

## DEP SPECIFICATION

# DESIGN OF CATHODIC PROTECTION SYSTEMS FOR ONSHORE BURIED PIPELINES AND ON-PLOT PIPING (AMENDMENTS/SUPPLEMENTS TO ISO 15589-1:2003)

DEP 30.10.73.31-Gen.

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## DESIGN AND ENGINEERING PRACTICE



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## PART I INTRODUCTION

### 1.1 SCOPE

This DEP specifies requirements and gives recommendations for the design of cathodic protection systems for onshore buried pipelines and on-plot buried piping.

This DEP is also applicable to short "offshore" pipelines or pipeline sections (e.g., loading lines) to be protected by onshore based cathodic protection installations.

This DEP is based on ISO 15589-1:2003. Part III of this DEP amends, supplements and deletes various clauses of ISO 15589-1 and follows the clause numbering of ISO 15589-1 for easy reference.

All clauses of ISO 15589-1 not modified by this DEP remain valid as written.

This is a revision of the DEP of the same number dated September 2011. This revision incorporates contents from DEP 30.10.73.34-EPE. See (Part I, 1.5) regarding the changes.

### 1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them. Any authorised access to DEPs does not for that reason constitute an authorization to any documents, data or information to which the DEPs may refer.

This DEP is intended for use on new pipeline construction projects as well as for retrofitting of cathodic protection on existing pipelines related to related to oil and gas production, gas handling, oil refining, chemical processing, gasification, distribution and supply/marketing. Application in other facilities may also apply.

When DEPs are applied, a Management of Change (MOC) process shall be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable with regards to the safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this DEP 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, the objective being to obtain agreement to follow this DEP as closely as possible.

### 1.3 DEFINITIONS

#### 1.3.1 General definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

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

The **Principal** is the party that initiates the project and ultimately pays for it. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

**1.3.2 Specific definitions**

| <b>Term</b>                         | <b>Definition</b>                                                                                                                                                                                                                                                                                                                                                        |
|-------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Cathodic Protection</b>          | The process to reduce or prevent corrosion of metal structures in contact with an electrolyte by the flow of direct current from the electrolyte into the structure surface.                                                                                                                                                                                             |
| <b>Cathodic Protection Station</b>  | A combination of equipment installed to provide cathodic protection to the pipeline.                                                                                                                                                                                                                                                                                     |
| <b>Coating Breakdown Factor</b>     | 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 related to bare steel.                                                                                                                   |
| <b>Current Density</b>              | The amount of current per unit area of the steel surface, coated or uncoated, in contact with the electrolyte.                                                                                                                                                                                                                                                           |
| <b>Drain Point</b>                  | The point on the pipeline where the connection of the negative terminal of the cathodic protection voltage source is made to conduct (drain) the returning current from the pipeline to the voltage source.                                                                                                                                                              |
| <b>Electrolyte</b>                  | A conductive liquid or material such as soil or water in which an electric current can flow.                                                                                                                                                                                                                                                                             |
| <b>Foreign Structures/Pipelines</b> | Metal structures or pipelines other than the pipeline under consideration, in contact with the same electrolyte as the pipeline, and which are or may become under the influence of the pipeline's cathodic protection system.<br>Foreign structures/pipelines may be owned by the principal or other companies and may or may not be equipped with cathodic protection. |
| <b>Groundbed</b>                    | The system of buried or submerged electrodes, to conduct the required current into and through the electrolyte to the steel surface to be protected.                                                                                                                                                                                                                     |
| <b>Midpoint</b>                     | The point on a pipeline between two cathodic protection stations where the influence of the two cathodic protection stations is expected to be equal and the protection levels are usually lowest.                                                                                                                                                                       |
| <b>Natural Potential</b>            | The pipe to soil potential measured when no cathodic protection is applied and polarization caused by cathodic protection is absent.                                                                                                                                                                                                                                     |
| <b>"OFF" Potential</b>              | The pipe to soil potential measured immediately after the cathodic protection system is switched off and the applied electrical current stops flowing to the pipeline surface, but before polarization of the pipeline has decreased                                                                                                                                     |
| <b>"ON" Potential</b>               | The pipe to soil potential measured while the cathodic protection system is continuously operating.                                                                                                                                                                                                                                                                      |
| <b>Pipeline</b>                     | The pipeline or pipelines with associated equipment as defined in the scope of the cathodic protection design contract.                                                                                                                                                                                                                                                  |
| <b>Pipe To Soil Potential</b>       | 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 soil potential, pipe to electrolyte potential, pipe to (sea)water potential are sometimes used as applicable in the particular context.                             |
| <b>Polarization</b>                 | The change of the pipe to soil potential caused by the flow of DC current between an electrolyte and a steel surface.                                                                                                                                                                                                                                                    |
| <b>Polarization Cell</b>            | A device that contains a series of contact plates separated by an electrolyte, which is inserted in the earth connection of a structure that isolates for DC in the cathodic protection voltage range.                                                                                                                                                                   |

| <b>Term</b>                 | <b>Definition</b>                                                                                                                                                                                                                                                                                                |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Reference Electrode</b>  | An electrode of which the electrochemical potential is accurately reproducible and which serves as a reference for pipe to soil potential measurements                                                                                                                                                           |
| <b>Requisition</b>          | The data/requisition sheets contained in DEP Requisition 30.10.73.93-Gen. are to be used by the Principal and completed by the Contractor.                                                                                                                                                                       |
| <b>Solid-State Isolator</b> | A device which is inserted in the circuit between two structures that isolates for DC or AC in certain ranges, depending on the design                                                                                                                                                                           |
| <b>Stray Currents</b>       | Electrical currents running through the electrolyte, originating from a foreign DC source, causing interaction with the corrosion and cathodic protection processes of the pipeline. Stray currents may also originate from the pipeline's cathodic protection system and act upon foreign structures/pipelines. |

