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SLF activities on damage stability verification of oil, chemical and gas tankers

Działalność Podkomitetu SLF w sprawie weryfikacji stateczności awaryjnej zbiornikowców, chemikaliowców i gazowców

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Abstract
The paper addresses the problem of verification of damage stability requirements of tank ships prior to departure. The surveys conducted by some IMO Member Governments show that a considerable number of tank ships sail in loading conditions different from those contained in approved stability booklets and furthermore the masters have no means to check compliance with relevant damage stability criteria prior to departure. In this context the Sub-Committee on Stability and Load Lines and on Fishing Vessels Safety (SLF) was tasked by the Maritime Safety Committee (MSC) to consider the matter and to elaborate proper guidelines for verification of damage stability criteria for tankers. It was decided that the guidelines would address both design and operational issues. The paper considers the current state of the Sub-Committee's work and in particular the terms of reference for Intersessional Correspondence Group established at SLF 53 in January 2011.

Słowa kluczowe: stateczność awaryjna tankowców, oceana stateczności, działalność SLF

Abstrakt
W artykule poruszono problemy weryfikacji wymagań dotyczących stateczności awaryjnej tankowców przed wyjściem w morze. Badania przeprowadzone przez niektóre kraje, będące członkami IMO, wykazały, że znacząca liczba tankowców pływa w stanach załadowania odbiegających od tych, które są zawarte w *Informacji o stateczności dla kapitana* oraz, że kapitanowie nie mają środków, którymi mogliby się posłużyć, aby sprawdzić przed wyjściem w morze, czy spełnione są odpowiednie kryteria stateczności awaryjnej. Komitet Bezpieczeństwa na Morzu (MSC) zobowiązał Podkomitet ds. Stateczności, Linii Ładunkowych i Bezpieczeństwa Statków Rybackich (SLF) do rozważenia tego problemu i do opracowania odpowiednich wytycznych w sprawie oceny stateczności awaryjnej tankowców przed wyjściem w morze. Zadecydowano, że w wytycznych zostaną poruszone sprawy zarówno projektowe, jak i eksploatacyjne. Artykuł przedstawia aktualny stan prac Podkomitetu SLF w tym zakresie, a w szczególności wytyczne dla Międzysesyjnej Grupy Korespondencyjnej, która została powołana w trakcie 53. Sesji SLF.

Introduction

Every tanker shall comply with relevant damage stability requirements for operational loading conditions prior to departure. The United Kingdom has conducted inspections on ships within its ports, consulted with industry and other flag State Administrations. Inspections have indicated that more than 50% of United Kingdom tank vessels regularly operate with loading conditions which are not included in their approved Stability Information Booklet and only use intact stability computers to check these conditions [1]. A similar pattern is seen on foreign vessels calling at United Kingdom ports.

In order to confirm this situation and to find out whether such ships have means to assess damage

stability in any loading condition prior to departure the International Maritime Organization invited Member Governments to conduct similar surveys [2].

Definition of non-compliance

Any operational tanker loading condition which includes cargo should be verified to meet the appropriate damage stability standard prior to departure. Any loading condition which does not closely reflect an approved condition in the approved Stability Information Booklet should be individually verified prior to departure, as required by international instruments. For the purpose of making a judgement when a vessel is closely loaded to an approved condition the researchers have applied a standard of 2% variation by weight in any cargo or ballast tank and 2 cm on overall GMf or KGf. Non-compliance is deemed to occur when a vessel is incapable of making an assessment whether a non-approved loading condition complies with residual damage stability (not whether the individual loading condition itself complies or not). Verification against intact stability requirements alone is not sufficient. Non-compliance is also deemed to occur in cases where the vessel is provided with a means to verify damage stability compliance, but does not routinely use this means, and also in cases where the vessel makes such verification and still sails even though the verification shows non-compliance with damage stability requirements.

