COURSE OVERVIEW FE0111
Metallurgical Laboratory Failure Examination for Refinery

Course Title
Metallurgical Laboratory Failure Examination for Refinery

Course Date/Venue
July 06-10, 2025/Florentine Meeting Room, The H Hotel, Dubai, UAE

3.0 CEUs (30 PDHs) AWARD

H-STK© INCLUDED

Course Reference
FE0111

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 learned will be applied using our state-of-the-art simulators

This course is designed to provide participants with a detailed and up-to-date overview of Metallurgical Laboratory Failure Examination for Refinery. It covers the refinery material failures and the importance of failure analysis in safety and cost management; the principles of failure analysis; the step-by-step failure investigation process and documentation and reporting practices; the metallurgical properties of refinery materials, microstructural influences on failure and the effects of temperature, pressure, and corrosive environments; the classification of failures, and failure analysis toolkit; the corrosion mechanisms in refineries.

Further, the course will also discuss the high-temperature corrosion, hydrogen damage, wear and erosion mechanisms and stress corrosion cracking (SCC); the basics of fracture surface analysis and the overload, fatigue, and brittle fractures; the microstructural analysis, chemical analysis techniques, residual stress analysis, and nondestructive examination (NDE) for failure analysis; the root cause analysis methodologies covering fault tree analysis (FTA), ishikawa (fishbone) diagrams and five whys technique; and the mechanical failures in refinery equipment, welding and fabrication defects and failures in specific refinery units.

During this interactive course, participants will learn the failure prevention strategies comprising of material selection and design considerations, process control and monitoring, inspection and maintenance best practices; the repair and remediation methods and developing failure analysis reports; the continuous improvement in asset integrity through learning from past failures, integrating failure analysis into asset management, and collaboration with design and operation teams and refinery best practices for integrity management; and the emerging trends in failure analysis consisting of AI and machine learning in failure prediction, advances in NDE technologies, industry 4.0 and digital twins and future challenges and opportunities.

Course Objectives

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

- Apply and gain comprehensive knowledge on metallurgical laboratory examination for refinery
- Identify refinery material failures and the importance of failure analysis in safety and cost management
- Discuss the principles of failure analysis and apply the step-by-step failure investigation process as well as documentation and reporting practices
- Recognize metallurgical properties of refinery materials, microstructural influences on failure and the effects of temperature, pressure, and corrosive environments
- Classify failures, apply failure analysis toolkit and discuss corrosion mechanisms in refineries
- Determine high-temperature corrosion, hydrogen damage, wear and erosion mechanisms and stress corrosion cracking (SCC)
- Explain the basics of fracture surface analysis and identify overload, fatigue, and brittle fractures
- Employ microstructural analysis, chemical analysis techniques, residual stress analysis, and nondestructive examination (NDE) for failure analysis
- Carryout root cause analysis methodologies covering fault tree analysis (FTA), ishikawa (fishbone) diagrams and five whys technique
- Assess mechanical failures in refinery equipment, welding and fabrication defects and failures in specific refinery units
- Apply failure prevention strategies comprising of material selection and design considerations, process control and monitoring, inspection and maintenance best practices
- Employ repair and remediation methods and develop failure analysis reports
- Apply continuous improvement in asset integrity through learning from past failures, integrating failure analysis into asset management, collaboration with design and operation teams and refinery best practices for integrity management
- Discuss the emerging trends in failure analysis consisting of AI and machine learning in failure prediction, advances in NDE technologies, industry 4.0 and digital twins and future challenges and opportunities

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

The course provides an overview of all significant aspects and considerations of metallurgical laboratory failure examination for refinery for materials engineers, corrosion engineers, process engineers, refinery management/executives, refinery operations and maintenance managers, metallurgists, health, safety, and environmental (HSE) professionals and other technical staff.

