

# Understanding and Preventing Process Equipment Failures

## INTRODUCTION

- Process equipment, structures and piping systems may be subjected to severe service conditions including high constant or fluctuating stresses, extreme temperatures and various types of corrosion. This could cause loss of structural integrity, leading to degradation and damage. If such damage is not detected and assessed in a timely manner, it could result in catastrophic failures with potentially enormous consequential losses of life and assets.
- To ensure that engineering systems are capable of handling the service conditions in all foreseeable operating scenarios, they must first be designed through the selection of appropriate materials of construction and in accordance with recognized design methodologies and codes.
- It is also important to incorporate safeguards and controls to prevent operation outside the "design and operational envelope" and to inspect the process equipment with the view to detect any damage, characterize it, and assess its impact on the equipment "Fitness For Service".
- This comprehensive and structured Understanding and Preventing Process Equipment Failures training seminar aims at providing a clear understanding of the major degradation mechanisms that process equipment and systems will be subjected to during their operating life, how to identify them, their effect on the integrity of the equipment and what appropriate measures can be taken to prevent and control the resultant damage.

This training seminar will feature:

- Main aspects of mechanical testing of structures
- Knowledge of the main types of structural failure
- Aspects of structural integrity and mitigation techniques
- Safe control and best practice use of engineering equipment
- Inspection and non destructive methods

## OBJECTIVES

- Understanding and prediction of the degradation mechanisms that affect process equipment fitness for service and could result in significant potential failures
- The inter-dependence of design, operation, and maintenance for achieving mechanical integrity of mechanical equipment
- Have a sound knowledge of the various types mechanical failure mechanisms, including fracture mechanics, Fatigue, Creep and corrosion
- Understand the basic concepts of inspection and NDT methods and their effective application
- Be familiar with relevant failure mitigation principles

## TRAINING METHODOLOGY

- This Understanding and Preventing Process Equipment Failures training seminar will be conducted along workshop principles with formal lectures and interactive worked examples included in relevant workshops. The emphasis in this training seminar will be on the explanation of all technical phenomena and providing answers to problems that are encountered in everyday industrial practice related to structural failure and mitigation techniques.
- There will be ample opportunities for active discussion and sharing professional experiences and exchange that will help solidify the gained knowledge.

## ORGANISATIONAL IMPACT

- The company will achieve improved mechanical integrity and availability of the equipment and piping systems
- Damage to process equipment and risk due to failure will be significantly reduced
- Reduction in cases of uncontrolled changes through better understanding of the significance and interdependence of design, operation and maintenance on integrity of the process equipment
- Improved competencies will result in higher staff productivity and effectiveness
- Learnings from failure investigations would prevent recurrence of failures
- The company will achieve improvement in loss prevention and safety as well as in financial performance

## PERSONAL IMPACT

- Participants will gain sound and practical understanding of the major degradation mechanisms in various industries, 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
- Participants will extend their knowledge about prevention of damage to process equipment through the effective application of key design, operation, maintenance, and integrity fundamentals and practices
- Participants will extend their knowledge about inspection and testing strategies and methods and their effective application to achieve the highest probability of detection of damage and defects

## WHO SHOULD ATTEND?

This training seminar is intended for:

- Staff who use or supervise activities requiring the selection, design / fabrication or use of mechanical equipment or component parts
- Engineers who seek a basic understanding of the practical aspects of evaluation of structural integrity
- Operation, Technical Service and Maintenance Professionals from various processing plants involved in everyday operation, control, inspection and maintenance of equipment
- Engineers and Consultants dealing with planning of new production plants, retrofitting plants and introducing new technologies
- Technical Professionals responsible for maintenance and repair of equipment
- Project and Asset Managers

## Course Outline

### Materials Testing and Failure

- Course Objectives and Overview
- Materials Testing – Tensile, Impact, Hardness
- Types of Failures – Ductile / Brittle Fracture, Temperature Effects
- Analytical Tools – Visual Examination of Fracture Surface, Fractography, Microscopy
- Industrial Failures – Examples of Failures and Causes

### Damage and Interpretation of Failure I

- Stress Concentrating
- Fracture Mechanics
- Fatigue Failure
- High Temperature Creep
- Thermal Expansion and Deflections
- Worked Examples

### Damage and Interpretation of Failure II

- Wear, Galling and Fretting
- Principles and Types of Corrosion Damage and Mitigation
- Vibration of Equipment and Piping
- Vibration Condition Monitoring
- Technical Problem Solving and Decision-making Approaches

## Examples of Equipment Failure

- Pressure Vessels and Life Extension
- Heat Exchangers
- Pumps and Compressors
- Mechanical Seals and “O” Ring Failures
- Bearing Failure
- Pipes and Repair Techniques

## Inspection, Testing and Condition Assessment

- NDT Methods and Techniques
- Inspection of Process Equipment
- Examples of Remaining Life Calculations
- Relevant Inspection Codes, API 570, etc.
- Course Summary and Wrap-up