船舶に係るリスクと利益２

高価な商品を運搬する船から、大量の物質を運搬する船への変化

旅客船の発達（19世紀後半～20世紀）

高リスク：ハイ・リターンの海運から、確実な輸送手段への変遷

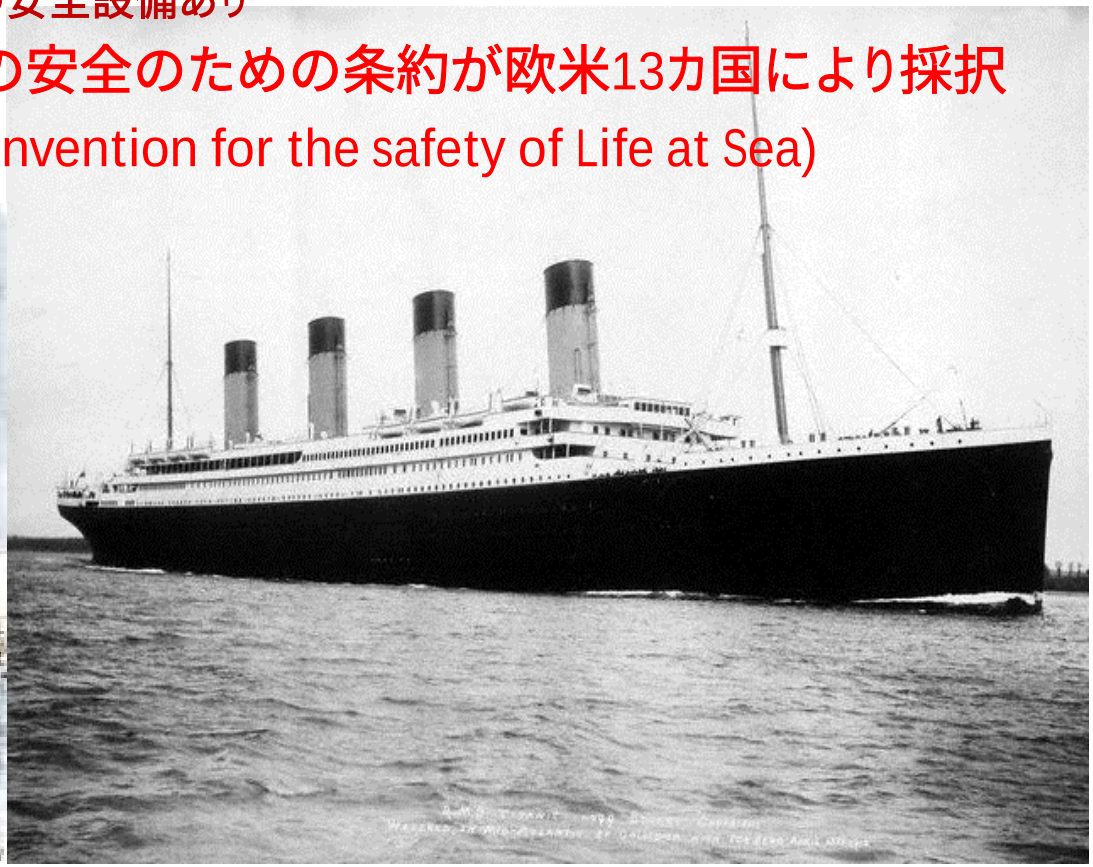
大西洋横断旅客船の競争（20世紀初頭）

タイタニック号の事故(1912年4月14日 北大西洋)

