INTERNATIONAL MARITIME ORGANIZATION

IMO

E

MARINE ENVIRONMENT PROTECTION COMMITTEE
56th session
Agenda item 18

MEPC 56/18/1
4 May 2007
Original: ENGLISH

FORMAL SAFETY ASSESSMENT

Environmental Risk Evaluation Criteria

Submitted by Greece

SUMMARY

Executive summary:	This document brings to the Committee's attention some points pertaining to Environmental Risk Evaluation Criteria. This document may be useful within the process of revision of the FSA guidelines
Action to be taken:	Paragraph 29
Related documents:	MSC 81/18; MSC 81/WP.8; MSC 82/INF.3; MSC 82/24; MEPC 55/18; MEPC 55/23 and MEPC 56/18

Introduction

1 FSA was introduced by the IMO as "*a rational and systematic process for accessing the risk related to maritime safety and the protection of the marine environment and for evaluating the costs and benefits of IMO's options for reducing these risks*" (see FSA Guidelines in MSC/Circ.1023 – MEPC/Circ.392).

2 At MSC 81, an FSA 'drafting group' proposed some amendments to these guidelines (see Annex 1 of document MSC 81/WP.8). These amendments have been approved by MSC 81 (MSC 81/18) and subsequently by MEPC 55 (MEPC 55/23).

3 As decided at MSC 80 (MSC 80/24), an intersessional group (MSC and MEPC) was tasked to "*consider the development of a **risk index** relevant to the protection of the marine environment*". Environmental risk assessment is about making estimations of harm to the ecosystem from shipping activities.

4 As a result of this effort, MSC 81/18 cites a report by EU project SAFEDOR[1] in which a methodology for environmental (and specifically oil spill pollution) damage is presented, and the so-called CATS criterion (for "Cost of Averting one Tonne of Oil Spilled") is defined. Various estimates of the maximum allowable value of CATS are made.

[1] Skjong, R., E. Vanem, Ø. Endresen, "Risk Evaluation Criteria", SAFEDOR-D-4.5.2-2005-10-21-DNV; 21 October 2005. Available at www.safedor.org.

5 Greece urged caution on the matter at both MSC 81 and MSC 82 (MSC 81/18/2 and MSC 82/INF.3).

6 The Japanese submission MSC 81/6/3 also included the results of several prior studies as reported by the International Ship and Offshore Structure Congress (ISSC 2000) which would shed serious doubt on any metric that consists only of volume of oil spilled and reported clean up costs. The IMO adopted a similarly cautionary stance on this issue, with MSC 81 turning the matter over to MEPC (MSC 81/25, paragraphs 18.5 to 18.13). MEPC 55 examined the matter (MEPC 55/18) and paragraph 18.4 of MEPC 55/23 states that:

> "*The Committee considered also the draft Environmental risk evaluation criteria set out in annex 3 to document MEPC 55/18 and agreed that the draft criteria still needed in-depth consideration from the marine environment protection perspective. Subsequently, the Chairman invited Members and international organizations to consider the draft Environmental risk evaluation criteria during the intersessional period and submit comments thereon to MEPC 56, for further consideration prior to referring the agreed text to the MSC for appropriate action.*"

7 This document is in response to the above invitation and can be considered as a follow-on to MSC 81/INF.3. Greece welcomes the initiative for developing sound environmental risk evaluation criteria in FSA and elsewhere and is prepared to contribute constructively toward that goal.

8 MEPC 56/18 reflects the following relevant developments at MSC 82:

> "***FSA-related information***
>
> *2 MSC 82 also noted the information provided in document MSC 81/INF.3 (Greece), and in particular the annexed academic paper entitled "Formal Safety Assessment: a critical review and ways to strengthen it and make it more transparent", which was considered to be useful within the process of revision of the FSA Guidelines.*
>
> ***Retention of the item on FSA in the agenda of MSC 83***
>
> *3 MSC 82 considered whether the item should be included in the agenda for MSC 83 and, recognizing that there may be an outcome of MEPC 56 regarding environmental risk evaluation criteria and other submissions at MSC 83, agreed, following the discussion, to retain the item in the provisional agenda for MSC 83, and encouraged Member Governments and international organizations to submit, to MSC 83, proposals and comments on the further improvements of the FSA Guidelines and the Guidance on the use of HEAP and FSA, taking into account the outcome of MEPC 56.*"

9 In the following, Greece comments on annex 3 of MEPC 55/18 and also on some of the other interesting points raised by the SAFEDOR report itself, as they may be of general interest and have interesting policy ramifications.

