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Development of Empirical Method to Calculate Natural Gas Pipelines Rupture Exposure Radius

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Abstracts

Natural Gas pipeline location classification are designed following an approach similar to ASME B31.8, which considers segmenting the pipeline length and count the population in each segment within a given distance from the pipeline (width of segment). ASMEB 31.8 utilizes fixed distance of 400m for the segment width, while other operators use the pipeline Rupture Exposure Radius (RER). This is a distance determined by the consequences modeling for pipeline full rupture. Since, the population density within the segment width affects the design factors of the pipeline, i.e. wall thickness requirements, over-predicting the distance can have significant cost implications. Some operators use default RER values on conservative estimates, while industrial best practices allow for detailed dispersion to calculate representative RER distances.

Detailed dispersion modeling was performed for a large number of Natural Gas Pipeline scenarios, and an empirical formula was developed to estimate the RER for these pipelines as a function of the pipeline diameter and pressure. The dispersion calculations results show that the default RER values current used by some operators are very conservative, and that the cost of pipeline design/construction can be optimized by using the empirical formula developed in this work. The formula, which produces the RER value in terms of the distance from the pipeline to the point of ½ lower flammable limit is easy to use, and accurately represents the dispersion results. This eliminates the need to using sophisticated modeling software/tools to assess the RER values of Natural Gas pipelines. The formula also uses minimum number of data/information available about the pipelines (diameter and pressure only) increasing its effectiveness as a tool replacing the modeling software. In addition, for pipeline projects, lower RER distances result in more flexibility in route selection, lower pipeline location class and hence thinner wall thicknesses, less emergency isolation valves required and longer span between sectionalizing valves, which all translate to cost savings and reduces potential sources of leak (sectionalizing valves).