

GENERAL SPECIFICATION

CORROSION

GS EP COR 501

Control of cathodic protection of submerged fixed structures

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1. Scope

This document describes the requirements for monitoring the cathodic protection of fixed underwater structures, applicable during subsea inspections:

- Carried out in order to check the structure after installation, or
- Subsequent inspections.

The measurements described in this specification are mainly for jackets of offshore platforms, but can also be applied to floating structures such as F(P)SO, FPU, TLP, etc.

These measurements are intended to be done in complement to those permitted by the integrated monitoring systems designed as per **GS EP COR 202**. They shall be done after installation of the offshore structures and during subsequent in service inspections as defined in **GS EP EXP 311**.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and addendums, is the latest revision published at the effective date of this document.

Reference	Title
Not applicable	

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and addendums, is the latest revision published.

Reference	Title
GS EP COR 201	Galvanic anodes
GS EP COR 202	Monitoring systems for cathodic protection of offshore structures
GS EP EXP 311	Plant integrity - Minimum inspection requirements

3. Qualification and Certification of Cathodic Protection specialists responsible for the survey

Survey of cathodic protection efficiency of submerged fixed structures shall be carried out exclusively by competent specialised personnel. The qualification of each of the specialists working for such a job shall be demonstrated to Company before commencement of the job.

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Therefore the verification of the formal Certification of the individuals shall be carried out as follows:

- Measurements to be carried out by level 1 certified personnel
- Selection of measurement methods, analysis and verification of results and validation of report to be carried out by level 2 certified personnel (or level 3 in case of complex situations).

Accepted Certification schemes are CEFRACOR Competence (Seawater Application Sector), APCE (Seawater Application Sector), Institute of Corrosion, NACE International.

Any use of non certified personnel for cathodic protection measurement shall be subject to the approval of Company on a case by case basis (demonstration of competence through detailed curriculum vitae and description of experience).

4. Measurements to be carried out

The Contractor shall:

- Perform a measurement of the metal/electrolyte potential over the entire structure (with a special attention to complex areas)
- Estimate the current output of representative anodes, and determine their degree of consumption by visual inspection

One of the methods described below shall be used for each kind of measurement to meet the objectives set out above.

5. Measurement of cathodic protection potentials

All the cathodic protection potentials shall be measured relative to an Ag-AgCl-seawater measurement electrode.

5.1 Influence of water salinity

The variation in salinity (variation in resistivity) affects the potential measured with respect to an Ag-AgCl-seawater electrode.

The potentials in this document are those encountered in a seawater environment (salinity 32 to 35 g/l).

For brackish water measurements (< 10 g/L) (lagoon, swamp), the measured values shall be corrected.

The resistivity of the water surrounding the structure shall first be measured. Then, the potential corrections shall be performed according to the chart defined in Figure 1 of Appendix 1.

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5.2 Measurements

Two measurement systems can be used.

5.2.1 Ag-AgCl-seawater electrode

This electrode shall be connected by cable to a voltmeter (2000 points minimum, and high impedance: minimum 10 MΩ).

The measurement shall be performed according to the so-called “fishing method” as follows:

- Connect the frame of the structure to be tested to the (+) pole of the voltmeter (Caution: a good electrical contact is essential)
- Connect the electrode to the (-) pole of the voltmeter
- Position the measurement electrode as near as possible to the point of the structure to be measured
- Record the measured potential.

5.2.2 Submersible, direct reading built-in measurement unit

The measurement shall be performed by divers or by ROV as follows:

- If necessary, remove all marine fouling (shells, barnacles, etc.) at the measurement point in order to obtain a perfect electrical contact between the measurement point of the unit and the steel.

Caution: Poor electrical contact will give an erroneous measurement.

- Record the measured potential.

5.3 Calibration

The measurement electrode or submersible built-in unit shall be immersed in the seawater at least 1 h before calibration in order to stabilize its potential.

5.3.1 Calibration of the measurement electrode against a Saturated Calomel Electrode (SCE)

Calibration is mandatory at least on equipment mobilisation and demobilization.

The equipment required is:

- 1 SCE electrode with Certificate of Calibration less than 1 year old (+ 1 spare electrode)
- 1 voltmeter (2000 points, high impedance 10 MΩ minimum) with Certificate of Calibration less than 1 year old.

Calibration shall be performed as follows (Figure 2a of Appendix 1):

- Immerse the measurement electrode in a bucket containing seawater for at least 1 hour before the calibration
- Immerse the SCE electrode in the same seawater bucket 5 minutes before calibration
- Connect the measurement electrode to the (+) pole of the voltmeter

- Connect the SCE electrode to the (-) pole of the voltmeter
- Record the potential difference $V_{\text{Ref/SCE}}$ reading on the voltmeter.

Potential measurements shall be corrected in accordance with the table below:

Value of V_{SCE}	Correction	Example
$0 \text{ mV} < V_{\text{Ref/SCE}} < +10 \text{ mV}$	no correction	
$+10 \text{ mV} < V_{\text{Ref/SCE}} < +30 \text{ mV}$	$P_{\text{MC}} = P_{\text{M}} + V_{\text{Ref/SCE}} - 5 \text{ mV}$	$P_{\text{M}} = -980 \text{ mV}$ $V_{\text{Ref/SCE}} = +25 \text{ mV}$ $P_{\text{MC}} = -980 + 25 - 5 = -960 \text{ mV}$
$-20 \text{ mV} < V_{\text{Ref/SCE}} < 0 \text{ mV}$	$P_{\text{MC}} = P_{\text{M}} - V_{\text{Ref/SCE}} - 5 \text{ mV}$	$P_{\text{M}} = -940 \text{ mV}$ $V_{\text{Ref/SCE}} = -20 \text{ mV}$ $P_{\text{MC}} = -940 - 20 - 5 = -965 \text{ mV}$
$V_{\text{Ref/SCE}} > +30 \text{ mV}$ or $V_{\text{Ref/SCE}} < -20 \text{ mV}$	Replace Ag-AgCl/seawater electrode	

P_{M} : Potential measured on the structure or the anodes

P_{MC} : Corrected measured potential

5.3.2 Check of the measurement cable connecting the Ag-AgCl/seawater electrode to the voltmeter

Any deterioration of the measurement cable can cause measurement errors of up to a few hundreds of mV because the copper core may disturb the potential measurement.

The continuity of the electrical insulation of the cable shall be checked according to the method defined in Figure 2b of Appendix 1. The same potential shall be measured with the cable inside and outside the seawater bucket.

5.3.3 Calibration of the submersible built-in measurement unit against a Saturated Calomel Electrode (SCE)

This calibration is mandatory on equipment at least at mobilisation and demobilization.

The equipment required is:

- 1 SCE electrode with Certificate of Calibration less than 1 year old (+ 1 spare electrode)
- 1 submersible built-in measurement unit.

Calibration shall be performed as described in Figure 1 of Appendix 2:

- Immerse the submersible measurement unit in a bucket containing seawater at least 1 hour before the calibration
- Immerse the SCE electrode in the seawater bucket 5 minutes before the calibration
- Connect the SCE electrode cable to the measurement point of the unit