Mehdi Eskandarzade[1], Ali Kalaki[2], Reza Shahrivar[3]

THE APPLICATION AND LIMITATIONS OF CORROSION MANAGEMENT PROCESS

PRIMENA I OGRANIČENJA PROCESA UPRAVLJANJA KOROZIJOM

Originalni naučni rad / Original scientific paper
UDK /UDC: 620.193.4:665.7

Rad primljen / Paper received: 10.07.2018

Adresa autora / Author's address:
[1)] Faculty of Engineering, University of Mohaghegh Ardabili, Ardabil, Iran email: m.eskandarzade@uma.ac.ir
[2)] Technical and Corrosion Protection Department, Iranian Central Oil Fields Co., Tehran, Iran
[3)] Asset Integrity Manager, LifeTech Engineering Ltd, Aberdeen, United Kingdom

Keywords
- corrosion management
- oil and gas industry
- inspection
- monitoring

Ključne reči
- upravljanje korozijom
- industrija nafte i gasa
- kontrola
- praćenje

Abstract

Oil and gas industry lose directly and indirectly lots of money because of corrosion. Corrosion management (CM) helps to mitigate a substantial part of corrosion costs. Although the theoretical concept of corrosion management process is simple, the implementation of CM in practice is very challenging and a difficult task, and takes a long time, which also calls for great patience of top managers. This paper reviews the definition of CM process and describes the steps needed to deploy a process in the oil and gas industry. In addition, the corrosion management concept is criticized and the associated limitations are discussed.

Izvod

Usled korozije, direktni i indirektni gubici u industriji nafte i gasa obuhvataju ogromna novčana sredstva. Upravljanje korozijom (UK) pomaže u ublažavanju većeg dela troškova usled korozije. Iako je teorijski koncept upravljanja procesom korozije jednostavan, implementacija UK u praksi je veoma izazovan i težak poduhvat, koji zahteva vreme, što iziskuje ogromno strpljenje glavnih menadžera. U radu je dat pregled definicije UK procesa i dat je opis neophodnih koraka za uvođenje procesa u industriju nafte i gasa. Pored toga, koncept upravljanja korozijom je posmatran kritički i data je diskusija odgovarajućih ograničenja.

INTRODUCTION

Corrosion management (CM) is that part of the overall management system, which is concerned with the development, implementation, review and maintenance of the corrosion policy, /1/. The corrosion policy provides a structured framework for identification of risks associated with corrosion, and the development and operation of suitable risk control measures, /1/. CM activities are categorized as corrosion engineering related activities and non-corrosion engineering measures, /2/. Some major goals of CM activities are the reduction in cost of corrosion, number of failures per year, corrosion rate /3/, equipment maintenance completed, /4/, and improvements in environmental protection. The basics of implementing CM in oil and gas industries has been presented in literature /5-8/. Furthermore, API-RP-970 provides users with the basic elements for developing, implementing, and maintaining a Corrosion Control Document for refining, petrochemical and chemical process facilities, /9/. In addition, useful information about implementing CM in oil and gas pipeline has been offered in the EFC-64 document, /9/. The concept of CM process is highly interested for decision makers and top managers. However, deploying of the CM system is a struggling and challenging task in practice. If not any, there are rare publications which discussed the limitations of CM process in oil and gas industry. The goal of this study is to describe steps toward deploying corrosion management system in large oil and gas companies and also offer the basic limitations of the CM system.

STEPS OF IMPLEMENTING CM PROCESS

Review existing integrity management measures

This stage starts with description and registers. The goal of the basic structure register is to document a full list of facilities for which an operating company is responsible for their corrosion management. These registers should contain basic information required to document the characteristics of the piping/pipeline/equipment, as well as the responsibility of the operating company with regard to corrosion management with a specific attention to interfaces when relevant, /9/. Examples of required information in this stage have been tabulated in Fig. 1, which are based on information in reference /9/.

