NACE SP0110-2010
Item No. 21146

Standard Practice

Wet Gas Internal Corrosion Direct Assessment Methodology for Pipelines

Approved 2010-10-22
NACE International
1440 South Creek Dr.
Houston, Texas 77084-4906
+1 281-228-6200

ISBN 1-57590-241-9

Foreword

This standard practice formalizes a methodology to assess internal corrosion for onshore and offshore pipelines and other piping systems that normally carry natural gas with condensed water, or with water and liquid hydrocarbons, termed *wet gas internal corrosion direct assessment* (WG-ICDA). This standard is intended for use by gas pipeline operators and others who manage gas pipeline integrity (both onshore and offshore) in which pipelines are normally under wet loading conditions and are beyond the application of NACE SP0206[1] and NACE SP0208.[2]

The WG-ICDA methodology has been developed to meet the needs of gas pipeline operators to assess the integrity of pipelines with respect to internal corrosion. WG-ICDA is a structured process that combines preassessment, indirect inspection, detailed examination, and postassessment to evaluate the effect of predictable pipeline integrity threats such as internal corrosion. Specifically, the goal of WG-ICDA is to identify locations with the greatest likelihood of internal corrosion, and its influencing factors such as water content, flow regime, liquid holdup, flow velocities, temperature changes, and pressure changes. These locations shall be exposed and examined in accordance with criteria established in Section 4. The results of these detailed examinations are used as a basis for assessing the condition and integrity of the remainder of the pipeline segment (with less likelihood of corrosion). WG-ICDA does not depend on the ability of a pipeline to undergo in-line inspection (ILI) by smart pigs or pressure testing, making it most valuable to those pipeline segments unable to accept pigs or that cannot be hydrostatically tested. This standard is intended to be a stand-alone assessment methodology for internal corrosion in lieu of ILI analyses; however, the WG-ICDA methodology may also serve or assist those cases in which ILI may have been performed or is contemplated to demonstrate the reliability of the WG-ICDA process. It may also be used for optimizing the selection/justification or prioritization of pipelines that are subjected to ILI.

In wet gas systems, WG-ICDA subregions of a WG-ICDA region may accumulate water and liquid hydrocarbons. The accumulation of water and liquid hydrocarbons can be determined by a flow model that uses a phase envelope for dew point (water and hydrocarbon) prediction under flowing conditions and shows local temperature, pressure, and gas composition for a pipeline. Depending on the flow conditions (e.g., velocity, gas quality, temperature, pressure, wall surface conditions), the liquid in some WG-ICDA regions and the subsequent WG-ICDA subregions of a pipeline segment can flow or accumulate until the WG-ICDA subregion is full and then carries over to the next downstream WG-ICDA subregion. For specific operating conditions, the liquid can accumulate and remain stagnant within the WG-ICDA subregion (liquid holdup). As liquid continuously travels between accumulation points, the effects of flow regimes shall be considered. These flow dynamic characteristics influence internal corrosion, and thus are a threat to the pipeline integrity.

The goal of WG-ICDA is to identify confirmatory or most probable locations (MPLs) along a WG-ICDA region for determination of the position of assessment sites. These assessment sites are where internal corrosion damage has been identified by means of integrating available historical information in combination with the use of flow models to determine liquid holdup and flow regimes and internal corrosion prediction models (ICPMs) that a pipeline operator deems appropriate for its specific application to predict or calculate internal corrosion rates. The essential focus is the discrimination of conditions along the length of a WG-ICDA region so that possible local WG-ICDA subregion integrity threats with respect to internal corrosion are identified for prioritized damage assessment, repair, and mitigation. WG-ICDA emphasizes damage distribution over absolute corrosion rate, and the ICPMs can fit into the overall process by serving as a tool, whenever possible, to predict wall losses within one flow pattern (e.g., stratified, slug, annular, or annular/mist) within a specific WG-ICDA region and/or WG-ICDA subregion.

This standard was prepared by Task Group (TG) 305, "Internal Corrosion Direct Assessment for Wet Gas Pipelines." TG 305 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.

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*. The terms *shall* and *must* are used to state a requirement, and are considered mandatory. The term *should* is used to state something good and is recommended, but is not considered mandatory. The term *may* is used to state something considered optional.

NACE International
Standard Practice

Wet Gas Internal Corrosion Direct Assessment Methodology for Pipelines

Contents

Section 1: General

1.1 Introduction

1.1.1 This standard covers the NACE internal corrosion direct assessment (ICDA) process for wet natural gas pipeline systems (i.e., WG-ICDA). It is intended to serve as a guide for applying the WG-ICDA process to onshore and offshore natural gas pipeline systems that:

(a) contain wet gas (gas-liquid ratio [GLR] > 5,000);

(b) are not covered by dry gas internal corrosion direct assessment (DG-ICDA); and

(c) meet the feasibility requirements described in Paragraph 3.3 of this standard.

1.1.2 The two primary purposes of the WG-ICDA methodology are (1) to enhance the assessment of internal corrosion in natural gas pipelines, and (2) to improve pipeline integrity.

1.1.3 The WG-ICDA methodology assesses where along a pipeline segment the internal corrosion severity is potentially highest. The methodology includes existing methods of detailed examination available to a pipeline operator to determine occurrence, as well as the extent and severity, of internal corrosion.

1.1.4 WG-ICDA also uses flow modeling results (e.g., dew point, flow velocities, liquid holdup, and flow patterns) and provides a framework to use those models.

1.1.5 WG-ICDA was developed for onshore and offshore natural gas pipelines that have produced or condensed water as a normal impurity. WG-ICDA is applicable to wet gas gathering and gas producing pipelines.[3,4] The basis of WG-ICDA is for wet gas pipelines and consists of a detailed examination of selected assessment sites with the highest expected corrosion severity where there may be a reduction of the pipe wall thickness to an extent that would pose a threat to the pipeline if mitigation or other measures are not taken before the next assessment. This allows inferences to be made about the remainder of the pipeline segment.

1.1.6 One benefit of the WG-ICDA approach is that, for gas pipelines, an assessment can be performed on a pipeline segment for which alternative methods (e.g., ILI, hydrostatic testing) may be impractical.

1.1.7 WG-ICDA has limitations, and not all pipelines can be successfully assessed with WG-ICDA. These limitations are identified in the preassessment step.

1.1.8 Drips, compressing stations, vessels, and other equipment unrelated to pipelines are not included in this standard.

1.1.9 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 or related practical experience, are qualified to engage in the practice of corrosion control and risk assessment for pipeline systems. Such persons may be (1) registered professional engineers, (2) recognized as corrosion specialists by organizations such as NACE International, or (3) professionals (i.e., engineers or technologists) with professional experience, including detection/mitigation of internal corrosion and evaluation of internal corrosion on pipelines.

1.1.10 For accurate and correct application of this standard, the standard shall be used in its entirety. Using or referring to only specific paragraphs or sections may lead to misinterpretation or misapplication.