouled?
- Is the FD Fan performing according to curve? How to continuously determine the heatrate of a coal fired steam plant without knowing the heating value of coal or having an accurate load cell to measure the coal flow?

This course will cover the analytic methods used to evaluate power plant performance and quantify the degradation of major power plant equipment. Performance test calculation methods (like the ASME Performance Test Code procedures) will be presented, but the course focuses mainly on detailed heat balance and expected equipment performance prediction methods. These more detailed methods are the essential building blocks of performance monitoring systems that are truly capable of evaluating degradation with repeatable precision. The methods in this course will be presented in sufficient detail to enable participants to construct useful customized performance monitoring calculations for their own power plants.

The course is designed to provide the power plant personnel with the fundamental knowledge to be able to begin the development, or to implement an effective heat rate improvement program. Design and operating theories of power plant equipment will be presented. Thermodynamics and heat transfer will be reviewed and practically applied to operation. Calculations will be performed, using actual case studies, to determine steam and gas turbine efficiency, condenser cleanliness, turbine cycle heat rate, corrections, HRSG efficiency, and feedwater heater performance.

Course Objectives

Upon the successful completion of this course, each participant will be able to:-

- Apply systematic techniques on power plant efficiency and performance monitoring particularly the aspects of ASME test codes, curve based methods, additive performance factors and model-based performance analysis
- Analyze heat balance including the local heat balances and learn data validation by means of range checking, averaging sensor data and time averaging
- Obtain accuracy of calculated results using the Monte Carlo method, instrument error and uncertainty of a calculated test results
- Review and improve the overall power plant performance monitoring and economics by establishing performance standards and targets and recognize the impacts of degradation on overall plant performance
- Identify the performance characteristics of turbines and understand the acceptance testing of turbines & auxiliary plant
- Employ gas turbine, heat recovery steam generator and steam turbine performance and recognize their importance in power plant performance and monitoring
- Discuss boiler performance characteristics and improve boiler, fuel and combustion efficiency, boiler heat balance analysis and boiler degradation
- Describe and carry-out air heater and feedwater performance and heighten knowledge on deaerators, drums and open heaters
- Analyze the design and performance of steam surface condensers and become acquainted with condenser heat balance analysis, condenser ventilation, air cooler and ejector RAPs
- Assess cooling tower performance as well as inlet and exhaust pressure losses and evaluate the procedure on pump performance

Exclusive Smart Training Kit - H-STK®

*Participants of this course will receive the exclusive "Haward Smart Training Kit" (**H-STK®**). The **H-STK®** consists of a comprehensive set of technical content which includes **electronic version** of the course materials conveniently saved in a **Tablet PC**.*

Who Should Attend

This course covers systematic techniques and methodologies of the performance and efficiency of power plant for managers, planners, engineers, superintendents, supervisors and other technical staff who work in power generation plant and equipment and who feel that a more comprehensive grasp of its performance and the underlying engineering issues would be of practical benefit.

Course Certificate(s)
Internationally recognized certificates will be issued to all participants of the course who completed a minimum of 80% of the total tuition hours.

Certificate Accreditations
Certificates are accredited by the following international accreditation organizations:-

- British Accreditation Council (BAC)

  Haward Technology is accredited by the **British Accreditation Council** for **Independent Further and Higher Education** as an **International Centre**. BAC is the British accrediting body responsible for setting standards within independent further and higher education sector in the UK and overseas. As a BAC-accredited international centre, Haward Technology meets all of the international higher education criteria and standards set by BAC.

- The International Accreditors for Continuing Education and Training (IACET USA)

  Haward Technology is an Authorized Training Provider by the International Accreditors for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, VA 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 2018-1 Standard** which is widely recognized as the standard of good practice internationally. As a result of our Authorized Provider membership status, Haward Technology is authorized to offer IACET CEUs for its programs that qualify under the **ANSI/IACET 2018-1 Standard**.

  Haward Technology's courses meet the professional certification and continuing education requirements for participants seeking **Continuing Education Units** (CEUs) in accordance with the rules & regulations of the International Accreditors for Continuing Education & Training (IACET). IACET is an international authority that evaluates programs according to strict, research-based criteria and guidelines. The CEU is an internationally accepted uniform unit of measurement in qualified courses of continuing education.