防水区画、水密扉の遠隔閉鎖などの安全設備あり

1914年の海上における人命の安全のための条約が欧米13カ国により採択

（1914 SOLAS International Convention for the safety of Life at Sea）



海上における人命の安全のための条約
SOLAS International Convention for the safety of Life at Sea

1914年、1929年、1948年、1960年、1974年に採択

1974年に採択されたSOLASが現在のもの（1974 SOLAS）で、その後、多くの改正を経て、今に至っている。

条約本体は13条から成る（義務、適用、批准、発効、改正手続き、など）

附属書（規則本体）

第I章　一般規定

第II-1章　構造（構造、区画及び復原性、並びに機関及び電気設備）

第II-2章　構造（防火、火災探知及び消火）

第III章　救命設備

第IV章　無線通信

第V章　航行安全

第VI章　貨物の運送

第VII章　危険物の運送

第VIII章　原子力船

第IX章　船舶の安全運航管理

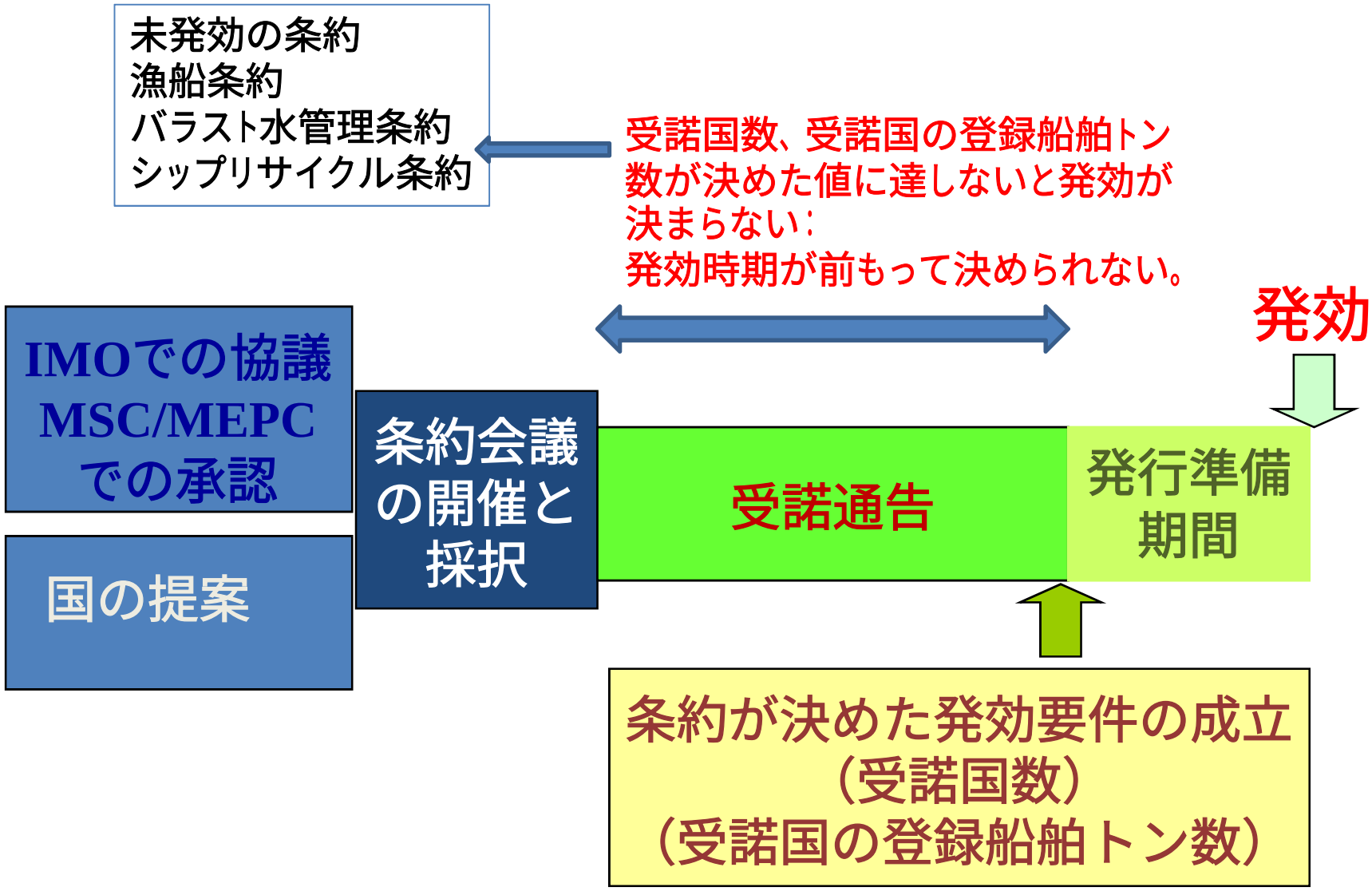
第X章　高速船の安全

第XI-1章　海上の安全性を高めるための特別措置（検査強化）

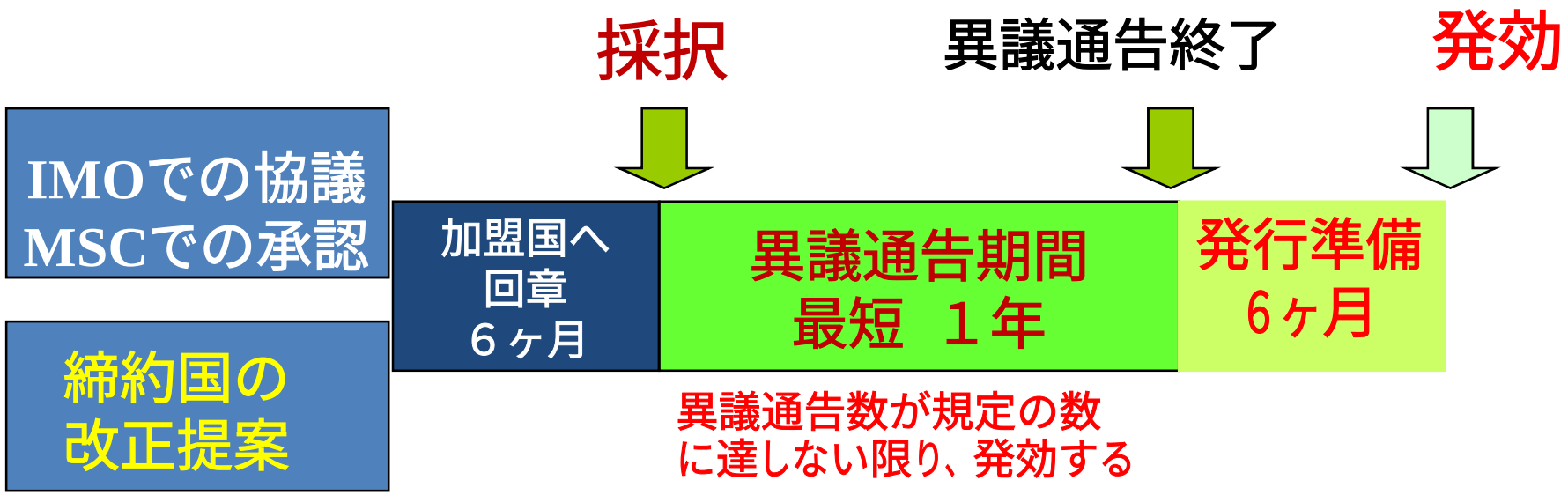
第XI-2章　海上の安全性を高めるための特別措置（セキュリティ）

第XII章　ばら積み貨物船のための追加安全措置

新条約


未発効の条約
漁船条約
バラスト水管理条約
シップリサイクル条約
受諾国数、受諾国の登録船舶トン数が決めた値に達しないと発効が決まらない：
発効時期が前もって決められない。
発効
IMOでの協議
MSC/MEPCでの承認
国の提案
条約会議の開催と採択
受諾通告
発行準備期間
条約が決めた発効要件の成立
（受諾国数）
（受諾国の登録船舶トン数）

