

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)

Thirty-sixth session

Geneva, 27-30 January 2020

Item 4 (e) of the provisional agenda

Implementation of the European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN):

Matters related to classification societies

Proposal for an update of 9.3.4 (alternative constructions) of the ADN

Transmitted by the Group of ADN Recommended Classification Societies

1. During the meetings of the Group of Recommended Classification Societies it has been recognised that there's a need for updating 9.3.4 of the ADN. As the Dutch Institute of Applied Science (TNO) has been one of the parties which were heavily involved in the development of these requirements, this institute has been approached for assisting in the updating of this part.
 2. The Annex to this document reflects the proposal for the approach for the updating of this part. During the 36th session a presentation will be delivered by TNO to introduce the topic.
 3. The Safety Committee is invited to agree on the instalment of a temporary working group for this topic.
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Memorandum

To
UNECE Committee on Inland Transport, working party 3

From
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Subject
Revision ADN 9.3.4

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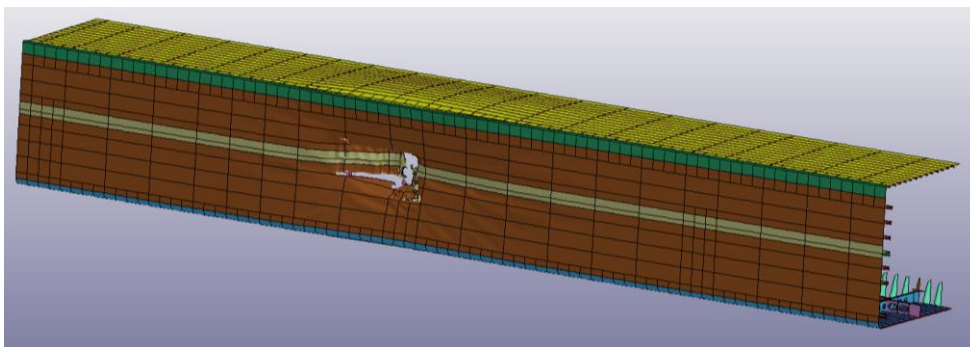
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Introduction

In the beginning of this century the ADN was extended with section 9.3.4 titled *Alternative Structures*. This section states that an inland waterway tanker can be equipped with cargo tanks exceeding the maximum allowable volume of 380 m³, as specified in section 9.3.1.11 of ADN, when sufficient collision protection is provided. It further describes how this can be demonstrated. Section 9.3.4 has been applied successfully over the last 25 years. The figure below illustrates a typical crash calculation result as demanded by the regulation.



There is an urgent need to revise section 9.3.4 because the collision energy curves are based on ship statistics dating from the 1990-ies. Moreover application of the regulation has revealed some shortcomings and ambiguities which must be rectified in the next revision.

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The most important issues in this respect are:

1. How to deal with structural designs with an exceptional high collision resistance, yielding a probability of leakage of zero?
2. Which fracture criteria to use in case of (new) materials such as lean duplex, S690, 316L, 304, high manganese and 9%nickel steels?
3. Which constraints/ contact options to use in the crash calculations especially in case of independent tanks?

There are also new tank types which have now entered the market, i.e. membrane tanks and vacuum pressure tanks, both cryogenic, which need to be addressed in the next version of 9.3.4 as well.

Another aspect the current upper limit of maximum tank size of 1000 m³. Some owners have indicated that raising this limit would be attractive to them. Hence in the revision process this aspect needs to be considered.

It is also felt that substantial simplifications are possible without jeopardising the goal of the regulation. The most important one is probably the concept of comparing a reference design to the new design. It may be possible to replace reference designs by reference energies. This would relieve the designers/ analysts from designing a reference design.

Proposal

It is proposed to carry out a project which generates the data required for revising section 9.3.4 of ADN and then, with this data available, update and revise the regulation. The following tasks are envisaged;

- a) develop a sound procedure for dealing with 'probability nil' cases (intrinsic safety),
- b) replace reference ship by reference energies,
- c) reduce # of collision scenarios,
- d) update collision energy statistics,
- e) identify meaningful fracture criteria for 'new' steels,
- f) expand the current guidance on how to conduct the FE calculations,
- g) reconsider the current 1000 m³ limit,
- h) consolidate results a) through f) in an updated formulation of regulation 9.3.4,
- i) discuss results with classification societies and flag authorities,
- j) defend results in ADN working party.

ad a) *probability nil cases*

Especially in case of type G tankers, cases are known where the collision energy absorbing capacities exceeds the value where the probability of encountering such an energy is zero. Currently the regulation does not cater for such cases explicitly, albeit that it does in general terms. This task is about developing/ formulating an explicit method for dealing with these cases.

