

# CORROSION ENGINEERING AND CATHODIC PROTECTION



**cescor**



# MATERIAL INTEGRITY. OUR MISSION.

Integrity of industrial and civil structures is to be maintained throughout their design life.

Corrosion represents the main threat to integrity and durability.

Our commitment is to provide our Customers with state-of-the-art engineering expertise in the field of materials, corrosion and corrosion mitigation. This would contribute to ensure integrity and durability of assets as well as to improve safety, environment preservation and energy saving.

***We care about your expectations.***









# CORROSION AND MATERIALS

Cescor started in 1988 as an Association of professionals and in 1994 the company Cescor srl was established. Its background lies in the Italian tradition of Applied Electrochemistry and Corrosion Science, which had prof. Giuseppe Bianchi (University of Milan) and prof. Pietro Pedefferri (Polytechnic of Milan), one of the founder of the company, as undisputed scholars. From its early days Cescor adopted a modern approach to corrosion and material engineering, perceiving the discipline as a strategic contribution to design. It has developed an integrated approach which combines knowledge on metallic materials properties, corrosion fundamentals and prevention methods, in a cost optimization perspective. Focusing but not limiting to the oil&gas industry, Cescor's activity extends also to civil and industrial infrastructures.

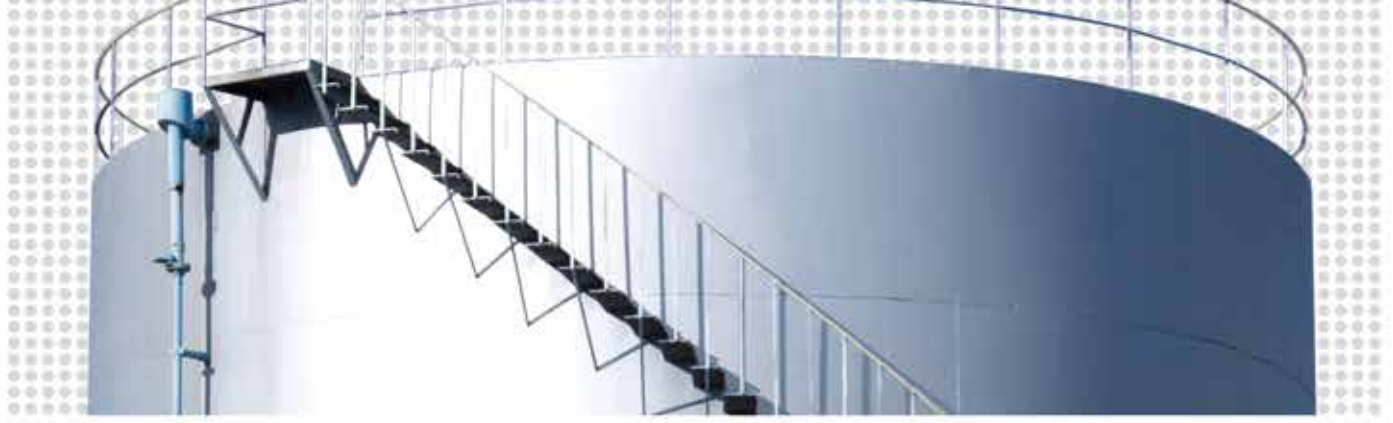
# A PROFESSIONAL

Corrosion is a *time dependent* phenomenon and its effects can occur at all stages of a structure lifetime. Corrosion control measures must be provided from the design phase and performed during the operating life. Cescor devotes many efforts to the monitoring of corrosion processes through a dedicated unit qualified for carrying out surveys, inspections and corrosion assessments. Main areas of interest are: cathodic protection on-land surveys, stray current, reinforced concrete structures. After more than two decades, Cescor can benefit from trained engineers who learned on the field as well as from the discussion of a variety of case studies.

# SERVICES







Cathodic protection is a worldwide established technique for corrosion prevention that has its roots in corrosion mechanism principles. Through the book Cathodic Protection, by Luciano Lazzari and Pietro Pedferri, Cescor has contributed to give a rational support for all practical applications.

Cescor provides consultancy and design services as well as turn-key systems, in cooperation with qualified suppliers for main items (like anodes, feeding units and ancillary components).

As documented in Cescor's Selected Reference List, Cescor deals with all types of applications, including soil, marine, reinforced concrete and equipment.

# CATHODIC PROTECTION



# ENGINEERING COMPANY

Cescor has developed, tested and patented a series of highly sophisticated products for corrosion monitoring and control, now available on the market.

