UNITED
NATIONS

E

Economic and Social Council

Distr.
GENERAL

ECE/TRANS/SC.3/WP.3/2010/6
2 December 2009

ENGLISH
Original: ENGLISH AND RUSSIAN

ECONOMIC COMMISSION FOR EUROPE

INLAND TRANSPORT COMMITTEE

Working Party on Inland Water Transport

Working Party on the Standardization of Technical and Safety Requirements in Inland Navigation

Thirty-sixth session
Geneva, 10-12 February 2010
Item 7 (e) of the provisional agenda

RESOLUTION NO. 61, "RECOMMENDATIONS ON HARMONIZED EUROPE-WIDE TECHNICAL REQUIREMENTS FOR INLAND NAVIGATION VESSELS"

Special provisions applicable to river-sea navigation vessels

Proposal submitted by the group of volunteers on Resolution No. 61

Note by the secretariat

At its fiftieth session, the Working Party on Inland Water Transport asked the group of volunteers on Resolution No. 61 to consider possible ways to develop specific requirements for sea-river vessels based on the proposal of the Russian Federation in ECE/TRANS/SC.3/2006/8 (ECE/TRANS/SC.3/174, para. 33).

The Working Party may wish to exchange opinions about the proposal on the first draft of Chapter 20B, "Special provisions applicable to river-sea navigation vessels", prepared by the group of volunteers.

DRAFT PROPOSAL ON CHAPTER 20B, "SPECIAL PROVISIONS APPLICABLE TO RIVER-SEA NAVIGATION VESSELS"

I. INTRODUCTION

1. During its fiftieth session, the Working Party on Inland Water Transport took note of the proposal by the Russian Federation on possible ways and methods to develop technical recommendations for river-sea navigation vessels (ECE/TRANS/SC.3/2006/8).

2. First draft of Chapter 20B, "Special provisions applicable to river-sea navigation vessels" was developed through two stages:

(a) Stage I: development of issues related to cargo vessels (dry cargo and tankers), passenger vessels, tugs and barges (dry cargo and tankers);

(b) Stage II: issues will be developed with reference to river-sea navigation of pushed convoys with prior justification of a selected coupling unit and available degrees of freedom provided in convoy articulation. Special attention was paid to this issue by Ukraine Shipping Register in its comment to document ECE/TRANS/SC.3/2006/8.

3. Results of stage I with respect to Resolution No. 61 were submitted to the group of volunteers in two documents: first draft Chapter 20B "Special provisions applicable to river-sea navigation vessels" and the Memorandum. The present document is the Memorandum to second draft Chapter 20B "Special provisions applicable to river-sea navigation vessels". It consists of:

(a) As far as stage I is concerned: clarifications introduced to the first draft proposal of Russia on river-sea navigation vessels with due regard to decisions of the 2nd meeting of the Group of Volunteers held on December 11-14, 2007 in Brussels;

(b) As far as stage II is concerned: basis for selection of type of the coupling device and number of degrees of freedom to be provided by coupling devices when connecting formations to a pushed convoy.

4. The draft Chapter 20B is presented in the addendum to this document.

II. DEVELOPMENT OF UNECE TECHNICAL REGULATIONS FOR RIVER-SEA NAVIGATION VESSELS

A. General

5. Section 20B-1 "General" on purposes and application scope is extended by addition of vessels of RS 6,0 class vessels and inland navigation vessels:

(a) para. 20B-1.1.2 (i) – vessels of RS 6,0 class are allowed for navigation on waves with 3 per cent probability of over-topping and height up to 6,0 m – closed seas up to 100 miles away from places of refuge (distance between places of refuge up to 200 miles); open seas up to 50 miles away from places of refuge (distance between places of refuge up to 100 miles);

(b) para. 20B-1.1.2 (vii) – inland navigation vessels are allowed for navigation according to established procedure in restricted zones between ports of the same country provided additional requirements to operational restrictions for navigation season and waves and special requirements to navigability, stability, hull structure, machinery, electrical equipment, navigational aids and communication equipment are met.

