COURSE OVERVIEW ME0795
Gas Turbine Operation & Maintenance

Course Title
Gas Turbine Operation & Maintenance

Course Reference
ME0795

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

Course Date/Venue

Session(s)	Date	Venue
1	March 03-07, 2024	Fujairah Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE
2	June 23-27, 2024	Al Azziya Hall, The Proud Hotel Al Khobar, Al Khobar, KSA
3	September 22-26, 2024	Boardroom 1, Elite Byblos Hotel Al Barsha, Sheikh Zayed Road, Dubai, UAE

Course Description

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

The use of gas turbines in the process industries has increased considerably during the past few years. Gas turbines offer continuous combustion, low vibration, non-reciprocating motion and low weight to the horsepower ratio. Gas turbines have long been used in simple cycle mode for peak lopping in the power generation industry, where natural gas or distillate liquid fuels have been used, and where their ability to start and shut down on demand is essential.

The course is designed to introduce operations and maintenance personnel to the routine preventative maintenance procedures of the gas turbine generator support systems, and to the major mechanical maintenance required to attain high levels of availability, and reliability from the gas turbine generator.

This course will also cover borescope procedures, troubleshooting, and a summary of the disassembly inspections required for major gas turbine generator mechanical maintenance. Operating and maintenance personnel should attend this course together to develop a working relationship regarding the maintenance requirements of the unit, and how unit operation may affect these requirements.

The course will include detailed descriptions of the turbine generator and support systems. This will include a functional description of the systems as well as the routine preventative maintenance requirements. The course will also detail the gas turbine combustion inspection process with an overview of the hot gas path, and compressor inspections, with an emphasis on component inspection criteria.

Course Objectives

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

- Troubleshoot, operate and maintain the gas turbine generator in a professional manner
- Apply the best preventative maintenance requirements of the gas turbine support systems
- Discuss the guiding principles of ASME PTC 22 gas turbine performance test and prepare for test, conduct test and apply test records and test validity
- Carryout instruments and methods of measurement covering pressure measurement, temperature measurement, gas fuel heat input and liquid fuel heat input
- Illustrate electrical generation measurement, mechanical power measurement, speed measurement, humidity measurement, heat losses and other measurements
- Apply computation of results from electrical power calculations, mechanical power output calculation and heat rate calculations
- Report results as well as test uncertainty that include unit output and thermal efficiency, comparative testing uncertainty and uncertainty of flow calculation from heat balance
- Review and improve the major gas turbine mechanical maintenance procedures
- Identify the construction, support & auxiliary systems as well as the mechanical maintenance of the gas turbine generator
- Recognize the borescope including its functional use
- Apply proper troubleshooting techniques on generator turbine system and explain its unit documentation

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, sample video clips of the instructor's actual lectures & practical sessions during the course conveniently saved in a **Tablet PC**.*

Who Should Attend

This course covers systematic techniques on the operation, applications, performance, maintenance and troubleshooting of gas turbine. Maintenance and operation engineers and other technical staff will gain an excellent knowledge from the practical aspects of this course. Experienced specialists, project engineers and supervisory personnel involved in management, selection, operation, troubleshooting and maintenance of gas turbines will definitely benefit from the operational aspects of the course. Throughout the course, participant will have ample opportunity to have gas turbine related questions answered by the instructor.

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.

Course Fee

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.
Al Khobar	**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.
Dubai	**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.

Accommodation

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

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:-

- 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.

- 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.

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. Mohamed Refaat, MSc, BSc, is a **Senior Mechanical & Maintenance Engineer** with almost **30 years** of extensive experience in **Rotating Equipment** and **Machinery** including **Pumps**, **Compressors**, **Turbines**, **Motors**, **Turbo-expanders**, **Gears**, etc. His wide experience also covers **Centrifugal Compressor & Steam Turbine**, **Centrifugal Pump**, **Pump** Technology, **Gas Turbine** Technology, **Heat Exchanger**, **Turbines & Motors**, **Variable Speed Drives**, **Seals**, **Control Valves**, Advanced **Valve** Technology, **Dry Seal**, **Fired Heaters**, **Air Coolers**, **Crude Desalter**, **Process Vessels & Valves**, **Industrial Equipment & Rotating Machinery**, **Mechanical** Engineering, **Mechanical Equipment & Turbomachinery**, **Piping**, **Pipelines**, **Valves**, **Lubrication Technology**, **Vibration Analysis**, **Power System Hydraulics**, **Security Detection** Systems & Operation, **Process Plant** Equipment, Troubleshooting **Process Operations**, **Maintenance Management** Best Practices, **Rotating Equipment** Reliability Optimization, Practical **Machinery Vibration**, **Vibration** Techniques, Effective **Reliability Maintenance**, Excellence in **Maintenance & Reliability** Management, **Preventive & Predictive Maintenance**, Machinery Failure Analysis (**RCFA**), **Reliability** Optimization & Continuous Improvement, **Maintenance** Planning, Scheduling & Work Control, **Maintenance Management** Strategy, **Mechanical & Rotating Equipment** Troubleshooting, Preventive Maintenance, Predictive Maintenance, Reliability Centered Maintenance (**RCM**), Condition Based Monitoring (**CBM**), **FMEA** and Troubleshooting of machinery and rotating equipment including turbines, bearings, compressors, pumps etc. He is currently the **Mechanical Maintenance Section Head** of the **Arab Petroleum Pipelines Company** where he is in charge of planning, scheduling & managing the execution of preventive & corrective mechanical maintenance activities for all equipment. He is responsible for executing the scheduled inspections & major overhauls for gas turbines, valves & pumps, carrying out off-line vibration monitoring plans, troubleshooting, fault diagnosing & investigating failures of machinery.

