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INTACT SHIP STABILITY – THE WAY AHEAD

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SUMMARY

This paper, prepared as introduction to the Session on Stability Standards: the Way Ahead, contains some notes and considerations of the author following the discussion of the item Revision of the Intact Stability Code at the recent meeting of the IMO Sub-Committee on Stability and Load Lines and Fishing Vessels Stability held in London in July 2002.

1. INTRODUCTION

Ship Stability rules were introduced at a very late stage of Naval Architecture development. This is particularly true for rules accepted at international level.

1.1 AT THE BEGINNING THERE WAS THE DAMAGE

The intact stability at IMO[1] was originated, as Adam's rib, by a recommendation contained in the conclusions of SOLAS'60. "The Conference, having considered proposals made by certain governments to adopt as part of the present Convention regulations for intact stability, concluded that further study should be given to these proposals and to any other relevant material which may be submitted by international Governments.
The Conference therefore recommends that the Organization should, at a convenient opportunity, initiate studies on the basis of the information referred to above, of:

a) intact stability of passenger ships;
b) intact stability of cargo ships;
c) intact stability of fishing vessels, and
d) standards of stability information…"

The evidence presented at SLF 44 in September 2001 by a number of national delegations and in particular the documents prepared by Germany and Italy gathered sufficient consensus to propose to the Maritime Safety Committee the introduction of the item Revision of Intact Stability Code for the next SLF 45 (July 2002).
Both an ad hoc working group and an intersessional correspondence group were constituted under the chairmanship of the author and of Mr. Mains respectively.
In Appendix a synthesis of the draft final document containing the conclusions of SLF45 is given with particular emphasis on the points relevant to the discussion contained in this paper.

[1] at the time IMCO – for simplicity in the following we will use throughout the paper the present denominations IMO and SLF even when speaking of previous bodies.

2. THE INTACT STABILITY IN PRESENT IMO INSTRUMENTS

There is general consideration about nomenclature. The term "Stability" in ship stability matters has not the same meaning as in theoretical mechanics. It could be more appropriately be represented by "boundedness" of a relevant motion, usually rolling [1,2]. Anyway, the intact stability provisions grew in time, starting almost in 1968 with IMO Res A.167 and are now collected in a couple of publications [3] and an MSC Circular [4]. Actually, the Intact Stability Code covers several ship typologies, but the core of the recommendations can be grouped in three main typologies which, apart considerations on their being mandatory or not, are to be applied simultaneously. Each of these possesses pros and cons, but undoubtedly constituted a step forward in the road of increasing safety of navigation.

2.1 IMO RES. A167 ("STATISTICAL CRITERION") 1968

This recommendation originated from the studies of Rahola [5] and was developed in terms of global quantities related to in initial metacentric height, static and dynamic stability arms satisfying a set of standards obtained empirically from statistics of casualties.
It is simple to use. On the other hand it is difficult to improve, has no physical modelling, no mention to sea state [6] and the level of safety is *presently* unknown (although there is some claim of 60-70% to 80-85% [7] with respect to the *original* sample of ships).
The introduction of A.267 constituted a tremendous improvement of previous state of art regarding stability at international level (practically …nothing!). In comparison all subsequent changes and new introduction can be considered *smooth* changes…

2.2 IMO RES. A.562 ("WEATHER CRITERION") 1985

Again, this recommendation originated as an answer to a recommendation given in the conclusions of SOLAS'74:
"(IMO) Recommends that steps be taken to formulate improved international standards on intact stability of

ships taking into account, *inter alia*, external forces affecting ships in a seaway which may lead to capsizing or to unacceptable angles of heel".

Weather Criteria were already enforced in several countries including Japan and Australia. We just mention here [8,9] that present weather criterion was obtained merging the Japanese standard, which still constitutes the "backbone", with the Russian standard especially for the evaluation of roll-back angle and the effect of appendices on roll damping.

