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A probabilistic approach to estimate the remaining life and reliability of corroded pipelines

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Abstract: Considering corrosion rate during the remaining life assessment of aging pipelines is fundamental to calculate the interval between two consecutive inspections. A total of 798 internal and external corrosion defects have been detected, using the Magnetic Flux Leakage intelligent inspection tool, over 48 km of a pipeline length located in the west region of Algeria. The statistical analysis has shown that there is a strong correlation between the corrosion defect length and the corrosion defect circumferential width, with a significant correlation coefficient equal to 82.87%. A probabilistic methodology is presented for the assessment of the remaining life of a corroded pipeline transporting gas, and a finite element method (FEM) was used to assess the pipeline failure pressure. The numerical FEM modeling results were compared with the commonly used codes-models for calculating limit pressure to establish a more realistic and accurate engineering model. The reliability analysis of an API 5L X60 steel made Algerian natural gas pipeline, in service for thirty years, and exposed to active corrosion attack, is presented. The sensitivity analysis of the basic random variables within the nonlinear limit state function was carried out to bring out the relative contribution of each variable affecting the remaining life of corroded pipelines. The reliability analysis is carried out by using Breitung's formula, based on the second-order reliability method (SORM). The reliability assessment of the corroded pipeline is based on the usage of the notched failure assessment diagram (NFAD), different codes for the calculation of the failure pressure, and the numerical results using the finite element analyses (FEA) software ANSYS.

Keywords : Corrosion defects, pipelines, Remaining life, Probability of failure, Reliability, Probabilistic approach