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ad b) reference energies

Over the past 25 years crash calculations have been done on inland waterway tankers, which have been reported to the classification societies. Calculated energy absorbing capacities are therefore now available for a considerable number of reference ships featuring 380 m³ tanks, which comply with ADN. Hence, in principle, this data can be used to determine energies of failure for reference designs. These can then be included in the ADN regulations. Obviously, in case of a ship design not comparable to any ship in the data base, a reference design will still be required. The intention is however that this will be an exception rather than the rule.

ad c) # of collision scenarios

In the current regulations the number of collision scenarios to consider is large. In case of a chemical tanker, the number of collision locations may be as large as 18 (3 long. locations, 3 heights, 2 bows), both for the reference ship and the new design. On top of this comes the number of scenarios according 9.3.4.3.1.4.2, as shown below.

Tabelle: Geschwindigkeitsreduktionsfaktoren für Fall I oder II mit Gewichtungsfaktoren

Szenarien der ungünstigsten Fälle	V-förmiger Bug, Anfahrwinkel 90°	Schubbleichter-Bugform, Anfahrwinkel 55°	Ursachen		
			Kommunikationsfehler und schlechte Sicht	Technische Fehler	Menschliches Verhalten
I	0,20	0,80	0,50	0,20	0,30
II	0,20	0,80	0,66	0,50	1,00
	0,20	0,80	0,30		1,00

So per ship 5 x 18 = 90 cases must be analysed. This task is about investigating if this number can be reduced. If so a new specification will be drafted for this requirement.

ad d) updating collision energy statistics

The current cumulative probability density functions (CPDF) on collision energy available to inflict damage are based on statistics of the early 90ties. Since then ships have become larger and heavier. Therefore the CPDF's need to be updated. This can be done by tracking ship data, in terms of displacement and speed, from river information systems or gps. This data can then be 'organised' in bardiagrams from which CPDF's can be calculated.

ad e) fracture criteria for 'new' steels

New steels with large fracture strains (improving collision resistance) are entering the ship building market. The regulations should include some guidance on how to determine realistic fracture strains and which technical evidence should be provided to prove the qualities of the steel. This should allow for materials which are used under cryogenic conditions.

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ad f) *expand guidance on FE calculations*

The finite element analyses are very sensitive to boundary conditions, mesh size, the way contact between bow and struck structure and between structural elements is defined. Moreover the way the equations are solved and, in case of explicit analysis, the calculation time step size have an equally large influence on the results. It is therefore felt that in the regulations more guidance should be given on how to deal with these topics.

ad g) *reconsider 1000 m³ tank size limit,*

The upper tank size limit will be reconsidered through an effect analysis on chemical spills exceeding 1000 m³. This will be done in terms of affected area and population density of the affected area. The assessment of the results will be based on guidelines currently in place in The Netherlands for shore based installations.

ad h) *consolidate results*

The findings and results from the previous tasks will be documented and formulated in a fashion suitable for ADN. Finally chapter 9.3.4 will be rewritten.

ad i) *discuss results with classification societies and flag authorities*

This task is about discussing the revision with specialists within the classification societies. This will require face to face meeting and a few Skype meetings.

ad j) *defend results in ADN working party*

The results of the work described in this proposal as well as the final revision of 9.3.4 will be presented to the ADN working party. Amendments and additions, when approved by the working party, will be included in the revised regulation, which will then be submitted for approval.

Parties involved

It is proposed to establish a core group which is responsible for revising ADN regulation 9.3.4 consisting of parties who are familiar with applying the regulation. The parties which could already be identified in this respect are:

1. Damen Schelde Naval Shipbuilding,
2. Bureau Veritas,
3. DNV – GL,
4. Lloyd's Register,
5. TNO The Netherlands.

They have been or will be requested to participate in the revision effort. TNO is willing to chair this group. The project group will report to the UNECE Committee on Inland Transport, working party 3.

Schedule

It is proposed to complete this project in one year.