It is simple to use, it is based on a (although rough) physical modelling [10] and it can be improved and "updated" to some extent for new ship typologies. On the other hand, the simplified modelling takes into account only beam waves and wind, while no internal degree of freedom is introduced (shifting of cargo, water on deck, etc.). Finally it concerns only one mode of ship loss. Here too the level of safety is to a large extent unknown, although some studies [11-14] try to quantify it with quite different figures, also depending on ship typologies. In principle, the level of safety (probability of non-capsizing) is "computable" once assumed a mission profile [15] or in general terms connected with the expected operational life of the ship in the environment assigned by the criterion rules.

2.3 MSC CIRCULAR 707 OF 1995.

This addresses the operational indications to avoid dangerous phenomena occurring in longitudinal/quartering waves. Stability is not directly addressed but safety in the mentioned environmental conditions is the primary concern. This circular is relatively simply to use. On the other hand, no provision is included for head seas, for stability standards or for manoeuvrability standards.

2.4 GENERAL COMMENTS ON THESE INSTRUMENTS

The general outcome of Res. A.167 and A.562 is typically in the form of a limiting curve for GM or KG as a function of ship draught. Comparisons have been made for families of ships of same typology between statistical and weather criteria requirements [16,17], generally finding that the second one is more severe. Comparisons have also been made between A.562, A.167 and SOLAS'90 for particular types of ships, like the modern large passenger cruise ships. In this case it was found that weather criterion is exceedingly more severe that SOLAS'90 [8,9,18].

It has to be observed that the A.167 is usually only marginally subjected to criticism, while the other two instruments are severely criticized. On the other hand, the set A.562+MSC Circ.707 in the original Japanese formulation constitute a set of complementary rules giving:

- indications of operational value to avoid parametric rolling/surf riding/broaching, i.e. guidance on route/speed;
- provisions for ship survival in the extreme case of loss of ship controllability (failure in the set engine/propulsion/rudder) as a consequence of which the ship falls at zero speed in quasi beam sea condition.

In addition, the weather criterion was supplemented by a GM and a GZ criteria (something relative of A.167).

2.5 RECOMMENDED VERSUS MANDATORY

An additional item adds some confusion to the picture: the question of being mandatory or only recommended. There is overlapping of competencies between International rules, national rules, rules of the Classification Societies, the International Society of Classification Societies and recently the role of European Community. The IMO Intact Stability Code itself is a recommendation, but many national codes, the IACS, ect., make it mandatory…

3. SIMPLICITY VERSUS PHYSICAL MODELLING

As a general rule IMO approach to change safety rules is based on the statement "New regulations should provide the same average level of safety of existing ones". There are indeed several factors behind the endorsement (and the success) of new approaches in addition to reliability and sound physical basis:

- simplicity;
- economic implications;
- connection with engineering design practice.

As an example of importance of simplicity and connection with engineering design practice, we can consider the introduction and the development of new subdivision and stability rules based on probability to replace the traditional SOLAS'60 approach based on the concept of floodable length. After many years work and cont emporary to SOLAS'74, IMO Res. A.265 was produced. It took into account the new ship typologies, the probabilities, the environmental action, the different distribution of spaces on board (engine rooms!) with respect to the formulas used in SOLAS'60, etc.

The new formulation was more sound, but much more complicated, without simple connection with design and with a puzzling "equivalent level of safety" to SOLAS.

As a result, very few applications were made up to now and it is still under discussion at present, although very deep studies progressed on the subject in the last almost 30 years!

As an example of the importance of the economic implications, we can quote the formula of the four factors [19] *Persons on board/Payload/Ship/Environment* proposed recently to balance the subdivision index of different ship typologies in the attempt to cope with the very different "physical" indexes obtained by a pure hydrostatic/dynamic approach.

