CFD Based QRA of an LNG Liquefaction Facility
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Abstract
Quantitative risk assessments (QRAs) of oil and gas or chemical process facilities have historically been performed using analytical tools (often referred to as “2D” models because of the familiar two-dimensional footprint representation of the risk contours). Analytical models rely upon correlations and simple equations to calculate the hazard distances for fire, flammable or toxic gas dispersion and gas explosion scenarios. Therefore, a large number of scenarios can be calculated in a short period of time and risk contours can be calculated.

Analytical models, however, incorporate several critical assumptions which can limit their applicability and/or strongly affect their accuracy. For example, they neglect the presence of obstacles and obstructions on gas dispersion, the shielding effect of buildings or large equipment on thermal radiation, and are generally unable to accurately describe the flame propagation and resulting overpressures within congested areas. The typical solution to these limitations is to increase the degree of conservatism in the analysis, but this approach does not improve the accuracy of the analysis – instead, it masks obvious limitations by overdesigning the facility and ultimately increasing the financial burden on the project’s owner.

A more accurate approach to QRAs is to perform the analysis using computational fluid dynamics (CFD) models, which can eliminate many of the limitations and conservative assumptions required by analytical models. The most frequent criticism of CFD models for QRAs is that “it would take years…”.

The paper will introduce how a CFD based QRA can be performed properly and within reasonable times. It represents the first in a series of papers on CFD based QRAs, which will demonstrate a QRA performed on a small-scale LNG liquefaction facility using the CFD tool FLACS. The future work will demonstrate how a QRA can be performed properly and within reasonable times, and how CFD results compare to those obtained using the traditional analytical approach.