

**Assessment Report – Study of
Applicability of Stockholm
Agreement Requirements in
Conjunction with Future SOLAS
2009 Revised Damage Stability
Rules**

Lisbon, 9 March 2007

TABLE OF CONTENTS

1.	INTRODUCTION.....	3
2.	BACKGROUND.....	3
3.	THE AVAILABLE DATA OF MEMBER STATES ON STOCKHOLM AGREEMENT AND SOLAS 2009	4
3.1	The United Kingdom Presentation	4
3.2	The German Study	4
3.3	The Swedish Study.....	5
4.	THE AUTHOR'S CONCLUSIONS FOR THE PRESENTED DATA	6
4.1	The United Kingdom Presentation	6
4.2	The German Study	6
4.3	The Swedish Study.....	6
5.	THE OPINION AND POSITION OF MEMBER STATES ON STOCKHOLM AGREEMENT AND SOLAS 2009	7
5.1	Sweden	7
5.2	Norway.....	7
5.3	Denmark	8
5.4	Finland	8
5.5	The Netherlands	9
5.6	Spain	9
5.7	The United Kingdom	9
5.8	Cyprus	10
6.	ASSESSMENT.....	10
6.1	The United Kingdom Presentation	11
6.2	The German Study	11
6.3	The Swedish Study.....	11
6.4	The Replies of Member States	11
7.	CONCLUSIONS OF THE ASSESSMENT	12
7.1	Possible Options.....	12
	APPENDIX A. LIST OF ANNEXES.....	14

1. INTRODUCTION

In accordance with the objectives and tasks of EMSA, as laid down in its founding Regulation (EC) 1406/2002 (as amended), and following the COSS authorised Workshop on Ro-Ro Passenger Ships Fitted with Long Lower Holds on the 17th November 2006, it was decided to establish a specific correspondence group to deal with the circulation of MS data related to the combination of the Stockholm Agreement requirements (Directive 2003/25/EC) with the future SOLAS 2009 Damage Stability Calculation Rules.

Further to receiving the presentation of above Workshop from the UK and the studies from Germany and Sweden from last year, the data was disseminated to the corresponding Member States. In order to collect the necessary information on the issue relating to EU flags, the MS were requested to provide to EMSA by 15th February 2007, their opinion on the above mentioned material and the overall position of the country they represent relating to the use of the Stockholm Agreement requirements in connection with the future SOLAS 2009 Damage Stability Calculation Rules, in their present form.

2. BACKGROUND

As a result of the discussions of the COSS Working Group held on 30th October, the issue of future probabilistic stability regulation of SOLAS 2009 (which will enter into force in Jan.2009), was raised. According to the minutes of the COSS meeting, Sweden stated that Directive 203/25/EC of The Stockholm Agreement has to be revised, as a minimum, in order to be compatible with the new SOLAS 2009 standards.

In the Workshop on Ro-Ro Passenger Ships Fitted with Long Lower Holds on the 17th November 2006, the UK provided a detailed presentation showing that SOLAS 2009 standards are less stringent than those in the SOLAS 90, including Stockholm Agreement (which derives from the deterministic SOLAS 90 and which will be rendered redundant by SOLAS 2009). Germany, supported by Norway, strongly disagreed with the UK assumptions. They underlined that the ship-building industry needs a clear way forward now for planning purposes, so either the Stockholm Agreement (Directive 2003/25/EC) or SOLAS 2009 must be adopted: Their industry has indicated that it could not design ships to comply with both sets of rules.

The Chairman asked that the available data would be forwarded to EMSA and circulated to the participants.

3. THE AVAILABLE DATA OF MEMBER STATES ON STOCKHOLM AGREEMENT AND SOLAS 2009

The above subject consists of one presentation and two studies:

3.1 The United Kingdom Presentation

The PowerPoint presentation by the UK was based on the studies on the same subject at The Ship Stability Research Centre, Universities of Glasgow and Strathclyde.

The UK began with the presentation of major recent sea accidents and SOLAS 2009 calculation formulas.

The stability data presented was collected from reports of damaged and lost vessels and from the same studies that are shown later, as well as from calculations from the research centre's own data, which was collected from ships of unidentified origin.

