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Shipbuilder's Views on Risk-Based Regulatory Framework (SLA-based GBS)

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Introduction

- **IMO GBS : a new regulatory regime for the maritime industry:**
  - GBS for the construction of bulk carriers and oil tankers
  - 'Generic GBS' for all types and all areas of ships will be discussed for several sessions from MSC 88
- **Methodology for the development of 'Generic GBS' will be one of the most controversial issue.**
- **Risk-based/Safety-Level Approach(SLA) has been considered by the EU SAFEDOR project, and related documents have been submitted to IMO**
- **Lacks of reviews from the shipbuilder's point of views.**

Background of RBA

- Increase of world-wide maritime transportation
  - Larger in size / faster in speed of ships
- Requirements for the novel ships and technologies
- Limitations of existing rules and regulations

➔ **Possibility of casualty is increasing**

Marine Casualty

Marine casualty is

"any event associated with a marine system that leads to adverse effects on members, the public, property, commerce, or the environment."

Characteristics of casualties:

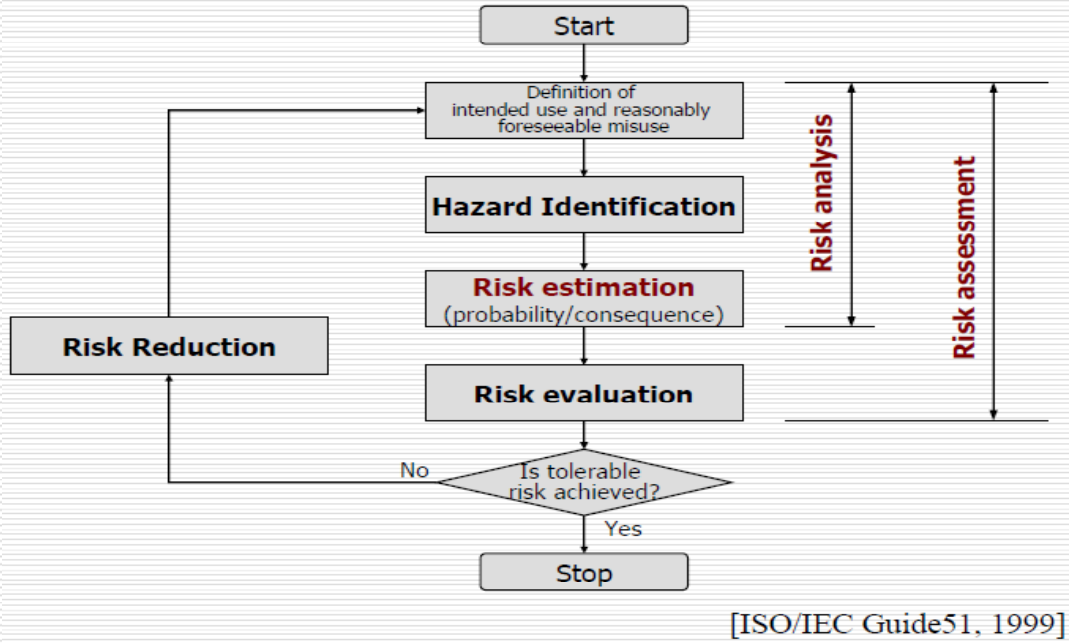
- Unplanned;
- Involve human errors, equipment failures, or external events;
- Impacts on the safety and health, the environment, and/or the properties;
- Having underlying root causes;
- Frequently preceded by related events that can be detected and corrected

☞ **Always possible, but effectively manageable**

RBA (Risk-Based Approach)

"A systematic, logical, and comprehensive tool to assess risks for the purpose of increasing safety in the life-cycle of a system(s)"

- Risk (R)= probability (P) X consequence (C) "
- Risk assessment and reduction process :



[ISO/IEC Guide51, 1999]

RBA vs. Current Approach

Current Approach	Risk-Based Approach
• reactive, responding to accidents	• **proactive**, trying to identify all conceivable hazards *- before they lead to accidents*
• continuous amendment of regulations	
• prescriptive regulations	• regulations, consistent with safety objectives
• principle of technical equivalency	• principle of safety equivalency
• contains mainly technical requirements	• encompasses technical, human and organizational aspects
• cost of safety identified	

