The Experts Group on Formal Safety Assessment (FSA) met from 10 to 12 November 2015 under the chairmanship of Mr. K. Yoshida (Japan).

The group was attended by the following experts nominated by Member Governments, intergovernmental organizations and non-governmental organizations:

- Mr. A. Bain
- Mr. J. Ballesio
- Mr. J. Bao
- Mr. L. Benedetti
- Mr. A. Breuillard
- Dr. E. Brünner
- Mr. B. Bubar
- Ms. M. Dewar
- Mr. S. Dexter
- Mr. R. Griffiths
- Mr. A. Hull
- Mr. V. Jenkins
- Mr. A.R. Kar

- Mr. J. Leroux
- Mr. A. Maccari
- Mrs. M. Mansoorian
- Mr. K. Metselaar
- Dr. Y. Ogawa
- Mr. J. Roos
- Mr. J. Sirkar
- Dr. R. Skjong
- Dr. Z. Szozda
- Prof. J. Wang
- Mr. M. Williams
- Mr. L. Zhuang

https://edocs.imo.org/Final Documents/English/SDC 3-3-4 (E).docx
and the following observers also attended the meeting:

- Mr. B. Aykan (Turkey)
- Mr. N. Charalambous (Cyprus)
- Dr. I. Cobos (Spain)
- Mr. R. Hamann (EC)
- Mr. L. Karlsen (Norway)
- Ms. A. Wypych-Namiotko (Poland)
- Mr. M. Koopmans (EC)
- Mr. M. Nunez (Spain)
- Mr. O. Olufsen (EC)
- Mr. S. Papageorgiou (EC)
- Mr. R. Hamann (EC)
- Mr. S. Papageorgiou (EC)
- Mr. L. Karlsen (Norway)
- Ms. A. Wypych-Namiotko (Poland)

**Terms of reference**

3 MSC 93 instructed the FSA Experts Group to validate the EMSA 3 study related to survivability of passenger ships, taking into account the risk models and calculated risk and the validity of the data and assumptions that were used, based on the Revised FSA Guidelines (MSC-MEPC.2/Circ.12/Rev.1; terms of reference of the group are described in paragraph 28 of appendix 10), and advise the SDC Sub-Committee accordingly. MSC 95 approved the timing of the FSA Experts Group and noted that its report would be submitted to SDC 3 for consideration under agenda item 3 (Amendments to SOLAS regulations II-1/6 and II-1/8-1).

**Presentation of EMSA 3 study**

4 The group noted the information on the study commissioned by the European Maritime Safety Agency (EMSA) on the combined assessment of cost-effectiveness of previous parts of the EMSA 3 study, FSA compilation and recommendations for decision making, as presented by Mr. S. Papageorgiou, Mr. O. Olufsen and Mr. R. Hamann.

**Review of EMSA 3 study**

**Adequacy of scope of the FSA**

5 Following a brief discussion, the group endorsed that the scope of EMSA 3 study was clearly defined in section 1 (Preface) of the annex to document SDC 3/INF.3 (EC) and was focused primarily on risk to persons on board; and that the study was within the scope of planned output 5.2.1.13 (Amendments to SOLAS regulations II-1/6 and II-1/8-1).

6 The group, having noted that EMSA 3 study did not provide any data for passenger ships carrying less than 400 persons on board, agreed to take this into account when considering the curves suggested for attained subdivision index A and required subdivision index R (see paragraph 18).

**Validity of the input data**

7 The group accepted the validity of the input data, taking into account the following comments:

- .1 the actual number of accidents available is small and, therefore, a risk model has been developed with a view to also using expert judgement;
- .2 the report contains references to data sources for grounding damages, some of which are not available for the FSA Expert Group for reasons of confidentiality; and
- .3 GISIS and the IHS database, which has a cost, were used as main sources for accident data gathering; otherwise, insufficient data on accidents/incidents was publicly available.
The group also noted the information that France, having independently repeated the risk model using the same sources of data, calculated the same probabilities for most of the risk model nodes.

**Consequential discussion on GISIS**

In view of the above, the group agreed to reiterate its views that Member Governments should be encouraged to upload more specific casualty information onto GISIS as per the Casualty Investigation Code, including root causes, damage penetrations, etc. In this connection, the following comments were noted by the group:

.1 the reporting of accidents/incidents by Member Governments should be revisited to enhance the quality and relevance of the data available in GISIS, for the purpose of carrying out FSA studies;

.2 a revised format of reporting casualties should be set up to ensure the transparency of the information available in GISIS; and

.3 only Member Governments are allowed to upload information onto GISIS.

**Adequacy of expertise of participants in the FSA**

Based on the explanations provided by the European Commission, the group confirmed the adequacy of expertise of the experts who participated in the EMSA 3 study.

**Adequacy of accident scenarios, risk models and calculated risks**

Having referred to part II of the final report on risk acceptance criteria and risk-based damage stability, the group noted that there was a difference between the recommendations from the GOALDS project and the EMSA 3 study.

After a lengthy discussion, the group noted the explanation on the differences between GOALDS and the EMSA 3 study and, in particular, on the different approaches applied in GOALDS and the EMSA 3 study for taking into account water ingress:

.1 in GOALDS: if water ingress was unknown, it was assumed that water ingress happened; and

.2 in the EMSA 3 study: if water ingress was unknown, the data point for that incident was excluded.

In this connection, it was brought to the group's attention that such a difference might lead to a higher ΔPLL and changes to the interval of confidence; and, subsequently, to a reconsideration of RCOs.

