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## AMENDMENTS TO THE IMSBC CODE AND SUPPLEMENTS

### Fumigation-related casualties

**Submitted by Bahamas, Indonesia, Kingdom of Saudi Arabia, United Kingdom, IMarEST, InterManager, International Bulk Terminals Association, International Transport Workers' Federation and The Nautical Institute**

#### SUMMARY

*Executive summary:* This document invites the Sub-Committee to note and consider the lessons learned from fumigation-related casualties and the recommendations for a further holistic review of the *Recommendations on the safe use of pesticides in ships applicable to the fumigation of cargo holds* (MSC.1/Circ.1264).

*Strategic direction, if applicable:* 6 and 7

*Output:* Not applicable

*Action to be taken:* Paragraph 23

*Related documents:* MSC 110/3/1; MSC.1/Circ.1264; MSC 107/17/1, MSC 107/17/30; CCC 10/5, CCC 10/5/9 and CCC 11/5

#### Introduction

1 This document invites the Sub-Committee to note and consider the lessons learned from fumigation-related casualties and the recommendations for a further holistic review of the *Recommendations on the safe use of pesticides in ships applicable to the fumigation of cargo holds* (MSC.1/Circ.1264).

#### Background

2 In 2020, the Bahamas registered cargo vessel, **Fri Dolphin**, suffered a very serious marine casualty. Phosphine entered the accommodation during shipboard fumigation of cargo. The phosphine exposure resulted in the death of one of the crew and hospitalization of three more. Review of casualty information available at the time identified that this was not an isolated event.

3 The resultant marine safety investigation identified that the periodic monitoring of the atmosphere within the accommodation was not an effective risk control measure. In this casualty, and others, the time between the toxic fumigant entering the accommodation to the death of crew was far less than the eight hourly cycle of periodic testing that MSC.1/Circ.1264 recommends.

4 A proposal was made by the Bahamas to the Editorial & Technical Group of the Sub-Committee on the Carriage of Cargoes and Containers (E&T 36/3/13). The proposal included a recommendation for continuous gas monitoring on board ships carrying fumigated cargoes. The proposal was not adopted on the basis that there was a need for further information and analysis. The Group invited interested Member States to submit a proposal for a new output to the Maritime Safety Committee.

5 MSC 107/17/1 (Luxembourg and the Kingdom of the Netherlands) proposed a new output to amend MSC.1/Circ.1264. This was taken forward by MSC 107 (MSC 107/20, paragraphs 17.8 to 17.10) which instructed CCC 9 to consider this proposal under the existing agenda item on "Amendments to the IMSBC Code and supplements". This resulted in draft revised Recommendations on the safe use of pesticides in ships applicable to the fumigation of cargo holds (CCC 10/5, annex 2).

6 China's comment on document CCC 10/5/9 highlighted that the revised Recommendations do not take into account wider lessons to be learned from casualties. The Sub-Committee, however, found that further revision was beyond the scope of the output and invited interested Member States and international organizations to submit a proposal to the MSC for a new output. The co-sponsors support China's position and invite consideration of lessons which need to be learned from fumigation-related casualties.

## Need

7 At least 46 seafarers and shore workers have lost their lives after being exposed to hazards associated with the fumigation of cargo holds since MSC.1/Circ.1264 ('the Recommendations' hereafter) was drafted in 2008.

8 There have been at least three deaths due to fire or explosion and several deaths associated with oxygen depletion but the predominant cause of death is exposure to fumigant gas. This includes at least 25 seafarers that have died when fumigant entered the accommodation during the voyage.