Finally, we can consider the factor “simplicity” versus “physical modelling” considering [2] the fact that A.167 practically gives rules so that the righting arm in calm water stays “sufficiently high” in a “sufficiently large range of angles”. As such, it cannot be reasonably improved. On the contrary, it is just the typical standard that, used in “optimisation procedures” can produce horrible results in terms of safety although satisfying the rules (see also [26]. The statistical criterion, in fact, is an "a posteriori" one. In addition, it expresses a correlation between observed ship losses, in a particular class of ships sailing a very restricted region, and computed static stability characteristics. The main criticisms can be sinthetically expressed as:

a) there is no direct connection between the requests and the needs. The criterion does not involve seakeeping qualities, the forcing effect of meteomarine environment, trim variations, coupling among different motions, course keeping ability, shifting of cargo, etc;
b) the statistical nature of the correlation averages between good and bad projects (with respect to safety), as a result, the good projects are penalized;
c) as long as the ship remains intact, the probability of casualty at sea is usually quite low as regards the mentioned mechanisms. Since ships are objects with a quite high index of reliability, this means that a few bad projects can be heavily conditioning. This means that even a small subset of casualties only explainable as a wrong correlation attempt as per a), can render the system almost "incompressible" in the sense that a very strong additional request (i.e. a very low KG reducing drastically the payload) contributes to a negligibly small increase in the observed safety at sea.

This could be advocated as a partial justification of the negative consideration paid by the owners to improving stability criteria.
Lets go back to 1982 [20], see also [1,2], (the square brakes in the reported text are by the author):
“Investigations into accident sometimes reveal that the relationships between safety, a word often used in an abstract way, and design, constructional and operational aspects are not always fully appreciated by those who are responsible. Furthermore, over-simplified [at the time A.167 and the still to come but under discussion A.562] regulations or codes of practice may inhibit sufficient original thought being directed to safety.
Ship stability [this issue is a recurrent one in ship stability debates] is, unfortunately, a property which is not amenable to simple definition. From the protracted debates at IMCO over the last 20 years it is evident that there has been developing world wide a desire to seek a better solution than is reflected in existing stability criteria.”
As an answer to this, in UK the SAFESHIP Project was undertaken. SAFESHIP Project was a very valuable one, on the other hand, no substantial change in IMO rules was produces from its results.
On the other hand [21]:
“Ship designers and approving authorities need to have guidance on what are acceptable safe minimum values of stability properties for the many different types and sizes of ships”.

4. PREVIOUS HISTORY

Depending on the philosophical doctrine, history can be seen as continuous progress, discontinuous progress or even complete chaos. In the first case we say that it is monotonic (in agreement with mathematical analysis), while it tends to be monotonous when same things happen repeatedly. This is to some extent the case of development of stability rules, as we shall see in this paragraph.

4.1 TIME NEEDED TO PREVIOUS CHANGES

A great amount of work on ship stability was done in the frame of IMO and outside, as it is witnessed by the huge volumes containing the proceedings of the 7 International Conferences on Stability of Ships and Ocean Vehicles or “STAB”, of the 5 International Workshops on Ship Stability and Operational Safety or “IWS”, by the investments and results obtained from Research Programmes (mainly at national level) in Japan, UK (SAFESHIP), Norway, etc.
Nevertheless, the progress in IMO regulations was slow with an average time interval of 20-30 years between scientific evidence and practical application:

- A.167 from Rahola PhD Thesis[5] (1939) to 1968;
- A.562 from Yamagata [22] paper (1959) to 1985
- MSC 707 from Takaishi [23] paper (1982) to 1995.

4.2 TWO-WAYS APPROACH

Both Kobylinski [24] and Bird [21], who played a relevant role in IMO/SLF working groups at the time (starting 1962), report that, following the SOLAS’60 recommendation, a working group was formed with a short and a long term goals. In order to make available usable criteria in the short term the Sub-Committee decided that “as a first step simple stability criteria applicable to ships under 100 m in length should be formulated”. These were to be based on an analysis of casualty data. For longer term development of improved criteria the Sub-Committee agreed “to continue studies on ships’ stability, paying particular attention to the effect of external forces and on variations of displacement on stability with a view to developing improved (rational) stability criteria”. The short term ended in A.167, while the long term was passed to a new working group in 1975.

