€TRAINING

Inspection, Evaluation and Repair of Process Plant Equipment and Connected Piping

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Introduction:

Petroleum refineries, petrochemical, and process plants have hundreds of pieces of equipment and thousands of meters of piping that handle hazardous and corrosive fluids and operate a wide range of temperatures and pressures. Plant integrity and reliability can only be achieved if this equipment and connected piping are designed properly and they remain fit for continued service between scheduled turnarounds.

The design and fabrication of process equipment and piping systems are carried out by industry codes and standards. Fabrication and welding processes are subjected to defined examinations and inspections to ensure that any deficiencies found are resolved to meet the acceptance criteria of the respective codes.

Once the new equipment and piping are put in service, they get exposed to the process fluids and start to undergo deterioration such as corrosion at various rates depending on the materials of construction and service conditions. It is therefore essential to know their current condition and the degradation rate so that appropriate repairs and maintenance can be carried out on time to prevent failures. Effective inspection and evaluation of the inspection data are vital for this purpose. The integrity of the plant cannot be achieved without effective inspection.

Regular and reliable inspections are an integral part of any effective industrial plant maintenance program. The success of such a program relies greatly on the Non-Destructive Inspection NDT or NDE or NDI techniques used. Non-destructive inspection NDT techniques detect flaws that can cause potential failure in the future. This way, NDT provides information on the integrity of the pipeline as well as a measure of its current safety margin. Hence, it is important to understand the scope and limitations of the common and advanced NDE tools that are available to maximize the effectiveness of each of the scheduled inspection activities.

Furthermore, in today s competitive environment plant operators need to reduce maintenance costs by minimizing downtime. Effective inspection contributes significantly to this objective

Course Objectives:

At the end of this course the participants will be able to:

- Understand the damage and degradation mechanisms that affect process equipment and piping and progressively adversely affect their condition and fitness for continued service.
- Understand that effective inspection is the backbone of plant integrity and that it has a significant impact on EHS and the financial performance of the company
- Increase the awareness of industry codes and best practices related to inspection, repair, and alteration of process equipment and piping including ASME BPVC and various API codes, standards, and recommended practices.
- Provide a sound and concise coverage of fitness-for-service assessment methodologies and API/ASME FFS standards to enable making run/repair/replace decisions about the damaged equipment/piping
- Cover the main industry codes and practices for repairs and alterations to achieve business focused repairs and lower maintenance costs
- Provide methodologies for performing fitness-for-service assessments of damaged equipment/piping to make run/repair/replace decisions

Targeted Audience:

- Process, Mechanical and Chemical Engineers
- Operation and Maintenance Engineers
- Project Engineers
- Supervisors and Managers
- Technical Personnel involved in the inspection

Course Outlines:

Unit 1: Inspection of the Backbone of Plant Integrity:

- Significance of inspection throughout the life cycle
- Inspection - Why? What? Where? How? When?
- The real function of inspection
- Regulatory requirements
- Impact on plant integrity, safety, reliability, and business performance
- Inspection and the construction codes
- Manufacturing, fabrication, and repair/alteration deficiencies
- QA/QC requirements in fabrication and welding
- ASME BPVC requirements - Examination vs. inspection
- ASME Code Case 2235-3 for Use of Ultrasonic Examination instead of Radiography
- Fraudulent/substandard materials in code construction
- Degradation and damage mechanisms affecting pressure equipment and piping
- Overview of API 571- Damage Mechanisms Affecting Fixed Equipment in the Refining Industry
- Areas of vulnerability in petroleum refineries
- Injection points
- Corrosion under insulation CUI
- Soil-to-air interface
- Integrity of structures and supports
- In-service inspection - the big picture
- Non Intrusive Inspections
- Shutdown inspections
- Inspector qualification and competence
- API inspector certification
- API Body of Knowledge

Unit 2: Inspection Strategies, Plans, Methods, and Techniques:

- Inspection Strategies and Systems
- External and internal inspections - limitations, costs, and benefits
- Inspection plans and procedures
- Statutory requirements
- Risk-based inspection RBI
- Fundamentals and benefits
- Overview of API RP 580 - Risk-Based Inspection
- Overview of API RP 581 - Risk-Based Inspection Technology
- Non-destructive testing NDT
- Highlights of main NDT methods and their application
- Overview of ASME BPVC Section V - Nondestructive Examination
- Advanced Inspection Techniques and best practices
- Guided Wave Ultrasonic Long Range Inspection
- Advanced Phased Array for weld inspection
- On-line monitoring - Sensors typically used are strain gauges, thermocouples, displacement transducers,

and pressure transducers.

Unit 3: Inspection Codes Standards and Best Practices:

- Pressure vessel inspection - API 572, API 510
- Fired boilers and heaters inspection
- API 573 - Inspection of Fired Boilers and Heaters
- ABSA AB 507 - Guidelines for the Inspection of Installed fired Heaters
- FTIS -Furnace tube inspection system Quest TruTec
- Inspection of Heat Exchanger, Condenser & Fin Fan Coolers Tubes
- Aboveground storage tanks inspection
- ANSI/API RP 575 - Guidelines and Methods for Inspection of Existing Atmospheric and Low-pressure Storage Tanks, Second Edition
- STI SP001- Standard for Inspection of Aboveground Storage Tanks
- API 653 - Tanks Inspection, Repair, Alteration, and Reconstruction
- API 12R1, Setting, Maintenance, Inspection, Operation, and Repair of Tanks in Production Service
- Piping and components inspection
- API 574 - Inspection Practices for Piping System Components
- API 570 - Piping Inspection Code: In-service Inspection, Repair, and Alteration of Piping Systems
- Pressure-relieving devices - Code and regulatory requirements and best practices
- API RP 576 - Inspection of Pressure-Relieving Devices
- Pressure testing - Code requirements and best practices
- Hydrostatic testing
- Pneumatic testing
- API Standard 936 - Refractory Installation Quality Control Guidelines - Inspection and Testing Monolithic Refractory Linings and Materials
- API Inspector Certification

Unit 4: Evaluation and Analysis of Inspection Data:

- Inspection data verification and evaluation
- Data completeness
- Data quality
- Data Management and Risk Assessment
- Inspection Data Management System IDMS
- Software System for Managing and Assessing Inspection Data
- Reliable assessment of damages
- Corrosion Rate calculations
- Remaining Life Calculations
- Fitness-for-service FFS assessment and remaining life determination
- Fundamentals and industry practices
- Overview of API Std 579-1/ASME FFS-1
- Inspection, Maintenance and Repair IMR Plan
- Appropriate mitigation activities

Unit 5: Repair and Alteration of Process Equipment and Piping:

- Repair codes, standards, and best practices - API 510, 570, 653
- API 578 Positive material identification PMI
- Post-Construction Codes - Overview of ASME PCC-2
- Repairs and Modifications
- Temporary and Permanent Repairs

- Welded Repairs - ASME BPVC IX
- Mechanical Repairs
- Specialized Repair Methods - Composites
- Hot tapping and line stops - Key Considerations, Practices, and Procedures
- API 2201 - Safe Hot Tapping Practices in the Petroleum & Petrochemical Industries
- Rerating
- Assessing Need for Rerating
- Minimum Required Thickness Determination
- MAWP Determination
- Authorization and Registration

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