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EQUIPMENT  
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Agenda item 10

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**DEVELOPMENT OF AMENDMENTS TO SOLAS CHAPTER II-2 AND THE FSS CODE  
CONCERNING DETECTION AND CONTROL OF FIRES IN CARGO HOLDS AND ON  
THE CARGO DECK OF CONTAINERSHIPS**

**Proposal for a road map amending SOLAS Chapter II-2 to address firefighting  
capabilities on board container vessels**

**Submitted by The Bahamas, France, Germany, Marshall Islands,  
Norway, Singapore, BIMCO, IACS and IUMI**

**SUMMARY**

*Executive summary:* This paper outlines a road map to provide a basis for future work on this output and provides an initial assessment of gaps and regulations which are considered neither practicable nor workable for fire detection and firefighting capabilities on board containerships.

*Strategic direction, if applicable:* SD 6 (Ensure regulatory effectiveness)

*Output:* Tbc

*Action to be taken:* Paragraph 5

*Related documents:* MSC 102/21/3, MSC 102/21/7, MSC 102/INF.2, MSC 102/INF.3, MSC 103/21

1 Documents MSC 102/21/3 and MSC 102/21/7 proposed a new output to address the issue of the increasing incidences and severity of fires on containerships. Details on the need for the work were provided in documents MSC 102/INF.2 and MSC 102/INF.3.

2 MSC 103 agreed to include in the biennial agenda of the SSE Sub-Committee for 2022-2023 and the provisional agenda for SSE 8 an output on the "Development of amendments to SOLAS Chapter II-2 and the FSS Code concerning detection and control of fires in cargo holds and on the cargo deck of containerships" (MSC 103/21, paragraphs 18.6 to 18.9).

3 The following is intended to serve as a road map to provide a basis for future work on this output, potentially to be taken forward in a Working or Correspondence Group. Steps 2-4

could be based on the Formal Safety Assessment (FSA) process (MSC-MEPC.2/Circ.12/Rev.2):

1. identify gaps and regulations which are neither practicable nor workable for containerships;
2. perform a quantitative risk analysis;
3. identify risk control options, quantify their impact on risk ( $\Delta R$ ) and determine related costs/benefits ( $\Delta C$  and  $\Delta B$ );
4. perform cost benefit assessment; and
5. develop draft amendments for SOLAS Chapter II-2.

4 Based on existing documentation and accident reports, a high level identification of possible shortcomings in the current regulations developed by a group of experts convened by IUMI is attached in the Annex and may prove useful in above analysis.

#### **Action requested**

5 The Sub-Committee is requested to consider the proposed road map in paragraph 3 together with the gaps and regulations which are considered neither practicable nor workable for containerships as per the annex, as well as the need to establish a Working or Correspondence Group, and to take action as appropriate.

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## ANNEX

### High level identification of possible shortcomings in the current regulations of SOLAS chapter II-2

#### Fire safety objectives and functional requirements

The overall fire safety objectives and functional requirements as set out in Regulation II-2/2.1 and II-2/2.2 are adequate. The general fire safety goals are summarized as high-level objectives under Regulation II-2/2.1. The functional requirements in Regulation II-2/2.2 provide the criteria to be complied with in order to meet the fire safety objectives as set out in Regulation II-2/2.1.

#### Probability of ignition

The purpose of Regulation II-2/4 (“Probability of ignition”) is to prevent the ignition of combustible materials or flammable liquids. Due to the set-up of containers being stacked on top of each other, most of them are out of reach and can neither be accessed nor controlled by crew. The physical inability to reach containers which are stacked up high is a specificity applicable to containerships only. The purpose set out in Regulation II-2/4 cannot currently be implemented appropriately on board containerships because the specificity of cargoes being stowed in containers which may be inaccessible due their height is not currently taken into account.

#### Fire growth potential

In Regulation II-2/5 regarding “Fire growth potential”, the first functional requirement states “a means of control for the air supply to the space shall be provided”. This is further specified in Regulation II-2/5.2.1.1 requiring that “the main inlets and outlets of all ventilation systems shall be capable of being closed from outside the spaces being ventilated. The means of closing shall be easily accessible [...]”. In Regulation II-2/5.2.1.2 it is further stated that power ventilation of cargo spaces shall be capable of being stopped from an easily accessible position outside the space being served.

The example of the MAERSK HONAM, which was built in compliance with current regulations, shows that the ventilator flaps were positioned so that a crew member had to walk on top of the burning cargo hold and on both sides of this cargo hold to manually close the ventilators. Due to the extreme conditions caused by the fire, the port side ventilator flaps could not be closed, rendering the CO<sub>2</sub> firefighting system ineffective.

