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This Technical Committee Report has been prepared by NACE International Task Group 169 on Control of External Corrosion of Steel Pipelines in Natural Waters: Report*

Electrical Isolation/Continuity and Coating Issues for Offshore Pipeline Cathodic Protection Systems

Foreword

This state-of-the-art report provides owners, engineers, contractors, and operators with information on electrical isolation/continuity issues and coating issues to consider when designing and operating offshore pipeline cathodic protection (CP) systems. The detailed specifications for application of pipeline coatings are beyond the scope of this report, though it gives references to some specifications that are used. This report is a support document for the pipeline CP design standards.

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NACE technical committee reports are intended to convey technical information or state-of-the-art knowledge regarding corrosion. In many cases, they discuss specific applications of corrosion mitigation technology, whether considered successful or not. Statements used to convey this information are factual and are provided to the reader as input and guidance for consideration when applying this technology in the future. However, these statements are not intended to be recommendations for general application of this technology, and must not be construed as such.

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Definitions

For the purposes of this report, the terms and definitions given in *NACE International 2002 Glossary of Corrosion-Related Terms* and the following apply:

Bracelet Anodes: Galvanic anodes with geometry suitable for direct attachment around the circumference of a pipeline. These may be half-shell bracelets consisting of two semi-circular sections or segmented bracelets consisting of a large number of individual anodes.

Cathodic Protection (CP): A technique to reduce the corrosion of a metal surface by making that surface the cathode of an electrochemical cell.

Coating: A liquid, liquefiable, or mastic composition that, after application to a surface, is converted into a solid protective, decorative, or functional adherent film.

Coating Disbondment: The loss of adhesion between a coating and the pipe surface.

Corrosion: The deterioration of a material, usually a metal, that results from a reaction with its environment.

Disbondment: The loss of adhesion between a coating and the substrate.

Holiday: A discontinuity in a protective coating that exposes unprotected surface to the environment.

Insulated: The subject (for example, a pipeline) is dielectrically insulated (or electrically isolated) from a related object. This does not refer to thermal insulation.

J Tube: Piece of pipe attached to an offshore platform through which a riser is run. The top of the J tube is above the splash zone, and the bottom ends somewhere between the bottom of the splash zone and the seabed. When the riser is installed it is pulled up through the J tube. The J tube provides protection to the riser from lateral forces and speeds up riser installation.

Riser: (1) That section of pipeline extending from the ocean floor up to an offshore platform. (2) The vertical tube in a steam generator convection bank that circulates water and steam upward. For the purposes of this report, the first definition applies.

Shielding: (1) Protecting; protective cover against mechanical damage. (2) Preventing or diverting cathodic protection current from its natural path. For the purposes of this report, the second definition applies.

Splash Zone/Spray Zone: The area immediately above and below the waterline that, because of local conditions, remains wet or submerged the vast majority of the time. CP is not effective in the splash zone; protection by coatings, wear plates, etc., is typically used.

Electrical Isolation/Continuity

General

Electrical isolation design and equipment are discussed in detail in NACE Standard RP0286.[1] Electrical isolation/continuity is generally considered when offshore CP system control is designed or assessed. Electrical isolation in a pipeline is normally accomplished by use of a dielectric insulation flange assembly, using an electrical isolation joint in the line, or other means whereby the pipeline is continuous but electrical continuity is not. There are a number of situations in which the corrosion control designer has considered the use of such devices. Examples are as follows:

At Changes of Ownership—A change of ownership often occurs at a riser attached to a host structure of different ownership. When there is a change of ownership, isolation between structures is normal practice. A riser attached to a host structure of different ownership is normally electrically isolated from the riser clamps and a dielectric insulation flange or an electrical isolation joint is installed in the above-water section of the riser.

At Landfalls—When an offshore pipeline makes landfall, it is often accompanied by a change in the CP system; there is often a switch between an offshore sacrificial and an onshore impressed current system. The systems are normally separated at this point to facilitate more accurate monitoring and control of each system and to prevent potentially detrimental system interactions.

At Change of CP System Type—Galvanic anode systems are electrically isolated from impressed current systems when offshore pipelines connect with structures or other pipelines protected with impressed current.

Bare Structures Tied to Coated Pipelines—Except as covered in previous paragraphs, electrical pipeline isolation between galvanic anode CP systems installed on platforms and pipelines is often omitted. With good CP design, both platform and pipeline are typically adequately protected without impairing the lives of their individual CP systems. However, offshore pipelines are typically isolated from other unprotected or less-protected structures, which can drain current from the pipeline CP system.

