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Inland Transport Committee

Working Party on the Transport of Dangerous Goods

Joint Meeting of the RID Committee of Experts and the Working Party on the Transport of Dangerous Goods
Geneva, 15 - 19 September 2014
Item 6 of the provisional agenda
Reports of informal working groups

Report of the informal working group on the reduction of the risk of a BLEVE

Transmitted by the Government of the Netherlands on behalf of the working group[1, 2]

1. The working group held its eleventh session, hosted by the International Union of Railways, on 23 to 25 April 2014 in Paris, France under the chairmanship of Mr. Claude Pfauvadel (France). The meeting was attended by representatives of France, Germany, Netherlands, Norway, Poland and the following non-governmental organizations: European Liquefied Petroleum Gas Association (AEGPL), the European Chemical Industry Council (CEFIC), the European Industrial Gas Association (EIGA) and the International Union of Railways (UIC).

2. Joint Meeting documents related to previous work were as follows:

- Documents from the spring 2006 session of the Joint Meeting: report ECE/TRANS/WP.15/AC.1/102 (OCTI/RID/GT-III/2006-A), para. 5-12, 20 and 21; report of the Working Group on tanks, ECE/TRANS/WP.15/AC.1/102/Add. 1 (OCTI/RID/GT-III/2006-A/Add.1), item 4; ECE/TRANS/WP.15/AC.1/2006/8 (OCTI/RID/GT-III/2006/8) (Netherlands); informal documents INF.3 (Netherlands) and INF.26 (AEGPL);

[1] In accordance with the programme of work of the Inland Transport Committee for 2014–2015 (ECE/TRANS/240, para. 100, ECE/TRANS/2014/23, cluster 9, para.9.2).

[2] Circulated by the Intergovernmental Organisation for International Carriage by Rail (OTIF) under the symbol OTIF/RID/RC/2014/53.

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- Documents from the spring 2007 session of the Joint Meeting: ECE/TRANS/WP.15/AC.1/2007/11 (Report of the first informal working group on the reduction of the risk of a BLEVE, meeting in The Hague, 8-10 November 2006); informal document INF.22 (AEGPL); report ECE/TRANS/WP.15/AC.1/106 (OTIF/RID/CE/2007-A), para. 62;
- Documents from the autumn 2007 session of the Joint Meeting: informal document INF.9 (Report of the second informal working group on reduction of the risk of a BLEVE, meeting in Tønsberg, 20-22 June 2007); report ECE/TRANS/WP.15/AC.1/108 (OTIF/RID/CE/2007-B), para. 105;
- Document from the spring 2008 session of the Joint Meeting: informal document INF.5 (Report of the third informal working group on reduction of the risk of a BLEVE, meeting in Rome, 27-28 November 2007);
- Documents from the autumn 2008 session of the Joint Meeting: informal document INF.6 (Report of the fourth informal working group on reduction of the risk of a BLEVE, meeting in The Hague, 16-18 June 2008); report ECE/TRANS/WP.15/AC.1/112 (OTIF/RID/RC/2008-B), para. 41;
- Documents from the spring 2009 session of the Joint Meeting: informal document INF.25 (Report of the fifth informal working group on reduction of the risk of a BLEVE, meeting in Paris, 4-6 February 2009); report ECE/TRANS/WP.15/AC.1/114 (OTIF/RID/RC/2009-A), para. 62; ECE/TRANS/WP.15/AC.1/2010/9 (OTIF/RID/RC/2010/9) (Report of the sixth informal working group on reduction of the risk of a BLEVE, meeting in Paris, 21-23 October 2009);
- Documents from the autumn 2010 session of the Joint Meeting: ECE/TRANS/WP.15/AC.1/2010/47 (OTIF/RID/RC/2010/47) (Report of the seventh informal working group on reduction of the risk of a BLEVE, meeting in Berlin, 19-21 April 2010); report ECE/TRANS/WP.15/AC.1/120 (OTIF/RID/RC/2010-B), para. 60-61;
- Documents from the spring 2011 session of the Joint Meeting: informal document INF.3/Rev.1 (Report of the eight informal working group on the reduction of the risk of BLEVE, meeting in Paris, 20-22 December 2010); report ECE/TRANS/WP.15/AC.1/122 (OTIF/RID/RC/2011-A), para. 57-58;
- Documents from the autumn 2011 session of the Joint Meeting: informal document INF. 14 (Report of the ninth informal working group on the reduction of the risk of BLEVE, meeting in Oslo, 8-10 June 2011); report ECE/TRANS/WP.15/AC.1/124 (OTIF/RID/RC/2011-B), para.107-110;
- Documents from the spring 2013 session of the Joint Meeting: informal document INF. 25 (Germany and France) (Announcement and scope of next meeting of the working group); report ECE/TRANS/WP.15/AC.1/130 (OTIF/RID/RC/2013-A), para.64;
- Documents from the autumn 2013 session of the Joint Meeting: ECE/TRANS/WP.15/AC.1/2013/61 (OTIF/RID/RC/2013/61) (Report of the tenth informal working group on reduction of the risk of a BLEVE, meeting in Berlin, 15-17 April 2013); informal document INF. 7; report ECE/TRANS/WP.15/AC.1/132 (OTIF/RID/RC/2013-B), para. 105-111.