Excerpts from the YANTIAN EXPRESS accident investigation report show that the hatch covers formed a partially watertight closure at the top of the cargo hold. This approved design is known as a non-weather-tight type hatch cover. Due to the design, a larger gap remains open between the individual lids. The gap on the YANTIAN EXPRESS was ≤ 5 cm. It was further found that the flap of the ventilation opening under the grill was not locked. Access to the flap was not possible because the grill was secured by a chain and a lock.

To implement the functional requirement as outlined under Regulation II-2/5.1.1 on board containerships, consideration must be given to a system which can be applied on board of this ship type effectively.

## **Detection and alarm**

The functional requirement in Regulation II-2/7.1.1 (“Detection and alarm”) states “fixed fire detection and fire alarm system installations shall be suitable for the nature of the space, fire growth potential and potential generation of smoke and gases”. Regulation II-2/7.2.2 states “A fixed fire detection and fire alarm system and a sample extraction smoke detection system required in this regulation and other regulations in this part shall be of an approved type and comply with the Fire Safety Systems Code”.

Fire detection in cargo holds currently works on the same principles as when smoke aspiration systems were first designed around 1918. The principle issue is the lag time:

- a. Smoke production in container
- b. Smoke escaping from container
- c. Smoke being carried into extraction system, and
- d. Smoke travelling through pipe system to detection (prolonged on large and ultra large containerships)

The spread of smoke and detection may also be affected by ambient temperatures and natural air flows in the hold. In the early stages of a fire, the smoke is typically cooler and less buoyant. This as well as natural air flows may further delay transport of smoke to extraction systems. This delay in detection and alarm exacerbates any firefighting measures.

The investigation report of the YANTIAN EXPRESS shows that the fire on board was detected by crew members by eyesight only. Despite the swift notification of the master, chief engineer and chief officer, the flames were already large and clearly visible at this point.

In the MAERSK HONAM and MSC FLAMINIA incidences, the respective officers raised the general alarm rather than the fire alarm. In the case of MAERSK HONAM, this delayed the process of closing of the magnetic fire doors and the accommodation air intake.

The absence of fire detection systems for on-deck cargo as well as the time lag between the fire occurring inside a container and its detection must be addressed for containerships to be in line with the functional requirements set out in Regulations II-2/7.1.1 and II-2/7.2.2.

## **Control of smoke spread**

SOLAS Chapter II-2/8.1 states: “The purpose of this regulation is to control the spread of smoke in order to minimize the hazards from smoke. For this purpose, means for controlling smoke in atriiums, control stations, machinery spaces and concealed spaces shall be provided.”

However, the smoke from the fire in cargo areas often finds its way into accommodation and fire control spaces making it difficult for the crew to use the remote control mechanisms or staying on the bridge as was the case during the MAERSK HONAM incident. This regulation therefore requires revision.

## **Fire fighting**

Under Regulation II-2/10 regarding “Fire fighting” the purpose is to “suppress and swiftly extinguish a fire in the space of origin, except for paragraph1.2.” The latter paragraph states

“For open-top container holds<sup>1</sup> and on deck container stowage areas on ships designed to carry containers on or above the weather deck, constructed on or after 1 January 2016, fire protection arrangements shall be provided for the purpose of containing a fire in the space of origin and cooling adjacent areas to prevent fire spread and structural damage.”

Regulation II-2/10.1.2 which is specifically addressing containerships should be reviewed. The overall purpose as stated under Regulation 10.1.1 (“to suppress and swiftly extinguish a fire in the space of origin” rather than “containing a fire in the space of origin and cooling adjacent areas to prevent fire spread and structural damage”) should be applicable to all ships, including containerships as referred to in Regulation II-2/10.1.2.

In general terms, this regulation requires a thorough revision with regard to the fire-fighting extinguishing systems which must be adjusted to be appropriate for containerships to fight fires on deck and under deck. The limitations of CO<sub>2</sub> must also be addressed. Excerpts from the accident investigation report of the MSC FLAMINIA illustrate the inadequacy of CO<sub>2</sub> in certain situations.

Page 99, paragraph 2:

“Due to its properties, carbon dioxide is used as an extinguishing agent in enclosed cargo areas for inerting purposes. Here, it is only partially suitable for preventing the spread of fire in a cargo area. This is primarily due to the fact that the actual source of the fire [in a container] is not directly accessible and only open flames outside the containment will be extinguished. Due to the low cooling capacity of CO<sub>2</sub>, the thermal energy is not removed from the immediate vicinity of the fire. Pockets of embers remain intact.

Hence, the use of this extinguishing agent brings about a status quo that has to be maintained for a relatively long period until the temperatures in the immediate area of the fire have dropped to values below ignition temperature. If it cannot be ensured that the effective concentration of extinguishing agent is maintained, then the fire flares up again.”