6. Special provisions for RS 6,0 class vessels on operational restrictions for navigation areas, waves (para. 20B-1.1.2 (i)), navigability (seaworthiness), hull structure (section 20B-3), stability

(sections 20B-3.4, 20B-3.5), subdivision (section 20B-3.4), ship arrangements and equipment (sections 20B-5-3, 20B-5.4) were developed with due regard to the requirements of the Rules for classification and construction of sea-going ships of the Russian Maritime Register of Shipping to vessels of R2–RSN class and provisions of international conventions.

7. It is recommended to apply special provisions for inland navigation vessels on operational restrictions for navigation seasons and waves, navigability (seaworthiness), stability, hull structure, machinery and electrical equipment, navigational aids and communication equipment (para. 20B-1.1.2 (vii)) according to the regulations of the Administration and/or a recognized classification society (para. 20B-1.1.4), i.e. in Belgium – on the basis of the Royal Decree on inland navigation vessels which are applicable also for coastal navigation.

B. Strength

8. Level of strength requirements to the hull of river-sea navigation vessels is directly related to the wave factor in navigation and defined by the main class notation of the vessel. The International Convention for Safety of Life at Sea (1974) places the issue of sea vessel hull strength within authority of a Classification Society recognized by Administration (Rule 3-1 Part A-1 “Vessel design”).

9. In Resolution No. 61, issues of inland vessel hull strength are also relegated to competences of Administrations. Therefore, a similar standing may well be adopted with reference to hull strength issues for river-sea navigation ships in the first draft Chapter 20B.

10. No more clarifications have been introduced to Section 20B-3.1 of the second draft Chapter 20B.

C. Design requirements

11. The scope of the abovementioned requirements is related, on the one hand, to the vessel class (as far as design solution to the hull strength is involved) and, on the other, to the vessel designation and her design particularities. These requirements are sufficiently well represented in regulations of various Classification Societies and applicable in development of river-sea navigation vessels under surveillance of Classification Societies.

12. Design requirements to vessels engaged in international voyages are given in the International Convention for Safety of Life at Sea (SOLAS-74), the International Convention for Prevention of Pollution from Ships (MARPOL 73/78) and the International Convention on Load Lines (LL 66/88). Compliance with requirements of these international conventions for river-sea navigation vessels engaged in international voyages is compulsory, therefore there is no need to refer to these in the text of the Regulations. There are, however, some requirements which developers deemed necessary to include in the Regulations, since these are also vital for coastal sailing vessels. Among these are requirements for double hull, safe access to the bow for tankers, chemicals carriers and gas tankers as well as requirements for navigation in icy environments.

13. No more clarifications have been introduced to Section 20B-3.2 of the second draft Chapter 20B.

D. Stability

14. Recommendations to stability of river-sea navigation vessels were developed on the basis of valid regulations of the Russian River Register and the Russian Maritime Register of

Shipping, they comply with the Intact Stability Code of 1993 and do not require additional clarifications and validations for section 20B-3.3 of the second draft Chapter 20B.

E. Subdivision

15. Recommendations of Section “Subdivision” are harmonized with the Rules of the Russian River Register and the Russian Maritime Register of Shipping for river-sea navigation vessels and they are not in contradiction to requirements of the International Convention for Safety of Life at Sea (1974).

16. No more clarifications are needed for Section 20B-3.4 of the second draft Chapter 20B.

F. Criteria to check vessel stability

17. Recommendations by weather criterion were harmonized with the Intact Stability Code with consideration for corrections 1, 2, 3 given in Section 1.6 of the first draft of the Memorandum and introduced to Section 20B-3.5.2 of the first draft Chapter 20B.

18. As far as for vessels of newly introduced class RS 6,0 static wind pressure P_v , Pa, is taken equal to 252 Pa and the lever arm means the distance between the centre of gravity of the lateral area and the centre of water pressure on the underwater part of the vessel or, approximately, half draught, m, there is no need for additional clarifications of correction 1 and correction 2 of Section 20B-3.5.2 of the first draft Chapter 20B for weather criterion.

19. Correction 3 has been expanded for class RS 6,0.

20. According to the Rules of classification society’s stability of vessels carrying bulk cargoes shall be checked by acceleration criterion k*.

$$k^* = \frac{0,3}{a_{des}} \geq 1,0 ,$$

where a_{des} is design acceleration in g-fractions (acceleration of gravity, g=9,81 m/s^2).

