Peter Vidmar, Stojan Petelin

METHODOLOGY OF USING CFD-BASED RISK ASSESSMENT IN ROAD TUNNELS

ABSTRACT

The definition of the deterministic approach in the safety analyses comes from the need to understand the conditions that come out during the fire accident in a road tunnel. The key factor of the tunnel operations during the fire is the ventilation, which during the initial fazes of the fire, impact strongly on the evacuation of people and latter on the access of the intervention units in the tunnel. The paper presents the use of the computational fluid dynamics model in the tunnel safety assessment process. The model is validated by comparing data with experimental and quantifying the differences. The set-up of the initial and boundary conditions and the requirement for grid density found during the validation tests is used to prepare three kind of fire scenarios 20 MW, 50 MW, and 100 MW, with different ventilation conditions; natural, semi transverse, full transverse, and longitudinal ventilation. The observed variables, soot density and temperature, are presented in minutes time steps trough the entire tunnel length. Comparing the obtained data in a table, allows the analyses of the ventilation conditions for different heat releases from fires. The second step is to add additional criteria of human behaviour inside the tunnel (evacuation) and human resistance to the elevated gas concentrations and temperature. What comes out is a fully deterministic risk matrix that is based on the calculated data where the risk is ranged on five levels, from the lowest to a very danger level. The deterministic risk matrix represents the alternative to a probabilistic safety assessment methodology, where the fire risk is represented in detail as well as the computational fluid dynamics model results are physically correct.

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