

## **Economic Commission for Europe**

### **Inland Transport Committee**

#### **Working Party on the Transport of Dangerous Goods**

**16 August 2011**

#### **Joint Meeting of the RID Committee of Experts and the Working Party on the Transport of Dangerous Goods**

Geneva, 13-23 September 2011

Item 7 of the provisional agenda

#### **Reports of informal working groups**

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

#### **Transmitted by the Government of the Netherlands on behalf of the working group**

#### **Introduction**

1. The working group held a ninth session on 8 to 10 June 2011 in Oslo, Norway under the chairmanship of Mr. Claude Pfauvadel (France). The meeting was attended by representatives of Belgium, France, Germany, the Netherlands, Norway, Poland, and the following non-governmental organisations: European Liquefied Petroleum Gas Association (AEGPL), the European Railway Agency (ERA), the International Union of Private Wagons (UIP) and the International Union of Railways (UIC).

2. The documents on the agenda were as follows:

- Report Joint Meeting March 2006, ECE/TRANS/WP.15/AC.1/102 (OCTI/RID/GT-III/2006-A), para. 5-12, 20 and 21;
- Report Joint Meeting working group on tanks, ECE/TRANS/WP.15/AC.1/102/Add. 1 (OCTI/RID/GT-III/2006-A/Add.1), item 4;
- Doc. ECE/TRANS/WP.15/AC.1/2006/8 (OCTI/RID/GT-III/2006/8) (NL);
- Doc. March 06/ INF. 3 (NL);
- Doc. March 06/ INF. 26 (AEGPL);
- Doc. 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);
- Doc. March 07/INF.22 (AEGPL);
- Report Joint Meeting March 2007, ECE/TRANS/WP.15/AC.1/106 (OTIF/RID/CE/2007-A), para. 62 ;
- Doc. September 07/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 Joint Meeting September 2007, ECE/TRANS/WP.15/AC.1/108 (OTIF/RID/CE/2007-B), para. 105 ;
- Doc. March 08/INF.5 – Report of the third informal working group on reduction of the risk of a BLEVE (meeting in Rome, 27-28 November 2007) ;

- Doc. September 08/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 Joint Meeting September 2008, ECE/TRANS/WP.15/AC.1/112 (OTIF/RID/RC/2008-B), para. 41 ;
- Doc. March 09/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 Joint Meeting March 2009, ECE/TRANS/WP.15/AC.1/114 (OTIF/RID/RC/2009-A), para. 62 ;
- Doc. 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) ;
- Doc. 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 Joint Meeting September 2010, ECE/TRANS/WP.15/AC.1/120 (OTIF/RID/RC/2010-B), para. 60-61;
- Doc March 11/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 Joint Meeting March 2011, ECE/TRANS/WP.15/AC.1/122 (OTIF/RID/RC/2011-A), para. 57-58.

Furthermore several working documents and presentations submitted by participants were scheduled.

3. The meeting was welcomed by Mr. Claude Pfauvadel, chairman of the working group session. The chairman referred to the key elements of the mandate given by the RID/ADR/ADN Joint Meeting:

- (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.

4. The meeting discussed on the conclusions of data of accidents and on a testing program of the Federal Institute for Materials Research and Testing (BAM) in Germany. It was concluded in working group session that the testing program should include the following items:

- (1) Definition of the conditions of a representative pool fire;
- (2) Description of the criteria for the selection of the coatings to be tested;
- (3) Description of the criteria for the selection of the safety valves to be selected, including evaluation of negative effects of safety valves (e.g. heat radiation);
- (4) Evaluation of the tests already performed by BAM, TNO and of tests described in literature, which results in a list of questions not answered;
- (5) List of tests to be performed based on the not answered questions (result of item (4)), including test priority.

5. France, Germany and the Netherlands intend to participate in the testing program by BAM. After the results of the testing program are available a new working group meeting will be arranged.

## **Annex to the report of the working group meeting in Oslo, June 2011**

Several documents are presented to the working group for this meeting:

- Documents by UIC on data and a complementary analysis on accidents of all events with the transport of Class 2 in tank-wagons or tank-containers;
- Presentation by the Netherlands on analysis of rail and road accidents;
- Presentation by AEGPL on how to proceed;
- Presentation by ERA concerning the EU railways databases on accident statistics and on accident investigations;
- Report by BAM on the testing results of dangerous goods tanks in a fire and the result of a discussion on a further testing program.

