



Maintenance Of Process Plant And Equipment



Introduction:

- Pressure vessels, heat exchangers, above ground atmospheric storage tanks, and piping systems typically represent over half the capital investment in a process plant. Mechanical engineers at end-user locations or in central engineering organizations are often responsible for the evaluation and maintenance of all these items, not just one or two
- The purpose of this programme is to present the requirements of the relevant industry standards and practices to the maintenance of pressure vessels, heat exchangers, piping systems, and aboveground atmospheric storage tanks; develop inspection and maintenance programmes for process plant equipment and piping systems; and prepare appropriate details for repairs and alterations to process plant equipment and piping systems
- The fundamental principles of fluid behaviour are first introduced, then applied to all of the various equipment and systems comprising production operations. Emphasis is on understanding the internal workings inside the piping, valves and vessels

- A major goal of this programme is to improve communication among the technical disciplines, field and office in order to enhance operational efficiencies, lower costs and improve production economics. Daily sessions include formal presentation interspersed with directed discussion and problem solving

Who Should Attend?

- Engineers, managers, and others who are responsible for the inspection and maintenance of pressure vessels, heat exchangers, aboveground atmospheric storage tanks, and piping systems
- Engineers who are responsible for fitness-for-service evaluations
- Maintenance Engineers and Technicians involved with repair and inspection of process equipment

Pre-Requisite:

Programme participants should already have a good fundamental understanding of the mechanical design requirements for these equipment items

Training Methodology:

Maintenance of Process Plant and Equipment is a hands-on, stimulating learning experience. The programme will be highly interactive, with opportunities to advance your opinions and ideas. Participation is encouraged in a supportive environment. To ensure the concepts introduced during the programme are understood, they will be reinforced through a mix of learning methods, including lecture style presentation, and open discussion. The programme will be presented with the use of PowerPoint slides and videos. This will be augmented by case studies and facilitated discussions, to engage the delegates and to encourage the exchange of ideas.

Programme Summary:

This programme describes the requirements for efficient, effective, and safe maintenance of process plant and equipment. This material is covered by concentrating only on the most commonly applied topics in each case, rather than attempting to discuss everything.

Therefore, participants receive broad, practical training in a single programme rather than having to attend multiple programmes. This maximizes their learning in a relatively short amount of time. The material presented demonstrates some concepts that are not always shown or described in textbooks.

The programme emphasis is on developing a practical understanding of the maintenance requirements for fixed equipment and piping systems in process plant applications. Sample problems and participant exercises are included throughout the programme to illustrate the concepts discussed and provide the participants with practice in applying them.

Course Objectives:

Upon completion of this programme, participants will be able to apply the requirements of the relevant industry standards and practices to:

- The maintenance of pressure vessels, heat exchangers, piping systems, and aboveground atmospheric storage tanks
- Develop inspection and maintenance programmes for process plant equipment and piping systems
- And prepare appropriate details for repairs and alterations to process plant equipment and piping systems

Course Outline:

DAY 1 - Overview

- Deterioration Mechanisms
- Fitness-for-Service Assessments
- Pressure Vessel Maintenance
- Pressure Vessel Integrity Program
- Overall Risk Assessment
- Inspection Plan
- Fitness-for-Service Assessments

- Overview of API RP 579 requirements
- Data Requirements

DAY 2 - Assessment methods and acceptance criteria

- **API-510 Requirements**
 - ❖ Scope
 - ❖ Definitions
 - ❖ Pressure Vessel Inspection Practices
- Causes of Vessel Deterioration
- Inspection Intervals
- Corrosion Rate Determination
- Evaluating Corroded Pressure Vessels for Continued Operation
- **Determining Minimum Actual Thickness**
 - ❖ Acceptability of Corroded Area
 - ❖ Brittle Fracture Assessment
 - ❖ Fracture Toughness Determination
- Brittle Fracture Evaluation of Existing Equipment
- Details for Welded Repairs and Alterations
- Classification of Repairs and Alterations
- Welding and Design Requirements
- Defect Repairs
- Rerating Pressure Vessels
- Changes to Original Design Conditions
- Hydrotest Requirements
- Glossary
- Heat Exchanger Maintenance
- Evaluating the Suitability of Corroded Components

- DAY 3 - Typical maintenance and inspection procedures
- **Leaks**
 - ❖ Locating Leaks
 - ❖ Leak Repairs
 - ❖ Retubing Considerations
 - ❖ Typical Cleaning Methods
- Tube Inspection Techniques
- Rerating Exchangers
- Piping System Maintenance
- **Piping Materials and Modes of Failure**
 - ❖ Materials Considerations
- Corrosion Rate and Remaining Life Calculation
- Cracking Mechanisms in Piping
- Piping Deterioration
- Piping Inspection and Evaluation
- API-570 Requirements
- Piping Inspection Planning and Data Analysis
- **Inspection Techniques for Piping and Components**
 - ❖ Piping Retirement
 - ❖ Piping System Repair, Alteration, Rerating, and Pressure Testing
- **Valve Repair and Maintenance**
 - ❖ API-570 Piping Repair, Alterations, Rerating, and Testing Requirement
 - ❖ Piping System Repair
 - ❖ Piping System Alterations and Rerating
 - ❖ Pressure Testing After Repairs or Alteration

- ❖ Flange Joint Assembly and Bolt Up Procedure
- ❖ Establish Flange Joint Categories
- ❖ Identify and List Flange Joints in Critical Services
- ❖ Determine Required Bolt Type and Material
- ❖ Select Bolt Tightening Method
- ❖ Develop Flange Joint Assembly and Bolt Up Procedures
- Procedure qualification
- Crew qualification
- **Hot Bolting**
 - ❖ Additional leakage control procedures
- **Guidelines for Hot tapping (Pressure Tapping)**
 - ❖ Necessary Conditions for Performing a Hot Tap
 - ❖ Hot Tap Design Considerations
 - ❖ Selecting the Hot Tap Site
 - ❖ Installation
 - ❖ Inspection
 - ❖ Pressure Tests Before Cutting Pipe
 - ❖ Hot Tap Operations
 - ❖ Special Safety Considerations
 - ❖ Hot Tap Machines

DAY 4 - Above ground storage tank maintenance

- Introduction
- Scope of API-653
- Definitions
- Starting an API-653 Compliance Program
- **Tank Inspection**

- ❖ Objectives
- ❖ Prioritization
- ❖ Inspection Frequencies
- ❖ Record Keeping
- ❖ Inspector Qualifications
- ❖ Tank Component Evaluation
- ❖ Shell
- ❖ Bottom
- ❖ Roof
- ❖ Foundation
- ❖ Shell and Bottom Settlement
- ❖ Tank Repair and Alteration
- ❖ General Considerations
- ❖ Material Considerations

DAY 5 - Rotating Equipment

- **Pumps**

- ❖ Pump Bearing Removal & Installation
- ❖ Bearing Failure Analysis
- ❖ Simple Vibration Measurement
- ❖ Troubleshooting Guide

- **Turbines**

- ❖ Maintenance of Gas Turbine Systems
- ❖ Lube Oil System Description/Maintenance
- ❖ Hydraulic Oil System Description/Maintenance
- ❖ Fuel Systems Description/Maintenance
- ❖ Starting Systems Description/Maintenance
- ❖ Cooling and Sealing Air Description/Maintenance

- ❖ Additional Systems Description/Maintenance

- **Compressors**

- ❖ Reciprocating compressors

- ❖ Rotary compressors

- ❖ Centrifugal compressors

- **Compressor selection**