既存の条約の改正
by Tacit Acceptance（SOLASの例）



国際規則の制定

従来は、海難事故が起こり、その再発防止のために、国際規則を作ってきた。

タイタニック号事故 1912年：
　水密区画壁、救命設備、遭難通信

トニーキャニオン号座礁・油流出事故 1967年
　海洋汚染防止条約(MARPOL)の制定

スカンジナビアン号火災事故 1990年
　全居住区へのスプリンクラ設置

エクソン・バルディス号座礁・油流出事故 1989年
　タンカーのカーゴタンク区域の二重化

事故を未然に防ぐべき、という議論が1990年代から高まってきた。

旅客船の大型化が進む中、IMOでは「大型旅客船の安全」をテーマに
綜合的に議論・検討した。

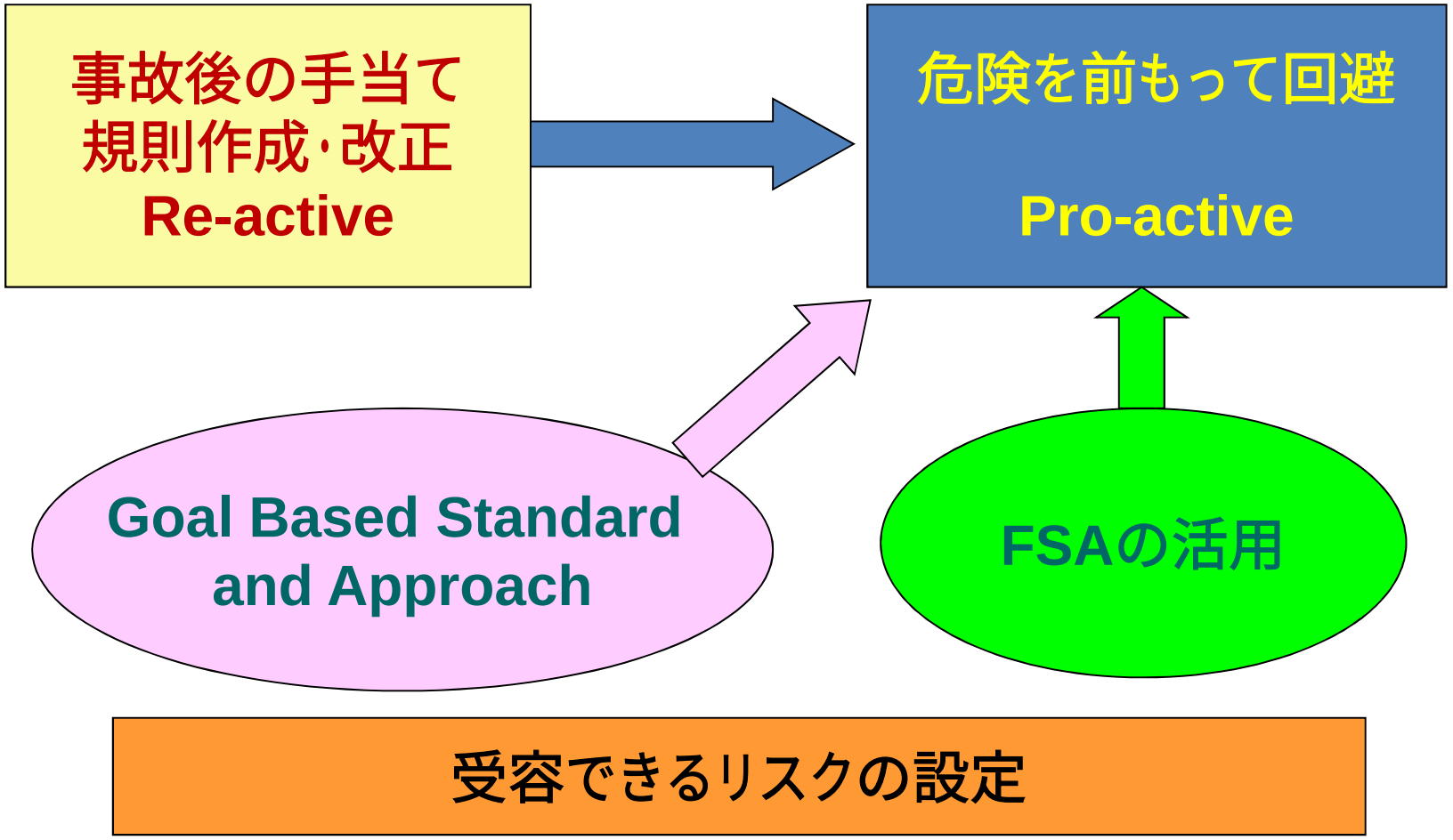
大型旅客船

MSCファンタジア
2008-12-10
137,936GT
乗客3274名
乗員1313名

ノルウェジアン･エピック
2008-04-24
乗客4228名
乗員1708名

オアシス･オブ･ザ･シーズ
2009-10-28
乗客5400名
乗員2160名

IMOにおける規則作成

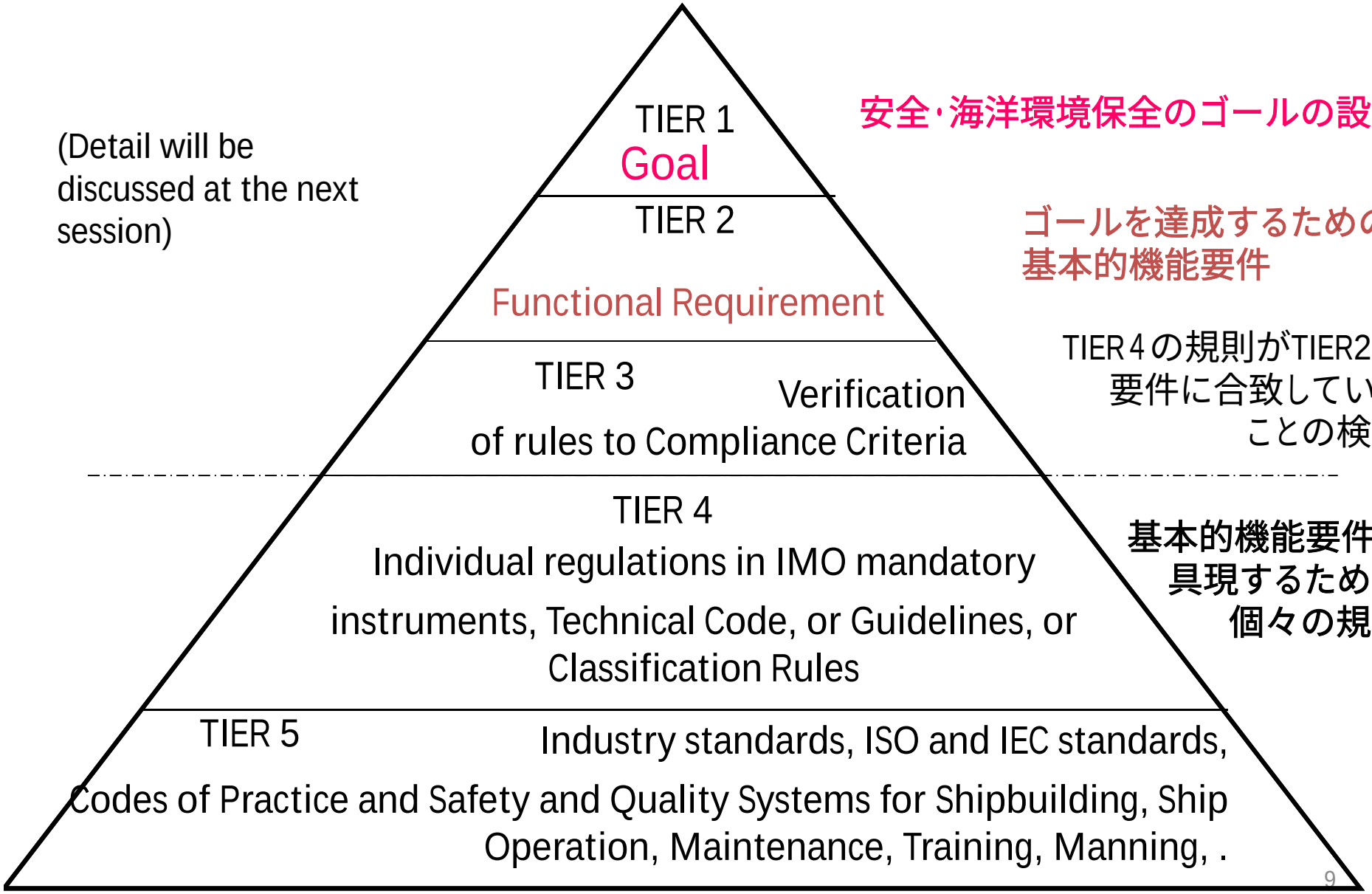


目標指向型基準
Goal-based Standard（GBS)

- 達成する目標を定める
- 目標を達成するために必要な、基本的性能要件を定める。
- 基本性能要件を実現するために必要な、具体的な規則を定める。
- 具体的な規則に合致する設計、設備、機器、材料のための標準を定める。

まず、安全の目標 (ゴール) を
設定してから、規則を構築する

Goal based approach in IMO Rule making process GBS (Goal Based Standard)



(Detail will be discussed at the next session)

安全･海洋環境保全のゴールの設定

ゴールを達成するための
基本的機能要件

TIER 4 の規則がTIER2の
要件に合致している
ことの検証

基本的機能要件を
具現するための
個々の規則

目標指向型新船構造基準 Goal based New Ship Construction standard

- **Aged Tankerの船体損傷事故ー重大海洋汚が頻発**
  エリカ号（1999年）、プレステージ号(2002年)
- **頑丈なTanker、Bulk Carrier への指向**
- **北大西洋海象で２５年のLifeの船舶（Goal 指向）**

SOLASには船体構造に関する具体的な規則がない
ー主管庁が船体構造の安全性について、判断する根拠がないのは、SOLASの欠陥

SOLAS II-1 以前のregulation 3-1

Ships shall be designed, constructed and maintained in compliance with the structural, mechanical and electrical requirements of a classification society which is recognized by the Administration in accordance with the provisions of regulation XI-1/1, or with applicable national standards of the Administration which provide an equivalent level of safety.

classification society : 船級協会

目標指向型新船構造基準
Goal based New Ship Construction standard

For oil tankers and bulk carriers

- 油タンカー、ばら積み貨物船の船体構造基準を、船級協会に任せないで、IMOの場で国際規則として定めようという意見
- 船体構造の基準と検査は、歴史的に船級協会が確保してきた
- そこで、船級協会等の船体構造基準に関して、IMOが基本的な要求事項を「goal-based standard」として決めようということになった。

船級協会

保険の対象となる船舶とその装備品を検査する独立機関。

船舶と設備の技術上の基準を定め、設計がこの基準に従っているように確認し、船舶と設備を建造から就役の過程で検査し、さらに就役後も繰り返し検査し続けて基準に沿っていることを保証する。

世界の主な船級協会は、IACS（International Association of Classification Societies）のメンバーとなっている。

LLOYD'S, ABS, DNV, GL(DNVと合併する予定) , BV, RINA, NK, RS, KR, CCS

Basic Principles of GBS
Mission Statement: Tier 0

…Quoted from working description developed at MSC 79

IMO goal-based standards are:

- broad, over-arching safety, environmental and/or security standards that ships are required to meet during their lifecycle;
- the required level to be achieved by the requirements applied by class societies and other recognized organizations, Administrations and IMO;
- clear, demonstrable, verifiable, long standing, implementable and achievable, irrespective of ship design and technology; and
- specific enough in order not to be open to differing interpretations.

目標指向型新船構造基準

MSC79(Dec.2004): Tier I：Goal合意

Ships shall be designed and constructed for a specified design life to be safe and environmentally friendly, when properly operated and maintained under the envisaged operating and environmental conditions, intact and foreseeable damage conditions throughout their life.

北大西洋海域で耐用25年/最初にタンカーとばら積み貨物船（ギリシャの主張）

Risk-based approach で考えるべき（北欧、独、日本、等）

MSC80(May 2005)

Japan, Canada, Denmark, Germany, Netherlands, Norway, Sweden, UK:

GBSにおいてはRisk-based approachの検討も行うべきと主張

EU project: SAFEDOR: Design, Operation and Regulation for Safety

International Congress for Ship and Offshore Structure (ISSC):

Risk Assessment Committee1997-2000 chaired by K. Yoshida (Japan)

2000-2003 chaired by W. Moore (Norway-USA)

Set-up Risk-based (Safety Level based) Goal, Requirements, Criteria and Validation method

タンカー・バルクキャリアの 新造船構造基準に関するGBS
2010年5月 MSC87で採択

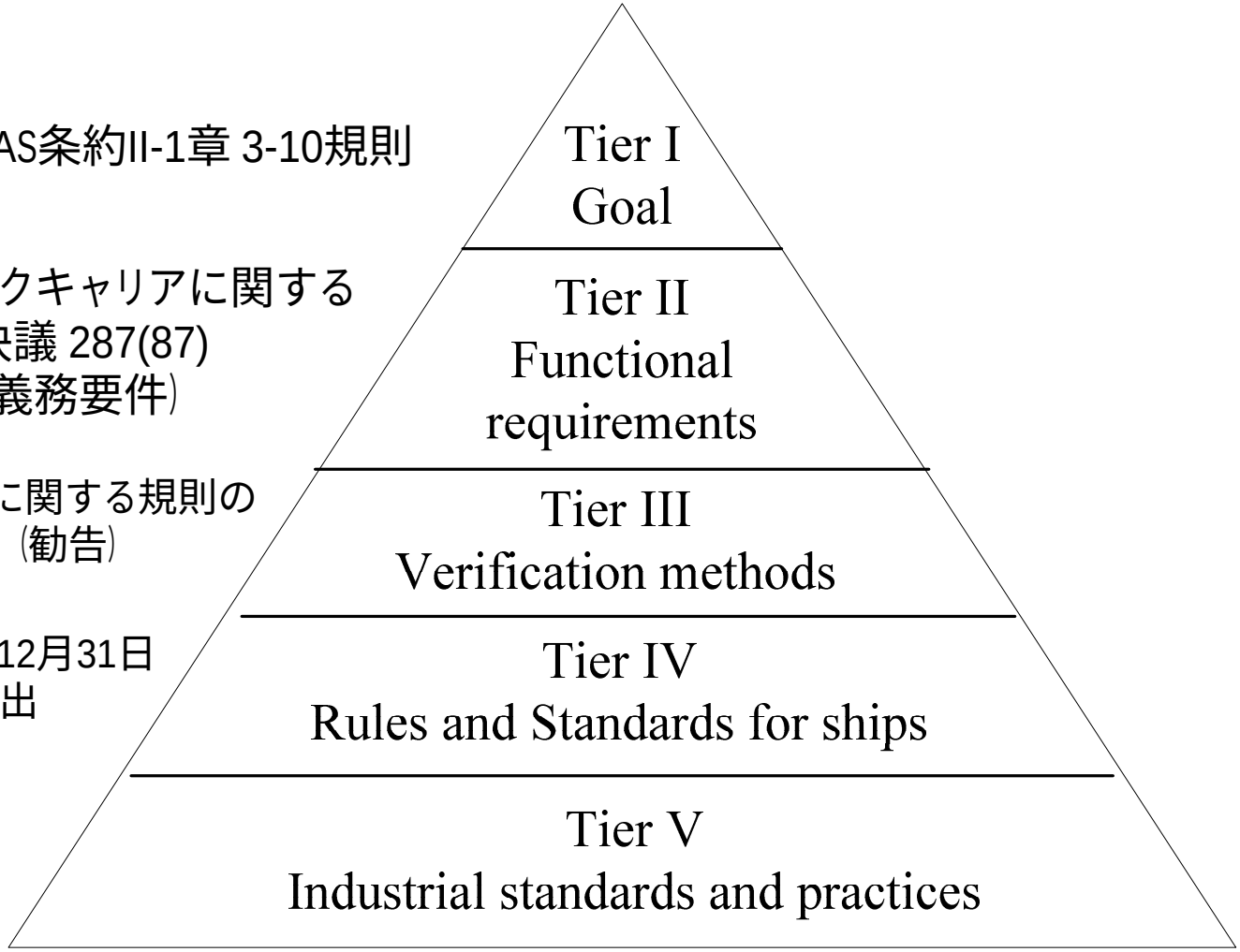
内容は、Tier I Goalを含め、定性的な規定であり、リスクコントロールを定量的に定めたものではない。

