



Safety Considerations for Ship Operators Related to Risk-Based Stowage of Dangerous Goods on Containerships

Part One

A Publication of CINS (the Cargo Incident Notification System)

Version 1.00

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Background

These Safety Considerations have been prepared by a working group comprising Members of CINS (Cargo Incident Notification System) and Classification Societies as listed below. The development has been coordinated by American Bureau of Shipping (ABS). The target audience includes ship operators, cargo carriers, and port personnel.

The scope of this document is considered to be a first stage in a collective industry approach on this important matter which is designed to enhance safety on board container ships, recognising the significant complexities involved in achieving effective and compliant stowage of containers. Further, arising as they do from serious fire incidents in recent years, often relating to deficiencies in cargo declaration and packing, these Safety Considerations represent one of a number industry and regulatory initiatives.

CINS – Cargo Incident Notification System

CINS is a shipping line initiative, launched in September 2011, to increase safety in the supply chain, reduce the number of cargo incidents on board ships and on land, and highlight the risks caused by certain cargoes and/or packing failures. Membership of CINS comprises over 85 percent of the world's container slot capacity.

CINS enables analysis of operational information on cargo and container incidents which lead to injury or loss of life, loss or serious damage of assets and environmental concerns. Data relating to any cargo incident on board a ship, in terminals etc. may be uploaded to the CINS database. The data include information on cargo type, nature, packaging, weight, journey (load and discharge ports), type of incident and root cause analysis.

Acknowledgements

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- China Classification Society
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- Hapag Lloyd
- International Group of P&I Clubs
- Lloyd's Register
- Maersk Line
- Mediterranean Shipping Company
- National Cargo Bureau
- TT Club

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1. INTRODUCTION

1.1 Enhance Existing Ship Safety Stowage and Segregation Requirements

The stowage of Dangerous Goods and the associated control measures to address safety related issues onboard containerships are primarily addressed by the applicable versions of:

- The International Convention for the Safety of Life at Sea 1974 (SOLAS), as amended.
- The International Maritime Dangerous Goods Code (IMDG)¹, as amended.

Major fires continue to occur on board containerships carrying Dangerous Goods, resulting in loss of life, harm to the environment, and damage or loss of cargo and property. Measures to reduce the occurrence of container fires and, in the event they do occur, to mitigate their effects include, but are not limited to, having suitable cargo declaration and acceptance procedures at the cargo booking stage and retaining on-board fire-detection and fire-fighting capability. The scope of this document is to address on-board Dangerous Goods stowage considerations to enhance the SOLAS and IMDG requirements.

These Safety Considerations **do not** replace the SOLAS and IMDG requirements for stowage and segregation, including IMDG Code Part 7, MSC.1/Circ. 1440, and the Document of Compliance for Carriage of Dangerous Goods on the ship.

These Safety Considerations provide an initial proposal for a risk-based Dangerous Goods stowage strategy, applying to all sizes of containership and, as it is further developed, intended to complement **but not replace** ship operators' existing measures for the carriage of properly declared Dangerous Goods.

This is the first version and initial stage in collectively seeking to enhance safety relating to this important matter. It is intended that further elements of these Safety Considerations will be developed and published, aimed at producing additional information on the stowage of dangerous goods on container ships including, but not limited to, risk assessment, risk-based stowage of Dangerous Goods based on UN Numbers and addressing effective vertical and athwartships segregation.

1.2 Analysis of Fire and Explosion Incidents

This document concerns Safety Considerations relating to the stowage and segregation of Dangerous Goods on board containerships. It is recognised that all cargo related incidents resulting in fire and explosions are rooted in cargo problems. Investigations, litigation and inspections demonstrate various deficiencies relating to cargo presented for shipment including, but not limited to:

- Erroneous classification and declaration.
- Packing, segregation and securing not complying with IMDG or not following the CTU Code².
- Packaging not complying with IMDG.

¹ This Code is mandatory and contains requirements for the safe carriage of packaged Dangerous Goods. It is published by the International Maritime Organization (IMO) and revised biennially.

² IMO/ILO/UNECE Code of Practice for Packing of Cargo Transport Units.

Presentation for shipment of cargoes that are not compliant with national and international regulations results in unacceptable risks to all stakeholders involved in movement of goods.

Certain commodities that may be declared as not subject to the provisions of IMDG have been shown to present heightened risks on board ships and are likely therefore to be subject to greater scrutiny. Such commodities include, but are not limited to:

- Charcoal.
- Wood pellets.
- Metal scrap.
- Borings, shavings, turnings.
- Seed cake.