Year	Vessel	Flag	Summary	Lives lost	Ref.
2008	Not disclosed	Romania	Fumigant ingress to accommodation through ventilation system. One fatality, several crew taken ill.	1	<a href="#">Journal of Occupational Medicine</a>
2008	Monika	Antigua and Barbuda	Corrosion in hold bulkhead led to fumigant ingress to victim's cabin. One fatality.	1	<a href="#">MAIB report</a>
2010	Wilson Mersin	Cyprus	Corrosion in hold ventilation shaft led to fumigant ingress to the accommodation. One fatality.	1	Flag internal investigation
2010	Hermann Schoening	Liberia	Extended exposure to fumigant through ventilation system. Hold communicating with engine room and accommodation through electrical conduits. All crew taken ill, no fatalities.	0	Flag internal investigation
2011	DHL Forester	Malta	Explosion of fumigant gases in cargo hold. No injuries.	0	<a href="#">GISIS ref: C0008352</a>

Year	Vessel	Flag	Summary	Lives lost	Ref.
2012	Arklow Meadow	Ireland	Crew and shore worker exposed to fumigant that had not dissipated during voyage. Fumigant socks ignited once removed from hold. 11 hospitalized due to fumigant exposure.	0	<a href="#">GISIS ref: C0009120</a>
2012	Theofylaktos	Malta	Explosion in cargo hold 4, followed by further explosions and a violent explosion in cargo hold no. 2. The investigation concluded that the immediate cause of the explosions was an explosive mixture of phosphine and air.	0	<a href="#">GISIS ref: C0009465</a>
2013	Hellenic Wind	Liberia	Explosion occurred in cargo hold due to the high dosage of Aluminium Phosphate. Three injuries.	0	<a href="#">GISIS ref: C0009561</a>
2014	Star Hyperion	Panama	Crew exposed to fumigant (phosphine) in the focsle store.	2	<a href="#">GISIS ref: C0010295</a>
2015	Nefryt	Malta	Extended exposure to fumigant through ventilation system. Two fatalities, all crew taken ill.	2	<a href="#">SMAIC (Poland) report 47/15</a>
2016	Panagia Stenion	Cyprus	Crew entered cargo hold to collect fumigant after testing with dosimeter tube at the surface. One fatality due to fumigant exposure.	1	<a href="#">GISIS ref: C0009150</a>
2017	Rimeo	Panama	Crew member overcome by fumigant after entering space adjacent to cargo hold whilst wearing gas mask. One fatality, several rescuers taken ill (initial rescue using EEBD).	1	<a href="#">GISIS ref: C00010577</a>
2017	Orion II	India	Fumigant ingress to ballast tank adjacent to cargo hold during lightering operations. Three fatalities (including two first responders).	3	<a href="#">GISIS ref: C1000205</a>
2018	Great Reward	Hong Kong (China)	Bosun entered a fumigated cargo hold, wearing gas mask unaware that the cargo had depleted oxygen levels. One fatality.	1	<a href="#">GISIS ref: C0011130</a>
2018	Nazmehr	Iran	Fumigant ingress to the accommodation through ventilation system. Symptoms attributed to food poisoning. Three fatalities.	3	<a href="#">GISIS ref: C0013642</a>
2019	Green World	Panama	Crew member involved in opening the hatch covers was found unconscious on the fumigated woodchip cargo in the hold. Another crew member then attempted a rescue without wearing breathing apparatus and also collapsed. Both died due to fumigant exposure.	2	None available

