EUROPEAN
COMMISSION

Brussels, 18.2.2022
SWD(2022) 29 final

COMMISSION STAFF WORKING DOCUMENT

Simplification of EU Passenger Ship Safety Legislation

Accompanying the document

Proposal for a Directive of the European Parliament and of the Council amending Directive 2003/25/EC as regards the inclusion of improved stability requirements and its alignment with stability requirements defined by the International Maritime Organisation

{COM(2022) 53 final}

Content

1. Introduction
2. REFIT fitness check on passenger ship safety legislation
3. Regulatory framework on stability standards for ro-ro passenger ships (ro-pax)
4. The upgrade of stability standards for passenger ships, including ro-ro passenger ships at international level
   - 4.1 The EU research projects
   - 4.2 The SOLAS 2020 damage stability requirements
5. Problems with Directive 2003/25/EC
6. The study for aligning the deterministic damage stability requirements according to directive 2003/25/EC with the probabilistic requirements as developed at international level
   - 6.1 Outline of the study
   - 6.2. Summary of results
   - 6.2.1. Mapping of the fleet of ro-ro passenger ships operating within the EU in International trade and domestically in classes A, B and C
   - 6.2.2. Damage stability calculations of 18 sample ships and 9 reference ships
   - 6.2.3. Wave height limitations
   - 6.2.4. Options for the review of directive 200/25/EC
   - 6.2.5. Stakeholder consultations
   - 6.2.6. Impact assessment
   - 6.2.7. Results and findings
7. Proposals for amending directive 2003/25/EC
   - 7.1. Assumptions
   - 7.2. The level of R
   - 7.3. Wave height limitations
   - 7.4. Deterministic requirements in addition to the probabilistic requirements
   - 7.5. Correction of unintended consequences
   - 7.6. Outdated references

Annex 1: Summary of targeted consultation of the relevant stakeholders

1. Introduction

This initiative is the completion of the REFIT fitness check on EU passenger ship safety legislation, the results of which have been reported in the Commission report and the accompanying Staff Working Document 'Adjusting course: EU Passenger Ship Safety Legislation Fitness Check', adopted on 16 October 2015 (SWD(2015)197). The report and Staff Working Document covered three of four main Directives on passenger ship safety (Directive 2009/45/EC[1], Directive 1999/35/EC[2] and Directive 98/41/EC[3]). In finalizing the REFIT fitness check on EU passenger ship safety legislation the present initiative aims to seek alignment of the fourth text, Directive 2003/25/EC on specific stability requirements for ro-ro passenger ships[4] with international standards, while as a minimum retaining the same level of safety.

Passenger ships play an important role in the mobility of EU citizens - more than 400 million people pass every year through EU ports, with 120 million passengers being transported between ports of the same Member State. The EU passenger ship safety legislation improves the safety of life on passenger ships sailing in EU waters, facilitates search and rescue operations and contributes to the internal market in maritime transport. It ensures that the majority of passengers transported by domestic passenger ships travel on ships complying with common EU safety standards.

The EU passenger ship safety legislation has been put in place over a period of nearly 20 years mainly in response to accidents that took place. It addresses several areas of maritime safety laying down (1) technical requirements for domestic passenger ships through adapting and complementing where necessary international standards, (2) special requirements for ro-ro passenger ships (also known as ro-pax ships), (3) requirements for surveys and (4) requirements for counting and registration of persons on board.

2. REFIT fitness check on passenger ship safety legislation

In 2009, the Legislator adopted the third maritime package that aimed to improve the effectiveness of the existing measures on maritime safety. However, it did not include specific

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1 Directive 2009/45/EC of the European Parliament and of the Council of 6 May 2009 on safety rules and standards for passenger ships (OJ L 163, 25.6.2009, p. 1).

2 Council Directive 1999/35/EC of 29 April 1999 on a system of mandatory surveys for the safe operation of regular ro-ro ferry and high-speed passenger craft services (OJ L 138, 1.6.1999, p. 1).

3 Council Directive 98/41/EC of 18 June 1998 on the registration of persons sailing on board passenger ships operating to or from ports of the Member States of the Community (OJ L 188, 2.7.1998, p. 35).

4 Directive 2003/25/EC of the European Parliament and of the Council of 14 April 2003 on specific stability requirements for ro-ro passenger ships (OJ L 123, 17.5.2003, p. 22–41)

measures on passenger ship safety. The 2011 White Paper for the future of transport[5] recognised the need to modernise the current EU passenger ship safety legislative framework. This led the Commission to undertake a fitness check of the complex regulatory set up of the EU passenger ship safety. The fitness check was announced in the Commission REFIT Communication of October 2013[6] and its results were reported to the European Parliament and the Council on 16 October 2015[7].

In the spirit of the Commission's REFIT and Better Regulation agenda, the results of the 2015 fitness check indicated how to go about simplification and clarification of the Directives dealt under this initiative.

The objective of the revision was to simplify and streamline the existing EU passenger ship safety regulatory framework, in order to (i) maintain EU rules where necessary and proportionate; (ii) ensure their correct implementation; and (iii) eliminate potential overlap of obligations and inconsistencies between related pieces of legislation. An overarching objective is to provide for a clear, simple and up-to-date legal framework that is easier to implement, monitor and enforce, increasing thus the overall safety level.

Following the completion of the fitness check, the Commission drafted three amending proposals. The negotiations on these proposals in the Transport, Telecommunications and Energy Council and with the European Parliament have led to the adoption of Directive 2017/2108[8], Directive 2017/2109[9], and Directive 2017/2110[10] respectively.
Directive 2003/25/EC was also part of the fitness check but could not be included in the first phase because of the developments that were taking place at international level on stability standards for ships in damaged conditions.

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5 White Paper 'Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system' (COM/2011/0144).

6 COM(2013)685.

7 COM(2015)508.

8 Directive (EU) 2017/2108 of the European Parliament and of the Council of 15 November 2017 amending Directive 2009/45/EC on safety rules and standards for passenger ships (OJ L 315, 30.11.2017).

9 Directive (EU) 2017/2109 of the European Parliament and of the Council of 15 November 2017 amending Council *Directive* 98/41/EC on the registration of persons sailing on board passenger ships operating to or from ports of the Member States of the Community and Directive 2010/65/EU of the European Parliament and of the Council on reporting formalities for ships arriving in and/or departing from ports of the Member States (OJ L 315, 30.11.2017, p. 52–60).