As such, ship operators need to establish cargo acceptance policies and management operations, including effective cargo screening, in order to detect such higher risk cargoes and plan stowage positions that facilitate control on board the ships.

In this context, it is important to implement the appropriate standards, procedures and management systems to cover the scope of the Containers and Cargoes Risk Assessment and Supply Chain Management. This may be considered part of the ISO 9001:2015 standard.

2. DEFINITIONS

All terminology used in these guidelines is taken from IMDG. In addition, the following definitions are applied to this document.

- Accessible Position: A stowage position accessible from a fixed platform, deck or a lashing bridge.
- Block Stowage: A method whereby cargo containers packed with Dangerous Goods of the same IMDG Class are stowed in same bay and adjacent to each other.
- Higher Risk Cargoes: Commodities which are not subject to the full requirements of IMDG through application of a Special Provision.
- Mis-declared: Containers presented for shipment where an item or items of Dangerous Goods are not declared correctly, including but not limited to where offered on a fraudulent basis.
- Risk: The term “risk” will be used throughout the document in alignment with SOLAS . Risk is defined as the product of the likelihood of failure with which an event is anticipated to occur and the consequence of the event’s outcome. Risk analysis is used to determine the likelihood of failure and consequence of a hazardous event. The likelihood of failure and consequence are then combined to determine the level of risk. The categorisation considers the likelihood and consequence of the potential fire and exposition events caused by different Dangerous Goods including, self-combustible, self-reacting, heat sensitive and higher risk cargoes.
- Self-Reacting Commodities: Commodities that under certain conditions may self-heat and ignite spontaneously. The intent of this term is to state the commodities that have self-reacting properties and may be shipped under Special Provisions as not subject to the provisions of IMDG.
- Undeclared: Cargo presented for shipment as non-dangerous goods which should have been declared as Dangerous Goods and/or not all Dangerous Goods items in the containers are declared, including but not limited to where offered as non-dangerous goods on a fraudulent basis.

3. NATURE OF DANGEROUS CARGO

In IMDG, Dangerous Goods are categorised into nine classes and further broken down into sub-divisions according to the predominant type of hazard they represent:

- Class 1: Explosives
- Class 2.1: Flammable gases
- Class 2.2: Non-flammable, non-toxic gases
- Class 2.3: Toxic gases
- Class 3: Flammable liquids
- Class 4.1: Flammable solids, self-reactive substances, solid desensitized explosives and polymerizing substances
- Class 4.2: Substances liable to spontaneous combustion
- Class 4.3: Substances which, in contact with water, emit flammable gases
- Class 5.1: Oxidizing substances
- Class 5.2: Organic peroxides
- Class 6.1: Toxic substances
- Class 6.2: Infectious substances
- Class 7: Radioactive material
- Class 8: Corrosive substances
- Class 9: Miscellaneous dangerous substances and articles

When considering the stowage of Dangerous Goods in accordance with the Safety Considerations set out in this document, each individual cargo UN Number is to be carefully considered for its own unique properties and characteristics taking into account the requirements of IMDG and SOLAS.

4. GENERAL SAFETY CONSIDERATIONS TO ENHANCE IMDG AND SOLAS REQUIREMENTS FOR STOWAGE OF DANGEROUS GOODS ON CONTAINERSHIPS

Dangerous Goods on containerships shall be stowed safely and correctly in accordance with IMDG and SOLAS. Optimal stowage shall also consider actions required in the event of serious incidents including, but not limited to, fire, gas leakage or explosion.

The general safety considerations for stowing Dangerous Goods on board containerships are set out below:

- a. **Dangerous Goods shall be stowed in accordance with IMDG, SOLAS and the ship's Document of Compliance for Carriage of Dangerous Goods as well as any requirements set by the Flag State of the ship.**
- b. **Ship operators should apply appropriate additional standards, policies and procedures in relation to the cargoes and Dangerous Goods being loaded on their ships, taking into account the technical design and characteristics of each ship.**
- c. **Safe stowage of Dangerous Goods and higher risk cargoes can be enhanced further by utilising risk-based Dangerous Goods Stowage Concept methodologies. A CINS Working Group Model is set out in Section 5.2 and Appendix B of these Safety Considerations, which, amongst other models, provides a general example for the stowage of individual classes and groups of commodities.**
- d. **Safe stowage of Dangerous Goods and higher risk cargoes should always be based upon the UN Number of each consignment and the related cargo characteristics.**

