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Shipping Guidance Notice – 147

Enclosed Space Entry – Gas Detection and CO2 Hazards

To: Ship Owners, Operators, Master's, Classification Societies and Recognised Organisations

References:

- International Maritime Solid Bulk Cargoes Code (IMSBC) Code
- MSC.1/Circ.1477 - Guidelines to facilitate the selection of portable atmosphere testing instruments for enclosed spaces as required by SOLAS regulation XI-1/7
- Resolution A.1050(27) – Revised Recommendations for Entering Enclosed Spaces Aboard Ships
- SOLAS Chapter VI – Carriage of cargoes and oil fuels
- SOLAS XI-1/7 - Atmosphere testing instrument for enclosed spaces

1. Introduction

1.1. This Shipping Guidance Notice (SGN) has been developed by the Red Ensign Group (REG) Administrations, and is predominantly targeted at dry cargo operators since statistics show that these vessels have highest incidence of enclosed space accidents, although some of the interpretations and guidance is applicable to other operators. The purpose of the SGN is to advise that hazards presented by cargoes should be systematically considered prior to loading the cargo, with a particular emphasis on cargoes which may emit CO2 but it is also hoped to be received as an informative notification to the wider industry wherever CO2 exposure is possible.

2. Background

2.1. The MAIB have recently conducted a casualty investigation on behalf of an REG member and their interim report was issued in August 2023. In the case of this casualty, the cargo being loaded onto the vessel was coal, which is a partially organic cargo. Organic cargoes present a particular hazard as they will absorb O2 and emit CO2 into the atmosphere, creating the dual hazards of oxygen depletion and the toxicity of CO2 when encountered in high concentrations.

2.2. Despite this, the REG is aware of instances where vessels carrying organic cargoes have done so without 'appropriate instruments'[1] onboard their vessel to detect CO2 levels making it very difficult to fully manage the risks presented by this hazard without a means to measure it's concentration. The following guidance is intended to assist operators with cargo hazards related to enclosed space entry with a particular emphasis on CO2 emitting cargoes, although parts of the guidance will also apply to other cargo types.

3. Gas Detection Requirements

3.1. Various codes and conventions contain requirements for 'appropriate equipment' for detecting flammable and toxic gases within confined and enclosed spaces to be provided, 'together with detailed instructions for their use'. References to such include:

- IMSBC Code Section 3
- A.1050(27) – Revised Recommendations for Entering Enclosed Spaces Aboard Ships – Section 7
- SOLAS Chapter VI regulation 3.1 which states – 'when transporting a solid bulk cargo which is liable to emit a toxic or flammable gas or cause oxygen depletion in the cargo space, an appropriate instrument for measuring the concentration of gas or oxygen in the air shall be provided together with detailed instructions for its use. Such an instrument shall be to the satisfaction of the administration'.
- SOLAS Chapter VI regulation 3.2 which states – 'The administration shall take steps to ensure the that crews of ships are trained in the use of such instruments'.
- SOLAS Chapter XI-1 regulation 1.7

3.2. Noting the increase in frequency of enclosed space accidents which is documented by various IMO papers[2], taken together with the findings of recent casualty investigations and bearing in mind the ongoing work at IMO, the REG has established more detailed interpretations of the gas detection requirements in the relevant codes and conventions (as above), pending the updated IMO guidelines in A.1050(27). The aim of this is to develop more comprehensive gas detection guidance that we hope will reduce enclosed space accidents, without 'gold-plating' the existing IMO requirements.

3.3. The REG has therefore established the following interpretations:

3.3.1. Flammable gas detectors, as referred to in SOLAS Chapter VI Regulation 3.1 and IMSBC Code Paragraph 3.4.2, should be interpreted as being of a type still capable of working in an oxygen deficient atmosphere, as flammable gas sensor range readings may be affected by the lack of O2.

3.3.2. 'Detailed instructions for its use', also in reference to the requirement in SOLAS Chapter VI Regulation 3.1, should cover at least the following:

- Correct operation of the specified equipment
- Correct calibration
- Span gas compositions to be used for calibration
- Specific reagent tubes to be used for toxic gases; and
- Maintenance instructions

3.3.3. The above points should be comprehensively covered by the company SMS (which may be reviewed at DOC audits). Additionally, vessel planned maintenance systems should have calibration/testing schedules included to ensure regular inspection of condition and correct operation of the equipment provided.

