

PRESENTATION OF CATHODIC PROTECTION SYSTEM DESIGN

Procedure

This Standard replaces and cancels its previous revision.

The CONTEC - Authoring Subcommittee provides guidance on the interpretation of this Standard when questions arise regarding its contents. The Department of PETROBRAS that uses this Standard is responsible for adopting and applying the clauses thereof.

Technical Requirement: a provision established as the most adequate and which shall be used strictly in accordance with this Standard. If a decision is taken not to follow the requirement ("non-conformity" to this Standard) it shall be based on well-founded economic and management reasons, and be approved and registered by the Department of PETROBRAS that uses this Standard. It is characterized by the verb forms "shall," "it is necessary...," "is required to...," "it is required that...," "is to...," "has to...," "only ... is permitted," and other equivalent expressions having an imperative nature.

Recommended Practice: a provision that may be adopted under the conditions of this Standard, but which admits (and draws attention to) the possibility of there being a more adequate alternative (not written in this Standard) to the particular application. The alternative adopted shall be approved and registered by the Department of PETROBRAS that uses this Standard. It is characterized by the verbal form "should" and equivalent expressions such as "it is recommended that..." and "ought to..." (verbs of a nonmandatory nature). It is indicated by the expression: **[Recommended Practice]**.

Copies of the registered "non-conformities" to this Standard that may contribute to the improvement thereof shall be submitted to the CONTEC - Authoring Subcommittee.

Proposed revisions to this Standard shall be submitted to the CONTEC - Authoring Subcommittee, indicating the alphanumeric identification and revision of the Standard, the clause(s) to be revised, the proposed text, and technical/economic justification for revision. The proposals are evaluated during the work for alteration of this Standard.

"The present Standard is the exclusive property of PETRÓLEO BRASILEIRO S.A. - PETROBRAS, for internal use in the Company, and any reproduction for external use or disclosure, without previous and express authorization from the owner, will imply an unlawful act pursuant to the relevant legislation through which the applicable responsibilities shall be imputed. External circulation shall be regulated by a specific clause of Secrecy and Confidentiality pursuant to the terms of intellectual and industrial property law."

CONTEC

Comissão de Normalização
Técnica

SC - 15

Cathodic Protection

Foreword

PETROBRAS Technical Standards are prepared by Working Groups - WG (consisting of specialists from PETROBRAS and its Subsidiaries), are commented by PETROBRAS Units and PETROBRAS Subsidiaries, are approved by the Authoring Subcommittees - SCs (consisting of specialists from the same specialty, representing the various PETROBRAS Units and PETROBRAS Subsidiaries), and ratified by the Executive Nucleus (consisting of representatives of the PETROBRAS Units and PETROBRAS Subsidiaries). A PETROBRAS Technical Standard is subject to revision at any time by its Authoring Subcommittee and shall be reviewed every 5 years to be revalidated, revised or cancelled. PETROBRAS Technical Standards are prepared in accordance with standard PETROBRAS N-1. For complete information about PETROBRAS Technical Standards see PETROBRAS Technical Standards Catalog.

FOREWORD

This Standard is the English version (issued in MAR/2007) of standard PETROBRAS N-1983 REV. D MAR/2007, which is the Revalidation of standard PETROBRAS N-1983 REV. C APR/2001, the contents thereof not altered.

1 SCOPE

1.1 This Standard describes the documents and information which shall be included in the design of a Cathodic Protection System (CPS).

1.2 This Standard is applied to the design of CPS of buried or submerged structures such as oil pipelines, gas pipelines, ship berthing dolphins and piers, fixed and mobile offshore platforms, ships, vessels, storage tanks, buoys, casings, submarine outfalls and metallic foundation piles.

1.3 This Standard is applied to designs started as of its date of issuance.

1.4 This Standard only contains Technical Requirements.

2 SUPPLEMENTARY DOCUMENTS

The documents listed below are mentioned in the text and contain valid requirements for the present Standard.