During his career life, Mr. Mohamed was able to modify the gas turbines self cleansing system to improve its maintainability and extend the air filters' lifetime. He was responsible for defining & updating the equipment codes and parameters for replacing the old **CMMS** with **MAXIMO**. He also worked as the Operations Supervisor wherein he was closely involved with the operation of the crude oil internal **pipeline** system between the tankers and tank farm, operation & control of the booster pumps for pumping crude oil for main pipelines and the development & implementation of the plans & procedures for draining the main terminal internal lines for maintenance purposes. He also held the position of Measurement Engineer where he was responsible for the crude oil custody transfer, performing loss control analysis and operating the crude oil automatic sampler & related equipment. Prior to that, he was the Design Engineer responsible for the design phase of the Truck Mixer Manufacturing Project of the Mechanical Design Department.

Mr. Refaat has **Master** and **Bachelor** degrees in **Mechanical Engineering** and a General Certificate of Education (**GCE**) from the **University of London**, **UK**. Further, he is a **Certified Instructor/Trainer**, a **Certified Internal Verifier/Assessor/Trainer** by the **Institute of Leadership & Management** (**ILM**) and a member of the Engineering Syndicate of Egypt. He has further delivered numerous training, courses, workshops, seminars and conferences worldwide.

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	***Gas Turbine Overview*** *Gas Turbine Basics ● Gas Turbine Construction ● Gas Turbine Device Summary ● Gas Turbine Instrumentation (function and maintenance) ● Gas Turbine-Generator Arrangement ● Operating and Maintenance Factor Considerations ● Standard Practices ● Clearance Diagrams ● Weights and Center of Gravity Diagram*
0930 – 0945	*Break*
0945 – 1100	***Gas Turbine Support Systems: Description, Maintenance & Troubleshooting*** *Turbine and Auxiliary System Preventive Maintenance Scheduling ● Inlet, Exhaust, and Control Air ● Inlet Cooling ● Lube Oil*
1100 – 1215	***Gas Turbine Support Systems: Description, Maintenance & Troubleshooting (cont'd)*** *Hydraulic and Control Oil ● Lift Oil ● Trip Oil ● Cooling Water*
1215 – 1230	*Break*
1230 – 1420	***Gas Turbine Support Systems: Description, Maintenance & Troubleshooting (cont'd)*** *Cooling and Sealing Water ● Fuel Systems(s) – Gas & Liquid ● Atomizing Air ● Purge Air*
1420 – 1430	***Recap***
1430	*Lunch & End of Day One*

Day 2

0730 – 0930	***Gas Turbine Support Systems: Description, Maintenance & Troubleshooting (cont'd)*** *Water Injection ● Heating and Ventilation ● Fire Protection ● Hazardous Gas*
0930 – 0945	*Break*
0945 – 1100	***Gas Turbine Support Systems: Description, Maintenance & Troubleshooting (cont'd)*** *Inlet Bleed Heat ● Inlet Guide Vanes ● Starting Means*
1100 – 1215	***Gas Turbine Support Systems: Description, Maintenance & Troubleshooting (cont'd)*** *Water Wash ● Power Augmentation (Steam) ● Performance Monitoring*
1215 – 1230	*Break*
1230 – 1420	***ASME PTC 22 Gas Turbine Performance Test: Guiding Principles*** *Preparations for Test ● Conduct of Test ● Test Records ● Test Validity ● Uncertainty*
1420 – 1430	***Recap***
1430	*Lunch & End of Day Two*