Probabilistic data from vessels sources was compared with the similar data, calculated with the old regulations of deterministic base. The same data was also compared to the other data from probabilistic base, namely to significant wave heights around Europe and to the probability factors derived from existing casualty data of the vessels, calculated with old SOLAS deterministic criteria.

3.2 The German Study

The technical study of DE was made as graduation work of an engineer Student, supervised by The Technical University of Hamburg-Harburg and The Germanischer Lloyd Class Society.

Further to the short introduction to the current Damage Stability Rules, the two vessels involved in this study and the current deterministic Stockholm Agreement, a deeper look was made to the SOLAS 2009 Damage Stability Rules, to their probabilistic indexes in general, to the special requirements of passenger vessels and to the procedure of probabilistic calculation.

After this, the damage stability of one named existing vessel was calculated with probabilistic SOLAS 2009 rules in different trim and heel conditions, taking in account special conditions in the vessel's subdivision and different moments affecting the hull.

A second probabilistic damage calculation for a project vessel of more modern design was also made with the same bases as above. Some different damage cases were calculated in addition.

The developments of two specific indexes of probabilistic base were introduced in detail, starting from the IMO meetings and the accident statistics of collisions of vessels. The survivability index **S** is compared in view of different rules, and then calculated for the two vessels for comparison. A general trend of subdivision index **R** of probabilistic base is presented, before the final summary.

3.3 The Swedish Study

The technical study by SW was done as the graduation work of an engineering student, supervised by Chalmers University of Technology and advised by the Swedish Maritime Administration.

The short introduction described the purpose of the study. Then the Stockholm Agreement and SOLAS 2009 calculation rules were presented.

The study concentrates on the calculation of damage stability for eight existing ro-ro passenger vessels, that were converted to fulfil Stockholm Agreement requirements, according to the SOLAS 2009 Damage Stability Rules. The results were compared.

The damage stability of three of these eight vessels was also calculated before conversion. For these vessels, some damage cases are calculated and the results compared.

4. THE AUTHOR'S CONCLUSIONS FOR THE PRESENTED DATA

4.1 The United Kingdom Presentation

- The presentation suggested that there is no incontestable evidence that the Stockholm Agreement should be dispensed with.
- Instead, according to their studies, the requirement for Stockholm Agreement is to be retained.

4.2 The German Study

- As both vessels under this study failed to meet the required safety level demanded by the SOLAS 2009 calculations, it has been concluded that the future rule for damage stability calculation (SOLAS 2009) provides at least the same safety level as the current SOLAS 90, including the Stockholm Agreement.
- It is impossible to compare the safety level differences between the current and future SOLAS rules.
- Obtained results strongly depend on the geometry of the vessel and interpretation of the regulation.
- Vessels designed with symmetrical flooding are favoured by SOLAS 2009 Rule.
- The safety level requirements for the survivability of very large passenger ships increase by SOLAS 2009 criteria and decrease by SOLAS 90 criteria.
- The Stockholm Agreement may be dispensed with vessel stabilities calculated in accordance with SOLAS 2009.

4.3 The Swedish Study

- The conversion of the vessels to meet the Stockholm Agreement has provided an increase of safety level towards the needs of SOLAS 2009. However, this has not been sufficient to attain the final requirements of SOLAS 2009 in all cases.
- Designs to prevent and resist accumulated water on open ro-ro decks increase the safety level in view of calculations in general, and some particular reconstructions are more efficient to increase the safety level in view of calculations than others.
- From the vessels under study, larger vessels had more difficulties to reach the new requirements than the smaller ones, i.e. their safety level requirements have been increased with the SOLAS2009.
- Generally, the SOLAS2009 damage stability rules incorporate also the demands of Stockholm Agreement together with SOLAS 90.

5. THE OPINION AND POSITION OF MEMBER STATES ON STOCKHOLM AGREEMENT AND SOLAS 2009

Eight Member States gave their opinion and overall position for the subject:

5.1 Sweden

Sweden presented the background of IMO Res.14, the so called Stockholm Agreement, developed in the aftermath of disaster of M/V Estonia in 1994, which was issued as a footnote to the SOLAS Reg.II-1/8-1 at the 1995 IMO SOLAS Conference.