Again the short term approach was devoted to immediate problems like the offshore supply vessels for which making compliance with the A.167 was impracticable. Due to the difficulties of progressing the long term fundamental programme [qualified as rational, risk-based, taken probabilities into account, containing a satisfactory physical modelling, etc] it was decided, as an interim solution, to develop a weather criterion. This took several sessions to complete. The view of IMO was that it should complement A.167 instead of replacing it.

It was also decided that the most dangerous situations, beam and following sea, were to be addressed separately, while the head sea condition was not interesting inasmuch as it was not present in the records of casualties.

In a series of interesting papers [25-27] Kobylinsky debates his view of developing "rational" criteria, reporting also the difficulties to correctly understanding the exact meaning of this term in IMO discussions. Finally he gives-up [27] "From the above discussion the conclusion could be drawn that there is practically no chance to develop new rational (probabilistic?) criteria which would substantially improve safety against capsizing. To assure safety only by inbuilt features is unfeasible; no ship could be built which can not be capsized by negligence or bad operation (difference between *artificial intelligence* and *natural one* in [1]). It seems on the other hand that the existing criteria serve quite satisfactory the design purposes, although they do not assure absolute safety. Therefore in order to increase safety against capsizing the stress should be put elsewhere."

Attention should thus be moved to operational measures…

4.3 TIME NEEDED TO NEXT (SUBSTANTIAL) CHANGE

The papers presented at SLF 45 by German delegation [28-30] call for a substantial change in IMO attitude towards Intact Ship Stability passing from prescriptive rules to *performance based* rules. As we have seen in this paper, something similar was in the long term programme several times, but contingency and theoretical limitations always stopped its development.

Subdivision and stability rules are slowly migrating from a deterministic environment to a (mild) probabilistic one taking also into account the presence of waves.

A probabilistic approach for intact stability, based on time domain simulation, has been introduced in the long term part of a two ways programme of revision of intact stability code (see Appendix). The initial prevision of time needed to complete the exercise is 5 to 10 years depending on the degree of complexity of phenomena required to simulate in efficient way. Again international cooperation is called to overcome the many difficulties and to produce a tool useful to evaluate the effect of ship design parameters (not limited to KG) on ship safety in a seaway. These should in principle take into account the phenomena in sea from any direction, including head seas [31, 32].

5. POLISHING VERSUS DELETING

Some documents presented at SLF45 and in particular that of the Italian delegation [18] required the modification/updating of Weather Criterion, while the discussion in plenary opened also the possibility of its deletion *tout court*.

The discussions in the working group and the final discussions in plenary rejected this possibility in the short term on the basis that this is a criterion containing at least a rough physical modelling and it can thus be improved by changing some formulas and tables, while leaving as it is the general philosophy.

Additional evidence is thus required as regards all details of its application:

- computation of roll-back angle;
- computation of wind effect;
- evaluation of gust effect;

especially for ships with parameters (B/T, Roll period, CB, …) out of the ranges used at the time of initial formulation.

Some proposals for factors "r" and for factor "s" are reported in Appendix, while other are contained in other papers [6,8,9,33] or are subject of research at national or international level.

For factor "r" (effective wave slope coefficient) it is clear that the formula contained in [3] is not acceptable for OG/draught>0 and in any case when it leads to r>1. On the other hand the evaluation of r by computations based on Froude-Krylov hypothesis did not prove to be reliable [34]. In addition, the evaluation of "r" cannot be separated from that of the damping [35] …

One important aspect, connected with the factor "s" is the following:

"how big is a big wave?", of course with reference to the presence of *a train of waves able to excite large amplitude rolling* in beam sea conditions. Present rules assume that at a period of 30 seconds the waves are higher about 50 meters (Fig. 1). This is surely unrealistic.

Proposal contained in Table 3.2.2.3-4 are based on a 27 meters wave, but there is still matter for discussion. For example, Pierrottet [36], who can be considered a precursor of Weather Criterion stated that there are no significant waves longer than 600 m (~20 seconds).

Should for example we be contented by assuming as an upper limit for the nominal wave height h_{max}=20 m ?