### **Presentation on data and complementary analysis rail accidents by UIC and discussion**

The representative of UIC presents an analysis on reported rail accidents in France over the period 2000-2010 of all events with the transport of Class 2 in tank-wagons or tank-containers. This analysis is complementary to the analysis by UIC in the previous meeting in Paris. The data from Germany and Spain were not specific enough for this analysis. The analysis took a lot of time.

The representative of the UIC underlines that the columns "Events TDG" of the table do not exactly match with the criteria used for the Common Safety Indicators of the Railway Safety Directive (Directive 2004/ 49/EC) and with the regulation on the common safety method. It will be adapted later, in particular to take also into account orientations taken by the RID/ADR/ADN Joint Meeting concerning the collection of information relating to DG incidents and accidents.

This adaptation (common indicators/criteria) would facilitate the common definition of possible measures of prevention or protection which might also have an impact on the railway operations. Finally, this coherence will be indispensable to perform cost-benefit analyses which are required for the development of (new) EU railway safety measures.

The complementary analysis concentrates on flammable gasses. Over the period 2000-2010 there were 1023 events in the database concerning Class 2. Approximately 600 events concern cooled gas, 250 flammable gases and 150 other gases. Approximately 10% of the events of the Class 2 were identified as false alarms. Within the category flammable gases 154 events concerned the transport of LPG of UN number 1965. 80% of the events concerned loaded tank wagons and 20% were empty. UIC notes that the events concerning gases have a very large impact on the railway production and traffic because even in the case of false alarms, emergency procedures are applied. In particular, any abnormality is notified and immediate safety/security measures are implemented, including stopping the traffic. To date, around 10 % of the alerts are "false alarms" where rescue services have intervened. This situation has a big impact on the railway operation performance.

The UIC presented a summary of the analysis of the data. The complete table with data has been sent to the participants and can be used for further analysis of rail accidents.

The representative of France asks for the relation between the events and the amount of transport.

The representative of UIC answers that over the concerned period approximately 720 000 loaded TDG units (tank-wagons and tank-container circulated in France. The corresponding traffic amounts to 250 000 000 tank kilometres. Taken into account also the traffic of the

not degassed or not cleaned units, the traffic rises to approximately 400 000 000 tank kilometres. The traffic concerning flammable gases represents approximately 60% of the total traffic of the Class 2, while the events involving flammable gases represent only approximately 25 % of the events of the Class 2.

The representative of the Netherlands asks how many releases of gas are reported.

The representative of the UIC answers that a lot of events reported an abnormality of the load, but this concerned mostly bad closure of valves. There were 47 derailments and collisions, and 4 wagons overturned. In case there was a leakage after derailment or collision, the diameter of breach was less than 5 mm. In fact, most of the time these accidents resulted in problems of leakproofness without breach.

The representative of the UIP adds that the most events linked to a leakage concern a bad smell or condensation and result in a safety alert. They do not concern real leakage of the content of the tank.

The representative of France says we look at all incidents to say something about causes and try to rank measures on the basis of accidents that happen.

The representative of AEGPL complements UIC on the analysis but likes to see similar data of other countries.

The representative of France answers that not every country has a database with events and that it was very difficult to introduce the 1.8.5 reports in the regulations. Only few incidents are 1.8.5 incidents. Minor events or human failure happen often, but there is not much information about such incidents. Accidents with dangerous goods cause fear with the public. In Viareggio 33 people died and there is more discussion about the prohibition of the transport of dangerous goods. The cause of accidents is in 15% of the cases a technical failure, in 40% a human failure of the crew and in 45% human failure of other persons. That means that ADR measures cannot solve all causes of accidents linked to human failure. RID measures can be more effective in that respect. The problem for this working group is the lack of sufficient data for statistical analysis and on the human factor. France suggests to collect more data in a simple Excel format on an anonymous basis and available for everyone.

The representatives of Poland and ERA say that in EU significant and serious accidents are mandatory to report.

The representative of AEGPL agrees with France that a simple database for statistical analysis is a good idea.

The representative of ERA points out that the purpose of the database must be clear because statistical analysis and accident analysis are two different purposes with different demands.

The representative of the Netherlands is of the opinion that the reporting discipline is not sufficient. Severe accidents according 1.8.5 happened in the past without reporting according to 1.8.5.2 to other Contracting States. Reporting should be obligatory and improved to be able to work with it.

