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Specifications for oil and gas pipeline integrity assessment

油气管道完整性评价技术规范

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Table of Contents

Foreword

This document was drafted in accordance with the rules given in GB/T 1.1-2020 "Directives for standardization - Part 1: Rules for the structure and drafting of standardizing documents".

This is the first edition of the standard: it does not replace an earlier document.

Attention is drawn to the possibility that some of the elements of this standard may be the subject of patent rights. The issuing body of this document shall not be held responsible for identifying any or all such patent rights.

This document was proposed and prepared by SAC/TC 355, the Technical Committee on Petroleum and Natural Gas of Standardization Administration of China, which is also in charge of the official English translation. In case of any doubt about the contents of the English translation, the Chinese original is authoritative.

1 Scope

This document specifies the elements, methods and requirements of integrity assessment of oil and gas pipelines, including the preparation and analysis of assessment data, inspection and monitoring, fitness for service, and integrity assessment reporting.

It applies to the integrity assessment of onshore steel pipelines transporting oil and gas.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies; for undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 27699 Technical specification for in-line inspection of steel pipeline · GB/T 30582 Risk-based-inspection and assessment methodology of external damage for buried steel pipelines · GB 32167 Oil and gas pipeline integrity management specification · GB/T 36676 External inspection methodology of stress corrosion cracking (SCC) for buried steel pipelines · GB 50251 Code for design of gas transmission pipeline engineering · GB 50253 Code for design of oil transportation pipeline engineering · GB 50369 Code for construction and acceptance of oil and gas long-distance transmission pipeline engineering · SY/T 0087.1 Standard of steel pipeline and tank corrosion assessment - Part 1: External corrosion direct assessment for buried steel pipeline · SY/T 0087.2 Standard of steel pipeline and tank corrosion assessment - Part 2: Internal corrosion direct assessment for buried steel pipeline · SY/T 0087.4 Standard of steel pipeline and tank corrosion assessment - Part 4: Stress corrosion cracking direct assessment for buried steel pipeline · SY/T 0087.5 Standard of steel pipeline and tank corrosion assessment - Part 5: Comprehensive analysis of corrosion data for oil and gas pipeline · SY/T 6597 Specification for in-line inspection of oil and gas pipeline

3 Terms and definitions

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

3.1 Pipeline integrity assessment - the process of adopting applicable inspection, monitoring or testing technology to obtain status information of pipe bodies and to make a comprehensive assessment of the safety status of the pipeline, based on the analysis of material and structural reliability, in order to determine its fitness for service. NOTE: the commonly used methods are fitness for service based on in-line inspection data, pressure test and direct assessment.

3.2 In-line inspection (ILI) - the method of letting inspection tools move inside the pipeline by means of a fluid pressure differential, to inspect pipeline defects (corrosion, damage, deformation, cracks and so on, on the inner and outer walls), centreline positions and structural features such as welds, tees and elbows.

3.3 Direct inspection - inspection of the pipe body, the corrosion protection system and the like from the outside, through instruments and equipment; it covers the direct inspection of internal corrosion, of external corrosion and of stress corrosion.

3.4 Pressure test - a pipeline test intended to verify the operating pressure of the pipeline and to judge whether there is any leakage in the pipeline system; it assesses the pressure-bearing capacity of the pipe body at that time.

3.5 Fitness for service (FFS) - the quantitative assessment of the structural integrity of in-service components carrying defects or damage. NOTE: consistent with API 579-1.

3.6 Comprehensive assessment - the method of taking into account factors such as pipeline operation, changes in the external environment and stress-strain monitoring, aligning the data collected by the various assessment methods, making correlation, causation and load analysis, and proposing integrity assessment conclusions and suggestions in a systematic manner.

3.7 Data aligning - the process of aligning pipeline data from several sources or runs to a benchmark, according to linear reference systems, through easily identifiable features such as valves, nipples, elbows, girth welds and pipe piles.

3.8 Baseline assessment - the first pipeline integrity assessment, based on the first pipeline integrity inspection, including centreline inspection, deformation inspection, magnetic flux leakage ILI and other inspections.

3.9 Metal loss - the phenomenon of concentrated loss of metal in some areas of the pipe surface. NOTE: usually due to corrosion, but gouges or mechanical damage can also cause it.

3.10 Manufacturing defect - a defect occurring during the manufacture of steel plate or the fabrication of steel pipe, pipe fittings, flanges, valves and other elements.

3.11 Deformation - a change in the shape of the pipe body, such as a bend, buckle, dent, ovality, ripple or wrinkle, or any other change that affects the roundness or straightness of the pipe cross-section.

4 Overall principles and requirements

4.1 General. Pipeline integrity assessment is carried out periodically: the baseline assessment of a newly built pipeline shall be completed within 3 years after commissioning, and the interval between assessments of an in-service pipeline follows GB 32167. A long pipeline with several stations should be assessed in sections. The identification of pipeline hazards and damage mechanisms shall be accurate and comprehensive at the baseline assessment, and verified testing and assessment methods shall be used to assess structural integrity. One or more assessment methods may be selected from fitness for service based on ILI data, pressure test, or direct assessment; for a pipeline that can be inspected in line, the assessment shall at least include FFS based on ILI data. Special inspection and assessment may be carried out for crossings, special parts and sections under special operating conditions. Where the results show abnormal external corrosion, the effectiveness of the external corrosion protection system shall be assessed. The data from ILI and direct inspection shall be analysed together to find the possible causes of defects, and the growth of time-dependent defects shall be predicted so that future structural integrity can be assessed. The re-assessment interval and maintenance suggestions are part of the integrity assessment output.

4.2 Assessment content. The remaining strength of pipe carrying defects shall be assessed and its remaining life predicted through a comprehensive analysis of factors such as pipeline stress and operating environment. Where data have been obtained by several methods, a comprehensive assessment should be carried out in accordance with 7.5, and experience from previous integrity assessments should be used in choosing the methods for the next one.

5 Data preparation and analysis

5.1 Data preparation. Existing data are collected and analysed to evaluate the potential threats and damage mechanisms of the pipeline. The scope of the data is set by the assessment object, the damage mechanism and the assessment level, and the data may come from any stage of the pipeline life cycle - design, construction, operation and maintenance. Where the pipeline's own data are not sufficient, failure analysis reports, risk assessment reports and integrity assessment reports of similar pipelines should also be collected. Annex A lists the data required for an integrity assessment based on ILI.

5.2 Data integration and alignment. Data from different sources are aligned according to defined rules, the benchmark being the data of higher accuracy; where the pipeline has been inspected in line, the alignment is based on the ILI data, otherwise on the mapping centreline data. The items to be aligned are set by the assessment object and the defect type - for external corrosion, for instance, ILI data may be aligned with basic pipeline information, coating inspection, cathodic protection effectiveness, stray current interference, soil corrosiveness and direct excavation inspection.

5.3 to 5.4 Data quality analysis and defect causation analysis follow, and 5.5 Identification of hazardous and harmful factors classifies them into three types: factors deteriorating over time, including external corrosion, internal corrosion, SCC and hydrogen-induced cracking and dent fatigue damage; inherent factors, including pipe weld and pipe material defects, girth weld defects, dents, gouges and buckles or wrinkles arising at the welding stage of construction; and random factors, including mechanical damage during operation and pipe body damage caused by natural disasters.

5.6 Sufficiency analysis on data. The sufficiency of the data is judged against the data quality, the defect causation analysis, the assessment method and level and the maintenance requirements. Where the data do not meet the assessment requirements, the