

GENERAL SPECIFICATION

CORROSION

GS EP COR 110

External cathodic protection of buried pipelines

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1. Scope

This document defines the minimum requirements for the design, installation and commissioning of external cathodic protection of buried pipelines used for hydrocarbons, gas or water transportation.

It applies to low carbon steel or stainless steels, coated or uncoated pipelines, including buried equipment installed along their routes such as sectioning valves, tees, anchoring flanges, etc.

It also applies to buried production flowlines between wellheads and intermediate stations and/or treatment centres.

This document does not apply to onshore facilities located in restricted areas such as wells, intermediate stations, treatment or storage centres. Cathodic protection of these facilities is specified in **GS EP COR 111**.

2. Reference documents

The reference documents listed below form an integral part of this General Specification and apply when they are not in conflict with those of the present document.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document. Should some requirements of these documents differ, those from [ISO 15589-1](#) prevail

Reference	Title
BS 7361-1	Cathodic protection - Part 1: code of Practice for land and marine applications
EN 12954	Cathodic protection of buried or immersed metallic structures - General principles
ISBN 88 7398 020 1	Cathodic Protection - Luciano Lazzari, Pietro Peddeferri - Polipress
ISBN 1-57590-092-0	Peabody's control of pipeline corrosion
ISO 15589-1	Petroleum and natural gas industries - Cathodic protection for pipeline transportation systems
NACE SP0169	Control of external corrosion on underground or submerged metallic piping systems
NACE SP0177	Mitigation of alternating current and lightning effects on metallic structures and corrosion control systems
NACE SP0286	The electrical isolation of cathodically protected pipelines

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Total General Specifications

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Reference	Title
GS EP COR 111	External cathodic protection of onshore facilities
GS EP COR 201	Supply of sacrificial anodes
GS EP COR 210	Monolithic insulating joints
GS EP COR 220	Three layer polyethylene external coating for pipelines
GS EP COR 221	Three layer polypropylene external coating for pipelines
GS EP COR 222	Fusion Bonded Epoxy (FBE) external coating for pipelines
GS EP COR 350	External protection of offshore and coastal structures and equipment by painting
GS EP COR 420	External field joint coatings of pipelines
GS EP ELE 079	Electrical apparatus for potentially explosive gas atmospheres
GS EP ELE 141	Power transformers

3. General requirements

3.1 Qualification and Certification of Cathodic Protection specialists responsible for the design, installation supervision, commissioning and routine inspection

Design, installation supervision, commissioning, and routine inspection of cathodic protection systems of buried pipelines shall be carried out exclusively by competent and specialised personnel.

The qualification of each of the specialists shall be demonstrated to Company before commencement of the work.

Verification of the formal Certification of the individuals shall be as follows:

- Conventional design work, supervision of installation, pre-commissioning and routine monitoring works shall be carried out by certified personnel at level 2 for all certification schemes except for NACE International where it shall be level 3.
- Complex design work, verification or commissioning shall be carried out by certified personnel at level 3 for all certification schemes except for NACE International where it shall be level 4.

Accepted Certification schemes are AFAQ AFNOR Compétence (Land Application Sector), APCE (Land Application Sector), Institute of Corrosion, NACE International. Any other certification scheme shall be approved by Company.

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Any use of non certified personnel for cathodic protection design shall be subject to Company approval on a case by case basis (demonstration of competence through detailed curriculum vitae and description of experience).

3.2 Company involvement

Contractor shall involve Company specialist or its appointed representative at each phase of the project, and more particularly during:

- Study
- Design
- Equipment selection and procurement (Factory Acceptance Tests)
- Installation
- Commissioning.

Company specialist or its appointed representative shall have the right to visit the site/plant/factory and to review documents/reports/drawings when he considers appropriate. Approval by Company specialist shall be mandatory at each phase of the project.

3.3 Sub-contractors

When Contractor sub-contracts the study, works supervision, adjustments commissioning, or the preparation of the final report to a specialised Sub-contractor, the choice of Sub-Contractor shall be submitted to Company for approval.

Notwithstanding the above, Contractor remains responsible to Company for the successful completion of the cathodic protection project and in no case he may use:

- Company approval for the choice of Sub-contractor
- Company approval for the study report

to release him from his contractual liability.

If the simultaneous intervention of several Contractors is needed, special dispositions in the Contracts shall apply to ensure: coordination and compatibility of the various cathodic protection studies, standardisation for the selection of equipment, checking of technical requirements at interfaces, preparation of an overall start-up and commissioning activity, and the issue of a common final report.

3.4 Definition of tasks

Unless the Contract specifies otherwise, a cathodic protection project shall include all of the tasks listed below.

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3.4.1 Study

The study shall include a site survey including:

- The collection of all relevant information, the data required for the estimation of corrosion risks and the evaluation of coating materials
- The collection of all documents and information on the design of the structure to be protected, its size, and its characteristics which are likely to influence the design of the cathodic protection system
- The collection of all documents and information pertaining to the environment of the work: the presence of nearby metallic structures whether cathodically protected or not, the presence of works likely to emit stray currents, the presence of high voltage cables or transmission lines, electric power stations, transformer stations, etc., which may damage cathodic protection installations, coatings, or the structures itself
- The collection of all information on availability of electrical power for the supply of cathodic protection installations.

The study shall also comprise a detailed study report including:

- An analysis of all information gathered and measurements taken, and an estimate of corrosion risks
- Justified design hypotheses, particularly for the electrical insulation values of the coatings, in new and aged conditions,
- A technico-economical discussion of the various schemes envisaged,
- Design notes justifying the sizing and layout of equipment: anodes, transformers-rectifiers, cables, etc. Unless otherwise specified, the cathodic protection system shall be designed for a service life of 20 years minimum
- A list of materials, including assembly accessories, and the corresponding technical specifications
- A list of possible Suppliers
- Schematic diagrams
- Detailed equipment diagrams
- Detailed installation drawings, indicating:
 - The location of insulating joints
 - Electrical bonding to be installed
 - Special insulations to be installed
 - The layout of different types of equipment and the relevant installation procedure
 - Wiring diagram for electrical equipment.

