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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

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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. The working group held a fifth session on 4 to 6 February 2009 in Paris, France under the chairmanship of Mr. Claude Pfauvadel (France). The meeting was attended by representatives of Canada, 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:
- 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)
- 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 the reduction of the risk of a BLEVE (meeting in Tønsberg)
- 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 the reduction of the risk of a BLEVE (meeting in Rome)
- Doc. September 08/INF.6 – Report of the fourth informal working group on the reduction of the risk of a BLEVE (meeting in The Hague)

- Report Joint Meeting September 2008 ECE/TRANS/WP.15/AC.1/112 (OTIF/RID/RC/2008-B), para. 41

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 a bow-tie model for ranking the measures with a good potential for reducing risks of BLEVEs and on the principles for the costs of measures to be taken into account in decisions on the introduction of measures. The detailed bow-tie model for road transport is agreed upon. It was decided that a small group of experts will prepare a detailed bow tie for rail transport before the next meeting of the working group.

5. France and AEGPL invite the working group for the next three-day meeting in Paris. The meeting will be held from 21 to 23 October 2009.

Annex 1 to the report of the working group meeting in Paris, February 2009

Presentation by Poland on a road accident with LPG

The representative of Poland presents data and pictures of an accident near Chrzanow in September 2008 with a semi-trailer loaded with 21 ton LPG. The two PRV's of the trailer were destroyed when passing a low railway bridge. LPG leaked and ignited immediately. The fire lasted for 25 hours. The rescue operations lasted for 47 hours. The fire fighters poured water onto the tank to avoid overheating and evacuated people from the danger area. In the last phase of the operation nitrogen was pumped into the tank to neutralize propane/butane remaining in the tank and to minimize the risk of the flame being sucked into the tank. After the fire was extinguished the leakage hole in the tank was plugged by the wooden wedge. Additionally the whole was wrapped in wet material. The material was frozen by refrigerated carbon dioxide creating a thermostable "ice plug". The remaining LPG was pumped over into an empty road tank vehicle.

The road under the railway bridge had road signs that lorries were forbidden and the maximum height for a vehicle under the railway bridge was 3,2 m. The driver of the tank vehicle did not take notice of these signs. The requirements for PRV's in the standard EN 12252 already prescribe that PRV's located in the upper part of the tank shall be sited flush with the tank shell and with the operating mechanism inside the tank, or any protrusion shall be adequately guarded against impact damage and any damage to be guard shall not interfere with the satisfactory operation of the valve.

The representative of AEGPL says that the relief valves inside the shape of the shell are usual and that older tanks still have external relief valves that can damage more easily under low tunnels and bridges. Mechanical protection for outside relief valves is not adequate for this kind of collision.

The representative of Germany suggests to pass a question for the tank working group of the Joint Meeting whether only PRV's inside the shape of the shell should be allowed.

The representative of France asks what would have happened without a PRV on the tank vehicle.

The representative of UIP answers that no fire would have occurred without a PRV in this case. A PRV is a risk for release of gas. The representative of the United Kingdom and Canada say that it is possible to have good working PRV's.

The chairman concludes that the tank working group can be asked to advise on PRV's to avoid this kind of accident. Without destruction of the PRV there would have been no release of gas in this case because the tank itself was intact.

Presentation by Canada on BLEVEs in Toronto/Canada

The representative of Canada presents data and pictures of the Sunrise Propane Incident in Toronto that happened in August 2008. A fire started at the storage location of LPG that resulted in three BLEVEs of tank vehicles and in explosions of gas cylinders. The incident was in an area where 12 000 people lived in 1.6 km around the storage location and were evacuated from their homes for 1 day. After the incident there were a lot of houses damaged. The investigation of the incident is ongoing, the results are not yet available.

The three exploded tank vehicles on the location carried 20 000 litres of gas each. A committee that investigated the incident advised to consider thermal protection of tank vehicles to avoid a BLEVE. The Canadian ministry of transport will make a cost/benefit analysis for thermal protection on tank vehicles. Therefore the representative of Canada is interested in the results of this working group on preventing a BLEVE.

