API – 571 DAMAGE MECHANISMS INSPECTOR PREPARATORY COURSE,2015

Duration: 3 days

INTRODUCTION:

Train individuals who are interested in obtaining the API 571 Inspector Certification. Provide individuals with an advanced knowledge of how corrosion mechanisms drive RBI conclusions.

COURSE OBJECTIVES:

This course is drawn up to meet following objectives:-

- To help the participants to understand the various degradations and damages inflicted on equipments in refinery service.
- To know how to detect, evaluate, and prevent degradations and damages of Refinery Equipment.
- To enable the attendees to grasp the advanced information in preventive as well as predictive maintenance of equipment.
- To present different forms of degradations and various mechanisms and related environmental factors.
- To know the factors contributing the damage, the correct monitoring & inspection of damage, Prevention/mitigation of damage mechanisms.
- To present typical corrosion failures and to illustrate the inter-relationship between material and service conditions.
- Help participants to pass the certification examination successfully.
- Score very well in API 571 examination

WHO SHOULD ATTEND?

Plant inspection engineers and managers, inspection personnel, plant operating engineers who wish to appear for API 571 examination. Maintenance engineers and technicians and people involved in trouble shooting of plant operations.This course will be equally beneficial to all QA/Qc engineers even though they may or may not be planning to take API 571 examination.Corrosion engineers will have immense benefit from this course in terms of identifying, understanding, prevention and mitigation of corrosion mechanisms and related damages of refinery equipment.

COURSE CONTENTS

1. **Introduction to Corrosion**

1.1 Corrosion: Definition and Examples
1.2 Basic Concepts in Electrochemistry
1.3 Why Do Metals Corrode
1.4 Kinetics: the Rate of Corrosion
1.5 How Do Metals Corrode: Different Forms of Corrosion
1.6 General Methods for Corrosion Control

2. Common Alloys Used in the Refining and Petrochemical Industries

3. Overview of API RP 571-2011

4. General Damage Mechanisms – All Industries Including Refining and Petrochemical, Pulp and Paper, and Fossil Utility

4.1 General
4.2 Mechanical and Metallurgical Failure Mechanisms
- 4.2.1 Graphitization
- 4.2.2 Softening (Spheroidization)
- 4.2.3 Temper Embrittlement
- 4.2.4 Strain Aging
- 4.2.5 885oF Embrittlement
- 4.2.6 Sigma Phase Embrittlement
- 4.2.7 Brittle Fracture
- 4.2.8 Creep / Stress Rupture
- 4.2.9 Thermal Fatigue
- 4.2.10 Short Term Overheating – Stress Rupture
- 4.2.11 Steam Blanketing
- 4.2.12 Dissimilar Metal Weld (DMW) Cracking
- 4.2.13 Thermal Shock
- 4.2.14 Erosion / Erosion-Corrosion
- 4.2.15 Cavitation
- 4.2.16 Mechanical Fatigue
- 4.2.17 Vibration-Induced Fatigue
- 4.2.18 Refractory Degradation
- 4.2.19 Reheat Cracking
- 4.2.20 Gaseous Oxygen-Enhanced Ignition and Combustion

4.3 Uniform or Localized Loss of Thickness
- 4.3.1 Galvanic Corrosion
- 4.3.2 Atmospheric Corrosion
- 4.3.3 Corrosion Under Insulation (CUI)
- 4.3.4 Cooling Water Corrosion
- 4.3.5 Boiler Water Condensate Corrosion
- 4.3.6 CO2 Corrosion
- 4.3.7 Flue Gas Dew Point Corrosion
- 4.3.8 Microbiologically Induced Corrosion (MIC)
- 4.3.9 Soil Corrosion
- 4.3.10 Caustic Corrosion
- 4.3.11 Dealloying
- 4.3.12 Graphitic Corrosion

4.4 High Temperature Corrosion [400oF (204oC)]
- 4.4.1 Oxidation
- 4.4.2 Sulfidation

4.4.3 Carburization
4.4.4 Decarburization
4.4.5 Metal Dusting
4.4.6 Fuel Ash Corrosion
4.4.7 Nitriding
4.5 Environment – Assisted Cracking
4.5.1 Chloride Stress Corrosion Cracking (CI–SCC)
4.5.2 Corrosion Fatigue
4.5.3 Caustic Stress Corrosion Cracking (Caustic Embrittlement)
4.5.4 Ammonia Stress Corrosion Cracking
4.5.5 Liquid Metal Embrittlement (LME)
4.5.6 Hydrogen Embrittlement (HE)
4.5.7 Ethanol Stress Corrosion Cracking (SCC)
4.5.8 Sulfate Stress Corrosion Cracking

5. Refining Industry Damage Mechanisms

5.1 General
5.1.1 Uniform or Localized Loss in Thickness Phenomena
5.1.1.1 Amine Corrosion
5.1.1.2 Ammonium Bisulfide Corrosion (Alkaline Sour Water)
5.1.1.3 Ammonium Chloride Corrosion
5.1.1.4 Hydrochloric Acid (HCl) Corrosion
5.1.1.5 High Temperature H2/H2S Corrosion
5.1.1.6 Hydrofluoric (HF) Acid Corrosion
5.1.1.7 Naphthenic Acid Corrosion (NAC)
5.1.1.8 Phenol (Carbonic Acid) Corrosion
5.1.1.9 Phosphoric Acid Corrosion
5.1.1.11 Sulfuric Acid Corrosion
5.1.1.12 Aqueous Organic Acid Corrosion
5.1.2 Environment–Assisted Cracking
5.1.2.1 Polythionic Acid Stress Corrosion Cracking (PASCC)
5.1.2.2 Amine Stress Corrosion Cracking
5.1.2.3 Wet H2S Damage (Blistering / HIC / SOHIC / SCC)
5.1.2.4 Hydrogen Stress Cracking – HF
5.1.2.5 Carbonate Stress Corrosion Cracking (ACSCC)
5.1.3 Other Mechanisms
5.1.3.1 High Temperature Hydrogen Attack (HTHA)
5.1.3.2 Titanium Hydriding
5.2 Process Unit PFD's
5.2.1 Crude Unit / Vacuum
5.2.2 Delayed Coker
5.2.3 Fluid Catalytic Cracking
5.2.4 FCC Light Ends Recovery
5.2.5 Catalytic Reforming – CCR
5.2.6 Catalytic Reforming – Fixed Bed

5.2.7 Hydroprocessing Units – Hydrotreating, Hydrocracking
5.2.8 Sulfuric Acid Alkylation
5.2.9 HF Alkylation
5.2.10 Amine Treating
5.2.11 Sulfur Recovery
5.2.12 Sour Water Stripper
5.2.13 Isomerization
5.2.14 Hydrogen Reforming