CORRESPONDENCE GROUP ON GUIDELINES FOR UNIFORM OPERATING LIMITATIONS OF HIGH-SPEED CRAFT

DISCUSSION DOCUMENT FOR ROUND 1

COMMENTS FROM NGO RINA

Background

This Correspondence Group was established by DE 49 with the following terms of reference:

.1 *to develop draft Guidelines for uniform operating limitations of high-speed craft, taking into account documents DE 50/18, DE 49/5/3 and DE 49/INF.5 and comments and proposals made in plenary, as well as contributions from the COMSAR, NAV and SLF Sub-Committees as they become available; and*

.2 *to submit a report to DE 51.*

This work is required to be carried out in the context of the new paragraph 1.9.7 inserted in the 2000 HSC Code by res. MSC.222(82) as follows:

1.9.7 In determining the worst intended conditions and the operational limitations on all craft for insertion in the Permit to Operate, the Administration shall give consideration to all the parameters listed in annex 12. The limitations assigned shall be those that enable compliance with all of these factors.

Annex 12 to the 2000 HSC Code, as also adopted by res. MSC.222(82) states in part:

As a minimum, the following factors shall be considered:

.1 *The maximum distance from refuge implied by 1.3.4.*

.2 *The availability of rescue resources to comply with 1.4.12.1 (category A craft only).*

.3 *Minimum air temperature (susceptibility to icing), visibility and depth of water for safe operation as addressed by 1.4.61.*

.4 *The significant wave height and maximum mean wind speed used when applying the requirements for stability and buoyancy in chapter 2 and associated annexes.*

.5 *The safe seakeeping limitations (especially significant wave height) considering the known stability hazards listed in 2.1.5, the operating conditions on the intended route (see 18.1.3.2) and the motions experienced during operation defined in 3.3 of annex 9.*

.6 *The structural safety of the craft in critical design conditions according to chapter 3.*

.7 *The safe deployment and operation of evacuation systems and survival craft as required by 8.6.5.*

.8 *The safe handling limitations determined in accordance with the sea trials required by chapter 17 and annexes 3 and 9, identifying any limitations on weight and centre-of-gravity position according to 17.3, and the effects of failures and malfunctions according to 17.4.*

Consideration of Issues

The group should note the outcome of the consideration of this item by DE 50, and in particular paragraphs 18.3 and 18.5 in relation to the submission DE 50/18 by China. Bearing this in mind, of the documents referred to this group the only one that attempts to cover all of the factors from Annex 12 is DE 49/INF.5 (RINA).

The contents of DE 49/INF.5 have therefore been edited into a “first draft” of the required guidelines for consideration by the group. This editing process has involved re-ordering the text from DE 49/INF.5 to reflect the above list of factors and to delete comments that relate to possible future amendments to the Code rather than implementation of the existing Code. It has been done in something of a hurry in order to get the document into circulation, so any damage done to the content of the source document is regretted.

Depending on the comments received in relation to this draft, further text may need to be inserted to take appropriate account of DE 50/18 in similar manner to the text developed by the group in relation to factors 1 to 5 and 7 and 8.

Comments requested

Comments are sought on this document as follows:

- General comments on the proposal to use DE 49/INF.5 as the source document
- Comments on the accuracy of translation of the Appendix from DE 49/INF.5
- Proposals for incorporating material from DE 50/18
- Detailed comments for improving the Appendix

RINA: General Comment

It is suggested that it might be helpful to list all the specific issues to be addressed, and attempt to identify those which may involve or be the prime responsibility of other Sub-Committees.

RINA suggests that the principal subjects to be discussed can be itemised as follows:

- determination of wave height limits (including consideration of structure, stability, handling, evacuation, etc) (which would probably involve the DE, NAV, SLF Sub-Committees)
- presentation of wave height limits (that is their format and display of information on the bridge) (which would probably be the main responsibility of the DE Sub-Committee)
- application of other Worst Intended Conditions parameters (which would probably be the main responsibility of the DE Sub-Committee)
- interpretation of evacuation testing requirements (which would probably be the main responsibility of the DE Sub-Committee)
- assessment of rescue availability on a given route (which would probably be the main responsibility of the COMSAR Sub-Committee)
- ambiguity regarding craft motion limits and how they are recorded (which would probably be the main responsibility of the DE Sub-Committee)
- discretionary limitations:

- wash wave restrictions (which would probably involve the DE and NAV Sub-Committees)
- minimum safe speed to avoid worsening sea conditions (which would probably involve the DE and NAV Sub-Committees)
- navigational safety (which would probably be the main responsibility of the NAV Sub-Committee)

Of course delegates may be aware of other issues that should also be addressed in this work.

