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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

## Technical evaluation of the CARGOSAFE FSA study

**Submitted by IACS**

**SUMMARY**

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| *Executive summary:* | This document provides information on the technical evaluation of the CARGOSAFE FSA study, performed by IACS, and IACS' initial deliberations on the risk mitigating measures proposed therein. |
| *Strategic direction, if applicable:* | 7 |
| *Output:* | 7.15 |
| *Action to be taken:* | Paragraph 0 |
| *Related documents:* | MSC 103/21; SSE 8/20, SSE 8/10/3; MSC 107/10 and SSE 10/10 |


## Introduction

1 The Maritime Safety Committee, at its 103rd session, agreed to include in the biennial agenda of the SSE Sub-Committee a new 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, paragraph 18.8).

2 SSE 8 agreed to a roadmap for the work, noting the information in document SSE 8/10/3 (Germany et al.) that the CARGOSAFE FSA study report commissioned by EMSA would become available in the beginning of 2023. Accordingly, SSE 8 agreed to postpone the discussions on the new output and to consider documents to be submitted in conjunction with the FSA study's outcomes at a future session (SSE 8/20, paragraph 10.5).

3 The CARGOSAFE FSA study report has been submitted to MSC 107 (MSC 107/10) and subsequently forwarded for review to the Formal Safety Assessment Experts Group, which met from 23 to 26 October 2023 (SSE 10/10 (Chair of the FSA Experts Group)).

**Discussion**

4 The CARGOSAFE FSA study is structured in accordance with the Revised FSA Guidelines (MSC-MEPC.2/Circ.12/Rev.2) and summarizes for each step of the FSA process applied methodology, additional investigations (e.g. statistical analysis), developed quantitative risk model (including data for quantification), identification of risk mitigating measures, cost-benefit assessment of risk control options; and closes with recommendations.

5 In the CARGOSAFE FSA study report, 72 risk control measures are described for the areas of prevention, detection, fire-fighting and containment of fire. The detailed analysis of the effectiveness and cost effectiveness was performed on the basis of 19 risk control options (RCOs) which consider 39 of these measures.

6 IACS is of the view that the entire CARGOSAFE FSA study should be considered as an important element of the upcoming discussion of the Sub-Committee on how to address cargo fire risk of containerships, because the study provides not only recommendations but also detailed information on the issue, e.g. the current risk level, potential risk mitigating measures and the cost effectiveness with respect to the IMO-agreed criteria.

7 In view of fostering the upcoming discussion at SSE 10 and considering the proven division of tasks between the Sub-Committee and the FSA Experts Group in verifying compliance with respect to IMO's investigation requirements, IACS performed an initial technical evaluation of the risk mitigating measures considered by the CARGOSAFE FSA study. This evaluation focused on aspects like feasibility in marine environment, expected effectiveness, how to address the measures in IMO's regulatory framework, and considered also additional measures. All risk mitigating measures of the CARGOSAFE FSA study were considered in IACS' evaluation.

**Results of the technical evaluation**

8 The outcome of IACS' technical evaluation is provided in the annex. Some of the key considerations relate to:

.1 the impact on crew regarding possible additional workload and potential new hazards related to new fire-fighting systems and equipment;

.2 improvement of training and drills with respect to fire-fighting (new and existing means), taking into account ship size;

.3 review of the IMDG Code regarding quantity limitations, stowage location and testing; and

.4 improved performance standards for detection and fire-fighting systems/equipment better reflecting the state-of-the-art.

**Action requested of the Sub-Committee**

9 The Sub-Committee is invited to consider the above and take action, as appropriate.

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**ANNEX**

**CONSIDERATIONS BY IACS IN ITS TECHNICAL EVALUATION OF THE CARGOSAFE FSA STUDY**

## 1 Introduction

IACS members' experts have performed a technical evaluation of the risk mitigating measures provided in the CARGOSAFE FSA study of 17 March 2023 and related annexes. This evaluation focused on aspects like feasibility (on board, integration in transport process), additional aspects to be considered for investigated risk mitigating measures, and additional/improved risk mitigating measures. This evaluation performed by IACS experts was a general review of the risk mitigating measures and, as such, experts were not tasked to put emphasis on dedicated aspects or exclude such aspects.