Year	Vessel	Flag	Summary	Lives lost	Ref.
2019	Minoan Glory	Liberia	Cargo hatch blew open due to explosive overheating 24 hours after fumigant applied. No injuries.	0	None available
2019	Bahri Bulk	Saudi Arabia	Crew tasked to collect cargo samples for customs. AB entered hold and collapsed, C/O and master both entered to assist. All died from exposure to fumigant.	3	<a href="#">GISIS ref : C0012313</a>
2020	Golden Taurus	Hong Kong (China)	Fumigant ingress to accommodation through electrical conduit. One fatality.	1	<a href="#">GISIS ref: C0010823</a>
2020	Fri Dolphin	Bahamas	Fumigant ingress to the accommodation through ventilation system. Crew attributed symptoms to food / sea sickness. One fatality and three hospitalized.	1	<a href="#">GISIS ref: C0013054</a>
2020	Darya Tapti	Hong Kong (China)	Crew member entered hold during fumigation top-up wearing gas mask. One fatality.	1	<a href="#">GISIS ref: C0013511</a>
2021	Thorco Angela	Marshall Islands	A stevedore suffered nerve damage after handling cans containing fumigant while discharging cargo. The fumigant did not fully volatilize and disperse during the voyage. The use of the fumigant in the cargo holds was neither documented nor communicated to the port.	0	<a href="#">MAIB preliminary report</a>
2021	Barramundi	Marshall Islands	Crew entered cargo hold to remove fumigant after testing with dosimeter tube at the surface. One fatality.	1	<a href="#">GISIS ref: C0013488</a>
2021	Magic Striker	Bahamas	Two shore workers entered a cargo hold, wearing gas masks along with a phosphine gas detector unaware that the cargo had depleted oxygen levels. One fatality.	1	<a href="#">GISIS ref: C1000078</a>
2022	Jupiter	Bahamas	Crew entered cargo hold that had been certified "gas free" by fumigators to inspect cargo. One fatality, two injured.	1	<a href="#">GISIS ref: C1000067</a>
2022	Wu Zhou 8	China	Fumigant ingress to the accommodation. Crew attributed symptoms to food poisoning. 13 fatalities.	13	<a href="#">GISIS ref: C1000538</a>
2022	Wei He	Hong Kong (China)	After secondary fumigation at the discharge port, two stevedores died in the Australian ladder space whilst attempting to enter a cargo hold. The Investigation did not confirm cause of death.	2	<a href="#">GISIS ref: C1000084</a>
2022	Conrad Oldendorff	Liberia	Explosive opening of booby hatch due to over pressurisation of fumigant in hold. One fatality	1	<a href="#">GISIS ref: C10013776</a>

Year	Vessel	Flag	Summary	Lives lost	Ref.
2022	China Express	Singapore	One member of the fumigation team collapsed after he entered the fumigated hold without protection. Another collapsed whilst attempting a rescue, whilst wearing a gas mask. Two fatalities.	2	<a href="#">KNKT report</a>
2023	Basic Victory	Marshall Islands	Explosion of residue of the fumigant aluminium phosphide stored on deck. No injuries.	0	<a href="#">GISIS ref: C1000344</a>
2024	Sea Pegasus	Marshall Islands	Two shore workers were removing fumigant materials from cargo holds. One worker entered a hold which as well as fumigant, lacked oxygen. One fatality.	1	<a href="#">GISIS ref: C0000357</a>

9 These casualties share a significant number of common factors:

- .1 In **Monika, Nefryt, Fri Dolphin** and at least seven other casualties, there was a lack of effective physical barriers between fumigated cargo space and accommodation. Evidently, inspections prior to loading were either not conducted or proved ineffective.
- .2 In almost all the casualties, the carbide/garlic smell present in the phosphine fumigant as an olfactory warning was ineffective due to masking, olfactory fatigue or lack of awareness of its significance.
- .3 In **Nazmehr, Fri Dolphin, Wu Zhou 8**, and at least ten other casualties, crew were unaware of the effects of exposure to the fumigant gas. Their symptoms were mistaken for food poisoning or seasickness.
- .4 In **Nazmehr, Golden Taurus, Wu Zhou 8**, and at least eight other casualties, the prescribed 8-hourly frequency of testing was insufficient to detect the presence of phosphine before crew were exposed to lethal levels of fumigant.
- .5 As highlighted in **Panagia Stenion, Jupiter** and **Barramundi**, the measurement of the atmosphere at a single point provides a false sense of safety. Pockets of fumigant may not be detected unless crew are provided with equipment capable of continuous monitoring. Equally, seafarers cannot operate a handpump when they are using their hands to complete other work.
- .6 As highlighted in **Jupiter** and **Magic Striker**, the risk associated with the fumigant is not eliminated when the spent fumigant is removed and the cargo is certified as "gas free".
- .7 As highlighted in **Conrad Oldendorff, Hellenic Wind** and at least six other casualties, the fire and explosion risk posed by fumigants is not limited to the handling of the fumigant remnants.
- .8 As highlighted in **Magic Striker, Sea Pegasus**, and at least four other casualties, controls that focus only on a single hazard are not effective at mitigating risk. Exposure to fumigant is not the only hazard associated with the carriage of fumigated cargoes.

