DRAFT INTERNATIONAL STANDARD ISO/DIS 13173

Attributed to ISO/TC **156** by the Central Secretariat (see page iii)

Voting begins on **2005-04-05**

Voting terminates on **2005-09-05**

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

FAST-TRACK PROCEDURE

Cathodic protection for steel offshore floating structures

Protection cathodique des structures en acier flottant en mer

ICS 47.020.99; 77.060

NOTE FROM THE ISO CENTRAL SECRETARIAT

This draft International Standard is submitted for voting to ISO member bodies under the fast-track procedure.

Technical Committee ISO/TC 156, *Corrosion of metals and alloys*, at its meeting held in May 2004, decided to approve the submission of the standard EN 13173:2001, *Cathodic protection for steel offshore floating structures*, for processing under the “Fast-track procedure”, in accordance with the provisions of Clause F.2, Annex F, of the ISO/IEC Directives, Part 1 (fourth edition, 2001).

F.2 “Fast-track procedure”

F.2.1 Proposals to apply the fast-track procedure may be made as follows.

F.2.1.1 Any P-member or category A liaison organization of a concerned technical committee may propose that an **existing standard from any source** be submitted for vote as an enquiry draft. The proposer shall obtain the agreement of the originating organization before making a proposal. The criteria for proposing an existing standard for the fast-track procedure are a matter for each proposer to decide.

F.2.1.2 An international standardizing body recognized by the ISO or IEC council board may propose that a **standard developed by that body** be submitted for vote as a final draft International Standard.

F.2.1.3 An organization having entered into a formal technical agreement with ISO or IEC may propose, in agreement with the appropriate technical committee or subcommittee, that a **draft standard developed by that organization** be submitted for vote as an enquiry draft within that technical committee or subcommittee.

F.2.2 The proposal shall be received by the Chief Executive Officer, who shall take the following actions:

a) settle the copyright and/or trademark situation with the organization having originated the proposed document, so that it can be freely copied and distributed to national bodies without restriction;

b) for cases F.2.1.1 and F.2.1.3, assess in consultation with the relevant secretariats which technical committee/subcommittee is competent for the subject covered by the proposed document; where no technical committee exists competent to deal with the subject of the document in question, the Chief Executive Officer shall refer the proposal to the technical management board, which may request the Chief Executive Officer to submit the document to the enquiry stage and to establish an ad hoc group to deal with matters subsequently arising;

c) ascertain that there is no evident contradiction with other International Standards;

d) distribute the proposed document as an enquiry draft (F.2.1.1 and F.2.1.3) in accordance with 2.6.1, or as a final draft International Standard (case F.2.1.2) in accordance with 2.7.1, indicating (in cases F.2.1.1 and F.2.1.3) the technical committee/subcommittee to the domain of which the proposed document belongs.

F.2.3 The period for voting and the conditions for approval shall be as specified in 2.6 for an enquiry draft and 2.7 for a final draft International Standard. In the case where no technical committee is involved, the condition for approval of a final draft International Standard is that not more than one-quarter of the total number of votes cast are negative.

F.2.4 If, for an enquiry draft, the conditions of approval are met, the draft standard shall progress to the approval stage (2.7). If not, the proposal has failed and any further action shall be decided upon by the technical committee/subcommittee to which the document was attributed in accordance with F.2.2 b).

If, for a final draft International Standard, the conditions of approval are met, the document shall progress to the publication stage (2.8). If not, the proposal has failed and any further action shall be decided upon by the technical committee/subcommittee to which the FDIS was attributed in accordance with F.2.2 b), or by discussion between the originating organization and the office of the CEO if no technical committee was involved.

If the standard is published, its maintenance shall be handled by the technical committee/subcommittee to which the document was attributed in accordance with F.2.2 b), or, if no technical committee was involved, the approval procedure set out above shall be repeated if the originating organization decides that changes to the standard are required.

Contents

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 219 "Cathodic protection", the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2001, and conflicting national standards shall be withdrawn at the latest by July 2001.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

Cathodic protection is usually applied, mostly as a complement to protective coating or paint, to protect the external surfaces of steel offshore floating structures and appurtenances from corrosion due to sea water or saline mud.

Cathodic protection works by supplying sufficient direct current to the immersed surface of the structure in order to change the steel to electrolyte potential to values where corrosion is insignificant.