## 2 Method of work

The evaluation considered risk control measures, risk control options (considered in CBA[1]) and effectiveness of RCOs[2] (basis for CBA). In the CARGOSAFE FSA study, risk mitigating measures are grouped according to the following four categories:

.1 prevention;

.2 detection;

.3 fire-fighting; and

.4 containment.

## 3 Findings

The evaluation findings are assigned to the following categories:

.1 general findings; and

.2 RCO/RCM related findings.

### 3.1 General findings

3.1.1 Based on the review of all 19 RCOs:

.1 All safety systems and equipment need to be "fit for the marine environment". Main aspects to be considered are humidity, rain, wind, sea water, vibrations, accelerations, ship movement. In addition, high/low temperatures and icing need to be considered (this may be regarded insignificant but nevertheless it is highlighted).

.2 It should be verified whether new hazards arise when introducing risk mitigating measures and, if so, these new risks are adequately addressed (mitigated).

1 CBA: Cost-Benefit Assessment.

2 RCO: Risk Control Option.

.3 Potentially, some of the RCMs/RCOs include crew activities on board. This additional workload needs to be carefully evaluated including the need for additional crew.

3.1.2 These general findings should not be regarded as obstacles but as an aspect to be duly considered when developing amendments to the IMO regulatory framework:

.1 several RCMs/RCOs consider new or improved means for detection, fire-fighting, etc. Effectiveness of such means rely also on human factor, i.e. the best equipment is not effective if not adequately used;

.1 it is recommended to consider the following in the Sub-Committee discussions:

.1 a review of the current requirements for training and drills (STCW, SOLAS) with respect to adequacy for current containership designs, e.g. large containerships. For instance, including drills on the usage of a water mist lance (performing penetration of container) and the correct use of a $CO_2$ system, which may require HTW Sub-Committee's input;

.2 the study explains (CARGOSAFE, figure 19) that dangerous goods (declared) can be a relevant ignition source:

.1 regarding prevention, it is recommended to verify whether the IMDG Code, as referred to by SOLAS regulation II-2/19, needs improvements with respect to:

.1 quantity limits of dangerous goods (thresholds for declaration);

.2 stowage location of class 5.1 cargo;

.3 segregation requirements of Part 7 of the IMDG Code; and

.4 test methods for self-heating cargo,

which may require CCC Sub-Committee's input; and

.3 provide to the master detailed information on declared dangerous goods and position on board, including excepted and exempted quantities.

### 3.2 RCO/RCM related findings

IACS' evaluation of the feasibility of the RCO/RCMs investigated in the CARGOSAFE FSA study resulted in initial considerations on 11 of the 19 RCOs that are summarized below. For the time being, no findings are reported for the remaining RCOs. The IACS considerations listed below highlight some aspects that should be considered in the final evaluation of the risk mitigating measures and subsequent development of amendments to the IMO regulatory framework.

3.2.1 Container screening tool (P1) [3]

It is noted that concerns exist regarding the implementation:

.1 Integration in the cargo handling process: screening of containers by X-ray during loading is anticipated to have a negative impact on the loading efficiency, i.e. leading to an increase in loading times. Therefore, such screening needs to be done when containers enter terminals via a truck, train or smaller inland ships. It is questionable if all container terminals can provide sufficient capacity for a seamless screening procedure.

.2 Enforcement of onshore installation, worldwide in all harbour handling containers.

.3 Terminal equipment and procedures would be outside the remit of the IMO's regulatory framework.

3.2.2 Improved control of lashing (P4)

This RCO seems to have been suggested based on two casualties in 2013 and 2021 where overturned containers (stack collapse) damaged the cargo inside, subsequently leading to the fire. It is noted that when a container stack collapse is linked to a loss of dynamic stability, even a new and perfectly installed lashing gear is not able to withstand the forces generated in a parametric or synchronous roll event. Therefore, the relevance is not considered to be sufficiently justified.

3.2.3 Optimizing current smoke detection system (D1)

It is noted that modern sensors are available (for instance used on ro-ro ships) which allow detection of gases released in the beginning of a fire. It is expected that these gases are detected much earlier than smoke. Such sensors may be used in the existing smoke extraction system (reduce costs, adequate for retrofitting).

