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**ECONOMIC COMMISSION FOR EUROPE**

**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

Bern, 22-26 March 2010  
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<sup>1, 2</sup>

1. The working group held its sixth session from 21 to 23 October 2009 in Paris, under the chairmanship of Mr. Claude Pfauvadel (France). The session was attended by representatives of France, Germany, Italy, the Netherlands, Norway, Poland, the United Kingdom and the following non-governmental organisations: European Liquefied Petroleum Gas Association (AEGPL), the International Union of Private Wagons (UIP) and the International Union of Railways (UIC).
2. The documents on the agenda were as follows:
  - (a) Report of the Joint Meeting on its spring 2006 session (March 2006), ECE/TRANS/WP.15/AC.1/102 (OCTI/RID/GT-III/2006-A), para. 5-12, 20 and 21;

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<sup>1</sup> In accordance with the programme of work of the Inland Transport Committee for 2006-2010 (ECE/TRANS/166/Add.1, programme activity 02.7 (c)).

<sup>2</sup> Circulated by the Intergovernmental Organisation for International Carriage by Rail (OTIF) under the symbol OTIF/RID/RC/2010/9.

- (b) Report of the 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;
- (c) ECE/TRANS/WP.15/AC.1/2006/8 (OCTI/RID/GT-III/2006/8) (Netherlands);
- (d) Informal document March 06/ INF. 3 (Netherlands);
- (e) Informal document March 06/ INF. 26 (AEGPL);
- (f) 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);
- (g) Informal document March 07/INF.22 (AEGPL);
- (h) Report of the Joint Meeting on its spring 2007 session (March 2007) ECE/TRANS/WP.15/AC.1/106 (OTIF/RID/CE/2007-A), para. 62;
- (i) Informal document September 07/INF. 9 – Report of the second informal working group on the reduction of the risk of a BLEVE (meeting in Tønsberg);
- (j) Report of the Joint Meeting on its autumn 2007 session (September 2007) ECE/TRANS/WP.15/AC.1/108 (OTIF/RID/CE/2007-B), para. 105;
- (k) Informal document March 08/INF.5 – Report of the third informal working group on the reduction of the risk of a BLEVE (meeting in Rome);
- (l) Informal document September 08/INF.6 – Report of the fourth informal working group on the reduction of the risk of a BLEVE (meeting in The Hague);
- (m) Report of the Joint Meeting on its autumn 2008 session (September 2008) ECE/TRANS/WP.15/AC.1/112 (OTIF/RID/RC/2008-B), para. 41;
- (n) Informal document March 09/INF.25 – Report of the fifth informal working group on the reduction of the risk of a BLEVE (meeting in Paris);
- (o) Report of the Joint Meeting on its spring 2009 session (March 2009) ECE/TRANS/WP.15/AC.1/114 (OTIF/RID/RC/2009-A), para. 62.

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

4. The meeting was welcomed by the Chairman. He 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.

5. The meeting discussed a method for ranking the measures presenting a good potential for reducing risks of BLEVEs as well as principles for the costs of measures and adverse side effects to be taken into account in decisions on the introduction of measures (see Annex I)<sup>3</sup>.

6. The terms of references have been settled by the working group and are represented in annex II<sup>3</sup>. The output of the expert meeting in the Netherlands (Utrecht) should be a first assessment of the risk reducing potential of measures (see especially points 3 and 5 of the terms of references).

7. The government of Germany invites the working group for a next session in Berlin, to be held from 19 to 21 April 2010.

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<sup>3</sup> Note by the secretariat : Annexes I and II are reproduced as transmitted.

## **Annex I**

### **Report on discussions**

Three documents are presented to the working group for discussion and validation in this meeting.

- (a) A document by AEGPL on a bow tie model and event tree for road together with the cost of measures.
- (b) A document on a bow tie model for rail by the Netherlands.
- (c) A document on the cost of measures for rail by UIP.

### **Discussion on selecting measures**

The representative of the Netherlands makes a general comment that the goal is a selection of measures, but that the information needed is not yet completed. It is very difficult to select measures on this basis.

### **Presentation of AEGPL on the event tree and discussion**

The representative of AEGPL says their event tree is a tool for selecting measures. Accident data are needed to complete the event tree. These data are not yet available. The working of the tool is explained by AEGPL. The bow tie model has been accepted in a previous meeting. The event tree can show the effectiveness of a measure on the basis of accident data, data on the frequency of failure of a measure, or assumptions.

The representative of France remarks that the event tree is a compilation of many different possible events. That makes the event tree a very complex tool. It is hard to tell whether this tool can deal with sequential events and combined measures. The tool is very scientific. A BLEVE does not happen often. Accident data are available for top events like derailment and collision, but may not be available for some more specific causes. Some accident data is relevant in general for all transport and some accidents are only relevant for dangerous goods. The tool seems to be very precise, but due to lack of accident data available needs to have further development.