21. The standard of acceleration criteria is introduced in the Rules of Russian Maritime Register and those of the Russian River Register which covers all river-sea navigation vessels. The structure of formula to determine the design acceleration in the Rules of Russian River Register seems sufficiently substantiated and, therefore, taken as the basis:

$$a_{des} = 1,1 \cdot 10^{-3} B x^2 \theta_r .$$

22. When k^*<1,0, Administration can permit operation of a vessel with limited wave height in case of well-grounded application from a shipowner, thereby the height of waves with 3 per cent probability of over-topping shall be determined depending on the criterion k^* from Table 20B-3.5.3.1. Values of Table 20B-3.5.3.1 are taken from assumption of h being in linear dependence on k^*, as seen on the plot of Fig. 1.

23. The plot is based on values k^*<1 in determining the permitted height of waves with 3 per cent probability of over-topping as per the Rules of Russian River Register (Table 1).

Table 1

k^*	1,0 and above	1,0÷0,50	0,50 and below
$h_{3\%}$, m	3,5	3,0	2,5

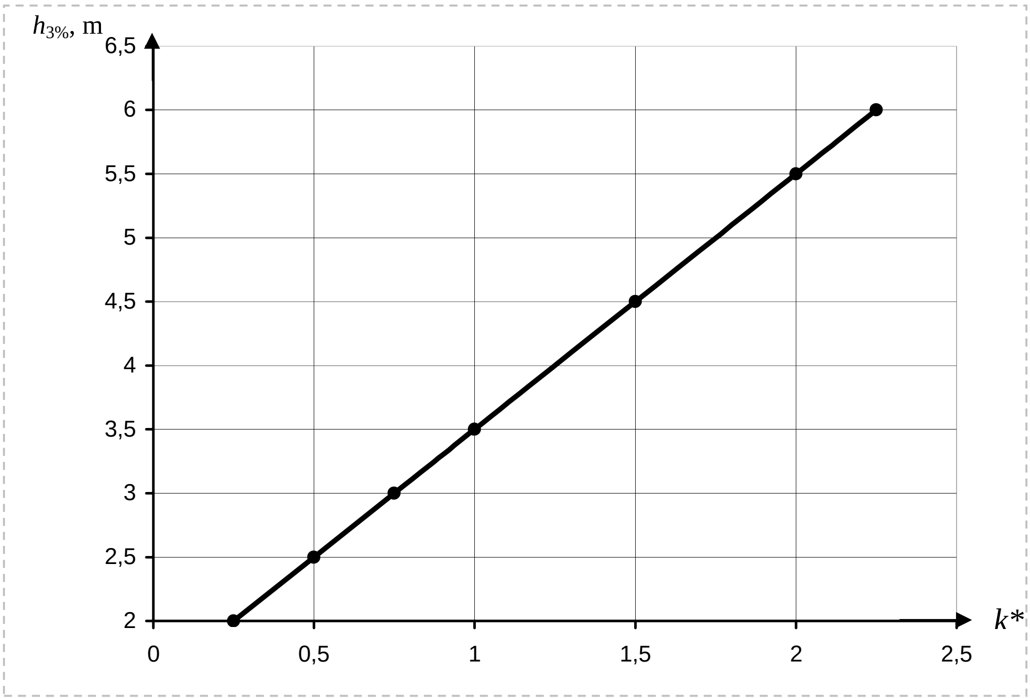

Fig. 1. Relationship between the wave height and calculated k^*

G. Fire protection

24. First draft Chapter 20B contains requirements for compliance with provisions of SOLAS-74 for vessels engaged both on coastal and international voyages (para. 20B-3A.1.1) as provision of structural fire protection to river-sea navigation vessels.

25. No more clarifications have been introduced to Section 20B-3.A of the second draft Chapter 20B.

H. Freeboard and load line

26. Due to introduction of class RS 6,0 to the second draft Chapter 20B a clarification has been added to para. 20B-4.2.1 providing that the minimal summer freeboard depth of RS 6,0 class vessel regardless of the voyage designation (coastal or international) shall be assigned according to the provisions of LL 66/88.

27. No more clarifications have been introduced to Section 20B-4.2 of the second draft Chapter 20B.

I. Ship mechanisms

28. Due to introduction of class RS 6,0 to the second draft Chapter 20B a new text of Section 20B-5.3 “Anchor equipment” has been introduced.