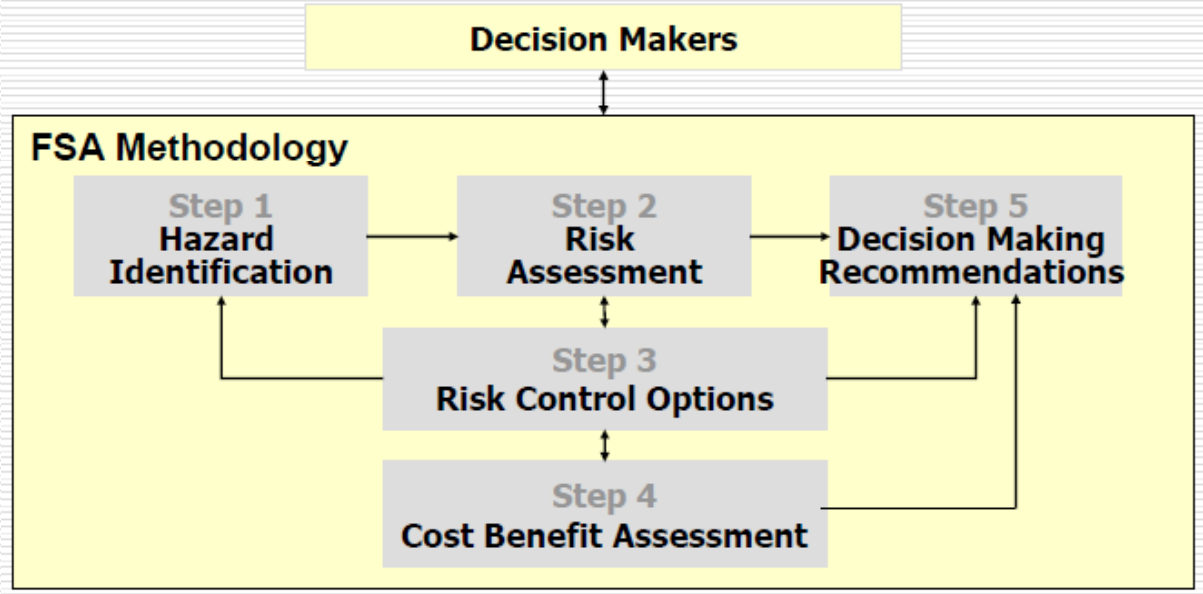
[R. Skjong, 2008]

RBAs in the Maritime Industry

- **Safety Case**
  (UK Health and Safety Executive,1992)
- **FSA for IMO Rule-Making**
  (IMO MSC/Circ.1023 and MEPC/Circ.869)
- **Alternative Design and Arrangements**
  (SOLAS II-1/55, II-2/17, III/38)
- **GBS/SLA-based** (IMO MSC81/6/2)
- **Risk-Based Design** (EU SAFEDOR)
- **…**

IMO FSA (Formal Safety Assessment)

"A structured and systematic methodology, aimed at enhancing maritime safety, including protection of life, health, the marine environment and property, by using risk and cost-benefit assessment."



- MSC/Circ.1023–MEPC/Circ.392, Guidelines on FSA (See ref. [2])
- MAC/Circ.1022 - MEPC/Circ.391, Guidance for the use of HEAP and FSA (See ref. [3])

FSA Studies at IMO

- **Trial Applications:**
  - High-Speed Passenger Catamaran Vessels . United Kingdom, MSC 68/INF.6, DE 41/INF.7, MSC 69/14/4, MSC 69/INF.14;
  - HAZID Water Ballast Exchange . IACS, MEPC 41/9/2, MEPC 45/2/1;
  - Helicopter Landing Area . Norway/ICCL COMSAR 3/2, DE 41/INF.2;
  - Helicopter Landing Area . Italy, MSC 69/14/7, MSC 69/INF.31;
- **FSA for Bulk Carriers:**
  - International Study (United Kingdom), MSC 76/5/4;
  - IACS, MSC 74/5/4;
  - Japan Study, MSC 75/5/2;
  - Life-saving Appliances . Norway/ICFTU MSC 72/16, MSC 74/5/5; and
  - less than 150 m . Cyprus, MSC 77/5/2.
- …

Lessons Learned

- **Scope of the FSA: too large**
  - problems in coordination and management;
  - input data not consistent;
  - unbalanced level of detail;
  - long time to arrive at results; and
  - problems with review.
- **Insufficient casualty data**
- **Poor risk acceptance criteria**
- **Interdependency of RCOs**
- **Poor incorporation of human factors**
- **Poor verification/validation scheme and lacks of supporting tools, …**

➔ **Amendment to the Guidelines (MSC/INF.2)**

☞ High-level FSAs in EU SAFEDOR

☐ Objectives :

- To make explicit the current risk level for specific ship types;
- To develop a generic risk models for use within other subprojects;
- To identify cost-effective risk-control options.