10 Directive (EU) 2017/2110 of the European Parliament and of the Council of 15 November 2017 on a system of inspections for the safe operation of ro-ro passenger ships and high-speed passenger craft in regular service and amending Directive 2009/16/EC and repealing Council Directive 1999/35/EC (OJ L 315, 30.11.2017, p. 61–77)

On 13 November 2015, the EU put forward a joint proposal to the International Maritime Organization, proposing the upgrade of the international damage stability standards for passenger ships. The EU proposal resulted in the increased damage stability international standard that entered into force in 2020. With that, the international developments have been concluded and Directive 2003/25/EC can now be dealt with.

In the framework of the regulatory fitness check completion, the proposed revision of Directive 2003/25/EC concerns the safety level comparison between the international agreed standards and the European one with a view to consider possible amendments to the EU regulatory framework.
More specifically, this initiative aims at:

- Consistency as far as practicable with the recently updated international damage stability standards as agreed at the IMO for passenger ships;
- Reducing complexity, technical and administrative burden, primarily stemming from two different regimes of evaluating the survivability of ro-ro passenger ships in damaged condition;
- Reducing ambiguity of definitions and requirements where possible in light of the amended Directive 2009/45/EC; and
- Eliminating outdated provisions concerning international instruments not anymore relevant or in force.

3. Regulatory framework on stability standards for ro-ro passenger ships (ro-pax)

For ships engaged in international voyages, which include voyages between two EU Member States, international conventions (IMO) and certain EU rules apply. The most relevant convention with respect to safety is the International Convention for the Safety of Life At Sea, 1974, and its Protocol of 1988 (SOLAS). In addition, specific EU rules apply to passenger ships, ro-ro passenger ships (known as ro-pax ships) and to high speed craft (HSC). Directive 2003/25/EC lays down stability requirements for ro-ro passenger ships in damaged condition, in addition to the ones laid down in the SOLAS Convention, for all ro-ro passenger ships operating to or from a port of an EU Member State on a regular service, regardless of their flag, when engaged in international voyages. The requirements laid down in Directive 2003/25/EC are also applicable to ro-ro passenger ships trading domestically within the European Union through Directive 2009/45/EC. This Directive divides ships and sea areas in four categories (A, B C and D) based on distance from the coast and critical wave height. For ro-ro passenger ships of Class A, B and C, the requirements of Directive 2003/25/EC must be applied.

Until 2009 the general stability requirements for passenger ships, including ro-ro passenger ships, in damaged condition as laid down in the SOLAS Convention were on a deterministic basis. These were the so-called SOLAS 90 standards. In the aftermath of the Estonia accident

in September 1994, eight northern European countries, including seven EU Member States, agreed in Stockholm on 28 February 1996 to introduce a higher damage stability standard for ro-ro passenger ships (known as the Stockholm Agreement). The possibility for concluding such an agreement within the framework of international Conventions was provided for by SOLAS 95 Conference Resolution 14 “Regional agreements on specific stability requirements for ro-ro passenger ships”, adopted on 29 November 1995. Subsequently, this Agreement was included within Directive 2003/25/EC and became applicable throughout the whole European Union.

Directive 2003/25/EC lays down a uniform level of specific stability requirements for ro-ro passenger ships, which improve the survivability of this type of vessels in case of collision damage.

These specific stability requirements come on top of the SOLAS damage stability requirements to take account of water on the ro-ro deck when the ship is damaged; the amount of which depends on the freeboard in damaged condition and the significant wave height in the area of operation.
The total number of ships flying a third country flag calling in an EU port, and certified according to Directive 2003/25/EC, is estimated at around 220.
Since Directive 2003/25/EC came into force, the SOLAS Convention has gone through substantial amendments in the area of damage stability (SOLAS Chapter II-1, parts A, B and B-1). Through these amendments, commonly referred to as “SOLAS 2009”, a probabilistic damage stability framework has been implemented for ships in damaged condition. (SOLAS 2009 amendments, applicable as of 1 January 2009). These amendments were designed to achieve the same safety level as the original SOLAS 90 standard (deterministic framework).

In June 2017, the international standards for passenger ships in a damaged condition were significantly upgraded. This upgrade was driven by an EU proposal and based on studies commissioned by the European Maritime Safety Agency and extensive research work funded by the EU. . The compelling need for the upgrade of safety standards established in the late 80s’ was driven by the continuous innovations, including a significant enlargement of the carrying capacity, incorporated into the design of passenger ships. Consequently, the European Commission committed to assess whether the specific EU damage stability requirements for ro-ro passenger ships remain necessary and whether they should be aligned to the upgraded international standards. The possibility for such an alignment was highlighted in the Commission's report on the results of a fitness check on EU passenger ships safety legislation.

Based on the results achieved by the EU at international level (IMO), supported by the results of the fitness check, the European Commission commissioned a technical study. The aim of the study was to evaluate if the requirements contained in Directive 2003/25/EC would

remain relevant as long as the corresponding safety level determined at international level is not proven equivalent or superior.

4. The upgrade of stability standards for passenger ships, including ro-ro passenger ships, at international level

4.1 The EU research projects

The long term strategy of the Commission with respect to the damage stability requirements for (ro-ro) passenger ships has been twofold: (1) an increase of the safety level at international level within cost-effective limits and (2) adapting the European legislative framework to the standards adopted in the international fora, i.e. IMO.

To pursue such strategy, a coordinated series of actions was undertaken. The European Commission requested EMSA to carry out a series of studies to identify the possible problems introduced with the SOLAS 2009 damage stability requirements in relation to ro-ro passenger ships sailing in EU waters and, including *inter-alia* the formulation used in SOLAS 2009 for "s_i"[11] in the framework of the damage stability regulations.

The final report of the first EMSA study (EMSA 1[12], 2009), identified differences in the survivability for example between ro-ro passenger ships with mainly closed vehicle decks and those with open decks, from which water can escape more easily (refer to SLF53/INF.53 – "Review of damage stability regulations for ro-ro passenger ships; damage stability parameters of ro-ro passenger ships according to SOLAS 2009 amendments, including water on deck").

In December 2011, the final report of the second study on ro-ro passenger ships, commissioned by EMSA (EMSA 2), was published[13]. The objective of the second study was to propose possible amendments to the SOLAS 2009 damage stability requirements such that the "Water-on-Deck" (WoD) problem of ro-ro passenger ships is taken into account and to identify potential damage stability issues[14] ().
In the first part of the study it was found that:

[11] The factor s_i defined in SOLAS 73 II-1 Regulation 7.1, accounts for the probability of survival after flooding the compartment or group of compartments under consideration, and includes the effect of any horizontal subdivision.