### **Presentation by the Netherlands on analysis of data of accidents**

TNO investigated the German rail accidents database (presented at Berlin working group, April 2010) and the French road accidents database (presented at Paris working group, December 2010). Also previous TNO research presented at the Berlin working group (April 2010) is used for this analysis.

Germany has a database with 934 rail incidents dangerous goods (in the period June 1996 – February 2010). The database is anonymous and that gives some uncertainty. Small releases (drip leakages) are included in these data (these are not relevant incidents for this working group). Railway derailments and collisions are relevant because they can lead to a

spill of dangerous goods. Analysing the German data of all tank transport it appears that there are twice as much collisions as derailments. The number of collisions is high because collisions with persons are included, however collisions with persons do not result in a spill of hazardous goods. The data have to be further investigated whether the proposed measures will exclude the causes of the serious collisions and derailments.

TNO concludes that the rail figures of France, Germany, the Netherlands, UIC and ERADIS sometimes look contradictory, because there are differences between the figures. However the analysis of UIC on rail accident in France just presented and the TNO analysis come to the same conclusion, that there are twice as much derailments as collisions. This result can be useful for the bow-tie accident causes collision/derailment.

Other important conclusions are:

- the majority of collisions and derailments are at stations and shunting yards with low speed;
- BLEVEs did not occur during rail transport;
- Some rail accidents (Schönebeck 1996, Lillestrom 2000, Osnabrück 2004 and Zwijndrecht/Kijfhoek 2011) can be seen as near miss of a BLEVE.

The representative of France asks whether special provisions TE 22 (use of energy absorption elements) and TE 25 (measures to avoid overriding) of RID could help to resist impact at low speed.

TNO also analysed 165 LPG tank vehicle accidents in the French database at causes and consequences. It shows that 33% of the accidents had a release of gas with overturn as the main cause.

From the literature TNO concludes that several countries (B, UK, NL) and the Int. Association of Oil and Gas producers (a.o. Shell, BP) use a BLEVE of liquefied flammable gases as a realistic accident scenario during road and rail transport. Also it is concluded that thermal insulation can delay a BLEVE for 60-100 minutes.

The representative of France says that the work of UIC and TNO illustrate the need for a very precise analysis of the available data. It is difficult to say exactly what the risk is and to work with it in ADR/RID there should also be a discussion on the level of risk acceptance. This is a more general issue. How this working group proceeds in this matter can be a precedent for this issue in general.

The representative of the Netherlands says that the available data give figures about the causes of accidents that can be applied in the bow tie model. It appears that overturn is an important cause of road accidents. That means that a measure should withstand overturn. This kind of conclusions can be made on the basis of the available information.

The representative of France concludes that it is too soon for solutions in this matter.

### **Presentation by AEGPL on how to proceed**

The representative of AEGPL presents a brief history of the work in the previous meetings of the working group and makes suggestions on how to proceed the work. The French data on road accidents have been analysed by AEGPL. Data from other representative countries are not available or not workable. AEGPL concludes on the basis of the French data that human error is the most important cause of accidents. The measure to prevent this cause should be training and control. Another conclusion is that many accidents are unspecified; therefore the reporting of accidents should also be improved. For the medium term AEGPL recommends to focus on good practices to prevent accidents on marshalling yards. Serious accidents with LPG road vehicles in December 2010 and in September 2009 seem to show that existing regulation is rather good. The remaining issue is the enforcement of law.

The representative of the Netherlands says that progress is possible on the information that is already available. Preventive measures are not enough, because accidents will happen and have consequences. Member states should choose how to proceed. Problems should be resolved at the source and not on the marshalling yards.

The representatives of ERA, UIP and Belgium point out that marshalling yards have specific functions to form the trains and prepare their operation. The function is not a safety measure for the traffic. Many incidents are discovered on shunting yards but the source lies elsewhere.

The representative of France agrees with AEGPL that detailed information on incidents is needed to draw conclusions.

The representative of Germany illustrates that also different responsibilities on marshalling yards complicate the problem of small (drip) leakages in Germany.

The representative of UIC remarks that in the future there will be fewer marshalling yards in Europe, because of a concentration process. The representative of UIC reminds that the detection of the abnormalities in marshalling yards and their repairs must be considered as a significant contribution to the safety/security of the railway transport chain. Too much restriction on marshalling yards will be counter-productive from overall safety point of view. It would be more efficient to act where the actual risks are.

The representative of France expects more restrictions on traffic as a reaction to serious accidents.