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:

Professor Martin Glu, PhD, MSc, BSc, is a **Senior Metallurgical Engineer** with over **30 years** of extensive teaching/training experience. His wide experiences cover in the areas of **Materials Selection & Failure Analysis**, **Welding Metallurgy**, **Heat Treatment** Techniques, **Metal Extractions & Degradation**, **Cathodic Protection & Alloy Selection**, **Pipeline Materials & Integrity** Management, **Failure Analysis & Material Testing**, Non-destructive Examination (**NDE**), **Welding & Fabrication** Defects, **Failure Prevention** Strategies, **Composite Failure**, **Failure Investigation** Process, **Wear & Erosion Mechanisms**, **Corrosion Mechanisms**, **High-Temperature Corrosion**, **Corrosion** Control & Prevention, **Corrosion** Monitoring, Stress Corrosion Cracking (**SCC**), **Corrosion Analysis** Techniques, Manufacturing Processes, Filament Winding, Fractography, Fracture Mechanics, Fracture Surface Analysis, **Material Science & Engineering**, **Refinery Material Failures**, Manufacturing Techniques of **Material Systems**, **Material** Inspection & Quality Control, **Material** Characterization & Testing, **Root Cause Analysis** Methodologies, Fault Tree Analysis (**FTA**), **Metallurgy Heat Treatment** of Metallic Structures, Metal Foam Structures, Composite Science, Composite Materials Design & Processing, Nano & Micro-Structured Composites, Reinforced Plastics & Composites, Polymer Composites and High Performance Polymers.

During his career life, Professor Glu has gained his practical and field experience through his various significant positions and dedication as the **Technical Manager**, **Metallurgical Engineer**, **Professor**, **Associate Professor**, **Assistant Professor**, **Senior Representative**, **Researcher** and **Graduate Research Assistant** for various universities such as the Innoma Innovative Materials Techonoligies Inc, İzmir Institute of Technology, University of Delaware.

Professor Glu has a **PhD** and **Master's** degree in **Materials Science and Engineering** from the **University** of **Delaware, USA** and a **Bachelor's** degree in **Metallurgical Engineering**. Further, he is a **Certified Instructor/Trainer**, an **Honorary Member** of **Composite Manufacturers Association,** a **Board Member** of **Aviation & Space Cluster Association** and a **Member** of American Society of Materials (**ASM**). He has further received various awards and honors, published and presented numerous papers and journals and delivered trainings, seminars, courses, workshops and conferences internationally.

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 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.

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 06th of July 2025***

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Overview of Refinery Material Failures*** *Common Failure Modes in Refineries • Case Studies of Significant Refinery Failures • Importance of Failure Analysis in Safety & Cost Management • Introduction to Relevant Standards (API, ASTM)*
0930 – 0945	*Break*
0945 – 1100	***Principles of Failure Analysis*** *Definition & Objectives • The Step-By-Step Failure Investigation Process • Role of Multidisciplinary Teams • Documentation & Reporting Practices*
1100 - 1200	***Material Properties & Behavior*** *Metallurgical Properties of Refinery Materials • Microstructural Influences on Failure • Effects of Temperature, Pressure, & Corrosive Environments • Case Study Analysis*
1200 – 1230	***Classification of Failures*** *Ductile versus Brittle Failures • Fatigue & Creep Mechanisms • Stress Corrosion Cracking (SCC) • Hydrogen-Induced Damage*
1230 – 1245	*Break*
1245 – 1330	***Failure Analysis Toolkit*** *Overview of Metallurgical Lab Equipment • Optical Microscopy & Scanning Electron Microscopy (SEM) • Energy-Dispersive X-Ray Spectroscopy (EDS) • Mechanical Testing Methods (e.g., Tensile, Hardness, Impact)*
1330 - 1420	***Hands-On Session: Failure Analysis Workflow*** *Demonstration of Specimen Preparation • Introduction to Microscopy for Failure Evaluation • Discussion on Initial Findings & Hypothesis Formulation*
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, 07th of July 2025