SOLAS条約II-1章 3-10規則

タンカー及びバルクキャリアに関する
GBSの指針 MSC決議 287(87)
（SOLAS II-1により義務要件）

タンカー及びバルクキャリアに関する規則の
評価方法 MSC決議 296 (87) （勧告）

船級協会などの規則2013年12月31日
までに 審査のため IMOへ提出



タンカー・バルクキャリアの 新造船構造基準に関するGBS

2010年5月 MSC87で採択

SOLAS II-1 Regulation 3-10

Goal-based ship construction standards for bulk carriers and oil tankers

1 This regulation shall apply to oil tankers of 150 m in length and above and to bulk carriers of 150 m in length and above, constructed with single deck, top-side tanks and hopper side tanks in cargo spaces, excluding ore carriers and combination carriers:

.1 for which the building contract is placed on or after 1 July 2016;

.2 in the absence of a building contract, the keels of which are laid or which are at a similar stage of construction on or after 1 July 2017; or

.3 the delivery of which is on or after 1 July 2020.

Review the progress towards the implementation of SOLAS regulation II-1/3-10 in 2014 and, if proven necessary, to adjust the time periods set forth in paragraph 1 of the regulation.

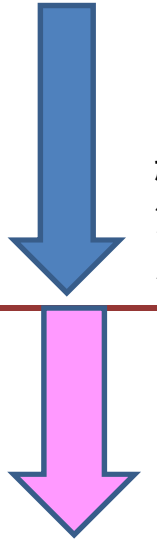
Classification societies are requested to submit their Tier IV rules by 31 December 2013.

タンカー・バルクキャリアの 新造船構造基準に関するGBS
SOLAS II-1 Regulation 3-10

Goal-based ship construction standards for bulk carriers and oil tankers

採択：2010年5月21日

発効：2012年1月1日



船級協会：
油タンカーとばら積み貨物船の
ルールをIMOに提出

2013年12月31日

適用開始日の見直し（必要なら）

IMOによる
船級協会ルール評価と承認

適用開始：2016年7月1日

2016年7月1日以降に建造契約する船

建造契約がなければ 20176年7月1日以降に建造を開始する船

2020年7月1日以降に建造を完了する船

は、IMOのGBSに合致した船級協会の規則を満足すること

タンカー・バルクキャリアの 新造船構造基準に関するGBS
SOLAS II-1 Regulation 3-10

Goal-based ship construction standards for bulk carriers and oil tankers

2 Ships shall be designed and constructed for a specified design life to be safe and environmentally friendly, when properly operated and maintained under the specified operating and environmental conditions, in intact and specified damage conditions, throughout their life.

2.1 *Safe and environmentally friendly* means the ship shall have adequate strength, integrity and stability to minimize the risk of loss of the ship or pollution to the marine environment due to structural failure, including collapse, resulting in flooding or loss of watertight integrity.

2.2 *Environmentally friendly* also includes the ship being constructed of materials for environmentally acceptable recycling.

タンカー・バルクキャリアの 新造船構造基準に関するGBS
SOLAS II-1 Regulation 3-10

Goal-based ship construction standards for bulk carriers and oil tankers

2.3 *Safety* also includes the ship's structure, fittings and arrangements providing for safe access, escape, inspection and proper maintenance and facilitating safe operation.

2.4 *Specified operating and environmental conditions* are defined by the intended operating area for the ship throughout its life and cover the conditions, including intermediate conditions, arising from cargo and ballast operations in port, waterways and at sea.

2.5 *Specified design life is the nominal period that the* ship is assumed to be exposed to operating and/or environmental conditions and/or the corrosive environment and is used for selecting appropriate ship design parameters. However, the ship's actual service life may be longer or shorter depending on the actual operating conditions and maintenance of the ship throughout its life cycle.

SOLAS II-1 Regulation 3-10

Goal-based ship construction standards for bulk carriers and oil tankers

3 The requirements of paragraphs 2 to 2.5 shall be achieved through satisfying applicable structural requirements of an organization which is recognized by the Administration in accordance with the provisions of regulation XI-1/1, or national standards of the Administration, conforming to the functional requirements of the Goal-based Ship Construction Standards for Bulk Carriers and Oil Tankers.

4 A Ship Construction File with specific information on how the functional requirements of the Goal-based Ship Construction Standards for Bulk Carriers and Oil Tankers have been applied in the ship design and construction shall be provided upon delivery of a new ship, and kept on board the ship and/or ashore* and updated as appropriate throughout the ship's service. The contents of the Ship Construction File shall, at least, conform to the guidelines developed by the Organization.*

* Guidelines for the information to be included in a Ship Construction File (MSC.1/Circ.1343)

GBS for tanker/bulker 第二階層 MSC Resolution 287(87)

INTERNATIONAL GOAL-BASED SHIP CONSTRUCTION STANDARDS F OR BULK CARRIERS AND OIL TANKERS

DESIGN

- **II.1 Design life** The specified design life is not to be less than **25 years.**
- **II.2 Environmental conditions**
- **II.3 Structural strength**
  - **II.3.1 General design**
  - **II.3.2 Deformation and failure mode**
  - **II.3.3 Ultimate strength**
  - **II.3.4 safety margins**
- **II.4 Fatigue life**
- **II.5 Residual strength**
- **II.6 Protection against corrosion**
- **II.7 Structural redundancy**
- **II.8 Watertight and weathertight integrity**
- **II.9 Design transparency**
- **II.10 Construction quality procedures**

CONSTRUCTION

- **II.11 Survey**
- **II.12 Maintenance**

IN-SERVICE CONSIDERATION

- **II.13 Survey and maintenance**
- **II.14 Structural accessibility**

RECYCLING CONSIDERATION

- **II.15 Recycling**

GBS for tanker/bulker 第二階層 MSC Resolution 287(87)

(Applicable to bulk carriers and oil tankers in unrestricted navigation)

Design

II.1 Design life The specified design life is not to be less than **25 years.**

II.2 Environmental conditions

Ships shall be designed in accordance with **North Atlantic environmental conditions** and relevant long-term sea state scatter diagrams.

II.3 Structural strength

II.3.1 General design

The ship's structural members shall be of a design that is compatible with the purpose of the space and ensures a degree of structural continuity. The structural members of ships shall be designed to facilitate load/discharge for all contemplated cargoes to avoid damage by loading/discharging equipment, which may compromise the safety of the structure.

II.3.2 Deformation and failure mode

The structural strength shall be assessed against excessive deflection and failure modes, including but not limited to buckling, yielding and fatigue.

II.3.3 Ultimate strength

Ships shall be designed to have adequate ultimate strength. Ultimate strength calculations shall include ultimate hull girder capacity and related ultimate strength of plates and stiffeners, and be verified for a longitudinal bending moment based on the environmental conditions in functional requirement II.2.

GBS for tanker/bulker 第二階層MSC Resolution 287(87)

II.3.4 safety margins

Ships shall be designed with suitable safety margins:

1. to withstand, at **net scantlings***, in the intact condition, the environmental conditions anticipated for the ship's design life and the loading conditions appropriate for them, which shall include full homogeneous and alternate loads, partial loads, multi-port and ballast voyage, and ballast management condition loads and occasional overruns/overloads during loading/unloading operations, as applicable to the class designation; and
2. appropriate for all design parameters whose calculation involves a degree of uncertainty, including loads, structural modelling, fatigue, corrosion, material imperfections, construction workmanship errors, buckling, residual and ultimate strength.

* The net scantlings should provide the structural strength required to sustain the design loads, assuming the structure is in intact condition and without any corrosion margin. However, when assessing fatigue and global strength of hull girder and primary supporting structures, a portion of the total corrosion margin may be added to the net scantlings to reflect the material thickness that can reasonably be expected to exist over the design life.

GBS for tanker/bulker 第二階層 MSC Resolution 287(87)

II.4 Fatigue life

The design fatigue life shall not be less than the ship's design life and shall be based on the environmental conditions in functional requirement II.2.