Sweden noted that further developments to stability rules should be forwarded as proposal to IMO.

Sweden also presented the background for the new probabilistic Damage Stability Rule Reg.II-1 of SOLAS 2009, which turns out to have historical roots before the year 1994 and the M/V Estonia disaster, which is the major turning point in the evaluation of the subject.

The original goal of the new standard, to give equivalent level of safety for all dry cargo and passenger vessels to the old regulation, was superseded by increasing the safety level for ro-ro cargo and passenger vessels. This was concluded at the end of the debate, due to the low average safety level on these ship types, as shown by accident statistics.

In the final comparison of safety levels between the old and new rules, the results of the Swedish study have been enlightening. Having come to the same conclusions already notified, Sweden commented that the calculated safety values of studied vessels are almost the same, **on average**, when compared between the new rules and the old rules.

This conclusion did not changed when the vessels in the German studies and the UK presentation were taken in account.

The argument (of UK) that the new regulation (SOLAS 2009) is less stringent than the combination of the two old ones (SOLAS 90 + Stockholm Agreement) is considered unfair, as the new regulation incorporates more uniformly different conditions of the vessel, concluded Sweden.

Sweden said it was in favour of the further development of the damage stability rules in relation to collision accidents and underlined the same rational approach as above. If showed necessary, the Stockholm Agreement requirements might be taken into account for the new Damage Stability Calculation of Ro-Ro Passenger Vessels, but in the opinion of Sweden, their present form is inadequate for this.

5.2 Norway

Norway is in favour of discussing the involvement of the Stockholm Agreement in the new regulation (SOLAS 2009), as it was not originally incorporated in this Rule at the evaluation stage. The Stockholm Agreement Rule is not directly compatible with the new calculation rule of probabilistic base. If the subject vessel types have been more prone to accidents than others, as claimed by accident statistics, it should be decided whether if the

subdivision index, calculated with the new rule, should be raised for the vessels that are under the regulation of Stockholm Agreement, according to Norway.

Following the presentation of the results of the Swedish and German studies, Norway acknowledged that the subdivision index according to SOLAS 90 does not have particular changes if calculated with or without the requirements of Stockholm Agreement.

Norway is of the opinion that SOLAS 2009 gives at least the same safety level as the combination of SOLAS 90 and the Stockholm Agreement. The demand for the increase in the Required Index may be examined, should future studies show different results.

5.3 Denmark

Denmark has the opinion that the demands of the Stockholm Agreement are incorporated in SOLAS 2009. Their response repeated the evaluation history of SOLAS 2009, saying that originally a method was proposed to incorporate also the needs of Water on Deck in this new Damage Stability Calculation, but the results had only negligible influence to the Attained Index A of the vessel. The method was abandoned due to its complexity.

If supported, Denmark would be ready to discuss about the Requested Index R, which has some prescriptive nature and could be derived in a probabilistic direction.

5.4 Finland

For the application of SOLAS 2009 vs. SOLAS 90 and the Stockholm Agreement Finland states that it has a positive attitude towards the German and Swedish studies, but reserved its final opinion. This is due to the fact that Finland is going to do its own study involving eight existing vessels, which were upgraded earlier to SOLAS 90 standards with Stockholm Agreement Requirements. The results will be ready in late June 2007.

For the rest, Finland has the opinion that any Ro-Ro passenger vessel has to comply with either SOLAS 74 as amended or Res.A.265 in full.

All non-compliant vessels should be set outside the Ship Transfer Regulation EC/A 789/2004 until upgraded by appropriate conversion.

If this basic requirement is not fulfilled, the competence between the flag states would be distorted by means of the demands of the Ship Transfer Regulation EC/A789/2004. According to Finland, this EU Regulation was issued in order to ensure sound competition between flag states and provide common levels of safety. Vessels that do not comply with SOLAS 74 as amended or Res.A.265 would have commercial advantages in comparison with upgraded ships. (parts of the text of the directive were presented)

5.5 The Netherlands

The Netherlands said they do not have an opinion yet.