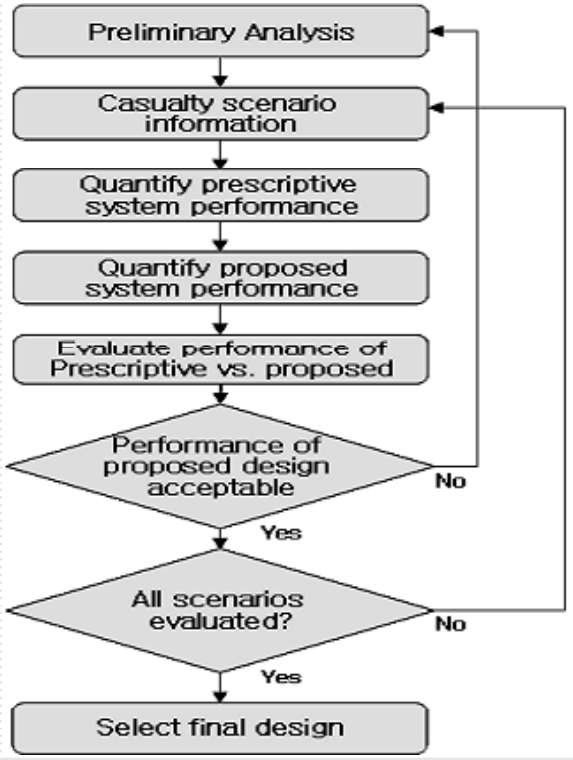
☐ The FSA studies submitted to IMO:

- LNG carriers (MSC 83/21/1, MSC 83/INF.8,);
- Container vessels (MSC 83/21/2, MSC 83/INF.3);
- Cruise ships (MSC 85/17/1, MSC 85/INF.2);
- RoPax ships (MSC 85/17/2, MSC 85/INF.3);
- Crude oil tankers (MEPC 58/17/2, MEPC 58/INF.2);
- Dangerous goods transport with open-top containerships (MSC 87/18/1, MSC 87/INF.2)

☞ ***Establishment of Expert Group for review at MSC86***

Alternative Design and Arrangements

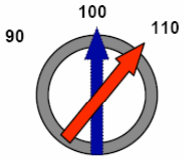
- Measures which deviate from the descriptive requirement(s) of SOLAS, but are suitable to satisfy the safety objective(s) and the functional requirements
  - SOLAS I/5
  - SOLAS II-2/Reg.17
  - SOLAS II-1/Reg.55
  - SOLAS III/Reg.38
- No. of RBD is increasing
- Focused on selected functions / layouts rather than complete ship design aspects

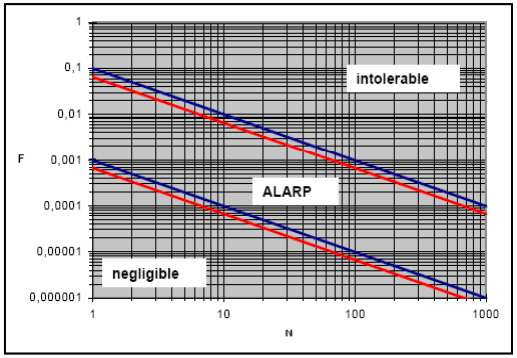


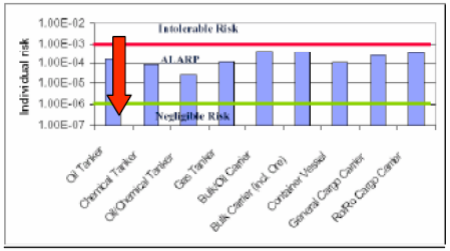
- MSC /Circ .1002 Guidelines on AD&A for SOLAS Ch.II-2
- MSC.1/Circ.1212, Guidelines on AD&A for SOLAS Ch.II-1 and III

SLA-Based GBS

- **SLA (Safety Level Approach) is a risk-based approach for the development of IMO GBS**
- **Why SLA?**
  - Transparency
  - Comparison
  - Ability to adjust the level of safety





