COURSE OVERVIEW ME0420-4D
Turbo Expander Operation, Performance, Maintenance & Troubleshooting

Course Title
Turbo Expander Operation, Performance, Maintenance and Troubleshooting

Course Date/Venue
December 09-12, 2024/Club B Meeting Room, Ramada Plaza by Wyndham Istanbul City Center, Istanbul, Turkey

Course Reference
ME0420-4D

Course Duration/Credits
Four days/2.4 CEUs/24 PDHs

Course Description

This practical and highly-interactive course includes real-life case studies where participants will be engaged in a series of interactive small groups and class workshops.

Turbo-expanders have been used for decades in hundreds of applications and are used to drive generators, pumps and compressors in the most demanding of applications. Turbo-expanders are manufactured in both radial inflow (centrifugal) and axial configurations in sizes ranging from a fraction of a HP up to 50,000 HP. The turboexpander is a centrifugal or axial flow turbine through which a high pressure gas is expanded to produce work that is typically used to drive a compressor. Because work is extracted from the expanding high pressure gas, the expansion is isentropic and the low pressure exhaust gas from the turbine is at a very low temperature, often as low as 200 K (-100 °F) or less.

Turbo-expanders are essential components in air separation plants; cryogenic processes; LNG plants; natural gas and propane pressure letdown applications - gas plants & pipeline compressor stations; geothermal applications; and waste heat recovery systems. It is common to have two or more turbo-expanders driving a single generator, pump or compressor. High-pressure turboexpanders, usually installed in pairs, are typically used to provide refrigeration for the production of cryogenic liquids.

The expander extracts work from a high-pressure gas stream providing refrigeration to the process. The work removed from the gas stream by the expander is used to provide compression power to cycle. These applications demand high efficiency and reliability at a low installed cost. The efficiency of the turboexpander has a significant impact on the cost of the cryogenic liquid produced.

Another application for turboexpanders is in power recovery from various heat sources utilizing the Rankine cycle. The heat sources presently being considered for large scale power plants include geothermal and ocean-thermal energy, while small systems are directed at solar heat, waste heat from reactor processes, gas turbine exhaust and many other industrial waste heat sources. The number of power recovery applications is steadily increasing. Large and small demonstration plants are operating, or are about to begin operation. Some of these were built to study or minimize potential problem areas for new, large power plants in the planning stage. Indeed, the potential is for large-scale utilization of such sources as ocean-thermal energy, solar heat, geothermal, waste heat, natural gas, waste gas pressure letdown, and undoubtedly others.

This course is designed to provide participants with a complete and up-to-date overview of the turboexpanders from the basic knowledge and applications to the maintenance and troubleshooting techniques. The course will cover turboexpander fundamentals; application of cryogenic turboexpanders: processes; applications of hot gas turboexpanders; overview of turboexpander construction features; rotor dynamics; construction materials; fabrication issues; installation guides; turboexpander maintenance; failure analysis and troubleshooting.

Course Objectives

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

- Perform the various process applications for turbo-expanders including energy conversion, power recovery, power absorption methods, etc
- Acquire a very good background on the fundamental application of turbo-expanders including its efficiency & sizing applications
- Identify cryogenic & hot gas turbo-expanders by discussing the processes, applications and importance in plants
- Determine the various specification and purchase of turbo-expanders
- Demonstrate the performance, operation and special features of the various types of turbo-expanders and recognize the importance in the performance of turbo-expanders
- Carryout complete maintenance & troubleshooting of turbo-expanders and identify scheduled maintenance activities as well as check seal clearances and shaft end-play efficiently
- Execute the disassembly and assembly of core unit & parts inspection
- Identify the various maintenance strategies of turbo-expanders and determine the optimized/reengineered design and economics of turbo-expanders

Who Should Attend

This course covers systematic techniques and methodologies on the operation, performance, maintenance & troubleshooting of turbo expander for the widest possible spectrum of engineering functions, including technical support, maintenance, operating and managerial personnel in process plants, refineries, air liquefaction, natural gas separation, geothermal mining, power generation and design contracting.

Course Fee

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.

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 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 **2.4 CEUs** (Continuing Education Units) or **24 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:

Dr. John Sproston, PhD, MSc, BSc, is a **Senior Mechanical & Instrumentation Engineer** with over **45 years** of industrial experience in **Engine Management System**, **Valves**, **Pumps**, **Piping System**, **Pipelines**, **Process Equipment**, **Gearboxes**, **Thermodynamics**, **Fluid Mechanics**, **Gas Turbines**, **Steam Turbines**, **Diesel & Gas Engines**, **Compressors**, **Heat Exchangers**, **Flowmeters**, **Process Control** and **Instrumentation**. He is currently a **Visiting Research Fellow** at the **University of Liverpool** (**UK**) as well as a Senior Consultant to various industries in **Europe**, **United States**, **Asia** and the **Middle East** wherein he provides consultancy services on the application, maintenance and operational constraints of flowmeters, gas turbines and diesel/gas powered engines in the oil & gas industries.