The general principles of cathodic protection are detailed in EN 12473.

1 Scope

This European Standard defines the means to be used to cathodically protect the submerged metallic surfaces of steel offshore floating structures and appurtenances in sea water and saline mud.

1.1 Structures

This European Standard covers the cathodic protection of the external surface of offshore floating structures which are static during their usual operating conditions. This essentially includes: barges, jack-ups, semi-submersible platforms, storage tankers, buoys, etc.

It also covers the submerged areas of appurtenances, such as chains, attached to the structure, when these are not electrically isolated from the structure.

It does not cover the cathodic protection of ships, fixed offshore structures, elongated structures (pipelines, cables) or harbour installations, which are covered by other standards.

This European Standard concerns only the cathodic protection of external surfaces immersed in sea water, including sea chests and water intakes up to the first valve.

This European Standard does not include the internal protection of surfaces of any components such as ballast tanks and hull internals of floating structures.

1.2 Materials

This European Standard covers the cathodic protection of structures fabricated principally from bare or coated carbon manganese steels

As some parts of the structure may be made of metallic materials other than carbon manganese steels, the cathodic protection system should be designed to ensure that there is a complete control over any galvanic coupling and minimise risks due to hydrogen embrittlement or hydrogen induced cracking (see EN 12473).

This European Standard does not cover concrete structures.

1.3 Environment

This European Standard is applicable for the whole submerged zone in sea water, brackish waters, saline mud which can normally be found where the floating structure is anchored, moored or moving.

This European Standard is also applicable to appurtenances which may be in contact with muds (e.g. chains).

For surfaces which are alternately immersed and exposed to the atmosphere, the cathodic protection is only effective when the immersion time is sufficiently long for the steel to become polarised.

1.4 Safety and environment protection

This European Standard does not cover safety and environmental protection aspects associated with cathodic protection. The relevant national or international regulations shall apply.

2 Normative references

This European Standard incorporates, by dated or undated references, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 12473, *General principles of cathodic protection in sea water.*

prEN 12496, *Galvanic anodes for cathodic protection in sea water.*

3 Terms and definitions

For the purposes of this European Standard the terms and definitions in EN 12473 and the following apply:

3.1
atmospheric zone
zone located above the wetted zone; that means above the level reached by the normal swell, whether the structure is moving or not

3.2
boot topping
section of the hull between light and fully loaded conditions, which may be intermittently immersed

3.3
Cathodic Protection zone
that part of the structure which can be considered independently with respect to cathodic protection design

3.4
immersed zone
zone located below the water line at draught corresponding to normal working conditions

3.5
submerged zone
zone including the immersed and the buried zones

3.6
underwater hull
part of the hull vital for its stability and buoyancy of a floating structure, i.e. below the light water line

4 Design basis

4.1 Objectives

The major objective of a cathodic protection system is to deliver sufficient current to protect each part of the structure and appurtenances and distribute this current so that the potential of each part of the structure is within the limits given by the protection criteria (see 4.2).

Potentials should be as uniform as possible over the whole structure. This objective may only be approached by an adequate distribution of the protective current over the structure during its normal service conditions. However, it may be difficult to achieve in some areas such as chains, water intakes, sea chests, when supplementary cathodic protection systems should be considered.

The cathodic protection system for a floating structure is generally combined with a coating system, even though some appurtenances, such as chains, may not benefit from a coating protection.

Dielectric shields may be used in conjunction with anodes to minimise the risk of local over-protection.

The cathodic protection system should be designed either for the life of the structure or for a period corresponding to the maintenance dry-docking interval.

The above objectives should be achieved by the design of a cathodic protection system using galvanic anodes or impressed current systems or a combination of both.

4.2 Cathodic protection criteria

The criteria for cathodic protection are detailed in EN 12473.

To achieve an adequate cathodic protection level, steel structures should have potentials as indicated hereafter.

The accepted criterion for protection of steel in aerated sea water is a potential more negative than -0,80 V measured with respect to Ag/AgCl/sea water reference electrode.

A negative limit of -1,10 V (Ag/AgCl/sea water reference electrode) is generally recommended.

Where there is a possibility of coating disbondment and corrosion fatigue, the negative limit should be more positive. This negative limit should be documented.