The representative of the Netherlands suggests a qualitative approach on the possible lines of defence in the bow tie model to make a selection of measures; the quantitative approach in the event tree can be useful in addition to check the qualitative selection. There is worry about the progress made since the previous meeting and national efforts to prevent a BLEVE will continue.

The representative of AEGPL thought progress would be easy, but it is not obvious to agree on the methodology.

The representative of the United Kingdom does not understand why the presented event tree makes a difference between rural and urban area.

The representative of France thinks it is not necessary to distinguish between rural and urban area and number of casualties. ADR allows local measures if a risk is not acceptable. The probability of a BLEVE should be very low.

The representative of UIP questions whether the disadvantages and problems of some measures are not forgotten in the presented event tree.

The representative of France says disadvantages are relevant for selecting measures.

The representative of the Netherlands has the experience that it takes a lot of time to come to terms with several parties on an event tree. It is faster to discuss on a qualitative way.

The representative of AEGPL says the methodology can embrace all dangerous goods. Estimates are possible on some effects, but a quantitative approach is also needed.

The representative of Germany thinks it is not possible to decide on measures when data material is not available. Any assumptions made should be discussed. The experts can make proposals to fill in the bow tie model with judgements that can be discussed later in this working group. The experts can use data together with expert judgement for this work.

The representative of France says we have to find a way to combine a qualitative way of judging measures with an efficient approach. Quantifying measures is very scientific. The elements costs and disadvantages of measures should also have a place in the selection of measures. The railway sector is legally bound by a costs/benefits approach because of the European directives..

The representative of the Netherlands reminds that a complete quantitative risk analysis was presented earlier and this methodology was not accepted by the working group. The same methodology is used in the UK, Belgium and Switzerland. The quantitative approach of AEGPL is correct but for the general public it is very difficult to understand this methodology. The working group has to find a way to make clear how hazards can be prevented in an effective way. For example corrosion hardly contributes to accidents. The working group can concentrate on preventing important accidents like derailment and collision.

The representative of AEGPL thinks a safety management system can prevent all kind of accidents.

The bow tie for road is validated. The event tree is a good starting point and can be changed according to remarks and questions.

The representative of France means that derailment and collision are the most problematic accidents.

The qualitative discussion on measures has to take place in the working group. If we identify quantitative problems for the experts, that can be prepared separately for further discussion in the working group.

The representative of Germany suggests to identify measures that a member state wants to have accepted, because the scientific approach takes a lot of time.

The representative of France agrees that propositions of useful measures that are not expensive and have no disadvantages can already be accepted rather easy by the working group to make progress in this matter.

At the time these propositions are not made by member states.

### **Presentation of the Netherlands on a bow tie model for rail and discussion**

The representative of the Netherlands presents a bow tie diagram for rail that is drafted by TNO, UIP, UIC and UK. The measures in the diagram are numbered according to the list of measures. Measures that are not on the list of the working group are placed between brackets.

The representative of France remarks that measures can be introduced for dangerous goods that are interesting for the general safety as well. The infrastructure is not regulated by RID. Measures to prevent derailment should be coordinated by ERA.

The representative of the Netherlands says that measures like speed limitations and the composition of trains are good measures. The Netherlands prepares such measures to increase safety.

The representative of France confirms that some measures out of the scope of this working group can contribute to safety. Local measures can be based on chapter 1.9 of RID. The composition of trains that cross borders is not a local matter.

The representative of UIP adds to the presentation of the bow tie model that there is a difference between the model for rail and road concerning overfill. Overfill is an incident in the model for rail caused by wrong loading operations. There are measures to prevent overfilling. The bow tie for road shows overfilling as a hazard.

The representative of the Netherlands says the small group presented a complete bow tie. If specific measures are not a RID matter, this can be clarified by remarks.

The representative of UIC has spread the presented bow tie to members to get their opinion. In general they are in favour of the approach, but some comments and reservations are also made. Most of the measures are linked to general rail safety and not to dangerous goods. The approach should see to a fire on the railway and an external fire. The question is how to connect other railway organisations like ERA in matters that concern general rail safety. Some preventive measures can also be control measures, for example a measure like telematics can also be useful after an accident to deal with the consequences.

The representative of UIC says that the measure segregation of wagons in trains has already been discussed by the RID Committee of Experts and has not been supported. Communication is important, because some measures are analysed and not supported for lack of predictability.

The representative of France points out that ERA will not look specifically at dangerous goods.

The representative of Germany says ERA has to consider all measures that concern general rail safety.

The ERA has a different view on risk acceptance. The ERA accepts 600 derailments in 10 year because the costs of preventive measures are high. The frequency of a BLEVE is low and therefore the costs to prevent it are higher.