29. Provisions of the present Section for vessels of classes RS 2,0, RS 3,0, RS 3,5, RS 4,5 based on the analysis of the Russian River Register Rules, Resolution No. 61, International Code on Life-Saving Appliances (LSA Code), RVBR, SOLAS-74 with amendments have no changes.

30. Provisions for vessels of class RS 6,0 are based on the analysis of the Rules of Russian Maritime Register of Shipping depending of the equipment number. Formulae are added for calculation of the total mass of bow anchors (para. 20B-5.3.5) and total anchor chain length (para. 20B-5.3.6). Since these formulae are introduced for the first time, test calculations are shown as the basis for them. Results of test calculations have been compared with data based on the norms of Russian Maritime Register of Shipping.

Example 1. Determine the total mass of bow anchors of class RS 6,0 vessel with equipment number N_A = 800. Using the relevant formula of para. 20 B-5.3.5, kg:

$$P = 1/\left(1{,}997 \cdot 10^{-6} + 0{,}1625/N_A\right) = 1/\left(1{,}997 \cdot 10^{-6} + 0{,}1625/800\right) = 4875$$

31. Mass of one anchor is 2438 kg, this result differs from the tabular value from the Rules of Russian Maritime Register of Shipping by 0,9 per cent regarding the fact that tabular value of bow anchor mass — 2460 kg is taken for equipment number within the range 780 – 840.

32. For a vessel with average value of equipment number for the given range N_A =810 bow anchor mass P = 2467 kg thus differing from the tabular value from the Rules of Russian Maritime Register of Shipping by 0,3 per cent.

Example 2. Determine the total bow anchor chain length of class RS 6,0 vessel with equipment number NA = 1000. Using the relevant formula of para. 20 B-5.3.6, kg:

$$l_A = 57{,}19 + 9{,}12\left(\ln N_A\right)^2 = 57{,}19 + 9{,}12\left(6{,}908\right)^2 = 492{,}4$$

33. Calculated total anchor chain length is 492,4 m and differs from the tabular value from the Rules of Russian Maritime Register of Shipping by 0,5 per cent regarding the fact that the tabular value of the total anchor chain length 495,0 m is taken for equipment number within the range 980 – 1060.

34. Provisions for the mooring equipment are added in para. 20B-5.4.3 concerning the number and length of mooring ropes for class RS 6,0 vessels depending on the equipment number.

35. Sections 20 B-6 “Propulsion plant and systems”, 20B-8A “Prevention of pollution”, 20B-9 “Electrical equipment”, 20B-9A “Radio communication means”, 20B-9B.1 “Navigation aids” – no changes have been introduced.

III. BASIS FOR SELECTION OF COUPLING DEVICE TYPE AND NUMBER OF DEGREES OF FREEDOM TO BE PROVIDED BY COUPLING DEVICES WHEN CONNECTING SECTIONS TO A PUSHED CONVOY

36. For the purposes of the present Memorandum the following definition is introduced:

“Ship course”: vessel longitudinal axis direction measured clockwise by a deflection angle between the north part of meridian and stern part of vessel longitudinal axis from 0° to 360°.