II.5 Residual strength

Ships shall be designed to have sufficient strength to withstand the wave and internal loads in specified damaged conditions such as collision, grounding or flooding. Residual strength calculations shall take into account the ultimate reserve capacity of the hull girder, including permanent deformation and post-buckling behaviour. Actual foreseeable scenarios shall be investigated in this regard as far as is reasonably practicable.

II.6 Protection against corrosion

Measures shall be applied to ensure that net scantlings required to meet structural strength provisions are maintained throughout the specified design life. Measures include, but are not limited to, coatings, corrosion additions, cathodic protection, impressed current systems, etc.

GBS for tanker/bulker 第二階層 MSC Resolution 287(87)

II.6.1 Coating life

Coatings shall be applied and maintained in accordance with manufacturers' specifications concerning surface preparation, coating selection, application and maintenance. Where coating is required to be applied, the design coating life shall be specified. The actual coating life may be longer or shorter than the design coating life, depending on the actual conditions and maintenance of the ship. Coatings shall be selected as a function of the intended use of the compartment, materials and application of other corrosion prevention systems, e.g., cathodic protection or other alternatives.

II.6.2 Corrosion addition

The corrosion addition shall be added to the net scantling and shall be adequate for the specified design life. The corrosion addition shall be determined on the basis of exposure to corrosive agents such as water, cargo or corrosive atmosphere, or mechanical wear, and whether the structure is protected by corrosion prevention systems, e.g., coating, cathodic protection or by alternative means. The design corrosion rates (mm/year) shall be evaluated in accordance with statistical information established from service experience and/or accelerated model tests. The actual corrosion rate may be greater or smaller than the design corrosion rate, depending on the actual conditions and maintenance of the ship.

GBS for tanker/bulker 第二階層 MSC Resolution 287(87)

II.7 Structural redundancy

Ships shall be of redundant design and construction so that localized damage (such as local permanent deformation, cracking or weld failure) of any stiffening structural member will not lead to immediate consequential collapse of the complete stiffened panel.

II.8 Watertight and weathertight integrity

Ships shall be designed to have adequate watertight and weathertight integrity for the intended service of the ship and adequate strength and redundancy of the associated securing devices of hull openings.

II.9 Design transparency

Ship's structures and fittings shall be designed and arranged using ergonomic principles to ensure safety during operations, inspection and maintenance. These considerations shall include, but not be limited to, stairs, vertical ladders, ramps, walkways and standing platforms used for means of access, the work environment, inspection and maintenance and the facilitation of operation.

II.10 Construction quality procedures

Ships shall be designed under a reliable, controlled and transparent process made accessible to the extent necessary to confirm the safety of the new as-built ship, with due consideration to intellectual property rights. Readily available documentation shall include the main goal-based parameters and all relevant design parameters that may limit the operation of the ship.

CONSTRUCTION

II.11 Survey

Ships shall be built in accordance with controlled and transparent quality production standards with due regard to intellectual property rights. The ship construction quality procedures shall include, but not be limited to, specifications for material, manufacturing alignment, assembling, joining and welding procedures, surface preparation and coating.

II.12 Maintenance

A survey plan shall be developed for the construction phase of the ship, taking into account the ship type and design. The survey plan shall contain a set of requirements, including specifying the extent and scope of the construction survey(s) and identifying areas that need special attention during the survey(s), to ensure compliance of construction with mandatory ship construction standards.

GBS for tanker/bulker 第二階層 MSC Resolution 287(87)

IN-SERVICE CONSIDERATION

II.13 Survey and maintenance

Ships shall be designed and constructed to facilitate ease of survey and maintenance, in particular avoiding the creation of spaces too confined to allow for adequate survey and maintenance activities. Areas shall be identified that need special attention during surveys throughout the ship's life. In particular, this shall include all necessary in-service survey and maintenance that was assumed when selecting ship design parameters.

II.14 Structural accessibility

The ship shall be designed, constructed and equipped to provide adequate means of access to all internal structures to facilitate overall and close-up inspections and thickness measurements.

RECYCLING CONSIDERATION

II.15 Recycling

Ships shall be designed and constructed of materials for environmentally acceptable recycling without compromising the safety and operational efficiency of the ship.

GBSの利用の拡大

- タンカーとばら積み貨物船に関するGBSは、定性的な解析と検討に依って作成した。
- 安全のレベルを定量的に把握し、目標とすることが、引き続き求められている。
- GBSの適用は、船体構造だけではなく、また、タンカーやばら積み貨物船だけではないはず。

Generic framework of IMO Goal-based Standard for rule making

MSC Circular 1394, 14 June 2011
GENERIC GUIDELINES FOR DEVELOPING IMO GOAL-BASED STANDARDS

Set-up Generic and Probabilistic GOAL For Safety and Environmental protection

Generic framework of Goal-based Ship Construction Standard

Goal-based Ship Construction Standard for oil tankers and bulk carriers

Goal-based Standard by Safety Level Approach

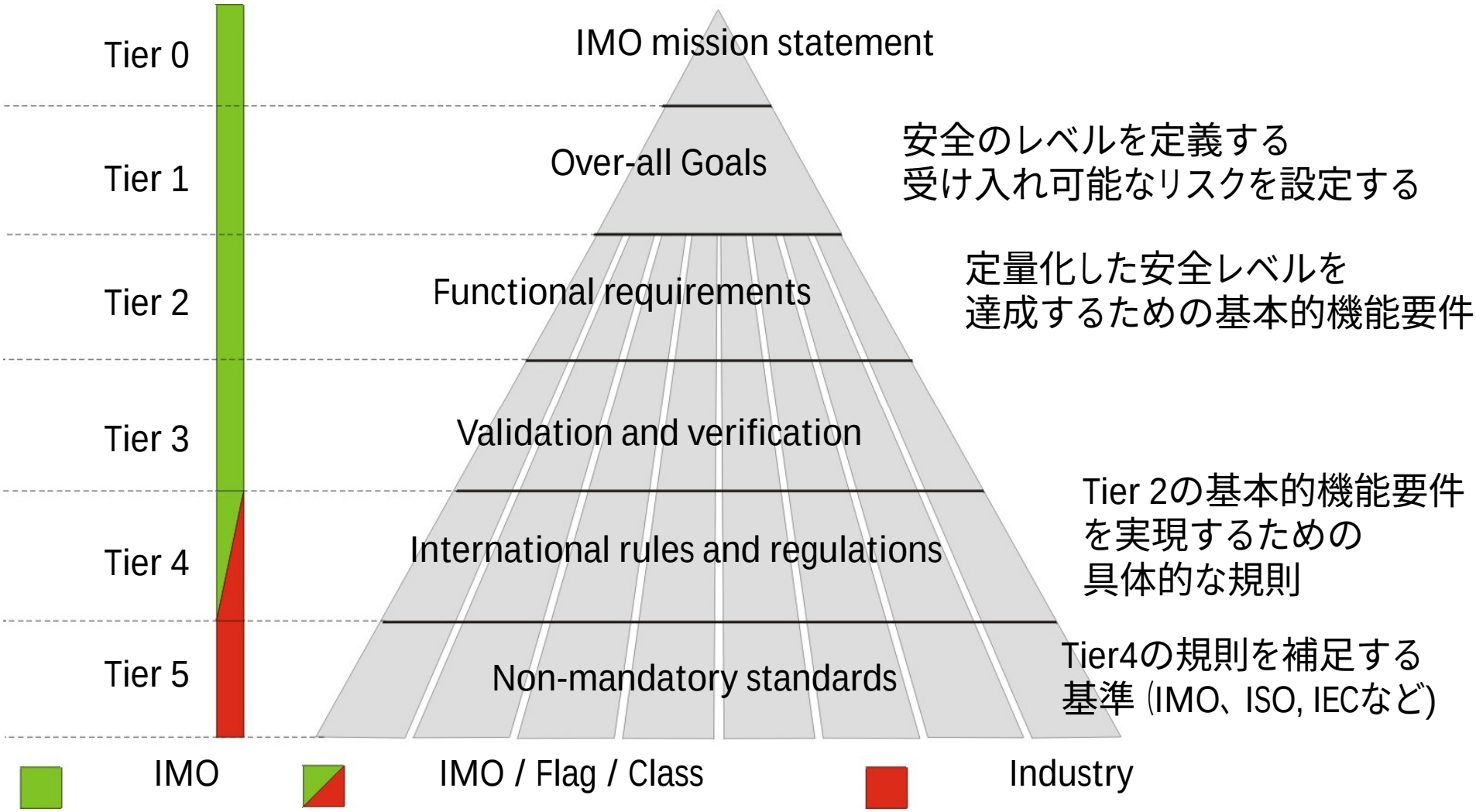
Goal-based Ship Construction Standard for other types of ship or construction in general

Goal-based Standard for Subject Other than structure

Fire Protection
Life Saving
Etc.