3.3.4. 'Vessels provided equipment/arrangement' should, as a minimum, take into account the cargo list and those risks arising from the specific cargos on that list. For example, in the case of organic cargoes; if a vessel's arrangement of gas detection equipment provides only the basic four gas combined detector (H2S, LFL, O2 and CO) prescribed by MSC.1/Circ.1477, then it should be considered insufficiently equipped to carry organic cargoes (as it is unable to mitigate the CO2 hazards without a means of detecting it).

3.3.4.1. Although the 'basic four' detector will detect a drop in O2 associated with this process, it should be borne in mind that a small drop in O2 can result in a large increase in CO2 concentration when considered in proportion to the 'normal' quantities in air and that CO2 can begin to have adverse physiological affects with as little as 1,000 or 2,000ppm depending upon exposure period (the 8hr time weighted average (TWA) in the UK is 5,000ppm).

3.3.4.2. It should be noted that, to some extent, this point is covered by paragraph 2 of MSC.1/Circ.1477 which states 'given a ship's specific characteristics and operations, additional atmospheric hazards in enclosed spaces may be present that may not be detected by the instrument recommended to be selected by these Guidelines and in such case, if known, additional appropriate instruments should be carried'. However, evidence gathered by the REG, including from casualty investigations, suggests that this is not in all cases being interpreted in the above way for organic cargoes where CO2 is now understood to be a particular hazard. Accordingly, a more prescriptive interpretation of 'additional appropriate instruments' is likely to have a more meaningful benefit.

3.3.5. Lists of Cargoes, such as those appended to the 'Statement of Compliance for the Carriage of Sold Bulk Cargoes', should be filtered by gas detection equipment arranged on board to safely handle them, taking account of the above bullet points – for example, organic and other CO2 emitting cargoes would need CO2 detection equipment to be provided on board the vessel to be included on the List of Cargoes (without it then the cargo shouldn't even be listed).

3.3.6. Lastly, paragraph 9 of MSC.1/Circ.1477 states that 'if the instrument is fitted with an alarm function, it should activate at the appropriate level as determined by the flag State Administration – this is in reference to the four measurements of H2S, LFL, O2 and CO. At the present time we defer an interpretation on this point pending discussions at IMO on this subject.

4. Safety Management Systems – Enclosed Space Entry in General

4.1. In addition to the above detection requirements, the vessel's Safety Management System plays a crucial role in mitigating the human element risks associated with enclosed space entry.

4.2. IMO Resolution A.1050(27) provides a basic framework in this regard, although it is acknowledged that it has not been successful in reducing enclosed space casualties and is therefore undergoing a revision at IMO. In the meantime, the REG makes the following strong recommendations in respect of the SMS, in addition to A.1050(27):

- SMS enclosed space risk assessment and space entry procedures should also be revised to specifically include cargo hazard assessment (and mitigation) which includes CO2 if those types of cargoes are to be carried.
- Enclosed space entry drills required by SOLAS III- Regulation 19.3.6 should periodically include 'cargo hazard/atmospheric risk assessment' methodology to make crews more aware of the risks posed by CO2 which is an odourless, tasteless gas often generated by the cargoes being carried on board the vessel (in addition other cargo hazards).
- Safety Management System operating procedures for safe entry and occupation of spaces where CO2 may be present should be developed using 15min threshold limit and 8hr time weighted average levels - span gas for calibration and regular bump testing of any provided CO2 meter should also be supplied to the vessel.
- Working 'at depth' should also be considered within SMS operational procedures to properly risk assess enclosed spaces – instead of falling from height, rescue from depth and all it entails should be considered (avoidance of descent into an oxygen deficient or potentially toxic atmosphere, potentially need vertical rescue or use of hoist/stretcher, manpower necessary to achieve this, etc.)
- Physical barriers to entry (until tested) could also be considered as part of entry procedures.
- Enclosed space entry procedures should ensure that everyone involved in an enclosed space entry knows who to contact and where to go for medical/rescue equipment and advice should it be needed.

[1] - *See SOLAS XI-1/7 (referencing both MSC.1/Circ.1477 and A.1050(27))*

[2] - *See IMO Papers CCC 5/INF.12, CCC 6/INF.7,CCC 9/INF.3 and CCC10/INF.32*

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For & on behalf of the Maritime Administrator

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