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FORMAL SAFETY ASSESSMENT

Application of the FSA Guidelines and review of FSA studies

Submitted by Greece

SUMMARY

Executive summary:	This document comments on FSA studies submitted by Denmark
Strategic direction:	12.1
High-level action:	12.1.1
Planned output:	12.1.1.1
Action to be taken:	Paragraph 15
Related documents:	MSC 86/17; MSC 85/17/1; MSC 85/26 paragraph 17.9; MSC 83/21/1; MSC 83/INF.3; MSC 83/21/2; MSC 83/INF.8; MSC 85/17/1; MSC 85/17/2; MSC 85/INF.2; MSC 85/INF.3; MEPC 58/17/2; and MEPC 58/INF.2

1 This document is submitted in accordance with the provisions of paragraph 4.10.5 of the Guidelines on the organization and method of work of the MSC and MEPC and their subsidiary bodies (MSC-MEPC.1/Circ.2) and comments on document MSC 86/17.

Introduction

2 The Committee, at its eighty-fifth session, invited Member Governments and international organizations to submit to MSC 86 comments on the FSA studies on various types of ships submitted to the Committee for review.

General comments on the FSA studies

3 Greece has reviewed the FSA studies on LNG carriers, container ships, crude oil tankers, cruise ships and RoPax ships and submits preliminary and brief comments, reserving a more comprehensive position during the review process.

4 As a general comment, a requirement for any FSA study to be considered is that the adopted IMO FSA guidelines (MSC/Circ.1023-MEPC/Circ.392 consolidated in document MSC 83/INF.2) should be followed. Greece notes that there are a number of instances in the submitted FSA studies in which conformance with the guidelines is lacking. For instance, timely and open access to all supporting documents and the results of an FSA study (paragraph 9.2.1 of the FSA guidelines, MSC/Circ.1023-MEPC/Circ.392), is a central requirement of the guidelines in order to verify which accidents are included and check the validity of ensuing risk analyses. Another major issue with some of the submitted FSAs seems to be that Step 2 does not follow Step 1 in the manner prescribed by the IMO FSA guidelines. These guidelines (MSC 83/INF.2, annex, section 6.1.1) state *"The purpose of the risk analysis in Step 2 is a detailed investigation of the causes and consequences of the more important scenarios identified in Step 1*". However, in many instances, such as the following, the most important hazards identified in Step 1 (Hazard identification) are simply not examined in the rest of the FSA.

FSA study on LNG carriers (MSC 83/21/1 and MSC 83/INF.3)

5 This FSA study recommends several risk control options (RCOs). Regarding conformance with FSA guidelines, there are at least two points in which such conformance seems to be lacking: First, one proposed RCO (ECDIS) was found to have a Gross Cost to Avert a Fatality (GCAF) slightly over the criterion $3 million. Granted, the exceedance is small but the question is how far can an RCO exceed it to still be recommended for adoption? Second, no RCO interdependencies have been analysed, either in quantitative or qualitative terms which seems contrary to FSA guidelines, as specified in document MSC 83/INF.2, (annex, section 7.2.3.3). At first glance, there should be interdependencies among the recommended RCOs, perhaps even strong ones, which would render the results of the analysis less relevant.

6 A usual issue in FSAs is that of the justification and criticality of the assumptions used. There are a number of assumptions in the study that seem arbitrary and need better justification. For example, the probability of water ingress found in other studies for passenger ships or bulk carriers is assumed valid also for LNG's, whereas for fire fighting it is assumed (page 42): "*For the purpose of this study on LNG carriers, it is assumed that the fire fighting systems have a similar success rate to that of HSC and passenger ships and the average will be used, i.e. 85% chance of controlling the fire and 15% chance of escalating fire. These values are inserted in the event tree*". Is such an assumption appropriate, given that fire-fighting systems and the potential of fire escalation of drastically different ship types (HSC/passenger vs. LNG) are not necessarily similar? Another example (page 120): "*For the purpose of this study the following assumptions were made: 15% of fire/explosions in the engine room could be avoided … 20% of all drift groundings due to unavailability of the propulsion system could be avoided*". How were these numbers estimated? Their justification, and more critically, the results of the study should be elaborated.

FSA study on container vessels (MSC 83/21/2 and MSC 83/INF.8)

7 Perhaps the most significant deficiency of this FSA study, and one that Greece thinks that makes it non-conformant with FSA guidelines, is the serious discrepancy between Step 1 (HAZID) and Step 2 (Risk Analysis). Among the various hazards in Step 1, it is stated that three have Risk Index (RI) = 9 and four have RI = 8 (MSC 83/INF.8, annex, page 10). But these are not identified nor mentioned anywhere else in the FSA. The study goes on to consider as top hazards those with RI = 7.4 or below. The hazard with RI =7.4 is "bad working conditions during lashing (icy, wet floor)". However, this hazard is also eliminated from the rest of the FSA on the ground that it involves port personnel rather than the ship's crew.