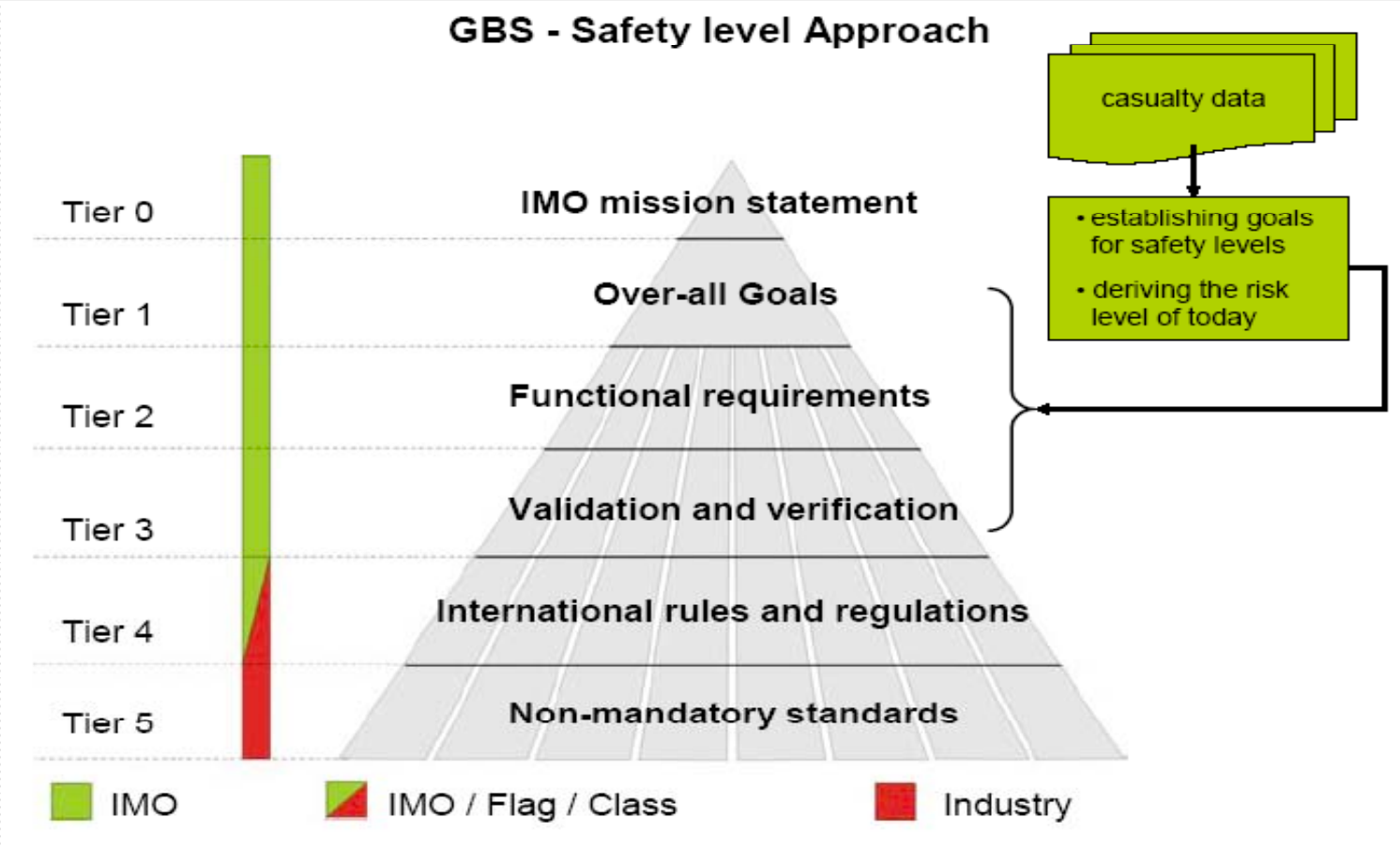


Control of Safety Level (Safety Knob)

CAF- value 

[Source: MSC 81/6/8, submitted by Denmark and Germany]

☞ Framework of SLA-Based GBS

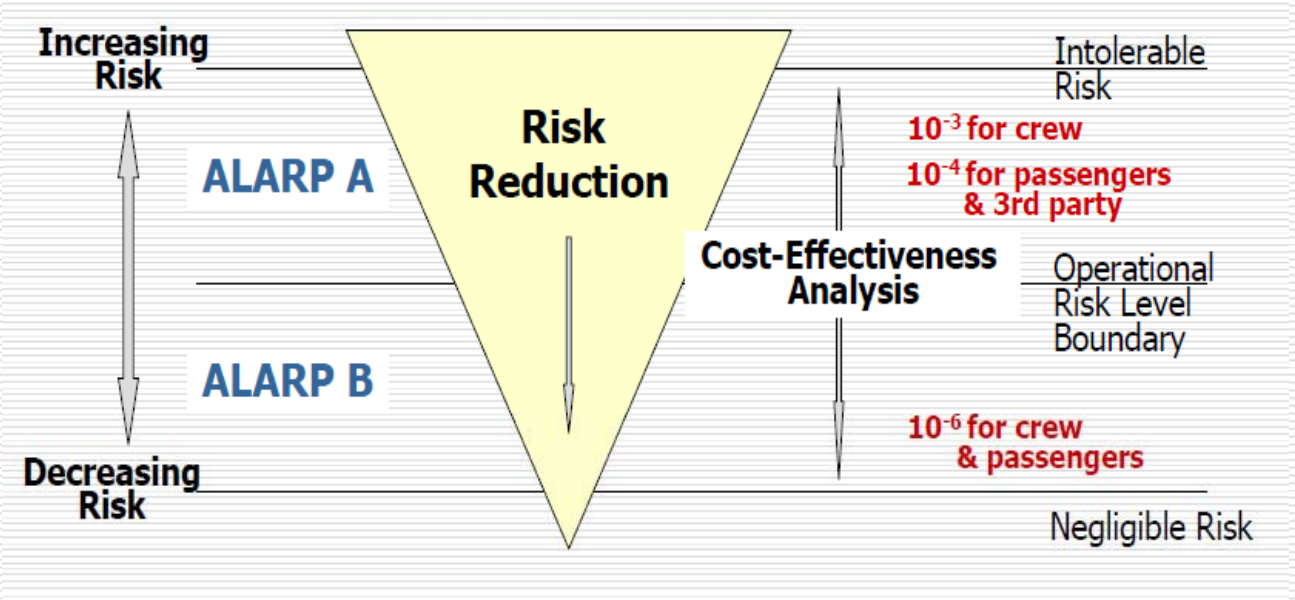


[Source: MSC 81/6/2, submitted by Denmark, Germany, Norway and Sweden]