Outcome of surveys

The United Kingdom survey made in 2005 and the IMO data gathering exercise conducted in 2009 consistently show that approximately one third of

Table 1. Breakdown of non-compliant vessels by GT and type – IMO survey [1]
Tabela 1. Zestawienie statków niespełniających wymagań według GT i typu – badanie IMO [1]

GT	Rate (%) of non-compliance by Vessel Type				Total
	Oil	Chemical	Oil/Chemical	Gas	
0 < 5.000	1/4 (25%)	2/5 (40%)	1/4 (25%)	1/4 (25%)	5/17 (29%)
5.001 < 10.000	–	–	2/5 (40%)	1/2 (50%)	3/7 (43%)
10.001 < 25.000	–	2/3 (67%)	4/7 (57%)	0/1 (0%)	6/11 (54%)
25.000 < 50.000	2/13 (15%)	0/1 (0%)	2/3 (67%)	–	4/17 (23%)
50.000 < 75.000	3/15 (20%)	–	–	–	3/15 (20%)
> 75.000	2/5 (40%)-	–	–	0/1 (0%)	2/5 (40%)
Total All Ships	8/37 (22%)	4/9 (44%)	9/19 (47%)	2/8 (25%)	23/73 (31%)

Table 2. Breakdown of non-compliant vessels by GT and type – UK survey
Tabela 2. Zestawienie statków niespełniających wymagań według GT i typu – badanie brytyjskie

GT	Rate (%) of non-compliance by Vessel Type				Total
	Oil	Chemical	Oil/Chemical	Gas	
0 < 5.000	14/24 (58%)	–	1/5 (20%)	1/1 (100%)	16/30 (53%)
5.001 < 10.000	1/4 (25%)	–	0/10 (0%)	0/2 (0%)	1/16 (6%)
10.001 < 25.000	1/1 (100%)	2/8 (25%)	3/7 (43%)	0/7 (0%)	6/23 (26%)
25.000 < 50.000	–	–	2/2 (100%)	–	2/2 (100%)
50.000 < 75.000	–	–	–	–	–
> 75.000	–	–	–	–	–
Total All Ships	16/29 (55%)	2/8 (25%)	6/24 (25%)	1/10 (10%)	25/71 (35%)

Table 3. Breakdown of non-compliant vessels by GT and type – combined survey
Tabela 3. Zestawienie statków niespełniających wymagań według GT i typu – wyniki zbiorcze

GT	Rate (%) of non-compliance by Vessel Type				Total
	Oil	Chemical	Oil/Chemical	Gas	
0<5.000	15/28 (54%)	2/5 (40%)	2/9 (22%)	2/5 (20%)	21/47 (47%)
5.001< 10.000	1/4 (25%)	–	2/15 (53%)	1/4 (13%)	4/23 (17%)
10.001<25.000	1/1 (100%)	4/11 (37%)	7/14 (37%)	0/8 (0%)	12/34 (35%)
25.000<50.000	2/13 (15%)	0/1 (0%)	4/5 (80%)	–	6/19 (32%)
50.000<75.000	3/15 (20%)	–	–	–	3/15 (20%)
>75.000	2/5 (40%)	–	–	0/1 (0%)	2/6 (33%)
Total All Ships	24/66 (36%)	6/17 (35%)	15/43 (35%)	3/18 (17%)	48/144(33%)

examined tank ships regularly sail in conditions of loading significantly different from those in the approved stability information and either have no means to assess damage stability compliance or do not use or ignore such verification measures where these are provided [1]. Examples of the outcome are shown in tables 1, 2 and 3.

For this reason it is believed that there is presently an unacceptable increase in the risk of loss of life and / or marine pollution following damage or grounding of such vessels, and that this requires urgent action to ensure compliance on a global basis.

As a consequence, a new work programme item for the SLF Sub-Committee was proposed by some Member Governments and accepted by the Maritime Safety Committee at its 83. Session to examine and develop acceptable methods of damage stability verification for use on tank ships prior to departure to sea and the specification of a definitive calculation method to be used for this purpose. The aim is to enhance the ability of all concerned to verify the damage stability of tankers. All concerned are seen here as designers, certification institutions, Port State Control inspectors and ship masters.

Methods to demonstrate verification of compliance prior to departure

There are currently four possible options for an operator (ship master) to demonstrate compliance with damage stability [3, 4]:

1. To load the vessel only in accordance with standard loading conditions from the approved Intact Stability Information Booklet, as these should also have been approved for damage.
2. Where there is a significant variation from the standard loading conditions in the approved Intact Stability Information Booklet, to obtain approval from the Administration, or a recognized organization acting on its behalf, for the proposed loading condition (see Note below).
3. To use an approved Stability Programme or other acceptable method to check that specific loading condition complies with damage as well as intact stability.
4. To use a simplified critical KG data, for example curves of maximum vertical co-ordinate of the centre of gravity or minimum allowable initial metacentric height.

