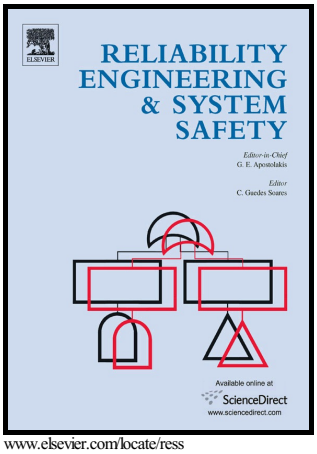

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Integrated failure probability estimation based on structural integrity analysis and failure data: natural gas pipeline case

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Abstract
In this paper, the authors present an approach as an overall framework for the estimation of the failure probability of pipelines based on: the results of the deterministic-probabilistic structural integrity analysis (taking into account loads, material properties, geometry, boundary conditions, crack size, and defected zone thickness), the corrosion rate, the number of defects and failure data (involved into the model via application of Bayesian method). The proposed approach is applied to estimate the failure probability of a selected part of the Lithuanian natural gas transmission network. The presented approach for the estimation of integrated failure probability is a combination of several different analyses allowing us to obtain: the critical crack's length and depth, the failure probability of the defected zone thickness, dependency of the failure probability on the age of the natural gas transmission pipeline. A model's uncertainty analysis and uncertainty propagation analysis are performed, as well.

Keywords: Fracture Mechanic Analysis, Deterministic-Probabilistic Structural Integrity Analysis, Finite Element Method, Bayesian Method, Failure probability, Gas Pipeline.

Nomenclature

BM	Bayesian method
cdf	cumulative distribution function
CI	confidence interval
DPSIA	deterministic-probabilistic structural integrity analysis
Gamma	gamma distribution
LogN	lognormal distribution
N	normal distribution
NDT	non-destructive testing
pdf	probability density function
W2P or W	two parameter Weibull distribution
$R_{p0.2}$	yield stress, MPa
R_m	ultimate strength, MPa
A_5	relative elongation, %
Z	relative cross-section reduction, %
HB	hardness