



THE CHEMICAL ENGINEERING MAJOR

Cathodic Protection System in Oil & Gas Exploration Industry

Website: www.btsconsultant.com

Email: info@btsconsultant.com

Telephone: 00971-2-6452630

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Introduction:

Maintaining the ageing infrastructure such as underground pipelines is a challenge to the oil and gas industry worldwide. Corrosion is one of the major causes of ageing the industrial infrastructures. Understanding its mechanism and how to control it can lead to a remarkable reeducation in the operation cost of piping and static equipment. Cathodic protection (CP) is one of the most widely used methods to control corrosion control in industry. The cathodic protection is a method of that eliminates the corrosion of metals by the use of sacrificial anodes or the application of an electric current. It is a technique that has been known for 160 years, and is extensively applied to pipelines and tank farms, etc. with great success. However, despite this long history and broad applicability, it is a technique that is all too often inadequately or even improperly applied; with the result that structures are poorly protected or, worse, adversely interfered with. This course provides you with fundamental principles, evaluation and applications of cathodic protection, helping participants recognize them, select cathodic protection control methods and apply them to protect the assets of the organization.

Who Should Attend?

Corrosion Control Engineers & Personnel, Process Engineers, Metallurgists, Inspection Personnel, Mechanical Engineers, Material Selection Personnel, Plant Contractors, Operations Engineers, Team Leaders & Supervisors, Maintenance Engineers, Maintenance Supervisors, Senior Plant Supervisors, Mechanical Engineers, Corrosion Control & Monitoring Systems Personnel, Equipment Engineers, Maintenance Engineers and Planners, Team Leaders, Managers & Coordinators, Construction Coordinators, Technologists, Safety Officers, Maintenance Team Leaders & Engineers, Design Engineers, Service Company Representatives, Oil and Gas Production Facilities Personnel, Chemists, Chemical Engineers, Inspectors and Inspection Engineers & Supervisors, Technicians and Supervisors, Environmental Specialists, New Petroleum Engineers, Asset Management Personnel, Construction Engineers, Refinery Chemists, Chemical Engineers, Personnel who are / will be responsible for detecting, inspecting, monitoring, controlling corrosion in oil and gas piping, pipelines used in production operations and Personnel responsible for metallurgy, corrosion or the prevention of failures in plant and equipment.

Course Objectives:

By the end of this course, delegates will be able to:

- The theoretical basis and the practical ability necessary operate and maintain cathodic protection (CP) systems in the oil and gas surface production facilities
- Understanding of the basic principles of corrosion and applications of galvanic and impressed current CP systems
- Understanding of the field equipment used to monitor CP systems and how they work
- Understanding of the various factors that impact the performance of these systems
- Learn about essential CP monitoring techniques to ensure effective operation
- Understanding of increase productivity by avoiding costly shutdowns thus reducing the cost of the overall corrosion control program

Course Outline:

Significance of Corrosion Control

- Corrosion - largest single cause of plant failure
- Economic effects
- Environmental effects
- Safety effects
- Corrosion management preventive strategies
- Cost of corrosion

Corrosion & Its Control

- Requirements for corrosion to occur
- Metallurgical factors
- Forms of corrosion
- Corrosion control methods
- Environmental modification
- Protective coatings
- Introduction to cathodic protection

Corrosive Environments & Construction of Materials

- Atmospheric environments
- Marine atmospheres
- Industrial atmospheres
- Underground environments
- Material selection
- Corrosion properties of steels
- Concrete structure environment

Fundamentals of Cathodic Protection Systems

- Galvanic series
- General application of cathodic protection
- Industry standard & codes
- Principle of CPS
- The cathodic protection cell
- Methods of applying cathodic protection
- Sacrificial cathodic protection system
- Impressed-current cathodic protection system
- Advantages of SCPS
- Disadvantages SCPS
- Advantages ICCP
- Disadvantages ICCP
- CPS selection
- Basic requirements for cathodic protection
- Cathodic protection criteria
- Current rectifiers/dc power source
- High impedance voltmeter
- Reference cells (half cells) reference cells
- Applicable NACE standard for cathodic protection systems

Cathodic Protection System Design

- Design factors
- Electrolyte resistivity survey
- Electrolyte pH survey
- Structure versus electrolyte potential survey
- Current requirement

- Coating resistance
- Protective current required
- Sacrificial anode (galvanic) cathodic protection design
- Impressed current cathodic protection system design
- Soil resistivity
- Current requirement test
- Typical CPS design parameters

Cathodic Protection Systems and Coatings

- Role of protective coating in CPS
- Selection factors
- Coating defects
- Coating efficiency
- Overvoltage
- Cathodic disbondment
- Commonly used coating in conjunction with CPS

Anodes & Rectifiers

- Anode selection
- Anode material types, magnesium, zinc, aluminum, etc.
- Current output
- Driving potential
- Anode life
- Anode shape & dimension
- Anode efficiency
- Galvanic anode types
- Current requirements for ICCP system

- Anode materials for ICCP
- Anode backfilling
- Installation of sacrificial anodes
- Impressed current anode beds
- Impressed current rectifiers/DC power source
- CP equations
- Solved CP calculation examples

Practicing & Construction of Cathodic Protection System

- Components of cathodic protection systems
- Essential components
- Isolating joints
- Junction boxes
- Test stations, measuring points and coupons
- Thermite weld
- Earthing systems
- Line current measurement
- Pipe sleeves/casings
- Cathodic protection vessels & tank internals vessels & tank
- Tanks for storage of chemicals
- Water circulating systems
- Heat exchangers (tube and shell)

Inspection of Pipeline and Coating Defects

- Pearson surveys
- Close interval potential survey (CIPS) technique
- Direct current voltage gradient (DCVG) technique

- Signal attenuation coating (SAC) survey
- Common impressed current rectifier problems
- Over the trench pipe holiday inspection

Instrumentation & Safety Aspects

- Alkalinity
- Hydrogen evolution
- Chloride evolution
- Installation adjacent to telecommunication services
- Installation adjacent to railway signal & protection circuits
- Interaction at discontinuities in cathodically protected structures
- Installation at jetties & ships
- Danger of electric shock
- Installations on immersed structures
- Installations for the internal protection of plant
- Fault conditions in electricity power systems
- Stray current corrosion

Corrosion Management Systems

- Economic considerations
- Corrosion key performance indicators (KPIs)
- Asset integrity and corrosion management
- Corrosion data management