To support its Clients' needs, Cescor enables the manufacturing of dedicated products in accordance with specific project requirements, in particular for cathodic protection applications. These include reference electrodes, monitoring and control units, anode assemblies for either impressed currents or galvanic systems.

# PRODUCTS





# WE CARE ABOUT OUR PEOPLE AND OUR CLIENTS

## MATERIAL AND CORROSION ENGINEERING



### CORROSION AND MATERIAL SELECTION

- Fluid Corrosivity Evaluation Studies and Material Selection Reports
- Oil&gas:
  - well completion (tubular, DHE and wellheads)
  - gathering, injection and transportation pipeline networks
  - on-land and subsea
  - treatment plants
- Chemical and petrochemical
- Coatings
- Consultancy
- Company Standards

### CORROSION RISK ASSESSMENT

- Corrosion Risk Assessment studies: for sets of homogeneous items - vessels, pipework, pipelines, etc. - corrosion probability and entity of the consequences are assessed and Risk Matrices produced
- Risk Based Inspection Reports
- Life Extension Reports
- Inspection plans
- Corrosion Management Manuals
- Expert Reports

### PIPELINE INTEGRITY

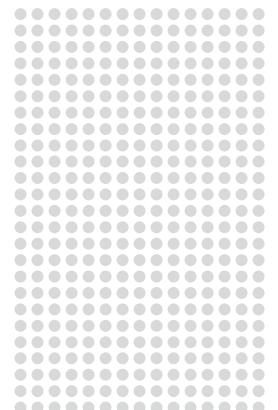
- Internal corrosion
- External corrosion and cathodic protection
- Design of corrosion inhibition treatments and monitoring systems
- Re-qualification and life-extension
- Fit-for-purpose assessment
- Inspection plans
- Defects acceptability
- Failure analysis

### CATHODIC PROTECTION DESIGN

- Feasibility studies
- Design of cathodic protection systems
  - galvanic anodes and impressed currents, for all applications
  - soil, marine, equipment, reinforced concrete.
- Company Standards
- Expert reports

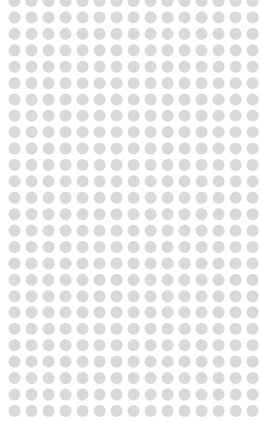


FAILURE PROBABILITY	RISK MATRIX					RISK CLASS
failure expected						Severe
high						High
medium						Medium
low						Low
safe						Safe
	A	B	C	D	E	
	Consequence of failure					





# CATHODIC PROTECTION



Cescor provides complete cathodic protection services, covering: feasibility studies, site surveys, detail design packages, materials procurement, erection supervision, start-up and commissioning, periodical controls and maintenance.

Cathodic protection systems – impressed current and galvanic anodes - are supplied using first quality materials procured through a network of qualified manufacturers.



## PIPELINE

- On-land pipelines
- Oil&gas gathering networks
- Water mains - steel, cast iron and reinforced concrete
- Urban gas distribution networks
- Subsea pipelines
- Monitoring and control systems

## PLANT AREA AND TANKS

- In-plant area cathodic protection systems (piping, earthing systems, concrete foundations)
- Above ground storage tanks- bottom and internal
- Above ground storage tanks with secondary containment
- Buried drums and tanks

## MARINE

- Fixed steel offshore platforms
- Floating platforms
- FSO and FPSO
- Marine piers and jetties
- Sheet piling

## PLATFORMS RETROFITTING

- CP of in-service offshore platforms shows unique features with respect to new ones. Cescor provides a wide range of retrofitting solutions, including:
- Anode sleds
  - Tensioned anode strings
  - Buried anode strings
  - Pile mounted anodes



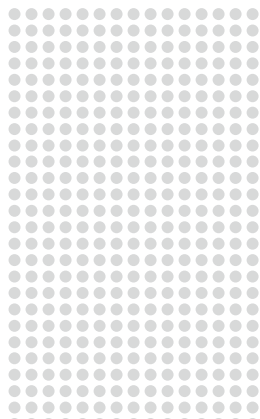
## REINFORCED CONCRETE

- Bridges, viaducts, buildings, marine piers. Existing and new



## EQUIPMENT

- Desalination Plants
- Water boxes and pumps





# SERVICES



## CP SYSTEM CONTROL AND MAINTENANCE

- On and Instant-Off potential measurements
- CP systems inspection
- Performance assessment of isolating joints and flanges