0730 – 0830	***Corrosion Mechanisms in Refineries*** *Uniform & Localized Corrosion • Pitting, Crevice Corrosion, & Galvanic Corrosion • Case Examples of Refinery Corrosion Failures • Mitigation Techniques & Material Selection*
0830 - 0930	***High-Temperature Corrosion*** *Oxidation & Sulfidation • Metal Dusting • Carburization & Decarburization • Case Studies in Hydroprocessing Units*
0930 – 0945	*Break*
0945 – 1100	***Hydrogen Damage*** *Hydrogen Embrittlement • High-Temperature Hydrogen Attack (HTHA) • Blistering & Cracking • Detection & Prevention Strategies*
1100 – 1230	***Wear & Erosion Mechanisms*** *Abrasion, Erosion, & Cavitation • Impacts of Fluid Velocity & Particulates • Material Behavior Under High Wear Conditions • Case Studies of Refinery Equipment Failures*
1230 – 1245	*Break*
1245 - 1330	***Stress Corrosion Cracking (SCC)*** *Mechanisms & Contributing Factors • SCC in Carbon Steel & Stainless Steel • Methods of Detection & Control • Case Histories*
1230 – 1420	***Lab Exercise: Corrosion Analysis Techniques*** *Surface Examination of Corroded Specimens • Corrosion Pit Measurement Using Microscopy • Use of X-Ray Diffraction for Phase Analysis • Interpretation of Results*
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, 08th of July 2025

0730 – 0830	***Fractography*** *Basics of Fracture Surface Analysis • Identifying Overload, Fatigue, & Brittle Fractures • SEM Applications in Fractography • Case Examples of Fracture Evaluations*
0830 - 0930	***Microstructural Analysis*** *Metallography Techniques & Etching • Interpreting Microstructures of Carbon & Alloy Steels • Heat-Affected Zones & Weld Failures • Case Studies*
0930 – 0945	*Break*
0945 – 1100	***Chemical Analysis Techniques*** *Optical Emission Spectroscopy (OES) • X-Ray Fluorescence (XRF) • Elemental Analysis Using EDS • Practical Session on Alloy Composition Identifiation*
1100 – 1230	***Residual Stress Analysis*** *Importance of Residual Stress in Failure Mechanisms • X-Ray Diffraction & Hole Drilling Methods • Interpretation of Stress Maps • Case Applications in Refinery Equipment*

1230 – 1245	Break
1245 - 1330	***Nondestructive Examination (NDE) for Failure Analysis*** *Magnetic Particle Inspection (MPI) • Ultrasonic Testing (UT) • Radiography (RT) & Eddy Current Testing (ECT) • Integration of NDE Results in Failure Investigations*
1230 – 1420	***Lab Session: Advanced Techniques*** *Demonstration of SEM/EDS • Practical Use of OES & XRF • Analysis of Real-World Failure Samples*
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, 09th of July 2025

0730 – 0830	***Root Cause Analysis Methodologies*** *Fault Tree Analysis (FTA) • Ishikawa (Fishbone) Diagrams • Five Whys Technique • Practical Exercises*
0830 - 0930	***Mechanical Failures in Refinery Equipment*** *Failures in Pressure Vessels & Piping • Rotating Equipment & Pump Failures • Heat Exchanger Failures • Case Studies & Lessons Learned*
0930 – 0945	*Break*
0945 – 1100	***Welding & Fabrication Defects*** *Common Welding Flaws (e.g., Porosity, Cracks) • Inspection Techniques for Weld Quality • Case Examples of Weld Failures • Repair & Prevention Strategies*
1100 – 1230	***Failures in Specific Refinery Units*** *Hydrocracker & Catalytic Reformer Units • Crude Distillation Column Failures • Delayed Coker Unit Case Studies • Mitigation & Design Improvements*
1230 – 1245	*Break*
1245 - 1330	***Case Study Analysis*** *Group Exercise on Real-World Failure Investigations • Identification of Root Causes • Recommendations & Preventive Measures • Presentation & Discussion*
1230 – 1420	***Hands-On Session: Mock RCA Exercise*** *Analyze a Provided Failure Scenario • Apply RCA Tools to Identify Issues • Develop a Failure Analysis Report*
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*

