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## Economic Commission for Europe

### Inland Transport Committee

26 July 2011

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

#### Joint Meeting of Experts on the Regulations annexed to the European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN) (ADN Safety Committee)

#### Nineteenth session

Geneva, 22–25 August 2011

Item 4 of the provisional agenda

#### Proposals for amendments to the Regulations annexed to ADN

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## Explosion protection on tank vessels

### Transmitted by the Governments of Germany and Netherlands

#### I. Background:

1. A number of accidents on tank vessels caused by explosions happened because of unclear or missing explosion protection measures (**zoning, associated protective measures, additional protective measures**).
2. The assignment of zones (zoning) and the associated protective measures as described in the current ADN are not in any case sufficient.
3. Scientific investigations carried out in Germany between 1996 and 2002 (financially supported by the Federal Ministry of Transport, Building and Urban Development) provide a reliable basis for the modification of explosion protection on tank vessels.
4. On this basis the dangerous goods group (MDG) of CCNR started the discussion on the modification of the explosion protection and found solutions to some extent. Some of these solutions became part of the ADN.
5. In 2009 the Netherlands and Germany started discussions on the open (unresolved by MDG) issues again.

#### II. Proposal

6. As a result of the discussions in the MDG group and of the recent discussions the Netherlands and Germany propose:
  - (a) Modified classification of the explosion-hazardous areas into zones (zoning);
  - (b) A precision of the measures to be taken within the zones (associated protective measures);
  - (c) A modification of the additional measures to be taken during loading and unloading (additional protective measures) to prevent explosive atmospheres inside accommodation, wheelhouse and service places outside the cargo area in the case of minor releases of liquid or gas/vapour.

*Note 1:* In this context a minor release is considered a maximum 1 m<sup>3</sup> liquid and 10 m<sup>3</sup>/min gas/vapour over a period of a maximum 10 min. These additional protective measures do not aim to cover accidents with the release of large amounts of liquid/vapour e.g. breakaway of piping.

#### **ad. 1 Zoning**

7. The zoning should make use of zone 0, zone 1 and zone 2 as common in other fields of application. Such a zoning which is permanent provides a clear classification as well as a specification of areas without explosion hazard. The latter is especially important for the ventilation of accommodation, wheelhouse and service areas outside the cargo area. Alternative 1 and alternative 2 give possibilities for zoning on tank vessels for inland waterways with a high degree of safety using the example of a type C vessel. Alternative 2 stays more abreast of the changes in modern construction of cargo vessels. Both alternatives require however (minor) constructional measures:

- (a) Enlarging the distance between the HJ valve and the end of the cargo area (alternative 1) respectively the end (below deck) of zone 0 (alternative 2) to 12 m;

*Note 2:* The distance of 12 m results from the research carried out. At that distance the lower explosion limit is well underrun so an explosive atmosphere is very unlikely to occur at that distance.

- (b) Coamings (vertical protection wall) on deck from one side of the vessel to the other at the end (below deck) of zone 0 (alternative 2);
- (c) Coamings (vertical protection wall) surrounding the wheelhouse partly facing the cargo area and the hatchways in case the wheelhouse is movable (alternative 2).

#### **ad. 2 Protective measures**

8. The electrical and non-electrical (mechanical) equipment to be used within the zones should fulfil the requirements of the corresponding categories (according to *Directive 94/9/EC of the European Parliament and the Council of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres*):

Zone 0 ↔ category 1 equipment

Zone 1 ↔ category 2 equipment

Zone 2 ↔ category 3 equipment

#### **ad. 3 Additional protective measures**

9. Reduction of the probability that explosive vapour(gas)/air mixtures generated by leakages during loading and unloading reaches accommodation, wheelhouse and service areas outside the cargo area.

This can be achieved by a distance between the shore connections/vessel pumps and the end of the cargo area (alternative 1) respectively the end (below deck) of zone 0 (alternative 2) of at least 6 m.

10. Prevention of an uncontrolled spreading of leaking liquid into the area of accommodation, wheelhouse and service spaces outside the cargo area in order to prevent the generation of explosive vapour(gas)/air mixtures by the evaporation of the liquid in that area.

