

MARITIME SAFETY COMMITTEE
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Agenda item 11

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FORMAL SAFETY ASSESSMENT

Editorial changes to the Revised FSA Guidelines

Submitted by IACS

SUMMARY

Executive summary: The document proposes editorial changes to the Revised FSA Guidelines (MSC-MEPC.2/Circ.12/Rev.2).

Strategic direction, if applicable: 2

Output: 2.21

Action to be taken: Paragraph 3

Related document: MSC 109/11/1

Introduction

1 MSC 108 invited relevant submissions with concrete text proposals in order to improve the text of the *Revised guidelines for Formal Safety Assessment (FSA) for use in the IMO rule-making process* (Revised FSA Guidelines) (MSC-MEPC.2/Circ.12/Rev.2) (MSC 108/20, paragraph 11.4.3). In this regard, document MSC 109/11/1 (Germany and IACS) provided core proposals for changes to the Revised FSA Guidelines, excluding editorial changes. This document suggests editorial changes which are aimed to further support the enhancement of the Revised FSA Guidelines.

2 The proposed editorial changes to the Revised FSA Guidelines are provided in the annex to this document.

Action requested of the Committee

3 The Committee is invited to consider the editorial changes to the Revised FSA Guidelines as provided in the annex and to take action, as appropriate.

ANNEX

**EDITORIAL OR MINOR CHANGES TO THE REVISED FSA GUIDELINES
(MSC-MEPC.2/CIRC.12/REV.2)**

The following editorial or minor changes to the Revised FSA Guidelines are proposed*:

1 For paragraph 3.1.1.2, the following change is proposed:

"Figure 1 is a flow chart of the FSA methodology. The process

.....
The group carrying out the FSA process should comprise suitably qualified and experienced ~~people~~ persons to reflect the range of influences and the nature of the "event" being addressed."

2 For section 4.1, the term "routing" as mentioned in paragraph 4.1.4 should be shifted to paragraph 4.1.3, as shown below:

".1 ship operation (e.g. operations in port and/or during navigation, ~~routing~~;

.2 external influences on the ship (e.g. Vessel Traffic System, weather forecasts, reporting, ~~routing~~);"

3 For paragraph 7.1.1, the following change is proposed in the chapeau:

"The purpose of step 3 is to first identify Risk Control Measures (RCMs), i.e. ~~measures that reduce current risk~~, and then to group them into a limited number of Risk Control Options (RCOs) for use as practical regulatory options."

4 In figure 2 (Example of Loss Matrix), the following changes are proposed in the table:

"

Ship accident loss (£ or \$ or € per ship year)					
Accident type	Ship accident cost	Environmental damage and clean up	Risk to life	Risk of injuries and ill health	Total Cost
	£ or \$ or €	(£ or \$ or €)/tonne x number of tonnes	Fatalities x (£ or \$ or €) m	DALY* x (£ or \$ or €) Y	£ or \$ or €
...
...

"

5 Within section 2 (Basic terminology) of appendix 1, the equation pertaining to "Human error probability" is proposed to be better elucidated using the equation format as shown below:

$$HEP = \frac{\text{Number of human errors that have occurred}}{\text{Number of opportunities for human error}}$$

* Tracked changes are indicated using "grey shading" to highlight new insertions and "strikethrough" to highlight deletion of the text.

6 It is proposed that table 1 of references within appendix 1 be relocated towards the end of the Revised FSA Guidelines to collect the citation of all references at one location. The other tables should be renumbered consequently.

7 With regard to section 2 of appendix 5, it is proposed that the equation for the Individual Risk (IR) be converted to a suitable digital format, as shown below:

$$IR_{for\ Person\ Y} = F_{of\ undesired\ event} \cdot P_{for\ Person\ Y} \cdot E_{of\ Person\ Y}$$

8 With regard to appendix 7, the equations for NCAF and GCAF are proposed to be converted to a suitable digital format, as shown below:

$$GCAF = \frac{\Delta Cost}{\Delta Risk}$$
$$NCAF = \frac{\Delta Cost - \Delta EconomicBenefit}{\Delta Risk} = GCAF - \frac{\Delta EconomicBenefit}{\Delta Risk}$$

9 With regard to section 1.3.1 of appendix 7, the reference "Nathwani et al." is not correctly referenced, as the year of publication is missing. This sentence is proposed to be revised as below so as to reflect the correct year of publication:

"1.3.1 NCAF and GCAF

...