Even minor changes to a standard loading condition can have significant effects on residual stability following damage. For this reason some Member Governments claim that use of critical KG is not proper for the purpose of verification of damage stability requirements. Secondly, there is no accepted definition as to what significant variation of the loading condition means. These problems require further consideration.

The Master should not sail until the vessel is in full compliance with all stability requirements. In a situation where it has not been possible to demonstrate compliance by any of the previously mentioned methods, there are a number of choices available, as follows:

1. To adjust the loading of the vessel so that it complies with an approved condition in the vessel's stability booklet.
2. To adjust the loading of the vessel until the loading computer damage stability module (if installed onboard) shows that compliance has been achieved, whilst ensuring that all other requirements of the voyage such as load line and strength requirements are met.
3. To contact company shore-based support and request assistance in the calculation of the damage stability and compliance with the regulations.
4. To contact the ship's classification society and request assistance in the calculation of the damage stability and compliance with the regulations.

Action of SLF Sub-Committee

The Sub-Committee on Stability and Load Lines and on Fishing Vessels Safety (SLF) considered matters related to verification of damage stability requirements at three subsequent sessions (SLF 51 in 2008, SLF 52 in 2010 and SLF 53 in 2011) before decided to take further action. At SLF 51 the Sub-Committee, acknowledging the importance of complying with relevant damage stability requirements for operational loading conditions, had invited Member Governments and international organizations to submit relevant information to SLF 52 which agreed that the future guidelines should be divided into two parts (i.e. design and operational). Consequently, Member Governments and international organizations were invited to submit proposals on the design and operational guidelines for tankers to SLF 53, in particular, on the scope, ship types and extent of such guidelines.

SLF 53 (in January 2011) had the following documents for its consideration:

1. SLF 53/8 (OCIMF, SIGTTO), providing a draft text of operational guidance on verification of

damage stability for tankers, for further consideration by the Sub-Committee;
2. SLF 53/8/1 (China), providing information on the outcome of the investigation carried out by China on operational loading and damage stability verification of tankers of eight major Chinese tanker companies and making proposals on the development of guidelines for damage stability verification;
3. SLF 53/8/2 (Norway and United Kingdom), providing comments on the document SLF 53/8 with regard to the draft operational guidelines for the verification of damage stability of oil, chemical and gas tankers, including an annex containing definitions and interpretations that could complement the aforementioned draft guidelines, as a response to requests for clarification in relation to certain aspects of damage stability verification;
4. SLF 53/8/3 (IACS), providing comments on document SLF 53/8/2 and describing the concerns caused by uncertainties contained in existing IMO instruments to be used as a basis for damage stability verification;
5. SLF 53/8/4 (Islamic Republic of Iran and IPTA), commenting on the document SLF 53/8 and supporting the content of the document and the annex, as a contribution to the development of Guidance for the operational verification of compliance with damage stability requirements for tankers;
6. SLF 53/INF.9 (IACS), providing a Guideline for scope of damage stability verification on new oil tankers, chemical tankers, and gas carriers, as revised by IACS (IACS Recommendation No.110) containing the existing procedures used by, and the practical experience of, IACS members relating to damage stability calculations; and SLF 53/INF.11 (Spain), providing complementary information to the document SLF 53/8 on the use of minimum required GM (or maximum allowable KG) curves as the means of verification of compliance, based on the Spanish experience and investigation on damage stability for parcel tankers.

Having considered the above documents, the Sub-Committee noted, in particular, the following views expressed in the discussion:

1) the proposals and comments contained in the aforementioned documents should be further considered by a correspondence group, established to deal specifically with the verification guidelines;
2) the scope of the Guidelines should be clearly defined;
3) definitions and interpretations need to be clarified and ways to avoid differing interpretations and ensure consistency should be considered;
4) taking into account the agreement at SLF 52 that the Guidelines should be divided into two parts (i.e. design and operational), there is a need for the incorporation of a new part in the Guidelines to provide evidence of compliance for Port State Control officers (PSCOs);
5) the first part of the Guidelines (design) and the second part (operational) should be based on documents SLF 53/INF.9 and SLF 53/8, respectively;
6) ambiguities in existing IMO instruments with regard to damage stability requirements should be identified and considered;
7) the method of verification of compliance, such as stability computer, stability booklet and shore assistance should be clearly defined;
8) the appropriate use of type 2 or 3 computers for verification, should be considered;
9) tolerances (what constitutes a significant deviation from the loading conditions in the stability booklet) need to be defined; and
10) the suitability of critical KG/GM curves for tankers should be considered.