[12] http://www.emsa.europa.eu/publications/technical-reports-studies-and-plans/download/325/160/23.html

[13] http://www.emsa.europa.eu/implementation-tasks/ship-safety-standards/download/1774/1457/23.html

[14] SLF 55/7/1 – "Revision of the damage stability regulations for ro-ro passenger ships; changes to the "s_i" formulation", submitted by Austria *et al.*

- Ro-ro passenger ships designed in accordance with SOLAS 2009 have, on average, a lower ability to survive damage than those designed to SOLAS 90 plus the Stockholm Agreement;
- SOLAS 90 plus the Stockholm Agreement needs to be further analysed against the requirements of SOLAS 2009; and
- The number of damage cases with no residual damage stability, meaning negative or zero GZ values[15], varied between 10 and 14 per cent of all possible damage cases for the five ship designs that had been investigated and that were in compliance with SOLAS 2009 only. These damage cases were expected to lead to an unstable damage condition and capsize even in calm waters.

The second part of the study proposed changes to the SOLAS 2009 framework that would ensure that the effect of water-on-deck would be taken into account when it occurs on ro-ro passenger ships and proposed furthermore to raise the safety level. In order to achieve this, specific changes to SOLAS 2009, regarding certain parameters (commonly referred to as the si, w, k and R parameters) were proposed to IMO[16]).
Since 2011 other studies have been carried out to further improve SOLAS 2009 in several aspects including WoD.

In January 2013, the results of the EU funded research project GOALDS[17], addressing inter alia the revision of the 'Required Subdivision Index R' (hereafter the 'R-index'), also became available. Proposals for amendments to SOLAS were provided to IMO (see SLF55/INF.7, SLF55/INF.8 and SLF55/INF.9 by Denmark and the United Kingdom reporting on the results of the GOALDS project).

Further in May 2014, MSC 93 instructed the SDC Sub-Committee to continue the technical consideration for an increase in the R-index[18] as part of the comprehensive package of revisions to SOLAS chapter II-1 (subdivision and damage stability regulations), thereby taking into account the outcome of the third study commissioned by EMSA.

[15] GZ refers to the righting arm. Negative or zero righting arm means loss of or vanishing stability.
[16] SLF 55/INF.6 - Review of the damage stability regulations for ro-ro passenger ships; damage stability parameters of ro-ro passenger ships according to SOLAS 2009 amendments, including water-on-deck calculations - and later in document SDC3/21, Annex I
[17] https://cordis.europa.eu/project/id/233876/reporting
[18] The degree of subdivision to be provided for a ship shall be determined by the required subdivision index R, as stipulated in SOLAS 74 II-1 Regulation 6.

The EMSA 3[19] study report was published in July 2015 including, inter alia, a proposal on the R-index. During the third session of IMO's Sub-Committee on Design and Construction a compromise on the R-index was reached, partly based on the proposal of EMSA 3, which was adopted during MSC 97 in November 2016. The new SOLAS provisions (called 'SOLAS 2020') entered into force on 1 January 2020.

4.2 The SOLAS 2020 damage stability requirements

SOLAS 2020 brings in two important changes – the revisited R-index and more stringent stability requirements for the damages involving ro-ro-ro cargo spaces. The latter introduces new target values of 0.2 m and 20 degrees for respectively GZ_{max} and Range. The R-index according to SOLAS 2020 is shown in figure 1 below together with that according to SOLAS 2009, EMSA 3.2 and the compromise value as was proposed at the 3rd session of IMO's Sub-Committee on Ship Design and Construction. EMSA 3.2 is based on the results derived from optimized designs whereby cost-effective risk control options have been implemented. It is to be noted that in the EMSA 3.2 proposal the benefits of the various risk control options with respect to grounding accidents are included in the cost benefit analysis.

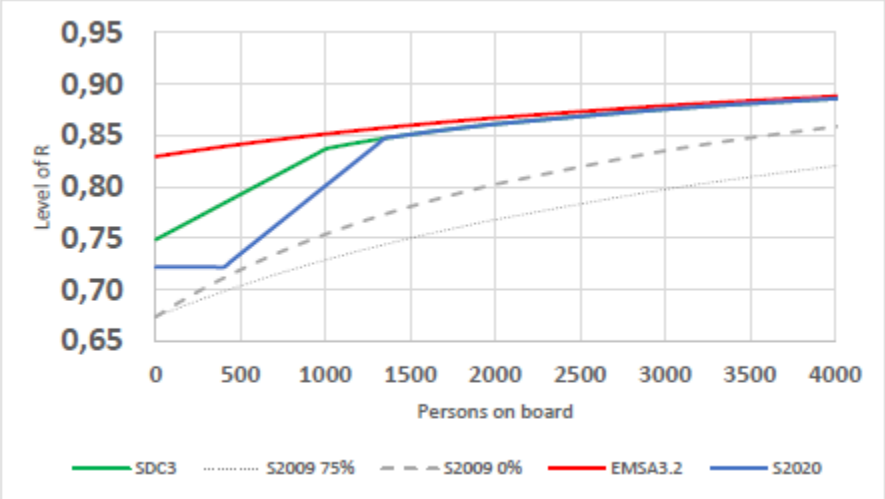


Figure 1: Required subdivision index according to SOLAS 2020, SOLAS 2009, the EMSA 3.2 proposal and the SDC 3 compromise proposal

5. Problems with Directive 2003/25/EC

[19] http://www.emsa.europa.eu/damage-stability-study.html

Taking into account the considerable changes at international level with respect to the damage stability requirements for passenger ships, Directive 2003/25/EC obviously contains outdated and inconsistent references and inconsistent provisions.

Furthermore the directive applies deterministic damage stability requirements to ro-ro passenger ships that do not match the international probabilistic regime. The coexistence of Directive 2003/25/EC (and part of Directive 2009/45/EC as amended) and the SOLAS 2020 damage stability requirements make the European passenger ship safety legislation complex. It effectively requires ship designs to comply with two different regulatory approaches; the probabilistic SOLAS 2020 requirements and the deterministic requirements according to SOLAS 90 + Stockholm Agreement. In practice, this means that ro-ro passenger ships sailing to and from EU ports have to comply with the requirements in accordance with both regimes. Full reliance on a single set of requirements, i.e. the more recent SOLAS 2020 standards or aligned with that, would be more effective and efficient. However, this would require that SOLAS 2020 provides an equivalent level of safety to SOLAS 90 + Stockholm Agreement.

The abovementioned research projects demonstrated that SOLAS 2009 did not provide an equivalent level of safety to SOLAS 90 + Stockholm Agreement. Therefore, Directive 2003/25/EC in combination with the requirements laid down into SOLAS 90 needed to be maintained in addition to the SOLAS 2009 requirements, thereby imposing more stringent damage stability requirements for ro-ro passenger ships sailing to or from EU ports[20].