3. The key elements of the mandate given by the RID/ADR/ADN Joint Meeting are:

   (a) Prevention of a BLEVE;

(b) Reduction of the effect of a BLEVE;

(c) Hot BLEVE and cold BLEVE should be considered;

(d) Technical and other measures should be taken into account;

(e) Other matters of principle.

Discussion on TNO report

4. The main issue of the agenda was a discussion on the TNO report “Heat resistant coatings and pressure relief devices on transport tanks for liquefied gases; Investigation of uncertainties”. The report is reproduced as informal document INF.8, in English only. See annex for the discussion on this report.

5. The working group concluded on the basis of scientific knowledge that a thermal coating is an effective measure to protect a tank with liquefied gases in the event of a fire. The tensile strength and yield strength of steel strongly decreases at temperatures above 300 °C. A tank with liquefied gases and an effective thermal insulation in the event of a fire stays intact for at least one hour provided the coating has the appropriate level of insulation. A thermal unprotected tank with liquefied gases in an engulfing fire is a risk that cannot be managed.

6. A Pressure Release Valve (PRV) as regulated in ADR/RID is designed to release high pressure in the tank and is in itself not able to prevent overheating of the steel of the tank in an engulfing fire. The reduction in strength resulting from overheating of the steel of the tank in a fire leads to the rupture of the tank, which in that case also causes a BLEVE. Although the delay may be a little bit longer as without valve most of the evidence show that this delay is not long enough. After a discussion on this topic those who felt that with certain types of valves this goal could however be reached were invited to provide clear evidences and specifications related to the valves design. This is a technical conclusion relevant for the existing paragraphs 4.2.5.3, provision TP6, and 6.7.3.8.1 in ADR/RID.

Presentation of AEGPL/DNV on risk management

7. The representative of DNV presents the principles of a risk management model that is generally used for cost effective risk management (for instance on workers safety and environmental safety) (see informal document INF.9). The DNV representative clearly identified the importance of prevention and control measures, in addition to mitigation measures. The conclusion of this presentation was that risk based approaches help to provide guidance on the size of the risk and lead to a prioritisation of options/measures to control it.

8. The representative of AEGPL suggests to continue the work on a risk management model for transport and the work on a European transport accident database, and proposes to update the risk analysis of road transport, by using more detailed information collected from BLEVE accidents over the last 50 years in Europe (not only from the accidents themselves but also including numbers of deliveries, kms run, tons transported, etc.) in order to assess if the concerned risks are acceptable or not.

9. A discussion followed after the presentation. It was recalled that the working group followed this way earlier on. However a risk management model uses calculations on the basis of statistical information, but this model does not answer the question whether a measure in itself is effective or not as a barrier for the possibility of a BLEVE. The working group now focuses on the effectiveness of a thermal coating or a PRV to prevent a BLEVE. The effectiveness of a technical measure has to be clear before measures are ranked with the help of a risk management model. A technical measure that can effectively prevent a

BLEVE can prevent societal costs that are not considered in a standard risk management model.

How to proceed

10. It was noted that much time was spent on this subject and many efforts were made. Most of the competent authorities represented in the working group felt that there are enough data to support a requirement for thermal coating. This requirement would concern liquefied gases but could also be relevant for other goods where protection against fire would improve safety.

11. Based on this support from competent authorities representatives the working group invites the Joint Meeting to decide in principle on a requirement in ADR/RID for thermal protection of rail/road transport tanks with the objective of being able to resist in a complete fire engulfment for at least 60 minutes.

12. Based on that principle decision the working group would be able to continue its work on technical specifications for thermal coating (and PRV when associated with it) as well as operational issues related to it. This would at least cover the following points:

- Certification of coating materials
- Mechanical strength resistance to choc and accident
- Ageing
- Corrosion
- Inspection (including possibility of removing thermal coating)
- Changes to the fire fighting strategy (advices from fire brigades)
- List of entries to which the requirement should apply.

Annex

Discussion on the report by TNO

The chairman opens the meeting with a short resume of the findings of the working group so far, the discussion in the Joint Meeting in September 2013 after the presentation of the results of the French and German testing programme and the aim of this meeting to discuss the report by the Netherlands to answer remaining scientific questions on the use of thermal protection and PRVs to withstand a BLEVE of transport tanks with liquefied gases in a fire.