- e. **Shippers and Consignors should be prepared to evidence that the goods offered for transport are correctly classified in accordance with IMDG and UN Orange Book³.**
- f. **Where there is concern that the goods may present a HSSE⁴ risk, the container and contents may be inspected in order to ensure there is no danger to the crew on board, the ship or any stakeholder in the supply chain**

4.1 These Safety Considerations recommend that declared Dangerous Goods and higher risk cargoes should not be stowed:

- 4.1.1 Adjacent to accommodation.
- 4.1.2 Adjacent to the engine room.
- 4.1.3 In cargo holds above the engine room/shaft tunnel area.
- 4.1.4 In the bottom tiers in the hold.
- 4.1.5 In the rows under deck adjacent to wing fuel tanks and internal bulkhead fuel tanks.
- 4.1.6 In the outermost rows on deck.
- 4.1.7 In the forward most bay on deck.
- 4.1.8 In the aft most bay on deck.
- 4.1.9 On deck without being protected from direct sunlight.
- 4.1.10 Over working spaces and walk-ways.

4.2 These Safety Considerations recommend the following measures in relation to stowage of declared Dangerous Goods and higher risk cargoes:

- 4.2.1 Dangerous Goods which cannot be extinguished by CO₂ should be stowed on deck.
- 4.2.2 Dangerous Goods which cannot be extinguished by either water or CO₂ should be stowed on deck.
- 4.2.3 Dangerous Goods prone to fire or explosion should be segregated from known ignition sources.
- 4.2.4 Explosives should be stowed furthest from the accommodation and primary life-saving appliances.
- 4.2.5 Limited Quantities and Excepted Quantities of goods should be stowed in the appropriate Risk Zone (see Section 5) according to the IMDG Class and UN Number as non-exempted Dangerous Goods.
- 4.2.6 Empty uncleaned items that may contain the residue of Dangerous Goods should be stowed in same Risk Zone (see Section 5) as the classified equivalent.
- 4.2.7 Non-Dangerous Goods barriers should be introduced between adjacent Risk Zones (see Section 5) in the fore-and-aft line of the ship.
- 4.2.8 IMDG Class 4.3 Packing Group I containers should be restricted to second or third tier or higher depending on lashing bridge height.
- 4.2.9 Dangerous Goods should not be block stowed unless each individual cargo UN Number, rather than simply IMDG Class, is carefully considered for its own unique properties and characteristics.
- 4.2.10 IMDG Class 9 cargoes should be scrutinised with particular care to understand inherent hazards and apply adequate safety and security precautions in stowage planning.

³ The UN Orange Book means the UN Recommendations on the Transport of Dangerous Goods Model Regulations, a guidance document developed by the United Nations to harmonize dangerous goods transport regulations.

⁴ Health, Safety, Security and Environment.

4.3 These Safety Considerations recommend the following measures in relation to stowage of Dangerous Goods declared as subject to IMDG Special Provisions:

- 4.3.1 Self-reacting commodities (including but not limited to Dangerous Goods such as charcoal, fish meal, seed cake, hay, cotton, etc.) which are not subject to the provisions of IMDG through application of a Special Provision should be stowed in an accessible position as far as is practicable.
- 4.3.2 All commodities not subject to the provisions of the IMDG through application of a Special Provision should be stowed in same Risk Zone (see Section 5) as the classified equivalent.

5. SAFETY CONSIDERATIONS FOR RISK-BASED STOWAGE OF DANGEROUS GOODS

There is a zero-risk tolerance when dealing with Dangerous Goods. Safety of life is the paramount objective for the maritime industry.

In order to be effective, Safety Considerations and related Risk Management should be:

- a. **Theoretically sound based on the stowage strategies identified by goal-based criteria and functional requirements. An example can be found in Appendix A of this document.**
- b. **Practical and pragmatic.**
- c. **Ensuring as far as possible the safety of people on board.**
- d. **In compliance with the standards of ISO 9001:2015, ISO 14001, ISO 45001 and ISO 22301.**

5.1 Ship operators' Own Risk-Based Stowage of Dangerous Goods on Containerships

The Safety Considerations set out in Appendix A may be evaluated alongside the strategies and measures that ship operators already have in place relating to their own risk-based stowage of Dangerous Goods and higher risk cargoes on board the ships they operate, taking into account the recommendations set out on Section 4 of these Safety Considerations.