#### 1.4 CROSS-REFERENCES

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

#### 1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated September 2011. The following are the main, non-editorial changes.

| <b>Old section</b> | <b>New section</b> | <b>Change</b>                                                                                                                                                |
|--------------------|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Part I, 1.1        | Part I, 1.1        | The scope of the DEP has been expanded to include on plot buried piping. This change has been adopted throughout the DEP.                                    |
| General            | General            | Contents from the regional standard 30.10.73.34-EPE has been incorporated into this DEP-Gen.                                                                 |
|                    | Part III, 5.2      | Added new bullet addressing shielding.                                                                                                                       |
| Part III, 5.3.2.1  | Part III, 5.3.2.1  | Modified the maximum temperature for pipelines operating above ambient temperature to 40 °C (104 °F) for which polarized potential protection level applies. |
| Part III, 5.5      | Part III, 5.5      | Added requirements for isolation of import and export pipelines.                                                                                             |
| Part III, 5.5      | Part III, 5.5      | Modified last par. to reference painting requirements.                                                                                                       |
| Part III, 5.5.2    | Part III, 5.5.2    | Added new last par.                                                                                                                                          |
| Part III, 5.7      | Part III, 5.7      | Modified this section                                                                                                                                        |
| Part III, 5.8      | Part III, 5.8      | Added current density design criteria.                                                                                                                       |
| Part III, 5.9.1    | Part III, 5.9.1    | Added requirements to this section.                                                                                                                          |
| Part III, 6.1      | Part III, 6.1      | Added requirements to this section                                                                                                                           |

|                  |                  |                                                                                |
|------------------|------------------|--------------------------------------------------------------------------------|
| Part III,<br>7.5 | Part III,<br>7.5 | Added color coding requirements for cables.                                    |
|                  | Part III,<br>9.4 | Clarified additional lightening protection is not required for on plot piping. |

## 1.6 COMMENTS ON THIS DEP

Comments on this DEP may be submitted to the Administrator using one of the following options:

|                                                                      |                                                                                                                                                                                                                                                                   |
|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Shell DEPs Online</b><br>(Users with access to Shell DEPs Online) | Enter the Shell DEPs Online system at <a href="https://www.shelldeps.com">https://www.shelldeps.com</a><br><br>Select a DEP and then go to the details screen for that DEP.<br><br>Click on the "Give feedback" link, fill in the online form and submit.         |
| <b>DEP Feedback System</b><br>(Users with access to Shell Wide Web)  | Enter comments directly in the DEP Feedback System which is accessible from the Technical Standards Portal <a href="http://www.shell.com/standards">http://www.shell.com/standards</a> .<br><br>Select "Submit DEP Feedback", fill in the online form and submit. |
| <b>DEP Standard Form</b><br>(Other users)                            | Use DEP Standard Form 00.00.05.80-Gen. to record feedback and email the form to the Administrator at <a href="mailto:standards@shell.com">standards@shell.com</a> .                                                                                               |

Feedback that has been registered in the DEP Feedback System by using one of the above options will be reviewed by the DEP Custodian for potential improvements to the DEP.

## 1.7 DUAL UNITS

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

## PART II GENERAL REQUIREMENTS

### 2.1 GENERAL

Part III of this DEP is written as amendments/supplements to ISO 15589-1:2003.

Wherever reference is made to ISO 15589-1, it shall be understood to mean ISO Standard 15589-1:2003 as amended/supplemented by this DEP.

For ease of reference, the section and clause numbering of ISO 15589-1 is used in Part III of this DEP.

Clauses of ISO 15589-1 that are not amended by this DEP shall remain applicable as written.

### 2.2 DESIGN

The design of cathodic protection systems shall be carried out by a professional and experienced cathodic protection engineering Contractor approved by the Principal.

For new construction projects, the design of the cathodic protection system shall be an integral part of the total pipeline design. Pipeline isolation and a suitable pipeline coating system shall be provided for in the pipeline design.

To achieve an effective cathodic protection design for a pipeline system or on-plot piping, a site survey shall be performed to collect essential information on soil resistivity, geographical factors, the likelihood or the existence of stray currents and any other important features along the pipeline route.

When designing a cathodic protection system for retrofitting to an existing pipeline or on-plot piping, certain repairs and modifications to the pipeline may be necessary to comply with these specifications. Other requirements may have to be determined by site investigations.

The cathodic protection system shall be designed so that any external corrosion on the pipeline or piping is eliminated and any adverse stray current effects on the pipeline or on foreign structures/pipelines is avoided.

### 2.3 DESIGN INFORMATION TO BE SUBMITTED BY THE PRINCIPAL

By means of the requisition, the Principal shall submit to the Contractor all technical information required to carry out the cathodic protection design.

This information shall include at least:

- a) detailed information on the pipeline/piping to be protected (length, diameter, coating, scope limits, etc.)
- b) the required design life of the cathodic protection system. This design life is normally equal to the design life of the pipeline /piping
- c) requirements on cathodic protection systems and/or materials
- d) relevant drawings (pipeline route, on-plot piping structures, existing systems, foreign structures/pipelines)
- e) applicable environmental and operating conditions for the cathodic protection equipment.

### 2.4 BASIC DESIGN FOR REVIEW

The Contractor shall submit to the Principal a basic cathodic protection design for review and approval that shall include:

- the documentation listed in the first seven bullet items in clause 13.1.1 of ISO 15589-1,
- justification of the selected cathodic protection system and anode materials,