The representative of France says that the choice is to prevent derailment or to build a tank that can resist a shock. The ERA will not analyse a measure from RID about the tank. But the question is whether it is wise to build a very strong tank and to accept derailments. It is better to take account of the costs of alternative measures.

The representative of the Netherlands points out that the Dutch general public is not interested in how things are organized internationally. An accident like the one in Viareggio last summer is not acceptable for them. International organisations should cooperate in preventing this kind of accidents.

The representative of France says the different approach between ERA and RID may need a more general discussion. International transport needs the same approach in all member states. The ERA is aware there is no harmonized way of risk acceptance and does not calculate risks. The ERA is aware there is no harmonized criteria for risk acceptance and therefore the study made on derailment detector did not calculate localised risks. The ERA merely compared global costs of measures with costs of accidents and victims and did not consider the probability for things to happen at a defined place. Thus it is not easy to draw immediate conclusions from that study for our work.

The representative of the Netherlands says that the working group can consider things in a quantitative way, but that discussions show that the results will not be accepted by other organisations.

### **Presentation by the Netherlands on the national coating project and discussion**

The representative of the Netherlands presents the progress on the national thermal coating project for existing tank vehicles used for deliverance of LPG at filling stations. The question was what kind of heat resistant material can prevent a BLEVE in stationary situations. A matter of concern was the possibility of inspections. The result is a cover on the tank with 2 blankets of silicon heat resistant material. The cover can be removed for inspections. The cover can be considered to comply with regulation 6.8.3.2.14 of ADR.

The representative of France asks if this cover can also resist a shock and prevent a BLEVE in a road accident. It is possible that the regulations could prescribe a level of temperature control and a level of impact resistance. It is interesting to know if a known material can provide this.

The representative of the Netherlands answers that an intumescent epoxy insulating coating (e.g. Chartek 7) cover has a shock resistance comparing to steel. These silicon blankets are not

resistant to serious road accidents. He also mentions that the representative of the USA informed him about a new intumescent insulating material of only 4 mm thickness.

The representative of Germany says thermal insulation has no impact resistance, based on tests that show cracks in the layer when exposed to high temperatures.

The representative of AEGPL points out the need to have clear terms of reference for the studies and tests developed by TNO. In the furnace test performed by TNO with a tank filled with only propane vapour the tank wall achieved a surface temperature above 350 °C. In case of a tank filled with liquid LPG, the LPG pressure in the vessel could become very high (80 / 90 bar), even with the thermal coating protection.<sup>1</sup>

The representative of the Netherlands answers that the combination of a good thermal insulation and safety valves can prevent a BLEVE by keeping the wall temperature and pressure in the tank below destructive values.

### **Presentation by Germany on tests of insulation by BAM and discussion**

The representative of Germany presents three tests of thermal insulation and safety valves. The results are not yet available. The tests raise questions about the possible impact of safety valves on the thermal insulation when venting. Further investigations will be necessary, because a lot of questions remain to be answered. Germany would like to share experience with other organisations to come to results. If member states have questions about the tests this may be of influence on further testing. Results are expected by the end of next year. The costs to prepare the tests have to be made this year. In addition Germany will start a project on the use of safety valves next year.

The representative of France adds that the influence of a venting safety valve on the thermal insulation is also important to consider and suggests to test different materials both on heat and impact resistance.

The representative of the UK points out that there are safety valves available that do not influence the tank.

The representative of AEGPL complements Germany with the good work and is available to help.

The representative of the Netherlands says there is some literature about the resistance of thermal coatings to jet flames. But some questions about safety valves may be of interest to the Dutch program as well.

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<sup>1</sup> The power point presentation of TNO showed a maximum wall temperature of 376 °C of a tank filled with only propane vapour exposed for 90 minutes to a furnace temperature of 900 °C, the pressure will be then approximately 18 bar (propane vapour only!). The same presentation showed that a tank filled with 20% propane liquid after 90 minutes exposure to the furnace temperature of 900 °C will reach a maximum wall temperature of 256 °C. The propane temperature will be lower, but the propane pressure in the vessel can be above the burst pressure of the tank. A Pressure Relief Valve will avoid pressures in the tank above 20 bar.



The representative of Germany is not in favour of the Dutch approach to filling stations. Perhaps a sandwich construction of layers can resist both heat and impact.

The representative of the Netherlands adds that the approach on filling stations is just a part of a broader interest in the prevention of a BLEVE under transport conditions.

The representative of France adds that there are discussions in France and Germany on the acceptance of transport of dangerous goods. Experts that deal with the safety regarding installations (the Seveso Directive) have doubts about the safety level of the transport (delivery) of dangerous goods.

### **Discussions on the costs of measures for railway**

The representative of UIP says the cost table for railway is made congruent with the cost table for road. The costs for retrofitting are a rough estimation of a wagon being out of business for 2 or 3 weeks.