37. Variants of transport systems for carrying cargoes in river-sea going vessels are shown on Fig. 2.

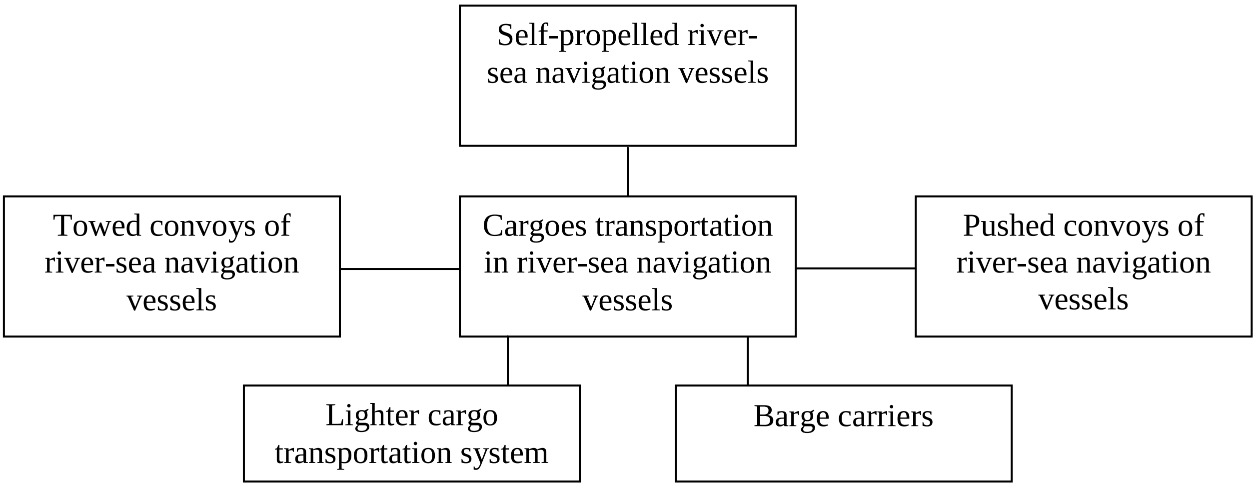

Fig. 2. Variants of transport systems for carrying cargoes in river-sea going vessels

38. Each of the systems shown in the Figure has advantages and in specific operating conditions may be the most efficient one.

39. On the basis of numerous feasibility reports the priority has been given to self-propelled vessels and river-sea navigation vessels.

40. The main reason hindering the development of sea and ocean transportations by pushed convoys had been the lack of reliable coupling device between the pusher and the barge. At the present moment there are patents for hundreds of designs for pusher-barge connection and new applications for patenting are under consideration. This fact proves that transportation system by sea-going pushed convoys is in urgent demand by many countries. Among a great number of patented designs of coupling devices only a few types have proven practical and are being implemented.

41. According to a comparative evaluation of test results of models of sea and river-sea navigation pushed convoys, the latter have specific features (regarding proportion of main dimensions, tonnage, draught, interaction of pusher and barge on waves etc.) which need to be modified for specific types of pushed convoys.

42. All coupling devices which are applied successfully on rivers and lakes proved to be ineffective in sea conditions. They come out of service for a very short period due to non-synchronous oscillations of the barge aft end and the pusher bow at pitching motions even at low waves.

43. The conclusion on non-applicability of coupling devices used on rivers and lakes for sea and ocean transportation has made it necessary to revise the initial basic recommendations of some experts and to further develop new types of coupling devices for sea-going pushed convoys. Publications and articles concerning designs and patents of coupling devices for sea-going pushed convoys can be found in literature of many countries, i.e. USA, Japan, Germany, UK, France, Belgium, Sweden, Norway, Czech Republic, Poland, Austria, Bulgaria, etc.

44. Classification diagram of coupling devices of pushed convoys with due regard to different special features is shown in Fig. 3.

