

PETRONAS TECHNICAL STANDARDS

DESIGN AND ENGINEERING PRACTICE

TECHNICAL SPECIFICATION

DESIGN OF CATHODIC PROTECTION SYSTEMS FOR OFFSHORE PIPELINES (AMENDMENTS/SUPPLEMENTS TO DNV RP B401)

PTS 30.10.73.32

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The objective is to set the recommended standard for good technical practice to be applied by PETRONAS' OPU/Divisions in oil and gas production facilities, refineries, gas processing plants, chemical plants, marketing facilities or any other such facility, and thereby to achieve maximum technical and economic benefit from standardisation.

The information set forth in these publications is provided to users for their consideration and decision to implement. This is of particular importance where PTS may not cover every requirement or diversity of condition at each locality. The system of PTS is expected to be sufficiently flexible to allow individual operating units to adapt the information set forth in PTS to their own environment and requirements.

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PART I INTRODUCTION

1.1 SCOPE

This PTS specifies requirements and gives recommendations for the design of cathodic protection systems for offshore pipelines.

This PTS may also be applied to submerged pipeline sections of on-shore pipelines.

Short "offshore" pipelines or pipeline sections (e.g. loading lines) may sometimes be protected by onshore based (impressed current) cathodic protection installations. For such installations reference is made to PTS 30.10.73.31.

This PTS is based on DNV Recommended Practice RP B401, 1993 edition. Part III of this PTS gives amendments and supplements to RP B401.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by PETRONAS, the distribution of this PTS is confined to companies forming part of PETRONAS group and to Contractors nominated by them.

This PTS is intended to be used for new offshore pipeline construction projects in relation to oil and gas production facilities, oil refineries, chemical plants, gas plants and supply/marketing installations. This PTS is not intended to be used for retrofitting of cathodic protection systems on existing offshore pipelines.

If national and/or local regulations exist in which some of the requirements may be more stringent than in this PTS the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable as regards safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this PTS which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned with the object of obtaining agreement to follow this PTS as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party which carries out all or part of the design, engineering, procurement, installation, and commissioning or management of a project or operation or maintenance of a facility. The Principal may sometimes undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party which manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party which initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant, authorised to act for the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Specific Definitions

Anode Manufacturer/Supplier - the manufacturer/supplier of sacrificial anodes and related materials

Cathodic protection design Contractor - the party responsible for the design of the cathodic protection system and ultimately responsible for the functioning of the cathodic protection system.

Cathodic protection installation Contractor - the party responsible for the installation of the cathodic protection system in accordance with the design and with this PTS.

Coating breakdown factor - the ratio between the surface area of exposed metal due to coating breakdown and the total surface area under consideration. The factor is used to determine the average current density on coated metal from current densities compared with that for bare steel.

Conceptual design - early design phase, preceding detailed design.

Foreign structures/pipelines - metal structures, or pipelines other than the pipeline under consideration, in contact with the same electrolyte as the pipeline, and which (may) come under the influence of the pipeline's cathodic protection system. Foreign structures/pipelines may be owned by the Principal or other companies and may or may not be equipped with cathodic protection.

Pipe to (sea)water potential - the difference in electrochemical potential between a pipeline or foreign structure/pipeline and a specified reference electrode in contact with the electrolyte. Similar terms such as structure to (sea)water potential, pipe to electrolyte potential and pipe to soil potential are sometimes used as applicable in the particular context.

Requisition - the data/requisition sheet(s) PTS 30.10.73.94., to be used by the Principal and completed by the Contractor. A specimen copy for information is included in [Appendix 1](#). The actual sheets can be found in the requisitioning binder (PTS 30.10.01.10.).

1.4 ABBREVIATIONS

Ag/AgCl	Silver/silver chloride as used for the Silver/silver chloride type of reference electrode.
Cu/CuSO ₄	Copper/copper sulphate as used for the Copper/copper sulphate type of reference electrode.
AC	Alternating current
Ah/kg	Ampere-hours per kilogram
DC	Direct current
DNV	Det Norske Veritas
GRE	Glass reinforced epoxy
PE	Polyethylene
SCE	Saturated calomel electrode

1.5 CROSS-REFERENCES

Where cross-references to other parts of this PTS are made, the referenced section is shown in brackets. Other documents referenced by this PTS are listed in [\(Part IV\)](#).