Environmental Risk Index/Matrix

10 Greece is of the opinion that all FSA steps should be looked at carefully, and this includes the adoption of a proper environmental Risk Index, and specifically one that produces no distortions in ranking environmental hazards. It is logical that before the last step of the FSA is decided on (acceptance criteria) the first step should be first agreed (Risk Index used for hazard

ranking). In fact, the objectives of the first step of every FSA (Hazard Identification- HAZID) are (a) to identify all potential hazardous scenarios which could lead to significant consequences, and (b) to prioritize them by risk level.

11 The explicit consideration of the frequencies and of the consequences of hazards is typically carried out by the so-called risk matrices. These are used to rank risk in order of significance. A risk matrix divides the dimensions of frequency and consequence into categories. Each hazard is allocated to a frequency and consequence category and the risk matrix then ranks the risk that is associated with that hazard.

12 The currently used Frequency Index (MSC/Circ.1023 – MEPC/Circ.392) can also be used for assessing environmental risk. However, the current Severity Index deals only with the effects on human safety and the ship itself. In order to be able to measure the effect on the environment we need to define a Severity Index that measures effects on the environment. This is not a trivial task.

13 Annex 3 of MEPC 55/18 offers no explicit proposal for an environmental Risk Index, or something equivalent, but it refers to the aforementioned SAFEDOR report. As a basis for further discussion, Greece proposes that the following Severity Index, which, as stated in the SAFEDOR report, is based on NORSOK Standards Z-013, be analysed and debated:

SI	Severity	Effect on the environment (recovery time)
1	Minor	Between 1 month and 1 year
2	Moderate	Between 1 and 3 years
3	Significant	Between 3 and 10 years
4	Serious	In excess of 10 years

14 By combining the Frequency and Severity Indices, the Risk Index could be defined the same way as in the FSA Guidelines:

Risk Index = **F**requency **I**ndex + **S**everity **I**ndex.

Note that if the aforementioned four-category Severity Index is used, the resulting risk matrix is the same as the one currently in use (MSC/Circ.1023 – MEPC/Circ.392).

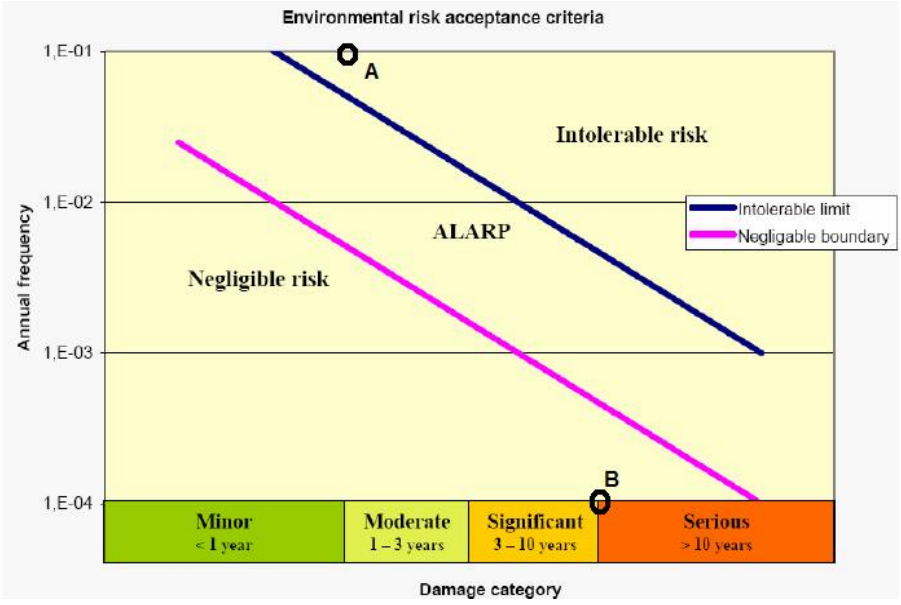

Figure 1: Environmental risk acceptance criteria (from MPC 55/18, annex 3, page 4, Fig. 3)

