BUENOS AIRES 2023
JUNE 4 - 8

WCCE11 - 11TH WORLD CONGRESS OF CHEMICAL ENGINEERING

IACCHE - XXX INTERAMERICAN CONGRESS OF CHEMICAL ENGINEERING
CAIQ2023 - XI ARGENTINIAN CONGRESS OF CHEMICAL ENGINEERING
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"The global engineering working for a better future world"

Proceedings of

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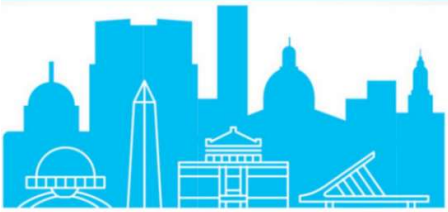

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Risk-Based Approach for Safety Distance Estimation in the Process Industry

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Different approaches have been proposed for safety distance estimation from hazardous facilities. The most widespread method is mainly based on the evaluation of the consequences of potential accidental events and the limitation of the physical vector on people, or on atmospheric and pressure process units, seeking to prevent the domino effect [1]. In this methodology, the stochastic variables involved in the phenomena (fire, explosion, or toxic dispersion) are fixed by defining a conservative scenario. This is particularly appropriate for accidents where the influence of environmental variables is relatively small (Boiling Liquid Expanding Vapor Explosions –BLEVEs–, mechanical explosions). However, the consequences of the worst-case scenario for events involving toxic or flammable gas dispersion, for example, could be much greater than the rest and not be representative of the site. This approach does not consider the occurrence frequency of the event and therefore, a remote accidental event would demand the same effort as a frequent one in the case of layout design. In addition, some accidental events such Vapor Cloud Explosions (VCE) or projectile ejection from BLEVEs can reach distances of more than 1000 meters and therefore, this approach results impracticable in some cases of plant layout design. Bearing this in mind, this article proposes a risk-based methodology to estimate safety distances to overcome the mentioned limitations of the impact threshold method. Here the quantitative risk is evaluated for different receptors, including the impact on people and on process equipment by using probit equations corresponding to the probability of escalation by domino effect.
Methodologically, the contribution to risk at different points located in eight directions is quantified by evaluating several scenarios generated by Monte Carlo simulation and composing the consequences and frequencies of each one. An iterative algorithm is developed to determine the distance that satisfies the risk threshold in each direction. This approach is applied to LPG storage tanks (spheres and cylinders) of different sizes and considering the historical information of wind speed and direction of Rosario city. The estimated safety distances are compared to those recommended by international standards such as NFPA 58 [2], and those obtained by evaluating the consequences to given impact thresholds. Finally, risk thresholds are assessed and recommended in order to define a general algorithm to estimate safety distances. Future works will intend to generalize the proposed approach to automatically determining separation distances matrixes for layout optimization.

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