APPENDIX

SUGGESTED DRAFT OF GUIDELINES

1 INTRODUCTION

An explicit element of the *Code of Safety for High-Speed Craft, 2000* (2000 HSC Code – "the Code") is that unrestricted operation is not suitable for the high-speed craft it regulates and that operating limitations are necessary. In this regard, attention is drawn to clauses 1.2, 1.3.4 and 1.4.61 of the Code

These guidelines have been prepared to assist in the uniform implementation of paragraph 1.9.7 and Annex 12 of the Code and to provide information on the rationale underpinning such operating limitations.

Matters determining the operational limitations may be divided into three sectors:

- those affecting the safety of the craft as a whole;
- those specifically affecting the safety of the passengers and crew as individuals; and
- those affecting the safety of persons outside the craft.

The factors listed in each of the following sections can be related to one or more of these items.

Any operational limitations resulting from consideration of those factors should be clearly communicated to the craft's operating personnel and referenced on the Permit to Operate.

2 MAXIMUM DISTANCE FROM REFUGE (1.2.5 & 1.3.4 OF CODE)

Clause 1.3.4 gives time limits for passenger craft (4 hours) and cargo craft (8 hours) for the passage to a place of refuge when proceeding at operational speed (90% of maximum speed when fully loaded). This is to allow the craft to operate solely in areas where the necessary shore-based support is available and to safely retire to shelter in the event of changes in the weather and hence sea state.

This limitation is generally set by the referenced provisions of the Code, but should be clearly stated in the craft's documentation and preferably shown on the permit to operate unless covered indirectly (eg. by coordinates of boundaries of the operational area).

RINA Comment: A reference to the definition of "a place of refuge" given in 1.4.48 would be helpful.

3 AVAILABLE RESCUE AND OPERATIONAL SUPPORT RESOURCES (1.2.6, 1.2.7 & 1.4.12)

In some cases the operational limitations are functions of the resources available on the route, rather than the craft's limitations. Specifically, the Code is predicated on adequate communications facilities, weather forecasts and maintenance facilities being available within the area of craft operation. Taken in conjunction with the requirement for proximity to place of refuge, the weather forecast requirement is intended to facilitate timely decision-making with regard to seeking refuge.

In setting the operational limitations, the flag Administration should consider whether the wave height corresponding to the Worst Intended Conditions should be such as to permit the craft to complete its passage without relying on a drastic reduction in speed, thus increasing the exposure of the passengers and crew to progressively more severe conditions. Such consideration should be based on the concept that the craft may be considered its own best survival craft in deteriorating conditions, even up to Critical Design Conditions.

Clause 1.2.7 of the Code states: *"in the intended area of operation, suitable rescue facilities will be readily available."* Further, clause 1.4.12.1 states that a category A high-speed craft is one *"operating on a route where it has been demonstrated to the satisfaction of the flag and port States that there is a high probability* **RINA Comment:** It would be helpful if we could define "a high probability". *that in the event of an evacuation at any point of the route all passengers and crew can be rescued safely within the least of:*

- *the time to prevent persons in survival craft from exposure causing hypothermia in the worst intended conditions,*

- *the time appropriate with respect to environmental conditions and geographical features of the route, or*

- *4 hours"*

Although the Code gives no guidance on what constitutes "suitable rescue facilities", the Permit to Operate should only be issued where the flag and relevant coastal State Administrations are satisfied that appropriate measures have been implemented and an appropriate assessment made that demonstrates to their satisfaction that the Code's requirements are met across the operational area.

RINA Comment: It can be expected that COMSAR will debate the issue of availability of suitable rescue resources, and the CG should not pre-empt their input.

4 MINIMUM AIR TEMPERATURE, VISIBILITY & DEPTH OF WATER (1.4.61)

Clause 1.4.61, in defining the Worst Intended Conditions, makes specific reference to the following parameters, which should therefore appear on the Permit to Operate, when appropriate:

- significant wave height
- wind force
- minimum air temperature
- visibility (eg. impaired vision and at night)
- minimum safe water depth.