The representative of the United Kingdom is missing Excess flow valves in the table and can deliver information about the costs.

The representative of France is missing information on how long a thermal coating lasts in relation to the lifetime of a wagon.

The representative of Germany suggest to ask Canada or the USA about their experience and adds that there are at least 3 kind of coatings with different costs.

The representative of the Netherlands remarks that a wagon will be out of service for 4 till 6-weeks to bring on a thermal coating and that a Chartek coating has a long lifetime guaranteed by the supplier.

The representative of UIP says railway organisations have reserves about pressure-relief-valves on wagons, especially about tightness and malfunctions in case of accidents.

The representatives of the UK and Germany are of the opinion that all portable tanks on rail have such valves and there has never been a serious problem with them.

The representative of France asks if there is experience with these valves in accidental situations.

The representative of the Netherlands says there is some experience with this on road.

The representative of Germany learned from an accident in Schönebeck with vinyl chloride that a torch and impinging from valves should be avoided to prevent domino effects.

The representative of UIP concludes that it is important to have a common discussion about the advantages and disadvantages not only about pressure-relief- valves but also about all of the other mentioned measures.

The representative of France agrees to this and concludes that the cost table is a document in progress that can be further discussed during the next meeting. The aim is not to make costs absolute, but to use it in the qualitative discussion on the selection of measures.

### **Work proceeding**

The working group discussed on terms of reference for proceedings of a next (intersessional) working group. The result is in **annex 2**.

Other conclusions on how to proceed:

- (a) The conclusions of the working group have to be transparent.
- (b) The meaning of the red barriers in the bow tie reading “leak and/or fire” is not clear enough. The bow tie can be simplified by removing this barrier and adding remarks if necessary.
- (c) The measures in the bow tie will be numbered according to the list of measures or placed between brackets if not on the list of measures, because the measure is no RID concern.
- (d) The list of hazards in the bow ties will be completed with percentages of occurrence. Preferably on the basis of accident data from the member states, or on the basis of expert judgement. Member states will send their data about road and rail accidents to AEGPL. The ERA has statistics about rail accidents. The data needed are about accidents in general, not only the accidents regarding dangerous goods.
- (e) The event tree is a tool to be used in addition to the bow tie. There should be no conflicts between the event tree and the bow tie model. The event tree can be used to check the findings on the basis of expert judgement.
- (f) Data about the effectiveness of measures should be investigated and obtained. The effectiveness of measures could be based on expert judgement.

### **Next meetings**

- (a) Germany invites the working group for the next meeting from 19 to 21 April 2010 in Berlin. France is willing to chair the meeting. The Netherlands offers to make the report.
- (b) AEGPL will send a frame to the members to collect accident data. Members can comment on the first frame and after agreement, the frame will be sent to member states to fill in data.
- (c) The Netherlands will organize an expert meeting (TNO together with AEGPL, UIP, UIC, UK, ERA and possibly others) on 12 and 13 January 2010 in Utrecht. The output of the expert meeting should be a first assessment of the risk reducing potential of measures (see especially points 3 and 5 of the terms of references).

## Annex II

### Terms of Reference of the Working group

1. To issue a list of definitions of the “key-terms” that will be used in the work to be done (hazards, threads, preventive measure, containment & control measures, mitigation measures, frequencies, likelihood, top-event, etc.....).
2. To gather information on statistics of “incidents-accidents” (data) involving transport, in general and Dangerous Goods in particular (according to the “top-events identified here above) on Road and Rail and including causes when available:  
  
→ Action for the National Representatives: available information to be transmitted to AEGPL for consolidation and diffusion
3. **Qualitative part of the study:** to agree on the content and presentation of the respective “BOW-TIE” (Road and Rail),
  - (a) First, on the basis of the accident data showing the most frequent event to be mentioned in the Bow-Tie:
  - (b) Secondly on the basis of expert judgment of other possible events.
4. To list the measures with their respective identification number (see previous table)
5. **Quantitative part of the study:** to use the revised “bow-tie” in order to have a first assessment of the relevancy of the measures (where the measures have to be placed in the succession of events and how they can act).
6. Results of the work of the WG should be used to work out an up-dated “Tool” according to the above:  
  
→ Action: AEGPL
7. To gather information concerning the “failure frequencies of equipment” (data), used for both type of Dangerous Goods transport:  
  
→ Action: WG participants
8. To identify “qualitative” advantages and/or disadvantages of measures, including their “side effects” concerning the potential disadvantages.  
  
→ Action: WG
9. To use the data available (see here above), as “inputs” into the “Tool”.T

**N.B.:** when data is not available, “agreed assumptions” will be taken for missing information.

➔ Action: AEGPL in coordination with the WG

10. Issue a first list of “measures”, based on the “relative output” of the different scenario’s “tool” to be taken into account for further discussion within the next plenary WG.

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