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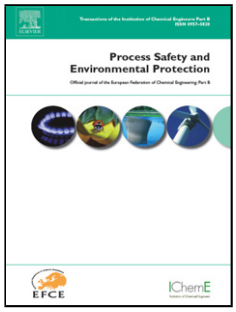

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Simulation and assessment of underwater gas release and dispersion from subsea gas pipelines leak

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highlights

- A modeling approach for describing subsea gas release and rising gas plume is presented
- An equivalent short pipeline model for estimating subsea gas release rate is built
- An Eulerian-Lagrangian modeling concept is utilized to track the rise of gas plume
- The effect of various factors on subsea gas release and dispersion behavior is studied

Abstract: Subsea gas release and dispersion can cause safety concerns such as fire, explosion or stability loss of floating installations. This paper presents a Computational Fluid Dynamics (CFD) based approach to describe the behavior of underwater gas release and dispersion from subsea gas pipelines leak. The uniqueness of the present study is the integration of estimating subsea gas release rate and predicting rising gas plume. The proposed approach is comprised of two submodels. An equivalent short pipeline model is established to calculate the subsea gas release rate, considering the change of hole size and environmental pressure. A 3D model based on Eulerian-Lagrangian modeling concept is built to predict the rising gas plume, in which bubbles are treated as discrete particles. The validation is carried out by comparing CFD results against experimental data. The underwater gas dispersion simulations include a matrix of scenarios for different gas release rates, water depths, ocean current speeds and leak positions, to study their effects on the behavior of underwater gas plume. The developed CFD model can provide some valuable outputs, e.g., gas release rate, rise time, horizontal dispersion distance and surfacing area size. These results could help to conduct the risk assessment and the emergency planning for accidental leakage of subsea gas pipelines.

Keywords: CFD simulation; risk assessment; underwater gas release; dispersion; subsea pipelines

1. Introduction

Subsea pipelines are the primary transportation tool of offshore natural gas. A number of factors such as third-party damage, corrosion or fatigue failure can lead to accidental leakage of subsea pipelines (Li et al., 2016). The likelihood of subsea pipelines leak is increasing with the increase of their service time. If an unplanned release of gas from damaged subsea pipelines occurs, the released gas will generate a gas plume