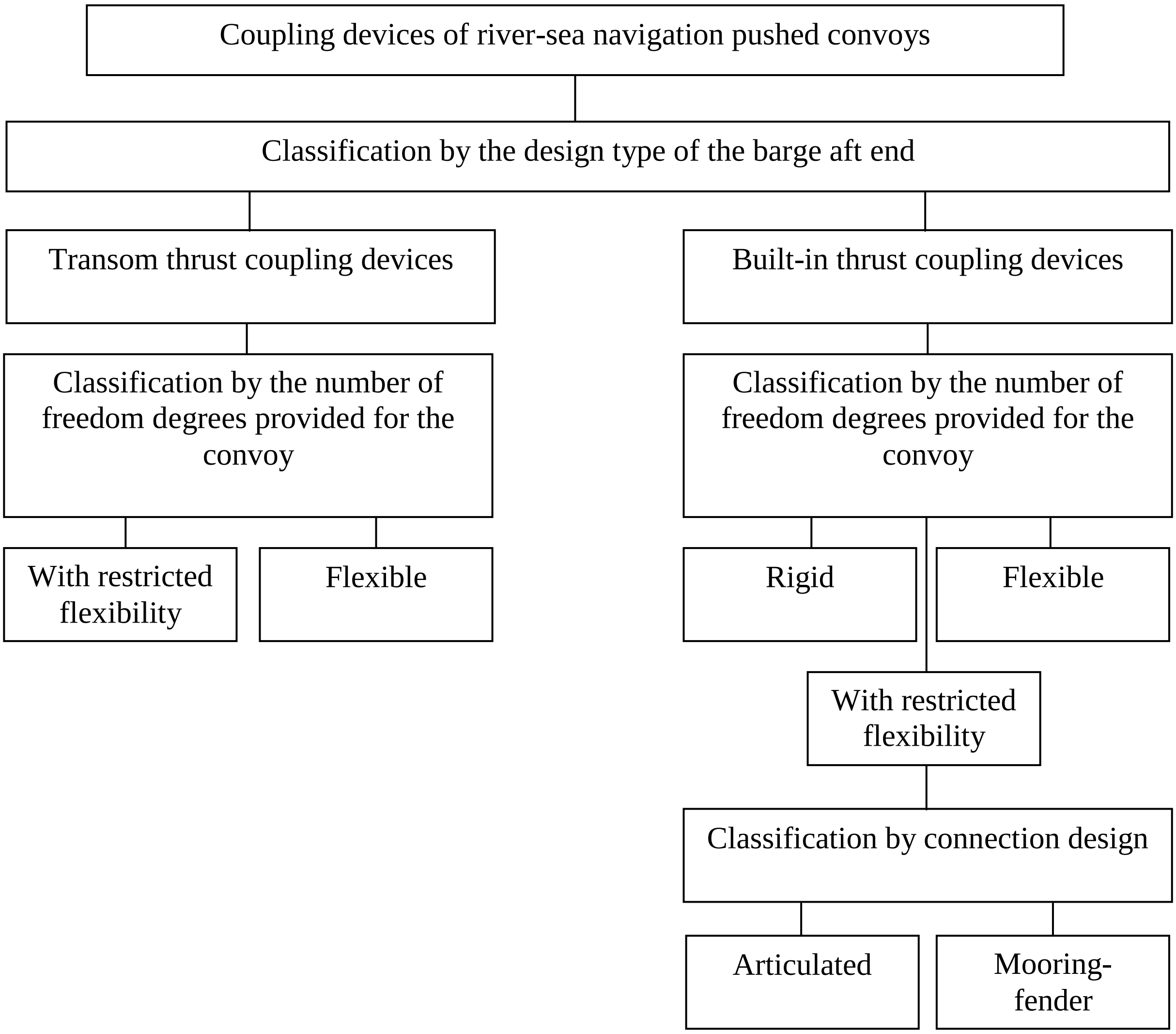

Fig. 3. Classification diagram of coupling devices of pushed convoys

45. Convoys with built-in coupling devices include those where the pusher enters the aft cut-out of the barge for a certain distance and is being connected with the barge there. Convoys with transom thrust include those convoys where the aft end of the pushed barge has no cut-outs for the pusher and the pushing is realized by special thrusts designed as a part of the coupling device.

46. Up to the present moment both types of coupling devices are developed and proven by practice. Typical examples of designs of coupling devices are shown below.

47. All coupling devices depending on the connection type can be divided into three main groups. The basis for this division is the number of degrees of freedom provided by the devices in the connection. The first group forms rigid connections; after connection the pusher and the barge form a structural unit preventing any relative displacements of both sections of the convoy.

Such coupling devices are used on pushed convoys of systems T.B.S., Mitsui T.B.S., Murviker, Catug, etc. The second group of coupling devices forms connections with restricted flexibility, where the pusher, after connection with the barge, can move relatively to the barge with one or two degrees of freedom (pitching or pitching-heaving motions).

48. There are two trends in developing design of coupling devices which are named according to the names of main connecting elements as articulated and mooring-fender connections. The articulated coupling system is the most popular one. Such systems as Artubar, First Joint, Articouple are widely known. The mooring-fender connection, one of simple designs, is not as popular, as the convoys with such coupling devices can operate only in closed seas or not far from the shore. Mooring-fender connections are used on pushed convoys of Belgian shipowners and by the Japanese company Mitsui Zosen.

49. The third group of coupling devices forms flexible connection where the connected pusher can move with three degrees of freedom relating to the barge (rolling, pitching and heaving motions) or with four degrees of freedom (rolling, pitching, heaving motions and transverse motions relative to the course direction). An example of a flexible connection is Seebeck system, developed by the German company Weser.