It is clear that the choice of the worse meteomarine condition is important in any approach to ship stability.

The choice made by SLF for the short term does not mean that in the long term present criteria could not be substituted by performance based criteria, but the evaluation of the equivalent level of safety rests on the presently unknown level of safety, and there are still many aspects that need to be clarified in developing a performance based criterion.

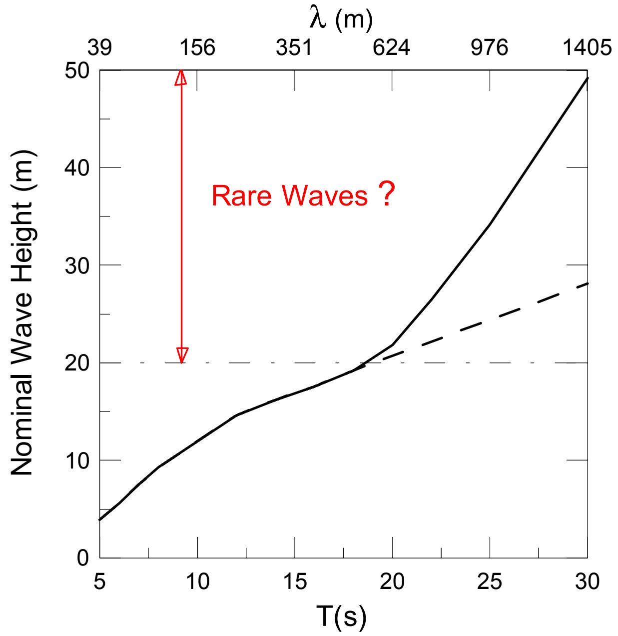

Fig. 1.Nominal wave height corresponding to nominal present IMO Weather Criterion factor "s" as per [3] (solid line) and proposed as per table 3.2.2.3-4 (dashed line).

6. WHY INTACT STABILITY

Unlike other means of transportation, ships are complex objects operating at the surface of separation between water and air and frequently travelling in high waves and hostile environment. This unique peculiarity entails big problems as regards safety of navigation, and yet ships are usually a highly reliable mean of transportation and recreation. It is not easy, however to model the behaviour in an environment characterised by waves and wind taking into account the relevant differences in ship typologies and scope. The conclusion of SAFESHIP Project was [20]:
"The SAFESHIP project has confirmed how complex a subject is stability when attempt is made to account adequately for wind, waves and dynamic motions".
Damage stability criteria only consider a limited environmental action and don't take into account properly the dynamics of motion that can lead to a ship loss through a chain of factors even in the intact ship condition. There is thus a continuous need to develop stability criteria, design recommendations and codes of practice to ensure safety taking into account extreme environment but also ship route and speed controllability, cargo securing, water on deck, effects of liquid or semi-liquid cargoes, etc.
In the safety of a complex system some level of redundancy is in any case acceptable to account for unforeseen effects.

7. CONCLUSIONS

The proposal of formulating rational ship stability criteria based on performance [37] or of building a rational alternative to the weather criterion based on nonlinear systems theory [38] and the requirement to include head sea among the dangerous situations [32] are again on the table.

7.1 DIFFICULTIES CONNECTED WITH NEW PROPOSALS

Some important problems are waiting a clarification (hopefully starting with this session!). Numerical time domain simulation tools indeed:

- are very attractive;
- allow to improve physical modelling both intensively and extensively;
- are versatile and, differently from existing prescriptive rules, allow effective design optimisation preserving or improving the level of safety;

On the other hand there are also problems connected with:

- proprietary software;
- reliability;
- rough simplifications presently required (3D nonlinear hydro+aero-dynamics for extreme motions in extreme weather is not around the corner);
- difficulty/ambiguity in defining the "non-return threshold";
- the performance standard are so different from prescriptive standards?
- design optimisation/level of safety connected with mission profile, but what happens changing mission profile?