Regularly monitoring the performance

The main objective in previous stage of the CM process was to understand and document the current condition of the structure. In next steps the current situation will be criticized and evaluated. Understanding the failure mechanisms throughout service life of the structure and (human) fault sources is essential in this stage. Some of failure sources in oil and gas piping systems are illustrated in Fig. 2. Each item in Fig. 2 should be evaluated to know whether they are in acceptable range or require changes.

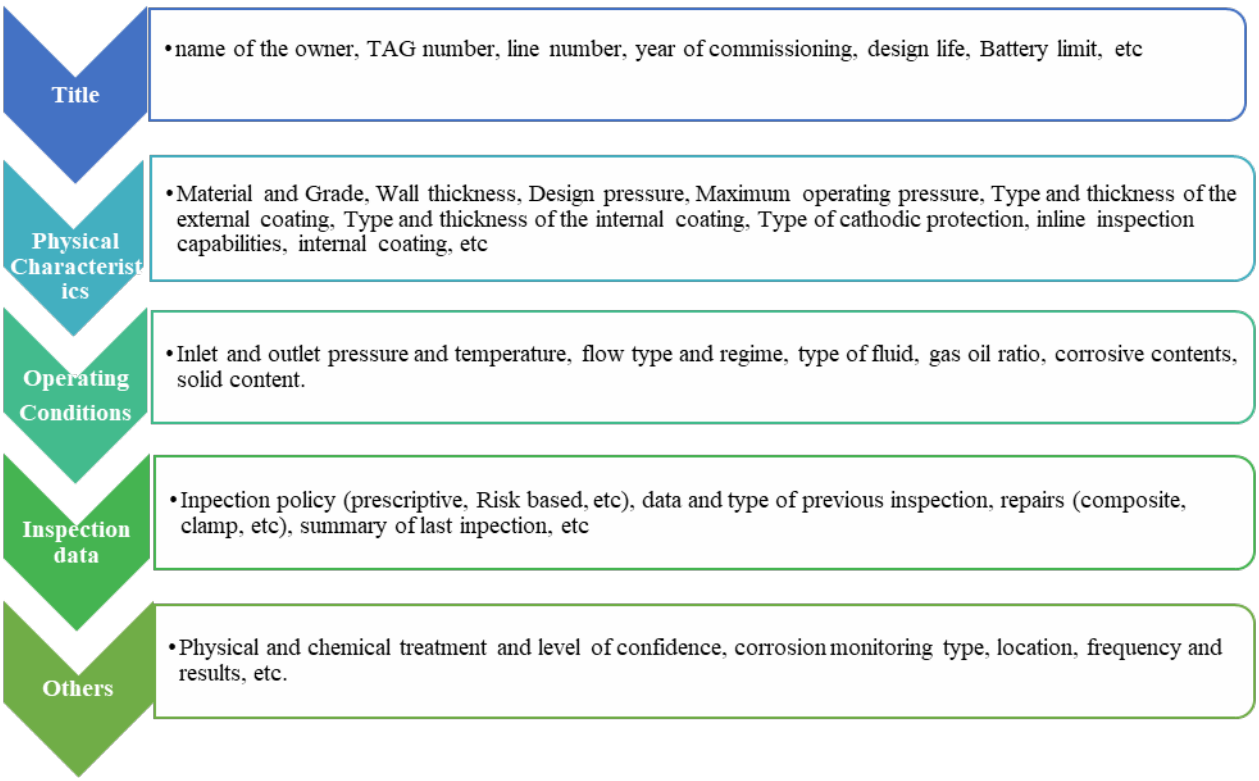

Figure 1. Least required data in review of existing integrity management measures stage of CM process.