Over all Goals (Tier I)

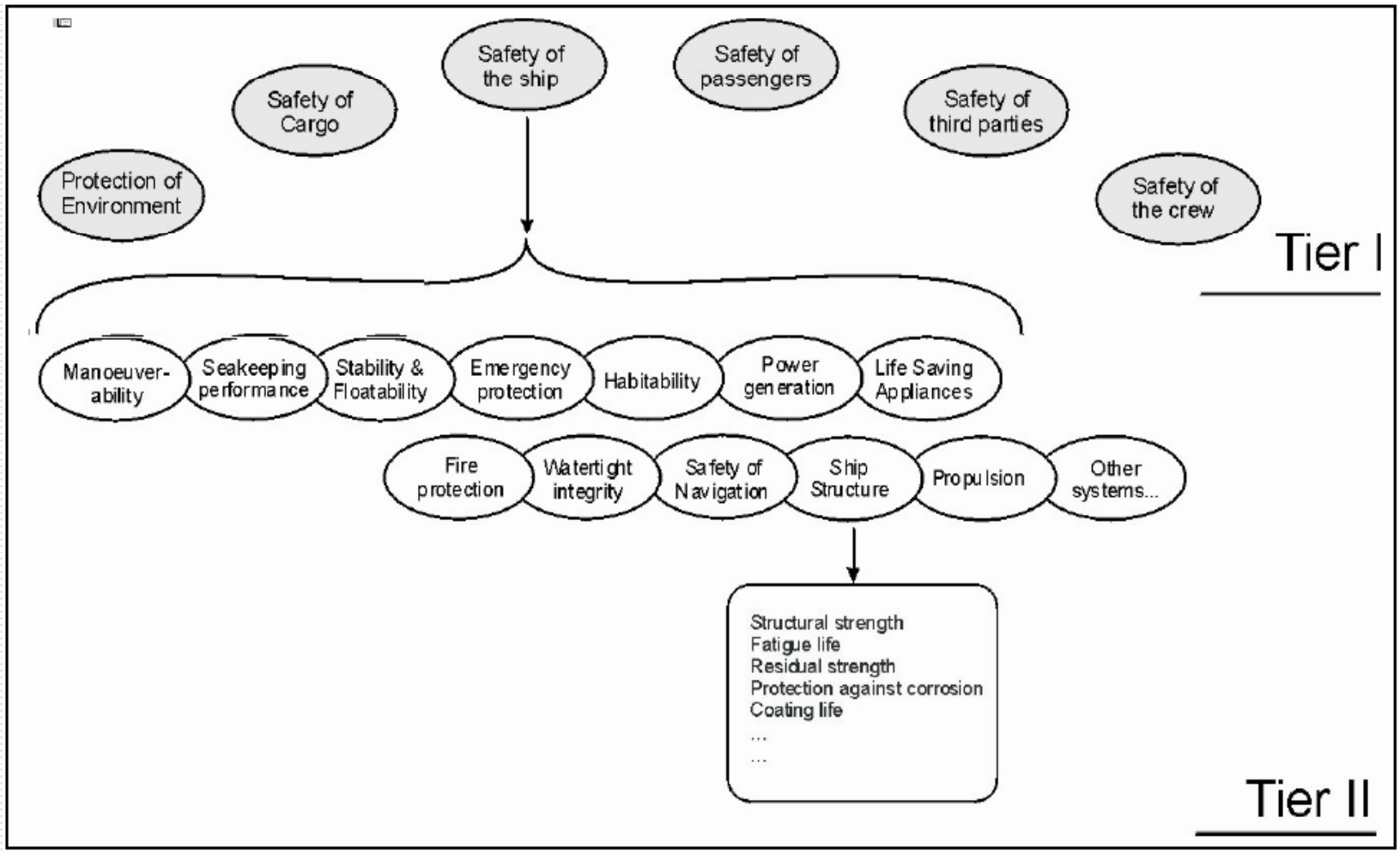
"Ships should be safe and environmental friendly, implying that risks associated with ship operations should be Tolerable and ALARP (As Low As Reasonably Practicable)" - R. Skjong

☞ALARP (As Low As Reasonably Practical)



[Source: MSC 72/16 , submitted by Norway]