7.2 CHANCES OF SUCCESS

A look to previous history as reported in this paper could appear disheartening at first glance. Many things are changed, however, at scientific level. Present state of the art, benefiting from the previous intensive research, shows great improvements in the capability of simulating complex phenomena in time domain. The possibility to conduct a direct assessment based on analytical, numerical, experimental or combined approaches accepted during the discussion at SLF45 (Appendix, point 6.7) is also a key factor for future developments.
A look to the proceedings of the 5th IWS or of the 23rd ITTC Specialist Committee on Extreme Motions and Capsizing where a comparative exercise was undertaken to check the ability of time domain simulations to predict capsize is encouraging, although the solution is not around the corner. The time domain simulation is indeed much more effective in the simpler case of damage stability, which to some extent ends as a quasi-static phenomenon, than in the intact stability case, where complex dynamics and multi degrees of freedom approach is heavily involved. There is of course a need of international

cooperation and of standardisation of computer codes and experimental procedure. We strongly recommend, to this end, the continuation f the ITTC Specialist Committee on Extreme Motions and Capsizing as a permanent Committee and the establishment of mutual relations between ITTC and IMO.

8. ACKNOWLEDGEMENTS

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9. DISCLAIMER

Although this paper was written while the author was serving as chairman of the IMO ad hoc Working Group on the Revision of Intact Stability Code, the content only expresses the opinions of the author.

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APPENDIX

DRAFT REPORT TO THE MARITIME SAFETY COMMITTEE (IMO Document SLF 45/WP.10 – 25 July 2002)

Parts 1 to 5.12 omitted

6 REVIEW OF THE INTACT STABILITY CODE

6.1 The Sub-Committee recalled that SLF 44, following discussion on further action to be taken with regard to the proposals for amendments to the IS Code contained in submissions to that and previous sessions, had agreed that there was sufficient justification to select the item on “Review of the Intact Stability Code” for inclusion in the provisional agenda for this session, subject to the approval by the Committee, … omitted.

Establishment of the working group and its terms of reference

6.4 As agreed at SLF 44, the Sub-Committee established the Working Group on Revision of the Intact Stability Code, and instructed it to:

1. prepare a work methodology and scope for the revision exercise, taking into account the discussion in plenary on a two-way approach, whereby, on a short term basis, a plan of action leading to the completion of a list of tasks by 2004, as scheduled, could be identified, possibly including the interim deletion of some criteria, and, on a long-term basis, a redevelopment of the Code could be undertaken according to a performance standards approach, identifying at the same time how long it would take to complete the exercise;
2. consider in detail all the documents submitted to this session on the subject together with the comments thereon made in plenary;
3. commence discussing the proposed modifications of the Code, bearing in mind the suggested work methodology and scope referred to in subparagraph 1. above;
4. consider whether it is necessary to establish a correspondence group to progress the tasks intersessionally and, if so, prepare relevant draft terms of reference for consideration in plenary; and
5. submit a written report (part 1) on progress made by thursday, 25 July, and continue working through to the end of the week and submit a further report (part 2) to SLF46, which should also be taken into account by the correspondence group, if established.

Work methodology and scope for the revision exercise of the Code

6.6 The Sub-Committee agreed to a two-way approach, which would, on one hand, allow the completion of some tasks by 2004, as scheduled, and, on the other hand, give time for developing performance-based criteria, taking into account the information contained in document SLF 45/6/2.

6.7 In this context, the Sub-Committee, identifying the possibility of developing a physical description of phenomena and scenarios as a means to improve upon a prescriptive approach, agreed that the gathering of information on experience gained so far and on ongoing and planned research projects would be useful when distributing the different tasks according to a two-way approach.

6.8 Having recognised that the time needed for the development of fully matured performance-based criteria could be in the range of five years, the Sub-

Committee agreed that the work methodology should be based on the following plan of action:

.1 identification of the areas of concern;

.2 collection of information on the existing related knowledge on the areas of concern and identification of the needs for future research;

.3 setting up the framework of performance-based stability criteria; and

.4 definition of criteria with appropriate standards.

