

Assessment of the Capabilities of FireFoam for the Simulations of a Large Scale Fire in Confined Compartments

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In the recent years, the use of the Computational Fluid Dynamic (CFD) fire models have been increased in fire performance based engineering. This work is part of an ongoing research study to assess the capabilities of CFD fire model in modeling the fire problem in high consequence industry facility. The objectives of the present study are to perform Large Eddy Simulations (LES) of a large scale fire propagating inside confined and ventilated compartments, and assess the capabilities of the present LES tool applied to a well specified fire scenario. FireFoam is the selected LES code including the Eddy Dissipation Concept (EDC) model for combustion, discrete ordinate method for radiation, and one k equation model for the sub-grid scale closure. The fire scenario corresponds to the PRISME (Propagation dun Incendie pour des Scnarios Multi-locaux Elmentaires) Integral Test 4, which is a multi-room configuration with a single pool fire burning tetra-propylene and fully open doors. PRISME Integral Test 4 was conducted within the Diva Facility that was constructed to be similar to compartments found in the nuclear industry. The experimental conditions are reproduced as closely as possible in the simulations. The numerical predictions focus on transient and time-averaged temperature, carbon dioxide (CO₂) concentrations, and pressure in the different rooms. A detailed comparison is made with the experimental data where good agreement between the LES results and experimental values is achieved for temperatures, doorway velocity, and CO₂ concentration. However, the pressure fluctuations are not well captured by FireFOAM and methods to improve these predictions are currently being investigated. Overall, FireFoam is shown to have good predictive capabilities for the present confined large scale fire scenario.