# Comparative study of the flow within water mist and sprinkler fire protection systems by means of CFD

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## Abstract

In the present study, the transient air and water flow within a low-pressure water mist system and a sprinkler fire protection systems was investigated. In this prospect, Computational Fluid Dynamics (CFD) simulations within the OpenFOAM package were carried out to flow in the pipework consequently to the activation of one nozzle or sprinkler head. First, the ability of the CFD model to accurately predict the dynamic behavior of the flow was verified by comparing the simulation results to measurements on a reduced scale wet-pipe and dry-pipe sprinkler system. The numerical results were confronted to experimental data with good agreement, and the performance of several RANS turbulence models (standard k-ε; realizable k-ε, RNG k-ε) was evaluated. Then, simulations were performed on scale 1 commonly used fire protection system ("Gridded" design). A centrifugal pump model was considered for the sprinkler system while a positive displacement pump was used for the water mist system. The results were then compared between the water mist and the sprinkler systems, for wet-pipe, dry-pipe and preaction technologies. In particular, the time constant of the systems, *ie.* the time necessary to reach steady-state water flow at the nozzle or sprinkler head required to control a specific fire hazard was evaluated, allowing to highlight the pros and cons of both technologies. Regarding the results for the wet-pipe systems, the lower amount of water required for the water mist system resulted in a faster time constant compared to the wet-pipe sprinkler system. In the case of the dry-pipe systems, it was reported that electronic accelerators in particular allow to improve the performance of dry-pipe sprinkler systems and to reach similar time constants as for the water mist system. Overall, good predictions were obtained from the simulations which indicates CFD as a proper tool for the prediction of flow within water mist and sprinkler systems.

**KEYWORDS:** water mist systems, sprinkler systems, comparison, modelling.

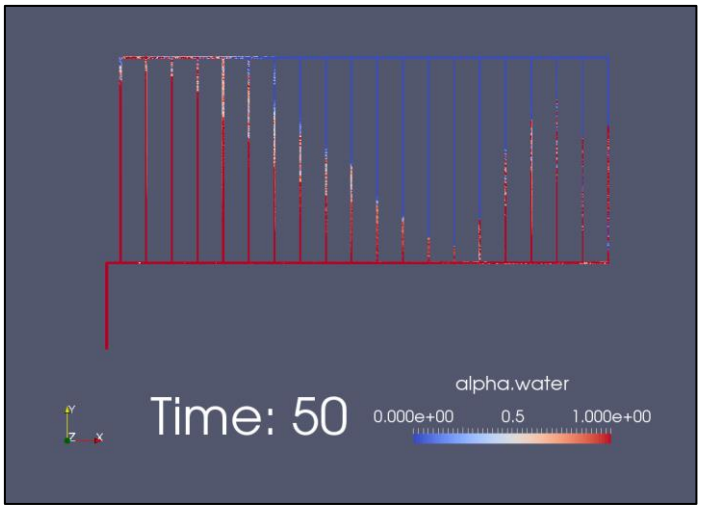


Figure: Example of the obtained results - water fraction in a dry-pipe sprinkler system (system volume : 3.6m$^3$) at t=50s after sprinkler activation for a K115 l/min/bar$^{1/2}$ sprinklerhead.