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Discussion

Discussion on 'BLEVE prevention using vent devices' by Shebeko, Shevchuck and Smolin [1]

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In the section on modelling the Alma-Ata incident, the assumed area of the pressure relief valve is taken as 66 mm^2. This seems very small for a vessel of the stated size. In the same section, the heat input into the vessel is assumed to be 65 kW m^{-2}. This would seem more appropriate for a vessel engulfed by a kerosene pool fire than a LPG jet fire.

The authors' third conclusion implies that 100 pressure relief valves of the size actually fitted would be needed 'to prevent or significantly reduce the consequences'. This strikes me as rather impractical, particularly for a vessel used in transport. Given my query about the size of the pressure relief valve fitted, this may reduce to about 10 valves of a more normal size.

One of my current interests is the modelling of pressure liquefied flammable gas vessels when subject to an impinging jet fire. I have carried out a large number of modelling runs with horizontal propane vessels of 2, 12, 30, 60 and 100-tonne nominal capacity, of designs that might be encountered at fixed installations. This has involved discussions with mechanical engineering specialists about the design philosophy for pressure systems. My work leads me to some general views relevant to the topic of this paper in the context of pressure liquefied flammable gas systems.

The pressure relief valve setting usually adopted is determined by the cold strength of the vessel, and not the demands placed upon it by its contents. As many vessels have design pressures that significantly exceed that required for the substance they contain, the beneficial effects of early venting during jet fire impingement are not realised, if pressure relief valve settings are not reduced to the minimum value consistent with the properties of its contents and location of the installation.

In many examples of assessments that I have modelled, the tank fails before the pressure relief valve has started venting. This is because the strength of the vessel shell, in the vapour space, has dropped below the pressure at which the pressure relief valve

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operates before the internal pressure has risen sufficiently to cause it to vent. In such cases the pressure relief valve has no benefit. This seems most likely to be the case for the larger capacity tanks.

Where modelling indicates that the pressure relief valve does open, there is usually a noticeable reduction in the temperature of the vessel shell in the vapour space, due to the lower temperature of the gas boil off which displaces the initial heated gas. Even where the pressure relief valve setting is reduced to the minimum value consistent with the properties of the vessel's contents, there must be sufficient margin between it and the vessel's cold strength to ensure that the margin is not eliminated once the tank is weakened by the jet fire.

At fixed installations, there is the possibility of providing water spray systems, insulation, or automatic depressurisation systems to control the temperature of the vessel shell in the first two cases, and the internal pressure in the third. Of these, insulation is probably the only practical measure for vessels used in transport.

This is an issue that is not well covered in the operational standards published by the LPG industry in the UK and would merit further attention.