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Pipeline corrosion control engineering life cycle — General requirements

Ingénierie du contrôle de la corrosion des conduites au cours du cycle de vie — Exigences générales

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Foreword

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This document was prepared by Technical Committee ISO/TC 156, *Corrosion of metals and alloys*, Subcommittee SC 1, *Corrosion control engineering life cycle*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Pipeline corrosion control engineering life cycle — General requirements

1 Scope

This document specifies the general requirements for control elements in the life cycle of pipeline corrosion control engineering.

This document is applicable to all types of pipeline corrosion control engineering programmes.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
pipeline corrosion testing and monitoring system
online technology for the real-time testing and feedback of corrosion conditions on both external and internal pipelines

3.2
temporary decommissioning
suspended operation of a system due to emergencies (such as natural disasters, corrosion leakage, etc.)

Note 1 to entry: The decommissioning system will continue to operate after the emergency measures are taken.

3.3
permanent decommissioning
permanent shutdown of a system

Note 1 to entry: The system has been assessed to have significant technical and economic risks via rigorous procedures and will no longer continue to operate.

4 General principles

4.1 This document summarizes all the aspects of the pipeline corrosion control engineering life cycle to provide general requirements for selecting technical and management standards. This document does not provide specific techniques and management procedures for pipeline corrosion control.

4.2 A traceable and supportive management system shall be established to achieve full control and sustainable improvement on all aspects of the pipeline corrosion control engineering life cycle.

5 Objectives

5.1 To optimize and coordinate all aspects of the pipeline corrosion control engineering life cycle, the life cycle of pipeline corrosion control engineering shall be suitable for the full life cycle of the protected pipeline.

5.2 The objectives of corrosion control engineering shall be communicated, implemented and maintained at all stages of the pipeline life cycle. The objectives shall be regularly reviewed and improved to ensure their suitability.

6 Corrosion sources

6.1 Corrosion sources include:

a) internal corrosion sources, including, but not limited to, pipeline transmission medium, flow rate, temperature and pressure;

b) external corrosion sources, including, but not limited to, environmental factors and corrosive medium that potentially reacts with pipes under different environmental conditions;

c) new corrosion sources during pipeline operation, including, but not limited to, cathodic disbondment and pipeline maintenance-related and replacement-related electrochemical corrosion;

d) corrosion sources caused by working conditions changes, including working conditions changes in both pipeline and pipeline corrosion control facilities.

EXAMPLE Cathodic disbondment caused by a current overload of cathodic protection.

6.2 By referring to the implementation cases and relevant standards, all corrosion sources shall be accurately identified according to the life cycle requirements of the pipeline system.

NOTE 1 For corrosion sources of pipelines in atmospheres, refer to ISO 9223.

NOTE 2 For corrosion sources of buried pipelines, refer to EN 12501-1.

7 Pipeline materials

7.1 The selection of a pipeline shall be based on the corresponding standards.

NOTE For the selection of a pipeline in petroleum and natural gas industries, refer to ISO 13623.

7.2 The following pipeline selection principles shall be fulfilled.

a) The selected pipeline and its applied environment shall be investigated to ensure corrosion resistance as well as environmental protection.

b) Once the application requirements are satisfied, the processability, versatility and cost-effectiveness of the pipeline shall also be considered.

7.3 The pipeline shall be selected using the following procedures.

a) A field investigation on the pipeline working environment shall be carried out to determine corrosion sources, corrosion factors and corrosion magnitude.

b) With reference to corresponding standards and manuals, an appropriate pipeline that meets the corrosion resistance requirements shall be selected.

c) The pipeline resistance shall be evaluated. In the absence of relevant data for the same or a similar engineering application, a laboratory simulation or field test is required for the pipeline selection.

d) When a satisfactory durability of the pipeline operation has been achieved, versatility shall be considered next. It shall take precedence over cost-effectiveness.

7.4 The selected pipeline shall be reviewed and assessed by established procedures. The process of pipeline selection shall be documented and archived.

8 Technology

8.1 One or more appropriate technologies shall be implemented for pipeline corrosion control according to the corrosion sources. Considerations of pipeline corrosion control technologies include, but are not limited to, the following.

a) Reasonable structure design: insulation techniques, the installation of electrical isolation points and isolation devices, a detailed integrated plan of sleeve, facilities and other electrical affected zones, and the prevention of unpredicted corrosion, such as shielding of cathodic protection or cathodic disbondment.

b) Coating protection: selecting coatings materials suitable to the expected operating conditions and construction process, taking into account budgetary and environmental considerations.

c) Electrochemical protection: evaluating the current density required to resist corrosion via pipeline polarization or the current flow required for the cathodic protection system, taking total electricity costs into consideration.

d) Corrosion inhibitor selection: fully investigating the cause of the internal corrosion and the chemical property of the pipeline transmission medium to select the inhibitor type, frequency and dose, taking into account the total cost of the use of corrosion inhibitors, if applicable.

e) Cleaning, including chemical and physical cleaning. The type and amount of pollutants pigged from the pipeline shall be analysed to detect the inhibiting effect and to determine the required pigging frequency.

f) Environmental protection: environmental-friendly pipeline corrosion control technology and construction technology shall be preferred.

g) Composite technology: composite pipeline technology without electrochemical corrosion shall be preferred.