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- Installation instructions, indicating all precautions to be taken. Particular emphasis shall be given to the construction of:
 - Ground beds
 - Connections on anode circuits
 - Insulation between protected and non protected items
 - Insulation between items protected by different cathodic protection systems
 - Insulation between items protected by the same system, which must be separated temporarily for various operational reasons, such as routine checking of the quality of the coating, etc.
 - Influence correction with third parties or nearby installations
 - Reference electrode installation at fixed points.

As a general rule, the location of electrical equipment in hazardous areas shall be avoided. If this is impossible, the use of equipment corresponding with the safety classification of the area in question shall be specified.

The study shall be submitted to Company or to its representative for approval.

3.4.2 Administrative formalities

If local legislation requires that an enquiry takes place before a cathodic protection system is installed, the preparation of the legal file is the responsibility of Contractor, and the study shall not receive definitive approval until the results of the official enquiry have been obtained.

Company shall be responsible for transmitting the file to the competent administrative body. Company shall also receive the results of the enquiry.

Company shall be responsible for any question of property which may be involved in the installation of the cathodic protection system.

Contractor shall provide Company with all information and documents required to deal with these property matters, including:

- Extracts of land survey maps
- Delimitation on the land survey maps of the land to be acquired and the temporary and/or permanent rights of way to be acquired.

If the installations require a power supply from a local distribution network, and unless otherwise specified, the formalities with the local distribution company shall be carried out by Contractor. However, the network extension and connection costs shall be borne by Company.

3.4.3 Equipment supply

Unless otherwise specified, supply of all equipment shall be the responsibility of Contractor.

Contractor shall also supply spare parts recommended by Vendors for a two year operating period.

Contractor shall also supply all those spare parts which might be required during startup of the installation.

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Contractor shall make all the necessary arrangements with Vendors to allow Company access at all times to the workshops during the manufacturing period to check:

- Manufacturing progress
- Equipment conformity with specifications
- And to be present during Factory Acceptance Testing.

A provisional manufacturing schedule shall be given to Company for planning inspections.

Vendors shall supply factory test reports, anode material chemical analysis, certificates of approval for electrical equipment to be used in hazardous areas, etc., to Contractor who shall include them in the final report.

The final report shall consist of:

- A detailed description of the installation
- Vendor's drawings and operating and maintenance instructions
- As built drawings
- Equipment list with references and Vendor's addresses
- A list of spare parts for two years of operation, with complete references
- Operating procedures
- A complete list of measurements taken before and during startup of the system
- Reports stating agreements made with owners of neighbouring structures (duly signed by the various parties concerned) on the corrective actions to be taken for any interference with these structures.

The results of the enquiry and the permission of the local authorities if the installations are to be in countries where such installations are subject to special legislation.

4. Protection criteria

4.1 General

Unless otherwise indicated, all the requirements of [ISO 15589-1](#) shall apply.

In addition, and unless otherwise indicated in this document, all the requirements of [EN 12954](#), [NACE SP0169](#) and [BS 7361 - Part 1](#) shall apply. With zinc reference electrode (see § 9.7.2) the criteria will be modified accordingly.

Unless justified by particular circumstances, any buried pipeline that requires cathodic protection shall be electrically insulated from other structures to which it may be connected.

4.2 Protection potential

The pipe-to-soil potential is used as a criterion for effective cathodic protection.

This potential is measured relative to a saturated copper/copper sulphate reference electrode.

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The cathodic protection system shall permanently modify the electrochemical free potential of the entire surface of the pipeline in the negative direction, and below the following limits:

- -850 mV/Cu/CuSO₄ for steel in an aerated soil
- -950 mV/Cu/CuSO₄ for steel in a de-aerated soil with confirmation of the presence of active sulphate reducing bacteria.

To avoid detrimental effects on the applied coating (cathodic disbanding) or hydrogen induced stress cracking of the steel, the potential shall be higher than the overprotection potential. This overprotection potential may vary from -1.2 V/Cu-CuSO₄ for low carbon steel pipe to -1.0 V/Cu-CuSO₄ for a high strength steel pipe in aerated soils.

Potentials shall be measured as close as possible to "true" values, correcting the error due to ohmic drop in the soil.

More specific protection criteria may be accepted by Company on a case by case basis, according to pipeline characteristics, coating and surroundings.

5. Site studies

5.1 Site surveys

Before definition of the cathodic protection design, Contractor shall undertake a site survey including:

- Soil resistivity measurements along the pipeline route to assess apparent corrosiveness level and, at points either side of the route, for the installation of impressed current anodes
- Measurements of pipe-to-soil potentials, if applicable, on crossing and parallel buried metallic structures (pipelines, rails) or on the existing pipeline to be protected
- A list of low voltage power lines which may be used to feed an impressed current DC source, and high voltage lines, which may have a detrimental influence
- A list of existing cathodic protection equipment for crossing and parallel buried structures in the vicinity of the pipeline route.

Note: In the case of an existing pipeline, Contractor may, conditions permitting, carry out one or more cathodic protection trials, so that the apparent insulation resistance and initial current requirement can be evaluated.

5.2 Soil resistivity measurements

Soil resistivity shall be measured by the four aligned and equidistant pins method (Wenner's method), or by the Schlumberger method or by inductive electromagnetic technique, according to the following minimum requirements: