SLOVENSKI STANDARD
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Ovrednotenje verjetnosti nastanka korozije vkopanih cevovodov - Uporaba pri katodno zaščitenih cevovodih

Evaluation of a.c. corrosion likelihood of buried pipelines applicable to cathodically protected pipelines

Beurteilung der Korrosionswahrscheinlichkeit durch Wechselstrom an erdverlegten Rohrleitungen - Anwendung für kathodisch geschützte Rohrleitungen

Évaluation du risque de corrosion occasionnée par les courants alternatifs des canalisations enterrées protégées cathodiquement

Ta slovenski standard je istoveten z: prEN 15280

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23.040.99	Drugi sestavni deli za cevovode	Other pipeline components
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Evaluation of a.c. corrosion likelihood of buried pipelines applicable to cathodically protected pipelines

Beurteilung der Korrosionswahrscheinlichkeit durch Wechselstrom an erdverlegten Rohrleitungen - Anwendung für kathodisch geschützte Rohrleitungen

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 219.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (prEN 15280:2011) has been prepared by Technical Committee CEN/TC 219 “Cathodic protection”, the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

This document will supersede CEN/TS 15280:2006.

With this document, CEN/TS 15280:2006 is converted into an European Standard.

The main modification concerns the criteria assumed in presence of a.c. interference on a pipeline. While CEN/TS 15280:2006 represented a collection of various experiences in the field of a.c. corrosion, this draft European Standard has incorporated these criteria and thresholds together with most recent data. Various European countries have a very different approach to the prevention of a.c. corrosion depending primarily on the d.c. interference situation. These different approaches are taken into account in two different ways:

— either in presence of “low” d.c. potential, which allows a certain level of a.c. voltage (up to 15 V),

— or in presence of “high” d.c. potential (with d.c. stray currents interference on the pipeline for instance) which requires to reduce the a.c. voltage towards the lowest possible levels.

This draft European Standard gives also some parameters to consider to evaluate the a.c. corrosion likelihood, as well as detailed measurement techniques, detailed mitigation measures and detailed measure to carry out for the commissioning. Note that an annex proposes other criteria that require further validation based on practical experiences.

1 Scope

This European Standard is applicable to buried cathodically protected metallic structures that are influenced by a.c. traction systems and/or a.c. power lines.

In this document, a buried pipeline (or structure) is a buried or immersed pipeline (or structure), as defined in EN 12954.

In the presence of a.c. interference, the criteria given in EN 12954, Table 1, are not sufficient to demonstrate that the steel is being protected against corrosion.

This European Standard provides limits, measurements procedures, mitigation measures and information to deal with long term a.c. interference and the evaluation of a.c. corrosion likelihood.

This standard deals with possible a.c. corrosion of metallic pipelines due to a.c. interferences caused by inductive, conductive or capacitive coupling with a.c. power systems and with the maximum tolerable limits of these interference effects. It takes into account the fact that this is a long-term effect which occurs only during normal operating conditions.

Short term a.c. interferences appearing during fault conditions in the a.c. power system will not cause a.c. corrosion.

This standard does not deal with the safety issues associated with a.c. voltages. These are covered in national standards and regulations (see FprEN 50443).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 12954:2001, *Cathodic protection of buried or immersed metallic structures — General principles and application for pipelines*

EN 13509:2003, *Cathodic protection measurement techniques*

EN 15257, *Cathodic protection — Competence levels and certification of cathodic protection personnel*

FprEN 50443, *Effects of electromagnetic interference on pipelines caused by high voltage a.c. electric traction systems and/or high voltage a.c. power supply systems*

ISO 8407:2009, *Corrosion of metals and alloys — Removal of corrosion products from corrosion test specimens*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in the IEC (International Electrotechnical Commission) and the following apply.

3.1
a.c. electric traction system
a.c. railway electrical distribution network used to provide energy for rolling stock

NOTE The system may comprise:

- contact line systems;
- return circuit of electric railway systems;
- running rails of non-electric railway systems, which are in the vicinity of, and conductively connected, to the running rails of an electric railway system.

3.2
a.c. power supply system
a.c. electrical system devoted to electrical energy transmission and including overhead lines, cables, substations and all apparatus associated with them

NOTE This includes the HV transmission lines with 16,7 Hz.

3.3
a.c. power system
a.c. electric traction system or a.c. power supply system

NOTE Where it is necessary to differentiate, each interfering system is clearly indicated with its proper term.

3.4
interfering system
interfering high voltage a.c. railway system and/or high voltage a.c. power supply system

3.5
interfered system
system on which the interference effects appear

NOTE In this standard, it is the pipeline system.

3.6
pipeline system
system of metallic pipework with all associated equipment and stations up to and including the point of delivery

NOTE 1 In this standard pipeline system refers only to metallic pipeline system.

NOTE 2 The associated equipment is the equipment electrically connected to the pipeline.

3.7
earth
conductive mass of the earth, whose electric potential at any point is conventionally taken as equal to zero

[IEC 60050 826-04-01]

3.8
operating condition
fault free operation of any system

NOTE Transients are not to be considered as an operating condition.

3.9
fault condition
unintentional condition caused by a short-circuit to earth

NOTE 1 The fault duration is the normal clearing time of the protection devices and switches.

NOTE 2 The short circuit is an unintentional connection of an energized conductor to earth or to any metallic part in contact with earth

3.10
conductive coupling
situation occurring when a part of the current belonging to the interfering system returns to the system earth via the interfered system or when the voltage to the reference earth of the ground in the vicinity of the influenced object rises because of a fault in the interfering system

NOTE The results of conductive coupling are conductive voltages and currents.

3.11
inductive coupling
phenomenon whereby the magnetic field produced by a current carrying circuit influences another circuit; the coupling being quantified by the mutual impedance of the two circuits

NOTE The results of inductive coupling are induced voltages and hence currents. These voltages and currents depend, for example, on the distances, length, inducing current, circuit arrangement and frequency.

3.12
capacitive coupling
phenomenon whereby the electric field produced by an energized conductor influences another conductor; the coupling being quantified by the capacitance between the conductors and the capacitances between each conductor and earth

NOTE The results of capacitive coupling are interference voltages into conductive parts or conductors insulated from earth. The interference voltages depend, for example, on the voltage of the influencing system, distances and circuit arrangement

3.13
interference
phenomenon resulting from conductive, capacitive, inductive coupling between systems, and which can cause malfunction, dangerous voltages, damage, etc.

3.14
disturbance
equipment malfunction due to interference, whereby the equipment loses its capability of working properly for the duration of the interference but, when the interference disappears, starts working properly again without any external intervention

3.15
damage
permanent reduction in the quality of service which can be suffered by the interfered system

NOTE 1 Examples of damage are: coating perforation, pipe pitting, pipe perforation, permanent malfunction of the equipment connected to the pipes, etc.

NOTE 2 A reduction in the quality of service could also be the complete cancellation of service.

3.16
danger
state of the influenced system which is able to produce a threat to human life

3.17
interference situation
situation in which an interference can appear (permanently or intermittently) between an a.c. power system and a metallic pipeline system

NOTE 1 A given interference situation is defined by the geometrical and electrical characteristics of the a.c. power system and of the metallic pipeline system, as well as by the medium between the two systems.

NOTE 2 An interference situation can cause:
- danger to persons;
- damage to the pipeline and/or to the connected equipment;
- disturbance of the electrical and/or electronic equipment connected to the pipeline.

3.18
interfering current
vectorial sum of the currents flowing through the conductors relevant to the a.c. power system (i.e. catenaries, feeders, return conductors, phase conductors, earth wires)

NOTE This interfering current is used to simplify the calculations when the distances between the interfering system and the interfered system are high when compared to the distances between the conductors of the interfering system.

3.19
interference voltage
voltage on the interfered system by the conductive, inductive and capacitive coupling with the nearby interfering system between a given point and the earth or across an insulating joint

3.20
prospective touch voltage
voltage between simultaneously accessible conductive parts when those conductive parts are not being touched by a person or an animal

[IEC 60050-195-05-09]

NOTE In the case covered in this standard, the prospective touch voltage coincides with the interference voltage. This is due to the fact that in the worst case the interfered pipe might not discharge the current to ground.

3.21
spread resistance
ohmic resistance through a coating defect to remote earth or from the exposed metallic surface of a coupon towards remote earth. This is the resistance which controls the d.c. or a.c. current through a coating defect or an exposed metallic surface of a coupon for a given d.c. or a.c. voltage

3.22
coupon
representative metal sample with known dimensions

3.23
probes
device incorporating a coupon that provides measurements of key parameters to assess the corrosion risk

4 Cathodic protection personnel competence

Personnel who undertake the design, supervision of installation, commissioning, supervision of operation, measurements, monitoring and supervision of maintenance of cathodic protection systems shall have the appropriate level of competence for the tasks undertaken.

NOTE 1 EN 15257 constitutes suitable methods of assessing competence of cathodic protection personnel which may be utilised.

NOTE 2 Competence of cathodic protection personnel to the appropriate level for tasks undertaken should be demonstrated by certification in accordance with qualification procedures such as EN 15257 or any other equivalent scheme.

5 Parameters to be considered in case of a.c. interference

5.1 Parameters

5.1.1 General

This standard is applicable to all new metallic pipelines and all new high voltage a.c. railway systems and high voltage a.c. power supply systems and all major modifications that can significantly change the interference effect.

The effects to be considered within FprEN 50443 are the following:

a) danger to people who come in direct contact or contact through conductive parts with the metallic pipeline or the connected equipment;

b) damage of the pipeline or to the connected equipment;

c) disturbance of electrical/electronic equipment connected to the pipeline.

Electrical/electronic systems installed on the pipeline network shall be chosen such that they will neither become dangerous, nor stop production, because of the short term voltages and currents which appear during short circuits on the a.c. power system.

Long term a.c. interference on a buried pipeline can cause corrosion due to an exchange of a.c. current between the exposed metal of the pipeline and the surrounding electrolyte.

This exchange of current depends on an a.c. voltage whose amplitude is related to various parameters such as:

- the configuration of a.c. power line phase conductors and shield wires;
- the distance between the a.c. power line / traction system and the pipeline;
- the current flowing in the a.c. power line / traction system phase conductors;
- the average coating resistance of the pipeline (expressed in $\Omega.m^2$);
- the thickness of the coating;
- the soil resistivity;
- the a.c. voltage of the a.c. railway system or the a.c. power line system.

5.1.2 A.C. interferences evaluation

When necessary (see Clause 7), the level of influence and the effectiveness of mitigation measures of a.c. interferences shall be determined either by calculation, by measurements or a combination of both. It could however be very difficult to detect worst case conditions just by taking a single measurement.

This standard does not deal with short term interferences. For long term interferences, calculations can help to evaluate (see CIGRE for instance) the impacts of interferences (inductive, capacitive and conductive effects).

5.1.3 New pipelines

In the case of construction of a new pipeline within the area of possible influence of an a.c. system, calculations should be performed by using a procedure agreed between the pipeline operator and the interfering structure operator (e.g. ITU-T algorithms - see CIGRE in bibliography) to evaluate the theoretical a.c. interference level. Special analyses (soil resistivity measurements, influence on existing pipelines, connections with other pipelines) can also be made.

Calculations to determine the earthing requirements necessary to maintain touch voltages to acceptable safe levels can also be used to achieve the lower voltages necessary to reduce the a.c. corrosion likelihood.

5.1.4 Existing pipelines

In case of pipeline within the area of possible influence of an a.c. system, measurements and/or simulation shall be carried out. Measurements can be such as:

- pipe to remote earth a.c. voltage;
- pipe to soil d.c. potential;
- soil resistivity.

If coupons or probes are installed, the following measurements should also be performed:

- a.c. voltage;
- d.c. potential;
- a.c. current density;
- d.c. current density.

Calculations should be performed by using an acceptable procedure (e.g. ITU-T algorithms - see CIGRE in bibliography) to evaluate the a.c. interference level. They should be compared with field measurements.

5.2 New interference cases (pipelines/power lines/traction systems in the design phase) – Condition for calculation

During the design phase of interfering structures (electricity power line or railway line) or pipelines, an estimation of the level of a.c. interference should be calculated, taking into account the normal operating conditions of the interfering systems. In the case of existing structures, calculation can also be used in conjunction with field measurements. The risks of a.c. corrosion from shall be taken into account for every new structure. This can be done by direct measurements and / or calculations.

Calculations to determine the earthing requirements necessary to maintain touch voltages to acceptable levels can also be used to achieve the lower voltages necessary to reduce the a.c. corrosion likelihood.