Page 105, paragraph 1:

“The absence of typical fire parameters should have been [...] evaluated and interpreted more accurately. Specifically, extensive cooling should have been carried out early on to prevent the threat of the pyrolysis or [the] hydrogen gases from igniting and/or to energetically interrupt chemical reactions. This was complicated by the ship's equipment [...] in that no drencher system was installed in the cargo hold.”

These excerpts from the accident investigation report of MSC FLAMINIA indicate further inadequacies of Regulation II-2/10 as applicable to containerships:

Page 115, paragraph 2:

In the course of the investigation, it was not possible to clarify whether the discharge of CO<sub>2</sub> or actually its delayed use adversely affected the situation in cargo hold 4 and/or facilitated the explosion. Since no other extinguishing agent was provided for, there were no alternatives to CO<sub>2</sub> for the crew to use.

Page 119, Safety recommendations, 4.2:

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<sup>1</sup> Reference is made to the *Interim guidelines for open-top containerships* (MSC/Circ.608/Rev.1)

4.2 The Federal Bureau of Maritime Casualty Investigation recommends that the Federal Ministry of Transport and Digital Infrastructure campaigns within the International Maritime Organization (IMO) for a further development of the SOLAS-Convention, in order to improve the technical requirements for the fire-fighting equipment on container vessels. At least the cargo holds intended for the carriage of dangerous goods should be equipped such that they contain the possibility to use water as an extinguishing agent or for cooling via a permanently installed system as well.

An additional factor raised in many accident investigation reports pointed toward the decision making during the crucial time leading up to and during the fire incident. The decision to send crew members to fight a fire in the cargo hold, to abandon ship, etc. is a gap not sufficiently covered in current regulations. In the case of the MSC FLAMINIA, a fire drill was conducted only few hours prior to the actual fire, yet the ship lost three lives.

### **Fire-extinguishing arrangements in cargo spaces**

The rules on “Fire-extinguishing arrangements in cargo spaces” as stated in Regulation II-2/10.7.3 which look at “Firefighting for ships constructed on or after 1 January 2016 designed to carry containers on or above the weather deck” require amendments to address the specific nature of containerships carrying cargo on and under deck. Based on existing documentation and accident reports as well as feedback from various experts, the current rules are inadequate to effectively fight a fire on deck or under deck. The water mist lances as required under Regulation II-2/10.7.3.1 do not suffice.

The impossibility to effectively reach containers which have caught fire is evident in the fire on board the MSC FLAMINIA. Crew members tried to approach the burning cargo hold using hand-held firefighting equipment such as fire hoses. They were trying to set up a boundary cooling of the cargo hold by accessing the walkway between the cargo holds. At this point, a loud explosion occurred which resulted in several containers being thrown overboard and several others blocking the side walkways of the ship. This was also a crucial reason for the loss of lives.

The example of the MSC FLAMINIA illustrates that when a fire grows out of a certain proportion, crew members should not attempt to fight it using portable equipment but only fight it from a safe distance and place.

The need for an adequate fire protection system is also stated in Regulation II-2/19.1.1: “fire protection systems shall be provided to protect the ship from the added fire hazards associated with carriage of dangerous goods.” Regulation 19.3.1.1. related to the “Carriage of dangerous goods” further requires that “arrangements shall be made to ensure immediate availability of a supply of water from the fire main at the required pressure [...] by suitably placed remote arrangements for the fire pumps”.

Regulations II-2/19.3.1.1 to 19.3.1.5 set out the requirements for water supplies on board containerships which carry dangerous goods on deck and under deck.

The following excerpts from the YANTIAN EXPRESS accident investigation report demonstrate the gaps and the necessity to update Regulation II-2/10 to appropriately address firefighting measures on board containerships:

Page 33, paragraph 1:

The ship was not equipped with water based firefighting installations or -systems in the transverse corridors respectively at the lashing bridges that could have been easily activated in the event of a fire on the deck to prevent or delay it spreading to adjacent sections of the deck by means of hydro shields or firefighting monitors.

Page 72, Safety recommendation 7.1:

The Federal Bureau of Maritime Casualty Investigation recommends that the shipping company, Hapag-Lloyd, enter the drencher system for the transverse bulkheads in some of the cargo holds on the YANTIAN EXPRESS in the fire and safety plan, even if there is no requirement to enter this part of the equipment. This entry should also be made for other ships belonging to the shipping company with a similar installation.

### **Dangerous goods**

Regulation II-2/19.3.3 addresses detection systems in relation to the carriage of dangerous goods. For improved loss prevention and to avoid fires on board containerships due to dangerous goods, mitigation measures to better address mis-declaration and non-declaration should be addressed in this section.