The specific damage stability standards at international level have been upgraded to the SOLAS 2020 standards. The need for and the added value of Directive 2003/25/EC therefore needed to be revisited. To this end, DG MOVE.D.2 launched a study to review the Directive's requirements in light of the SOLAS 2020 damage stability requirements for passenger ships.

In the study the outcome and proposals of several studies on damage stability (in particular EMSA 1, EMSA 2, GOALDS and EMSA 3) and the development at the international level concerning the amendments to SOLAS Chapter II-1, Regulations 6-9 have been taken into consideration. All these results have been used as a basis to review the adequateness of the level of safety provided by the R-index for ro-ro passenger ships in relation to that provided by Directive 2003/25/EC.

More specifically the study provided an analytical analysis by:

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[20] As defined by Directive 2003/25/EC.

- comparing the regulatory framework as provided by Directive 2003/25/EC with that provided by SOLAS 2020, identifying and providing evidence of any potential safety gaps between the two sets of rules; and
- identifying, assessing and eventually proposing alternative measures that could close such safety gaps (towards an increased safety) by taking into account the overall survivability of the ship.

The outline of the study and the main results are discussed hereunder.

6. The study for aligning the deterministic damage stability requirements according to directive 2003/25/EC with the probabilistic requirements as developed at international level[21]

6.1 Outline of the study

The main objective of the study was to support the review of Directive 2003/25/EC, bearing in mind that the international regulations set forth by SOLAS, have developed significantly since the Directive entered into force.

As a first step in the study, the fleet of ro-ro passenger ships operating within the EU (internationally and domestically in classes A, B and C) was mapped by using various data sources.

The second step concerned damage stability calculations of 18 sample ships that were initially made available by the partners in the project. The ships made available represent the main characteristics of the fleet of ro-ro passenger ships operating in EU waters. Their common feature is compliance with Directive 2003/25/EC mainly by calculations. Some ships have also been approved by use of model tests. In addition, the requirements of either SOLAS 90 or SOLAS 2009 are applied, depending on the year of construction. One of the ships is designed in compliance with IMO Res.A265 (probabilistic prior to SOLAS 2009). The results of the sample ship calculations carried out in accordance with SOLAS 2020 presented possible options related to the survivability considering limitations in wave height and presented on a preliminary basis the implementation options, which provide the basis for the impact assessment.

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21 https://ec.europa.eu/transport/modes/maritime/studies/maritime_en

Thirdly the study included an analysis of the technical and policy options, namely the various options regarding the R-index, wave height limitations (as imposed in Directive 2009/45/EU) in a probabilistic concept and alternatives for additional deterministic requirements (still existent in the probabilistic framework).

The implementation options considered in the third step included input from a stakeholder consultation, which was carried out in accordance with the EU Guidelines.

Finally, the impacts of the suggested implementation options have been analysed based on five sample ships representative for the fleet profile identified in the first step. As a supplement to the Impact Analysis, where the assessments of costs and benefits are the basis for the recommendations, a comparison of the risk levels was carried out regarding the level of the R-index for the various implementation options.

6.2. Summary of results

6.2.1. Mapping of the fleet of ro-ro passenger ships operating within the EU in international trade and domestically in classes A, B and C

The main sources used are the IHS Fairplay/Seaweb database and the database of reported ships provided by EMSA. Based on the IMO numbers the operation of the ships was checked by using the AIS data for one year of operation. For verification and completion of this information several additional databases were consulted as well as a survey among the members of INTERFERRY.

For the year of 2016 the ships were categorized as follows:

- 256 ships in International trade
- 64 ships in Class A
- 88 ships in Class B
- 15 ships in Class C

Within each class of ships, a variety of designs was found such as single-enders, small and large double-enders, cruise ferries and ferries with long lower hold. There are significant variations in design, size parameters and capacity. This demonstrates that ro-ro passenger ships are designed to meet specific operational specifications that reflect a specific business case, specific route characteristics or as part of the domestic infrastructure.

6.2.2. Damage stability calculations of 18 sample ships and 9 reference ships

Initially, 18 sample ships were made available for investigation by calculations by the partners in the study. These ships were chosen to represent the fleet of ro-ro passenger ships operating in EU waters. The calculations were carried out following a stepwise procedure:

- Step 1: Calculate the 'Attained Subdivision Index A' (hereafter 'A-index') in accordance with SOLAS 2009 and compare with the level of the R-index. The basis for the calculation is the GM limit curve in the approved stability documentation[22].
- Step 2: Calculate the A-index in accordance with SOLAS 2020. The main difference is the new s-factor when the damage involves a ro-ro deck. Compare with the level of the R-index in accordance with SOLAS2020.
- Step 3: Investigate the possibility for optimising the GM limit curve. In several cases, there were substantial margins between the existing limiting GM curve and the loading conditions, which allowed for an adjustment of the limiting GM curve to a higher level. The A-index was recalculated and compared with the level of the R-index.
- Step 4: For the optimised GM limit curve developed in step 3, compliance with the deterministic damages according to SOLAS Chapter II-1, Regulation 8 was investigated.

A summary of results is shown in Table 1 below.

[22] GM limit curve refers to minimum metacentric height as provided for in Intact Stability calculations (SOLAS 74 II-1 Regualtion 5 and 5-1).

Id	POB	R SOLAS 2009	A SOLAS 2009	R SOLAS 2020	A SOLAS 2020	A SOLAS 2020 OPT	EU Class	H_s	Reg.8	Reg
								m		
M1	3000	0.82264	0.85483	0.87551	0.84093	0.85670	I	4.00	OK	S2009
M2	3000	0.82264	0.82319	0.87550	0.81244		I	4.00	OK	S90
M3	2200	0.81088	0.87150	0.86645	0.85997		I	4.00	OK	S2009
M4	2600	0.81101	0.80336	0.87040	0.78518	0.84850	I	4.00	OK	S90
LMG1	399	0.71125	0.75153	0.72200	0.7412	0.76926	B	4.00	OK	S90
LMG2	718	0.73582	0.77917	0.76395	0.75799	0.79074	C	2.50	N	S2009
LMG3	1500	0.78125	0.78934	0.85099	0.78789	0.83040	B	3.70	OK	S2009
LMG4	1032	0.75594	0.79364	0.80538	0.79364	0.82793	B	4.00	OK	S2009
N1	2620	0.81184	0.69029	0.87067	0.67678	0.76437	A	4.00	N	S90
N2	935	0.74158	0.79392	0.79258	0.78816	0.79501	I/A	4.00	OK	S90
N3	1825	0.79566	0.8112	0.85785	0.80316	0.83665	B	2.50	OK	S90
N4	1800	0.78908	0.84021	0.85886	0.83618	0.86073	B	3.25	N	S90
N5	650	0.73073	0.92137	0.75498	0.89745	0.90877	B	2.50	N	S90
N6	200	0.69259	0.67310	0.72200	0.66082	0.67394	B	2.50	N	S90
IF1	1774	0.78027	0.78031	0.85685	0.76956	0.77807	I	4.00	OK	S90
IF2	850	0.71805	0.78920	0.78137	0.78045	0.80977	I	4.00	N	S90
IF3	600	0.72356	0.72370	0.74838	0.70571	0.74828	I	4.00	N	S2009
IF4	471	0.70386	0.80096	0.73137	0.79751	0.8118	I	4.00	OK	IMO A265
A210	2000			0.86108	0.86172		I	4.00	OK	S2020
B150	2000			0.86108	0.86130		I	4.00	OK	S2020