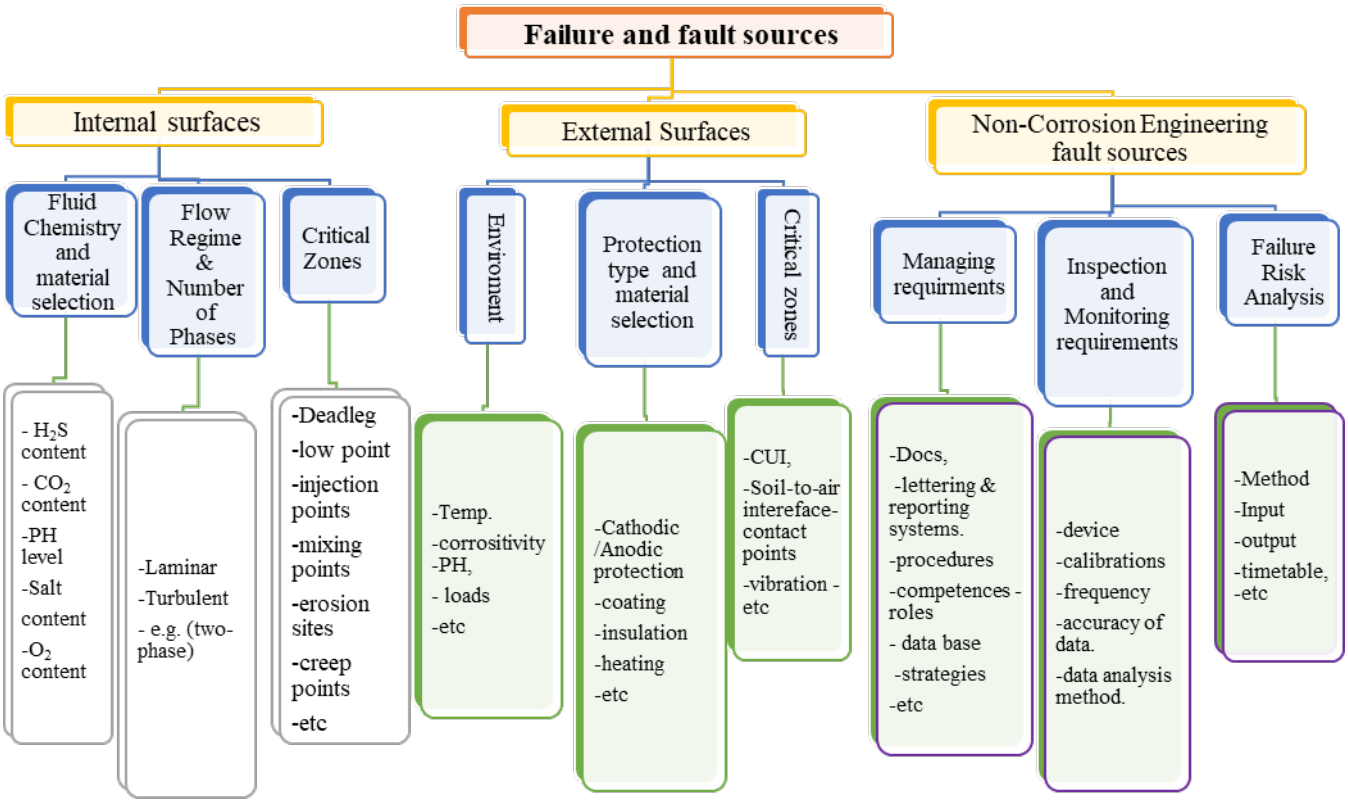

Figure 2. Failure and fault sources in a piping system.

Assessing effectiveness post-commissioning and feedback

Normally, Key Performance Indicators (KPIs) are used in order to assess the effectiveness of the current corrosion mitigation measures. KPIs are chosen by the corrosion management team. Some operators have different set of KPIs for their: site manager, middle level and top level managers' usage. Examples of common KPIs are offered in Table 1. After doing any change at the system, KPIs are re-evaluated and compared with their previous values to assure they are improved.

Table 1. Examples of Key Performance Indicators.