This could be achieved by the mounting of fixed coamings (vertical protection wall) on deck from one side of the vessel to the other at the end of the cargo area (alternative 1). With alternative 2 these coamings at the end (below deck) of zone 0 are an essential part of the zoning.

11. Prevention of the entry of explosive vapour(gas)/air mixtures generated by the vapours of the spilled liquid retained by the coamings into accommodation, wheelhouse and service areas outside the cargo area.

This could be achieved by a height of the fixed coaming (vertical protection wall) of  $\geq 20$  cm

- Note 3:*
- (a) Research showed that in the case of Acetone in the presence of cross-ventilation the concentration of the vapour/air mixtures generated above the surface of the liquid is below 25% of the LEL at a height of 10 cm above the surface of the liquid;
  - (b) 20 cm corresponds to the height of a step and would not constitute a tripping hazard.

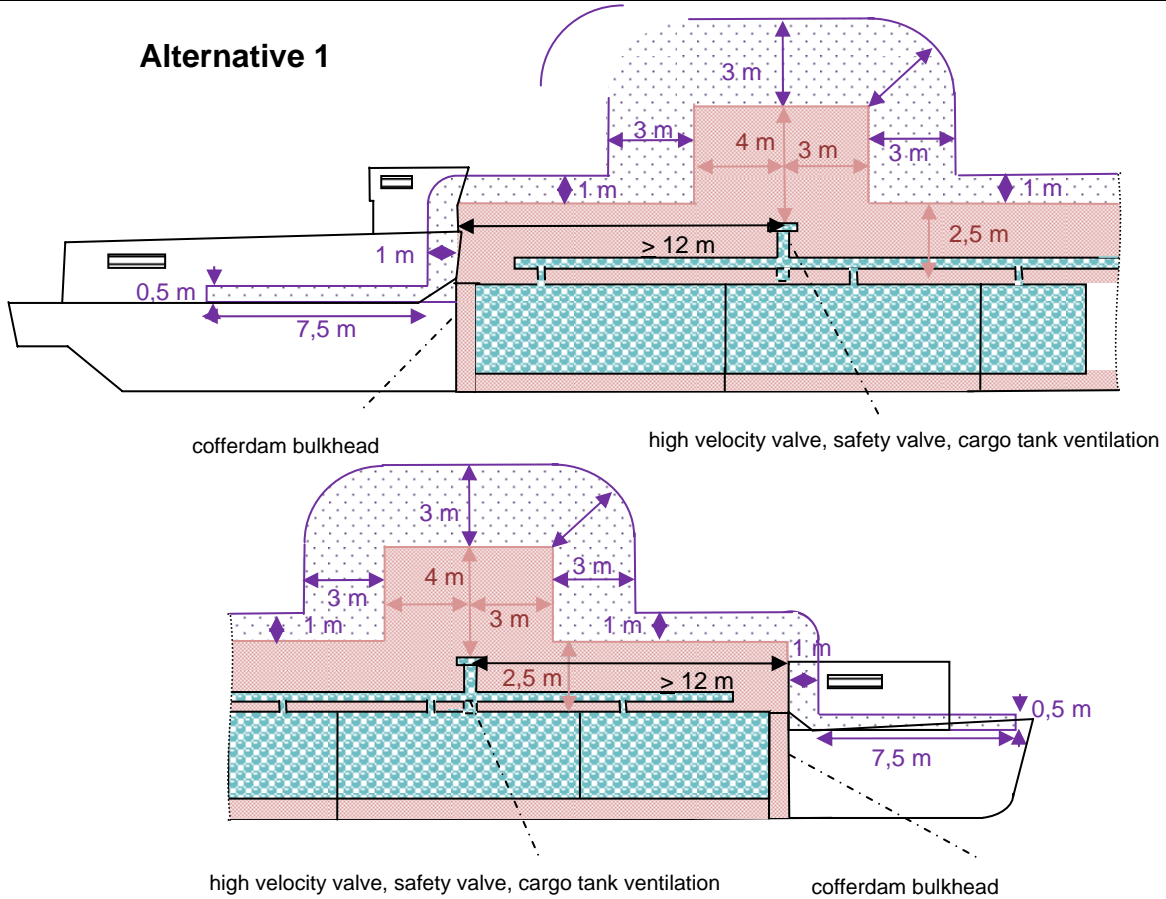
12. Prevention of the entry of explosive vapour(gas)/air mixtures generated by leaking vapours into accommodation, wheelhouse and service areas outside the cargo area.