15 The ALARP concept used in Figure 3 of MEPC 55/18 (annex 3, page 4) is the standard one already used in the FSA guidelines, using a slope of minus one in the F-N diagram. Greece is of the opinion that the use of a slope of minus one needs to be justified before adopted for environmental criteria. This can be seen by the following example. Let us add two points in this figure, A and B, as follows (see Figure 1 above). Point A: Spill of minor-to-moderate severity (recovery time 1 year) that may occur once a year with a probability of 1/10. Point B: Spill of significant-to-serious severity (recovery time 10 years) that may occur once a year with a probability of 1/10,000.

16 A pertinent question is if society is really sure that point B, which refers to a rare but catastrophic spill scenario, should be ranked so much less below point A, which refers to a more frequent but much less serious spill scenario. Note that point B lies in the 'negligible risk' region, whereas point A lies in the 'intolerable risk' region, meaning that a series of measures, rules, or even legislation to prevent type-A spills might receive much higher priority over equivalent actions to prevent type-B spills. Of course, pertinent recommendations for decision making would be made later in the FSA analysis. However, a hazard ranking that assigns so much lower importance to a rare but environmentally catastrophic event as opposed to a more frequent but less serious one runs the risk of distorting the picture. It should be noted that if the slope of the F-N diagram is not equal to minus one and if the ALARP region is different, point B may not necessarily be ranked below point A (see Figure 2 below). Greece therefore is of the opinion that the issues of Risk Matrices, F-N curves and ALARP regions for environmental criteria should receive thorough attention and debate before any of the numbers proposed in MEPC 55/18 are adopted.

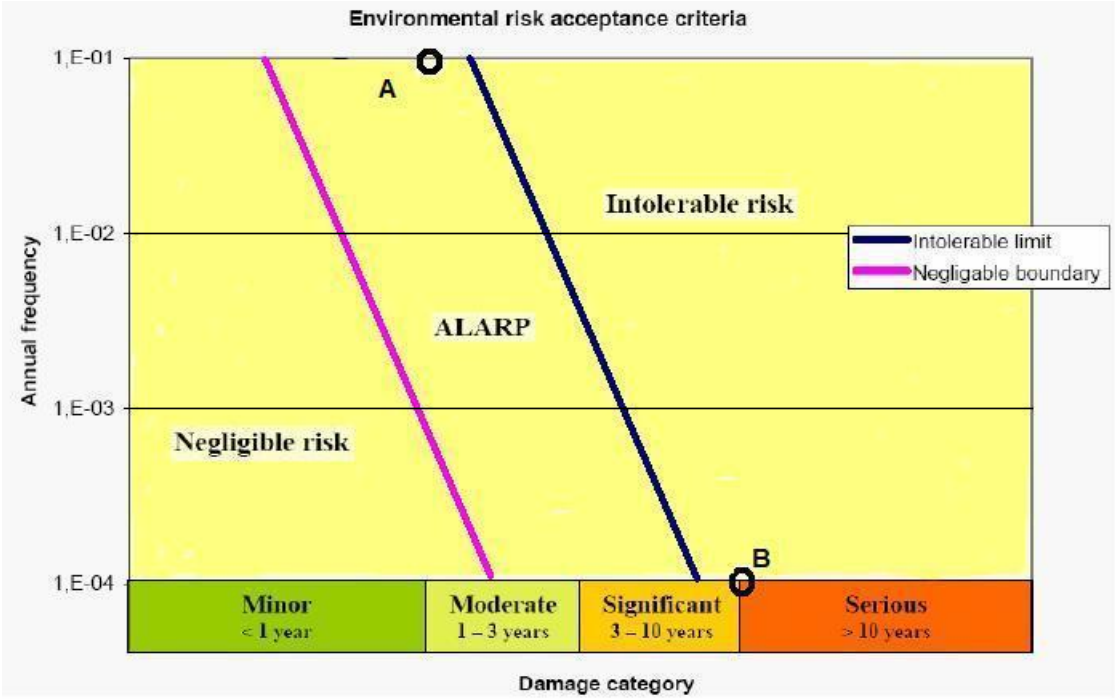

Figure 2: Alternate ALARP region if F-N slope is not equal to -1.