5.2 CINS Working Group Risk-Based Model for Stowage of Dangerous Goods on Containerships – Version 1.00

Ship operators may also take into account the provisions of the CINS Working Group Risk-Based Model set out in Appendix B⁵.

The model provides guidance for the stowage of individual classes and groups of commodities to enhance the safe stowage of Dangerous Goods, subject to the technical design and characteristics of any given ship.

For these purposes, Dangerous Goods as classified by IMDG are categorised into “Dangerous Goods Risk Zones” as set out in Table 1.

Dangerous Goods, including those which are not subject to the provisions of IMDG through application of a Special Provision, have been allocated in this model to one of six Risk Zones (RZ). This is done on the basis of class, subsidiary hazards, packing groups and other properties such as the ability to evolve toxic vapours. Where IMDG requires on deck stowage only, the zone number has been adjusted accordingly.

It should be noted that the model does not provide details of vertical or athwartships stowage and segregation of Dangerous Goods. It is intended that such elements will be developed and published.

⁵ This Model has been developed collaboratively by a CINS Working Group.

Ship operators may develop suitable ship-specific Risk Zone configurations for the ships they are operating. Appendix B provides example ship configurations showing the application of the stowage strategies.

When considering the allocation of Dangerous Goods to one of the six Risk Zones:

- Each individual cargo UN Number is to be carefully considered for its own unique properties and characteristics taking into account the requirements of IMDG.
- IMDG Class 4.3 which is not permitted in RZ2 is included in RZ4.
- RZ5 is primarily intended for IMDG Class 1 cargo; where none is carried, RZ5 can be used for stowage of other Dangerous Goods.
- Any item can be put into a higher-numbered Risk Zone, with the exception of IMDG Class 6.2 and 7 which remain in RZ1 if permitted under deck and in RZ3 if not. For example, if a specific ship has limited capacity in RZ4, Dangerous Goods can be stowed in RZ5 if no IMDG Class 1 is carried.
- Items in limited or excepted quantities do not require segregation from other Dangerous Goods but will remain in their allocated zone.
- Containers having a mix of Dangerous Goods of various Risk Zones should be in the highest-numbered of those Zones, except that a mix of RZ2 and RZ3 should be in RZ4.
- General cargo not classified and declared as subject to IMDG may be stowed in any Risk Zone.

	Description	IMDG Code Classification														Non-Dangerous Goods		
		1	2.1	2.2	2.3	3	4.1	4.2	4.3	5.1	5.2	6.1	6.2	7	8		9	
RZ0	General cargo not subject to the IMDG Code																	X ⁰
RZ1	IMDG Code cargo which should be effectively extinguished with CO ₂ . Taking consideration of the fire and spillage schedules.			X ¹³									X ⁸	X ⁸	X ¹	X ²		X ⁰
RZ2	As RZ1, but Class 4.3 if IMDG Code permits under deck without mechanical ventilation. IMDG Code cargo which should be effectively extinguished with CO ₂ . Taking consideration of the fire and spillage schedules.		X ¹⁰			X ¹¹	X ¹²		X ³				X ¹¹			X ¹	X ²	X ⁰
RZ3	Slow reacting cargo. IMDG Code cargo which should be effectively extinguished with water. Taking consideration of the fire and spillage schedules for class 8 and class 9.	X ⁴		X		X ⁵	X ⁶	X ⁶						X ⁹	X ⁹	X	X ⁷	X ⁰
RZ4	Flammables, oxidizing, and toxic cargo		X		X	X	X	X	X	X	X	X				X	X	X ⁰
RZ5	Explosives	X																X ⁰

Table 1. Risk Zone based on general IMDG Classes⁶
 “X” indicates the assignment of Risk Zone along with IMDG Dangerous Goods classification

⁶ IMDG Code requirements have been considered in the definition of these Risk Zones.

