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Internal Corrosion Direct Assessment Methodology for Pipelines Carrying Normally Dry Natural Gas (DG-ICDA)

ABSTRACT

Formalizes the process of internal corrosion direct assessment (ICDA) for pipelines carrying normally dry natural gas that can be used to help ensure pipeline integrity. The basis of DG-ICDA is a detailed examination of locations along a pipeline where water would first accumulate to provide information about the downstream condition of the pipeline. If the locations along a length of pipe most likely to accumulate water have not corroded, other downstream locations less likely to accumulate water may be considered free from corrosion.

KEYWORDS

internal corrosion, direct assessment, dry gas, pipelines.

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Foreword

In NACE standards, the terms shall, must, should, and may are used in accordance with the definitions of these terms in the NACE Publications Style Manual, 4th ed., Paragraph 7.4.1.9. Shall and must are used to state mandatory requirements. The term should is used to state something considered good and is recommended but is not mandatory. The term may is used to state something considered optional.

This standard practice formalizes a methodology termed internal corrosion direct assessment for pipelines carrying normally dry natural gas (DG-ICDA) that may be used to help ensure pipeline integrity. The methodology is applicable to natural gas pipelines that normally carry dry gas, but may suffer from infrequent, short-term upsets of liquid water (or other electrolyte). This standard does not address situations in which water vapor condensation occurs at locations along the length of the pipeline. Such situations are intended to be addressed using wet gas internal corrosion direct assessment (WG-ICDA).1 This standard is intended for use by pipeline operators and others who manage pipeline integrity.

The basis of DG-ICDA is a detailed examination of locations along a pipeline where water would first accumulate and provide information about the downstream condition of the pipeline. If the locations along a length of pipe most likely to accumulate water have not corroded, other downstream locations less likely to accumulate water may be considered free from corrosion. The presence of extensive corrosion found at many locations during the evaluation suggests that the transported gas was not normally dry, and this standard is not considered applicable.

DG-ICDA methodology for natural gas systems is described in terms of a four step process. The DG-ICDA method provides the greatest benefit for pipelines that cannot be in-line inspected; however, the method is not limited to unpiggable pipelines. Sample field data are provided in Appendix A (nonmandatory) to illustrate an example application of DG-ICDA. Appendix B (nonmandatory) provides example region definitions.

This standard was prepared by Task Group (TG) 293, "Pipeline Direct Assessment Methodology," in 2006, and revised by TG 293 in 2015. TG 293 is administered by Specific Technology Group (STG) 35, "Pipelines, Tanks, and Well Casings." This standard is issued by NACE International under the auspices of STG 35.

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Figures

Section 1: General

1.1 Introduction

1.1.1 This standard covers the NACE internal corrosion direct assessment (ICDA) process for normally dry natural gas pipeline systems. This standard is intended to serve as a guide for applying the NACE DG-ICDA process on natural gas pipeline systems that meet the feasibility requirements of Paragraph 3.3 of this standard.

1.1.2 The primary purposes of the DG-ICDA method are to enhance the assessment of internal corrosion in natural gas pipelines, and to ensure pipeline integrity.

1.1.3 DG-ICDA was developed for natural gas pipelines that normally carry dry gas, but may suffer from infrequent short-term upsets of liquid water. This standard does not address water vapor condensation. Because of this, DG-ICDA is not applicable to wet gathering and producing pipelines, storage fields or other pipelines where water vapor condensation occurs at distinct locations or throughout the length of the pipeline. Where water condensation occurs or is expected to occur, then assessment should be carried out in accordance with NACE SP0110, Wet Gas Internal Corrosion Direct Assessment Methodology for Pipelines.

1.1.4 One benefit of the DG-ICDA approach is that an assessment can be performed on a pipe segment for which alternative methods (e.g., in-line inspection (ILI), hydrostatic testing, etc.) may not be practical.

1.1.5 The basis of DG-ICDA for gas lines is a detailed examination of locations along a pipeline where water or other electrolyte first accumulates, allowing inferences to be made about the integrity of the remaining downstream length of pipe.

1.1.6 If the locations along a length of pipe that are most likely to accumulate water have not corroded, other locations less likely to accumulate water are unlikely to have suffered corrosion when operating under the same conditions.

1.1.7 Identifying areas in which internal corrosion (or the potential for future internal corrosion) exists, and conversely, where internal corrosion is unlikely, may also be incorporated into corrosion integrity and risk management plans.

1.1.8 In the process of applying DG-ICDA, other pipeline integrity threats, such as external corrosion, mechanical damage, stress corrosion cracking (SCC), etc., may be detected. When such threats are detected, additional assessments or inspections must be performed. The pipeline operator should utilize appropriate methods to address risks other than internal corrosion, such as those described in NACE standards, ASME[(1)] B31.8,[3] API[(2)] 1160,[4] ANSI[(3)]/API 579,[5] and BS[(4)] 7910,[6] international standards, and other documents.

1.1.9 The DG-ICDA methodology assesses the likelihood of internal corrosion and includes existing methods of examination available to a pipeline operator to determine whether internal corrosion is actually present, or may occur.

1.1.10 DG-ICDA uses flow modeling results and provides a framework to utilize those methods.

1.1.11 DG-ICDA has limitations, and not all pipelines can be successfully as-

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(2) American Petroleum Institute (API), 1220 L St. NW, Washington, DC 20005.
(3) American National Standards Institute (ANSI), 11 W. 42nd St., New York, NY 10036.
(4) British Standards Institute (BSI), British Standards House, 389 Chiswick High Rd., London W4 4AL, United Kingdom.

sessed with DG-ICDA. These limitations are identified in the preassessment step. For accurate and correct application of this standard, it shall be used in its entirety. Using or referring to only specific paragraphs or sections can lead to misinterpretation or misapplication of the recommendations and practices contained herein.

1.1.12 This standard does not designate practices for every specific situation because of the complexity of internal conditions that may be present in various pipeline systems.

1.1.13 This standard does not address specific remedial actions that may be taken when corrosion is found; however, the reader is referred to ASME B31.84 and other relevant documents for guidance.

1.1.14 The provisions of this standard shall be applied by or under the direction of competent persons who, by reason of knowledge of the physical sciences and the principles of engineering and mathematics, acquired by education and related practical experience, are qualified to engage in the practice of corrosion control and risk assessment on pipeline systems. Such persons may be (1) registered professional engineers, (2) recognized as corrosion specialists by organizations such as NACE, or (3) professionals (i.e., engineers or technicians) with professional experience including detection/mitigation of internal corrosion and evaluation of internal corrosion on pipelines.

1.2 Four Step Process

1.2.1 DG-ICDA requires the integration of data from multiple field examinations and internal pipe surface evaluations, including the pipeline's physical characteristics and operating history. A flow chart that illustrates the components of each step is shown in Figure 1.

1.2.2 DG-ICDA includes the following four steps:

1.2.2.1 Preassessment collects essential historic and present operating data about the pipeline, determines whether DG-ICDA is feasible, and then defines ICDA regions. The types of data to be collected are typically available in design and construction records, operating and maintenance histories, alignment sheets, corrosion survey records, gas and liquid analysis reports, and inspection reports from prior integrity evaluations or maintenance actions.

1.2.2.2 Indirect inspection covers multiphase flow predictions, developing a pipeline elevation profile, and identifying sites where internal corrosion may be present.

1.2.2.3 Detailed examination includes performing excavations and conducting detailed examinations of the pipe to determine whether metal loss from internal corrosion has occurred.

1.2.2.4 Post-assessment covers analysis of data collected from the previous three steps to assess the effectiveness of the DG-ICDA process and determine reassessment intervals.