QRA methodology of hydrogen tank rupture in a fire in a tunnel

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ABSTRACT

This paper aims to develop a quantitative risk assessment (QRA) methodology for a fire incident with fuel cell vehicles in a tunnel. The methodology is applied to a road tunnel. The consequence analysis of 70 MPa, 62.4 litre hydrogen tank rupture in a fire is considered for two states of charge, i.e. 99% and 59%. The risks in terms of fatalities per vehicle per year and a cost per accident are assessed. To reduce the risk to the acceptable level of 10-5 fatality/vehicle/year, the fire-resistance rating (FRR) of the onboard storage tank should be above 58 min in the tunnel. The increase of FRR to 91 min reduces both risks to acceptable levels in terms of fatality/vehicle/year and £/accident, i.e. £300 per accident. It is suggested for inherently safer use of hydrogen-powered vehicles in tunnels to increase the FRR accordingly or to use explosion free in fire self-venting thermally activated pressure relief device (TPRD)-less tanks.