The representative of the Netherlands tells about a recent accident on the marshalling yard Kijfhoek, where a rail wagon with ethanol collided and took fire. Some empty LPG wagons were near and the emergency services evacuated the people within a distance of 1 kilometre from the marshalling yard. It was difficult to extinguish the fire, because other rail wagons were blocking the location. It took some time before the emergency services knew that the LPG wagons were empty and the worst case scenario could be excluded.

The representative of Germany says that the member states are responsible for their own problems with the fire brigades, in Germany it took 10 years to solve this in the federal states.

The representative of Norway says that this working group discusses how to reduce the risk of a BLEVE. With a longer delay time for a BLEVE more time is available to evacuate and save people.

The representative of France says that the check has to be made whether the fire-brigade thinks it is a solution to postpone the BLEVE. The authorities can decide after accidents that the level of safety is not sufficient. This is contradictory to the goal of ADR/RID.

The representative of the Netherlands says that the aim to keep the risk as low as reasonable achievable is a political choice and does not depend only on the use of risk assessments.

The representative of Germany says that the accident reports show that on the road the behaviour of the driver is the most important failing factor. Therefore it is better to do something about that factor, rather than to take technical measures.

The representative of the Netherlands answers that it is a fact of life that people make mistakes and that technical measures remain important.

### **Presentation by ERA on reported railway accidents**

The representative of ERA presents railway accident data reported in Europe. The data are available in the European railway agency database of interoperability and safety (ERADIS) on the site <http://pdb.era.europa.eu>. In the future the ERA should take over the EUROSTAT database that is based on Annex H of the Commission regulation (EC) No. 1192/2003. As a result there will be only one database concerning "significant rail accidents". The ERA uses

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a statistical approach for assessment of Common Safety Target achievement. The investigation reports are not for statistical purposes, but for information on accident lessons, causal factors and issued safety recommendations. The corresponding “serious accident” database shows the reported accidents since 2006. The average number of reports is 170-200 per year. The investigation reports show that 30% of all reports concern freight trains. The number of fatalities of all these accidents amount to more than 100. The fatalities related to dangerous goods wagons are 33, due to the Viareggio accident.

The ERADIS historical database provides information about serious accidents from 1990 till 2007. The historical data show 34% of all reports concern freight trains. The number of fatalities of all these accidents amount to 305 fatalities. The fatalities related to dangerous goods wagons are 27. The data show that the main causes of accidents are collisions and derailments. The reported accidents with dangerous goods wagons show more derailments than collisions.

One conclusion is that the reporting is not complete because the OTIF website and the ERADIS website with accident data show only one duplication over the period 2002 to 2006.

Another conclusion is that 45 reported serious accidents with dangerous goods wagons show no BLEVE, 19 fires, 17 leakages (including 6 toxic events) and 7 explosions.

The Agency studies prevention and mitigation measures on freight train derailments on the basis of the reported data and of specific detailed surveys supplementing the existing data in the databases. The results are expected next year.

The representative of France expects that this kind of data results in a relatively high risk when an expert calculates the risk on a certain spot. The local authorities want a different route for the transport of dangerous goods in such cases.

The representative of ERA notes that the level of risk acceptance is not harmonized in Europe. The ERA data are general and have to be analysed further into the details before conclusions are possible.

The representative of Germany says the infringement on reporting should be improved to complete the accident data.

The representative of France says warning is effective to get the reports.

The representative of ERA also tells about the proceedings in the derailment study. There is a lot of information collected in DNV reports that can be sent to the working group. DNV identified 47 preventive and 13 mitigation measures. There was a first workshop organised on 6 May to discuss the intermediate results and a second workshop will be held in Lille on 29 September. The data is covering 80% of the freight transport in Europe. In total 700 derailments have been collected with dedicated surveys in addition to the data already present in the “significant accidents” database and the “serious accidents” database. The representative of Germany asks what this means for the working group. The representative of ERA says that the data and study of ERA are more detailed on derailments and the working group should benefit of the results.

The specific surveys allowed collecting data that are necessary to perform risk assessments, the “significant accidents” database and the “serious accidents” database being not established for the purpose of risk assessments. More detailed information was collected for this purpose.

The chairman concludes that the working group can work on other items and follow the work of ERA on derailments.