Table 1 Footnotes

0. Dangerous Goods exempt under IMDG section 3.4 (Limited Quantities), section 3.5 (Excepted Quantities), Dangerous Goods not subject to IMDG through application of a Special Provision and empty uncleaned items that may contain the residue of Dangerous Goods should **not** be stowed in RZ0. These Dangerous Goods should be stowed in the same Risk Zone as their fully classified equivalents.
1. IMDG Class 8 except where there is a subsidiary hazard or risk of toxic or corrosive vapours, gases or dust.
2. IMDG Class 9 except where there is a risk of fire or flammable, toxic, corrosive vapours, gases, dust, or mass detonation.
3. IMDG Class 4.3 if under deck stowage without mechanical ventilation is permitted.
4. IMDG Class 1 Division 1.4 except fireworks.
5. IMDG Class 3 packing group III only.
6. Dangerous Goods that are shipped as exempted under IMDG Special Provisions such as charcoal, cotton, fish meal, seed cake and hay, etc. These Special Provisions commodities should be stowed only in accessible positions in the midship part of the ship.
7. IMDG Class 9 except polymeric beads and ammonium nitrate.
8. IMDG Classes 6.2 or 7 if permitted under deck.
9. IMDG Classes 6.2 or 7 if not permitted under deck.
10. IMDG Class 2.1 may be stowed in RZ2 if the capacity in RZ4 on a specific ship is limited. Such stowage should be subject to the general safety considerations set out in Section 4 of this document.
11. IMDG Classes 3 or 6.1 may be stowed in RZ2 if the capacity in RZ4 on a specific ship is limited. Such stowage should be subject to the general safety considerations set out in Section 4 of this document and exclude Dangerous Goods which have an oxidizing sub-hazard or produce highly toxic gas in the event of a fire.
12. IMDG Class 4.1 may be stowed in RZ2 if the capacity in RZ4 on a specific ship is limited. Such stowage should be subject to the general safety considerations set out in Section 4 of this document and exclude solid desensitized explosives.
13. IMDG Class 2.2 may be stowed in RZ1 if the capacity in RZ3 on a specific ship is limited. Such stowage should be subject to the general safety considerations set out in Section 4 of this document and exclude Dangerous Goods which have an oxidizing sub-hazard in the event of a fire.

APPENDIX A - GOALS, FUNCTIONAL REQUIREMENTS AND STRATEGIES

Dangerous Goods carried on containerships shall be stowed safely. Based on this overall goal, six sub-goals are defined. Functional requirements to meet each of the six sub-goals are identified. In addition, risk-based stowage strategies are presented to satisfy the criteria provided by the functional requirements.

The following subsections described the sub-goals, the associated functional requirements and the risk-based stowage strategies.

A.1 Protect Lives

A.1.1 Functional Requirements

A fire or spillage from cargo packed in a container stowed near the accommodation and machinery spaces could impact the accommodation due to fire, explosion and/or toxic hazards. Therefore, the following functional requirements are identified to protect lives:

- Reduce the risk of exposure to crew.
- Reduce the risk of isolation of crew on ships due to obstructed means of escape.
- Reduce the risk of fire, explosion and/or toxic hazards affecting the life-saving appliances.
- Provide safe distance and additional time for emergency response.

A.1.2 Stowage Strategies

To satisfy the functional requirements, the following risk-based stowage strategies should be considered:

- Prohibit any Dangerous Goods adjacent to accommodations.
- Stow explosives furthest from accommodation and segregated from other Dangerous Goods.
- Introduce general cargo, RZ0, athwartships barriers between adjacent Risk Zones along the length of the ship.

A.2 Retain Main Propulsion

A.2.1 Functional Requirements

A fire event from a container stowed close to the engine room may lead to a loss of main propulsion. The propulsion loss may subsequently result in contact, collision and/or grounding of the containership. To minimise the damage to the engine, the following functional requirements are identified:

- Reduce the risk of cargo fire or explosion exposure to the engine room.

A.2.2 Stowage Strategies

To reduce the cargo fire exposure to the engine, the following risk-based stowage strategies should be considered:

- Prohibit any Dangerous Goods and higher risk cargoes adjacent to the engine room and settling tanks.
- Prohibit any Dangerous Goods and higher risk cargoes in cargo holds above the engine room or shaft tunnel area.
- Introduce general cargo, RZ0, athwartships barriers between adjacent Risk Zones along the length of the ship.

A.3 Retain Structural Integrity

A.3.1 Functional Requirements

Thermal loads from a fire from a Dangerous Goods container will increase the temperature of exposed structural members near the fire via radiation, convection and/or conduction.

These structural members may experience degradation in both strength and stiffness as a function of exposure time due to the elevated temperature. The degradation of individual structures can then result in either a local or global failure.

