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Results of In-Line SCC-Inspection with the Ultrascan CD Tool

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ABSTRACT

The occurrence of stress corrosion cracking (SCC) has become a serious matter for many pipeline operators around the world. Advanced in-line inspection technology using nondestructive methods is considered the most promising approach to detect and size this kind of damage thus providing basic information for managing pipeline integrity. Considerable progress has been achieved with a new generation of internal inspection device especially designed for the detection of axial crack-like defects in pipelines. Since its commercial introduction in October 1994, the crack detection tool described here has successfully inspected over 2,000 km of operating oil and gas pipelines. The inspection runs were followed by verification excavations at specific locations selected from the collected data. Comparison of the findings with corresponding verifications from excavations illustrate the sensitivity and reliability of the inspection concept and the ability of the tool to safely discriminate between injurious crack-like defects and different non-injurious reflectors such as e.g. inclusions. The performance has proved the tool to be a reliable internal inspection device for the detection and sizing of cracks (SCC, fatigue cracks and crack-like defects) in pipelines.

Keywords: Pipeline Integrity, In-line Inspection, Stress Corrosion Cracking (SCC), Hydrotesting, Nondestructive Testing, Ultrasonics

INTRODUCTION

Cracks in pipelines are one of the most severe and potentially dangerous defects in pipelines. In particular stress corrosion cracking (SCC) has already caused a significant number of service failures in gas pipelines as well as in crude oil pipelines all over the world (NEB, 1996). A necessary condition for the initiation of SCC is the combined influence of internal pressure, corrosive environment, and a particular microstructural susceptibility found in some pipeline steels. The mechanisms of initiation and growth in particular of the so-called near neutral SCC are still not fully understood and are the subject of ongoing research. SCC can occur in various forms from small isolated cracks to large crack fields (colonies) containing hundreds of cracks. Since the hoop stress is usually the driving force, SCC is (similar to fatigue cracks) normally axially orientated. SCC is generally found on the external pipe surface with some preference in the longitudinal weld area but also in the base material. Its occurrence is observed largely in connection with coating failure (mainly polyethylene tape).

For a long time, the use of hydrostatic testing was considered the only reliable way to prove the integrity of a pipeline that was a candidate for SCC attack. This type of test is expected to remove all critical cracks, i.e. cracks that could cause failure under normal operating conditions. However, since no information on sub-critical cracks is obtained the estimation of the safe future service life becomes rather uncertain. Moreover, hydrotesting can cause crack growth of near-critical cracks thus reducing the expected safety margin (Surkov and Khoroshih, 1996). Additionally, hydrostatic tests are expensive and time consuming as the line has to be taken out of service.

Another approach to find SCC in pipelines relies on predictive models and investigative excavations. The effectiveness of predictive models (soil models) for finding sites assumed to be susceptible to "significant" SCC depend on a number of parameters thus making this method unsuitable for detection and prioritization of SCC.

The crack detection tool describe here (UltraScan CD) is an in-line inspection tool ("smart" or "intelligent pig") developed with the goal to reliably detect and size cracks and related crack-like defects in pipelines. Since providing much more detailed information on the state of cracks in a pipeline, it is a superior alternative to hydrostatic retesting and any other approaches. The information obtained from an inspection run with the tool not only reveals the critical cracks, but also cracks as small as 1 mm (0.040 in.) deep and 30 mm (1.2 in.) long, thus enabling prioritization and growth monitoring.