ECC
Empire Conferencing Company

API 579 / ASME FFS1

Fitness for Service of Equipment and Piping
Virtual Training
27th September – 1st October 2021 (5 days)

5 CPD POINTS

ECSA

OVERVIEW:

This Training program covers the understanding of damages which may happen to equipment and connected piping while it is under fabrication, handling, erection and in prolonged service. Service exposures for a longer duration pose challenges to equipment safety and integrity. The damaged and defects are detected during regular inspection at different stages.

Fitness-For- Service (FFS) assessments are required through engineering analysis to demonstrate the structural integrity of components containing flaw or damages. The guidelines provided in API 579/ ASME FFS-1 are used to make run-repair-replace decisions of pressurised components after inspection, if they can continue to operate safely.

Recommended practice as presented supplement and augment requirements and decisions while implementing inspections as per API 510, API 570 and API 653.

The course will cover situations encountered in pressure vessels, heat exchangers, tanks and connected piping in refining and petrochemical industry.

BENEFITS:

The orientation during training program shall prove beneficial to participants and their employing company through;

- Understanding bad impact on safety due to defects and damages detected during inspection.
- Field case histories discussions to provide lead to understanding failures relevant to process equipment in service, remedial action in at proper stage, estimation of remaining safe life.
- Help experienced professionals who wish to brush up their knowledge and stay abreast with the latest design and integrity evaluation Procedures.
- Basic orientation to Engineers and Technologists and fresher from varied technical background interested in learning more about equipment damages, detection and evaluation of acceptance levels of defects and damages.

Who Should Attend?

Equipment Design Engineers / Managers, Safety Engineers, Inspection and Quality Control Specialists, Technical Supervisory Personnel, Operation Engineers, Maintenance Engineers

Course Agenda:

Day 1:

Session 1: Understanding of Process Plant System under Analysis

1.1 Original Equipment and System Design Data
1.2 Maintenance and Operational History
1.3 Inspection Techniques for detection of flaws and Damages
1.4 Assessment Techniques, Acceptance Criteria and Remediation
1.5 Remaining Safe Life Assessment, In-service Monitoring

Session 2: General Flaw and Damage Mechanism

2.1 Introduction to Broad Grades of Damages and Mechanism
2.2 Types of Damages
* Thinning, Corrosion
* Cracking, Brittle Fracture, Propagation, Fatigue, Creep
* Mechanical Damages, Dents, Distortions,
* Weld assisted Damages, Metallurgical Damages

Session 3: Assessment of Equipment and Piping for Brittle Fracture

3.1 Brittle Fracture:
* Mode of fracture
* Toughness Issues
* Effect of Temperature
* Role of Crack size

3.2 Assessment Techniques and Acceptance Criteria
* Pressure Vessels
* Piping Systems
* Storage Tanks

3.3 Remaining Life Assessment and Acceptability for continued service
3.4 Remediation, In-service Monitoring

Session 4: Assessment of General Metal Loss

4.1 In-service Monitoring and Inspection of components affected
4.2 Required Measurements and Data for FFS Assessment
4.3 Inspection Techniques and Sizing Requirements
4.4 Assessment and Acceptance Criteria
4.5 Remaining Life Assessment and Remediation

Day 2:

Session 5: Assessment of Local Metal Loss

5.1 Acceptability and Limitation:
* Types of Flaws
* Geometry

5.2 Required Measurements and Data for FFS Assessment
5.3 Inspection Techniques and Sizing Requirements
5.4 Assessment and Acceptance Criteria
5.5 Remaining Life Assessment and Remediation

Session 6: Assessment of Pitting Corrosion

6.1 Acceptability and Limitation
* Definitions of Types of Pitting
* Cross sectional shapes of pits

6.2 Required Measurements and Data for FFS Assessment
6.3 Inspection Techniques and Sizing Requirements
6.4 Assessment and Acceptance Criteria
6.5 Remaining Life Assessment and Remediation