1.6 GUIDANCE FOR USE

Part III contains amendments/supplements which are directly related to equivalent Sections in DNV RP B401. For clarity, the section numbering of DNV RP B401 has been used. Where sections in DNV RP B401 are referenced in this PTS, those sections as amended/supplemented by this PTS are meant. sections in DNV RP B401 that are not amended/supplemented by this PTS shall remain valid as written.

PART II DESIGN PHILOSOPHY

1.1 GENERAL

Offshore pipelines shall be protected from sub-sea corrosion using a combination of external coatings and cathodic protection. The cathodic protection system shall be designed to maintain the exposed pipeline metal surfaces within an electrochemical potential range which controls corrosion within acceptable limits without causing material damage.

The recommended cathodic protection system for newly constructed offshore pipelines features bracelet-type sacrificial anodes. The use of impressed current is not recommended except where successfully in use for existing pipelines and for retrofit purposes when sacrificial systems are not feasible.

For offshore pipelines the pipe-to-sea water "ON" potential is used as a criterion for effective cathodic protection. "OFF" potentials may be applicable to impressed current systems in high-resistivity waters.

The cathodic protection system shall maintain the pipe-to-sea water potential of pipelines between - 800 and -1100 mV with respect to an Ag/AgCl reference cell.

The effect of cathodic protection on corrosion resistant steels and some high strength steels depends on the susceptibility of the material to hydrogen induced stress cracking. Practical potential levels obtained from cathodic protection systems using Zinc or Aluminium sacrificial anodes are such that polarisation more negative than the above overprotection limit is avoided. Therefore, the use of materials, welded or not welded, susceptible to hydrogen embrittlement within the specified potential range shall not be used in conjunction with cathodic protection. Magnesium anodes or impressed current cathodic protection shall not be used for high strength steels or corrosion resistant steels.

The cathodic protection system shall be designed for the full design life of the pipeline.

Electrical pipeline isolation between compatible sacrificial anode cathodic protection systems installed on platforms and pipelines is not required. Offshore pipelines shall, however, be electrically isolated from on-shore pipelines and shore installations, structures equipped with impressed current systems and structures operated by third parties.

For new construction projects, the design of the cathodic protection system shall be an integral part of the total pipeline design. The design of cathodic protection systems shall be carried out by a professional and experienced cathodic protection design Contractor approved by the Principal.

1.2 CONCEPTUAL DESIGN

The Contractor shall submit to the Principal a conceptual cathodic protection design for review and approval which shall include the documentation listed in (6). Only after such approval shall the Contractor commence detailed design (1.3).

In some cases (e.g. on small projects or standard projects) the Principal may request the Contractor to carry out both conceptual design and detailed design in one operation.

1.3 DETAILED DESIGN

The detailed design shall contain all information required for the procurement of cathodic protection equipment and for the construction, commissioning, and hand over of the cathodic protection system. The detailed design package shall contain the documentation listed in (9).

PART III AMENDMENTS/SUPPLEMENTS TO DNV RP401, 1993 EDITION

The design of cathodic protection systems for offshore pipelines shall be in accordance with DNV RP B401, 1993 edition with the following amendments/supplements. Section numbers in the text of this sections correspond with the respective sections numbers in DNV RP B401. Unmentioned sections remain valid as written.

2. SCOPE

Delete this sections and refer to [Part I, Section 1.1](#) of this PTS.

3. DEFINITIONS, SYMBOLS AND ABBREVIATIONS

3.1 PARTIES AND RESPONSIBILITIES

Replace the definitions of the parties with the following:

The "Operator" is the Principal [\(1.3.1\)](#).

The "Designer" is the cathodic protection design Contractor [\(1.3.2\)](#).

The "Fabricator" is the anode Manufacturer/Supplier or the cathodic protection installation Contractor [\(1.3.2\)](#) as apparent from the context or as specifically indicated in the text.

5. GENERAL DESIGN CONSIDERATIONS

Add to the beginning of this section:

The contents of this section are to be regarded as background information only. They are technically valid but do not provide any direct guidance for designing the cathodic protection system.

For some related subjects forming part of the PETRONAS design philosophy on cathodic protection of offshore pipelines, refer to [\(Part II\)](#) of this PTS.