Table 1: Damage stability calculations sample ships

The proportion of sample ships failing to meet SOLAS 2020 is given in table 2 below

		Proportion of cases failing to meet SOLAS2020	
Capacity	Count	Original GM	Optimised GM
POB >= 1350	9	100%	89%
POB < 1350	9	67%	22%

Table 2: Proportion of sample ships failing to meet SOLAS 2020

In addition to the sample ships provided in this study, ro-ro passenger ship designs used in previous studies, namely GOALDS and EMSA 3, are referred to as well as to the submission to the third session of IMO's Sub-Committee on Ship Design and Construction by Denmark (Denmark, 2015), which includes calculation results for a number of ferries operating in Denmark. In total, the calculation results for 27 ships are provided.

A summary of results of the previous studies is provided in table 3 below.

Id	POB	R SOLAS2009	A SOLAS2009	R SOLAS2020	A SOLAS2020	A SOLAS2020 OPT
G1	3500	0.83296	0.83512	0.88105	0.82937	
G2	2200	0.79804	0.80984	0.86360	0.80255	
E1	3280	0.83000	0.85270	0.87872	0.83261	
E2	1700	0.77800		0.85536	0.83982	
E3	625	0.72143	0.77404	0.74970	0.72252	0.7947
E4	610	0.72780	0.76478	0.75168	0.74911	0.8412
DK1	600	0.72720	0.95650	0.75168	0.83680	
DK2	110	0.68270		0.72200	0.75420	0.78410
DK3	395	0.71010	0.75770	0.72200	0.71730	
DK4	250	0.69740	0.69500	0.72200	0.66930	0.74530
DK5	590	0.72520	0.89400	0.74700	0.78730	0.80380
DK6	410	0.70680	0.68880	0.72330	0.64890	0.72010

Table 3: Damage stability calculations reference ships

The proportion of reference ships failing to meet SOLAS 2020 is given in table 4 below.

		Proportion of cases failing to meet SOLAS2020	
Capacity	Count	Original GM	Optimised GM
POB >= 1350	4	100%	100%
POB < 1350	8	63%	40%

Table 4: Proportion of reference ships failing to meet SOLAS 2020

In the study it is concluded that generally, SOLAS2020 in itself represents a higher stability standard than the Stockholm Agreement in combination with earlier versions of SOLAS.

6.2.3. Wave height limitations

According to Directive 2003/25/EC the height of water accumulated on deck can be adjusted depending on the significant wave height (with a 10% probability of exceedance) in the specific area of operation. For areas where the significant wave height is 4.0 m or above, the height of accumulated water is as in the residual freeboard formulations while it is assumed to be 0.0 m when the significant wave height is 1.5 m or less, with linear interpolation in between.

SOLAS does not provide an instrument allowing for altering the requirements depending on sea state in the specific area of operation. Moreover, the regulations do not refer explicitly to the sea state at all. Nevertheless, the SOLAS s-factor is implicitly dependent not only on wave height but also on the specific distribution of sea states.

The question now was whether the critical wave height (HS_{crit})[23] should be included in the probabilistic framework and if yes, how this could be accommodated. To this end, two methodologies have been investigated:

- the normalised s-factor, where both the HS_{crit} and the s-factor formulae are modified to accommodate for the operational wave heights lower than 4 meters HS_{crit}; and
- the expected critical sea-state, where the second step of the above procedure (i.e. evaluation of the s-factor) is omitted and instead the individual critical wave heights are averaged.

Both methods are equivalent in this respect that they utilise the core concepts of survivability assessment present within the probabilistic framework. Furthermore, they both can be calculated alongside of the typical A-index calculations. The study reports that the application of both methods to the sample ships, even if there are some variations between the sample ships, does not show a significant effect when accounting for operational wave height.

6.2.4. Options for the review of Directive 200/25/EC

The options for the review of Directive 2003/25/EC are divided into three groups:

- Determination of the level of the R-index;
- Methods to account for wave height limitations; and
- Deterministic requirements in addition to the probabilistic requirements.

For the determination of the level of the R-index, three options have been considered:

- SOLAS 2020;
- SDC 3 compromise; and
- EMSA 3 proposal (EMSA 3.2).

These options reflect the proposals that have been considered in the process leading to the level of the R-index adopted as per SOLAS2020.
For taking into account wave height limitations in the probabilistic concept, three options have been considered:

- Use of the “normalised” s-factor;
- Use of the concept of “expected critical sea-state”; and
- No modification, use SOLAS2020 as is regardless of operational area.

[23] Critical significant wave height (HScrit), a threshold sea state in which the ship is likely to survive given damage with certain probability for a specific time.

For the deterministic requirements in addition to the probabilistic requirements, three options have been considered:

- Use SOLAS2020 Chapter II-1/B-1, Regulation 8 as it is without any addition;
- Use SOLAS2020 Chapter II-1/B-1, Regulation 8 with B/5 penetration instead of B/10;
- Retain Stockholm Agreement as set forth the by 2003/25/EC, as it is.

These options should be seen in relation to the implementation options listed above with respect to the level of the R-index. SOLAS 2020 includes the deterministic requirement set forth by Regulation 8. From the stakeholder consultation it was suggested that the current assumption regarding damage penetration in SOLAS Chapter II-1/B-1, Regulation 8 should be expanded to B/5 from B/10.

