SAFEDOR

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design, operation and regulation for safety

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Editorial

The SAFEDOR Consortium is pleased to welcome you as a reader of the 5th SAFEDOR Newsletter, which appears bi-annually and informs about research activities and progress of the SAFEDOR Project. Further public domain information from the SAFEDOR project is available on-line (http://www.safedor.org).

The SAFEDOR newsletters address readers from the whole spectrum of the maritime industry: flag state and government administrations, classification societies, designers, operators, researchers, educators, and practitioners of risk-based design. The present fifth issue of the SAFEDOR newsletters aims to inform you about the impact of SAFEDOR findings on the IMO regulatory framework.

SAFEDOR and regulatory framework

The principal aim of SAFEDOR is to promote risk-based design, operation and approval, while at the same time developing innovative ship design methods and tools.

Risk-based ship design and operation can only be successfully applied if the appropriate regulatory framework is established. It is therefore important that the risk-based regulatory framework developed in SAFEDOR is discussed and eventually accepted internationally, especially at IMO.

One main objective of SAFEDOR is the establishment of an alternative regulatory framework, capable of handling risk based design and approval, and allowing for performance optimization while minimizing risk as a means to provide more safe waterborne transport solutions cost-effectively.

To this end, Formal Safety Assessment (FSA) studies for selected ship types have been carried out, rendering explicit the currently implicit safety levels in existing rules and regulations.

Also, the aim has been to agree on and develop guidance on the necessary documentation for a risk-based regulatory framework that could be implemented in shipping as well as to propose and promote the new regulatory framework at the IMO and within IACS.

The principal goal of an FSA is to document the risk levels for selected ship types, including all major accident scenarios, in addition to the identification of cost-effective risk control options related to design and operation.

The following FSA studies have been carried out within SAFEDOR, covering the operational phase of ship's life cycle:
- Cruise ships
- RoPax ships
- LNG tankers
- Container ships
- Oil Tankers
-Transport of dangerous goods on open top containerships (to be finalized end of 2008)

Completed FSA Studies

In the following, the main findings of each finalized FSA study in SAFEDOR are presented. The conducted studies for the various ship types conclude that both the individual and the societal risk are within the ALARP (As Low As Reasonably Practicable) area. Also, that various cost effective risk control options may be implemented and further investigated.

FSA Cruise ships
The FSA study on Cruise ships demonstrated that:
a. The safety level of Cruise ships lies within the ALARP region.
b. The risk level is dominated by collision and grounding scenarios with low frequencies but potentially large numbers of fatalities.
c. Some identified risk control options were found to be cost effective according to the cost-effectiveness criteria outlined in MSC 83/INF.2.
The FSA study indicates that the following subject should be further examined with a view to possibly introducing the relevant legislation:
a. Implementation of guidelines for Bridge Resource Management (BRM).

In addition, the following risk control options were found to be *cost-effective* and may be *proposed* for the Cruise ship fleet, for further investigation:
a. Improved bridge design (above required SOLAS level).
b. ECDIS - Electronic Chart Display and Information System.
c. Increased Simulator Training for Navigators.
d. Improved damage stability (described in resolution MSC.194(80)).

FSA RoPax
The FSA study on RoPax ships demonstrated that:
a. The safety level of RoPax ships lies within the ALARP region.
b. The risk level is dominated by collision and grounding-related flooding.
c. Some identified risk control options were found to be cost-effective according to the cost-effectiveness criteria outlined in MSC 83/INF.2.

The following risk control options were found to be *cost-effective*, in order of importance:
a. Improved damage stability and survivability after flooding, in particular to avoid rapid capsize.
b. All measures aiming at improving navigational safety not requiring additional manning levels; risk-based maintenance of navigational systems.
c. Improved fire prevention and protection.
d. Improved evacuation arrangements.

The following recommendations may be *proposed* for the RoPax fleet:
a. Measures to improve the damage stability for RoPax vessels to levels consistent with current cost-effectiveness criteria and commensurate with the specialized operation of these ships. For the range of ships analysed, it was found that CAF values associated with the introduction of measures to improve survivability in flooded condition would be well below the current cost-effectiveness criterion (US$ 3 million), even for pessimistic assumptions of marginal costs.
b. All those measures aiming at improving navigation safety which do not require additional manning levels are all well below the US$ 3 million cost-effectiveness criterion.

FSA LNG Tankers
The FSA study on LNG carriers demonstrated that:
a. The safety level of LNG carriers lies within the ALARP region.
b. The risk level is dominated by collision, grounding and contact scenarios resulting in accidental release of LNG.
c. Some identified risk control options were found to be cost effective according to the cost effectiveness criteria in document MSC83/INF.2.

The following risk control options were found to be *cost effective*:
a. Risk-based maintenance of navigational systems.
b. ECDIS for improved navigational safety.
c. AIS integrated with radar for improved navigational safety.
d. Track control system for improved navigational safety.
e. Improved bridge design for improved navigational safety.
f. Risk-based maintenance of propulsion system.
g. Risk-based maintenance of steering systems.