The group noted that the uncertainty analysis did not allow for the same outcome for the study when the upper bound of confidence was used (many RCOs justified) or the lower bound was used (many RCOs rejected). Therefore, the results were based on average ΔPLL as the FSA guidelines are not specific in this respect.

Having discussed how sensitivity and uncertainty were addressed in the EMSA 3 study, the group, taking into account the concern that there were not enough confirmed events for judgement, agreed that sensitivity and uncertainty were properly covered by expert judgement.
Selection of RCOs

16 Having noted the specific types of ship considered in the EMSA 3 study, the group agreed that the selection of RCOs was appropriate. It was also noted that:

.1 RCOs were developed by the design teams (i.e. designers and operators) and correspond to the level of basic design; and

.2 the connection of RCOs and root cause was not required, considering the scope of the study (i.e. mitigating RCOs for damage stability, not preventive RCOs for avoiding groundings and/or collisions).

17 Apart from this particular study (i.e. EMSA 3 study), the group noted that, as a general principle, RCOs which cover both incident prevention and consequence mitigation should be considered.

18 The group, having noted that the EMSA 3 study did not provide any data for ships carrying less than 400 persons on board, agreed to advise the Sub-Committee that extrapolation below 400 persons on board is indicative only and requires further technical consideration.

Cost benefit analysis (CBA)

19 The group noted that cost-benefit analysis was generally conducted in line with the FSA Guidelines. The group also noted that all the related stakeholders, including shipyards and shipowners/operators, were involved in the EMSA 3 study.

Review of the methodologies used in the study and relevance of methods and tools

20 After some discussion on the methodology for attained subdivision index A, as agreed at SLF 55, the group endorsed that the methodology appropriately reflected the probability to survive after damage.

Conclusions

21 Having considered the EMSA 3 study, the group agreed that the study was adequately conducted in accordance with the FSA Guidelines.

22 No deficiency affecting the outcome has been identified by the group in the EMSA 3 study.

23 The group also agreed that the conclusions and the recommendations in the EMSA 3 study require immediate action and, therefore, need to be considered by SDC 3 under agenda item 3.

24 In figure 13-2 of the annex to document SDC 3/INF.3, it was observed that there are margins for further increasing the required subdivision index R (see also recommendations in paragraph 13.3):

.1 Table 12-1 demonstrates that the RCOs analyzed have a cost effectiveness far below the criteria and, therefore, there is a margin for further increasing the attained subdivision indices A; and
in figure 13-2, the proposed attained indices A are above the suggested formulations for index R, which was explained as being a margin for the designers in order to achieve the proposed formulations for index R.

25 The conclusions and recommendations, as set out in document SDC 3/INF.3, are credible. However, they need to be further considered by SDC 3 from a technical point of view, while preparing amendments to SOLAS regulations II-1/6 and II-1/8-1. In this connection, the group invited the Sub-Committee to note the following:

.1 The selection of ship designs and respective RCOs presented in the study in the form of cost boundaries (see, for example, figure 13-42 of part II of Report No. 2015-0166, Rev. 3, as referenced in document SDC 3/INF.3) was used for an intermediate assessment. This was then used by the designers in the study for choosing well performing RCOs for the final CBA. In the final CBA the ΔPLL values shown in tables 8-3 and 12-1 of document SDC 3/INF.3 were calculated as the differential between the optimized designs against the initial designs.

.2 It was explained that the water ingress node in the risk model accounts for hull breaches after collision accident that could lead to a potential water ingress.

26 With regard to further improvement of the current FSA Guidelines the group endorsed the view that it may be appropriate at this stage to have all the reports previously made by the FSA Experts Group collected and uploaded onto IMODOCS for ease of reference.

Action requested of the Sub-Committee

27 The Sub-Committee is invited to approve the report in general and, in particular, to:

.1 note that the scope of the EMSA 3 study is clearly defined in section 1 of the annex to document SDC 3/INF.3 and is focused primarily on risk to persons on board, and that the study is within the scope of planned output 5.2.1.13 (paragraph 5);

.2 encourage Member Governments to upload more specific casualty information onto GISIS as per the Casualty Investigation Code, including root causes, damage penetrations, etc. (paragraph 9);

.3 note the adequacy of expertise of the experts participated in the EMSA 3 study (paragraph 10);

.4 note that sensitivity and uncertainty were properly covered by expert judgement (paragraphs 14 and 15);

.5 note that the selection of RCOs is appropriate (paragraph 16);

.6 note that extrapolation of the proposed RCOs to passenger ships having less than 400 persons on board is indicative only and requires further technical consideration (paragraph 18);

.7 note that the cost-benefit analysis was generally conducted in line with the FSA Guidelines (paragraph 19);
.8 note that the methodology for attained subdivision index A, as agreed at SLF 55, appropriately reflects the probability to survive after damage (paragraph 20);

.9 note that the EMSA 3 study was adequately conducted in accordance with the FSA Guidelines (paragraph 21);

.10 note that no deficiency affecting the outcome has been identified in the EMSA 3 study (paragraph 22);

.11 consider, from a technical point of view, the conclusions and recommendations, as set out in document SDC 3/INF.3 and take action as appropriate (paragraphs 23 to 25);

.12 note that the conclusions and recommendations, as set out in document SDC 3/INF.3, are credible (paragraph 25); and

.13 note the group's view that it may be appropriate at this stage to have all the reports previously made by the FSA Experts Group collected and uploaded onto IMODOCS for ease of reference (paragraph 26).