6.2.5. Stakeholder consultation

The initiative aims at aligning specific technical requirements for the sub-division of ro-ro passenger ships with the recently updated international standards (IMO). Due to the specificity of the matter, it is very difficult for the public to provide valuable input. Therefore, a targeted consultation and a workshop were considered the best way for the efficient engagement of the experts from national administrations as well as sectoral organisations participating in the work of the Passenger Ship Safety expert sub-group dealing with ship standards. The outcome of stakeholder consultation forms the basis for the selection of the various implementation options, which were accounted for in the Impact Assessment study. More information on the stakeholder consultation can be found in Annex 1.

6.2.6. Impact assessment

The impact assessment was based on the same risk model as developed in the EMSA 3 studies. The same assumptions regarding occupancy rate and service time (30 years) have been applied. In the EMSA 3 studies the evaluation criterion VPF (Value of Preventing a Fatality) was updated in accordance with the IMO FSA Guidelines to MUSD 7.02 and was in this study converted to MEUR 6.

The selection of sample ships for the impact assessment in the present study was intended to be representative for all relevant ship categories of ro-ro passenger ships operating in European waters and to complement the sample investigated in the EMSA 3 project. For these reasons, the sample involves the following ships:

- Large Baltic ro-ro passenger ships in two versions (A210 & B150) designed for compliance with SOLAS 2020 and the Stockholm Agreement.

- Medium sized double-ended ferry (LMG2).
- Typical ferry with long lower hold (IF3).
- Small ro-ro passenger ship with less than 400 persons on board (LMG1).

The LMG vessels were new designs for operation in Baltic, Mediterranean and Norway and hence represent current state-of-the-art ships. IF3 is an in-operation ferry with a long lower hold. A210 and A150 are new designs, developed for compliance with SOLAS2020 and the Stockholm Agreement.
The results from the Impact Analysis and the cost benefit assessment are summarised as follows:

- LMG1 complies with the level of the R-index according to SOLAS2020 as it is, while the Risk control options investigated to meet the higher standard of SDC 3 exceed the cost threshold.
- LMG2 complies with the level of the R-index according to all options while meeting the cost threshold.
- IF3 complies with level of the R-index according SOLAS2020 and SDC 3 in its current configuration. RCOs meeting the EMSA3.2 exceed the cost threshold.
- A210 is designed for compliance with SOLAS2020 and is also meeting the level of the R-index according to SDC 3.
- B150 is designed for compliance with SOLAS2020 and is also meeting the level of the R-index according to SDC 3 and EMSA3.2.

As a supplement to the Impact Analysis where the assessments of costs and benefits are the basis for the recommendations, a comparison of the risk levels represented by the various implementation options for the R-index was carried out.
As all sample ships are in compliance with current regulations it is seen that:

- For larger ships with 1350 or more persons on board, SOLAS 2020 represents a significant risk reduction compared with current operating ships, i.e. ships complying with SOLAS 90 + the Stockholm Agreement or SOLAS 2009 + the Stockholm Agreement;
- If the SDC 3 level of the R-index is implemented there would be also a risk reduction in the segment below 1,350 POB.

6.2.7. Results and findings

Results and findings of the study are summarized as follows:

a) Regarding the level of the R-index, both the comparison of risk and the cost-benefit analysis demonstrate that compliance with SOLAS2020 for ships having a capacity larger than 1350 represents in general a higher safety standard that ensures that the current safety level is not compromised.

b) For ships with a smaller capacity (POB<1350), the picture is not so clear as safety levels of some ships compliant with SOLAS 2020 may be lower than achieved by the present combination of either SOLAS 2009 or SOLAS 90 with the Stockholm Agreement.
c) A level of the R-index according to SDC 3 would lead to a reduction in risk for all segments. It is noteworthy however, that in case of the sample ship LMG1 there were no risk control options found leading to compliance with SDC 3 that would meet the cost threshold.
d) The requirements of the Directives 2009/45/EC and 2003/25/EC can be replaced by the damage stability framework as per SOLAS 2020 but with a level of R as per the SDC 3 proposal (same as the R-index in SOLAS 2020 for ships of capacity exceeding 1350).
e) Alternatively to d), the current regulations can be replaced by the requirements of SOLAS 2020, provided that directive 2003/25/EC (i.e. the Stockholm Agreement) is retained for ships having a capacity of less than 1350 POB.
f) It needs to be underlined that ro-ro passenger ships are in many cases tailor made for a specific trade/route, which could be different from those included in this study. Further to this, some domestically operated ferries may also be a part of the national infrastructure and receiving governmental support. This may render assumptions regarding costs and occupancy (revenue) covered inaccurately. Therefore, the cost figures may be a less reliable measure in comparison with risk levels (1-A, 1- R) and qualitative measures used to compare various implementation options.
g) The SOLAS 90 standard is outdated and its application does not represent a uniform safety level.
h) All regulations, both existing and new include a “gap” at 400 persons on board. The deterministic damage scenario; SOLAS90, Regulation 8 of SOLAS2009 and SOLAS2020 all include a step change from one-compartment to two-compartment standards.
i) Based on the sample ship results there is no evidence that adoption of deeper transverse penetration (B/5) in place of the B/10, as required by SOLAS Regulation 8, would improve the overall survivability as expressed by the A-index.
j) The sample ship calculations do not show that wave-height limitations accounted for by either the normalised s-factor or expected critical wave height have significant impact on the overall survivability as expressed by the A-index. The study does not see any merit in introducing separate requirements with respect to the operational wave-height limitations for damage stability in a probabilistic concept.

7. Proposals for amending Directive 2003/25/EC

7.1. Assumptions

a) The proposal for amending Directive 2003/25/EC will be based on the study as outlined and summarized above, including previous studies referred to in this study.
b) The safety level as provided by Directive 2003/25/EC as it stands (i.e. application of SOLAS 90 + the Stockholm Agreement) is not to be compromised.
c) This proposal will be applicable to new ships, i.e. yet to be built. Existing Ships can continue to comply with the regime according to which these ships have been certified. However, as an option, existing ships may also be certified in accordance with the regime for new ships.

