

Scandinavian Academy Training Center

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Course: Process Equipment & Piping Systems Failures, Failure Prevention and Repairs

Code	City	hotel	Start	End	price	Language - Hours
OG-485SA	Abha	Hotel Meeting Room	2027-10-31	2027-11-11	22450 SR	En - 50

The Course

The mechanical integrity and reliability of process equipment and piping systems can only be achieved if they are designed by competent engineers and operated and maintained effectively within the design envelope, namely, the integrity operating window (IOW).
This course provides the appropriate mix of fundamentals, methodologies, best industry practices, and practical tools to enhance the competencies and improve the performance of design, operation and maintenance technical professionals individually and collectively with the objective of adding value to the organization and improving the plant safety and reliability.

Module 1 - Process Equipment & Piping Systems: Application, Design & Operation
Module 2 - Process Equipment & Piping Systems: Failures, Failure Prevention and Repairs

The Goals

The key objectives of this comprehensive course are as follows:

- To increase the participants` awareness and understanding that mechanical integrity of process equipment and piping systems depends jointly on the proper design, operation, condition assessment, and maintenance of the equipment, underscoring their vital individual and team roles in managing change.

- Provide participants with practical and sound methods and tools to enable them to carry out basic design calculations for pressure equipment in accordance with applicable industrial codes, standards and best practices.
- To provide the participants with a clear understanding of the degradation mechanisms that process equipment could be subjected to over their operating life, how to identify them, predict and determine their impact, and what appropriate measures can be taken to prevent and control the resultant damage.
- To provide the participants with the knowledge and failure analysis skills they need to conduct damage and failure analysis so as to prevent similar failures from happening.
- To enhance the knowledge and skills of the participants in hazard identification and analysis; and in risk assessment and management.

The Delegates

This is a `core` course for the professional development of engineers, technical professionals, operations and maintenance personnel involved in design, projects, operation, inspection and maintenance of oil & gas plants, oil refineries & petrochemical plants, and power plants.
New graduates will gain essential and integrated knowledge about pressure equipment and piping systems design and the significance of appropriate design, operation and maintenance on their mechanical integrity.

The Process

The course combines structured and focused presentations and discussions of topics covered with actual relevant worked examples to enforce the learnings. It combines sound engineering principles, methods, applicable industry codes & standards and best industry practices with workshops that cover case studies of major failures and their root causes with particular emphasis on the learnings from these incidents to prevent similar failures.
To maximize learnings, optional Question & Answer sessions are available at the end of

each day to avail participants the opportunity to ask the instructor one-on-one questions relating to the topics discussed as well as to other work related problems they may experience.
All delegates will receive a detailed set of course presentation and lecture notes which will provide an invaluable reference document.

The Benefits

- Delegates will enhance their knowledge and expertise in pressure equipment and piping system design, and will be equipped with structured procedures and effective guidelines to perform design calculations.
- Participants will gain a sound working knowledge of the interdependence of design, operation, and maintenance on integrity, reliability and cost-effectiveness of piping systems.
- Participants will extend their knowledge of the requirements and application of relevant sections of the ASME Boiler and Pressure Vessel Code and B31 Piping Codes, as well as relevant API Codes, standards, and Recommended Practices such as API 510 and 570 in pressure equipment and piping system design, operation, inspection repairs and alterations.
- The delegates will gain sound and practical understanding of the major degradation mechanisms that affect process equipment and piping systems, how to predict them, how to assess their impact on process equipment over their operating life, and how to prevent and control these degradation and damage mechanisms using best industry practices including API 571 and API 580.
- Participants will add to their ability and skills in process equipment and piping failure detection and analysis, estimating failure consequences, and conducting level 1 fitness-for-service assessments in accordance with API/ASME 579.

The Results

- This course will help the company achieve measurable improvement in mechanical integrity, as demonstrated by reduction in failure incidents, through improved

competency in design as well as through effective interaction and collaboration between the engineering, operation and maintenance functions. As a result, company will be able to enhance its loss prevention and safety performance.