At the same time, they brought up the following tentative conclusions:

- As the Stockholm Agreement Requirements and SOLAS 2009 have different bases, a vessel can not comply both. An overall safety level calculated by the probabilistic method may be decreased by additional deterministic demands. The conclusion would be to abolish Directive EC/2004/25 or the Stockholm Agreement.
- The Netherlands confirmed that the new SOLAS 2009 was evaluated in order to be as safe as the joint SOLAS 90 and Stockholm Agreement Requirements. They postulated that, if the safety index has been found to vary for existing ships calculated with both old and new rule, with and without Stockholm Agreement Requirements, how would we know which existing ships have been calculated "as safe"?
- Despite the above, The Netherlands would be confident with the average safety index value. If the vessels falling below average safety index should be eliminated, it would request a general increase of the Required Index R

5.6 Spain

Spain said that it has confidence in the current legislation and will apply Res.A.265 (VIII) in its entirety to its whole fleet, as well as Directive 2003/25/EC.

The SOLAS 2009 regulation will be used uniquely from the day it comes into force.

For this, Spain is in line with the Swedish study and the abolition of the Stockholm Agreement when the new regulation comes into force.

However, Spain also welcomed the envisaged new studies on the subject.

5.7 The United Kingdom

The UK has not changed its opinion with respect to demanding the retention of the Stockholm Agreement Requirements together with the new probabilistic SOLAS 2009.

For the two studies, the UK says it has the feeling that the calculation results for SOLAS 2009 may be misleading for vessels that have been planned and built according to the old standard. The UK supports the study which they are about to sponsor, which involves the testing of a hull model that has been designed according to new standards from the beginning.

Should the results of this study, ready by September 2007, show that the new regulation is at least as good for safety as the old one, they would be ready to abolish the Stockholm Agreement Requirements.

Another similar study is ongoing with a vessel which complies with Res.A.265. The results will be ready by mid-May.

The UK cautioned against for changing the rules without absolute certainty of the results.

After the last workshop meeting, the UK said that IMO has finalised the SOLAS 2009 Rules and their current work concentrates on the special problems of large passenger ships (LPS), to which the category of Ro-Ro passenger ships with long lower holds are believed to belong.

It is planned that these ships will conform to additional safety measures involving damage stability, which will only enter in force after January 2009. Meanwhile, the requirements of the Stockholm Agreement might well be needed for the new vessels, in the opinion of the UK.

As a final conclusion, the UK had heard that the deterministic criteria in the Stockholm Agreement Requirements have been implemented with the probabilistic Res.A.265(VIII) by some Member States. The UK do not see why they should not be implemented within SOLAS 2009.

5.8 Cyprus

Cyprus is in favour of undertaking studies relating to SOLAS 2009 which look at existing ships in order to confirm their safety in theoretical terms prior to applying SOLAS 2009 to new constructions. With respect to abolition of the Stockholm Agreement, they suggest a clear expiry date, after the safety initiatives introduced by the combination of SOLAS 95 and Stockholm Agreement Regulations have been incorporated into the new rules.

6. ASSESSMENT

In general, both studies used the same computer software for the damage stability calculation, so a computer based error for the overall calculation could be eliminated. This can not be concluded from the presentation of UK for the data of their own vessels, as the study was not available.

6.1 The United Kingdom Presentation

- The origin and evaluation of some calculated data is unknown.
- Lots of conclusions are made with respect to data of probabilistic base. It is to be noted, that a combined derivation of probabilistic data loses accuracy when compared to bases of mathematical and measured facts. (Measurable factors form the bases for the probabilistic calculations, i.e. the probability is calculated on the bases of facts. When the probability is derived from the probability data, the tolerance for error increases considerably).
- As no studies were published, the bases of the information can not be ascertained.

6.2 The German Study

- Deterministic and probabilistic methods are mixed in some of the explanations, although it seems the calculations have been done correctly.
- In case of the asymmetric vessel, the average index values are not calculated, as is common practice with cargo vessels.
- The study shows that the different factors affecting the hull are taken into account in the calculation.