RINA Comment: It is suggested that some elaboration of most of these parameters would be helpful. For example:

Significant wave height: The significant wave height to be quoted should be that for which all of the following aspects of the craft operation have been shown to be satisfactory:

- compliance with the intact and damaged stability requirements,
- safe seakeeping behaviour, with regard to (for example) bow or tunnel slamming in head seas, bow diving in following seas, motions that are safe for the craft occupants,
- the structural integrity of the craft,
- the safe operation of the evacuation system.

Wind force: The wind force quoted should be that for which all of the following aspects of the craft operation have been shown to be satisfactory:

- compliance with the intact and damaged stability requirements,
- the safe operation of the evacuation system,
- safe manoeuvering when entering or leaving port.

Minimum air temperature: Account should be taken of whether:

- icing has been considered in the evaluation of stability
- the properties of the materials used in the construction of the craft may be adversely affected.

Visibility: Account should be taken of:

- craft stopping distance
- whether night-vision equipment is fitted
- the requirements of pilotage on the routes being operated

Minimum safe water depth: Account should be taken of:

- squat and trim at speed in respect of navigational safety
- local environmental regulations
- the hazard of wash waves to nearby small craft and persons on the shoreline, and any restrictions on craft speed in relation to water depth[1] in order to avoid this should be stipulated in the Permit to Operate. Some Administrations require a formal risk assessment in respect of the wash hazard. (Further details of a wash wave risk assessment could be included in an annex.)

Other parameters: Attention is drawn to the last sentence of 1.4.61 of the Code, which refers to: *"and such other parameters as the Administration may require in considering the type of craft in the area of operation."* Administrations are therefore permitted to include such other parameters as they consider to be appropriate. Should we include any further examples?

[1] This would be the same for all high-speed craft as it is based on depth Froude Number.

5 SIGNIFICANT WAVE HEIGHT & MAXIMUM MEAN WIND SPEED FOR STABILITY AND BUOYANCY (CH. 2 & ANNEXES)

RINA Comment: It is suggested that the guidelines may be more readily understood if all aspects relating to the determination of limiting significant wave height are discussed in one main section, of which the following could then form one sub-section.

It is important that all aspects affecting the maximum significant wave height are addressed collectively, so that the Permit to Operate stipulates that which satisfies all the various requirements.

Several of the parameters used in evaluation of the stability and buoyancy relate to the environmental conditions. For example in:

- clause 2.6.11 the required minimum residual freeboard to downflooding is a function of the significant wave height corresponding to the Worst Intended Conditions; and

- Annex 7, 1.3 and 2.2, demonstration of sufficient residual stability uses the wind speed corresponding to the Worst Intended Conditions. Similarly in Annex 6, 1.1.4 and Annex 8, 1.1 and 2.1.4.3.

Therefore, the limiting significant wave height and the limiting mean wind speed used in compliance with the stability requirements should always be considered in setting the operational limits.

6 SAFE SEAKEEPING LIMITATIONS FOR DYNAMIC STABILITY (2.1.5, 18.1.3.2, 3.3 OF ANNEX 9)

RINA Comment: It is suggested that the guidelines may be more readily understood if all aspects relating to the determination of limiting significant wave height are discussed in one main section, of which the following could then form one sub-section.

Safe operation of most high-speed craft is significantly affected by the sea state. Safe seakeeping limitations may be as a result of some of the examples listed in clauses 2.1.5 and 17.5.4.1 of the Code, including most particularly: propensity to deck diving or broaching; incidence of hull or wet-deck slamming; plough-in, yawing and turning.

Implied but not explicit these limitations should also include excessively violent motions affecting the passengers and crew (see also 9 below).

Clause 18.1.3.2 of the 2000 HSC Code requires that the Administration be satisfied that the operating conditions on the intended route are within the capabilities of the craft. This should be verified during the full-scale tests, model tests or mathematical simulations conducted in accordance with Annex 9 and invoked by clause 17.2.1. It is suggested that it would be helpful to clarify the meaning of 18.1.3.2 as to whether this should include Critical Design Conditions.

Administrations should note that clause 3.1.2 of Annex 9 of the Code explicitly states that "*worst intended conditions, referred to in 1.4.57 of this Code, are those in which it shall be possible to maintain safe cruise without exceptional piloting skill. However, operations at all headings relative to the wind and sea may not be possible."* This provision should be taken into account when setting operational limitations.