Fires at the midship part of the ship and/or below deck have higher risk than other locations and have the potential to cause a structural failure with potential loss of life or significant environmental impact. Also, fires at the midship part of the ship have the potential to escalate and spread into other areas rapidly. Therefore, the following functional requirements are identified:

- Avoid fires which result in structural damage especially in the midship part of the ship which is particularly vulnerable.
- Avoid fires below deck.
- Avoid potentially large fires escalating from block stowage of Dangerous Goods.

A.3.2 Stowage Strategies

To avoid midship structural fire damage which has the highest potential risk to structural integrity, the following risk-based stowage strategies should be considered:

- Avoid escalating fires by considering fire-prone Dangerous Goods and higher risk cargoes.
- Block stowage within a Risk Zone should be avoided as far as is reasonably practicable in order to minimise severity of a fire event from escalation.

To avoid fires below deck, the following risk-based stowage strategy should be considered:

- Avoid fire-prone Dangerous Goods and higher risk cargoes under deck that cannot be extinguished by CO₂.

A.4 Facilitate Fire Prevention

A.4.1 Functional Requirements

The objective of fire prevention is to implement proactive measures to reduce the likelihood of a fire involving Dangerous Goods and higher risk cargoes. While there are many proactive measures to prevent a fire (e.g. training, ventilation, etc.), the focus is on how the Dangerous Goods and higher risk cargoes should be assigned stowage locations to minimise the potential for a fire.

Segregation/separation for thermally reactive substances has been identified as not being adequately covered by IMDG with the potential to result in fire or explosion event. Some Dangerous Goods and higher risk cargoes are water-reactive and will ignite when they are in contact with water. Also, it is necessary to prevent stowage of Dangerous Goods and higher risk cargoes close to an ignition source.

The following functional requirements are identified:

- Reduce risk of ignition by avoiding exposure to heat (i.e. direct sunlight or heated fuel tank, etc.).
- Reduce fire risk from contact with water.
- Reduce ignition risk from exposure to other fire-prone cargo.
- Avoid potentially large fires escalated from block stowage of Dangerous Goods and higher risk cargoes.

A.4.2 Stowage Strategies

To avoid exposure to heat, the following risk-based stowage strategies should be considered:

- No Dangerous Goods on deck without being protected from direct sunlight subject to specific voyage and/or commodity requirements.
- No Dangerous Goods in outermost rows on deck.
- No Dangerous Goods in most forward bay (above the height of the breakwater) or in aft most bay on deck. In case of a ship design without a breakwater, an artificial breakwater should be arranged by use of general cargo containers.
- No Dangerous Goods and higher risk cargoes next to or on top of heated fuel tanks.
- Avoid block stowage of Dangerous Goods within a Risk Zone in order to prevent rapid fire escalation caused by large volumes of flammable/combustible commodities.

To reduce risk of fire from contact of Dangerous Goods with water, the following risk-based stowage strategies should be considered:

- No Dangerous Goods and higher risk cargoes in bottom tiers in hold.
- Dangerous Goods which cannot be extinguished by water should be stowed under deck subject to careful consideration of each individual cargo UN Number, rather than simply IMDG Class, for its own unique properties and characteristics.

To reduce ignition risk by exposure to other fire-prone Dangerous Goods and higher risk cargoes, the following risk-based stowage strategies should be considered:

- Segregate fire-prone Dangerous Goods and higher risk cargoes from known ignition sources.
- Introduce general cargo, RZO, athwartships barriers between adjacent Risk Zones along the length of the ship.
- Stow explosives furthest away from accommodation and primary life-saving appliances and segregated from other Dangerous Goods and higher risk cargoes.

To avoid risk of rapid fire escalation, the following risk-based stowage strategies should be considered:

- Block stowage within a Risk Zone should be avoided as far as is reasonably practicable.

A.5 Facilitate Fire-fighting

A.5.1 Functional Requirements

Self-reacting commodities are a common cause of fires onboard containerships. These fires are slow-burning and can be extinguished promptly if in accessible position. Also, the compatibility of firefighting media with the Dangerous Goods and higher risk cargoes is a key aspect to consider within the stowage strategy. The use of incompatible fire-fighting media could result in an exacerbated or uncontrolled fire/explosion event. In addition, in order to avoid rapid fire escalation caused by large volumes of flammable/combustible commodities, block stowage of Dangerous Goods and higher risk cargoes within a Risk Zone should be avoided. Similarly, Dangerous Goods should not be stowed near heated fuel tanks. Therefore, the following functional requirements are identified:

- Stow higher risk cargoes and self-reacting commodities appropriately to reduce the risk of a smoldering fire escalating into a severe fire.
- Avoid the risk of a non-extinguishable fire in a hold (e.g., IMDG Class 5.1 and certain IMDG Class 9).