The representative of France refers to the Seveso Directive in Europe for the storage of dangerous goods. In France the storage of dangerous gas should be in underground tanks or in isolated aboveground tanks.

The representative of Canada says that temporary storage is not regulated as well as long time storage facilities. The chairman concludes that this incident was not a specific transport incident. In France there are plans and financial means for expropriating houses near risky facilities. Eventually it is a political choice what measures are necessary to avoid risks and what risks are acceptable for the public.

Presentation by Germany on open questions

The representative of Germany presents a definition of a BLEVE, the reasons for a container to fail at ambient, service or fire conditions. Also the phases of high pressure explosions (BLEVEs) are presented including causes and effects of a BBLEVE. Video's of fire tests are shown. An IBC filled with ethanol, an IBC filled with water, a CNG (type III-receptacle) and a rail tank car filled with propane were tested in a fire. The representative of Germany will do some more research and wants to know if the other delegates have more questions that need to be considered in this research. Germany wants to check what research is already done in other countries.

The representative of the Netherlands thanks Germany for the fundamental scientific questions and for the invitation to be present at German experiments. On the other hand it is important to consider what to do in this working group. The working group can use a practical definition of a BLEVE, where a cold BLEVE occurs at ambient temperature and a hot BLEVE in case of fire. The scope of the working group is not restricted tot flammable liquefied gasses. The scope does not exclude liquids, but the consequences of the failure of a tank with liquids are smaller (design pressure of tanks for liquefied gasses is about ten times higher than those for liquids).. There is no dispute in scientific literature about the difference between a hot and a cold BLEVE. The difference is in the causes and in the consequences, because the energy inside the tank is higher in case of a hot BLEVE. Norway and the Netherlands have identified a risk for a BLEVE with LPG which is politically not acceptable when there is a measure in use to prevent such a risk.

The representative of AEGPL suggests to limit the maximum inventory of a tank with liquefied gasses to limit the consequences.

The chairman concludes that the working group is not restricted to LPG or flammable liquefied gasses. All BLEVE situations should be considered, where pragmatically worst cases can be solved first. And maybe if measures are cheap or prevent any accident it can be applied on a wider range of goods. The size of the threat of a blast, projection and fireball is related to the amount of goods and the pressure.

Presentations of the Netherlands and AEGPL on a bow-tie model and discussions

The representative of the Netherlands presents a bow tie diagram for a hot and a cold BLEVE during rail and road transport of LPG. The TNO document presented was made available for the participants in the working group two weeks before this meeting.
The representative of AEGPL apologises for sending their information late to the participants.

The representative of AEGPL presents a bow tie scheme shown in the previous meeting with added hazards and measures in the scheme. Human error takes an important place in the AEGPL scheme because the ETAC (European Truck Accident Causation) study of IRU/EC shows that 85.2 % of the accidents are caused by human errors. The driver is responsible for 25% of the human errors. AEGPL has asked DNV to investigate the effectiveness of the list of measures using ADR methodology in previous cases. Experts of other delegates are invited to take part in the investigation of DNV.

The representative of United Kingdom says there is no event tree for rail available.
The representative of Germany is interested in the assumptions of the investigation of DNV.
The representative of AEGPL says the effectiveness of measures is assessed for LPG trucks. The costs of measures are related to a tank of 21 m^3, because that is the size of the majority of trucks. The focus is on road, because the LPG transport is mainly by road. The societal risk of LPG transport is acceptable according to DNV, because the frequency of a BLEVE is very low. The investigation of DNV is not yet available.

The representative of Germany says that the overwhelming information of AEGPL does not make it easy to keep a general view on the problem. The societal risk of a BLEVE may not be acceptable for the public even when the frequency is very low. We have seen that in reaction to industrial incidents with high consequences. Reasonable measures to avoid accidents should be taken and driver training cannot avoid all accidents.

