



Exploration & Production

GENERAL SPECIFICATION

CORROSION

GS EP COR 001

Corrosion control on production facilities: Design and construction
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03	01/2012	General review; New chapter 8: Interventions of TEC/COR in projects. "Corrosion management documents" have been specified in more detail
02	01/2011	General review, specification of a "corrosion management" document and inclusion of TLC and H ₂ S + CO ₂ corrosion assessment
01	10/2006	Remove reference to GM. Adjust prediction criteria on table 1
00	10/2005	First issue
Rev.	Date	Notes

Owner: DEV/TEC	Managing entity: DEV/TEC/COR
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1. Purpose

This specification defines the "corrosion management" bases to be used for the design and construction of any production facility, with a particular emphasis on:

- Functional requirements applicable to the performance of both an internal and an external "corrosion assessment"
- Functional requirements for defining appropriate corrosion mitigation solutions, as a result of this corrosion assessment.

"Corrosion management" is only one part of a complete "Integrity management system", Inspection activities complement corrosion management and the two tasks are very closely related. Although inspection activities are considered on a general basis within this document, they are not detailed here after as they are dealt with elsewhere.

2. Application

For internal corrosion, this specification applies to all components of a production installation which are in contact with process fluids (produced and injected fluids). Unless otherwise specified, internal corrosion of service and utility fluids is not relevant to this specification.

For external corrosion, this specification applies to onshore as well as offshore environments and to aerial, immersed and buried conditions.

3. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

Standards

Reference	Title
ISO 12944-2	Paints and Varnishes - Corrosion Protection of Steel Structures by Protective Paint Systems - Part 2: Classification of Environments
ISO 15156	Petroleum and natural gas industries - Materials for use in H ₂ S-containing environments in oil and gas production

Professional Documents

Reference	Title
API RP 14E	Recommended Practice for Design and Installation of Offshore Production Platform Piping Systems

**Regulations**

Reference	Title
Not applicable	

Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
Not applicable	

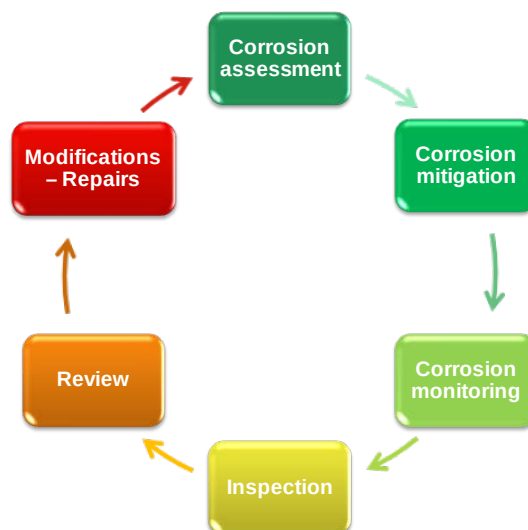
Total General Specifications

Reference	Title
GS EP COR 002	Corrosion control on production facilities: Field operations
GS EP COR 161	Internal corrosion and erosion-corrosion monitoring: Design and installation
GS EP COR 163	Chemical treatments for corrosion control: Engineering and construction requirements
GS EP COR 170	Materials for sour service (upstream applications): Specification for design

4. Definitions - Abbreviations

For the purpose of this document only, the following terms and definitions apply:

- "Corrosion management": The overall Corrosion Management process for any production facility is summarized in the following loop, which is applicable both during the Design and Construction and during the Field Operation:



The present document mostly covers the three first steps of this loop, i.e. the corrosion assessment, the corrosion mitigation, and the definition of corrosion monitoring.

- "Corrosion assessment": During design, an evaluation of the likelihood and the extent of corrosion damages if the installation is designed with the most standard material (usually carbon steel) and not subject to any mitigation action against corrosion.
- "Corrosion mitigation": The complete set of methods to be implemented for preventing corrosion and for verifying the efficiency of these methods.
- "Corrosion monitoring": The complete set of methods to be used in order to verify the proper implementation and efficiency of selected mitigation solutions if any, or to verify the lack of corrosiveness when no mitigation solution is used.
- "Inhibitor availability": The proportion of time during which the inhibitor is injected to protect the equipment considered at an injection flow rate $\geq 80\%$ of the specified injection rate. Depending on the number and on the reliability of injection systems used, inhibitor availability values of 95 to 98% are currently specified.
- BLC = Bottom-Line Corrosion: It does not characterize a specific corrosion mechanism, but a location where corrosion proceeds because produced water is present, i.e. mostly on the bottom part of production facilities (as opposed to the Top of Line Corrosion). Includes either CO_2 corrosion, $\text{H}_2\text{S} + \text{CO}_2$ corrosion, corrosion under deposits, preferential weld corrosion, all induced by produced water.
- TLC = Top of Line Corrosion: Corrosion due to water condensing on the upper section of gas - condensate facilities (as opposed to BLC), this water being acidified by a combination of CO_2 , H_2S , and organic acids supplied by the gas and the produced water.