Day 3

0730 – 0930	***ASME PTC 22 Gas Turbine Performance Test: Instruments & Methods of Measurement*** *General Requirements ● Pressure Measurement ● Temperature Measurement ● Gas Fuel Heat Input ● Liquid Fuel Heat Input*
0930 – 0945	*Break*
0945 – 1100	***ASME PTC 22 Gas Turbine Performance Test: Instruments & Methods of Measurement (cont'd)*** *Electrical Generation Measurement ● Mechanical Power Measurement ● Speed Measurement ● Humidity Measurement ● Heat Losses ● Other Measurements*
1100 – 1215	***ASME PTC 22 Gas Turbine Performance Test: Computation of Results*** *Electrical Power Calculations ● Mechanical Power Output Calculation ● Heat Rate Calculations ● Correction of Test Results – Fundamental Performance Equations ● Application of Correction Factors ● Degradation*
1215 – 1230	*Break*
1230 – 1420	***ASME PTC 22 Gas Turbine Performance Test: Report of Results*** *General Requirements ● Summary ● Test Description ● Test Equipment ● Calculations & Results*
1420 – 1430	***Recap***
1430	*Lunch & End of Day Three*

Day 4

0730 – 0930	***ASME PTC 22 Gas Turbine Performance Test: Test Uncertainty*** *Understanding Test Uncertainty ● Unit Output & Thermal Efficiency ● Comparative Testing Uncertainty ● Uncertainty of Flow Calculation from Heat Balance*
0930 – 0945	*Break*
0945 – 1100	***Major Gas Turbine Mechanical Maintenance*** *Combustion Inspection ● Hot Gas Path Inspection ● Major Inspection ● Borescope Inspection ● Gears – Accessory and/or Load*
1100 – 1215	***Generator Overview*** *Machine Theory (Generator Basics) ● Generator Construction ● Generator Arrangement and Load Gear (if applicable) ● Weights and Center of Gravity Diagrams*
1215 – 1230	*Break*
1230 – 1420	***Generator Support Systems*** *Seal Oil ● Hydrogen Gas ● Lube Oil ● Cooling Air Inlet ● Lift/Jacking Oil ● Collector Brush Rigging/Brushless Exciter ● Coolers ● High Voltage Bushings ● Condition Monitor*
1420 – 1430	***Recap***
1430	*Lunch & End of Day Four*

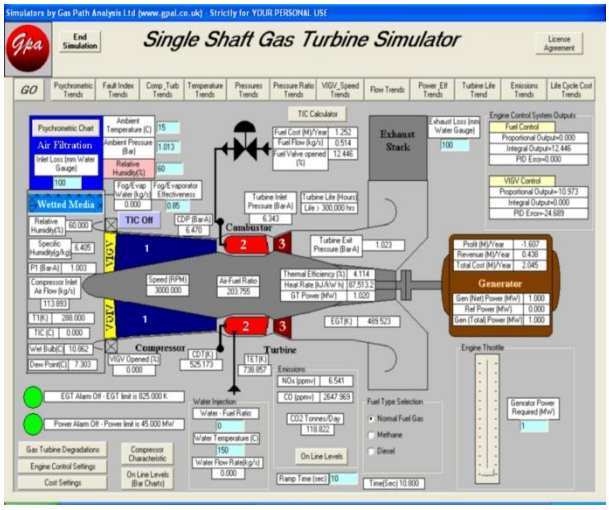
Day 5

0730 – 0930	***Generator Mechanical Maintenance*** *Rotor Removal ● Turbine Generator Alignment ● Load Gear*
0930 – 0945	*Break*
0945 – 1100	***Borescope Basics*** *Required Equipment ● Functional Use*

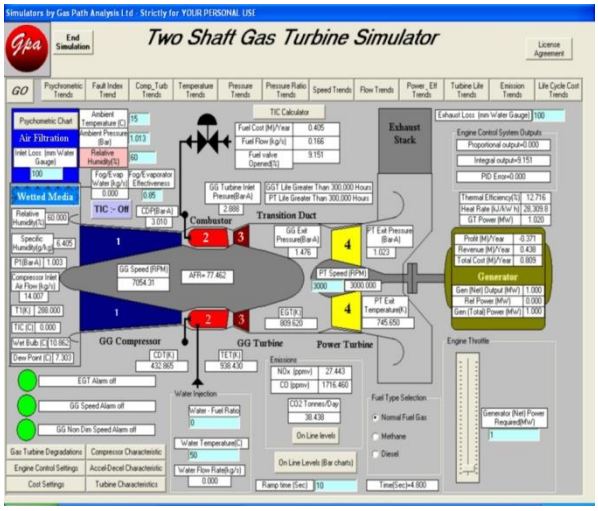
1100 – 1215	***Unit Documentation*** *Operation and Maintenance Manuals ● Reference Drawing Manuals ● TILs*
1215 – 1230	*Break*
1230 – 1345	***Maintenance Documentation***
1345 – 1400	***Course Conclusion***
1400 – 1415	***POST-TEST***
1415 – 1430	*Presentation of Course Certificates*
1430	*Lunch & End 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 "Single Shaft Gas Turbine Simulator" and "Two Shaft Gas Turbine Simulator".



Single Shaft Gas Turbine Simulator



Two Shaft Gas Turbine Simulator

Course Coordinator

Mari Nakintu, Tel: +971 2 30 91 714, Email: mari@haward.org