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Standard
Recommended Practice

Cathodic Protection of Prestressed Concrete Cylinder Pipelines

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Foreword

The purpose of this standard recommended practice is to furnish guidelines that provide corrosion control personnel with information on corrosion control of prestressed concrete cylinder pipe (PCCP) through the application of cathodic protection (CP). The guidelines presented are applicable to new or existing buried pipelines with or without a supplemental coating.

The provisions of this standard should be applied under the direction of competent persons who are qualified to engage in the practice of corrosion control on buried or submerged metallic pipelines. Such persons may be licensed professional engineers or persons recognized as corrosion specialists or CP specialists by NACE. The professional experience of such persons should include suitable experience in CP of prestressed concrete structures.

This standard was originally prepared in 2000 by NACE Task Group T-10A-28, a component of Unit Committee T-10A on Cathodic Protection. To provide the necessary expertise on all aspects of the subject and in order to receive input from all interested parties, Task Group T-10A-28 was composed of corrosion consultants, consulting engineers, architect-engineers, CP engineers, researchers, pipeline owners, and representatives from both industry and government. It was reaffirmed in 2004 by Specific Technology Group (STG) 05 on Cathodic/Anodic Protection. This standard is issued by NACE under the auspices of STG 05.

In NACE standards, the terms *shall*, *must*, *should*, and *may* are used in accordance with the definitions of these terms in the NACE Publications Style Manual, 4th ed., Paragraph 7.4.1.9. *Shall* and *must* are used to state mandatory requirements. The term *should* is used to state something good and is recommended but is not mandatory. The term *may* is used to state something considered optional.

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Section 1: General

1.1 Introduction

1.1.1 Concrete and prestressing wire are considered compatible materials because they have similar coefficients of thermal expansion and because concrete usually provides steel with excellent corrosion protection. Due to the high alkalinity of portland cement, a stable, corrosion-mitigating, passive oxide film forms on the surface of the encased steel. If this film does not form, or is weakened or destroyed, corrosion can occur.

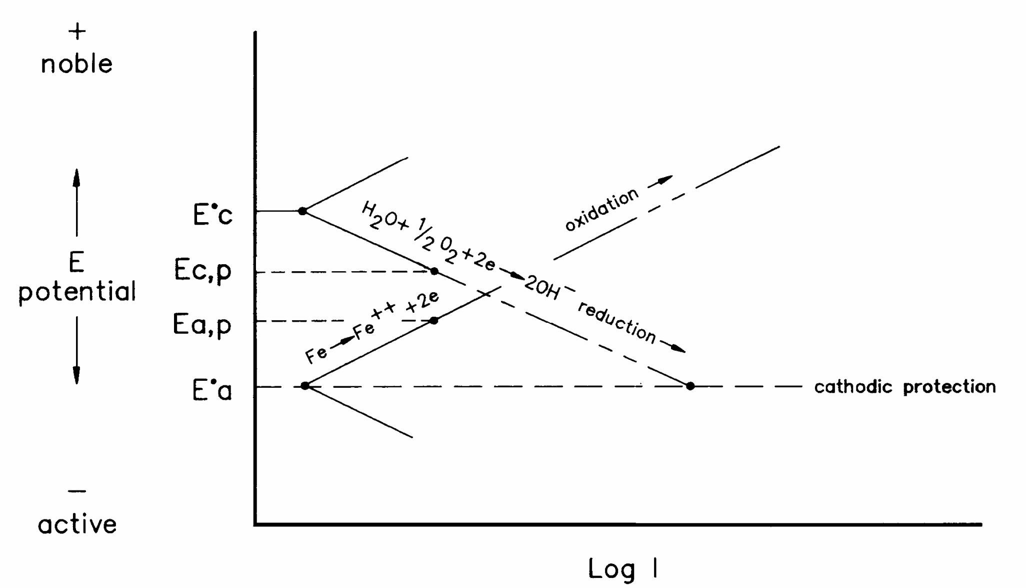
1.1.2 The protective oxide film formed on steel encased in concrete does not form or will be destroyed if the concrete does not fully encase the steel, the alkalinity of the concrete is lost by reaction with aggressive gases or liquids, or excessive amounts of chloride or other aggressive ions are present. If one or more of these conditions exists, and moisture and oxygen are in contact with the steel, corrosion can occur.

1.1.3 Corrosion occurs due to the formation of an electrochemical cell. An electrochemical cell consists of four components: an anode, at which oxidation occurs; a cathode, at which reduction occurs; a metallic path through which electrical current passes as a flow of electrons; and an electrolyte (concrete pore solution) through which electrical current passes as a flow of ions in an aqueous medium. If any one of the four elements of the electrochemical cell is eliminated, corrosion is prevented.

1.1.4 Within the electrochemical cell, the location of relative anodic and cathodic areas can be determined through potential (voltage) measurements. This is accomplished by measuring the potential between a metal immersed or embedded in an electrolyte and a stable reference electrode. This technique may also be used to assess the effectiveness of CP.

1.2 Cathodic Protection (CP)

1.2.1 The basic principles of corrosion can be used to understand the theory of CP. CP is defined as a technique to reduce the corrosion of a metal surface by making that surface the cathode of an electrochemical cell (see Figure 1).



E°a: Equilibrium or "open circuit" potential of anodic area
E°c: Equilibrium or "open circuit" potential of cathodic area
Ea,p: Polarized potential of anodic area (potential as observed on real structure)
Ec,p: Polarized potential of cathodic area (potential as observed on real structure)

FIGURE 1: Polarization Diagram[1]