8.2 The selection of pipeline corrosion control technology shall be based on the corresponding technical standards or specifications followed by a comprehensive evaluation. The general principles are as follows.

a) Considering the safety of the corrosion control process operation as a priority and evaluating whether safety requirements can be met.

b) In cases where all the technical requirements have been met, state-of-the-art technology, process, equipment and materials shall be selected preferentially, while minimizing the costs of corrosion control.

c) The selected pipeline corrosion control engineering technology shall meet the operating requirements for different working conditions as well as have a sufficient service life without generating pollutants.

d) The risk and associated hazards of a pipeline corrosion control technical failure shall be considered. Pre-controls are required to decrease risks and minimize potential losses from technical failures.

NOTE For techniques of risk management, refer to ISO 31000.

8.3 The selected technologies shall have corresponding supportive cases as references. Otherwise, they shall be verified by appropriate experiments.

8.4 When the requirements of the pipeline system have been met, the selected technologies shall be coordinated and optimized with other aspects in the pipeline corrosion control system to achieve the goals of safety, cost-effectiveness, and long-term and environmental-friendly operation.

8.5 All adopted corrosion control technologies shall be reviewed and evaluated via established procedures, then documented and archived.

9 Design

9.1 All elements, links and nodes in the entire life cycle of the pipeline corrosion control engineering shall be systematically designed according to the influence of the pipeline operating environment and transmission medium.

9.2 The principles of pipeline corrosion control engineering design are as follows.

a) Protect the environment and save energy.

b) The site of the pipeline engineering shall avoid environments with interference factors, such as populated regions, highways, railways, rivers and power lines. The appropriate distance between the pipeline and such environments shall be kept. The physical space occupied by pipeline infrastructure shall not be exploited for other purposes.

c) Optimize the design with key materials, facilities and processes according to specific corrosive environments. Determine the most cost-effective design.

d) It is acceptable to use state-of-the-art technologies, processes, facilities and materials.

e) Pipeline corrosion control engineering design for reconstruction and extension projects shall rationally use the original facilities.

f) It is acceptable that the expected life cycle of serviceable or replaceable materials and devices are shorter than the life cycle of the pipeline. The life cycle of unserviceable and unreplaceable materials and devices shall be consistent with the life cycle of the protected pipeline.

9.3 A green plan for temporary and permanent decommissioning, abandonment and disposal shall be developed in the stage of design.

9.4 The applicability of the design system shall be evaluated in accordance with the objectives of safety, cost-effectiveness, and long-term operation and environmental protection. The system design shall be improved constantly to meet the requirements of pipeline professional standards.

9.5 The design documents shall be reviewed and evaluated by established procedures, then documented and archived.

10 Research and development

10.1 All elements, links and nodes in the entire life cycle of pipeline corrosion control engineering shall be continuously researched, improved and developed during the implementation process to achieve the optimum benefits of safety, cost-effectiveness, and long-term operation and environmental protection.

10.2 Research and development mainly includes research of materials and technologies, process improvement, equipment and product development. The entire research and development process shall be carried out in accordance with established procedures, evaluated by experts and supported by experiments.

10.3 All research and development processes shall be documented and archived for future audits.

11 Manufacturing

11.1 The manufacturing of a new pipe for pipelines shall be based on relevant technical specifications, product standards, inspection standards, design documents and drawings.

11.2 The selection of a manufacturing supplier shall include its previous performance and supportive cases of the same type of pipeline engineering programme.

11.3 The manufacturing supplier shall develop a series of regulations to ensure pipeline quality and production safety as well as environmental protection. Processes, parameters and inspection records of manufacturing shall be documented and archived.

11.4 The product shall be marked with a product label and qualified certificate.

11.5 When the requirements of the protected pipeline have been met, the manufacturing procedures shall be optimized to achieve the goals of safety, cost-effectiveness, and long-term operation and environmental protection.

12 Construction and installation

12.1 The construction and installation of pipes, pipeline corrosion control facilities and system shall include protective measures (including emergency measures) based on corresponding standards, to avoid damage and corrosion. The whole process shall be documented and archived.

NOTE For the construction and installation of cathodic protection for pipelines on land, refer to ISO 15589-1.

12.2 Pipeline corrosion control facilities and systems with special requirements shall be provided with specific installation devices. Protective measures shall be established.

12.3 Safety and protective measures for the construction and installation of the pipeline and corrosion control facilities and systems shall be established to ensure the safety of personnel, equipment and the environment.

12.4 The construction and installation of pipeline corrosion control equipment and systems shall follow installation procedures based on design documents and corresponding standards.

12.5 The pipe fittings' corrosion control grade and performance shall be compatible with the corrosion control requirements of the protected pipeline.

12.6 For the construction of the pipeline connection, appropriate process technologies shall be adopted. The connecting material shall be identical to the material of the pipeline, or other materials used in same type of construction engineering. Measures shall be taken to avoid galvanic corrosion if different materials are used for connection. Local heat treatment shall be adopted to eliminate stress if the stress corrosion occurs in connected positions.