  Haward Technology Middle East will award **3.0 CEUs** (Continuing Education Units) or **30 PDHs** (Professional Development Hours) for participants who completed the total tuition hours of this program. One CEU is equivalent to ten Professional Development Hours (PDHs) or ten contact hours of the participation in and completion of Haward Technology programs. A permanent record of a participant's involvement and awarding of CEU will be maintained by Haward Technology. Haward Technology will provide a copy of the participant's CEU and PDH Transcript of Records upon request.

Course Fee

Doha	**US$ 6,000** per Delegate. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.
Dubai Abu Dhabi	**US$ 5,500** per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Course Instructor(s)

This course will be conducted by the following instructor(s). However, we have the right to change the course instructor(s) prior to the course date and inform participants accordingly:

Mr. Karl Thanasis, PEng, MSc, MBA, BSc, is **Senior Mechanical Engineer** with **40 years** of extensive industrial experience within the **Oil & Gas**, **Refinery** and **Petrochemical** industries. His wide expertise includes Fundamentals of **Engineering Drawings**, **Codes & Standards**, **P&ID Reading Interpretation & Developing**, **Boiler Design**, **Boiler** Inspection & Maintenance, **Boiler** Operation & Control, **Boiler** Troubleshooting & Inspection, **Boiler Instrumentation & Control**, **Steam Boiler** Maintenance, **Boiler & Steam Generation System**, **Boiler** Failure Analysis & Prevention, **Boiler** Burner Management, **Boiler** Water Treatment Technology, **Machinery Failure Analysis**, **Preventive & Predictive Maintenance**, **Condition Monitoring**, Root Cause Analysis (**RCA**), Root Cause Failure Analysis (**RCFA**), Reliability Centred Maintenance (**RCM**), Risk Base Inspection (**RBI**), **Metallurgical Failure Analysis**, **Corrosion Failure Analysis**, **Steam Generation**, **Steam Turbines**, **Power Generator Plants**, **Gas Turbines**, **Combined Cycle Plants**, **Boilers**, **Process Fired Heaters**, Air Preheaters, Induced Draft Fans, All Heaters Piping Work, Refractory Casting, Heater Fabrication, Thermal & Fired Heater Design, **Heat Exchangers**, Heat Transfer, Coolers, **Pumps**, Turbo-Generator, Turbine **Shaft Alignment**, **Lubrication**, **Mechanical Seals**, **Packing**, **Blowers, Bearings**, **Couplings**, **Clutches** and **Gears**. **Further**, **he is also versed in Wastewater Treatment Technology**, **Networking System**, **Water Network Design**, **Industrial Water Treatment** in Refineries & Petrochemical Plants, **Piping System**, **Water Movement**, **Water Filtering**, **Mud Pumping**, **Sludge Treatment** and **Drying**, **Aerobic Process** of **Water Treatment** that includes **Aeration**, **Sedimentation** and **Chlorination Tanks**. His strong background also includes **Design** and **Sizing** of all **Waste Water Treatment Plant Associated Equipment** such as **Sludge Pumps**, **Filters**, **Metering Pumps**, **Aerators** and **Sludge Decanters**.

Mr. Thanasis has acquired his thorough and practical experience as the **Project Manager**, **Plant Manager**, **Area Manager**, **Maintenance Manager**, **Engineering Manager**, **Technical Consultant & Trainer**, **Head of Capital Projects**, **Refractory Specialist**, **Construction Superintendent**, **Project Engineer** and **Thermal Design Engineer** of various companies worldwide in the **USA**, **Germany**, **England** and **Greece**.

Mr. Thanasis is a **Registered Professional Engineer** in the **USA** and **Greece** and has a **Master's** and **Bachelor's** degree in **Mechanical Engineering** with **Honours** from the **Purdue University** and **Southern Illinois University** (**USA**) respectively as well as an **MBA** from the **University of Phoenix** (**USA**). Further, he is a **Certified Instructor/Trainer**, **Certified Internal Verifier/Trainer/Assessor** by the **Institute of Leadership & Management** (**ILM**), a member of the **American Society of Heating, Refrigeration and Air-Conditioning Engineers** and delivered various trainings, courses, seminars and workshops worldwide.

