Assessment of the Reliability Level Embedded in Pipeline Design International Codes

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Abstract

The paper analyses the actual reliability level which is empirically embedded in pipeline design with international codes B31G, B31Gmod, Shell92, DNV, and Battelle (PCORRC), using a real pipeline section as an example. A brief review of the above design codes and description of the plastic fracture criterion, which is the basis for these design codes are presented. The considered pipeline section contains longitudinally oriented surface defects of the corrosion/erosion type. Estimates of residual strength of the pipeline were carried out. For two characteristic defects of pipeline section the influence of randomness of the pipeline geometry (diameter and pipe wall thickness), physical properties of pipe material (ultimate tensile strength and specified minimum yield strength), load (operating pressure) and defect geometry (depth and length) on probability of failure (POF) is analyzed. This approach can be applied when studying the inherent reliability of other pipelines with defects.

Assessment of the reliability/probability of failure of pipeline with defects was performed using the Gram-Charlier-Edgeworth (GCE) method. This method is an assessment of the probability that the limit state function (*LSF*) of pipeline defect is positive at a given moment of time *t*. $LSF(t) = P_f(t) - P_{op}$, where $P_f(t)$ is the failure pressure, which is estimated by any of the above design code; P_{op} is the operating pressure.

The GCE method allows estimating the probability of failure/reliability of the pipeline defect and considering the stochastic character of pipeline geometry parameters, physical properties of pipe material, parameters of pipeline defects and operating pressure, treating them as random variables. Recommendations for choosing probability distributions for these random variables and calculating their statistical parameters are also presented. Extensive calculations permitted discovering the reliability levels which are actually present in the analyzed international pipeline design codes.