Operational limitations in respect of significant wave height may be presented in a number of forms, including:

- polar diagram showing safely attainable speed versus wave height and relative heading, since the safe speed in head seas will often be less than that attainable on other headings (see Figure 1 below);

- graph having different lines for head, beam and following seas (see Figure 2 below); or

- a tabular summary of such data.

> ***Question:*** Should one agreed format be recommended, in order to facilitate rapid understanding?

Furthermore, the installation of instruments for onboard monitoring of vertical and lateral accelerations may assist in determining whether to restrict craft speed in order to avoid motions that are hazardous to the occupants.

[Insert Figures 1 and 2 from DE 49/INF.5 here]

7 STRUCTURAL SAFETY OF CRAFT (CH. 3)

RINA Comment: It is suggested that the guidelines may be more readily understood if all aspects relating to the determination of limiting significant wave height are discussed in one main section, of which the following could then form one sub-section.

It is clearly vital to the structural integrity of a high-speed craft that the craft is not operated outside the limitations to which the structure has been designed.

Classification societies generally base their maximum structural design loads on the vertical acceleration at LCG corresponding to the design significant wave height and the maximum craft speed.

The class society Rules generally include a method to predict the design vertical acceleration of average of 1 / 100 highest vertical accelerations for the design significant wave height and the maximum craft speed, that also includes the parameters of deadrise, displacement and running trim. This maximum structural load is referred to in Annex 3 Table 1 under “Type of Load “.

However because of the reference to 4.3.1 there can be the misunderstanding that the vertical acceleration to determine the maximum structural design load need not exceed 1.0 g

It is suggested that this be clarified by indicating that the design acceleration is the average of 1 / 100 highest accelerations determined by the classification society for the design significant wave height and maximum craft speed.

Where the resulting design vertical acceleration is less than 1.0 g, suggest the structural design is to be based on 1.0 g or possibly greater minimum value to establish a minimum structural strength that will ensure the structural integrity of the hull will exceed the upper level of vertical acceleration for passenger safety

It is understood that the vertical acceleration of 1.0 g referred to in 4.3.1 is considered by the Code as the maximum value for passenger safety, and not the maximum value for hull structural safety.

The craft operational envelope curve of craft speed versus significant wave height is determined based on not exceeding the design vertical acceleration at LCG. However such a diagram is usually only applicable to head seas, which generally comprise the most onerous case.

This operational envelope curve should consider; normal operation conditions, worst intended conditions and the critical design condition.

Sometimes speed reduction in waves may be involuntary, due to increased resistance. But quite often, deliberate speed reduction may be required in order to stay within safe limits.

RINA Comment on DE 50/18:

RINA considers that issues of structural safety should continue to be addressed through classification society rules, and notes that the equation proposed by China is very similar to that used by classification societies. Furthermore, many more issues in addition to structural safety in head seas need to be addressed by the guidelines.

8 SAFE DEPLOYMENT OF EVACUATION SYSTEMS & SURVIVAL CRAFT (8.6.5)

The Code places great emphasis on the ability to evacuate a high-speed craft quickly and safely, the maximum evacuation time being linked (in 4.8.1) to the Structural Fire Protection time. To this end, 8.6.5 requires that: *"Survival craft shall be capable of being launched and then boarded ... in all operational conditions and also in all conditions of flooding ...."*

Clarification would be helpful as to whether "all operational conditions" includes all conditions up to and including the Worst Intended Conditions (defined in 1.4.61) or up to and including Critical Design Conditions (defined in 1.4.19). In implementing 8.6.5, flag Administrations should take account of whether the operating limitations of the craft are less restrictive than the conditions to which the craft's MESs and survival craft have been subjected during type-approval and as a result whether an evacuation in worst intended conditions is likely to be conducted in relative safety.

(RINA) Clause 8.1.3 of the Code states:

"Before giving approval to lifesaving appliances and arrangements, the Administration shall ensure that such … arrangements are tested."

Some Administrations infer that such testing must take place in the Worst Intended Conditions in order to comply with 8.6.5. It could also be inferred that such testing should also be extended to rescue boats – see clause 8.7.5.

RINA Comment: It is suggested that an agreed interpretation of the intent of the Code is required, for example answering the following questions:

(a) Should a sea evacuation trial be required on each craft, or first of each class of craft, or alternatively should reliance be placed on type approval trials?

