DEVELOPMENT OF SECOND GENERATION INTACT STABILITY CRITERIA

Response to comments on sample calculation results of draft vulnerability criteria for parametric rolling and pure loss of stability by Japan

Submitted by Japan

SUMMARY

Executive summary: This document describes response to comments on sample calculation results of draft vulnerability criteria for parametric rolling and pure loss of stability by Japan

Strategic direction: 5.2

High-level action: 5.2.1

Planned output: 5.2.1.14

Action to be taken: Paragraph 11

Related documents: SLF 54/INF.12, SLF 54/WP.3; SLF 55/3/1 and SLF 55/INF.15

Introduction

1 This document is submitted in accordance with the provisions of paragraph 6.12.5 of the Guidelines on the organization and method of work of the Maritime Safety Committee and the Marine Environment Protection Committee and their subsidiary bodies (MSC-MEPC.1/Circ.4/Rev.2) and comments on documents SLF 55/3/1 and SLF 55/INF.15, annex 23.

2 Japan submitted its sample calculation results of draft vulnerability criteria for parametric rolling and pure loss of stability using 19 ships under full load conditions and 16 ships under lightest conditions to the intersessional correspondence group, as shown in document SLF 55/INF.15, annex 20. At the final stage of the correspondence group, the United States submitted the comments on them, but a lack of time prevented the discussion of their comments at the correspondence group. Thus it is expected to be discussed at SLF 55, as noted in document SLF 55/3/1, paragraph 7.

3 Responding to this note, Japan herewith submits its response to the United States' comments.
Assumption for parametric rolling criterion

4 The United States expressed its following opinion: "We agree that a weighted average over a wave scatter diagram that corresponds to the event of exceedance of 25° roll angle (or other limiting angle) is an appropriate form of the criterion. However, the assumption of uniform distribution of headings may be not conservative since head or oblique waves are more probable in high sea states. Thus, the conservative assumption would be to consider only head and following seas."

5 Japan agrees with the United States' opinion that the limiting angle of 25° should be reconsidered. This is because it could be related to the level of cargo securing and so on. For facilitating discussion at SLF 55, additional sample calculation results of the second check of draft level 2 criterion for parametric rolling using a post Panamax containership and a pure car carrier (PCC) are provided in figure 1.

Figure 1 – Effect of limiting roll angle for a containership (left) and a car carrier (right)

The results indicate that judgement at the level 2 criterion drastically depends on the limiting roll angle. Thus, it seems to be appropriate to determine the reasonable value of the limiting roll angle and to provide some additional allowances depending on the level of cargo securing with the approval of administration.

6 Japan is of the opinion that the assumption of uniform distribution of headings is reasonable. This assumption is widely used in the long-term prediction of ship seakeeping analysis such as the prediction of vertical bending moment. This is because the wave direction and the ship route can be regarded as independent for oceangoing ships. The United States also uses this assumption in their study reported in document SLF 55/INF.15, annex 3, paragraph 5.

Clarification of used standard

7 The United States expressed its following comments: "Please clarify what standards are equal to 0.06. To do so, please refer to a specific formula for the criteria used in a document that describes a version of the criteria used." As noted in document SLF 55/INF.15, annex 20, Japan used the standard value of 0.06 when we use the Italian wave proposal and that of 0.15 when we use the Japanese wave proposal. This is because the Italian wave proposal deals with the average of ocean wave height for each wavelength and the Japanese wave height takes account of all ocean waves in the scattering diagram. These values were used for all standards having the meaning of probability in the draft level 2 vulnerability criteria for parametric rolling and pure loss of stability. This means the standard for the first check of level 2 parametric roll criterion, i.e. \( R_{PR0} \) in Equation (11)
of document SLF 55/INF.15, annex 15, the standard for the level 2 pure loss criterion, i.e. $R_{PL0}$ in equation (21) of document SLF 55/INF.15, annex 15, and the new standard for the second check of level 2 parametric roll criterion.

**Criterion C1 for pure loss of stability**

8 The United States expressed its following comments: "We agree with assumption 3 concerning the level 2 vulnerability criteria. We propose to correct the criterion C1 based on these considerations." The opinion of Japan is to only minimize the weight of C1 in the level 2 pure loss criterion. Thus Japan does not support to add completely new criterion to the draft agreed at SLF 54. The concern of the United States is probably due to the deletion of "heeling moment effect caused by an asymmetry of the submerged part of the hull and rudder forces". The consideration of this effect was already agreed at SLF 54 for realizing consistency with physics observed in the model experiments and numerical simulation, and GM of 0.05 m was explained as the equivalent to zero in regulatory application by the United States' delegation at SLF 54. If we use the standard for C3 as proposed by Japan, which represents "heeling moment effect caused by an asymmetry of the submerged part of the hull and rudder forces", the critical wave steepness of the "ONR TH" for pure loss of stability is equal to 0.064 as reported in document SLF 55/INF.15, annex 14. This is consistent with the fact that roll angle exceeding 20 degrees occurs for the "ONR TH" with the wave steepness of 0.063 or over, which was reported in document SLF 54/INF.12, annex 22, figure 5. Thus, Japan would like to underline the importance of the "heeling moment effect caused by an asymmetry of the submerged part of the hull and rudder forces" in the standard of the level 2 pure loss criterion as agreed at SLF 54.

9 The United States expressed its following comments: "A justification for the formula (2) in paragraph 4) is recommended." It is essential to avoid frequent occurrences of inconsistency cases between the different levels. Thus logical relationship between two levels should be developed other than simple comparison between the results from different levels. It was agreed for parametric roll, at SLF 54, that ship-dependent roll damping should be used in the level 2 criterion but ship-independent roll damping should be used in the level 1 criterion for the sake of simplicity. If we use a constant value of roll damping for any ships in the level 1, the value should be very small so that the level 1 could be excessively conservative for ships having normal-sized bilge keels. Japan firstly proposed to set the critical value of bilge keel size. Then the minimum value of roll damping can be determined as shown in figure 2 so that the standard of the level 1 criterion is theoretically obtained. However, the sample calculation results revealed that a design strategy with very small bilge keel size and very small flare at bow and stern is also not uncommon. Therefore, Japan proposed to replace the constant roll damping value with the function of bilge keel area for roll damping. As shown in figure 2, the modified proposal requires the same roll damping at the previous minimum bilge keel size and the increase rate of the roll damping with bilge keel area ratio is obtained with Ikeda's simplified method. The reason why two formulae exist is that the smaller bilge circle, which means smaller midship section coefficient, increases the roll damping effect of bilge keels, as confirmed by Ikeda's simplified method.
The United States expressed its following comments: "The United States are not aware of any cases of parametric roll on LNG carriers and OSVs. However, significant operational experience exists for these types of vessels. The results of vulnerability assessment in these cases contradict the operational experience." In our sample calculation, two LNG carriers and two OSVs with full and lightest conditions were used and all of them passed the second check of the draft level 2 criterion for parametric rolling. This means that these ships are not vulnerable to parametric rolling. However, three cases of LNG carriers and two cases of OSVs failed to pass the level 1 criterion. On the other hand, all bulk carriers and oil tankers used in our sample calculation pass the level 1 criterion. This is because the LNG carriers and OSVs have some bow flares while bulk carriers and oil tankers have almost wall-sided bow as shown in figure 3. As a result, the LNG carriers and OSVs could have certain restoring variation so that they do not always pass the level 1 criterion depending on GM and bilge keel size.

Action requested of the Sub-Committee

The Sub-Committee is invited to consider the above and take action as appropriate.