6.9 The Sub-Committee endorsed the recommendation of the group that the scope of the revision exercise should include the preparation of instructions for the ship's crew on matters addressed by the Code, as well as the possibility to conduct a direct assessment based on analytical, numerical, experimental or combined approaches and agreed that due attention should be given to dangerous phenomena, such as parametric rolling.

6.10 The Sub-Committee also agreed that other means of demonstrating compliance with the requirements of any part of the future revised Code might be accepted, provided that the method chosen be shown to provide an equivalent level of safety. Such methods might include:

.1 mathematical simulation of dynamic behaviour;

.2 scale model testing; and

.3 full-scale trials.

Consideration of proposed amendments to the code

6.11 Taking into account the fact that two more sessions were allocated for the completion of tasks included in the newly identified short-term component of the two-way approach, the Sub-Committee considered the proposed amendments to the Code, as contained in the documents submitted and agreed as outlined in paragraphs 6.12 to 6.23.

Free surface effects of tanks

6.12 omitted

Consideration of issues raised in document SLF 45/6/1

6.13 to 6.16 omitted

Weather criterion

6.17 The Sub-Committee considered the weather criterion in section 3.2 of the Code, taking into account documents SLF 45/6/3 (Germany) and SLF 45/6/5 (Italy) and recognised that the existing criterion proved to be unsuitable for certain ships, owing to the unreliable estimation of the rolling period, of the coefficients "r" and "s", or of the wind moment, etc.

6.18 Taking into account the concerns expressed regarding the existing weather criterion, the Sub-Committee agreed to instruct the correspondence group to review this criterion as a matter of priority and, in the meantime, agreed to the proposed amendments of the "r" and "s" factors as follows:

$$\begin{cases} r = 0.73 + 0.6\dfrac{\overline{OG}}{d} \\ \text{but not greather than 1 (one)} \end{cases}$$

Table 3.2.2.3-4 – Values of factor "s"

T	s
≤ 6	0.100
7	0.098
8	0.093
12	0.065
14	0.053
16	0.044
18	0.038
20	0.032
22	0.028
24	0.025
26	0.023
28	0.021
30	0.020

6.19 On a provisional basis, the Sub-Committee endorsed the recommendation of the group that s=0.020 for "T">30 seconds and agreed that the values of relevant quantities of the weather criterion could be alternatively obtained from appropriate numerical calculations, scale model experiments or full-scale trials.

Anti-rolling devices

6.20 omitted

Consideration of document SLF 45/6/6

6.21 omitted

Head-Sea parametric rolling

6.22 The Sub-Committee took note of the information on head-sea parametric rolling based on the investigation conducted following the casualty of a C11 class post-Panamax containership, and, in particular the lack of unified standards by recognized organizations for predicting lifetime maxima for ship motions and accelerations, as well as the reluctance of the shipping community to recognize the severity of head-sea parametric rolling, as illustrated by this casualty.

6.23 The Sub-Committee also noted the information on the SNAME ad hoc Panel on investigation of Head-Sea Parametric Rolling and Resulting Vessel and Cargo Securing Loads and agreed that the information contained in the document under consideration should be re-submitted to the DSC Sub-Committee, as appropriate, and to the Secretariat, in the form of a full report of investigation, for possible analysis by the Correspondence Group on Casualty Analysis and possible reference in the Summary of Lessons Learned to be circulated on board ships.

Provisions for certain types of ships (section 4.9 of the Code) – parts 6.24 to 6.25 omitted

Establishment of a correspondence group

6.26 The Sub-Committee, in order to make progress intersessionally, agreed to establish a correspondence group to start working according to the proposed two-way approach under the following terms of reference:

.1 on a short-term basis aiming at the completion date of 2004, giving priority to the review of the weather criterion including the s-value for T>30 seconds, to compile a set of proposed amendments to the Code, taking also into account the progress made and the pending issues identified at this session (paragraphs 6.15, 6.18 and 6.21);

.2 on a long-term basis, to identify of the areas of concern, to start collecting information on the existing related knowledge on these areas and to identify the needs for future research; and

.3 to submit a report to SLF 46.

Parts 7 to the end omitted