The cost of averting a spill criterion

17 A major topic in Annex 3 of MEPC 55/18 and also in the SAFEDOR report is the definition and analysis of risk evaluation criteria for accidental releases to the environment. In fact, mention of the "cost of averting a spill" is made (equation (1), page 6 of annex 3). In the SAFEDOR report, the criterion of CATS is defined as a 'per tonne of spilled oil' environmental

criterion equivalent to CAF, the Cost to Avert a Fatality. The latter criterion is widely used in FSA studies in which risk to human life is assessed and Risk Control Options (RCOs) to reduce such risk are contemplated. According to the CATS criterion, a specific RCO for reducing environmental risk should be recommended if the value of CATS associated with it is below a specified threshold, otherwise that particular RCO should not be recommended. The equivalent threshold for the CAF analysis is $3 million (MSC 78/19/2).

18 MSC 81/18 cites the SAFEDOR report and states that the latter concludes with a $19,000 per tonne value as the CATS threshold. In fact, in page 60 of the SAFEDOR report a $63,000 per tonne value is given for CATS, based on a series of assumptions. One can immediately note that if this figure is used in some actual past accidents, the resulting damages come out astronomical: The damage of the **Prestige** oil spill would be $5.1 billion and that of the **Atlantic Empress** $20.7 billion. If one actually translates these figures in terms of equivalent fatalities, and assuming the $3 million per fatality yardstick, the latter spill would be considered as catastrophic as 6,900 deaths!

19 The question what is an appropriate threshold value of CATS is an interesting one, but in our opinion sidesteps a more general question, whether the CATS criterion itself, that is, formulating an environmental index of costs averted *on a per tonne of spill basis*, is appropriate.

20 To arrive at a single threshold figure for such a criterion, in MEPC 55/18 (page 5 of annex 3) the following assumptions are made for simplicity purposes. Per tonne clean-up costs are thus assumed (a) constant with spill size, (b) independent of oil type, ie, a generic oil type is assumed, (c) constant within certain locations, and (d) independent of all other factors.

21 Although the need for simplicity is understood, it is very hard to justify these rather drastic assumptions, particularly given there is ample reference in the literature[2] (and even in annex 3 of MEPC 55/18 itself) that the cost of oil spills on a dollar per tonne basis depends on a variety of parameters and has a broad variance. This is in agreement with document MSC 81/6/3 by Japan, which includes, among others, statements such as "*as mentioned above the quantity of oil outflow is not a good measure of the impact of the spill, since it does not have a linear relationship with the risks to people and the environment. By concentrating on the quantity of the oil spilled the real risks are not being investigated*" (from ISSC 2000, annex of MSC 81/6/3, page 16).

22 In fact, according to ITOPF[3], factors that determine the clean-up cost of spills include (a) type of oil, (b) amount of oil spilled and rate of spillage, (c) physical, biological and economic characteristics of spill location, (d) weather and sea conditions, (e) time of the year and (f) effectiveness of clean-up. And in general, costs involved in oil spill incidents include (i) clean-up costs, (ii) indemnification of the owner and (iii) compensation costs to third-parties.

23 In page 6 of annex 3 of MEPC 55/18, it is suggested that risk reduction measures are to be implemented if the costs of averting a spill are less than the costs of an occurred spill multiplied by F, where F is an "assurance parameter" postulated to be between 1 and 3 ($1<F<3$). That $F>1$ may be a plausible hypothesis (society should be willing to pay more to avert a spill than incur the clean-up cost of the spill itself). However, this hypothesis is not universally documented and factually one may witness situations where the opposite may be the case

[2] See for instance, Etkin, D.S., "Estimating Clean-up Costs for Oil Spills", Proceedings, International Oil Spill Conference, American Petroleum Institute, Washington, DC., 1999.

