COURSE OVERVIEW RE0150
Root Cause Analysis

Course Title
Root Cause Analysis

Course Date/Venue
April 27-May 01, 2025/TBA, Sheraton Riyadh Hotel & Towers, Riyadh, KSA

Course Reference
RE0150

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

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.

This course presents a systematic approach to fault diagnosis and failure analysis in the process, manufacturing, power generation and mining industries. A highly effective root cause failure analysis (RCFA) method is explained in detail.

The course will highlight two different approaches to fault investigation: One, addressing sporadic failures and two, solving inherent, chronic or recurring faults in equipment and systems. The course is based on the existence of three distinct levels of causes, namely immediate or physical causes, human causes and latent root causes. The course will illustrate how to perform data analysis to solve recurring failures by investigating real life equipment failure events. Participants are also encouraged to bring their own failure statistics for manual (plotting) or computerized failure pattern analysis.

Finally, it will be shown how to prepare recommendations based on faultfinding investigations and assure results by organizing effective follow-up processes. By reference to specific case studies, dealing with equipment components, centrifugal pumps and reciprocating compressors, it will be demonstrated that such a systematic program can lead to significant failure reductions and thus contribute to continuous improvement.

Upon completion of this course, participants will gain an understanding of structured, results-oriented root cause failure analysis methods. Participants will learn how parts fail and why they fail in a given mode related to cause. Participants will be able to approach the analysis of failures that happen either sporadically or chronically. They will also learn how to set up failure analysis teams and gain a thorough understanding of the importance of failure or repair data collecting. They will gain knowledge in applying statistical techniques in the analysis of available historical failure data enabling them to formulate maintenance and operating strategies. Everyone will leave with several techniques that they could apply right away in their daily work of failure fighting.

Course Objectives

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

- Apply and gain an in-depth knowledge on machinery root cause failure analysis (RCFA)
- Recognize the difference between structured problem solving and RCFA by comparing the problem-solving sequences, situation analysis, action generation, decision making and planning for change
- Identify RCFA steps, failure causes and benefits to RCFA in relation to cause analysis as well as the RCFA selection process and the failure classifications for the two-track approach
- Enumerate the different failure types and explain the three levels of cause by selecting the right failures and cost spreadsheet as well as the five P's of root cause failure analysis in collecting failure data
- List the parts and position related to RCFA which includes physical agents of failure (FRETT), metallurgical failures, piping failures and examples of equipment component failures
- Illustrate the analysis process, different levels of data analysis which includes weibull and operating deflection (FEA), and the KT approach as another way or approach to fault investigation
- Determine the human root causes including the unintended error and purposeful wrongdoing of failure to come up with the requirements for good solutions and apply computerized maintenance management systems (CMMS)
- Employ life cycle of recommendation and follow-up and recognize the importance of service factor committees and reliability teams in the stewardship of RCFA results

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 provides an overview of all significant aspects and considerations of root cause analysis and reliability improvement for maintenance, operating, manufacturing and equipment reliability professionals, supervisors, rotating equipment senior inspector, stationary equipment engineer I, and other technical staff involved in plant maintenance, operating, reliability and availability management. Personnel from process industries such as refining, petrochemical, chemical, mining, pharmaceutical, fertilizer, power, metal manufacturing, food processing and utilities will profit.

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

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:-

- 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 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 Maintenance & Reliability 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 **Modern Maintenance & Reliability** Management, **Maintenance Errors**, **Maintenance Audit & Site Inspection**, **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**), **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**, **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: ***Sunday, 27th of April 2025***

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Structured Problem Solving & RCFA*** *Problem Solving Sequences ● Situation Analysis ● Cause Analysis ● Action Generation ● Decision Making ● Planning for Change*
0930 – 0945	*Break*
0945 – 1100	***Cause Analysis*** *RCFA Steps • Failure Causes • Benefits to RCFA • Why We Don't Get Around to Doing RCFA?*
1100 – 1215	***Two-Track Approach*** *The RCFA Selection Process ● How to Determine the Vital Few ● Different Approaches to RCFA ● Failure Classifications ● Exercise: Why We Spend More Time on Problems than on Opportunities?*
1215 – 1230	*Break*
1230 – 1420	***Failure Types*** *Sporadic ● Chronic ● Examples from Your Operation*
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: ***Monday, 28th of April 2025***

0730 – 0930	***The Three Levels of Cause*** *Selecting the Right Failures ● Cost Spreadsheet ● Exercise in Selecting What Failures Need to be Addressed to Impact the Bottom Line*
0930 – 0945	*Break*
0945 – 1100	***Collecting Failure Data*** *The Five P's of Root Cause Failure Analysis ● Why a Logic Tree?*
1100 – 1215	***Parts & Position*** *Physical Agents of Failure (FRETT) ● Metallurgical Failures ● Equipment Component Failures ● Piping Failures ● Examples of Equipment Component Failures*
1215 – 1230	*Break*
1230 – 1420	***The Analysis Process*** *Describing the Failure Event ● Taking Failure Mode Inventory Building Hypotheses ● Determining the Causes ● Exercise Featuring a Valve Cap Failure on a Reciprocating Compressor*
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: Tuesday, 29th of April 2025

0730 – 0830	***Describing the Process*** *Exercise: Piston Rod Failure on a Reciprocating Process Compressor*
0930 – 0945	*Break*
0945 – 1100	***Data Analysis I*** *Scatter Plots ● Correlation ● Example Using Process Pump Failure Management Data*
1100 – 1215	***Data Analysis II*** *Weibull Analysis (Exercise Using Process Pump and Furnace Tube Failure Data) ● Modeling and Simulation*
1215 – 1230	*Break*
1230 – 1420	***Data Analysis III*** *Operating Deflection (FEA) ● Vendor Experience*
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: Wednesday, 30th of April 2025

0730 – 0930	***RCA Leadership*** *Competing Approaches to Fault Analysis ● The KT Approach ● Example of an Elusive Centrifugal Process Pump Failure*
0930 – 0945	*Break*
0945 – 1100	***Human Root Causes*** *Human Performance Reliability (HPR) ● Unintended Error ● Physical and Mental Limitations*
1100 – 1215	***Human Root Causes (cont'd)*** *Purposeful Wrongdoing ● HPR Example*
1215 – 1230	*Break*
1230 – 1420	***Solutions*** *Requirements for Good Solutions ● Purpose and Design of Computerized Maintenance Management Systems (CMMS)*
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: Thursday, 01st of May 2025

0730 – 0930	***Solutions (cont'd)*** *CMMS and its Role in Failure Analysis*
0930 – 0945	*Break*
0945 – 1100	***Stewardship of RCFA Results*** *Life Cycle of Recommendation and Follow-Up ● Service Factor Committees ● Reliability Teams*

1100 – 1215	***Stewardship of RCFA Results (cont'd)*** *Example: A Process Pump Failure Reduction Program ● Networking*
1215 – 1230	*Break*
1230 – 1345	***General Discussion, Question & Answers***
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 sessions 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 "iLearnVibration" simulator.

iLearnVibration Simulator

Course Coordinator

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