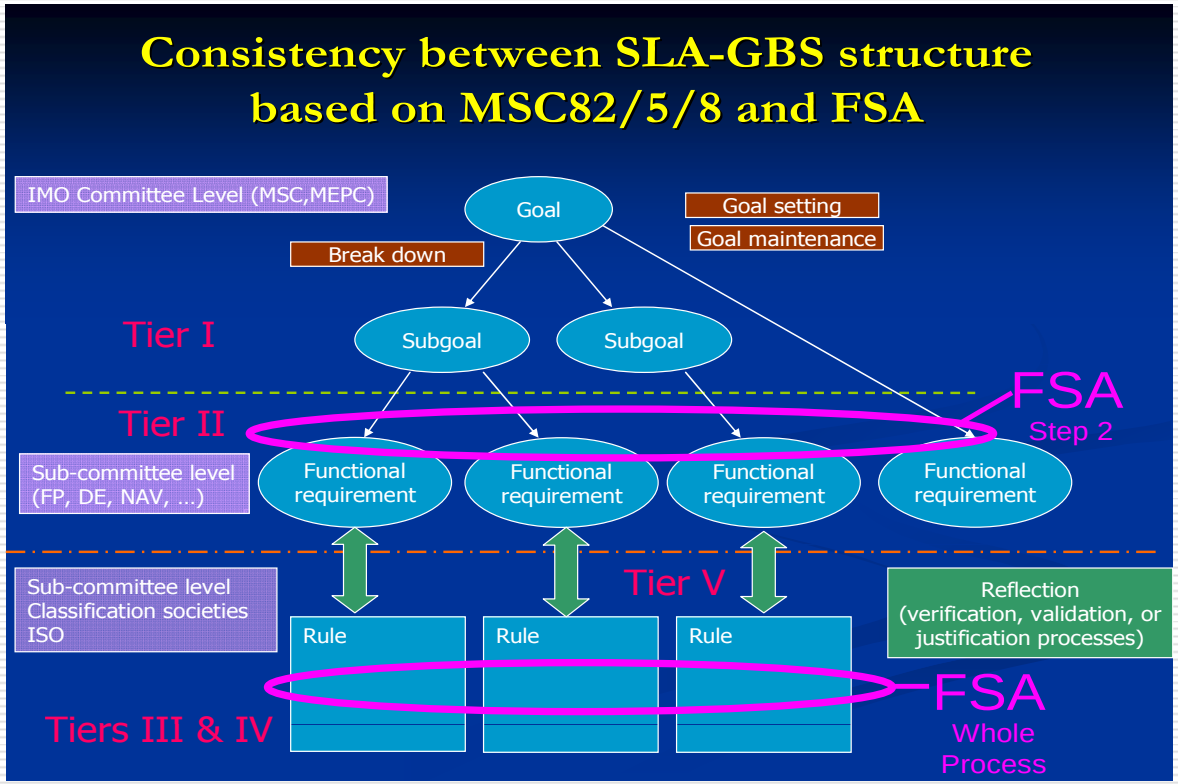
Functional Requirements (Tier II)



[Source: MSC 81/6/8, submitted by Denmark and Germany]

Linkage of FSA with GBS

- Definition of Safety objectives (tier I) and functional requirements (tier II) through the high-level FSA
- Definition of detail requirements (tier IV)