8 Eliminating these hazards from the rest of the FSA (along with any possible RCOs to mitigate them) apart from the conformance issue, substance-wise, it shifts regulatory focus to RCOs that cannot do anything for the hazards that the study itself recognizes as most important. A major cause for this seems to be the lack of coverage of these hazards in the used database. However, in such cases, other means of risk analysis, than just analysis of the historical database, should be followed in the FSA, such as first principles, modelling, etc. Also here no RCO interdependencies have been analysed, while another conformance matter is that there are no details on the Delphi method used by experts and no estimate of experts' degree of agreement, as specified in the IMO FSA guidelines section 3.3 and Appendix 9. Substance-wise, the study uses two reference ships, a 1,706-TEU feeder and a 4,444-TEU larger (mainline) vessel and the two size categories are lumped together as an "average" vessel of 2,150 TEU. Several questions can be raised on this issue and the related RCOs.

FSA study on crude oil tankers (MEPC 58/17/2 and MEPC 58/17/INF.2)

9 This study recommends for mandatory adoption a set of seven RCOs, including increased side tank widths and increased double bottom heights for crude oil tanker of new buildings. An important issue of conformance with FSA guidelines concerns the use of CATS (for "Cost to Avert a Tonne of Spilled Oil"). The use of such a criterion and its recommended threshold of 60,000 USD/tonne is only a proposal by project SAFEDOR and is nowhere described in the IMO FSA guidelines, let alone adopted by the IMO. The subject is under continued discussion by MEPC with no consensus so far (MEPC 58/17 and MEPC 58/23, section 17). A second conformance issue is a serious discrepancy between Step 1 (HAZID) and the rest of the FSA. Most (4 out of 7) of the top-ranked hazards from step 1 are attributed to communication problems. Yet, section 10 of the annex states that "*due to a large diversity of causes, communications problems were not further addressed at the current state*".

10 Collisions, groundings, fires and explosions are consequences, not causes. Yet, these are typically referred to as "initiating events", with no analysis as to what prior event really caused them. Thus, naturally, few of the analysed RCOs deal with accident prevention and most deal with what can be done after the accident occurs. For instance, machinery failures are not included in the risk model, allegedly because they are not among the causes that can lead to "Loss of Watertight Integrity" (LOWI) (Fig. 13 of annex). But **Amoco Cadiz** (1978), **Braer** (1993), **Nassia** (1994), among others, would suggest otherwise.

11 According to the analysis (section 4.2 of annex to document MEPC 58/INF.2), tank explosions are the most important type of hazard. Tank explosions are assumed independent of hull type but double hulls may be more prone to explosions due to cargo leaking into a ballast tank (e.g., **Nai Giovanna** (1974), **Berge Istra** (1975)). Also here RCO interdependencies have not been examined while the level of agreement among the experts (Delphi method) is not shown. The process used for evaluating an increase in double bottom height is not fully described. It seems it was assumed that, if the inner bottom is penetrated, and the ship is not completely lost, the spill will have the volume of an average tank. This is not only physically incorrect, but also inconsistent with IMO's guidelines for calculating spillage from grounding damage (regulation 13F of Annex I to MARPOL 73/78). Finally in the cost-benefit assessment, it is not clear how some of the costs and benefits are computed.

FSA study on cruise ships (MSC 85/17/1 and MSC 85/INF.2)

12 As in other FSA studies, collisions, contacts, groundings and fires/explosions are treated as primary causes of accidents. But these are consequences, not causes. A collision or grounding can be caused by other "higher-level" (or "root cause") events, such as a blackout, a steering gear failure, or other. Thus emphasis are placed on RCOs that try to mitigate the consequences of an accident, once that occurs, such as buoyancy enhancements, damage stability enhancements, etc. Importantly, it is notable that the risk analysis (annex II of document MSC 85/INF.2) uses fatality data of ferries and RoPax vessels to formulate worst-case scenarios for cruise vessels. In fact, Table 7-2 of annex II of document MSC 85/INF.2 (page 20) contains only accidents of ferries and RoPax vessels. But some of the very accident scenarios that have occurred on these ferries and RoPaxes, including water ingress via the bow door if left open (**Herald of Free Enterprise**) or is detached (**Estonia**), simply cannot occur on a cruise ship.

13 Much of the probability and consequence data that populates the various event trees used extensively in the analysis seems arbitrary or difficult to justify. Elaborate calculations, involving several assumptions, resulting in critical conclusions (e.g., that if freeboard is increased by 0.5 metres, this will save 2.1 lives per ship's ship lifetime for the collision scenario) are not available for scrutiny. It is understood that many numbers are based on expert opinion, yet no estimate of experts' degree of agreement is provided, as specified in FSA guidelines.

FSA on RoPax Ships (MSC 85/17/2 and MSC 85/INF.3)

14 A positive feature is that there is no apparent gap between step 1 and the rest of the FSA, however, as in other FSAs, consequential events are treated as causes which may skew the ensuing analysis including what may be appropriate RCOs. The RCOs that are proposed are very generic, e.g., "improved navigation safety", "improved evacuation arrangements", etc. It seems due to the "high level" nature of this FSA, the study does not calculate the specific ΔR associated with an RCO, but instead estimates the maximum risk reduction potential with a sensitivity analysis. It may be debatable whether this conforms to the guidelines.

Action requested of the Committee

15 The Committee is invited to consider the information in this document and decide as appropriate.

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