# Experimental and numerical studies to assess the benefits of water mist system in Mont-Blanc tunnel

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**Bio[1]:** Dr Sylvain Desanghere is a generalist engineer who holds a PhD in fire safety engineering. His technical expertise covers the physics of fire, numerical modeling and fire experimentation. He has been working for 15 years on fire safety in several companies, including research centers and engineering offices. He is currently head of Ventilation and Fire team at Lombardi France, and he is involved in fire safety engineering studies and smoke management systems design.

## Abstract

[*Background*] The use of water mist system in the Mont-Blanc tunnel is studied for almost ten years. It started with a bibliographic review of existing fixed fire fighting systems (FFS) and corresponding experimental results. It was then decided to assess the performance of several types of FFS for the Mont-Blanc tunnel by conducting new experiments at scale 0.8 in the TST tunnel tests facility. The next step of this global study was to use these experimental results to specifically assess the benefits of water mist system in the Mont-Blanc tunnel, considering interaction with existing safety equipment. [*Objectives*] In 2012, an experimental campaign has been performed, using 2 types of fire load and 3 FFS technologies. The results of 14 real fire tests shown that the high-pressure water mist system produced the best results. The present work consisted first in fitting numerical parameters of the Fire Dynamics Simulator (CFD code developed by NIST, USA) to be able to reproduce experimental trends. Second, the numerical model was used intensively to simulate fire scenarios in the Mont-Blanc tunnel, with the purpose of studying the interaction between water mist activation and existing safety procedures, including smoke management system and rescue operation. A key issue here is the time when the water mist system is activated. [*Methods*] The first part of the present work is devoted to performing numerical simulations of fire tests conducted in 2012. Once the numerical model gives acceptable accuracy, it is used to model the Mont-Blanc tunnel with its smoke management system, considering different fire sizes and natural airflow, traffic, etc. Over 35 realistic fire scenarios have been simulated to study advantages and drawbacks of water mist activation. [*Results*] A first investigation was needed to evaluate the heat release rate during water mist activation, for different fire sizes and development stages. Then, the results analysis focused on precise aspects: toxicity, visibility distance and temperature near the fire and far from the fire at people height, conditions for rescue operation, heat fluxes to structure. Numerical results show that a delayed activation seems to give better results in the case of Mont-Blanc tunnel because this tunnel has an effective smoke management system. So, in this context, the water mist system should not be used just after fire detection, but rather on rescue team demand. Calculations also demonstrate the good ability of water mist to strongly reduce the heat impact on the tunnel. [*Conclusion*] This final study gives a comprehensive and reliable insight of the benefits from water mist system in the context of a real tunnel, equipped with best-in-class smoke management system. It is the result of many years of research, based on the analysis of a large amount of experimental data used to adapt CFD numerical parameters, followed by intensive numerical simulations of many fire scenarios (roughly 3000 hours of calculation). The conclusion of this assessment clearly highlights the potential benefits from water mist system in the Mont-Blanc tunnel.

**KEYWORDS** : water mist system, experimental data, CFD recalibration, numerical simulation, Mont-Blanc tunnel