In considering the above documents, the Sub-Committee, having noted the views of those delegations that spoke on how best to proceed with the matter, agreed that a correspondence group would be the best way to progress the work on the output intersessionally. Consequently, the Sub-Committee agreed to establish the Correspondence Group on Guidelines for Verification of Damage Stability Requirements for Tankers, under the coordination of the United Kingdom, and instructed it to:

1) identify existing IMO instruments and relevant references relating to the issue of verification of damage stability requirements;
2) identify any ambiguities in the existing requirements and consider the need for clarifications and/or make recommendations for amendments to mandatory instruments;
3) develop draft guidelines for the verification of damage stability requirements for tankers, addressing design and operational issues [2, 3, 5], using documents SLF 53/INF.9 and SLF 53/8 as base documents;
4) consider whether demonstration of verification to third parties should be addressed in the draft guidelines and, if so, include appropriate text;
5) consider, when developing the above draft guidelines, in particular the following points:
   – scope of the draft guidelines;

- clarification of what is meant by 'loaded in accordance with an approved condition', whether any deviations are allowed and, if so, to what extent;
- methods of verification of compliance, such as stability software, stability booklet, shore assistance, KG/GM curves and conditions for use of these methods; and
- clarification of the terms and conditions for use of stability software and documentation which demonstrates that the software is appropriate for its purpose;

6) advise on any other relevant issues raised in the course of the group's discussion; and
7) submit a report to SLF 54 (January 2012).

Summary of other issues involved

There is a number of other issues related to the problem of the verification of damage stability of tankers prior to departure. The summary of these issues is given below.

Ambiguities in existing IMO instruments

According to the document SLF 53/INF.9 (by International Association of Classification Societies), IMO instruments which refer to damage stability verification on new oil tankers, chemical tankers and gas carriers are as follows [5, 6, 7, 8].

1. General Instruments:
   - SOLAS Chapter II-1, Regulations 4.1, 4.2, 5–1 and 19;
   - Res. MSC.143(77) "Adoption of amendments to the Protocol of 1988 relating to the International Convention on Load Lines, 1966", Regulations 27(2), 27(3), 27(11), 27(12) and 27(13);
   - Res. MSC.281(85) "Explanatory Notes to the SOLAS Chapter II-1 Subdivision and Damage Stability Regulations" (special attention should be paid to Guidelines for the Preparation of Subdivision and Damage Stability Calculations specified in the Appendix);
   - Res. MSC.245(83) "Recommendation on a Standard Method for Evaluating Cross-Flooding Arrangements";
   - MSC.1/Circ.1245 "Guidelines for Damage Control Plans and Information to the Master"; and
   - MSC.1/Circ.1229 "Guidelines for the Approval of Stability Instruments", paragraph 4.
2. Instrument applicable to oil tankers:
   - MARPOL Annex I, Regulation 28.
3. Instruments applicable to gas carriers:
   - International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code), Chapter 2, Paragraphs 2.1, 2.4, 2.5, 2.6.2, 2.6.3, 2.7, 2.8 and 2.9; and
   - MSC/Circ.406/Rev.1 "Guidelines on Interpretation of the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code) and the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code) and Guidelines for the Uniform Application of the Survival Requirements of the IBC and IGC Codes".
4. Instruments applicable to chemical tankers:
   - International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code), Chapter 2, Paragraphs 2.1, 2.4, 2.5, 2.6.2, 2.7, 2.8 and 2.9; and
   - MSC/Circ.406/Rev.1 "Guidelines on Interpretation of the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code) and the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code) and Guidelines for the Uniform Application of the Survival Requirements of the IBC and IGC Codes".

Some Member Governments claim that there are specific ambiguities in requirements [2, 8, 9] that shall be identified and considered by the SLF Intersessional Correspondence Group and Working Group which is intended to be established at SLF 54 (January 2012). The outcome of this work will be known probably after SLF 54.

