FE126:
Cathodic Protection System
(Technical)
Training Description:
This intensive training course covers the cathodic protection systems for a wide range of industrial structures including buried and subsea pipelines, storage tanks, petrochemical plants and concrete structures. It provides theoretical knowledge and fundamentals for testing on both sacrificial and impressed current systems.

This course is based on NACE International Standard Practices and NACE Official Cathodic Protection Technical Publications.

The course involves lectures and case studies describing equipment and instruments used in Cathodic Protection testing and In-Line current monitoring using new technology Cathodic Protection Current Measurement tool (CPCM).

Training Objectives:

By the end of the training, participants will be able to:

✓ Apply systematic techniques on the design, installation, testing and repair of modern cathodic protection systems
✓ Recognize the nature of corrosion, forms of corrosion and the various effects of soil condition and system operation
✓ Carryout cathodic protection and measurement and recognize their importance in the effectiveness of cathodic protection system
✓ Identify the associated aspects of corrosion control such as the materials selection, coatings and sacrificial cathodic protection including its design, types, selection and fabrication
✓ Discuss offshore cathodic protection design, operational integrity impact in offshore structures, CP anodes retrofitting forecast and replacement programs
✓ Discuss impressed current cathodic protection including their design, use and application
✓ Illustrate cathodic protection system design for tanks and explain the secondary containment, double bottom tanks and its monitoring issues
✓ Apply the impressed current cathodic protection design used in plants and explain stray current interaction with other structures
✓ Identify the corrosion and corrosion control present in reinforced concrete and employ the proper monitoring procedures of cathodic protection systems
✓ Employ the specialized survey techniques used in the evaluation of data for cathodic protection and demonstrate cathodic monitoring programmes
✓ Illustrate the technique of in-line cathodic protection current measurement (CPCM) to evaluate CP efficiency and possible interference currents as well as cathodic protection rectifiers

Training Designed for:
This course is intended for those who are responsible for cathodic protection systems, measuring the effectiveness of cathodic protection systems and/or recording this data, including pipeline design engineers, pipeline operations engineers, corrosion engineers, materials engineers, design engineers, mechanical engineers, inspection engineers, chemical engineers, marine maintenance people, offshore structure design and operation people, CP field personnel, supervisors and other technical staff.
Training Program:

**DAY ONE:**
- PRE-TEST
- Introduction
- Electrochemical Basis of Corrosion and Cathodic Protection
  - Electrochemistry, Electrochemical & Galvanic Series, Thermodynamics, Kinetics, Immunity and Passivity
- Introduction to Corrosion Forms
  - Nature of Corrosion, Forms of Corrosion, Effects of Soil Conditions, Effects of System Operation, Microbiological Corrosion, Electrolytic Corrosion
- Cathodic Protection Fundamentals
  - Mechanism of Cathodic Protection, Energy Diagrams, Equivalent Circuits, Types of Cathodic Protection Systems, Synergy with Coatings
- Cathodic Protection Measurements
  - Reference Electrodes, Voltmeters, Field measurements
- Cathodic Protection Design Fundamentals
  - Design Objectives, Required Information, Environment, Field Surveys, Current Requirement, Current Densities, Coatings, Sacrificial Anodes Design, Impressed Current Design
- Recap

**DAY TWO:**
- Associated Aspects of Corrosion Control
- Corrosion Control Using Coatings
  - Organic Coatings, Active (Galvanic) Coatings, Inhibitive Coatings, Application of Coatings, Failure Mechanism of Coatings, Test Methodologies
- Sacrificial CP Design – Offshore Structures and Pipelines
  - Platform Anodes, Design, Types of Anodes, Fabrication of Anodes, Effect of Temperature, Anodes Resistance, Connections, Crossing, Landfalls, Anodes Retro fittings, Anodes Sleds
- Offshore Sacrificial Cathodic Protection Systems - Statistics
  - Offshore CP Operational Integrity, CP Anodes Retrofitting Forecast and Replacement Plan
  - Case History Arabian Gulf
- Cathodic Protection Design – Land Pipelines
  - Sacrificial Anodes, Types of Anodes, Impressed Currents Anodes, Type of Anodes, Ground Bed Designs, Design Steps, Example Calculations, Road Crossings, Casings
- Recap

**DAY THREE:**
- Cathodic Protection Design – Production and Injection Well Casing
❖ Impressed Current Cathodic Protection Design – Onshore Pipelines
  • Corrosion Cells, Design, Preliminary Steps & Site Survey, Current Densities, Basic Calculations Road Crossings, Isolation Joints