Action after the previous meeting of the working group

Germany has sent the testing report of the Federal Institute for Materials Research and Testing (BAM) to the members of the working group. The report "BLEVE (Boiling Liquid Expanding Vapour Explosion) in dangerous goods tanks – investigations into the performance of tank constructions and equipment, particularly thermal and fire protection insulation in the event of a fire" shows the results of tests based on 2.75 m^3 storage tanks equipped with brass PRV's, under 75 kW/m^3 pool type fire conditions.

Presentation by TNO on the investigation of coating and PRV uncertainties with respect to transport tanks

The representative of the Netherlands/TNO presents the results of the investigation (see annex 2 (Informal document INF.8) to the report). With respect to transport tanks the investigation confirms the conclusions of the BAM report that was discussed in the previous meeting in Berlin in April 2013 and in the Joint Meeting of September 2013. One conclusion is that a PRV alone is not effective to prevent a BLEVE when a tank is fully engulfed in a fire. Another conclusion is that under these conditions an effective coating can delay a BLEVE for at least one hour. Furthermore the conclusion about a combination of a coating and a PRV is that this combination can delay a BLEVE for an even longer time.

The time to delay a BLEVE is important to gain time to take actions by the fire brigade to extinguish the fire or to evacuate people in the environment.

Results of the investigation and discussion

Are test conditions representative for a real road/rail tanker fire?

Conclusion: a representative engulfing heat load is 75 – 100 kW/m^2. The conditions of the BAM testing programme are representative for an engulfing fire.

Conclusion: a full or partly engulfing fire in a transport accident is possible on rail and on road. It is also a relevant risk for loading and unloading situations covered by ADR/RID. The scenario of full engulfment of a tank vehicle in a fire seems more likely in a situation of parking, loading and unloading than during transport.

Discussion: engulfing fires in parking situations and on sites not covered by ADR/RID can also leads to a BLEVE of a tank vehicle or rail wagon. Thermal protection on tank vehicles and rail wagons can also reduce the risks of tank filling stations, marshalling yards and on sites of the producing chemical industry.

What is the effect of a PRV?

Conclusion: one or two PRVs can delay the time to BLEVE, but not enough to prevent a BLEVE. The scientific explanation is that it takes more time to empty a tank vehicle or a tank wagon with PRV's than the time available before the tank ruptures as a result of the weakening of the steel.

Discussion: some representatives still have doubt about this scientific conclusion of the BAM and TNO. Anyone who cannot agree with this conclusion is invited to deliver scientific information why this conclusion is not correct. TNO has not yet received this kind of remarks.

What is the effect of a transport accident (overturning or collision) on coating performance?

Conclusion: there are very strong coatings with a high elasticity, that are not easily damaged.

Discussion: the French scientific organisation INERIS confirms that there are coatings that preserve their thermal protective function when damaged on small spots or by scratches.

Future work: define a test for the performing features of a thermal coating in transport conditions.

How does the coating affect the life time performance of a tank?

Conclusion: a well defined thermal coating has no negative effect on the life time performance of a tank.

Discussion: some representatives are not convinced of the beneficial properties of the tested coatings for transport conditions. The required properties of a good thermal coating under transport conditions (anti-corrosion and durability) can be defined by the working group. Tests can be defined by the working group to assure that the thermal coating indeed possesses the required properties for transport conditions.

Future work: define tests for a good thermal coating under transport conditions and possibly add regulations for inspections of a coated tank.

What is the effect of the additional weight of the coating?

Conclusion: the calculated effect is 2% loss of payload for a tank wagon and 3% loss op payload for a tank vehicle. No other negative effects.

Discussion: loss of payload will lead to more transport of dangerous goods and higher costs for the industry. The aim of ADR/RID is to secure the transport of dangerous goods against specific dangers in transport conditions. Higher costs of the transport of dangerous goods can lead to a higher transport tariff for the transporters and to a higher price of the product.

Which tests should be performed on heat resistant coatings before implementation?

Conclusion: tests prove 60-90 minutes delay of the failure of a small coated tank in an engulfing fire. On the basis of technical knowledge the results of small scale tests are conservative, because it takes more time to reach the same temperature for a real size transport tank than for a small tank.

Discussion: some representatives suggest that this effect may also have a positive influence on the results of one or two PRVs on a real size transport tank. The TNO investigation however shows that the positive effect of one or two PRVs on a real size transport tank is overruled by the negative effect of the weakening of the steel of the tank in an engulfing fire.

Future work: to confirm the calculation model that translates bonfire test results on smalls scale tanks to real size transport tanks one full scale test is needed.

Accident videos

Some videos of transport accidents with dangerous goods in fire conditions are shown and did not result in a BLEVE. Neither these videos nor the rare occurrence of a BLEVE in transport accidents prove there is no risk for a BLEVE. The TNO investigation shows that an engulfing fire is a realistic scenario in transport conditions (including loading and unloading situations).

In another shown video of an accident with a truck loaded with cylinders with gas in a fire several explosions could be seen.

Conclusion: a BLEVE in an engulfing fire in transport situations cannot be excluded.