Training Methodology

All our Courses are including **Hands-on Practical Sessions** using equipment, State-of-the-Art Simulators, Drawings, Case Studies, Videos and Exercises. The courses include the following training methodologies as a percentage of the total tuition hours:-

30% Lectures
20% Practical Workshops & Work Presentations
30% Hands-on Practical Exercises & Case Studies
20% Simulators (Hardware & Software) & Videos

In an unlikely event, the course instructor may modify the above training methodology before or during the course for technical reasons.

Accommodation

Accommodation is not included in the course fees. However, any accommodation required can be arranged at the time of booking.

Course Program

The following program is planned for this course. However, the course instructor(s) may modify this program before or during the course for technical reasons with no prior notice to participants. Nevertheless, the course objectives will always be met:

Day 1

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Introduction*** *Course Overview • Participant's Expectations*
0930 – 0945	*Break*
0945 – 1100	***Overview of Performance Monitoring*** *Concept of Performance Monitoring • ASME Test Codes • Performance Testing versus Online Monitoring • Curve Based Methods • Performance Curves • Expected Performance from Curves • Additive Performance Factors • Expected Performance from Curves • Correction Factors • Percent Change Correction Factors • Model-Based Performance Analysis*
1100– 1230	***Heat Balance Analysis*** *Local Heat Balances • Combined-Cycle Overall Plant Heat Balance • Combined-Cycle Balance Using Commercial Software • Rankine-Cycle Overall Plant Heat Balance • Rankine-Cycle Balance Using Commercial Software*
1230 – 1245	*Break*
1245– 1315	***Data Validation*** *Definition of Data Validation • Range Checking • Averaging Sensor Data • Time Averaging • Heat Balances for Data Validation*
1315 – 1420	***Accuracy of Calculated Results*** *Instrument Error • Uncertainty of a Calculated Test Result • Monte Carlo Method*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch &End of Day One*

Day 2

0730 – 0930	***Overall Power Plant Performance Monitoring and Economics*** *Equipment Performance versus Plant Performance • Specification of Overall Power Plant Performance • Overall Plant Expected Performance Models • Establishing Performance Standards and Targets • Records and Periodic Returns – Computerization, Plant Performance & Excess Generation Costs • Justifiable Investments • Degradation of the Overall Power Plant • Documentation and Monitoring*
0930– 0945	*Break*
0945 – 1100	***Impacts of Degradation on Overall Plant Performance*** *Definitions of Plant Impacts • Gas Turbine Impacts • Heat Recovery Steam Generator Impacts • Steam Turbine Impacts• Boiler Impacts • Feedwater Heater Impacts • Condenser Impacts • Inlet Air Filter Impacts •Exhaust Pressure Loss Impacts*
1100 – 1230	***Performance Characteristics of Turbines*** *Stage & Cylinder Efficiency – Throttle vs Nozzle Governing • Efficiency versus Load • Feed-heating • Plant/Boiler Feed Pumps • Acceptance Testing of Turbines & Auxiliary Plant • Routine Performance Monitoring • On-Line Computerized Systems • Heat-Rate Correction Factors*
1230 – 1245	*Break*
1245 – 1420	***Gas Turbine Performance*** *Overview • Power Generation • Airflow, Firing Temperature and Pressure Ratio • Control Algorithms • Correction Curves (Baseload Performance) • Part-Load Performance (Industrial Engines) • Part-Load Correction Curves • Aeroderivative Engine Performance*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch &End of Day Two*

Day 3

0730 – 0930	***Gas Turbine Performance (cont'd)*** *Overall Gas Turbine Heat Balance • Model-Based Gas Turbine Heat Balance • Physically-Based Models for Expected GT Performance • Gas Turbine Performance Evaluation • A Theoretical Degradation Curve versus Time is in • Experience with Measured Data from Operating • Performance Degradation and Engine Life*
0930 – 0945	*Break*
0945 – 1100	***Heat Recovery Steam Generator Performance*** *Overview • Duct Burner • HRSG Efficiency and Effectiveness • Expected HRSG Performance • HRSG Heat Balance Analysis • Model-Based HRSG Heat Balance Analysis • Expected Section-by-Section Performance • Impact of Fouling on HRSG Performance • HRSG Performance Evaluation • Example Performance Analysis Fouled HP Evaporator • Example of Section-by-Section Expected HRSG Perf • Conclusions and Recommendations*
1100 – 1230	***Steam Turbine Performance*** *Overview • Steam Turbine Configurations • Seals and Leaks • Steam Turbine Thermal Performance*