- Avoid potentially large fires escalating from block stowage of Dangerous Goods and higher risk cargoes.

A.5.2 Stowage Strategies

To stow higher risk cargoes and self-reacting commodities appropriately to reduce the risk of a smoldering fire escalating into a severe fire, the following risk-based stowage strategies should be considered:

- Higher risk cargoes and self-reacting commodities (including exempt Dangerous Goods charcoal, fish meal, seed cake, cotton, hay, etc.) should be stowed in accessible positions, preferably visible to crew, and separated from fast-reacting commodities.

To avoid the risk of a non-extinguishable fire in hold, the following risk-based stowage strategies should be considered:

- Stow Dangerous Goods and higher risk cargoes which cannot be extinguished by CO₂ on deck.

To avoid risk of rapid fire escalation, the following risk-based stowage strategies should be considered:

- Block stowage within a Risk Zone should be avoided as far as is reasonably practicable.
- No Dangerous Goods and higher risk cargoes should be stowed next to or on top of a heated fuel tank.

A.6 Facilitate Security

A.6.1 Mis-declared and Undeclared Dangerous Goods

Measures to reduce the occurrence of container fires include having suitable cargo declaration and acceptance procedures to reduce the risk from mis-declared and undeclared Dangerous Goods. A mis-declaration of the Dangerous Goods could involve any aspect of the freight, including the weight, commodity, description, quality and measurements. Undeclared Dangerous Goods can occur when hazardous materials are placed within a cargo transport unit with no markings to indicate the presence of Dangerous Goods, and when required documents fail to declare the presence of Dangerous Goods or are missing altogether. Such mis-declaration may be fraudulent.

A.6.2 High Consequence Dangerous Goods

Chapter 1.4 of IMDG addresses the security of Dangerous Goods during transport by sea. National competent authorities may apply additional security provisions, which should be considered when offering or transporting Dangerous Goods. Although the provisions of the chapter remain recommendatory (except 1.4.1.1 referring to the mandatory ISPS Code⁷), the general security provisions of 1.4.1 with respect to possible transport of high consequence Dangerous Goods which have the potential for misuse in a terrorist event and which may, as a result, produce serious consequences, may need to be considered. The stowage position of such Dangerous Cargoes must comply with IMDG and national competent authority requirements.

A.6.3 Maritime Law

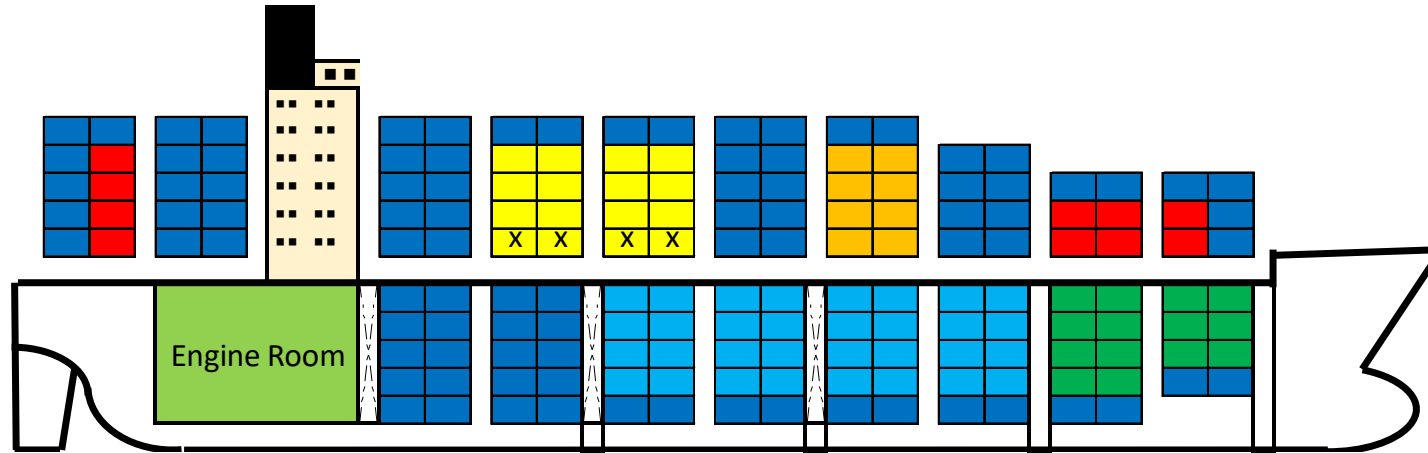
Responsibilities of ship operators in connection with the ISPS Code and the carriage of Dangerous Goods should be considered in accordance with section 4 of the IMO Guide to Maritime Security and the ISPS Code.