Flexible Sections—Flexible sections have been installed in offshore pipelines as jumpers or to handle excessive seabed movements. The flexible section is usually electrically continuous to avoid an electrical discontinuity in the pipeline. If the flexible section is not electrically continuous, continuity bonding provisions are often made, or both sides of the flexible section are protected independently.

At Changes in Material Being Protected—Where different cathodic protection potentials are typically used for different materials being protected. For example, the protection potential of stainless steel pipelines is typically held above -800 mV in order to avoid hydrogen induced stress cracking; electrical isolation would be used if this was connected to a carbon steel pipeline or a carbon steel structure.

When possible, the insulator is installed at a point with easy access to improve system maintainability. At a platform, the insulator is normally installed in the riser above the splash zone. If the flange is installed at an inaccessible location, CP monitoring is often difficult unless test leads are installed.

The most common electrical bypasses (electrical shorts) on offshore systems are uninsulated riser clamps, damaged insulation flange assembly, stainless steel control tubing bypasses, topside pipe supports, and piping bypasses. Riser clamps that are electrically insulated from the pipeline are typically cathodically protected either by bonding to the structure or by the provision of dedicated sacrificial anodes.

Bolting does not always guarantee electrical continuity, especially with coated bolts. The design is typically checked at all flanges where electrical continuity commonly occurs. Continuity bonding straps or exothermically welded continuity bond wires are commonly employed in order to ensure electrical continuity.

The potential sparking hazards of insulating devices are typically considered in the design and location of such devices. Precautions to prevent arcing are typically considered when these devices are installed where combustible environments may exist.

Coatings

Introduction

This section addresses common practices used for selecting, testing, evaluating, applying, handling, storing, and inspecting external coating systems for external corrosion control on offshore pipelines used in conjunction with a CP system. External coatings are also selected to provide resistance to marine biological growth (biofouling). Internal coatings for corrosion control or operating performance are not within the scope of this report.

Tables 1, 2, and 3 are general listings of external coating references used for coating materials and application, coating evaluation, testing and inspection, and storage, handling, and transportation. (NOTE: Many other references are available; thus the tables are not comprehensive.) Coating evaluation, testing and inspection, and storage and handling for each type of coating are also typically contained in the specific application specifications in Table 1. The latest revisions of each specification are used.

Table 1: External Coating Materials and Application

"External Fusion Bonded Epoxy Coating for Steel Pipe"	CSA[(A)]-Z245.20[2]
"Application, Performance, and Quality Control of Plant-Applied, Fusion-Bonded Epoxy External Pipe Coating"	NACE Standard RP0394[3]
"Fusion-Bonded Epoxy Coatings for the Interior and Exterior of Steel Water Pipelines"	ANSI[(B)]/AWWA[(C)] C 213[4]
"External Polyethylene Coating for Pipe"	CSA-Z245.21[5]
"Polyethylene Coatings for Steel Pipes and Fittings—Requirements and Testing "	DIN[(D)] 30670[6]
"Extruded Polyolefin Coatings for the Exterior of Steel Water Pipelines"	ANSI/AWWA C 215[7]
"Extruded Polyolefin Resin Coating Systems with Soft Adhesives for Underground or Submerged Pipes"	NACE Standard RP0185[8]
"Coal-Tar Protective Coatings and Linings for Steel Water Pipelines—Enamel and Tape—Hot Applied"	ANSI/AWWA C 203[9]
"Tape Coating for the Exterior of Steel Water Pipelines"	ANSI/AWWA C 214[10]
"Specification for the Application of Thermal Spray Coatings (Metallizing) of Aluminum, Zinc, and Their Alloys and Composites for the Corrosion Protection of Steel"	NACE No. 12/AWS[(E)] C2.23M/SSPC[(F)]-CS 23.00[11]
"Plant-Applied, External Coal Tar Enamel Pipe Coating Systems: Application, Performance, and Quality Control"	NACE Standard RP0399[12]
"Field-Applied Fusion-Bonded Epoxy (FBE) Pipe Coating Systems for Girth Weld Joints: Application, Performance, and Quality Control"	NACE Standard RP0402[13]
"Field-Applied Coal Tar Enamel Pipe Coating Systems: Application, Performance, and Quality Control"	NACE Standard RP0602[14]
"Exterior Protective Coatings for Seawater Immersion Service"	NACE Standard TM0204[15]