1230 – 1245	Break
1245 – 1420	***Steam Turbine Performance (cont'd)*** *Steam Turbine Heat Balance Analysis ● Curve-Based Expected Performance ● Model-Based Expected Steam Turbine Performance ● Building Steam Turbine Expected Performance Models ● Steam Turbine Degradation*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch &End of Day Three*

Day 4

0730 – 0830	***Boiler Performance Characteristics*** *Fuels & Combustion Efficiency ● Boiler Efficiency Testing – ASME Codes ● Combustion Calculations ● Theoretical Air ● Boiler Losses ● Flue Gas Loss ● Loss Due to Ash ● Loss Due to Radiation ● Credits for Heat Addition to Boiler ● Straight Line Law for Steam Generators*
0830 – 0930	***Boiler Performance Characteristics (cont'd)*** *Boiler Heat Balance Analysis ● Model-Based Boiler Heat Balance Analysis ● Expected Boiler Performance ● Routine Performance Monitoring ● Boiler Degradation ● Sootblowing Analysis*
0930 – 0945	Break
0945 – 1045	***Air Heater Performance*** *Overview ● Air Heater Heat-Balance Analysis ● Air Heater Expected Performance ● Air Heater Degradation*
1045 – 1230	*Feedwater Heater Performance* *Overview ● Feedwater Heater Heat-Balance Analysis ● Expected Feedwater Heater Performance ● Feedwater Heater Degradation*
1230 – 1245	Break
1245 – 1330	***Deaerators, Drums and Open Heaters***
1330 – 1420	***Steam Surface Condensers: Design & Performance*** *Overview ● Condenser Elements & Arrangements ● Heat Transfer Performance & Characteristics*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch &End of Day Four*

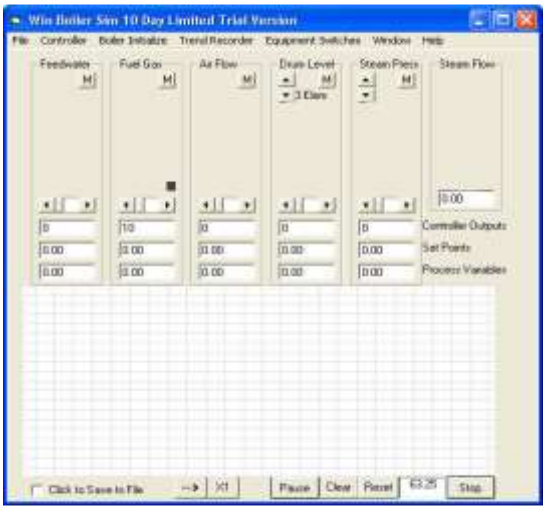
Day 5

0730 – 0930	***Steam Surface Condensers: Design & Performance (cont'd)*** *Condenser Heat Balance Analysis ● Condenser Expected Performance ● Condenser Degradation ● Condenser Ventilation ● Air Cooler ● Ejector RAPs ● Diagnosing Condenser Performance Problems*
0930 – 0945	Break
0945 – 1100	***Cooling Tower Performance*** *Overview ● Cooling Tower Performance Curves● Cooling Tower Heat Balance Analysis ● Expected Cooling Tower Performance ● Cooling Tower Degradation*
1100 – 1230	***Inlet and Exhaust Pressure Losses*** *Overview ● Fitting the Pressure Loss Equation to Data ● Pressure Loss Degradation*

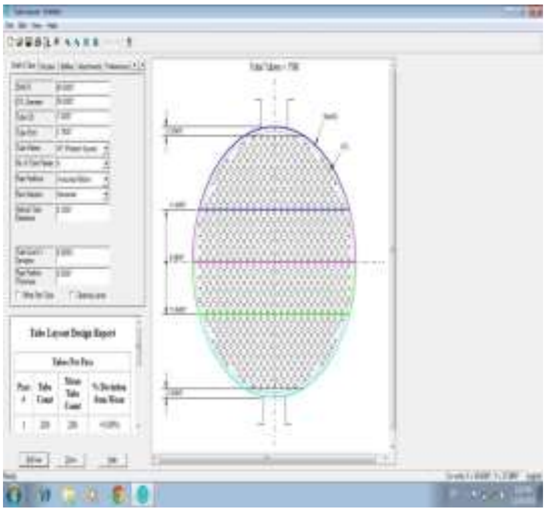
1230 – 1245	*Break*
1245 – 1345	***Pump Performance*** *Overview ● Extended Bernoulli Equation ● Pump Curves ● Affinity Laws ● Corrected Pump Performance ● Pump Flow Control ● Model-Based Pump Performance ● Pump Degradation*
1345– 1400	***Course Conclusion*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Course Topics that were Covered During the Course*
1400 – 1415	***POST-TEST***
1415 – 1430	*Presentation of Course Certificates*
1430	*Lunch &End of Course*

