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Flammable vapour cloud generation from overfilling tanks: learning the lessons from Buncefield

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The Buncefield Incident in 2005 led to a significant change in our understanding of how flammable vapour clouds could be generated from overfilling bulk storage tanks with volatile liquids. Prior to that incident, it was widely thought that an overfilling tank would produce a pool of liquid in the bunded area around a tank that would evaporate relatively slowly. However, in the Buncefield Incident, the release of liquid through vents in the tank roof led to waterfall-like cascade of fine gasoline droplets that produced flammable vapour at a much faster rate. It took only around 25 minutes for the dense current of flammable vapour to fill an area roughly 500m by 400m to a depth of between 2m and 4m. The wind speed was very low during the incident and the way in which the vapour cloud dispersed was strongly affected by the slope of the ground and presence of obstacles. The resulting explosion was severe, even across open unobstructed areas. Fortunately there were no fatalities, but the total damage from the incident was estimated to have cost around $1.5 billion. Since the Buncefield Incident took place, two further incidents with striking similarities have taken place at fuel depots in Puerto Rico and Jaipur.

This paper presents the findings of the Buncefield Incident investigation team and further research that has been carried out on tank overfilling releases over the last seven years at the Health and Safety Laboratory (HSL). The work has involved a combination of unique spill experiments and Computational Fluid Dynamics (CFD) modelling, and has resulted in a simple methodology for predicting the rate of flammable vapour production from overfilling tanks. This paper takes the opportunity to present for the first time a unified narrative, starting with the key findings of the incident investigation and culminating with the description of a workbook method for predicting which substances and storage tanks could create significant vapour clouds.