(b) If a sea trial is required, should operational wave height be limited to that in which this trial has been conducted?

(c) Alternatively should the operational wave height be limited to some multiple of that in which this trial has been conducted?

(d) If a sea trial is required, what precisely is required to be demonstrated?

NB 1: Smaller HSC are often not fitted with an MES and survival craft are boarded directly.

NB 2: Consideration should be given to the difficulties of obtaining the necessary sea and wind conditions for the conduct of the trials, and the hazard to personnel being evacuated as part of such a trial.

NB 3: The risks to personnel during MES trials may be reduced by:

(i) testing the strength of the system by loading the survival craft with water ballast, if necessary including a safety margin on the load to be tested, and

(ii) restricting the actual passage of personnel down the MES to a small number of persons.

Whichever approach is decided upon, an explicit methodology for complying with these requirements is needed.

9 SAFE HANDLING LIMITATIONS (CH.17 & ANNEXES 3 AND 9)

The Code makes reference to three Safety Levels (see Table 1 in Annex 3) and prescribes the acceptable probability that each Safety Level may occur. Level 1 is expected to have a probability of occurrence of greater than 10^{-5}, i.e. Frequent or Reasonably Probable. Table 1 in Annex 3 reveals that for Safety Level 1 (Minor Effect) only prescribes that horizontal accelerations should not exceed 0.2g.

Whilst such a limitation is entirely appropriate, no limitation whatsoever is given in terms of vertical acceleration. In this context the question is whether people are liable to fall if standing or be thrown out of their seats due to excessively violent motion. Motion sickness is not the issue.

Similarly, Table 1 in Annex of the 2000 HSC Code stipulates acceptable maximum horizontal accelerations for severe and extreme operating conditions.

Table 2 in Annex 3 of the 2000 HSC Code makes it clear that Safety Level 2 relates to conditions when emergency procedures are required and passengers may be injured, and Level 3 to conditions when there is a large reduction in safety margins, and serious injury to a small number of occupants may occur.

The upper limit of Level 2 corresponds to the Worst Intended Conditions - see 3.3.2 of Annex 9 of the Code. The onset of Level 2 could be used to define the conditions in which passengers must be seated.

Many forms of high-speed craft may have safe handling limitations as suggested in 17.5.4.1 of the Code, for example:

- Amphibious hovercraft may have to avoid certain speed and drift angle combinations in order that plough-in or skirt tuck-under and possible capsizing do not occur.

- Guidance may be required on avoiding or minimising bow-diving or broaching. **(RINA)**

- Many forms of high-speed craft may have to avoid excessive bow-down trim in order to preserve safe manoeuvring behaviour - see clause 17.2.1 of the 2000 HSC Code.

Chapter 17 of the 2000 HSC Code requires that safe handling limitations for normal service conditions are determined by sea trials supplemented by model tests where appropriate, as described in Annex 9, and documented in the Craft Operating Manual. Sometimes such documentation may need to be reinforced by warning plaques.

RINA Comment:

It is suggested that a number of issues need to be addressed, including:

(a) emphasizing the need to conduct safe handling trials, especially for less conventional craft such as hovercraft, hydrofoils, SWATHs or hybrid types,

(b) emphasizing the need to evaluate the action to be taken in the event of hardware or system failures (clause 17.4 refers)

(c) the meaning and application of clause 3.3.2 of Annex 9, which states that *"nor shall any other craft characteristic motion such as pitch, roll and yaw exceed levels that could impede the safety of passengers"*. Should limits on pitch, roll and yaw motions be indicated? Should maximum vertical accelerations within occupied spaces be included?

RINA submits that excessive vertical accelerations could impede the safety of passengers, not in respect of motion sickness, but of the danger of falling or being unseated. It should also be noted that clause 17.1 requires: *"As a minimum, the system shall measure accelerations in three axes close to the craft longitudinal centre of gravity."* It seems logical to use such data to verify that any required Safety Level is not being exceeded. It is therefore suggested that the guidelines should include limits on maximum acceleration in relation to Safety Level.

(d) clarification of how craft motions are to be measured and assessed (see Annex 9, clause 3.2 and the footnote 1 to Annex 3, Table 1). Views differ on the measurement parameters necessary in order to ensure that maximum values of acceleration are adequately identified.