Goal-based Ship Construction Standard

GBS structure for Safety Level Approach
(Risk-based approach)



safety level based goal

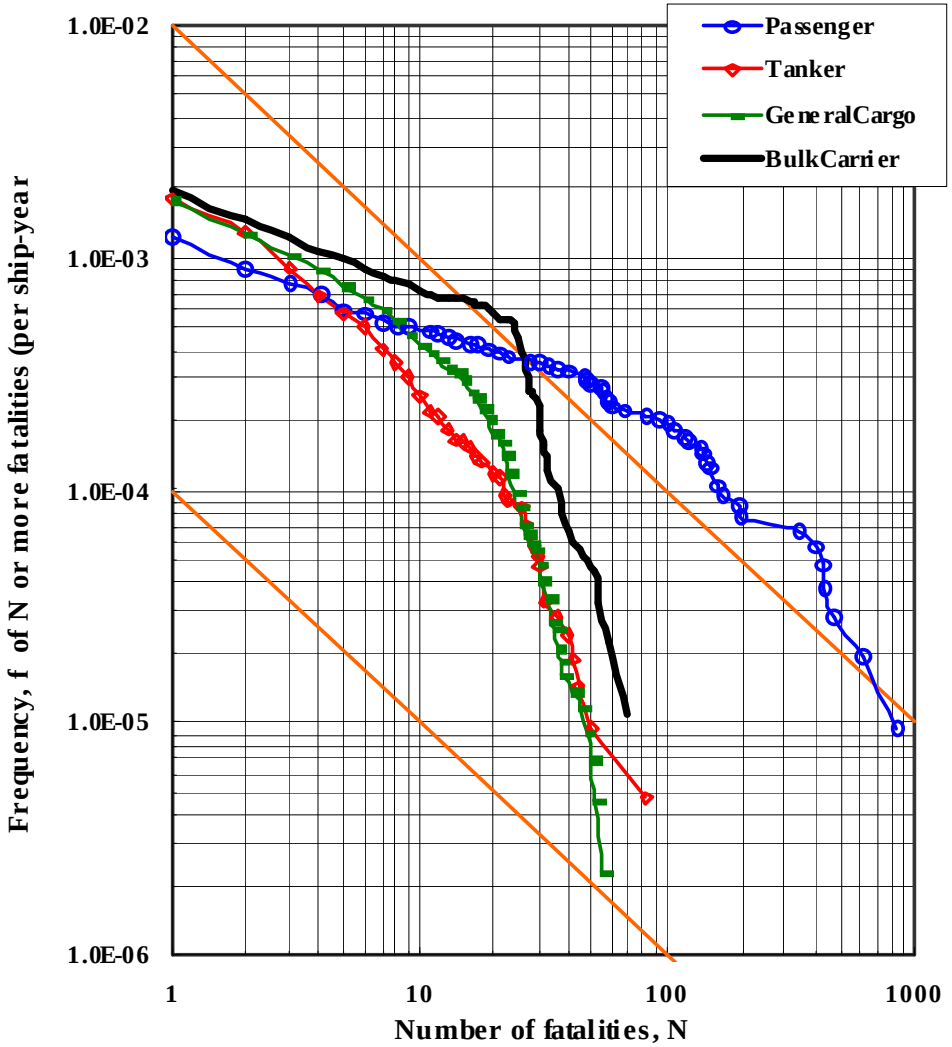
- いくつかの国では、産業における目標安全レベルあるいは受け入れ可能なリスクレベルの設定がすでに存在している (ISSSC2000, MSC 81/6/3)
- 定量的なリスクアセスメント及びその方法は、原子力、化学プラント、石油精製施設、海洋構造物（海洋油田）で、すでに存在する (MSC81/6/3, MSC 81/INF.7) (11-17の講義で示した)
  - Norway: Risk Analysis regulations NPD and regulations for management of Health, Environment and Safety (HES)
  - UK: Safety Case Regulations (UK HSE)
- 船舶に関しても、定量的なリスクアセスメント方法及び受け入れ可能なリスクレベルは確立可能
- 現状のリスクレベルを調べて、それを向上させることで目標を設定することも可能。いくつかの船舶では、事故記録・データベースが統計的に意味ある量として存在する。
- 新しい設計の船、船種、海洋構造物では、事故データ（過去の事故例）によって、安全目標を」さだめることは困難である。（過去の事故データがないか、データ量は少ないために統計的に意義のある事故率とならない）

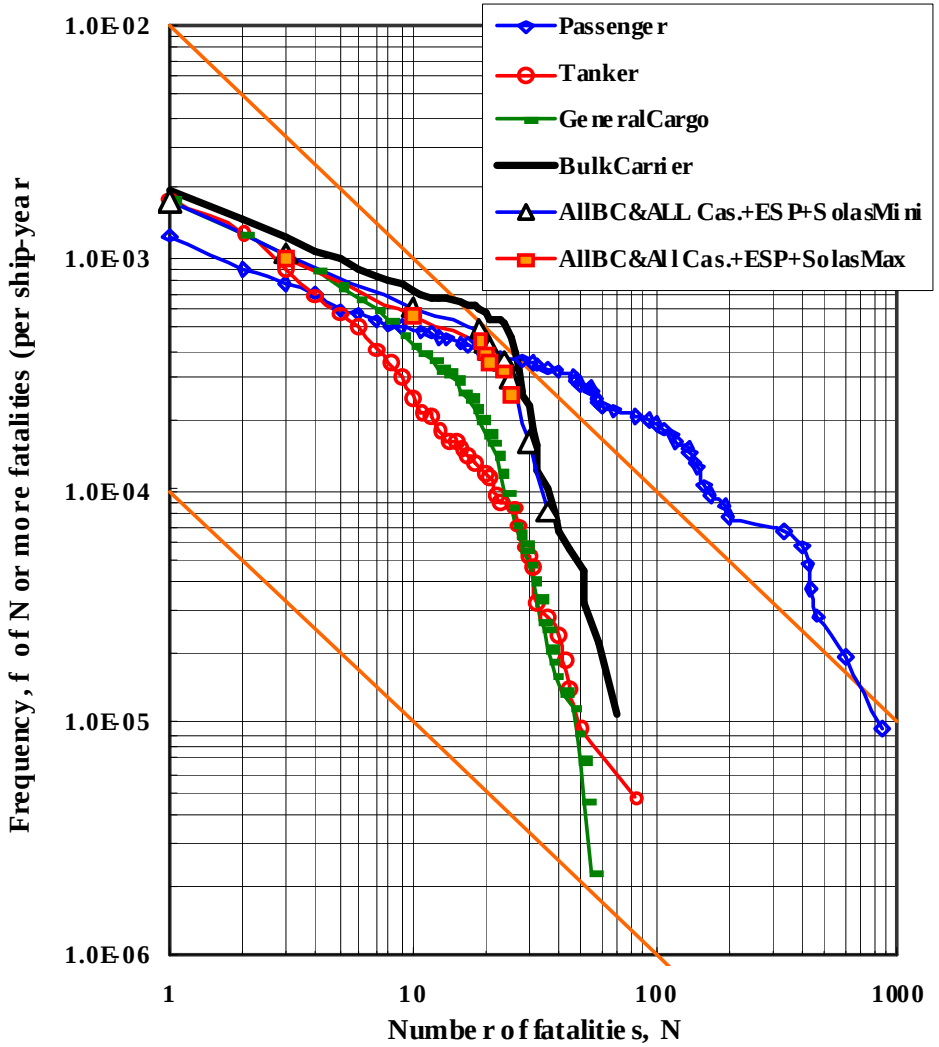
Existing safety level goals

TABLE 1: Individual Risk Criteria in Use (Annual Fatality Risk) MSC 81/6/10

Authority	**Description**	**Criterion (per year)**
U.K. HSE (1999)	Maximum tolerable risk to workers	10^{-3}
	Maximum tolerable risk to the public	10^{-4}
	Negligible risk	10^{-6}
Netherlands Bottelberghs(1995)	Maximum tolerable for existing situations	10^{-5}
	Maximum tolerable risk for new situations	10^{-6}
New South Wales, Australia DUAP (1997)	Sensitive developments (hospitals, schools etc.)	$5 \cdot 10^{-7}$
	Residential, hotels, motels, tourist resorts etc.	$1 \cdot 10^{-6}$
	Commercial, retail, offices etc	$1 \cdot 10^{-5}$
	Sporting complexes, active open space	$1 \cdot 10^{-5}$
	Industrial	$5 \cdot 10^{-5}$
Western Australia EPA (1998)	Sensitive developments (hospitals, schools etc.)	$5 \cdot 10^{-7}$
	Residential zones	$1 \cdot 10^{-6}$
	Non-industrial (commercial, sporting etc.)	$1 \cdot 10^{-5}$