**Analysis of the issue**

10 Fumigation on board ships is entirely within the control of the fumigators. Ship's masters and crew have little or no influence. Based on these casualties, the co-sponsors have identified four key areas where change would improve safety for people exposed to the hazards created by the fumigation process.

**Provision of gas detection equipment capable of continuous and reliable monitoring**

11 Fumigants are acutely toxic by design and exposure to high concentrations causes immediate effects. Smell/olfactory additives are not a reliable method of detection. Periodic monitoring may not detect the presence of fumigant before crew are exposed to a fatal dose.

12 Since the Recommendations were drafted, technological developments have meant that gas detection equipment that provide continuous monitoring for phosphine and other gases, are now readily available at a cost that is only marginally higher than for a manual pump. Adoption of modern technology would have the added benefit of not requiring specialized training or action from crew to provide a warning if limits are exceeded.

**Additional risk control measures when pre-loading inspection is not conducted**

13 The fumigator-in-charge generally does not inspect cargo holds prior to loading. Even if conducted, inspections that do not incorporate gas testing may not be effective.

14 Review of the casualty investigation reports found no instance where the holds were tested for gas tightness prior to loading. Instead of inspecting a hold, the fumigator-in-charge may ask the vessel's master to certify that holds are gas tight, creating a significant conflict of interest.

15 Where the fumigator-in-charge cannot determine with certainty whether the cargo holds are (or can be made) sufficiently gastight, all spaces where people are at risk should be provided with additional risk controls. This could include the provision of additional gas monitors that are capable of continuously monitoring the atmosphere.

**Effectively training and informing crew**

16 Investigations have highlighted that crews were not sufficiently aware of the risks of carrying a fumigated cargo, symptoms of exposure or actions to take if those symptoms were experienced. Paragraph 3.3.2.3 of the Recommendations require the fumigator-in-charge to provide training to two members of the crew. These "trained representatives of the master" are then required to brief the crew before fumigation and satisfy the fumigator-in-charge that this has been done.

17 Making the fumigator-in-charge responsible for the briefing and specifying the content would ensure that the crew receive standardized training from the person most qualified to do so. There would also be a benefit for the fumigator-in-charge to provide guidance that is effective and accessible to the crew.

18 The Recommendations provide that warning signs are removed from holds when the hold is "gas free". The hazards associated with the carriage of fumigated cargoes are evidently still present when the spent fumigant is removed. Fumigators must effectively communicate that the fumigant may be present in the cargo and/or trapped in the hold even after the cargo is discharged.

**Strengthening controls on associated risks**

19 Fumigation hazards are not limited to exposure to the toxic gas. Cargoes that are fumigated may be oxygen depleting and there is risk of fire or explosion at all stages of voyage, not just when dealing with fumigant remnants (as specified in the Recommendations).

20 Phosphine is not only flammable, it is highly reactive and prone to self-ignition in relatively low concentrations. Over-pressurization can lead to explosion in the early stages of fumigation. Application of the fumigant needs to be carefully planned to avoid over-pressurisation and steps must be taken to avoid ignition.

**Next steps**

21 The co-sponsors intend to submit a proposal for a new output to MSC 111, with a view to addressing the key areas outlined in paragraphs 11 to 20. The co-sponsors invite interested Member States and international organizations to provide input in that regard during CCC 11 or prior to the MSC 111 document submission deadline.

22 In addition, the co-sponsors are of the view that there would be significant benefit in updating and combining the other two circulars on the safe use of pesticides in ships, namely, the *Recommendations on the safe use of pesticides in ships* (MSC.1/Circ.1358) and the *Revised recommendations on the safe use of pesticides in ships applicable to the fumigation of cargo transport units* (MSC.1/Circ.1361/Rev.1)

**Action requested of the Sub-Committee**

23 The Sub-Committee is invited to note the analysis in paragraphs 7 to 20 and the intention of the co-sponsors to submit a proposal for a new output to MSC 111.

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