This could be achieved by observing a minimum distance between the shore connections/vessel pumps and any kind of opening of accommodation, wheelhouse and services areas outside the cargo area:

- (a) If it is possible to observe a minimum distance of 12 m (see note 2) no further additional protective measures as stated in the current ADN - e.g. 9.3.x.52.3 - are necessary.
- (b) If a distance of at least 12 m is not feasible a minimum distance of 6 m has to be met and the further measures as stated in the current ADN - e.g. 9.3.x.52.3 - are necessary. However, if flammable gas detectors are used they have to have a response time  $t_{90}$  of  $< 4$  s and the ventilation of accommodation, wheelhouse and service areas outside the cargo area has to be cut off automatically when the flammable gas detector trips.

*Note4:* Currently used flammable gas detectors have a response time  $t_{90}$  (time to reach 90% of the final displayed signal) of 20 s and more. This is not fast enough with respect to the spreading of explosive vapour(gas)/air mixtures.

**Alternative 1**



**Zone 0:**

comprises:



Inside all cargo tanks, tank-containers or portable tanks, pipings containing cargoes or cargo vapours including their equipment as well as pumps and compressors.

**Zone 1:**

comprises



Inside all compartments within the part of the cargo area below deck not part of zone 0.

An area above the entire deck within the cargo area up to a height of 2.5 m as well as:

An area surrounding cylindrically the HJ/safety valves with a radius of 3.0 m up to a height of 4.0 m above the opening.

An area surrounding cylindrically the openings in zone 0 with a radius of 2.5 m up to a height of 2.5 m above the opening.

an area surrounding the ventilation openings of the service spaces located within the cargo area which are actively ventilated, comprising a radius of 1.0 m centered over the opening.

**Zone 2:**

comprises:



An area of 1.0 m in height and length following zone 1.