7.2. The level of the Required Subdivision Index R'

It is proposed not to retain the Stockholm Agreement and to apply the framework of SOLAS 2020 to all ro-ro passenger ships within the scope of the present regulatory regime, but with a different level of the R-index than that defined in SOLAS 2020. The level of the R-index to be used within the SOLAS 2020 framework should be that according to the SDC 3 compromise proposal, which defines the R-index as follows[24]:

Persons on board	***R***
$N \leq 1{,}000$	R=0.000088*N+0.7488
$1{,}000 < N \leq 6{,}000$	R=0.0369*ln(N+89.048)+0.579
$N > 6{,}000$	R=1-(C1*6200)/(4*N+20,000) with C1=0.8-(0.25/10,000)*(10,000-N)

According to the results of the study[25], this is a viable option and it would be in line with the assumption not to compromise the safety level provided by the present regime. This proposal was approved at MSC 97 for adoption at MSC 98 and was supported by the EU Member States and the European Commission as a compromise for increasing the level of the R-index for passenger ships, including ro-ro passenger ships. At MSC 98 this proposal was amended which lead to the SOLAS 2020 damage stability requirements. As indicated by the study for ships with a smaller capacity (POB<1350) safety levels of some ships compliant with SOLAS 2020 may be lower than achieved by the present combination of either SOLAS 2009 or

[24] Reference is made to document MSC 98/3/Add.2

[25] Assessment of specific EU stability requirements for ro-ro passenger ships (2019), ISBN : 978-92-76-02274-9, doi:10.2832/968505

SOLAS 90 with the Stockholm Agreement. Therefore only adhering to the SOLAS 2020 damage stability requirements would not be a viable option.
The application of the level of the R-index according to the SDC 3 compromise proposal would align with the international regime since only the value of the R-index changes. The calculation method would be completely aligned, which is a major simplification compared to the present regime.

Options to be considered in conjunction with the above proposal:

Option 1
In this option the Stockholm Agreement is retained as an alternative to using SOLAS 2020 with a level of the R-index according to the SDC 3 compromise. The specific damage stability calculations for (new) ro-ro passenger ships would be carried out either in accordance with SOLAS 2020 with an R-index according the SDC 3 compromise or with Directive 2003/25/EC (the Stockholm Agreement in conjunction with the SOLAS 90 requirements). This option may cater for problems that some ro-ro passenger ships may have to comply with SOLAS 2020 with the level of the R-index according the SDC 3 compromise, because ro-ro passenger ships may be tailor made for a specific trade. In particular this may apply to ro-ro passenger ships engaged in domestic trade to which Directive 2003/25/EC applies through the requirements laid down in Directive 2009/45/EC. In order to comply, design solutions may have to be applied that are not cost-effective. Offering an alternative calculation method, while maintaining the level of safety, may cater for this problem. This option will also take account of ro-ro passenger ships trading seasonally or only performing short-time period operations, since this is catered for in Directive 2003/25/EC.
The drawback of this option is that the goal of the REFIT to simplify the regulatory framework will not be met. This option will require an extension of the present regulatory framework.

Option 2
This option sets a possible time limit on the use of the Stockholm Agreement in conjunction with SOLAS 90 as an alternative to SOLAS 2020 with the level of the R-index according to the SDC 3 compromise. In order to achieve this a review clause should be incorporated stating that the (amended) Directive would be reviewed before [xx] years after the entry into force. The aim of such a review would be to identify according to which regulatory regime (new) ro-ro passenger ships are certified and to conclude whether the Stockholm Agreement in conjunction with SOLAS 90 at that point in time should still be considered as a viable and necessary alternative for performing the damage stability calculations. If the answer is yes, maintaining the alternative should be considered. Otherwise, it may be decided to phase out the Stockholm Agreement in conjunction with SOLAS 90.

It should be noted that in either of these two options, for both international and domestic ships, the regulatory framework currently in force would still require new ships to comply with SOLAS 2020.

Furthermore, under both options outlined above, the possibility of using the current conditions of the Stockholm Agreement would be considered as an exemption to the future, simplified regulatory framework for the damage stability. A justified notification from the Member States to the Commission would be required, and conditions for applying such exemption defined in the revised Directive in order to enable the Commission to have a precise overview of the Directive implementation and, primarily guarantee the safety for passengers of the ro-ro ships sailing in the EU.

7.3. Wave height limitations

It is proposed not to account for wave height limitations in the probabilistic concept. This is based on the conclusion in the study that the sample ship calculations do not show that wave-height limitations accounted for by either the normalised s-factor or expected critical wave height have significant impact on the overall survivability as expressed by the A-index. Therefore, there is no merit in introducing separate requirements with respect to the operational wave-height limitations for damage stability in a probabilistic concept.

7.4. Deterministic requirements in addition to the probabilistic requirements

It is proposed to maintain SOLAS 2020 Chapter II-1/B-1, Regulation 8 as it is and not to use B/5 penetration instead of B/10. This is based on the conclusion that there is no evidence that adoption of deeper transverse penetration (B/5) in place of the B/10, as required by Regulation 8, would improve the overall survivability as expressed by the A-index'.

7.5. Correction of unintended consequences

Directives 2003/25/EC (Art.9) and 2009/45/EC (Art.9) as amended, allow for equivalents, exemptions and possibilities for adaptation respect to short-time period operations and seasonal operation. Through these provisions, it is possible to lift some of the requirements when for example there are specific design restrictions driven by the water depth or specific features of the port infrastructure that limit the design space for the ship itself.

7.6. Outdated references

The review also includes a number of proposals removing outdated, inconsistent or redundant references from the Directive, such as:

- Reference to Directive 96/98/EC replaced by a reference to Directive 2014/90/EC;

- Reference to Directive 95/21/EC replaced by a reference to Directive 2009/16/EC;
- Reference to Directive 94/57/EC replaced by a reference to Regulation (EC) 391/2009;
- Reference to Decision 1999/468/EC replaced by a reference to Regulation (EU) 182/2011 where appropriate;
- Outdated Article 7(2) on ro-ro passenger ships phased-out (1 October 2015) removed;
- Outdated Article 8(4)(second paragraph) and Article 8(4) on implementation reports (17 May 2006) removed;
- Redundant part of the reference to ICLL taken out in Article 2(m);
- Redundant Article 6(1)(c) is deleted {duplicates points (a) and (b)};
- Redundant part of the reference to DSC Code taken out in Article 6(4)(a).

Inconsistent provisions:

- Missing reference to the 2008 Intact Stability Code added in Article 2(b);
- Incorrect reference to HSC Code in Article 2 (g)(ii) replaced by a correct one (Regulation 1.4.38);
- Incorrect reference to 'passenger' taken out from Article 3(2)(a);
- Incorrect reference to Annex I took out from Article 9(2);
- Explicit reference to the requirements of the Directive added in Article 13(a);
- Missing references to equivalencies and additional safety provisions added in Article 13(b).

Annex 1: Summary of targeted consultation of the relevant stakeholders

Two main coordinated streams of consultation with the relevant stakeholders have been undertaken. One as part of the technical study carried out by the Contractor and a second one with the Passenger Ship Safety Expert Group (PSS EG) during nearly two years of work.