3.2.4 Heat detection looking at individual container temperature rise (D2)

It could be considered to install temperature sensors only on containers with class 4.1 and class 4.2 cargo. Focusing only on containers with declared cargo would limit the risk reduction, but also the costs. An efficient use of the sensors would require wireless transmission.

3.2.5 Portable IR (D5)

The effectiveness of this measure would depend on the frequency of fire patrol. It is expected that a positive impact on the detection time could only be achieved with a high frequency of fire patrols, which would imply additional workload (see section 3.1). Portable IR equipment is expected to be useful for locating the container after a fire has been detected by the fire alarm, e.g. below deck after fire alarm, and by this foster targeted fire-fighting measures.

3.2.6 Increasing effectiveness of current $CO_2$ system (F1)

As time is crucial, the efficiency of the sealing of the cargo hold could be considered, e.g. by quick closing devices, or more technically challenging, remotely controlled natural ventilation openings for each cargo hold. It is noted that the effectiveness of $CO_2$ systems

[3] RCO reference numbers in accordance with CARGOSAFE report (17/03/2023).

depends on the availability and adequate use. In section 3.1, it is recommended to review current training requirements. The following means to improve the effectiveness of $CO_2$ systems could be considered:

.1 improved training:

.1 avoid deficient/no release;

.2 insufficient release, i.e. the amount of $CO_2$ not adequate for the relevant hold;

.3 accidental/wrong release (hold not sealed, wrong hold);

.4 avoid wastage by insufficient sealing of hold; and

.5 avoid delay in decision for release;

.2 improved inspection/maintenance (improve availability); and

.3 provide equipment to measure $CO_2$ concentration in hold.

3.2.7 Improved manual firefighting tools for individual container breaching and firefighting (F2)

The effectiveness of a water mist lance depends, among others, on the position of the containers within the respective container stack in hold or on deck. Further, the distribution of the water mist in the container and, hence, the effectiveness of fire-fighting may be limited by the cargo in the container, e.g. cargo may act as a barrier subdividing the container into separated compartments. The following aspects may be considered to improve the effectiveness of water mist lance:

.1 clear marking of the location for penetrating the container;

.2 require drill (penetration) including various scenarios; and

.3 improve the performance of the equipment (see document SSE 8/10/2 (Denmark)).

3.2.8 Manual fire-fighting tools that increase reach (F3)

According to IACS' knowledge, new fire-fighting equipment provides much better performance than the equipment prescribed in the IMO's regulatory framework. Accordingly, the effectiveness of required fire-fighting equipment could be increased by considering improved performance requirements for various manual fire-fighting equipment.

3.2.9 Active protection (e.g. sprinklers) underneath hatch covers to protect from fire spread towards the deck (C1)

Cooling is a very effective way to contain a fire and may provide a barrier for a longer time than passive protection by insulation (e.g. "A-60"). Active protection is regarded as more feasible than passive protection by insulation. However, to maximise the effectiveness it should be combined with cooling of the bulkheads separating the holds (transversal bulkheads, "A-0") to reduce the probability of a fire spreading to the adjacent holds.

3.2.10 Passive protection to protect from fire spread towards the deck (C2)

The feasibility of this means should be considered in detail, including the impact on inspection/maintenance procedures, and the risk of damage to insulation during normal operation.

3.2.11 Flooding cargo hold to a limited degree (to a limited height) (C4)

This measure is only applicable if class 4.3 cargo is not allowed below deck/in this hold. For this RCO it is crucial to consider the following:

.1 ship stability and global hull girder strength (the ability of the hull structure to resist the total longitudinal bending moment and shear force) needs to be carefully considered for an actual fire incident and environment;

.2 water level detection and control in hold, among others, for monitoring the functionality of drainage arrangements, e.g. identify blockage by debris (see casualty report of **MSC Flaminia**, 2012); and

.3 excess water ingress into a hold from additional external fire-fighting activities, for instance, by fire-fighting tugs (see casualty report of **Hanjin Green Earth**, 2015).