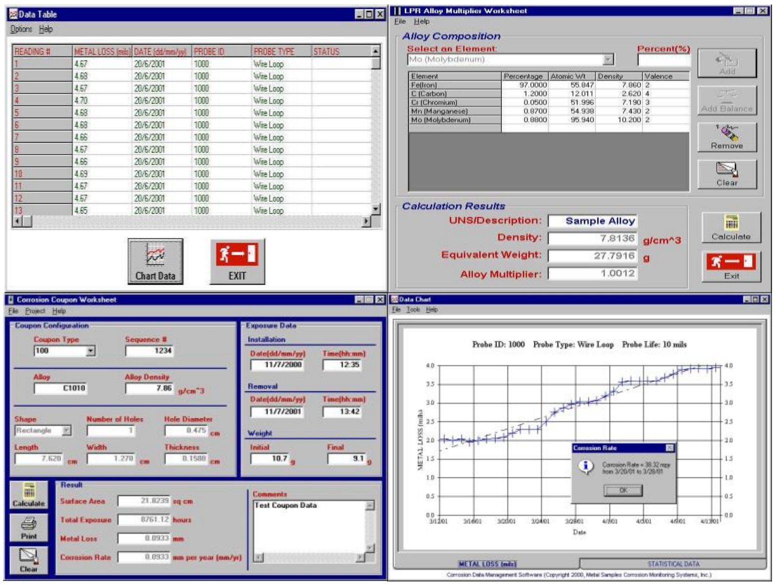
Day 5: Thursday, 10th of July 2025

0730 – 0830	***Failure Prevention Strategies*** *Material Selection & Design Considerations • Process Control & Monitoring • Inspection & Maintenance Best Practices • Real-World Examples*
0830 - 0930	***Repair & Remediation Methods*** *Welding & Heat Treatment for Repairs • Coating & Cladding Solutions • Replacement versus Repair Decision-Making • Standards & Guidelines*

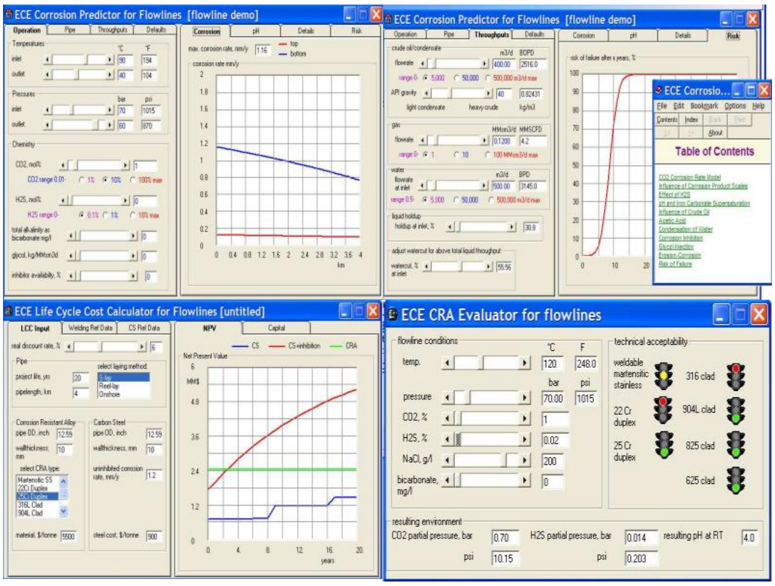
0930 – 0945	*Break*
0945 – 1100	***Developing Failure Analysis Reports*** *Structure & Key Components of a Report • Visual Aids: Photos, Diagrams, & Charts • Common Pitfalls in Reporting • Peer Review & Communication Strategies*
1100 – 1230	***Continuous Improvement in Asset Integrity*** *Learning from Past Failures • Integrating Failure Analysis into Asset Management • Collaboration with Design & Operation Teams • Refinery Best Practices for Integrity Management*
1230 – 1245	*Break*
1245 – 1345	***Emerging Trends in Failure Analysis*** *AI & Machine Learning in Failure Prediction • Advances in NDE Technologies • Industry 4.0 & Digital Twins • Future Challenges & Opportunities*
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 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 simulators “Corrosion Data Management Software (CDMS)” and “Electronic Corrosion Engineer (ECE®) 5”.



Corrosion Data Management Software (CDMS)



Electronic Corrosion Engineer (ECE®) 5

Course Coordinator

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