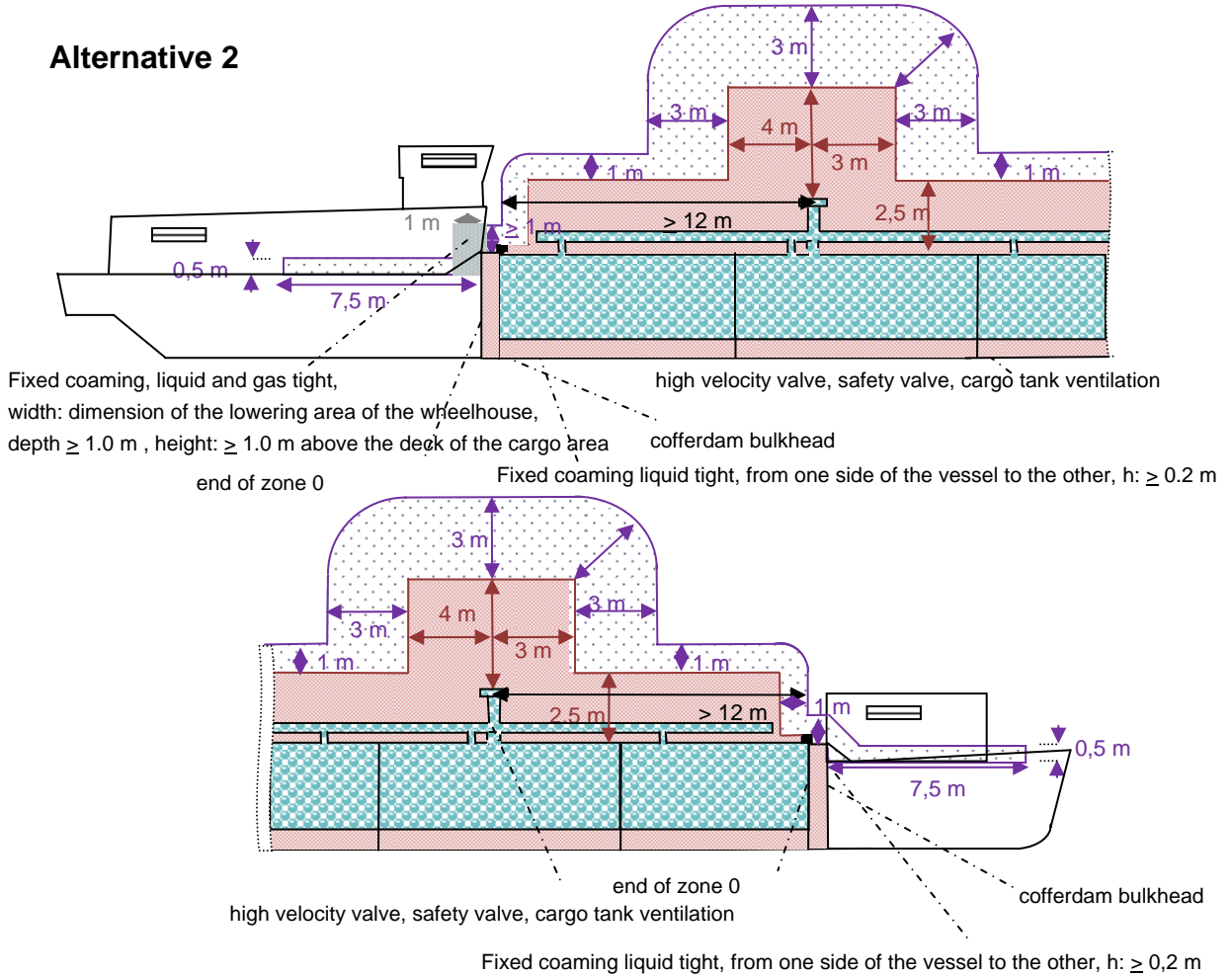
An area of 7.5 m in length and 0.5 m in height outside the cargo area adjacent to the aforementioned zone 2.

An area following zone 1 around the HJ/safety valves having an expansion of 3.0 m.

An area following zone 1 which surrounds the ventilation openings of the service spaces located within the cargo area which are actively ventilated, comprising a radius of 1.0 m centered over the opening.

The interior of closed compartments extending into zone 2 and being constructed in such a way that the penetration of gases from zone 2 is avoided, will not be part of the explosion-hazardous area.

**Alternative 2**



**Zone 0:**



comprises:  
Inside all cargo tanks, tank-containers or portable tanks, in pipings containing cargoes or cargo vapours including their equipment as well as pumps and compressors.

**Zone 1:**



comprises:  
Inside all compartments below deck within the part of the cargo area not part of zone 0.

An area above the deck within the cargo area up to a height of 2.5 m and in a length ending at the borders (below deck) of zone 0 as well as adjacent till the liquid-tight coaming up to the height of the coaming.

An area surrounding cylindrically the HJ/safety valves with a radius of 3.0 m up to a height of 4.0 m above the opening.

An area surrounding cylindrically the openings in zone 0 with a radius of 2.5 m up to a height of 2.5 m above the opening.

An area surrounding the ventilation openings of the service spaces located within the cargo area which are actively ventilated, comprising a radius of 1.0 m centered over the openings.

Zone 2: comprises:



Within the cargo area an area of 1.0 m in height and length following zone 1.

Adjacent on the afterdeck from one side of the vessel to the other an area of 1.0 m in length and 1.0 m in height related to the deck of the cargo area as well as an area of 7.5 m in length and 0.5 m in height related to the deck of the roof deck.

Adjacent on the foredeck an area accompanying the hatchways up to a height of 1.0 m well as an area of 7.5 m in length and 0.5 m in height.

An area following zone 1 around the HJ/safety valves having an expansion of 3.0 m.

An area following zone 1 which surrounds the ventilation openings of the service spaces located within the cargo area which are actively ventilated, comprising a radius of 1.0 m centered over the opening.

The interior of closed compartments extending into zone 2 and being constructed in such a way that the penetration of gases from zone 2 is avoided, will not be part of the explosion-hazardous area.