Session 7: Assessment of Blisters and Laminations

7.1 Acceptability and Limitation
* Geometry and shapes of Blisters

7.2 Required Measurements and Data for FFS Assessment
7.3 Inspection Techniques and Sizing Requirements
7.4 Assessment and Acceptance Criteria
7.5 Remaining Life Assessment and Remediation

Session 8: Assessment of Weld Misalignment and Shell Distortions

8.1 Acceptability and Limitation
* Categories and definition of weld distortions and shell distortions

8.2 Required Measurements and Data for FFS Assessment
8.3 Inspection Techniques and Sizing Requirements
8.4 Assessment and Acceptance Criteria
8.5 Remaining Life Assessment and Remediation

Day 3:

Session 9: Assessment of Crack-Like Flaws (Part 1)

- 9.1 Definition of Crack-Like Flaws
- 9.2 Acceptability and Limitation
- 9.3 Maintenance and Operating History
- 9.4 Required Measurements and Data for FFS Assessment
  - * Loads and Stresses
  - * Material Properties
  - * Flaw characterization
- 9.5 Inspection Techniques and Sizing Requirements

Session 10: Assessment of Crack-Like Flaws (Part 2)

- 10.1 Assessment and Acceptance Criteria
- 10.2 Remaining Life Assessment
  - * Subcritical Crack Growth
  - * Analysis for growing cracks
  - * Leak before Break Analysis
- 10.3 Remediation

Session 11: Assessment of Fire Damage

- 11.1 Acceptability and Limitation
- 11.2 Required Measurements and Data for FFS Assessment
  - * Collect fire damage data as practically possible
  - * Try to get video of incident, if available
  - * Identify heat exposed area of equipment, piping and structures
- 11.3 Inspection Techniques and Sizing Requirements
  - * Record degradations observed in heat Exposure zones
  - * Dimensional, metallurgical and mechanical test of heat exposed zones
  - * Extensive in-situ metallography as conducted shall be recorded
  - * Non-destructive examinations
- 11.4 Criteria
- 11.5 Remaining Life Assessment and Remediation

Session 12: Thickness, MAWP, Stress Evaluation for FFS Assessment

- 12.1 Calculation of Minimum Required Wall Thickness: Pressure Vessels and Tanks under internal pressure
  - * Shell, Head, Nozzle and Reinforcement area,
- 12.2 Calculation of Minimum Required Wall Thickness: Pressure Vessels under external pressure
  - * Shell, Head, Stiffening rings
- 12.3 Calculation of Minimum Required Wall Thickness: Piping under internal pressure
  - * Pipes, Bends
- 12.4 MAWP (Calculation of Maximum Allowable Working Pressure) of Vessel & Piping

Day 4:

Session 13: Stress Analysis for FFS Assessment (Part 1)

- 13.1 Role in establishing structural integrity
- 13.2 Linear Elastic Stress Analysis and Acceptance
  - * Basic Stress Intensity Categories
- 13.3 Establishing Allowable Stress Intensity
- 13.4 Non-linear Elastic-Plastic Stress Analysis
  - *Limit Loads
  - * Plastic Collapse Load
  - * Stress Analysis with a flaw
- 13.5 Assessment of Structural Stability

Session 14: Stress Analysis for FFS Assessment (Part 2)

- 14.1 Assessment of Structural Stability
- 14.2 Methods for Fatigue Evaluation
- 14.3 FFS Assessment using Finite Element Analysis

Session 15: Residual Stresses in FFS Evaluation (Part 1)

- 15.1 Weld Locations with Residual Stress Distribution
  - * Full Penetration Welds
  - * Fillet Welds
  - * Repair Welds
- 15.2 Variables which affect residual stresses
- 15.3 Residual stresses in Cylindrical shells and Piping
- 15.4 Residual Stresses in spherical shell and vessel Heads