Considering the results of this FSA study, the above listed risk control options a) to e) may be *proposed* for implementation in the LNG carrier fleet. Also, the identified risk control options f) and g) proved cost effective, but with limited risk reduction effects.

FSA Container Ships
The FSA study on container vessels demonstrated that:
a. The risk profile for the operation of container vessels lies within the ALARP region.
b. The risk level is dominated by collision, grounding and fire scenarios resulting in loss of lives and causing environmental damages by accidental release of fuel and cargo.
c. Some identified risk control options were found to be cost effective according to the cost effectiveness criteria in document MSC83/INF.2.

The following risk control options were found to be *cost effective*:
a. AIS integrated with radar for improved navigational safety.
b. Track control system for improved navigational safety.
c. High bilge level alarm in open cargo holds of open-top container vessels.

From the above, the risk control options a) and b) may be *proposed* for container vessels. In addition, the risk control option c) is already required by MSC/Circ.608/ Rev.1 – Interim guidelines for open-top container ships – and proved to be cost effective.

FSA Oil Tankers

The FSA study on crude oil tankers demonstrated that:

a. The safety level of modern double hull crude oil tankers lies within the tolerable risk region.

b. The risk level is dominated by collision, fire, and explosion scenarios.

c. Some identified risk control options were found to be cost-effective according to the cost-effectiveness criteria in MSC 83/INF.2.

The following risk control option was found to be *cost-effective* on the basis of GCAF (Gross Cost of Averting a Fatality):

a. Hot Works Procedures Training.

Furthermore, the following RCOs proved *cost-effective* on the basis of NCAF/CATS (Net Cost of Averting a Fatality/gross Cost of Averting a Tonne of Oil Spilt):

b. Active Steering Gear Redundancy.

c. ECDIS – Electronic Chart Display Information System.

d. Navigational Sonar.

e. Ship Design Modifications – Enhanced Cargo Tank Subdivision.

f. Ship Design Modifications – Increased Double Bottom Height (not economically viable for VLCC).

g. Ship Design Modifications – Increased Side Tanks Width.

The following RCOs are *recommended* for further consideration as costs are not grossly disproportionate:

h. Double Sheathed Low Pressure Fuel Pipes.

i. Engine Control Room Additional Emergency Exit.

From the above, the RCOs a) to g) may be *proposed* for crude oil tankers, noting that RCOs e., f. and g. (Ship Design Modifications) may be recommended for new buildings only.

Risk based Regulatory framework

Relevant documentation in order to define properly an alternative regime for Risk-based Design/ Approval (RBD /RBA) has been prepared within SAFEDOR, along with reports on risk evaluation criteria and acceptance criteria that are continually updated. Environmental risk criteria were discussed resulting that the CATS concept and criterion was accepted but the value is still debated. Target reliabilities for ship functions based on the cost/benefit criteria have been elaborated. Requirements to the documentation and verification related to the approval process have been specified.

A concluding document on approval for risk-based designs is currently being prepared and planned for submission to MSC 86.

Contributions to IMO

Many members of the Steering Committee and the wider SAFEDOR partnership are involved in the current debate on goal-based standards (GBS) and support the continuous development of the Formal Safety Assessment (FSA) method. The involvement of a European flag state administration (Danish Maritime Authority) particularly active in respect of innovation and of two major Classification Societies (DNV and GL) in SAFEDOR and in the development of the risk-based regulatory framework ensured that relevant project results were properly and timely submitted to the IMO.

The extent of this contribution is demonstrated by the following list of submissions to IMO, noting that this addresses only papers submitted to MSC83, 85 and MEPC58:

- Container vessels, submitted as MSC 83/21/2 and MSC 83/INF.8
- Liquefied natural gas tankers, submitted as MSC 83/21/1 and MSC 83/INF.3
- Cruise vessels, submitted as MSC 85/17/1 and MSC 85/INF.2
- RoPax ferries, submitted to MSC 85/17/2 and MSC 85/INF.2
- Oil tankers, submitted to MEPC 58/17/2 and MEPC58/INF2.

The particular documentation can be found in the SAFEDOR website: http://www.safedor.org/resources/index.htm

SAFEDOR Book on Risk based Ship Design

A book on Risk Based Ship Design will be published by Springer-Verlag in February 2009. The book, which is co-authored by renowned experts from the SAFEDOR consortium, facilitates the transfer of knowledge emanating from the research conducted within the SAFEDOR project to the wider maritime community and nurtures inculcation upon scientific approaches dealing with risk-based design and ship safety.

Formal reference: “Risk based Ship Design – Methods, Tools and Applications”, A. D. Papanikolaou (Ed.), Springer-Verlag, ISBN 978-3-540-89041-6.

SAFEDOR final conference

The final and public conference of SAFEDOR is currently being organised. It will take place on 27&28 April 2009 at IMO, London, UK. More information can be found at www.safedor.org.

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