PETROBRAS N-381	- Execution of Drawing And Other General Technical Documents;
PETROBRAS N-1493	- Equipamento de Drenagem Elétrica para Proteção Catódica;
PETROBRAS N-1710	- Coding of Technical Engineering Documents;
PETROBRAS N-1913	- Material Requisition Preparation;
PETROBRAS N-2245	- Levantamento de Dados de Campo para Projeto de Proteção Catódica - Dutos Terrestres;
PETROBRAS N-2608	- Rectifiers for Cathodic Protection.

Note: For documents referred in this Standard and for which only the Portuguese version is available, the PETROBRAS department that uses this Standard should be consulted for any information required for the specific application.

3 GENERAL CONDITIONS

3.1 The documents listed in Section 4 and prepared according to this Standard comprise a complete cathodic protection design, and some of those documents may be deemed dispensable by PETROBRAS.

3.2 It shall be understood that the content of each document represents the minimum necessary for its acceptance by PETROBRAS.

3.3 The documents mentioned in this Standard shall be presented in accordance with standards PETROBRAS [N-381](#) and [N-1710](#).

4 DOCUMENTS COMPRISING THE CATHODIC PROTECTION SYSTEM DESIGN

4.1 Descriptive Memo of Design

This document shall contain, in summarized form, all information describing how the design has been developed, including at least the following items:

- a) contents;
- b) objective of Descriptive Memo;
- c) brief description of structure to be protected;
- d) field data survey;
- e) description of design;
- f) list of design documents;
- g) list of reference documents.

4.1.1 The brief description of the structure shall contain information characterizing the structure, such as location, major dimensions, purposes and inter-relations with other structures.

4.1.2 The field data survey shall mention the documents which served as a basis for its development and the final report of the results obtained.

4.1.3 The description of the design shall contain information regarding parameters, criteria, elements comprising the design, as well as the distribution of services, which are detailed in the following sub-items:

- a) design parameters:
 - current density adopted;
 - utilization factor of anodes;
 - metal/electrolyte relative velocity;
 - operating temperature;
 - resistivity of electrolyte;
 - type and efficiency of coating;
 - current capacity, electrochemical potential and material of anodes for galvanic current systems;
 - wear rate and material of anodes for impressed current systems;
 - characteristics, types of rectifiers, in the case of current systems;
 - useful life adopted for cathodic protection system;
- b) general design criteria and justification:
 - selection and criteria for selection of system;
 - electrical insulations and interconnections adopted;
 - philosophy adopted in the design (total protection or by parts);
- c) elements comprising design:

- quantity, distribution and location of anodes, rectifiers and drainage equipment;
 - quantity, location and types of test points;
 - quantity and location of electrical insulations;
 - quantity and location of interconnecting devices;
 - quantity and location of protection of insulating joints;
 - major characteristics of monitoring system, where appropriate;
- d) distribution of installation and assembly services.

4.1.4 The list of design documents shall contain all documents prepared, with their respective identification number in accordance with standard PETROBRAS [N-1710](#), title, revision and date. This list shall contain at least the following documents:

- a) Descriptive Memo of Design;
- b) field data survey report;
- c) calculation notes;
- d) technical specifications;
- e) lists of materials;
- f) material requisitions;
- g) Data Sheets;
- h) drawings;
- i) standards PETROBRAS and other applicable standards.

4.2 Calculation Notes

All calculation procedures shall be presented in a clear manner, mentioning the codes and/or standards on which they were based and containing at least the following information:

- a) objective;
- b) design parameters and criteria, as described in items 4.1.3 a) and b) and specific standards on cathodic protection system design for the structure considered;
- c) calculation of areas to be protected, with details about the area of each region, for current distribution studies;
- d) detailed calculation of protection currents;
- e) calculation of mass of anodes, quantity of anodes, anode beds and cables, if that is the case, currents debited by anodes and selection criteria in the case of galvanic systems;
- f) sizing of anode beds, criteria for selection of rectifiers, anodes and cables, in the case of impressed current systems;
- g) studies on the distribution of anodes in galvanic systems and on the distribution of current sources, in impressed current systems;
- h) specific calculation such as, for example, the verification of stresses on anode supports in the galvanic protection of platforms, drainage systems in buried pipelines, among others.

