

The Control of Wall Thickness Tolerance during Pipe Purchase Stage Based on Reliability Approach

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Abstract : Metal-loss corrosion is a major threat to the safety and integrity of gas pipelines as it may result in the burst failures which can cause severe consequences that may include enormous economic losses as well as the personnel casualties. Therefore, it is important to ensure the corroding pipeline integrity and efficiency, considering the value of wall thickness, which plays an important role in the failure probability of corroding pipeline. Actually, the wall thickness is controlled during pipe purchase stage. For example, the API_SPEC_5L standard regulates the allowable tolerance of the wall thickness from the specified value during the pipe purchase. The allowable wall thickness tolerance will be used to determine the wall thickness distribution characteristic such as the mean value, standard deviation and distribution. Taking the uncertainties of the input variables in the burst limit-state function into account, the reliability approach rather than the deterministic approach will be used to evaluate the failure probability. Moreover, the cost of pipe purchase will be influenced by the allowable wall thickness tolerance. More strict control of the wall thickness usually corresponds to a higher pipe purchase cost. Therefore changing the wall thickness tolerance will vary both the probability of a burst failure and the cost of the pipe. This paper describes an approach to optimize the wall thickness tolerance considering both the safety and economy of corroding pipelines. In this paper, the corrosion burst limit-state function in Annex O of CSAZ662-7 is employed to evaluate the failure probability using the Monte Carlo simulation technique. By changing the allowable wall thickness tolerance, the parameters of the wall thickness distribution in the limit-state function will be changed. Using the reliability approach, the corresponding variations in the burst failure probability will be shown. On the other hand, changing the wall thickness tolerance will lead to a change in cost in pipe purchase. Using the variation of the failure probability and pipe cost caused by changing wall thickness tolerance specification, the optimal allowable tolerance can be obtained, and used to define pipe purchase specifications.

Keywords : allowable tolerance, corroding pipeline segment, operation cost, production cost, reliability approach

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