- The company will be able to enhance its ability to use risk-based inspection & maintenance, fitness-for-service assessments, and risk assessment methodologies to quantify and prioritize risks, and to allocate resources for optimum benefit. This will result in lower life cycle costs while complying with codes, standards, and other regulatory requirements.

The Core Competencies

Delegates will enhance their competencies in the following areas:

- Working knowledge in mechanical design of pressure equipment and piping systems in compliance with applicable codes, standards, and regulations - ASME B&PVC Section VIII, B31.3
- The inter-dependence of design, operation, and maintenance for achieving mechanical integrity of pressure equipment and piping systems
- Understanding, prediction and Identification and assessment of active degradation mechanisms and the failures they may cause
- Failure investigation techniques and root cause analysis
- Application of risk-based methodologies in inspection and maintenance - API 580
- NDT methods and their effective application - ASMEB&PVC Section V
- Performing Level 1 fitness-for-service assessments - API 579
- Engineering materials properties and selection criteria for specific applications
- Hazard identification and risk analysis and management

The Programme Content

Module 1:

Process Equipment and Piping Systems: Application, Design & Operation

Key Design Considerations, Guidelines and Practices

- Process Equipment - An Overview
- Plant Integrity and Reliability
  - Interdependence of engineering, operation and maintenance
  - Management of change
- Fitness for Purpose
  - Service conditions, equipment sizing and functional performance
  - Business-Focused-Facilities – Appropriate quality at lowest life cycle cost
- Safety by Design
  - Worst foreseeable credible scenarios, safeguarding, best industry practices
  - Codes, Standards, Industry Practices
- Compliance with Regulations and Acts - HS&E requirements and considerations

Design and Operation of Pressure Equipment

- Pressure Vessels and Reactors
  - Materials of construction and standards
  - Basic Design Methodology
  - ASME Boiler and Pressure Vessel Code Sections 2, 5, 8 and 9
  - Worked examples
- Storage Tanks
  - Types and application; cone roof tanks, floating roof tanks
  - Basic design methodology
  - Overview of API 650
- Piping Systems

- Materials of construction and standards
- Basic Design Methodology – hydraulic design, pressure integrity, mechanical integrity
- ASME B31.1 and B31.3
- Piping flexibility and support
- Piping system components – valves and fittings; classes, ratings
- Worked Examples

- Overpressure Protection
  - Types and application of pressure relieving devices
  - Code requirements
  - Sizing methodology: API 520 and 521
  - Specific operation and maintenance requirements: API 576

Design and Operation of Thermal Equipment

- Process Heaters
  - Types and configuration; box type, vertical cylindrical type
  - Thermal and mechanical design
  - API 560, API 530
- Boilers
  - Types and configuration; watertube, firetube and waste heat recovery boilers
  - Fundamentals of design and operation
  - Operating efficiency and testing
  - ASME B&PVC Section 1 and Section 4, ASME PTC-4
- Heat Exchangers
  - Types and application; Shell & Tube Heat Exchangers, Plate Heat Exchangers, Air Cooled Heat Exchangers
  - Thermal and mechanical design
  - Overview of TEMA standards, API 660, API 661
  - Operation, fouling, and effectiveness

Design and Operation of Fluid Handling Equipment

- Pumps
  - Types and application; Centrifugal, Positive Displacement
  - Performance characteristics
  - Selection and design considerations and standards; ANSI, API 610
  - Worked examples
- Compressors
  - Types and application; Centrifugal, Screw, Reciprocating
  - Design considerations and standards
  - Operation and troubleshooting
- Electric motors
  - Types and application
  - Operation and troubleshooting
- Condition Monitoring
  - Vibration monitoring
  - Lubricating oil analysis
- Troubleshooting
  - Methodology and guidelines
  - Reliability improvement