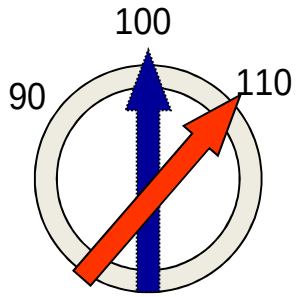
Today's safety level





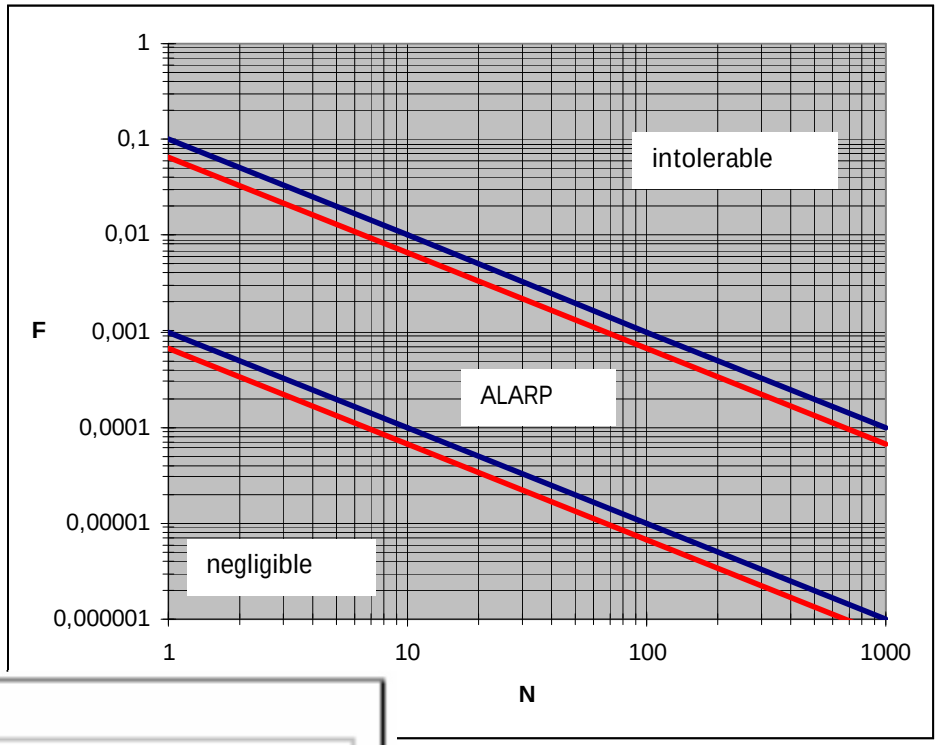
Extracted from MSC 75/5/2

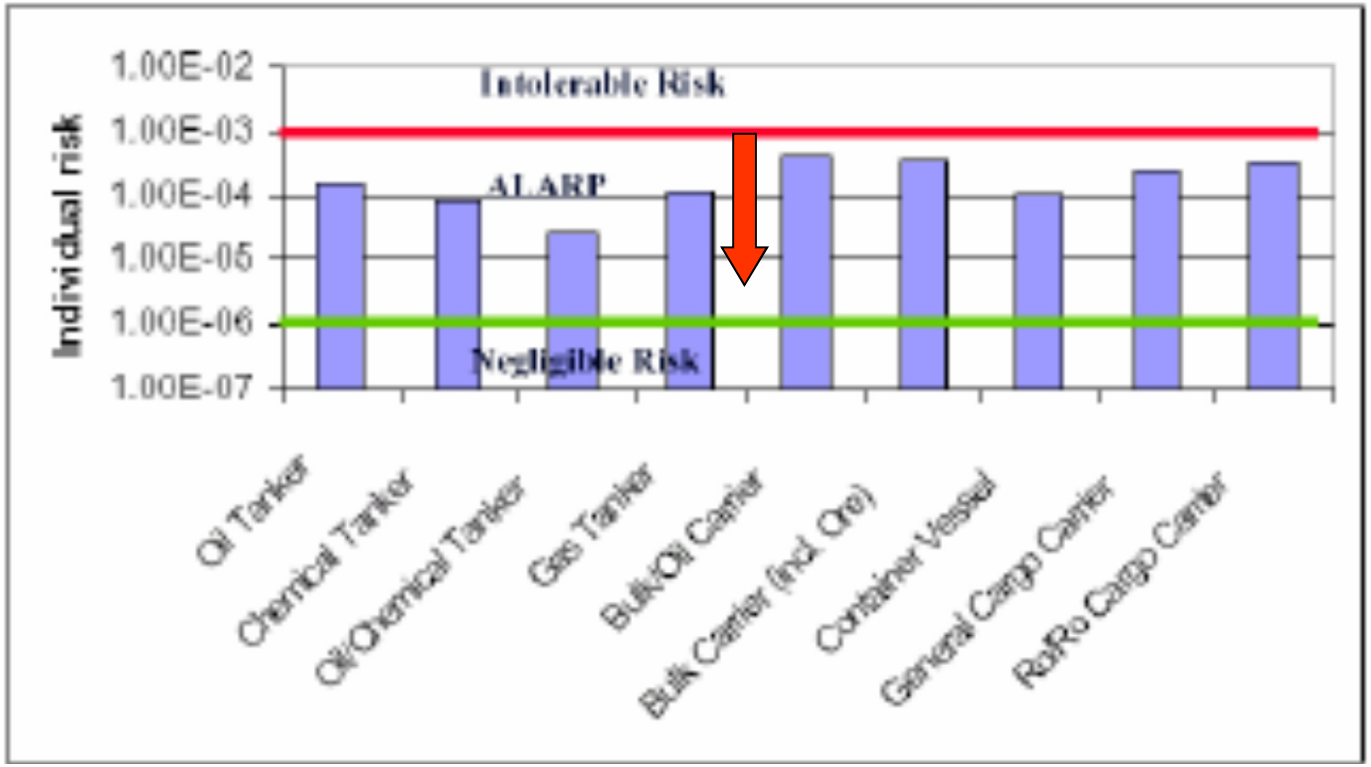
The Maritime Regulator‘s Safety Knob



to control individual risk levels, ALARP boundaries and cost effectiveness criteria

ALARP: As low As reasonably Practicable





Safety Level

- Individual risk
- Social risk

- for Crew
- for Passengers
- for Properties
- for Environment

RISK ASSESSMENT BASICS

Definition of RISK

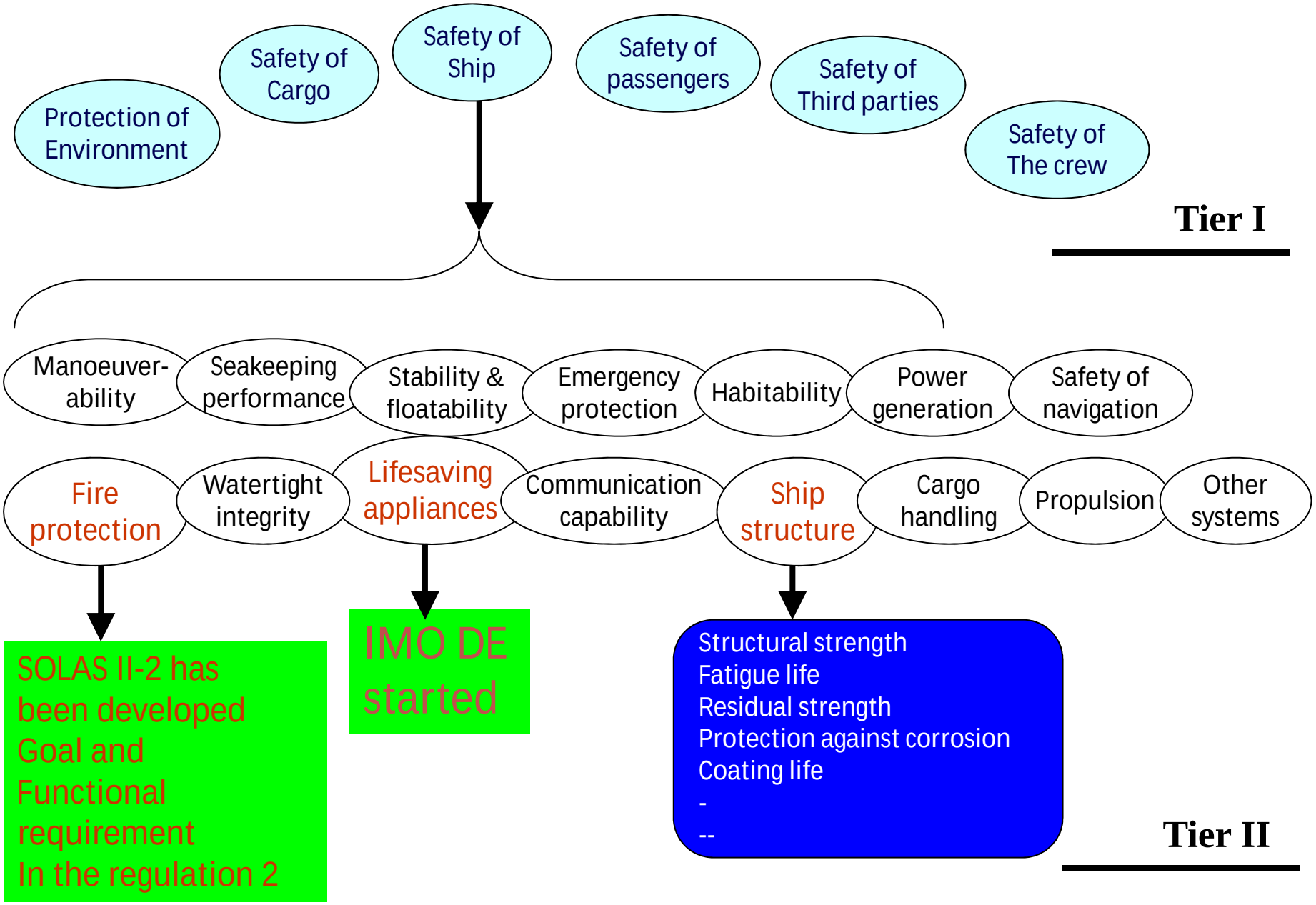
Risk = Frequency x Severity (IMO FSA)

Risk = Probability x Severity (ISO/IEC Guide 51)

Risk is never acceptable, but the activity implying risk may be acceptable because of its benefit.

