Guidelines for the assessment of corrosion threats in risk-based inspection

GUIDELINES FOR THE ASSESSMENT OF CORROSION THREATS IN RISK-BASED INSPECTION

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1 INTRODUCTION

The importance of corrosion management is represented in the EI *Guidance for corrosion management in oil and gas production and processing*. This document provides more detailed information to help the upstream oil and gas industry align on good practice for CTA to direct RBI and other corrosion management activities. It is consistent with key available public domain guidance but emphasises important factors for success with reference to North Sea experience.

The purpose of CTA is to assess and document material degradation/corrosion threats against equipment items, ensuring that corrosion management activities such as inspection and monitoring activities are aligned with risk. Understanding equipment condition provides visibility of risk, enabling targeted programmes of work to be delivered, which has significant benefits, particularly in a constrained operating climate.

Detailed definitions representing key concepts and terminologies for CTA are provided in the glossary section of this document and are recommended pre-reading before using this document.

1.1 SCOPE

The scope of this document was determined by an EI Steering Group comprising experienced corrosion and integrity technical professionals. It covers the full complement of criteria that can be used to assess corrosion threats specific to upstream oil and gas production and processing equipment, including offshore fixed and rotating pressure systems equipment, utilities systems, pipelines and structures.

Threats included in this document are aligned with those included in the Annexes of the revised EI *Guidance for corrosion management in oil and gas production and processing*:

– It covers North Sea or UK Continental shelf marine and temperate coastal environments.
– Includes corrosion threats applicable to gas sweetening and some consideration for H_2S but not refinery conditions.
– It includes corrosion threats up to a temperature of 300 °C.

The following degradation issues are excluded from this document:

– Thermo-mechanical degradation and equipment primarily affected by this mode of failure, such as flare tips and some components of fired equipment or waste heat recovery units.
– Purely mechanical degradation mechanisms such as fatigue, fretting or overload. Examples are: flexible hose fretting and wear; vibration of high-cycle fatigue; low-cycle fatigue (for example for moving well conductors); U-tube heat exchanger bundle baffle fretting; offshore platform dropped object impact damage, etc.
– Fitness-for-service assessment for equipment cracking or thinning.

Management of temporary repairs and the interface with maintenance and engineering to organise simple like-for-like component replacement are not included in this document. It is, however, considered good practice to manage the above areas in conjunction with the corrosion discipline for the following reasons.

The suitability and performance of temporary repairs can be strongly influenced by corrosion, even if this does not affect the life of the repair material in itself. Corrosion assessment is required for approval of temporary repair types and their monitoring strategies and designated life; for example, relating to damage beneath temporary wraps that could in time extend beyond, or create a hole beneath, the wrap, which some wraps are not designed for at high pressures. This also includes evaluation of the suitability of mechanical pipe connectors in critical service, which must be carefully evaluated due to the potential introduction of internal and external crevices as well as requiring mechanical input to address the ability to tolerate bending or additional loading to hoop stress.

1.2 APPLICATION

This document is intended for anyone who wishes to improve their understanding of CTA, or to gain further knowledge to improve corrosion and integrity management. This document is particularly relevant for:

- corrosion, inspection and integrity engineers;
- integrity managers, and
- engineering disciplines who aim to improve process safety or cumulative risk management.

The good practice outlined in this document can be used to:

- identify audit methods or improvement activities needed to avoid the pitfalls of inaccurate CTA;
- demonstrate good risk visibility, and
- improve the planning of corrosion management activities and eliminate low value work and avoid wasted effort on inspection, anomaly management, maintenance and upgrade projects.

2 WHERE TO FIND CTA GUIDANCE

CTA is heavily experience-based, and it is not always possible to obtain required knowledge from public domain books or codes of practice. Companies themselves often generate or collect their own internal information to justify assessment of key threats. This can be difficult for others to access and may even be proprietary.

It can be beneficial for smaller organisations, or those new to the upstream operating environment, to participate in one or more opportunities to formally or informally share information at conferences, or in the form of collaborative partnerships, networking forums and technical committees, whilst keeping up to date with Health and Safety Executive (HSE) safety alerts.

2.1 PUBLIC DOMAIN

CTA public domain guidance typically aligns on key principles of CTA.

All guidance is complex and requires simplification work to turn into methods geared for managing upstream operational integrity. There is no previous specific public domain CTA guidance for the upstream industry to share key factors for success based on the experience of upstream operating companies.

Public domain CTA guidance is not easy to locate but is well represented by the following:

– API 580 *Risk-based inspection (RBI)*;
– API 581 *RBI technology*, and
– DNV RP G101 *RBI of offshore topsides static mechanical equipment*.

CTA, or the word corrosion, is not a term used in titles within the above documents but is clearly dealt with under headings such as degradation mechanisms or Probability of Failure (PoF). Although not an exhaustive list, the following documents also provide guidance:

– Norsok M001 *Materials selection* includes requirements for corrosion protection of hydrocarbon production and processing facilities for fixed offshore installations and including subsea production systems. The standard assumes a minimum of 20 years' design life and includes various useful tables listing process condition/material/corrosion barrier combinations representative of general low PoF scenarios.
– EI *Guidance for corrosion management in oil and gas production and processing* deals with corrosion threats and corrosion barrier types in the Annexes in some detail. Each Annex contains information about how to best manage the threats or barrier. The document does not provide detailed guidance for implementation of CTA for RBI and development of chemical and corrosion control key performance indicators (KPIs).

Specific EI guidance documents or HSE website semi-circulars or various published papers can address specific threats.