For further detail, reference is made to Nathwani et al. (1997), Rackwitz (2002)."

10 Within section 1.3.2 of appendix 7, duplication is made in regard to the reference to the publication by Rackwitz. Likewise, the reference to Nathwani et al. is incorrectly shown to be published in 1996. It is proposed that the reference be corrected as below:

"1.3.2 The proposed values for NCAF and GCAF in table 2 were derived by considering societal indicators (refer to document MSC 72/16, UNDP 1990, Lind 1996). They are provided for illustrative purposes only. The specific values selected as appropriate and used in an FSA study should be explicitly defined. These criteria given in table 2 are not static, but should be updated every year according to the average risk free rate of return (approximately 5%) or by use of the formula based on LQI (Nathwani et al. (19967), Skjong and Ronold (1998, 2002), Rackwitz (2002-a, b))."

11 Paragraph 2.16 of appendix 7 is proposed to be revised as shown below:

"2.16 The FSA user-submitter/analyst is free to develop new approaches, taking into account the objectives of the FSA."

12 Paragraph 4.1 of appendix 8 is proposed to be revised as shown below:

"4 The level of detail of the report depends

...

.1 a summary report of limited length (i.e. maximum-generally 20 pages);"

13 Appendix 9: The references for further reading listed at the end of this appendix should be deleted and added to the list of references towards the end of the Revised FSA Guidelines.

14 Paragraph 16 of appendix 10: It is proposed to correct the reference provided for the reporting format which should be "appendix 8" rather than "annex 2". The correction is shown as below:

"16 Each instructed subsidiary body should carry out the parts of the FSA study assigned to them. Any progress reports that the Committee may require, and, on completion of the FSA study, the final report should be submitted to the Committee. This final report should be in accordance with the Standard Reporting Format, given in ~~annex 2~~ appendix 8 of the FSA Guidelines."

15 Paragraph 18 of appendix 10 contains incorrect reference to the "interim guidelines" (presumably when the Revised FSA Guidelines were in the interim stage). This is now proposed to be corrected as shown below:

"18 In addition to the final report submitted to the Committee by the Sub-Committees undertaking the FSA study, the Working Group should, at the completion of the FSA study, present to the Committee a summary report, which may include, inter alia:

- .1 an evaluation that the methodology applied is in accordance with the ~~interim guidelines~~ FSA guidelines;
- .2 any proposals for improvement of the ~~interim guidelines~~ Revised FSA guidelines;"

16 A list of references has been developed which is comprised of all the references referred to at present in the Revised FSA Guidelines. Some of the references did not have citations to enable the user to locate and study them, if necessary (e.g. Nathwani et al, Rackwitz, etc.). This list, set out below, contains the complete citations, including those references which were proposed from appendices 1 and 9 and an additional reference by Hamann and Cichowicz (2023), and may be inserted at the end of the Revised FSA Guidelines:

"List of references

Advisory Committee on the Safety of Nuclear Installations (1991) *Human Factors Study Group Second Report: Human reliability assessment – a critical overview*.

Annett, J. and Stanton, N.A. (1998) Special issue on task analysis. *Ergonomics*, 41(11).
Ball, P.W. (1991) The guide to reducing human error in process operations. *Human Factors in Reliability Group, SRDA – R3, HMSO*.

David, H. (1969) *The method of Paired Comparisons*. Griffin and Co, London.

Gertman, D.I. and Blackman, H.S. (1994) *Human Reliability and Safety Analysis Data Handbook*. Wiley & Sons: New York.

Hamann, R., Cichowicz, J. (2023) Updating threshold for IMO cost-benefit assessment. *Ship Technology Research*, Vol.70(3), pp 239 – 248.

Hollnagel, E. (1998) *Cognitive Reliability and Error Analysis Method*. Elsevier Applied Science: London.

Human Factors in Reliability Group (1995) *Improving Compliance with Safety Procedures – Reducing Industrial Violations*. HSE Books: London.