KPIs for the use of top level managers	1. Cost of Corrosion	2. Number of repairs	3. Number of leakages
KPIs for the use of middle level managers	1. Number of external surface defects reported per unit area per time	2. Number of reported problems related to cathodic protection system	3. The number and quality of the procedures prepared per unit time
KPIs for site managers	1. Fluid's PH level	2. Fluid Unsolved Iron	3. Inhibitor residuals

LIMITATIONS IN DEPLOYING CM PROCESS

Despite of attractive concept of the CM process in increasing profitability, there are several drawbacks associated with the CM process which make it a difficult task to implement. Here, some of the most important weaknesses associated with the CM process have been presented.

Complexity of the process

The CM process is a continuing process which investigates each corrosion related activity one by one and makes necessary changes where required. This is lengthy and time consuming process, because the number of corrosion related activities are high and mostly requires involvement of the several disciplines including maintenance engineers, HSE and technical inspectors. Being complex; the commitment of CM process calls for great patience and time from the management. In addition, deploying the CM process implies strong leadership and proper structured resources.

CM is a lengthy process

Appropriate implementation of the CM process implies spending proper quality time by the top managers. They should spend lots of time to review the situation, prepare the infrastructures and order workers. This long term orientation would hamper the regular activities of the managers. Hence, there is this risk that the top managers to delegate some of the responsibilities to individuals with not enough authority. In this situation it can be said that the job of CM implementation has been unsuccessful.

Tough implementation

CM process is a long term plan and requires close communication with employees to assure that they always remain fully attentive and eager. Deploying the corrosion management process is a challenging and difficult task. There should always be active participation among the employees and besides, the employees have to be accountable for their work. This accountability is meant not only for the top management, but for all employees across the hierarchy.

Proper planning

Implementation of the CM process needs proper and perfect planning which should theoretically and practically be proven. Perfect planning requires work of the group of multidisciplinary engineers with corrosion, HSE, chemists, integrity, process, commissioning and technical inspection expertise. Implementation of CM process is not the main job of the team members, but they should do this team work besides their daily work. Taking time to CM activities would disrupt member's daily responsibilities and in long term would affect adversely the economy of the company.

Difficulties to implement into ageing assets

A huge part of oil and gas facilities especially in developing countries are considered as ageing assets. Most of technical documents of the ageing assets are missed or not available. If not impossible, it is too costly and difficult to prepare new documents for such facilities. It means that the first step of the CM process; say review of existing integrity management measures step, will be challenging. Hence, the implementation of CM system for ageing asset will always be improper and challenging.

Competency of CM team

The initial competency of the young corrosion engineers heavily depends on content and quality of the courses in universities. At the current moment, the contents mostly emphasize on corrosion engineer based materials and less discusses the other techniques such as integrity management and inspection techniques (Risk based inspection) which are used in the CM process. As it is discussed by Morshed, /10/, it seems that the situation should be rectified by incorporating topics like 'asset corrosion management' in current courses for corrosion engineers.

CONCLUSION

This paper discusses the practical aspects of different steps in the corrosion management process. Despite of many advantages that the CM process brings to the oil and gas industry, it has some disadvantages such as complexity of the process, being long term and a huge process, needs for tough implementation, being time consuming in nature, necessitation for proper planning and the lack of good competency of CM team members in most of companies; which all are discussed in this paper.

REFERENCES

1. Capcis Ltd, Review of corrosion management for offshore oil and gas processing, Offshore Technology Report 044, Health and Safety Executive, 2001. ISBN: 0-7176-2096-4
2. Morshed, A., An Introduction to Asset Corrosion Management in the Oil and Gas Industry. 2nd Ed. (ebook) NACE International, 2016. ISBN: 978-1-57590-338-5
3. Olabisi, O. (2012), *Corrosion/Erosion Management Strategy in the North Slope: Use of Corrosion Rate as Key Performance Indicator (KPI)*, NACE-2012-1180, Conf. Corrosion 2012. NACE International.
4. Queen, D.M.E., Ridd, B.R., Packman, C. (2001). *Key Performance Indicators for Demonstrating Effective Corrosion Management in the Oil and Gas Industry*, NACE-01016, Conf. Corrosion 2001, NACE International.
5. Marsh, Z., Munday, M. (2010). *Corrosion Management of Aging Assets from the New Operator Perspective*, SPE Int. Conf. Oilfield Corrosion, SPE-130640-MS. Society of Petroleum Eng. doi: 10.2118/130640-MS