Human element

Inadequacies have been identified in the methods currently used to verify that tank vessels comply with damage stability requirements prior to departure. Reliance is often being placed on the use of intact stability computer programs for this purpose, but these do not confirm compliance with damage requirements. The importance and the difference between intact and damage stability requirements does not appear to be fully appreciated by seafarers, and the situation is seen to be confused through mandatory carriage of longitudinal strength computers under classification rules on many tank ships, most of which also incorporate an

intact stability assessment module. Current evidence suggests that seafarers may not always appreciate the significance of issues involved with safe loading of tank ships such that they comply with damage stability requirements. Implementation of corrective action through provision of suitable means of verification and placing responsibility on seafarers to check damage stability prior to departure should greatly increase seafarer awareness of this important aspect of ship operation.

Damage stability computers

For maximum operational flexibility it is the opinion of some Member Governments that the only practical solution is to fit an approved damage stability computer or other acceptable method of damage stability verification on all tank vessels. On the other hand it is recognized that there may be circumstances where mandatory carriage of a damage stability programme or other acceptable method may not be justified.

It is noted that IACS has published unified requirement UR L5 concerning approval of stability programmes for fitment to ships contracted after 1 July 2005, and that this contains information on performance and accuracy. It is considered that the development of guidelines for a definitive calculation method to be used for verification of damage stability in conjunction with this approval standard would form a suitable basis for a solution based upon stability programmes or simplified critical KG data.

A range of stability programmes approved by classification societies already exist which can address this issue, and these have been effectively rendered compulsory equipment on new tank vessels by IACS UR L5. However, in order to provide a uniform standard of calculation consideration must be given to developing guidelines on a specific calculation methodology which can be applied by all such programmes.

Cost to the maritime industry

Following the introduction of IACS UR L5, and its application to the majority of new tank ships, the additional cost for such vessels would only be that related to the cost of modifying the programmes to suit the guidelines for a definitive standard calculation method developed in accordance with the new work programme. This cost is likely to be low or included as a programme upgrade.

If damage stability programmes were made mandatory on existing vessels the cost would be that for purchase of a damage stability module for the existing strength and intact stability programme on board or to buy an entirely new system incorporating strength, intact and damage stability. It is anticipated that the likely range of software costs involved would be between £1,000 and £8,000, to which the associated costs of training personnel must be added.

For other methods, such as development of critical KG data, the compliance costs are anticipated to be no more than £5,000 plus associated costs of training personnel.

The compliance costs of a stability computer or critical KG data based system are both considered to be negligible compared to potential costs resulting from an incident resulting from non-compliance with existing damage stability provisions within IMO instruments.

Benefits

The development and introduction on tank vessels of acceptable methods to evaluate and verify damage stability compliance of alternative loading conditions from those in the approved stability information (such as stability programmes or simplified critical KG data) would serve to correct the present lack of damage stability verification observed on tank ships.

Application of a uniform requirement to undertake damage stability verification on all tank vessels prior to departure would provide a significant increase in maritime safety, and a reduction in risk of loss of life and marine pollution.

Compulsory onboard verification of damage stability of alternate loading conditions from those in the approved stability information would also ensure that where such checks are required under existing instruments these are actually undertaken and records kept in lieu of the general omission seen at present. This aspect will assist during PSC inspection.

Conclusions

Every tanker shall comply with relevant damage stability requirements for operational loading conditions prior to departure. The United Kingdom survey made in 2005 and the IMO data gathering exercise conducted in 2009 show that approximately one third of examined tank ships regularly sail in conditions of loading significantly different from those in the approved stability information and either have no means to assess damage stability compliance or are not using or are ignoring such verification measures where these are provided. It constitutes an unacceptable increase in the risk of

loss of life and / or marine pollution following a damage or grounding to such vessels. As a consequence a new work programme item for SLF Sub-Committee was proposed and accepted. The aim is to enhance the ability of all concerned to verify the damage stability of tankers. The Sub-Committee agreed to establish the Correspondence Group on Guidelines for Verification of Damage Stability Requirements for Tankers, under the coordination of the United Kingdom with the aim to consider the matter and to submit the report to SLF 54, which is planned for January 2012. The matter will be further considered during SLF 54 by the Working Group, if established.

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