Simulator (Hands-on Practical Sessions)

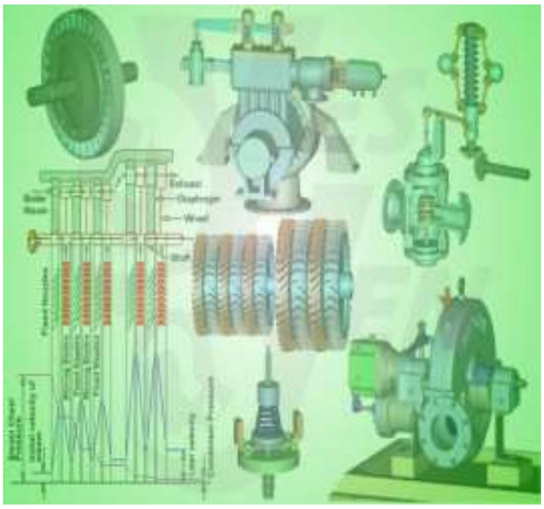
Practical session will be organized during the course for delegates to practice the theory learnt. Delegates will be provided with an opportunity to carryout various exercises using the state-of-the-art simulators“Win Boiler Sim”, “Tube Layout”, Steam Turbines & Governing System CBT”, “Single Shaft Gas Turbine Simulator”, “Two Shaft Gas Turbine Simulator” and “Centrifugal Pumps and Troubleshooting Guide 3.0”.



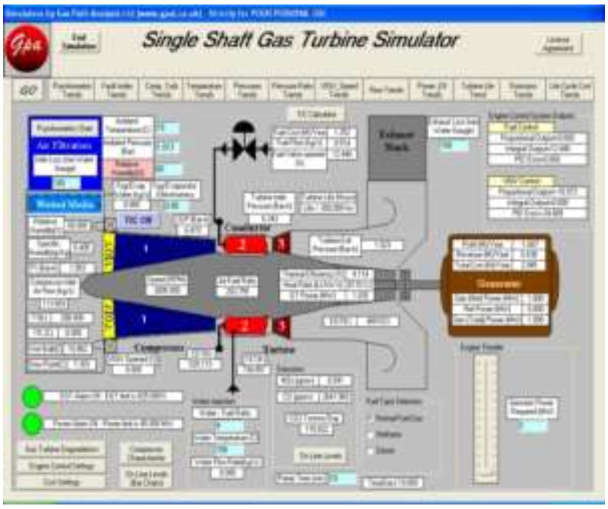
Win Boiler Sim



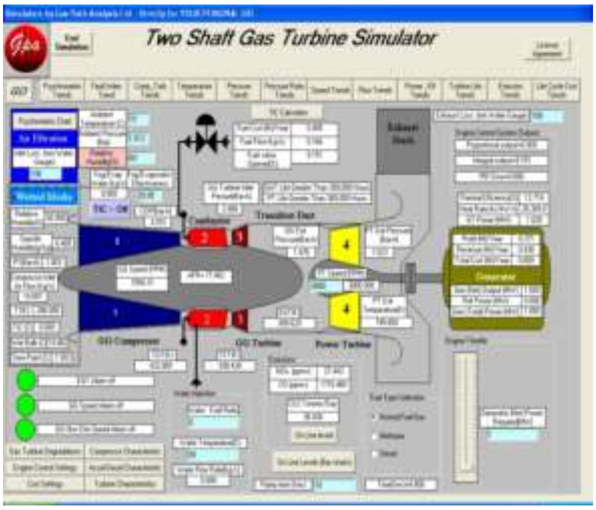
Tube Layout



Steam Turbines & Governing System CBT



Single Shaft Gas Turbine Simulator



Two Shaft Gas Turbine Simulator

Centrifugal Pumps and Troubleshooting Guide 3.0

Course Coordinator

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