

SIMPLIFIED APPROACH TO MODELLING SONIC GAS DISPERSION FOR OFFSHORE WELL TEST OPERATIONS

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ABSTRACT

During offshore well test operations, it is necessary to have the capability to release gas to the atmosphere using onboard vent lines, usually directed towards the water surface. In order to ensure safety of personnel and to avoid a hazardous scenario caused by the vented gas impinging on sources of ignition on the vessel, it is now a prerequisite to perform gas dispersion analysis prior to commencing any well test operation. Computational Fluid Dynamics (CFD) is a tool increasingly used to model the complex interactions and flow of the released gases into the prevailing atmospheric conditions. Results of this analysis are critical in assessing the levels of hazardous gas concentrations around the oil rig platform and ensuring the safe execution of the well test phase.

Modelling the gas dispersion from an oil rig platform is challenging as it involves multiple physical phenomena, including multispecies diffusion, turbulent flow and heat transfer. The highly non-linear nature of the flow, and high velocity gradients due to the sonic hydrocarbon jet dispersing in the comparatively low velocity atmospheric flow, require a high quality mesh that can accommodate different length scales. Generating a mesh with suitable resolution and quality to accurately model the gas dispersion process requires huge computational resources. To reduce the complexity and computational requirements for modelling gas dispersion, the analysis was simplified by using an analytical approach to approximate the sonic flow of the hydrocarbon jet. A highly resolved CFD model was constructed containing a single hydrocarbon jet, and analysis results for sonic flow were used to validate the simplified approach. A full multiphysics CFD model of an oil rig platform was built in ANSYS Fluent using the simplified approach for the sonic flow. Results are presented showing the flammable gas concentrations around the critical locations of the oil rig platform for various wind speeds and gas flow rates.

KEYWORDS

Multiphysics, offshore, oil and gas, gas dispersion, multispecies diffusion, CFD, hydrocarbon jet, sonic flow, hazardous gases, turbulent flow, heat transfer.