



Charisma Education Pvt. Ltd.

Training on

Fitness for Service of Equipment and Piping per API 579 and ASME FFS1

Vadodara, India, 5 Days, Year 2019

Training Program on **Fitness for Service of Equipment and Piping per API 579 and ASME FFS1** will be held in Vadodara organized by Charisma Education Pvt Ltd. CEPL is a Scientific and Technical Consultancy involved in the Design of Process Equipment, Technical Troubleshooting Process Plants, Failure Analysis of Equipment of Piping System etc. We also provide correspondence courses for Process Equipment and Pressure Vessel Design, Piping Technology.

OBJECTIVE:

This Training program covers 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 pressurized 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.

Benefit and Importance:

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.**

For Whom: Equipment Design Engineers / Managers, Safety Engineers, Inspection and Quality Control Specialists, Technical Supervisory Personnel responsible for operating plants, Operation Engineers, Maintenance engineers



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COVERAGE OUTLINES:

Handout shall be provided which will cover all the topics as listed.

Day 1:

Introductory Test/ Evaluation 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



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- 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



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- * 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 Assessment and Acceptance 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



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- 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



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Session 20: Discussion on plant damage case histories and Mock Examination

The training package includes

1. Comprehensive course material of 200+ pages to each participant & exposure to Operating Plant Piping conditions, Inspection and fitness.
2. Lectures by renowned experts of 30+ years of experience in the Industry

Our clientele include Oman Refinery , Qatar Petroleum, Oman Gas, STS Oman, PDO, L&T, ABB, TCE, EIL, GAIL, IFFCO, GSFC, IOC, RELIANCE, ALSTOM-POWER, LINDE, REAL, BHEL, TRANSPEK, ONGC, PRAJ, Tecnimont ICB, MECON, Chennai Petroleum, PTTEP Thailand & many others who have benefited from program conducted regularly by us.

METHODOLOGY

1. Technical Sessions
2. Problem Solving Sessions
3. Case Studies

DATE & TIME

Place- Vadodara

Date- **5 Days, Year 2019**

Time: 10.00 AM- 5 PM

VENUE

CEPL Conference Room, 302 Sunsilver Aptt, Productivity Road, Vadodara

REGISTRATION

The Registration fees:

Rs. 30000 per delegate

The fee may be sent to us in the form of a Cheque drawn in favour of **Charisma Education Pvt. Ltd.**, payable at Vadodara.

Request for nominations can be sent on the organization letter-head along with the fee as cheque. Fee may be paid through bank transfer to CEPL Bank account.

CONTACT India:

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