STREAM 1 – Consultation with relevant stakeholders

Task C of the study foresaw the Consultation of interested parties – Stakeholders' Consultations.

The objective of the Consultation with the interested parties was three-fold:

Objective 1 – Fleet profile

To consider the sample ships available in the study and assess whether the fleet is adequately covered. The characterisation of the relevant fleet falling under the Directive 2003/25/EC was conducted in Task A.1. This task was supported by INTERFERRY, representing ro-ro passenger vessel operators, therefore, making sure that Stakeholders' input and views were well represented.

Objective 2 – Damage stability calculations

To gather views on the following aspects associated with the calculations of the attained index of subdivision:

1. Functional relationship between s-factor and critical wave height.
2. Impact of the existing/proposed s-factor formulation on the A-index.
3. Impact of the existing/proposed R-index on the fleet's design and operational characteristics.

Objective 3 – Alternative regulatory options

To gather views on the following three regulatory options (as per Task B of the study):

1. Retain the relevant legislation as is (i.e. SOLAS 2020 + the Directive 2003/25/EC).
2. Assess the safety level of the probabilistic framework (e.g. through the R-index) to align it to the deterministic one without any additional deterministic measures.
3. Assess the safety level of the probabilistic framework (e.g. through the R-index) to align it to the deterministic one with some additional deterministic safeguarding measures.

Furthermore, part of the Consultation with the relevant stakeholders was complemented with a **Questionnaire** and a dedicated **Workshop**.

The consultation methods included in the plan included an open targeted consultation via email and a website, a stakeholders' seminar/workshop and individual interviews and ad-hoc meetings with targeted stakeholders.
The Questionnaire was distributed by the DG MOVE/D2 to the members and observers of the Passenger Ship Safety Expert Sub-Group, including an invitation to participate in the Stakeholders' workshop. Members (Type D) include:

- State Authorities of the EU 28 Countries.

Observers (Type C Organisations) include:

- 8 Trade and Business Associations,
- 3 Companies/Groups and
- 2 NGOs.

The consultation pack was also distributed among the 9 members of the consortium, which include

- 1 Trade and Business Association (INTERFERRY)
- 2 Companies/Groups – Ship Builders (Meyer-Werft and Meyer-Turku)
- 2 Companies/Groups – Designers (LMG Marin, NAP)
- 2 Companies/Groups – Consultants (HEC and Brookes Bell)
- 1 Companies/Groups – Classification Society (DNVGL)
- 1 Academic (University of Strathclyde)

The Workshop took place on 25th April 2018 from 10:00 to 17:00 in Brussels at the Albert Borschette Conference Centre, room 1B, Rue Froissart 36.

The workshop was attended by 38 participants, including members of the project Consortium, EC project officers, EMSA personnel and various representatives from State Members including Belgium, Cyprus, Denmark, Greece, Finland, Ireland, Italy, Iceland, Luxemburg, Malta, France, Norway, Sweden and the United Kingdom.
The invitation to the workshop was also extended to members of the Passenger Ship Expert Sub-Group.

Members of the project consortium include ship designers/builders (Meyer-Werft, Meyer-Turku, LMG Marin, NAP) ferry owners/operators (INTERFERRY), research institutions (MSRC of the University of Strathclyde), marine and naval architecture consultancies (HEC and Brookes Bell) and a class society (DNVGL).

State Authority	21
Trade and Business Associations	6
Class Society	4
Builder	1

Owner/Operator	2
University	3
Consultant	1

The detailed results of the Questionnaire replies and of the Workshop are contained in the study's final report Task C and its Annexes.

The objective of this consultation targeted at members of the Passenger Ship Safety Expert Group was to support the Commission, assisted by the European Maritime Safety Agency, in the concrete formulation of the envisaged simplification proposals, particularly as regards the technical definitions and the clarity of the legal drafting. The results formed a basis for the discussions that took place during the meeting of the Passenger Ship Safety Expert Group, on 2 February 2016.

Consultation period

The Questionnaire established by the Contractor in consultation with DG.MOVE.D.2 was addressing technical experts in the industry and administrations. Given therefore its technical nature and the need to execute certain basics calculations and evaluations to properly reply to the questions, it was left open for replies for several months. Originally foreseen for 3 months it was allowed to continue to provide replies until after the workshop (from month 9 to month 13 of the project).

Format and process followed

The relevant stakeholders were identified in first place on the knowledge of the sector of the group of companies engaged in the study, on the basis of the knowledge of DG.MOVE.D.2 and finally by using a systematic mapping process consistent with the guidelines implicit in Chapter 7 of the toolbox #50.

The questionnaire consisted of three main parts. Each one of the sections was dedicated one particular aspect of the study, namely:

- The choice of the sample ships to effectuate the evaluations,
- The calculation methodology (A-index and s-factor) and
- The Technical options

The Questionnaire was circulated by mailing list prepared by the contractor on the basis of the mapping of the stakeholders results and also made available for the MS via CIRCA of the PSS EG. As the working language of the Expert Group is English, the questionnaire was only available in English and, therefore, the same applies for the language of the present summary of the replies that have been received.

STREAM 2 – Consultation with the Passenger Ship Safety Expert Group

The Maritime Safety Group is an informal, permanent expert group on maritime safety set up by DG Mobility and Transport (Register of expert groups number E01079). The Passenger Ship Safety Experts Group is a subgroup of this group.
Members of this sub-group and the Member States and the stakeholders selected by a Call for Observers. The observers admitted and invited to the attend the meetings of the PSS EG were:

Applicant Name
ANEC, the European consumer voice in standardisation
BRITISH MARINE Federation Limited
BRITTANY FERRY
CLIA
EBI, European Boating Industry
ECSA, European Community Shipowners' Associations
IACS, the International Association of Classification Societies Ltd.
ICS, International Chamber of Shipping
INTERFERRY
NORSAFE
SEAEUROPE
SEEN, Association of Passenger Shipping Companies
STENA

The matter at stake was presented to the Passenger Ship Safety Expert Group in the following occasions:

- PSS EG 30 March 2017;
- PSS EG 23 October 2017;
- PSS EG 24 April 2018;
- PSS EG 25 September 2018;
- PSS EG 13 December 2018;
- PSS EG 04 June 2019
- PSS EG 24 September 2019.

At each occasion updates and findings on the then on-going study were provided, allowing for technical discussion of the participants to the meetings building a common understanding of the findings. In several occasions (such as on 13 December 2018 and 04 June 2019) the contractor was also present to further help the discussion providing additional clarifications. At each occasion both Member States and observers' stakeholders were invited.