

## Discussion

# Reply to the comments of M.H. Goose on the paper 'BLEVE prevention using vent devices'

Yu N. Shebeko \*

*Russian Scientific Research Institute for Fire Protection, Balashikha-3, Moscow Region, 143900, Russia*

Many thanks to Mr. M.H. Goose for his attention to the paper and very useful comments on it. The subject matter concerning BLEVE prevention in LPG storage and transportation vessels is very important because large BLEVE accidents have taken place during past years.

In modeling the Alma-Ata incident, the pressure relief valve of 77 mm<sup>2</sup> has been considered because this vent area is now used on LPG railway tanks. I agree with Mr. Goose that this vent area is very small for a vessel of the stated size, and this is one of the main ideas of the paper.

The heat input into the vessel was assumed to be equal to 65 kw/m<sup>2</sup>, and it is really typical for total engulfment of a vessel by a flame. In the case of the Alma-Ata incident, the jet flame was large enough for almost total engulfment of the railway tank.

The conclusion of the paper implies that the relief valve area must be 100 times larger than used in practice for the considered railway tank. This area can be reached by various ways, for example, by increasing the vent area of one or more valves. This total vent area is not so large (7700 mm<sup>2</sup> or 77 cm<sup>2</sup>) and can be achieved by a single valve.

I agree with Mr. M.H. Goose, that for large tanks their walls can be destroyed in the vapour space, if jet flame contacts these walls. This scenario is more suitable for large stationary vessels, when the liquid phase fraction in the vessel is low enough. But for relatively small transport tanks with high liquid level, the scenario considered in our paper is more typical. And for this scenario the appropriate relief valve can prevent BLEVE. The method proposed in the paper is just one possible, and for some kinds of tanks for LPG storage or transportation, other methods can be used. For example, we are currently investigating the influence of fire retardant coatings for protecting LPG vessels and their behaviour in fires. The results of this work will be published in the future. But

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\* Fax: +7 95 521 9157.

an application of thermal insulation is not, in my opinion, the only practical measure for vessels used in transport, but this is, without doubt, a very important method.

As in the UK, in Russia, the application of thermal insulation is also not well covered in the operational standards, and further work, both scientific and practical, is needed.