50. The following conclusions can be made as regards the design and selection of efficient types of coupling device when analyzing the specific features of river-sea navigation pushed convoys:

(a) priority shall be given to the development of integrated inland water transport systems which include ships, waterways (rivers, canals), hydraulic engineering facilities, ports etc. as compared with the design of individual ships;

(b) global strength of the convoy sections shall be the main condition for selection of the coupling device type for the ship length-depth ratios typical for river-sea navigation vessels;

(c) specific features of pusher-barge interaction at waves shall be considered, as the pusher and the barge are exposed to action of waves even at low waves due to small displacement.

51. Difficulties in combiing different and sometimes contradictory requirements for river-going and sea-going vessels have led to advanced investigations of pushed convoys or river-sea navigation in different aspects – fluid mechanics, fluid dynamics as well as construction mechanics.

52. The main conclusions are as follows:

(a) Rigid pusher-barge connection results in essential change of vertical bending moment in the barge hull;

(b) Replacing rigid coupling by articulated connection results in essential reduction of bending moment in the barge hull;

(c) Replacing rigid coupling by articulated connection results in reduction of vertical stresses in the coupling device at rolling, head sea and following sea;

(d) Selection of the type of coupling device can influence the main seaworthiness / navigability characteristics of the convoy. The main factor is the number of degrees of freedom of relative movements of the sections which are provided by the coupling device. Rigid connection leads to reduction of pitching (pitching-heaving) amplitude. At pitching of cargo section with articulated coupling device the vibration amplitude is usually being increased with speed increase at head sea and decreased at following sea, similar to vessels of traditional construction type. Amplitude-frequency parameters of oscillation motions of a convoy with articulated coupling device are higher than those of a convoy with a rigid coupling and lower than those of a convoy with flexible coupling;

(e) Model tests of flexible coupling convoy confirm the opinion of the experts that using flexible coupling for pushed river-sea convoys is not expedient due to worsening of habitability and possible jamming of the coupling when a convoy moves at oblique course to the wave direction due to significant rolling and yawing observed during the model tests;

(f) Decrease of pitching of the pusher leads to the decrease of additional resistance on waves. According to experimental data, additional resistance of the "rigid" model may be significantly lower than additional resistance of "articulated" model depending on waves' frequency. However, such improvement of navigability characteristics is reached by substantial increase of vertical loading in the coupling device therefore the pusher and barge hulls in the coupling area need to be strengthened. Vertical bending moment amidships the barge for rigid convoys is also increased as compared with the articulated convoy;

(g) In this respect the intermediate solution is the coupling device providing two degrees of freedom, i.e. relative angular and vertical movements. For this variant pitching of the pusher is decreased, but heaving is increased significantly, so no improvement of habitability and decrease of additional resistance are not observed unlikely to the rigid coupling. Moreover, for pushed river-sea convoys the increase of degrees of freedom at certain values of λ/L even impairs the convoy propulsion characteristics.

53. Therefore the preferable type of coupling device, of the most reliable and advanced types – rigid and restricted flexibility coupling devices – for shallow-draught pushed convoys of river-sea navigation, is the restricted flexibility (articulated) coupling device with one degree of freedom.

IV. CONCLUSION

54. Second draft of Chapter 20B "Special provisions applicable to river-sea navigation vessels" is based on the first draft with due regard to the provisions and recommendations of the Minutes of the second meeting of the group of volunteers which took place on December 11th – 14th, 2007 in Brussels.

55. It is proposed to organize further work on the second draft of Chapter 20B as follows:

(a) To circulate the materials to the members of the group for consideration;

(b) To discuss the changes introduced into the first draft of Chapter 20B, make corrections if necessary and discuss the submitted grounds for selection of the type of coupling device and number of degrees of freedom to be provided by the coupling device when connecting sections into the pushed convoy;

(c) To approve the respective proposal for the Working Party together with the recommendations for selection of the type of coupling device;

(d) With due regard to the results of discussion of the second draft Chapter 20B and grounds for selection of the type of coupling device by the group of volunteers, to start the second stage of work, i.e. to develop the recommendations of Chapter 20B as applied to pushed river-sea navigation convoys.

56. At the second stage of work the Russian side, which has already developed the provisions for coupling devices of pushed convoys of river-sea navigation, could prepare the first draft of provisions of Chapter 20B for pushed convoys of river-sea navigation.

- - - - -