During his career life, Dr. Sproston held key positions in **Rolls Royce** where he was largely involved in the design, application, operation and maintenance of diesel/gas powered engines and **turbine blading** subject to pre-specified distributions of pressure for aircraft engines. During this period, he has also been closely involved in various aspects of **Turbomachinery**, Thermodynamics and Fluid Mechanics where he has become a **recognized authority** in these areas. Later, he joined the **University of Liverpool** in **UK** as a **Senior Professor** of Mechanical & Instrumentation Engineering Courses. A substantial part of his work has been concerned with detailed aspects of flowmetering both of **single & multiphase flows**. He has supervised doctoral research students in this area in collaboration with various European flowmeter manufacturers.

Dr. Sproston has **PhD**, **Master** and **Bachelor** degrees in **Mechanical Engineering**. He is a **Certified Instructor/Trainer** and **published** about **120 technical papers** and has contributed to **various textbooks** related to Mechanical & Instrumentation Engineering fields. He was a member and held **chairmanships** over various governmental, industrial and research committees in the Mechanical Engineering sector 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: ***Monday, 09th of December 2024***

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Process Applications for Turbo-Expanders*** *Energy Conversion • Power Recovery • Power Absorption Methods • Turbo-Expander Qualities*
0930 – 0945	*Break*
0945 – 1100	***Fundamental Applications*** *Basic Applications • Gas Path Equations & Analysis • Cryogenic Applications • Some Future Applications • Radial Reaction versus Impulse Design • Efficiency & Sizing Applications*

1100 – 1230	***Cryogenic Turbo-Expanders*** *Natural Gas Liquefaction • Ethylene Plant Expanders • Gas Treating Methods*
1230 – 1245	*Break*
1245 – 1420	***Case Studies*** *Case Study #1: Cryogenic Application to Improve Productivity* *Case Study #2: Installation of Turbo-Expanders at Old Plant*
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: Tuesday, 10th of December 2024

0730 – 0930	***Hot Gas Turbo-Expanders*** *Nitric Acid Plant Applications • Integrally Geared Process Gas Radial Turbines • Geothermal Applications • Applications in Catalytic Cracking Units •*
0930 – 0945	*Break*
0945 – 1100	***Hot Gas Turbo-Expanders (cont'd)*** *Microprocessor-Based Management Systems • Material Selection for Power Recovery Turbines • Turbo-Expander Testing • Solid Particle Erosion • Power Recovery and the Eddy Current Brake*
1100 – 1230	***Specification & Purchase of Turbo-Expanders*** *Cryogenic Turbo-Expanders • Power Recovery Expanders for FCC Units in Main Air Blower or Generator Drive Service*
1230 – 1245	*Break*
1245 – 1420	***Case Studies*** *Case Study #3: LNG Parallel Expanders* *Case Study #4: New Gas Reservoir Production with Offshore Oil Site*
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: Wednesday, 11th of December 2024

0730 – 0930	***Performance*** *Performance Data • Design Operating Conditions • Off-Design Operating Conditions*
0930 – 0945	*Break*
0945 – 1100	***Operation*** *Startup Operations • Shutdown Operations • Troubleshooting*
1100 – 1230	***Special Features*** *Active Magnetic Bearings & Dry Gas Seals • Squeeze Film Dampers • Radial Fit Bolts*
1230 – 1245	*Break*
1245 – 1420	***Case Studies*** *Case Study #5: Natural Gas Pipeline Application* *Case Study #6: Gas Separation Plant*
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:	***Thursday, 12th of December 2024***
0730 – 0930	***Maintenance & Troubleshooting*** *Scheduled Maintenance Activities • Disassembly of Core Unit & Parts Inspection • Reassembly of Core Unit*
0930 – 0945	*Break*
0945 – 1100	***Maintenance & Troubleshooting (cont'd)*** *Check of Seal Clearances & Shaft End-play • Maintenance Strategies • PRT Load Shedding Concerns*
1100 - 1230	***Maintenance & Troubleshooting (cont'd)*** *Rotor Dynamics & Vibration Analysis • Optimized/Reengineered Design & Economics*
1230 - 1245	*Break*
1245 – 1345	***Case Studies*** *Case Study #7: Ethylene Plant in Kuwait* *Case Study #8: Phenol Plant*
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*

Practical Sessions

This practical and highly-interactive course includes real-life case studies and exercises:-

Course Coordinator

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