The representative of France says risk acceptance is a political issue. Transport conforming to the regulations has to be accepted, but draft annexes containing regulations has to be safe enough to be accepted. Transport should be safe, but criteria for safety can change. The French public is more aware of the risk of dangerous goods after the industrial incident in Toulouse. People tend to accept less risks. Local authorities will use the exceptions in chapter 1.9 if they think that normal transport regulations pose too great a risk to their inhabitants, even if the probability of casualties caused by the transport of dangerous goods is very low. The tools presented by AEGPL using ADR methodology are important for decisions in this working group.

The representative of Germany says that the assumptions in both the Dutch and the AEGPL approach should be clear to proceed in the discussion. Germany is interested in the DNV results.

The representative of France sees similarity in the Dutch and the AEGPL approach. Unclarity about preventive and mitigative measures should be avoided. The final event is a BLEVE, but road accidents and fires are initiating events in itself.

The representative of Italy agrees with France. The Netherlands is more concentrated on the BLEVE and the AEGPL has a wider approach on road accidents. The measures to prevent a BLEVE are already identified in this working group and need to be placed in a model to show the effectiveness of the measures.

The representative of AEGPL sees no fundamental difference between the two models.

The representative of the Netherlands says the AEGPL bow tie diagram is not complete because fires can also occur without a road accident and cause a BLEVE. The list of hazards in the diagram is not complete.
The representatives of Germany and France say the diagram should be completed and the representative of UIP says another diagram for rail transport is needed.

The representative of the Netherlands suggests that a small delegation of experts complete the AEGPL diagram for further discussion in the meeting.

The proposition is accepted and the resulting bow tie diagram is presented as **annex 2**.

The representative of Canada says the scheme applies on all dangerous goods.

The representative of France says the scheme has a good general global approach, because not only LPG can explode. The scheme shows possible interactions and domino effects and is not restricted to the tank vehicle itself and the driver anymore. The scheme shows that a pool fire and a torch fire have different causes. There are necessary conditions and additional conditions. For a BLEVE a torch fire, a leakage of gas and an ignition source are necessary conditions. The events are complex. This is a good basis for further discussion on the increase of safety in the regulations for dangerous goods.

The representative of the Netherlands asks whether the barrier to avoid ignition is fully effective.

The representative of AEGPL says the resulted scheme presents a bow tie with barriers. An event tree is something else. DNV works on an event tree with the effectiveness of measures which is very complicated. AEGPL asks for incident data of governments to complete the DNV work.

The representative of France says the resulting bow tie scheme can be presented to the Joint Meeting. France has no precise data on incidents for AEPGL/DNV.

The representative of the Netherlands warns not to overestimate the quality of the available data. There is much uncertainty in data. TNO consulted risk assessment guidelines of the Netherlands, UK, France and TNO. TNO is willing to cooperate with DNV in the investigation of effectiveness of measures. Perhaps other experts can participate as well.

The representative of France says that effectiveness can be dealt with in a comparative way. Perhaps INERIS in France can take part of the investigation by DNV as well.

The representative of AEGPL suggests that a group of experts deliver a technical tool that can be approved by the working group. The objective of the tool is to rank measures. The tool should help the working group to discuss the effectiveness of measures.

The representative of Germany agrees with the preparating work of a small intersessional group of experts on an event tree that can be verified in the working group.

The representative of the United Kingdom asks if an event tree for rail can be dealt with in parallel.

The representative of AEGPL says that the DNV investigation only applies on road because the members of AEGPL have no special interest in rail transport.

The representative of UIP says the bow tie scheme of AEGPL made him realise that for rail other hazards than the driver errors are relevant.

The representative of the Netherlands offers to make a similar bow tie scheme for rail transport, if possible together with the experts of UIP, UIC and the UK.

The representative of Germany suggests that also the inland waterways could be considered to be taken into account.

The representative of the Netherlands says that according to a risk assessment of TNO the risk on inland waterways is less than on road and rail. The representative of the Netherlands says ADN regulations are not the main concern of the Netherlands. There is more distance between waterways and surroundings that prevent serious consequences of an incident on a waterway.