Humphreys, P. (ed.) (1995) *Human Reliability Assessor's Guide: A report by the Human Factors in Reliability Group*: Cheshire.

Johnson, L. and Johnson, N.E. (1987) A Knowledge Elicitation Method for Expert Systems Design. *Systems Research and Info. Science*, Vol.2, 153-166.

Kendall, M. (1970) Rank Correlation Methods. Griffin and Co, London.

Kirwan, B. (1992) Human error identification in human reliability assessment. Part I: Overview of approaches. *Applied Ergonomics*, 23(5), 299-318.

Kirwan, B. (1997) A validation of three Human Reliability Quantification techniques – THERP, HEART and JHEDI: Part III - Results and validation exercise. *Applied Ergonomics*, 28(1), 27-39.

Kirwan, B. (1994) *A Guide to Practical Human Reliability Assessment*. Taylor & Francis: London.

Kirwan, B. and Ainsworth, L.K. (1992) *A Guide to Task Analysis*. London: Taylor & Francis.

Kirwan, B., Kennedy, R., Taylor-Adams, S. and Lambert, B. (1997) A validation of three Human Reliability Quantification techniques – THERP, HEART and JHEDI: Part II – Practical aspects of the usage of the techniques. *Applied Ergonomics*, 28(1), 17-25.

Lees, F. (1996) Human factors and human element. Loss Prevention in the Process Industries: Hazard Identification, Assessment and Control. Vol. 3. Butterworth Heinemann.

Lind, N. (1996) Safety Principles and Safety Culture. 3rd International Summit on Safety at Sea Conference. Norwegian Petroleum Society. Oslo.

Nathwani, J., Lind, N., Pandey, M. (1997) Affordable Safety By Choice: The Life Quality Method. Institute for Risk Research, University of Waterloo, Waterloo, Ontario, Canada.

Paliy, O., E. Litonov, V., Evenko. (2000) Formal Safety Assessment for Marine Drilling Platforms. Proceedings Ice Tech' 2000, Saint Petersburg.

Pidgeon, N., Turner, B. and Blockley, D. (1991) The use of Grounded Theory for conceptual analysis in knowledge elicitation. *International Journal of Man-Machine Studies*, Vol.35, 151-173.

Rackwitz, R. (2002) Optimization and risk acceptability based on the Life Quality Index. *Journal of Structural Safety*, Vol. 24(2-4) pp 297 – 331.

Rasmussen, J., Pedersen, O.M., Carino, A., Griffon, M., Mancini, C., and Gagnolet, P. (1981) Classification system for reporting events involving human malfunctions. Report Riso-M-2240, DK-4000. Roskilde, Riso National Laboratories, Denmark.

Skjong, R., Ronold, K. (1998) Societal Indicators and Risk Acceptance. International Conference on Offshore Mechanics and Arctic Engineering, OMAE 1998.

Skjong, R., Eknes, M. (2001) Economic Activity and Societal Risk Acceptance. Conference on Safety and Reliability ESREL 2001.

Skjong, R., Eknes, M. (2002) Societal Risk and Societal Benefits. *Journal of Risk, Decision and Policy*, Vol.7(1) pp 57 – 67.

Skjong, R., Ronold, K. (2002) So much for Safety. International Conference on Offshore Mechanics and Arctic Engineering, OMAE 2002.

Swain, A.D. (1989) Comparative Evaluation of Methods for Human Reliability Analysis. Gesellschaft für Reaktorsicherheit (GRS) GmbH.

Swain, A.D. and Guttmann, H.E. (1983) Handbook of Human Reliability Analysis with Emphasis on Nuclear Power Plant Applications: Final Report. NUREG/CR – 1278. U.S. Nuclear Regulatory Commission.

UNDP, United Nations Development Programme. (1990) Human Development Report. Oxford University Press.

Williams, J.C. (1986) HEART – A proposed method for assessing and reducing human error. Proceedings, 9th Advances in Reliability Technology Symposium, University of Bradford. NCRS, UKAEA. Culcheth, Cheshire."

17 As a consequence of some of the changes as proposed in the paragraphs above, there may be a need to renumber and/or reformat the tables in the Revised FSA Guidelines. These changes are not shown in this document.