Degradation and Condition Assessment of Process Equipment

- Degradation processes
  - Corrosion, erosion, fatigue, hydrogen attack
  - Overview of API 571
- Industrial Failures and Failure Prevention
- Inspection and Testing
  - Inspection strategies, plans and coverage – Real function of inspection
  - Nondestructive Testing (NDT) methods and their characteristics and applicability
  - Risk Based Inspection (RBI)
  - Overview of API 580 and API 581
- Fitness-For-Service Assessment
  - Overview of API 579

- Worked examples
- Maintenance Strategies and Best Practices
  - Optimum mix of reactive, preventive and predictive methods
  - Reliability Centered Maintenance (RCM)

Module 2:

Process Equipment & Piping Systems: Failures, Failure Prevention & Repairs
Failure Mechanics

- Wear & Failure Mechanisms
  - Imperfections and Defects
  - Corrosion Mechanisms
- Failure Modes
  - Fatigue
  - Fretting
  - Creep & Thermal fatigue
  - Stress Corrosion Cracking, Other modes
- Material properties, and selection
  - Carbon & Alloy steels
  - Nickel, Titanium, and Specialty alloys
  - Aluminum, aluminum alloys
  - Copper, copper alloys
  - Plastic piping
  - Alternative options-linings, cladding
  - Limitations and safeguards
  - Material selection - economics-life cycle costing

Failure Prevention By Design

- Failure Causes - Design, Operation; Maintenance, Other Causes

- Material properties, and selection
    - Physical properties and limitations of components
    - Physical properties of steel and alloy piping and tubing
    - Physical properties of fittings
- Basic Design
    - Pressure Vessels
    - Piping Systems
    - Liquid Storage Tanks
- Operation and Maintenance of Process Equipment
- Damage Mechanisms Affecting Process Equipment

Process Equipment Failures

- Failures in Pressure Vessels, Piping and Boilers
- Strength reduction through material loss
- Case histories
- Piping System Vibration
- Mechanical & Flow Induced Resonance
- Transient Hydraulic pulsation
- Pipe supports and restraints
- Wind Loading
- Industry Practices for Failure Prevention

Inspection, Assessment and Maintenance

- Inspection Strategies Plans and Procedures - Risk Based Inspection (API 580)
    - Developing an RBI Plan
    - Fitness-For-Service Assessment(API 579)
- NDT Methods and Techniques
    - Probability of Detection
    - Damage Characterization
    - Selecting the correct technique(s)
- Pigging of Pipelines

- Smart pigging
- Cleaning
- Operational procedures

Operation and Maintenance

- Maintenance Programs
- Repair and Alteration of Pressure Equipment and Piping
  - Rerating Piping and Pressure Vessels
  - Estimation of Consequences of Pressure Vessels and Piping Failures
- Failure Analysis Techniques

The Scandinavian Academy for Training Center adopts the latest scientific and professional methodologies in training and human resource development, aiming to enhance the efficiency of individuals and organizations. Training programs are delivered through a comprehensive approach that includes:

- Theoretical lectures supported by PowerPoint presentations and visual materials (videos and short films).
- Scientific evaluation of participants before and after the program to measure progress and knowledge acquisition.
- Brainstorming sessions and practical role-playing to simulate real-life scenarios.
- Case studies tailored to align with the training content and participants work nature.
- Assessment tests conducted at the end of the program to evaluate the achievement of training objectives.

Each participant receives the training material (both theoretical and practical) in printed form and saved on a CD or flash drive. Detailed reports, including attendance records, final results, and overall program evaluations, are also provided.

Training materials are prepared professionally by a team of experts and specialists in various fields. At the end of the program, participants are awarded a professional attendance certificate, signed and accredited by the Scandinavian Academy for Training Center.

Program Timings: 9:00 AM to 2:00 PM

The program includes:

- A daily buffet provided during the sessions to ensure participants comfort.
- A closing ceremony on the final day to distribute certificates and celebrate participants achievements.
- **Note: All prices are exclusive of 15% Value Added Tax (VAT).**

Our Success Partners

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