4.3 Design parameters

The design of a cathodic protection system should be made in accordance with the following parameters: structure subdivision, components description and service conditions.

4.3.1 Structure subdivision

A floating structure can be divided into different Cathodic Protection zones, (CP zones), which are then considered independently with respect to cathodic protection design, although they may not necessarily be electrically isolated.

EXAMPLE 1 For a storage tanker, some specific components may not be included in the underwater hull CP zone and therefore constitute a CP zone by themselves (e.g. : seachests).

EXAMPLE 2 For buoys, a single zone is generally considered, including two components: the body of the buoy and the influenced part of the mooring chain(s).

4.3.2 Description of CP zones

Each C.P. zone may consist of several components which should be fully described including material, surface area and coating characteristics (type, lifetime and coating breakdown factor).

4.3.3 Service conditions

The design of the cathodic protection system(s) will depend on service conditions which include: expected life time, environment and operating conditions.

- Life time: either the whole design life or dry-docking interval(s) should be considered.

- Environment: the sea water properties should be established (see EN 12473).

- Operating conditions: the cathodic protection design normally considers only the static conditions of the structure because the durations when dynamic conditions prevail are generally negligible.

4.4 Electrical current demand

4.4.1 General

To achieve the criteria for protection for the conditions outlined in 4.3, it is necessary to select the appropriate current density for each component.

The current demand of each metallic component of the structure is the result of the product of its surface area multiplied by the required current density.

4.4.2 Protection current density for bare steel

The current density required may not be the same for all components of the structure as the environmental and service conditions are variable.

The selection of design current densities may be based on experience gained from similar structures in a similar environment or from specific tests and measurements.

The current density depends on the kinetics of electrochemical reactions and varies with parameters such as the protection potential, surface condition, dissolved oxygen content in sea water, sea water velocity at the steel surface, temperature.

The following should be evaluated for each design:

- initial current density required to achieve the initial polarisation of the structure;

- maintenance current density required to maintain polarisation of the structure;

- final current density for possible repolarisation of the structure, e.g. after severe storms or cleaning operations.

As the initial polarisation preceding steady state conditions is normally short compared to the design life, the average current density over the lifetime of the structure is usually very close to the maintenance current density.

The (average) maintenance current density is used to calculate the minimum mass of anode material necessary to maintain cathodic protection throughout the design life.

Typical values of current densities as used for bare steel are given in annex A.

4.4.3 Protection current density for coated steel

The cathodic protection system is generally combined with suitable coating systems. The coating reduces current density and improves the current distribution over the surface.

The reduction of current density may be in a ratio of 100 to 1 or even more. However the current density will increase with time as the coating deteriorates.

An initial coating breakdown factor related mainly to mechanical damage occurring during the fabrication of the structure should be considered. A coating deterioration rate (i.e. an increase of the coating breakdown factor) should be selected in order to take into account the coating ageing and possible mechanical damage occurring to the coating during the life time of the structure or a period corresponding to the dry-docking interval.

These values are strongly dependent on the actual construction and operational conditions.

Guidelines for the values of coating breakdown factors (f_c) are given in annex A.

The protection current density needed for the protection of coated steel is equal to the product of the current density for bare steel and the coating breakdown factor.

$$J_c = J_b \cdot f_c$$

where:

J_c is the protection current density for coated steel in amperes per square metre,

J_b is the protection current density for bare steel in amperes per square metre,

f_c is the coating breakdown factor which varies with time due to ageing and mechanical damage:

f_c = 0 for a perfectly insulating coating,

f_c = 1 for a coating with no insulation property (equivalent to bare steel structure).

This formula should be applied for each individual component or zone as defined in 4.3 where the coating, or the current density for bare steel, may be different.

4.4.4 Protection current demand

An evaluation of the current demand required should be carried out to optimise the mass and size of galvanic anodes, or the capacity of impressed current systems.

The protection current demand I_e of each component of the structure to be cathodically protected is equal to:

$$I_e = A_e \cdot J_{ce}$$

where:

A_e is the surface area of the individual component in square metres,

J_{ce} is the individual protection current density for the component considered, in amperes per square metre.

The protection current demand I_z of each CP zone is therefore equal to the sum of current demands for each component included in the CP zone:

$$I_z = \Sigma_z(I_e)$$