4.3 Field Data Survey Report

4.3.1 It shall be prepared in accordance with standard PETROBRAS [N-2245](#).

4.3.2 The results of surveys of electrical resistivity of the soil and anode beds shall be plotted on documents standardized by standard PETROBRAS [N-2245](#).

4.4 Technical Specifications

4.4.1 Equipment and Materials

It shall include at least information allowing them to be purchased, regardless of the supplier:

- a) constructive characteristics;
- b) electrical characteristics;
- c) basic components;
- d) operating principles;
- e) presentation;
- f) tests;
- g) acceptance.

4.4.2 Installation and Assembly

It shall complement the specific drawings and contain information on the requirements and precautions for the installation and assembly of:

- a) rectifiers;
- b) anodes;
- c) electrical cables;
- d) drainage equipment;
- e) test points;
- f) devices used for protection of insulating joints;
- g) electrical interconnections;
- h) electrical insulations.

4.4.3 Commissioning

It shall contain information on the locations and procedures to be adopted in the cathodic protection system, such as:

- a) general inspection of the system, before energization, for each type of installation, of the items to be checked;
- b) initial surveys of natural potentials of structure, before energization of the system;
- c) procedures for partial and final adjustments, after energization of the system;
- d) final surveys of potentials and currents;
- e) presentation of results.

4.4.4 Inspection

An inspection routine shall be prepared containing at least the following items:

- a) inspections to be performed and their time intervals;
- b) measurement instruments;
- c) main areas to be inspected;
- d) cathodic protection criteria;
- e) inspection method.

4.4.5 Monitoring System

It shall contain information regarding:

- a) the location of reference electrodes;
- b) the location of anodes selected for current measurements;
- c) the location of tubes for carrying cables from reference electrodes and monitored anodes;
- d) panel with instruments for measurement of electrochemical potential and current;
- e) criteria for location and determination of the quantity of reference electrodes and anodes monitored.

4.5 List of Materials

This document shall include a listing of all materials and equipment provided for in the design, with the specifications, quantities, totals (planned and additional), the respective RMs (if any) and indication of the drawings on which such materials are to be applied. Reference shall be made to the standards of standardized materials.

4.6 Material Requisition - RM

It shall be presented in accordance with standard PETROBRAS [N-1913](#), and be comprised of design documents specifying and quantifying materials and equipment, with reference being made to standards and/or the corresponding technical specifications, where appropriate, and be in compliance with the lists of materials.

4.7 Data Sheet

In the case of rectifiers and equipment used for electrical drainage, reference shall be made in the RMs to the Data Sheets standardized by standards PETROBRAS [N-2608](#) and [N-1493](#), respectively.

4.8 Drawings

Drawings shall be presented in accordance with standard PETROBRAS [N-381](#) and contain all technical information allowing the understanding of the design, including at least the following documents:

- a) general drawing showing positioning of elements comprising the cathodic protection system;
- b) plans showing location and installation of anode beds and rectifiers, in the case of impressed circuit systems;
- c) plans showing location and installation of drainage equipment;
- d) drawing showing distribution of anodes;
- e) drawing giving details and showing installation referring to all components of the system;
- f) electrical diagram of each rectifier and its respective anode bed and drainage equipment;
- g) drawings of monitoring system.

5 DESIGN ACCEPTANCE

Acceptance of the design is subject to compliance with this Standard and the specific standard of the design of the cathodic protection system of the structure to be protected.



INDEX OF REVISIONS

REV. A, B and C

There is no index of revisions.

REV. D

[illegible]