



Process Equipment & Piping Resilience: Repairs & Prevention Training Course





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Process Equipment & Piping Resilience: Repairs & Prevention is a 10-day intermediate course focusing on metallurgy, corrosion degradation mechanisms, cathodic protection, and physical containment restoration techniques. It is designed for plant integrity specialists, corrosion technicians, and piping engineers tasked with arresting wall loss and executing code-compliant alterations. You will assemble the Equipment Resilience and Repair Selection Dossier. The course is delivered by Mercury Training Center.

About This Course

Operating facilities suffer severe asset degradation from wet sour service, localized external corrosion, and biological attack. To follow this course, you should already review piping isometric drawings, understand base metal designations, and track thickness monitoring records. You practice evaluating environmental cracking, sizing engineered clamp restorations, and calculating safe derating envelopes step by step.

Who It Is For

- Integrity specialists responsible for identifying damage morphology and calculating corrosion rates
- Corrosion engineers responsible for specifying protective linings, chemical inhibitors, and cathodic protection systems
- Piping restoration supervisors responsible for implementing engineered composite wraps and welded split sleeves
- Asset life extension specialists responsible for evaluating thinning boundaries and determining safe derating limits
- Quality assurance engineers responsible for verifying weld overlay integrity and nondestructive examination results

This course is not for grassroots structural layout designers, who are better served by an introductory plant layout course, nor for turnaround planning administrators seeking broad reliability scheduling tools, who are better served by a maintenance reliability management course.

Competencies You Will Build

- Metallurgical Degradation Diagnosis: you categorize wet hydrogen sulfide cracking, external environmental loss, and microbial corrosion attacks
- Cathodic Protection Verification: you calculate protective current densities and evaluate galvanic anode depletion across buried lines
- Containment Restoration Selection: you specify bolted enclosure clamps, flush weld patches, and composite sleeves for local defects
- Component Derating Analysis: you calculate reduced allowable stresses and establish derated working envelopes for thinned hulls
- Protective Barrier Specification: you select thermal spray coatings, internal weld overlays, and chemical dosing regimes
- Temporary Clamping Governance: you evaluate non-welded containment clamps against structural vibrations and design life limits

What You Will Be Able to Do

By the end of the course you will be able to:

- From destructive metallurgical cross-sections, identify sulfide stress cracking, hydrogen-induced blistering, and caustic embrittlement
- Given soil resistivity data and pipe potential logs, calculate protective current demand and check cathodic protection shielding risks
- Using ultrasonic wall thickness records, compute corrosion rates and establish remaining strength factors under ASME PCC-2
- From localized pipe wall pitting surveys, select between full-encirclement steel split sleeves and non-metallic composite restorations
- Given operating thermal profiles and lagging conditions, isolate corrosion under insulation hotspots and establish drainage retrofits
- Using degraded vessel shell measurements, calculate derated working pressures according to original construction codes

Course Content

Day 1: Base Metallurgy, Microstructures, and Material Selection

- Carbon Steel Microstructures and Phase Transformations in Fluid Service
- Austenitic and Duplex Stainless Steel Metallurgy for Aggressive Feeds
- Nickel Alloy Selection Criteria for High-Temperature Acidic Streams
- Non-Metallic Materials and Internal Polymer Cladding Boundaries
- Material Test Reports and Charpy Impact Toughness Verification

Day 2: Sour Service and Hydrogen-Induced Degradation

- Sulfide Stress Cracking Mechanics and NACE MR0175 Compliance
- Hydrogen-Induced Cracking and Stress-Oriented Cracking Identification
- Hydrogen Embrittlement and High-Temperature Hydrogen Attack Risks
- Post-Weld Heat Treatment Protocols for Hardness Control in Sour Fields
- Hardness Testing Methods for Production Welds and Heat-Affected Zones

Day 3: Localized Loss Mechanisms and Environmental Attack

- Corrosion Under Insulation Detection, Coating Systems, and Insulation Types
- Microbiologically Influenced Corrosion in Stagnant Water and Sludge Legs
- Erosion-Corrosion Modeling for Slurry Transport and High-Velocity Tees
- Chloride Stress Corrosion Cracking in Insulated Stainless Lines
- Galvanic Coupling Diagnostics Across Dissimilar Flanged Joints

Day 4: Cathodic Protection and Surface Barrier Preservation

- Sacrificial Anode Cathodic Protection Sizing for Buried Pipe Runs
- Impressed Current Cathodic Protection System Monitoring and Groundbeds
- Coating Degradation Mechanisms and Cathodic Disbondment Testing
- Internal Corrosion Inhibitor Evaluation and Chemical Injection Quills
- Thermal Spray Aluminum Cladding for Marine and Humid Facilities

Day 5: Wall Loss Mapping and Nondestructive Evaluation

- Phased Array Ultrasonic Testing for Thinning and Laminar Defects
- Pulsed Eddy Current Screening Beneath Thermal Insulation Jackets
- Radiographic Profiling for Localized Wall Loss and Slag Inclusions
- Magnetic Flux Leakage Assessment for Storage Tank Bottom Plates
- Corrosion Rate Trend Calculation and Baseline Inspection Logging

Day 6: ASME PCC-2 Welded Restorations and Alterations

- Full-Encirclement Steel Reinforcing Sleeves for Pipe Wall Defects
- Welded Split Tees and In-Service Hot Tapping Boundary Rules
- Flush Patch Insertion Guidelines for Vessel Shell Plate Rehabilitation
- Weld Overlay Cladding Procedures for Restoring Corroded Internal Faces
- Temper Bead Welding Techniques Eliminating Post-Weld Heat Treatment

Day 7: Non-Welded and Engineered Clamping Solutions

- Engineered Bolted Clamps for Flange Leak Containment and Pinholes
- Non-Metallic Composite Wrap Qualification and Reinforcement Sizing
- Sealant Injection Compound Selection for High-Temperature Service
- Structural Restraint Considerations for Clamped Vibrating Piping Spools
- Management of Temporary Repairs and Regulatory Conversion Timelines

Day 8: Flange Integrity and Structural Bolting Safeguards

- Gasket Creep Relaxation and Bolt Yielding Under Thermal Cycles
- Controlled Torque Tightening and Hydraulic Bolt Tensioning Methods
- Gasket Selection Criteria for Corrosive and Cyclic Hydrocarbon Streams
- Nut and Stud Metallurgy for Low-Temperature and Sour Environments
- Flange Face Refacing Tolerances and Serration Finish Standards

Day 9: Asset Rerating and Containment Margin Analysis

- Allowable Stress Reductions Based on Historical Shell Metal Depletion
- ASME PCC-2 Calculation Methods for Permanent Mechanical Patches
- Re-Evaluating Design Margins Following Extreme Wall Loss Surveys
- Hydrostatic Proof Testing Versus Pneumatic Tightness Testing Protocols
- Drafting the Containment Rerating Summary and Nameplate Stamping

Day 10: Repair Execution Planning and Dossier Finalization

- Exercise Sizing Type B Steel Split Sleeves for Deep External Crevice Loss
- Exercise Formulating Composite Wrap Plies for Internal Pinhole Containment
- Exercise Calculating Derated Design Envelopes for Local Thinning Areas
- Compiling In-Service Welding Safeguards and Hot Tapping Burn-Through Envelopes
- Completing and Presenting the Equipment Resilience and Repair Selection Dossier

Case Studies and Exercises

The following are suggested activities used during the course.

- Case study: a sour gas processing vessel experiencing severe blister formation; you evaluate hydrogen cracking morphology, select hardness limits, and draft remediation plans.
- Case study: an offshore cooling water trunkline with accelerated microbiologically influenced pitting; you interpret coupon loss data, review biocidal regimes, and size metallic repair sleeves.
- Exercise: an insulated refining transfer line showing signs of corrosion under insulation; you calculate remaining strength factors under ASME PCC-2 and specify a non-metallic composite wrap.
- Exercise: an aging separator vessel with generalized hull thinning; you evaluate minimum structural thickness, compute derated working envelopes, and draft code-compliant rerating sheets.

What You Take Back

You return with the Equipment Resilience and Repair Selection Dossier to guide rehabilitation projects across your production assets. In your first month back, you use it to identify environmental attack mechanisms, calculate safe thickness limits, and select appropriate welded or mechanical patch designs.

- Degradation mechanism screening guide covering sour service, external attack, and bacterial growth
- Repair selection matrix comparing steel sleeves, composite wraps, and bolted containment clamps
- Derating calculation template for assessing corroded vessel walls and piping spools
- Cathodic protection survey evaluation checklist and coating condition logging tool

Quick Answers FAQ

What should I know before Process Equipment & Piping Resilience: Repairs & Prevention?

You should understand baseline materials of construction, how to read piping diagrams, and basic plant terminology. Familiarity with ultrasonic thickness inspection reports and routine maintenance procedures will help you follow the calculations.

How does this course differ from general plant design training?

General plant design training covers initial sizing, layout drafting, and overall system configuration. This course concentrates specifically on existing assets, diagnosing active environmental degradation, specifying physical repairs, and derating thinned hardware safely.

Why prioritize permanent welded restorations over non-metallic composite wraps?

Permanent welded sleeves or flush patches restore original structural strength across long service lives. Non-metallic wraps offer rapid emergency installation without hot work, but often remain restricted by operational temperature limits and regulatory lifespans.

What work tool do I take back from Process Equipment & Piping Resilience: Repairs & Prevention?

You take back the completed Equipment Resilience and Repair Selection Dossier, including calculation templates, repair methodology decision trees, and material qualification checklists for immediate deployment across plant repairs.



For Your Manager

This course develops practical capability in diagnosing active corrosion mechanisms and choosing safe containment repairs for thinned hardware. The team member will learn how to evaluate environmental cracking, calculate ASME PCC-2 reinforcement geometries, and safely derate degraded shells. They return with the Equipment Resilience and Repair Selection Dossier, immediately used to prioritize structural interventions during upcoming facility turnarounds.