## ON-LAND PIPELINE SURVEY

- Close Interval Potential Survey (CIPS)
- Direct Current Voltage Gradient Survey (DCVG)
- Soil resistivity survey
- UT - thickness measurements



## OFFSHORE PIPELINE INSPECTION

- Subsea pipeline potential and current density profiles, including shore approaches
- Offshore structures potential
- Anode current density for residual life estimation



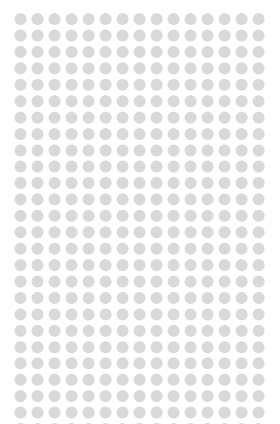
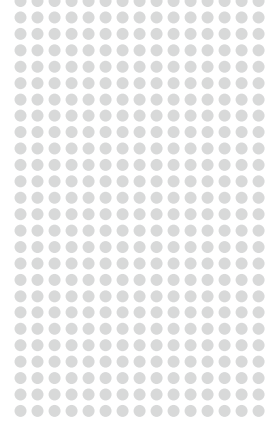
## STRAY CURRENTS SURVEY

- Buried pipeline interference survey (DC)
- Buried pipeline alternating current interference survey



## CORROSION DIAGNOSIS IN CONCRETE STRUCTURES

- Rebar Potential Mapping
- Linear Polarization Resistance
- Electrical interference (viaducts and bridges; tunnels)





# PRODUCTS



## **StrayProbe®**

StrayProbe is a cathodic protection monitoring probe designed to measure the true potential of a buried steel structure. The potential of a steel coupon is measured versus a mixed metal oxide activated titanium reference electrode, both embedded in a cement mortar with controlled porosity to simulate the one of a coating with holidays. In an alternative version, high purity zinc, embedded in a special backfill, is adopted as reference electrode. The probe is designed and manufactured for long term durability. Applications include: potential and stray current monitoring; electrode for SCADA and remote control in cathodic protection systems.



## **Ti MMO Electrode**

It is a permanent embeddable reference electrode for corrosion monitoring in reinforced concrete structures. It consists of a titanium probe activated with an iridium enriched mixed metal oxide, cast in a controlled cement filler which maintains constant pH around the probe and guarantees long term stability of the electrochemical potential. Applications include: corrosion monitoring, stray current monitoring and cathodic protection control.



## **MuRE**

MuRE is a probe for monitoring corrosion in reinforced concrete structures. <sup>(\*)</sup>It consists of a series of linear Ni-made reference electrodes. It gives the potential mapping of steel reinforcement. It detects pitting initiation and allows preventive diagnosis of onset conditions for hydrogen embrittlement on high strength steels. It is the unique reference electrode for the monitoring of pre-stressed and post-tensioned concrete structures.



## **CUSTOM DESIGNED PRODUCTS**

Several products are designed and manufactured based on project and customer needs. These include:

- Anode assemblies for all applications
- Permanent reference electrodes assemblies for all applications
- Remote monitoring and control units
- Data acquisition systems
- Junction and control boxes
- Test stations and monitoring devices



<sup>(\*)</sup>MuRE is a product developed based on patent N. MI 2004-A00969 owned by Politecnico di Milano.



## WE TAKE CARE OF OUR ENVIRONMENT

# SUSTAINABILITY. MATERIAL INTEGRITY AS

From the perspective of sustainability, corrosion engineering plays a wide-ranging role, which goes beyond the economics, since the integrity and the durability of the assets work in line with the respect of the environment, the safety of people and the saving of energy. This is pursued by extending the asset's life cycle within a safe envelope, whereby the need for replacement of high-energy content metals is limited or avoided.







Corrosion is a spontaneous degradation process, ruled by thermodynamics, which represents a persistent threat for the integrity and the durability of structures and plants. Corrosion control measures, when properly in place, can freeze the process or reduce its effect within acceptable levels.

# AN OPPORTUNITY.



Corrosion engineering and control, which include the design and the application of the best prevention measures and their verification along the operating life, is not only a cost but also and especially an opportunity to increase the value of the assets.

***We create value.***





UNI EN ISO 9001:2008  
QMS certified for activities reported in certify N. K062

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