❖ Impressed Current Cathodic Protection Design - Plants
  • Effects of Geometry, Earthing, Concrete Foundations, Drains & Slab-on Grade, Anode Layouts, Remote, Close, Combination, Monitoring Using Coupons, Voltage Gradient, Pulse Techniques

❖ Best Practices in Pipelines Cathodic Protection Design, Monitoring, Assessment and Maintenance
  • Best Practices during CP Design, CP Monitoring, CP Assessments, CP Maintenance, New Initiatives, Lessons Learnt

❖ Corrosion Management on Pipelines with Cathodic Protection
  • Pipeline Risks and Corrosion, Galvanic Sacrificial Anodes, Impressed Current System, Case Study SA, Case Study ICCP

❖ Recap

DAY FOUR:
❖ Cathodic Protection System Design for Tanks
  • New Systems, Retrofit Systems, Grid Systems, Secondary Containment, Double Bottom Tanks, Monitoring Issues

❖ Cathodic Protection System Design for Tanks – Case History
  • Background, Investigation Methodology, Diagnostic & Troubleshooting, Findings, Proposed Strategies

❖ Cathodic Protection Systems Interactions
  • Areas of Interferences, CP Interference, HVAC Interference, DC Interference, AC interference, Mitigation Methods

❖ Stray Current Interaction with Other Structures
  • Anodic Areas, Service Corridors, Pipeline Interactions, Stray Currents, Current Drainages, Electrical Fields, Traction Systems

❖ Reinforced Concrete – Corrosion and Corrosion Control
  • Rebar Corrosion, Types of Concrete Damage, Breakdown of Passive Film, Detection of Corrosion, Rust and Chloride Migration, Pourbaix, Current Densities, Cathodic Protection, Type of Anodes

❖ Underwater CP Inspection Methods
  • Why CP Inspection, Stds & Regulations, Offshore Structures Life, CP Measurements, CP Surveys, ROV, Trailing Wire, Calibrations, Reporting, Data Analysis

❖ Recap
❖ Practical Sessions
  • This hands-on, highly-interactive training includes simulator, real-life case studies and exercises

DAY FIVE:
❖ Monitoring of Cathodic Protection Systems
  • Test Point Monitoring, On/Off Potential, Soil Gradient, CP Coupons, Current Surveys, Close Interval Surveys, Offshore CP Monitoring, ROV
Specialized CP Survey Techniques
- CIPS, Pearson, DCVG, AC Attenuation, Combined Surveys, Evaluation of Data, CPCM Case History

Cathodic Protection Construction
- Sacrificial Anode, Deep Wells, Cables & Connections, Circuit Resistance and Soil Resistivity, Backfills, Example Calculations, CP Materials, HSE

CP Troubleshooting Techniques
- Measurements, Galvanic Anodes Troubleshooting, Potential Instant Off, Impressed Current Systems Troubleshooting

Cathodic Protection Rectifiers
- Basic Electrical Circuit, Output Regulation, Control Modes, Surge Protection, Fault finding

Course Conclusion

Post-Test and Evaluation

Training Requirement:

“Hand’s on practical sessions, equipment and software will be applied during the course if required and as per the client’s request”.

Practical sessions will be organized during the course for participants to practice the theory learnt. Participants will be provided with an opportunity to carryout various exercises using the “RE-5C Electrode”.

Please note that the above topics can be amended as per client’s learning needs and objectives. Further, it should be forwarded to us a month prior to the course dates.

Training Methodology:

This interactive training course includes the following training methodologies as a percentage of the total tuition hours:

- 30% Lectures, Concepts, Role Play
- 70% Workshops & Work Presentations, Techniques, Based on Case Studies & Practical Exercises, Software & General Discussions

Pre and Post Test

Training Certificate(s):

Internationally recognized certificate(s) will be issued to each participant who completed the course.

Training Fees:

As per the course location - This rate includes participant’s manual, hand-outs, buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Note: The 5% VAT (Value Added Tax), will be effective starting 01st of January 2018 as per the new regulation from the UAE Government. The VAT applies for all quotation both for local and abroad.
Training Timings:

Daily Timings:
- 07:45 - 08:00  Morning Coffee / Tea
- 08:00 - 10:00  First Session
- 10:00 - 10:20  Recess (Coffee/Tea/Snacks)
- 10:20 - 12:20  Second Session
- 12:20 - 13:30  Recess (Prayer Break & Lunch)
- 13:30 - 15:00  Last Session

For training registrations or in-house enquiries, please contact:
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Training & Career Development Department