Risk acceptance criteria may be related to:

- Safety, typically divided into *individual risk and social risk*
- Environment
- Economy


Safety of Ship
Safety of Cargo
Safety of passengers
Safety of Third parties
Protection of Environment
Safety of The crew
Tier I
Manoeuver-ability
Seakeeping performance
Stability & floatability
Emergency protection
Habitability
Power generation
Safety of navigation
Fire protection
Watertight integrity
Lifesaving appliances
Communication capability
Ship structure
Cargo handling
Propulsion
Other systems
SOLAS II-2 has been developed Goal and Functional requirement In the regulation 2
IMO DE started
Structural strength
Fatigue life
Residual strength
Protection against corrosion
Coating life
-
--
Tier II

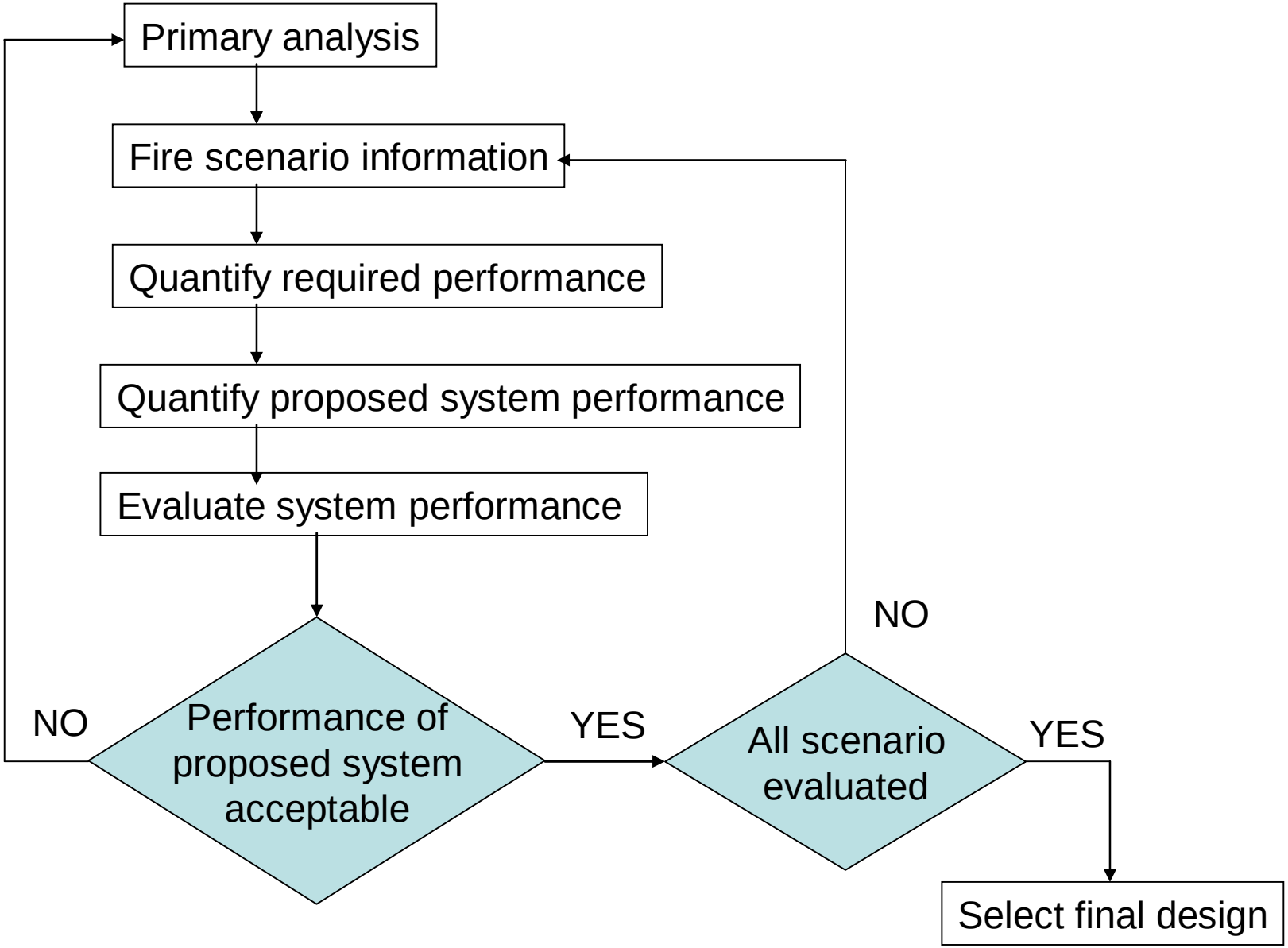
Container ship

新しいタイプの船舶には、過去の事故例、データがない。
リスクを予測し、安全対策を構築するしかない。

- LNG燃料船
- 大型客船、Ro-roフェリー
- プラスチック等の軽量材料の利用（構造、パイプ）

New Passenger Ferry (RoPax)

Alternative Design and Arrangement for Fire Safety



リスク管理:リスクを負う仕組み

実業者

リスクを管理する
リスクを下げる努力を実行する

保険会社

リスクを査定する

リスク検査機関

リスク管理の状態を検査する
リスクが一定値以下であることを確保する

IMOの規則作成ツールとしてのGBS

- 総合目標を定める(Tier I)
- 目標を達成するための性能要件を定める(Tier II)
- 規則の体系を構築する (Tier II and IV)
- 個々の規則を作成する。規則毎の目標を明示する(Tier IV)

進行中の作業対象

✓ 救命設備規則 (SOLAS 第III章)

✓ 堪航性(maneouveability)

✓ 復原性(Probabilistic approachはすでにSOLAS第II-1章に取り込んだが、目標が不明確)

✓ 極海域航行船舶のコード (基準)

IMOの規則作成ツールとしてのGBS
例：救命設備規則の基本要件の見直し
IMO 船舶設計設備章委員会DE52(2008)へ提案

Functions \ Assessment factors	1: Accessibility	2: Usability	3: Reliability	4: Performance	5: Management/ Maintenance	6: Environmental conditions
A: Communication	A1	A2	A3	A4	A5	A6
B: Personal life-saving	B1	B2	B3	B4	B5	B6
C: Mass-evacuation	C1	C2	C3	C4	C5	C6
D: Search and rescue	D1	D2	D3	D4	D5	D6

IMOの規則作成ツールとしてのGBS
例：救命設備規則案 SOLAS chapter III (IMO 文書DE54/10として提出した)

Goal and Objective

The objectives of this chapter are to enable persons on board to evacuate in case of emergency and to survive at water for the specified period, and to provide means of rescue for survivors in water, under the specified operating and environmental conditions, when the appliances required by this chapter are properly operated and maintained.

Functional requirements

The functional requirements are embodied in the regulations of this chapter in order to achieve the objectives set out in paragraph 1. The functional requirements are to:

F1 support appropriate decisions of masters of ships;

F2 ensure necessary means of communication in an emergency;

F3 enable passengers and crew to escape on board ships;

F4 enable passengers and crew to escape from ships;

F5 enable passengers and crew to survive in water in case of person overboard;

F6 enable passengers and crew to survive in survival craft;

F7 enable survivors to be recognized by others; and

F8 enable ships to rescue persons in water.

GBS based structure of each regulation

1. Objectives and functional requirements
2. Requirement in general, applicable to all types of ship
3. If necessary, requirements for particular type of ships (passenger ships, cargo ships and/or tankers)

Alternative Design and Arrangement for Fire Safety

- Each regulation contains prescriptive requirements.
- Alternative design and arrangement, deviating from those prescribed, can be used, if
  - that fulfills functional requirements,
  - that realizes the same level of fire safety, and
  - the designer provides those proofs.
- Regulation 17 specifies the method of proof.

IMOにおける今後の規則作成

目標指向型規則
Goal Based Standard

2000
SOLAS II-2章で
一部実現した

確率論的
目標設定も
考える

安全あるいは海洋
環境保護の目標の設定

目標を達成する
Designに
自由度がある

Designの
目標適合を検証・
判定する手法

受容できるリスクの設定

Pubic Demand