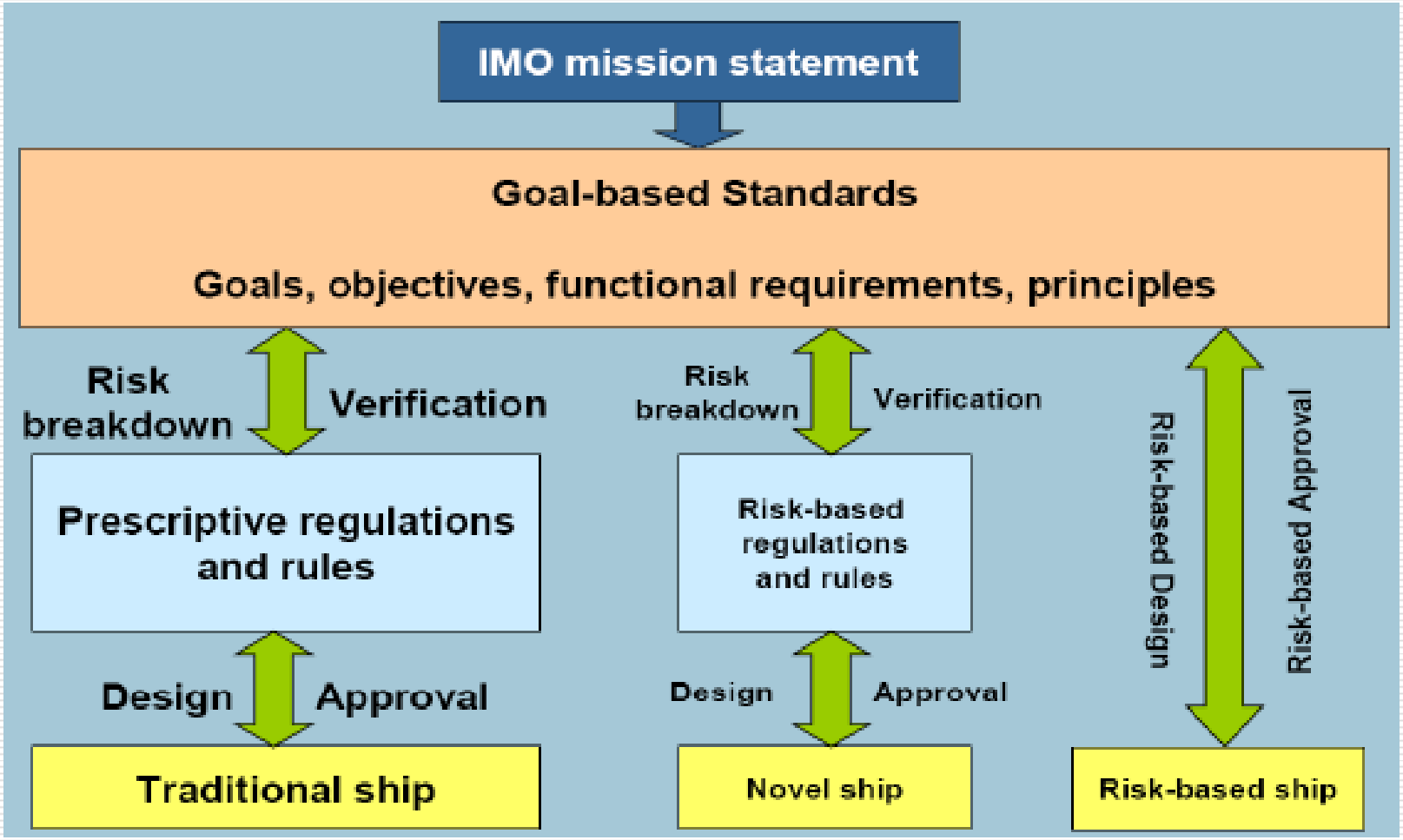
[MSC 84/5/3, proposed by Japan]

Risk-based Design / Approval

- A new methodology integrating probabilistic / risk-based approaches in the design and approval processes for ships and ship systems
- Safety is one additional quantified design objective along traditional objectives such as speed and cargo capacity
- Risk is used as measure to evaluate effectiveness of design changes with respect to safety
- Risk-based approval is the process of approving risk-based designed ships and their intended operation

☞ IMO MSC 86/5/3(2009) , 'Guidelines on approval of risk-based ship design', submitted by Denmark

☞GBS vs. Risk-Based Design



[EU SAFEDOR, 2006]

☞Current Design vs. RBD

	Current Design	Risk-Based Design
Design improvement	progressive	significant evolution, new prototypes
Compliance with regulations	full	substantial
Direct calculations	limited amount	large use
Equipment and suppliers	well known	innovative, new certification process
Innovation	limited, driven by new product availability	driven by risk based requirements, set against safety environment and business target
Cost	saving based on economy and mininum requirements	cost-benefit analysis to support innovative solutions
Plan approval process	standard	direct, complex and time consuming

[H. Luhmann and A. Maccari, 2009]

Risk-Based Design Offers:

- **Methodology linking risk prevention measures to ship's performance and cost**
- **Freedom for the designer to find optimal solutions and meet safety targets**
- **Safety as life-cycle issue (design + operation) supported by appropriate regulatory framework**
- **Possibility to integrate innovation with conventional design experience**
- **Opportunities for:**
  - increased safety -environmentally friendly ships
  - increased competitiveness
  - ship design and operation meeting future customer demands, …

☞ Ref. [16], H. Luhmann and A. Maccari, "Shipyard's view on Risk-based ship Design", 2009

Challenges to Shipbuilders

- **Very time consuming**
- **Difficult at pre-contractual stage**
  (new contractual relationships needed)
- **Sharing of huge amount of information quickly and effectively**
- **Lacks of supporting tools**
  (Some tools are still expensive, inaccurate, difficult to use, not fully validated)
- **Training and experiences for familiarity with the new methodology and approval process**
  (including suppliers and sub-contractors)

Discussions at ISSC 2009

- **ISSC 2009**
  - 17th International Ship and offshore Structures Congress
  - 16-21 August, Seoul, Korea
- **Committee IV.1 (Design principles and Criteria) focused on :**
  - Goal-Based Standards
  - Sustainability

[Members of TC IV.1]

