NOVA SCOTIA ENERGY
R&D CONFERENCE 2014

Abstract:

Devin O'Malley, Dalhousie University
Research Advisor: Jan Haelssig
Category: Environment

Using Computational Fluid Dynamics to Model Underwater Gas Blowouts

In offshore drilling, underwater pipelines are used for extraction, shipping and reinjection. For the latter, when sour gas is sweetened the resultant sulfur containing compounds must be returned to the well or disposed of. With these pipelines beneath the surface there is a very small risk for catastrophic loss. Should it occur, the rapid release can contain potentially toxic or explosive chemicals. For environmental and safety response planning, knowledge of the fate of the contaminants is required. At the source of the rupture, there would be expansion due to the pressurized gas flowing into the ocean. From there, the bubbles would drift towards the surface where they would be carried away by the wind currents. The proposed model seeks to characterize the gas release at the source of the rupture.

The work presented here is a result of preliminary study of the system, and seeks to analyze the capacity of currently available computational fluid dynamics (CFD) methods to predict the behaviour of the gas. In this study, a gas release into a simplified, scaled down geometry was modeled using a volume-of-fluid (VoF) approach. Starting from a highly refined mesh, the model was validated. The mesh was then coarsened to determine the minimum mesh resolution required to predict meaningful macroscopic behaviour. These simulations were performed for a variety of release pressures and orifice sizes. This study is critical to identify any current limitations of the VoF method for characterizing the fluid dynamic behaviour of the released gas. In the future, this model will be extended to include more complex effects related to the release of the gas, including compressibility, thermal effects and dissolution.