[3] White, I.C., F. Molloy, "Factors that Determine the Cost of Oil Spills", International Oil Spill Conference 2003, Vancouver, Canada, 6-11 April 2003.

(society is complacent and unwilling to invest in averting spills and eventually ends up paying more to clean them up when they occur). A fortiori, postulating that F<3 seems rather arbitrary, and it may be the case that values of F higher than 3 are warranted, particularly for some pollution situations and measures to prevent it (for instance, double-hull tankers). Greece is of the opinion that if such an assurance parameter F (different from 1) is introduced, its appropriate value should be ascertained after a quantitative assessment of society's willingness to pay to avert pollution. The value of F should not be inferred 'in reverse', that is, to certify that previous legislative action to prevent pollution has been correct.

24 A point of primary importance is the inadequacy of using any single dollar per tonne figure as an environmental criterion. According to the SAFEDOR report and its references[2], some average clean-up cost values in 1997 USD per tonne are: 1,600 (Africa), 12,700 (Europe) and 36,200 (USA). More recent data suggest the following average clean-up costs in 1999 USD per tonne: 6.09 [six USD] (Mozambique), 438.68 (Spain), 3,082.80 (UK), 25,614 (USA) and even the extreme value of 76,589 for the region of Malaysia[4]. Furthermore, the same report in page 54 states that "*ITOPF claims that as every oil spill is different with its own unique set of conditions, it is impossible to give, even within a limited geographic area, a reliable average cost per tonne spilt*". All of the above testify to the broad variation of values on a per tonne basis, which makes the use of any single dollar per tonne figure questionable[5].

25 Greece is therefore of the opinion that a non-linear function of spill volume is more realistic, one for which clean-up cost per volume spilled is a decreasing function of spill volume and is also a function of oil type and spill location. Environmental FSA would most likely be used to evaluate different regulatory options mostly on design issues. Having different non linear functions for quantity of different oils is therefore a reasonable way of proceeding as already MARPOL treats dirty oils, clean products and chemicals differently. Each of these could have a different CATS function reflecting the different behaviour of each of these oils. Greece is willing to work with other Member States and international organizations toward establishing such a function.

Conclusions

26 Formulating environmental risk evaluation criteria is an important task that should be pursued by research organizations and policy makers alike. However, the extreme variability of the per tonne cost (clean-up and damage) of oil spills worldwide cannot be overlooked, as a great number of factors other than volume are important. This means that one cannot produce a single number, to be applied worldwide, which, of all variables, uses oil spill volume alone as the main determinant of environmental pollution cost. If a regression analysis were made, it could very well establish that volume is not the most important variable in oil spill cost.

27 The premise that for tanker design purposes there should be global environmental criteria is tenable. But the logical chain of modeling from this premise to a single criterion based on a per volume linear cost is a long one, involving a large number of assumptions, most of which are difficult to justify. In addition to weaknesses in the analysis, such a single figure may have important regulatory ramifications, if adopted. It could be used as a worldwide yardstick for

4 See Etkin, D.S., 2000, "Worldwide Analysis of Marine Oil Spill Clean-up Cost Factors", Arctic and Marine Oil Spill Program Technical Seminar, June 2000.

5 See also Kontovas A., Psaraftis H. N., "Assessing Environmental Risk: Is a single figure realistic as an estimate for the cost of averting one tonne of spilled oil?", National Technical University of Athens, Working paper NTUA-MT-06-01, February 2006. Available at www.martrans.org.

damage claims. Such claims might seriously distort what should be claimed (upwards or downwards).

28 The need of IMO (and other regulatory bodies) to assess environmental risk and formulate relevant policy necessitates the development of a risk matrix to assess effects on the environment. The use of risk matrices is crucial in Formal Safety Assessment. After gaining the needed experience, quantitative criteria to evaluate cost effectiveness could be discussed. In any case, any environmental risk evaluation criterion should have a strong theoretical background and should be based on assumptions that can be justified.

Action requested of the Committee

29 The Committee is invited to consider this document in the process of developing environmental risk evaluation criteria and decide as appropriate.

_____