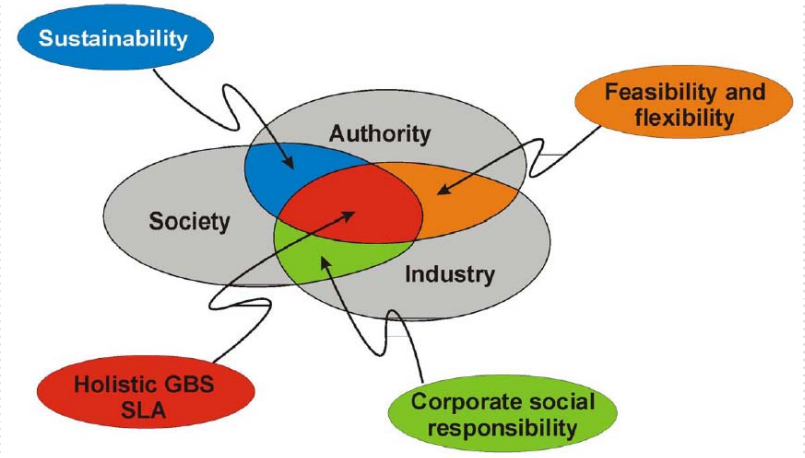
Views from ISSC 2009

Goal-Based Standards :

- Maritime industry (shipping and shipbuilding) will be indirectly influenced by GBS, while classification societies will be directly influenced.
- Quantitative measurement of "RISK" is of most importance.
- Development of technology and tools for maritime industries is required to make such measurement transparent.
- "The goals (tier I) are to be based on a certain safety level. " is agreeable, taking into account the level will change as time goes by (society's demand or need of the level will be increased.)
- While agreeing the proposal of establishment of safety level goals, The Committee considered that overall goal should be generic and quantitative goals for safety, environment, society and sustainability would be specified in somewhat separately. (further consideration is needed)
- Agree to "the difficult part will be to communicate "risk" to the various stakeholders, as the perception of threshold values vary." To cover all the stakeholders and develop acceptable envelop, "sustainability" would is important.
- …

Views from ISSC 2009 (cont.)

- **Risk based ship design :**
  - This will be encouraged for certain types of ship to give incentives to designer and shipping industries, and to enhance and promote the overall safety and environmental protection (society's benefit).
  - It is apparent that the Committee should investigate the technology for "risk based ship design" as a design principle.
- **Recommendations to future discussions (from official discussion):**
  - Focus on simple risk-modeling (e.g. related to the human element)
  - Further development of the blueprint related to the GBS-SLA long-term approach
  - Improvement of the disseminating part (e.g. sharing information to relevant parties)



[Interrelation between stakeholders]

Summary & Conclusions

- **RBA could be considered as a rational way for novel types of ships and systems**
- **However, related technologies are insufficient to support RBA in the maritime industry, and more R&Ds are required for:**
  - Development of risk models and database;
  - Establishment of evaluation criteria;
  - Quantification of safety levels as design objectives;
  - Verification/validation process and tools, etc.
- **Impacts on business and design/approval processes are anticipated.**
- **Consensus among the stakeholders is required for the development of SLA-based GBS, based on long-term plan.**
- **Collaborations among shipbuilders should be promoted.**

☞Expectations on GBS

IMO (Public / Regulators)
- Safe
- Environmentally Friendly
- Robust

Shipping Industry
- Fit for purpose
- Reliable
- Easy to Maintain

Higher Standards

?

Quality Control

Liability

Shipbuilding Industry

[Source: IACS, 2006]

References

[1] ISO/IEC Guide 51, "Safety aspects - Guidelines for their inclusion in standards", 1999
[2] IMO, MSC 83/INF.2, "Consolidated text of the Guidelines for Formal Safety Assessment (FSA) for use in the IMO rule-making process (MSC/Circ.1023−.MEPC/Circ.392)", 2007.
[3] IMO, MSC/Circ.1022-MEPC/Circ.391, "Amendments to the Guidance on the use of Human Element Analyzing Process(HEAP) and Formal Safety Assessment (FSA) in the rule-making process of IMO (MSC/Circ.1022 . MEPC/Circ.391)", 2006.
[4] ISSC, Proceedings of ISSC 2009 (TC IV.1), 2009

[5] IMO, MSC 86/5/3, Guidelines on approval for risk-based design, 2009
[6] IMO, MSC 86/5, GBS for bulk carriers and oil tankers, 2009
[7] IMO, MSC 83/5/3, Report of Correspondence Group on Safety Level Approach, 2007
[8] IMO, MSC 83/5/5, On the future of IMO GBS, 2007
[9] IMO, MSC 81/6/2, GBS-Safety Level Approach, 2006
[10] IMO, MSC 81/6/8, GBS-Safety Level Approach, 2006
[11] IMO, MSC 81/6/14, GBS-Safety Level Approach-Worked Example, 2006
[12] IMO, MSC 81/6/16, GBS-GBS and Risk/Safety Level Approach, 2006
[13] IMO, MSC 81/INF.6, Linkage between FSA and GBS, 2006
[14] IMO, MSC 80/6/6, GBS-General Principles for Structural Standards, 2005

[15] www.IMODOCS.imo.org : other related documents
[16] www.SAFEDOR.org : related documents

Thank you for your attentions

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