6. Debruyn, H. J., Al-Ghamdi, S.M. (2016), *Corrosion Management Implementation in Large Oil and Gas Projects*. NACE-2016-7255, Conf. Corrosion 2016, NACE International.
7. Dawson, J., Bruce, K., John, D.G., Corrosion risk assessment and safety management for offshore processing facilities, Offshore Technology Report 1999/064, HSE Books, 2001.
8. API RP 970 - Corrosion Control Documents, First ed., 2017.
9. Kermani, B., Recommended Practice for Corrosion Management of Pipelines in Oil & Gas Production and Transportation. CRC Press, 2017.
10. Morshed, A. (2014). *Corrosion management and the Widening Competency Gap*, NACE-2014-3740, Conf. Corrosion 2014. NACE International.

ICM13 – 13th INTERNATIONAL CONFERENCE ON THE MECHANICAL BEHAVIOUR OF MATERIALS

Melbourne, Australia, 11-14 June 2019

11 -14 JUNE 2019 MELBOURNE AUSTRALIA

Scope

Started in 1971 in Japan and held every four years around the world, the ICM conference series was established by ICM International Congress.
RMIT University are proud to facilitate the organisation of this premier quadrennial international conference. The conference aims to provide an international forum for researchers, industry practitioners, engineers and postgraduate scholars to promote, exchange and disseminate recent findings on contemporary and wide-ranging topics in Mechanics of Materials.
The scope of materials of interest encompasses engineering materials, including metals, polymers, ceramics, composites, as well as advanced materials under development for particular applications.

Main topics

The topics of ICM-13 range from nano- to macro-mechanics of materials including metals, composites, ceramics, polymers, biomaterials, computational mechanics, dynamics, material processing, manufacturing, optimisation, biomechanics.
• General mechanical behaviour and constitutive models
• Nano and micro mechanics
• Plasticity - theoretical, computational and experimental plasticity
• Computational mechanics - Finite element method, mesh-free methods and finite difference methods
• Computational materials design - atomic and molecular modelling
• Optimisation of structures and materials
• Multiscale modelling in materials
• Rock mechanics and geomechanics
• Lightweight alloys and structures
• High-strength alloys - steel, aluminium, titanium
• Composite materials - polymer composites, metal matrix composites, nano-composites and bio-composites, sandwich structures
• Cellular materials - polymeric and metallic foams
• Biomaterials, geomaterials and geopolymers
• High temperature materials
• Materials for fission and fusion
• Hierarchical multi-scale materials - auxetic materials, meta-materials
• Fracture mechanics and fatigue
• Impact behaviour of materials - high and low speed impacts

Conference Chair

Dr Raj Das, Aerospace and Aviation
Sir Lawrence Wackett Aerospace Research Centre
School of Engineering, RMIT University
raj.das@rmit.edu.au

Paper Submission

We invite you to submit an abstract and subsequently a full paper. The full papers will be peer-reviewed by two expert reviewers including members of the National Scientific and Local Organising Committees.
Please download the abstract template from conference website and note guidelines for preparing your abstract. Please register and upload your abstract to the conference website.
www.icm-13.com/paper-submission

Important Dates

Submission of abstracts: 30 Nov 2018
Notification of abstract acceptance: 15 Dec 2018
Deadline for early registration: 15 Mar 2019
Submission of full papers: 15 Apr 2019
Deadline for late registration: 15 May 2019
Conference: 11-14 June 2019

Conference secretariat

AusBiotech
Vincent Portier - events manager
Suite 4, Level4, 627 Chapel Street, 3141, South Yarra
icm13@ausbiotech.org
+61 3 9828 1400
www.icm-13.com