6.3 The Swedish Study

- The calculation process is simplified.
- The interpretation of different spaces of subdivisions according to SOLAS 2009 rules and presentation of different factors to calculations are missing, in general.
- The study has noted, but not mentioned in the conclusions, that one vessel fulfils SOLAS 2009 requirements even without conversion to meet the Stockholm Agreement requirements.

6.4 The Replies of Member States

The replies support the positions of the different Member States, that were acknowledged at the first meeting.

A discussion on the increase in the Required Index R concerning large passenger ships (LPS) could be desirable, as soon as the discussion on the specification of LPS has been concluded.

As a historical fact in the field of naval architecture, the damage stability of a hull design has been tested with model in a tank or pool only in conjunction with some special case, like during the investigation of a marine accident or the design of a special (military) vessel. It is not part of normal research of hull form.

A discussion of the possible influence of non-compliant vessels on the Ship Transfer Regulation EC/A789/2004 would be desirable, as a practical consequence of the conclusion within EU.

7. CONCLUSIONS OF THE ASSESSMENT

The main conclusion from the presentations is that there is lots of space for interpretation in the future SOLAS 2009 Damage Stability Rules, even though the above studies have incorporated the Explanatory Notes of Damage Stability Calculation (IMO SLF 47/4), as presented in their current development phase.

As the results of calculations show, just less than half of the vessels that fulfil SOLAS 90 including Stockholm Agreement, fulfil also SOLAS 2009.

The other half does not fulfil SOLAS 2009. The reasons for this are very difficult to point out and absolute conclusions are hard to draw.

Presented as a single case of the SW studies, it is possible to fulfil the damage stability criteria according to SOLAS 2009 calculation rules, by a vessel approved originally with SOLAS 90 calculations but without fulfilling the Stockholm Agreement requirements. This "shortcut" would give considerable advantage to some owners, flying under the flag of a MS which has ratified the Stockholm Agreement, to simply convert the SOLAS 90 vessel to SOLAS 2009 by calculations, without rebuilding onboard. (According to other explanations, this is not practically possible.) More clarifications would be needed for this.

It is obvious the Stockholm Agreement calculation rules are of deterministic base and may not be used as such with the probabilistic calculations. (As commented by UK presentation, "the two rules are different"). However, two to three member states claim that they apply Stockholm Agreement Rules with Res.A.265.

As the IMO legislation continues to develop for Ro-Ro passenger vessels, presenting new requirements for other problem solutions involving the same stability matters, the time is getting short for the involvement of Stockholm Agreement Requirements.

Solutions to the basic issue, namely the need to implement the Stockholm Agreement Requirements within the new SOLAS 2009, have not been found.

7.1 Possible Options

At the workshop only tendencies about the possible options will be explored. The decision is going to be reached at the relevant fora e.g. (COSS Shipping Working Partu).

As an interim solution, more comprehensive studies by experienced and recognised professionals could be obtained, in order to draw conclusions about the future of Stockholm Agreement.

Another option is to adapt the Stockholm Agreement Requirements to integrate SOLAS 2009. The method already applied by certain Member States in conjunction with Res.A.265 will be presented and discussed.

A final option would be to take a decision on the use of SOLAS 2009 as it is and abolish the Directive 2003/25/EU for Stockholm Agreement

In Lisbon 9th March 2007,

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PS. As the Comments of Sweden for the above data, received at publishing date of this Assessment Report, contain lots of historical information about the development of Stockholm Agreement, they are enclosed as annex 4.

APPENDIX A. LIST OF ANNEXES

Annex 1 The United Kingdom Presentation: *Stockholm Agreement and SOLAS2009*

Annex 2 The Study of Germany: *SOLAS 2009 and IMO/Circ.1891 (Stockholm Agreement) - Damage Stability Investigation of two ships and contrast of the requirements .*

Link to the web-site of the study:

http://www.ssi.tuharburg.de/doc/Veroeffentlichungen/2006/Diplomarbeit_Jan_Schreiber.pdf

Annex 3 The Study of Sweden: *Impact of the "Stockholm Agreement" on new probabilistic damage stability rules*

Annex 4 The Comments of Sweden: *Swedish position on the Stockholm Agreement and SOLAS 2009 damage stability requirements.*