⁷ The International Ship and Port Facility Security Code (ISPS Code), in force under SOLAS, Chapter XI-2.

Further Information

1. ABS. *Guidance Notes on Risk Assessment Application for the Marine and Offshore Oil and Gas Industries*. June 2000. Houston, TX.
2. IMO. *Guide to Maritime Security and the ISPS Code*. 2012 Edition. London, UK.
3. IMO. *Inspection Programmes for Cargo Transport Units Carrying Dangerous Goods*. MSC.1/Circ. 1442. June 2012. London, UK.
4. IMO. *Consideration of Reports of Incidents Involving Dangerous Goods or Marine Pollutants in Packaged Form on Board Ships or in Port Areas*. CCC 5/INF.2. July 2018. London, UK.

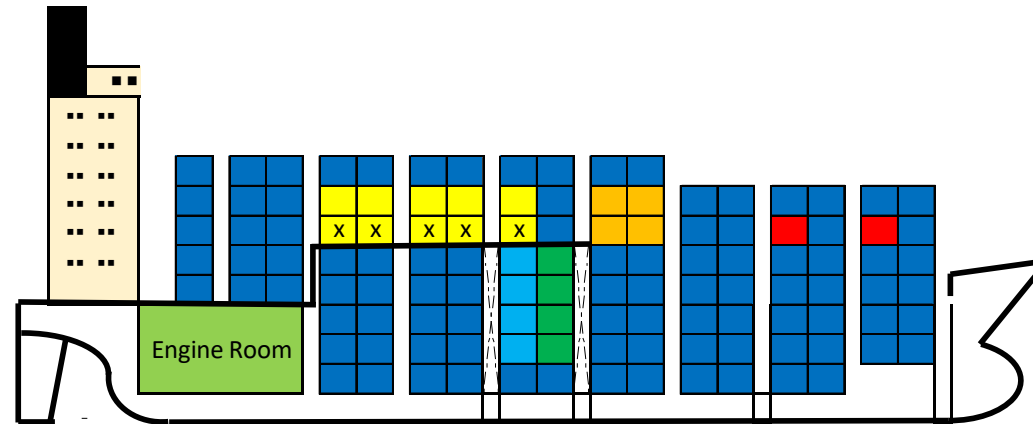
B.3 Feeder Ship with Bays Aft of Accommodation



An artificial breakwater is depicted in this diagram by use of general cargo containers.

RZ0	RZ1	RZ2	RZ3	RZ4	RZ5
General cargo not subject to the IMDG Code	IMDG Code cargo which should be effectively extinguished with CO ₂ . Taking consideration for the fire and spillage schedules.	As RZ1, but Class 4.3 if IMDG Code permits under deck without mechanical ventilation. IMDG Code cargo which should be effectively extinguished with CO ₂ . Taking consideration for the fire and spillage schedules.	Slow reacting cargo. IMDG Code cargo which should be effectively extinguished with water. Taking consideration for the fire and spillage schedules for class 8 and 9. "X" - Special provisions, self reacting cargo	Flammables, oxidizing, and toxic cargo	Explosives

B.4 Feeder Ship with Open Hatch Cargo Hold



An artificial breakwater is depicted in this diagram by use of general cargo containers.

RZ0	RZ1	RZ2	RZ3	RZ4	RZ5
General cargo not subject to the IMDG Code	IMDG Code cargo which should be effectively extinguished with CO ₂ . Taking consideration for the fire and spillage schedules.	As RZ1, but Class 4.3 if IMDG Code permits under deck without mechanical ventilation. IMDG Code cargo which should be effectively extinguished with CO ₂ . Taking consideration for the fire and spillage schedules.	Slow reacting cargo. IMDG Code cargo which should be effectively extinguished with water. Taking consideration for the fire and spillage schedules for class 8 and 9. "X" - Special provisions, self reacting cargo	Flammables, oxidizing, and toxic cargo	Explosives