
Economic Commission for Europe

Inland Transport Committee

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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)

Twentieth session

Geneva, 23–27 January 2012

Item 4 (b) of the provisional agenda

Proposals for amendments to the Regulations annexed to ADN:

Other proposals

Explosion protection on tank vessels

Transmitted by the German and Dutch Governments

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 m³ liquid and 10 m³/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. The main differences of the both alternatives to the current ADN are the dimensions of zone 1 and the clear assignment of a zone 2. Concerning zone 0 there are no changes. Both alternatives may however require (minor) constructional measures with sailing ships when becoming part of ADN.

- (a) Enlarging the distance in length between the end of the cargo area (alternative 1) respectively the end (below deck) of zone 0 (alternative 2) and the HJ valve to at least 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 distances from the HJ valve equal to or greater than 12 m.

- (b) 'Cargo-coamings' (vertical protection wall) liquid tight on deck from one side of the vessel to the other at the end (below deck) of zone 0 (alternative 2);
- (c) 'Wheelhouse-coaming' (vertical protection wall) liquid and gas tight 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 (manifold) 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 liquid tight 'cargo-coamings' (vertical protection wall) on deck from one side of the vessel to the other at the end of the cargo area (alternative 1), respectively the end (below deck) of zone 0 (alternative 2). With alternative 2 these 'cargo-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 'cargo-coamings' into accommodation, wheelhouse and service areas outside the cargo area.

This could be achieved by a height of the fixed 'cargo-coamings' (vertical protection wall) of ≥ 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.

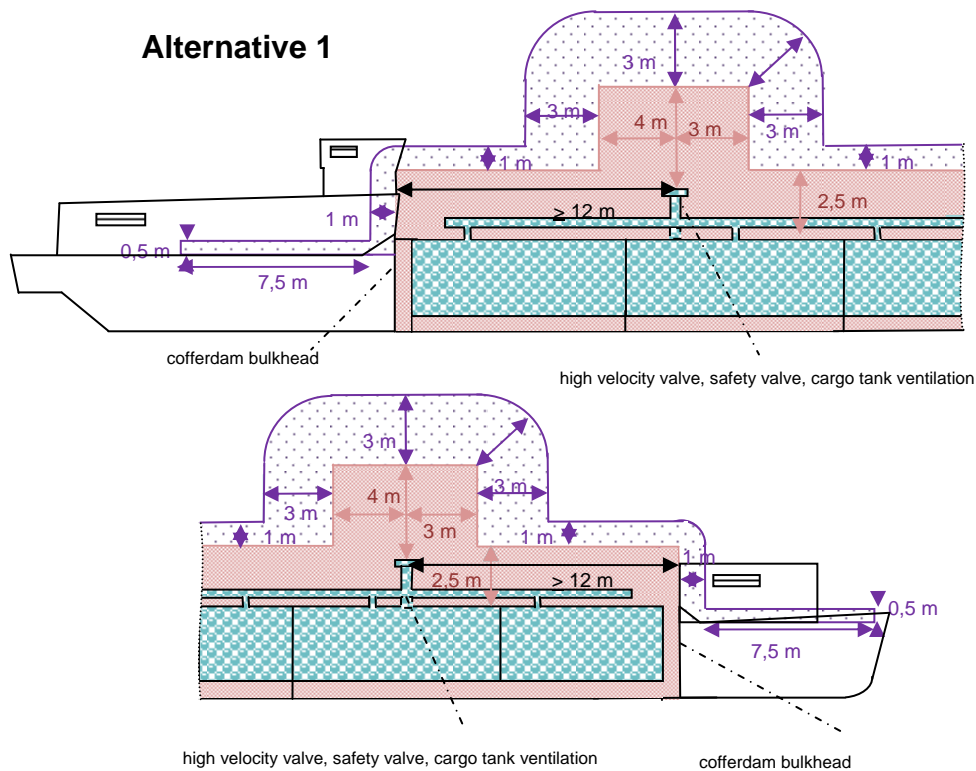
This could be achieved by ensure a minimum distance between the shore connections/vessel pumps (manifold) and any kind of opening of accommodation, wheelhouse and service areas outside the cargo area:

- (a) If it is possible to ensure a minimum distance of 12 m no further additional protective measures as stated in the current ADN - e.g. 9.3.x.52.3 - are necessary.

Note 4: 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 distances equal to or greater than 12 m.

- (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.

Note 5: 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.



Zone 0: comprises:



Inside all cargo tanks, tank-containers or portable tanks, pipings containing cargos 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 being not part of zone 0.

Compartments on deck within the cargo area

The deck from one side of the vessel to the other within the cargo area up to a height of 2.5 m:

whereas every opening in zone 0 except HJ/safety valves and shore connections/vessel pumps(manifold) has to be surrounded cylindrically by at least 2,5 m zone 1 up to a height of 2.5 m above the opening.

Note 6: This means the center of such openings has to have a distance of at least 2,5 m in width and length from the borders of zone 1 on deck.

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

A spherical segment 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.