The representative of France says transport by inland waterways is quite different from road and rail transport, there is a specific working group on ADN and it is not harmonised yet. The Joint Meeting could decide if ADN regulations should be involved in the prevention of BLEVE’s.

Presentation by UIP on costs of measures rail transport

The representative of UIP presents a cost scheme for the selected measures for rail transport. Only the costs of measures on the rail wagon are available for UIP. Costs of measures like routeing and safety management systems are unknown by UIP and the costs of some other measures depend on the chosen technical solution.

Presentation by AEGPL on cost of measures road transport and discussions

The representative of AEGPL presents a cost scheme for the selected measures for road transport. The maximum costs to retrofit a tank vehicle are high in relation to measures on a new tank vehicle. The operational costs, the costs of the days the tank vehicle is out of use and additional inspections of the notified bodies are included in the scheme.

The representative of the United Kingdom remarks differences in de cost schemes for road and rail transport. For instance the costs of retrofit are not presented in the scheme for rail transport.

The representative of the Netherlands says specific retrofit costs depend on how regulations deal with the transition after a new measure becomes mandatory. Retrofit costs can be avoided if combined with standard maintenance procedures and periodic inspections.

The representative of Germany says the industry tends to speed up retrofit once a measure becomes mandatory, for instance because private parties demand sooner action for better safety.

The representative of France says that only the costs related to what is mandatory in the regulations are of relevance to this working group. What is done on a voluntary basis is not our interest. On the other hand costs should be clear for anyone and for different conditions.

The representative of Italy has no problem with separately defined costs in one scheme to clarify the costs for different conditions.

The representative of UIC says that some measures can prevent several effects, that is also relevant for the cost assessment and efficiency of measures.

The representative of the Netherlands says that 10% loss of capacity as a disadvantage for complete thermal protection is high in general, because it depends on the capacity of the tank vehicle.

The representative of France says the use of stainless steel for corrosion prevention instead of carbon steel is only applicable on new tank vehicles.

The representative of AEGPL offers to take into account the remarks and to coordinate a similar approach on the cost scheme with UIP to solve the differences between the two cost schemes.

The chairman concludes that a cost differentiation will be made, i.e. a distinction between material costs, administrative costs, etc.
The representative of the Netherlands suggests that the cost effect per litre price of the transported goods is also relevant, so not only absolute costs. Therefore more information is needed.

The representative of France says that price-effect can easily be deducted.

The representative of UIP says that the average price of a rail wagon can be added, to show the level of investment.

The representative of the United Kingdom says the average lifetime of the vehicle, the average lifetime of the measure and the maintenance costs are also relevant.

The representative of Germany says a new and difficult discussion is started here. The costs of measures per litre of transported goods is almost nothing.

The representative of AEGPL and UIP say that the lifetime of a tank vehicle/wagon and of measures is not clear, because most material in Western Europe is sold before the end of its lifetime.

The representative of France says that we will do what we are able to do and that operators will have to take all possible safety measures when costs are relatively low.

The chairman concludes that costs are relative and that a cheap measure that is equivalent to an expensive measure is a better choice. But equivalence is needed to make that choice.

Next meeting

- France and AEGPL invite the working group for the next meeting from 21 to 23 October 2009 in Paris. France is willing to chair the meeting. The Netherlands offers to make the report.

- AEGPL (DNV together with TNO, INERIS and perhaps BAM) will send in an event tree for road to discuss at the next meeting. The document will be prepared in a small intersessional working group in June 2009 and will be sent to the working group in August 2009.

- The Netherlands (TNO together with UIP, UIC, UK and if possible ERA) will send a bow tie scheme for rail, similar to the scheme for road, to discuss at the next meeting. The document will be prepared in a small intersessional working group.

- AEGPL will coordinate the remarks made by the working group on the costs of measures for respectively road and rail transport with UIP. The cost schemes for road and rail should be similar and will be sent to the working group in August 2009.

- The representative of France will put the presentations of this meeting, not distributed before the meeting, on a down load link.

- The participants will present statistics on the frequency of incidents to DNV if available.