**Presentation by France on a recent road accident**

The representative of France tells about an accident on 16 December 2010 on a highway near Nice that happened around midnight. The official report is not yet available. The problem seems to be the behaviour of the tank bottom valve. It should not be possible that the destruction of the valve lead to an opening in the tank, but that happened in this case. The whole load flew out in 8-10 minutes. When the official report is available France intends to make a proposal to solve this problem. The subject will be presented to the tank working group of the Joint Meeting.

The representative of UIP says this is not a problem for rail, because the internal and the external valve should be independent.

**Presentation by Germany/BAM on the testing program**

The representative of Germany/BAM tells about a technical meeting in Berlin on 28/29 April 2011 to discuss the further testing program. TNO, AEGPL and BAM were present. Comparison criteria are selected for a coating for transport tanks. The objective of testing is to proof that measures can significantly reduce the risk of a BLEVE by at least 60 minutes and preferably 90 minutes when a tank is exposed to a fire. The boundary conditions of the testing are selected. Former tests of BAM, Birk and TNO will be included for conclusions. These tests already demonstrated that a PRV does not significantly delay a BLEVE. The English version of the BAM research report no. 3222 has been sent to the participants of the working group by e-mail on 20 April 2011. The further investigations performed by BAM/TNO (and possibly together other experts) will cost approximately 50.000 Euro per test. The results of medium scale tests will be extrapolated to full scale based on existing FME model for small and medium scale of TNO and University of PISA. The planning of the program ends with a final report at the end of 2012.

The representative of France says that France is able to contribute 85 000 euro this year on the basis of a good testing program. Perhaps next year another contribution is possible. There has to be made a contract to contribute to this testing. Without a good and final testing program a financial contribution is not possible.

The representative of the Netherlands says they can contribute 50 000 euro this year on the basis of a good testing program. The program should define the testing and it should be sufficient to conclude. It is mentioned that an extrapolation of results to another scale by TNO/University of PISA costs money.

The representative of Germany suggests that the Netherlands use their contribution to pay for these costs directly to TNO, that is easier and the extrapolation is part of the BAM research program.

The representative of Belgium asks whether we want to do something about this mitigative measure.

The representative of UIP agrees, the question whether this measure is necessary, has not been answered.

The representative of France says the question is whether the measure works. Some member states do not accept the calculated risk of a BLEVE. There is no agreement about risk assessment. This issue is not only related to BLEVE but also other risks. It is important to know whether a coating is sufficient to prevent a BLEVE.

The representative of Germany says the Netherlands proposed a coating and PRV to prevent a BLEVE and Germany wants to know more about the technical argumentation on this measure. In parallel there are other measures to avoid a BLEVE that are taken in consideration.

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The representative of the Netherlands points out that the Dutch proposal is a result of the conviction that a BLEVE is a realistic accident scenario and that a reasonable and available technical measure to prevent such a disaster should be taken in order to protect the people near transport routes. The Netherlands think a coating and PRV is such a measure.

The representative of France says the working group is not competent on risk acceptance or on general traffic safety. But any known risk concerning dangerous goods cannot be ignored or accepted by this working group.

The representative of Germany says the questions to investigate and what result we expect of the research program has to be clear to everyone.

After discussion BAM presents a configuration of former tests and tests needed for final conclusions on the effectiveness of a thermal coating and PRV in a fire.

After discussion the representative of France concludes that the testing program should include the following items:

- (1) Definition of the conditions of a representative pool fire
- (2) Description of the criteria for the selection of the coatings to be tested
- (3) Description of the criteria for the selection of the safety valves to be selected, including evaluation of negative effects of safety valves (e.g. heat radiation)
- (4) Evaluation of the tests already performed by BAM, TNO and of tests described in literature, which results in a list of questions not answered.
- (5) List of tests to be performed based on the not answered questions (result of item (4)), including test priority.

## **Work proceeding**

Conclusions on how to proceed

- The working group recommends to improve the reporting of accidents, and the development of a statistical accident database at international level, to make it systematic. If the joint meeting approves the principle of such database France is declared to be ready to work on proposals to achieve this goal.
- No conclusion can be drawn on how to proceed on ranking the measures, by lack of statistical information at this moment. In any case the ranking of measures should also integrate a cost-benefit analysis.
- Germany will produce a testing program as discussed to enable other member states to participate in the financial costs of the program.
- The member states shall discuss a new date for a meeting on the occasion of the Joint Meetings in September 2011 and March 2012 when more is clear about the testing program.

## **Next meeting**

- The next meeting will be planned after the results of the testing program by BAM are available. This may take till the end of 2012.
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