Session 16: Residual Stresses in FFS Evaluation (Part 2)

- 16.1 Residual stresses in storage tanks
- 16.2 Residual stresses at nozzles and piping branch connections
- 16.3 Residual stresses at Tee joints
- 16.4 Residual stresses in repair welds

Day 5:

Session 17: Material Properties for FFS Assessment

- 17.1 Yield and Tensile Strength
- 17.2 Flow Stress
- 17.3 Fracture Toughness, Fracture Toughness Parameters
- 17.4 Fracture Toughness Testing
- 17.5 Assessing Fracture Toughness from Charpy V-notch Data
- 17.6 Fracture Toughness after in-service degradation
- 17.7 Fracture Toughness of Austenitic Stainless Steel

Session 18: Crack Growth Types and Evaluation

- 18.1 Categories of Crack Growth
- 18.2 Fatigue Crack Growth
- 18.3 Stress Corrosion Crack Growth
- 18.4 Fatigue Strength of Welded Components
- 18.5 Creep Rupture and Creep Crack Growth

Session 19: Overview on Deterioration and Failure Modes

- 19.1 Pre-service Deficiencies
- 19.2 In-service Deterioration and Damage

Session 20: Discussion on plant damage, case studies and Mock Examination

About The Facilitator

Narendra Kumar Roy

Academic Qualification:

B.Sc. (Engineering) - Mechanical (1st Class), Bihar Institute of Technology, Sindri, Ranchi University, India (1966).

Master of Engineering; Specialization in Mechanical Machine Design; University of Roorkee; India (1968).

Professional Experience:

Working as Director on the board of Charisma Careers Pvt. Ltd and Charisma Education Pvt. Ltd Vadodara, Gujarat and Technical Expert with Charisma Global Networks Ltd, Auckland, New Zealand. Many training programs on Process Equipment Design, Fabrication and Inspection and Piping Design, Inspection and Engineering including failure analysis and corrosion controls were conducted for the benefit of engineers & supervisors in India and abroad (Oman, Qatar, Malaysia, Indonesia, Mozambique, Nigeria, Thailand and New Zealand).

Associated in many Fitness for Service Evaluation of equipment, piping and structures of process industries, petrochemical refineries and fertilizer plants under long time operation. Provided expert services of design and analysis of the equipment and piping systems including fracture mechanics, fatigue and FEA analysis interpretations.

Worked as Executive Director of Gramya Research Analysis Institute for its Scientific & Technical Consultancy Division. Worked as Advisor since inception of the organization (since Year 1984). Number of Pressure Vessel Design, Fabrication and Inspection training programs were conducted for the benefit of engineers & supervisors in India and abroad (Oman, Qatar).

Worked as Director (Technical) with SRV Engineers Pvt. Ltd, Vadodara Gujarat India guiding all the corporate level project engineering and management activities, business development, contracting, personnel and administrative activities.

Worked as General Manager, Humphreys & Glasgow Consultants Ltd. (A Project Engineering Consultant and Associate of Jacobs Engineering, UK /USA), Vadodara Regional Office, Gujarat, India guiding and heading all function of Project Management, Sales & Marketing, Engineering, Administration & Finance as regional head.

Professional Memberships:

- Member, American Society of Mechanical Engineers (ASME), USA
- Member, American Water Works Association (AWWA), USA
- Member, Gujarat Safety Council, Vadodara, India
- Member of the Indian Institute of Metals, Calcutta.
- Fellow of the Indian Institute of Plant Engineers, Chennai.
- Member of the Indian Society of Nondestructive Testing, Chennai; Worked as Secretary/Vice President of Baroda Chapter (1983-1986).
- Member, Society of Piping Engineers and Designers, USA
- Member, Project Management Institute, USA

API 579:Fitness for service assessment introductory course

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27th September – 1st October 2021
Online Training Course

Fill in the form and send to: **Ryan**

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