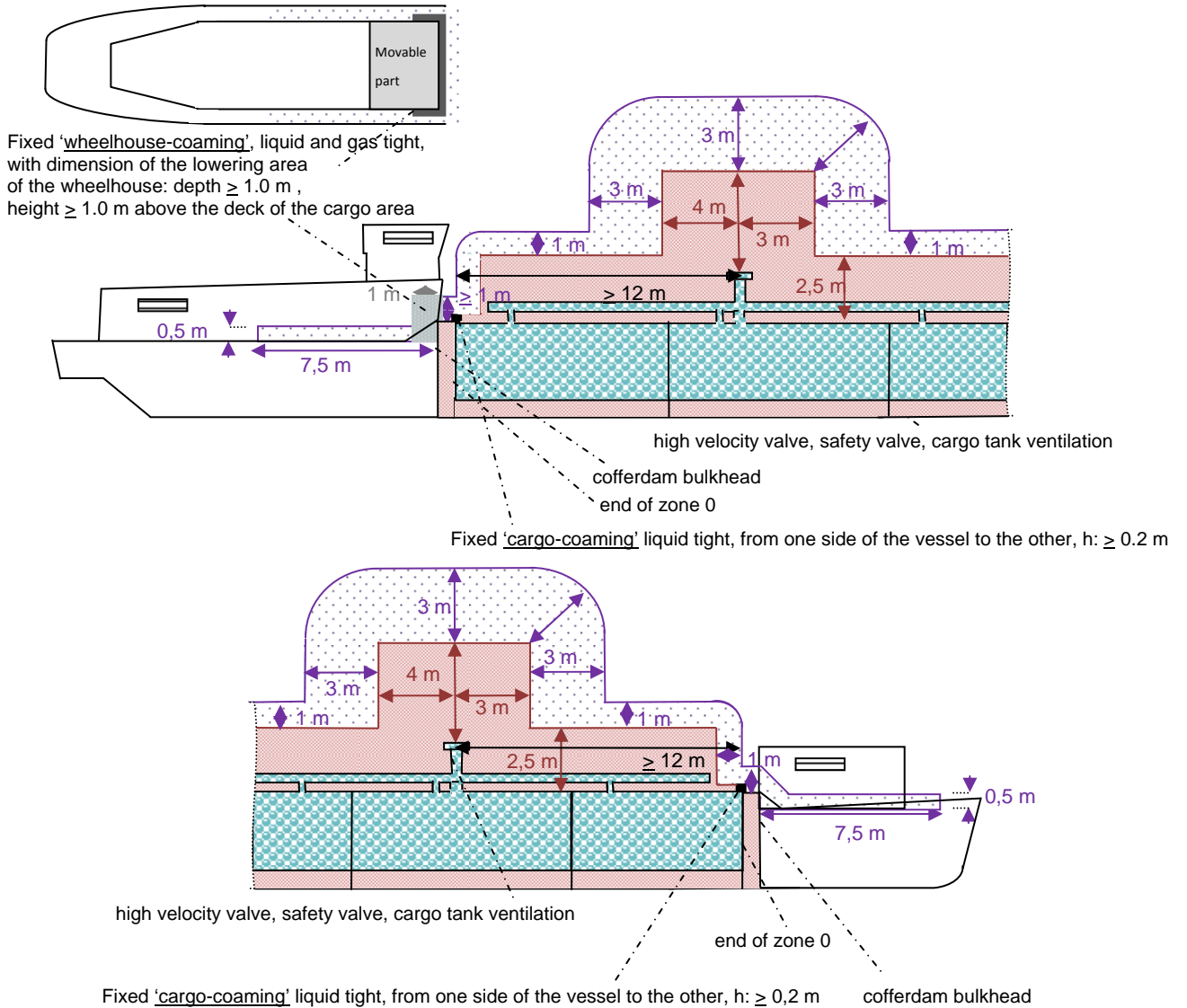
An area of 7.5 m in length and 0.5 m in height outside the cargo area adjacent to the aforementioned zone 2.

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

A spherical segment 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




Alternative 2 requires the following constructional measures as precondition:

- 'Cargo-coamings' (vertical protection wall), liquid tight' on deck from one side of the vessel to the other at the end (below deck) of zone 0
- 'Wheelhouse-coaming' (vertical protection wall) liquid and gas tight surrounding the wheelhouse partly facing the cargo area and the hatchways with a height of at least 1 m related to the deck of the cargo area. The parts facing the hatchways have of have a width of at least 1m

If these preconditions are fulfilled the zones are dimensioned as follows:

Zone 0: comprises:
 Inside all cargo tanks, tank-containers or portable tanks, in pipings containing cargos 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 being not part of zone 0.


Compartments on deck within the cargo area

An area above the deck within the cargo area up to a height of 2.5 m and in length ending 1 m before the end (below deck) of zone 0 as well as adjacent till the liquid-tight coaming located at the end (below deck) of zone 0 up to the height of the 'cargo-coamings', whereas every opening in zone 0 except HJ/safety valves shore connections/vessel pumps (manifold) has to be surrounded cylindrically by at least 2.5 m zone 1 up to a height of 2.5 m above the opening.

Note 7: This means the center of such openings has to have a distance of at least 2,5 m in width and 3,5 m length from the borders of zone 1 on deck.

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 of the HJ/safety valve.

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:
 on deck an area of 1.0 m in height and length following zone 1.

Adjacent on the afterdeck an area from the side of the vessel to the 'wheelhouse-coaming' in length and in height dimensioned as the 'wheelhouse-coaming' as well as a following area of 0.5 m in height till a complete length of 7,5 m from the end of the cargo area.

Adjacent on the foredeck an area accompanying the hatchways up to a height of 1.0 m and following area of 0.5 m in height till a complete length of 7,5 m from the end of the cargo area.

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.