- CO₂ corrosion: Corrosion occurring either as BLC or TLC, due to water containing dissolved CO₂ and other species promoting corrosion such as organic acids. Usually a localized weight loss corrosion mode with typical corrosion rates within 0.01 to 10 mm/y. Only occurs when the H₂S content is low to nil (H₂S / CO₂ < 0.05). Within this document, CO₂ corrosion includes "corrosion under deposits" and "preferential weld corrosion".
- H₂S + CO₂ corrosion: Localized weight loss corrosion occurring either as BLC or TLC, due to water containing dissolved CO₂ + H₂S and species promoting corrosion such as organic acids. Only considered when the H₂S / CO₂ ratio is ≥ 0.05. Includes "corrosion under deposits" and "preferential weld corrosion".
- MIC = Microbiologically Induced Corrosion
- CRA = Corrosion Resistant Alloy
- CS = Carbon Steel
- SHWHP = Shut-in Well Head Pressure
- IJ = Insulation Joint
- ITP = Inspection and Test Plan
- PPS = Project Particular Specification
- PQT = Procedure Qualification Trial
- PPM = Pre Production Meeting
- PPT = Pre Production Test
- SOR = State of Requirement
- TEC/COR: The Corrosion department of the Company.

5. The "Corrosion Management" document

The corrosion management document defines a plan of actions/solutions aiming at preventing corrosion failures susceptible to compromise the major functionality's of production facilities with regards to safety, environment, and production capabilities during their expected lifetime.

This document is an evolving document over the successive phases of a Project up to production start-up. The following table summarizes the main content of this document over these phases:

1. A first version, currently labeled "Corrosion control Philosophy", shall be issued during "Conceptual Studies" and may be up-dated during the Pre-Project phase in case of significant changes and to cover additional details/ components of the production facilities:
 - At these stages it shall establish a first Corrosion Assessment (internal and external) of all relevant production facilities, assuming bare carbon steel is used and no mitigation is applied,
 - The most appropriate mitigation solutions to be used, considering the corrosion assessment results and specific characteristics of the production facilities under evaluation. This definition is restricted to main facilities and to solutions significantly impacting the architecture, the feasibility, the cost or the reliability of the considered development.

- It may also define what uncertainties/ unknown exist which may impact the considered development, if any
 - At the stage of the Pre-Project, it shall define the basic corrosion monitoring and inspection requirements resulting from selected corrosion mitigation solutions, as well as what operational constraints may result from selected mitigation solutions during the Field Operation phase.
2. A second version, currently labeled "Corrosion Control Solutions" shall be established during the basic engineering. This document shall provide all details regarding corrosion mitigation solutions (material selection and others), corrosion monitoring, key inspection requirements, etc to allow all necessary equipments to be designed and built as needed to assure the satisfactory corrosion resistance.
 3. Another version, currently labeled "Corrosion Management during Field Operations" shall be established prior to the production start-up, to cover corrosion management requirements during the operational life of the facilities. The content of this document is defined in **GS EP COR 002**.

Content	Conceptual studies	Pre-Project	Basic engineering	Field Operations
Corrosion assessment	Vs C Steel	Up-dated		Vs existing facilities
Corrosion mitigation	X	More detailed	Detailed to all facilities	X
Corrosion monitoring		X	Detailed to all facilities	X
Associated inspection requirements		X	X	X
Unknowns and uncertainties	X	X		
Impact of adopted solutions to Field operations		X	X	

A typical table of content is given in Appendix 1 for the "Corrosion Control Philosophy" document issued at the end of preliminary Studies and/or Pre-Projects. This document shall summarize, for all production facilities involved:

- The internal and external assessments as per requirements given in § 6
- The materials selection for main equipment, per categories such as wells, flowlines, pipelines, general process facilities
- The requirements for chemicals injection, including injection facilities, inhibitor availability target, injection flow rates and control equipment, and the location of injection points
- The internal and external coating and cathodic protection requirements, where needed