

Human Element Industry Group
Enclosed Space Fatalities Work Group
Inventory of Enclosed Spaces

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Objective and Challenge-HEIG Enclosed Spaces Project

Objective of HEIG Enclosed Spaces Project

To reduce or even eradicate completely fatalities resulting from the entry of seafarers into enclosed spaces.

Scope

The project aims to reduce the risk to seafarers and shore visitors and worker in normal operations. Shore personnel affected could include surveyors who might wish access to a space (class, insurance, cargo, port state, flag etc,) and stevedores or others involved in loading and discharging of cargo. Shore Repairs in drydock and specialist repairers carrying out seagoing maintenance are not considered at this stage.

Non-Cargo Tank Challenge

While cargo tanks may require routine or near routine entry for operational reasons entry to non-cargo tanks may be for maintenance and inspection. The frequency of maintenance and inspection can be affected by design and maintenance. For this reason, a 'challenge' is proposed: -

Ships, their maintenance and operational standards as well as industry requirements should be designed such that ship's crew should not enter non cargo enclosed spaces other than in controlled conditions in dry-docks.

Purpose of the 'Inventory'

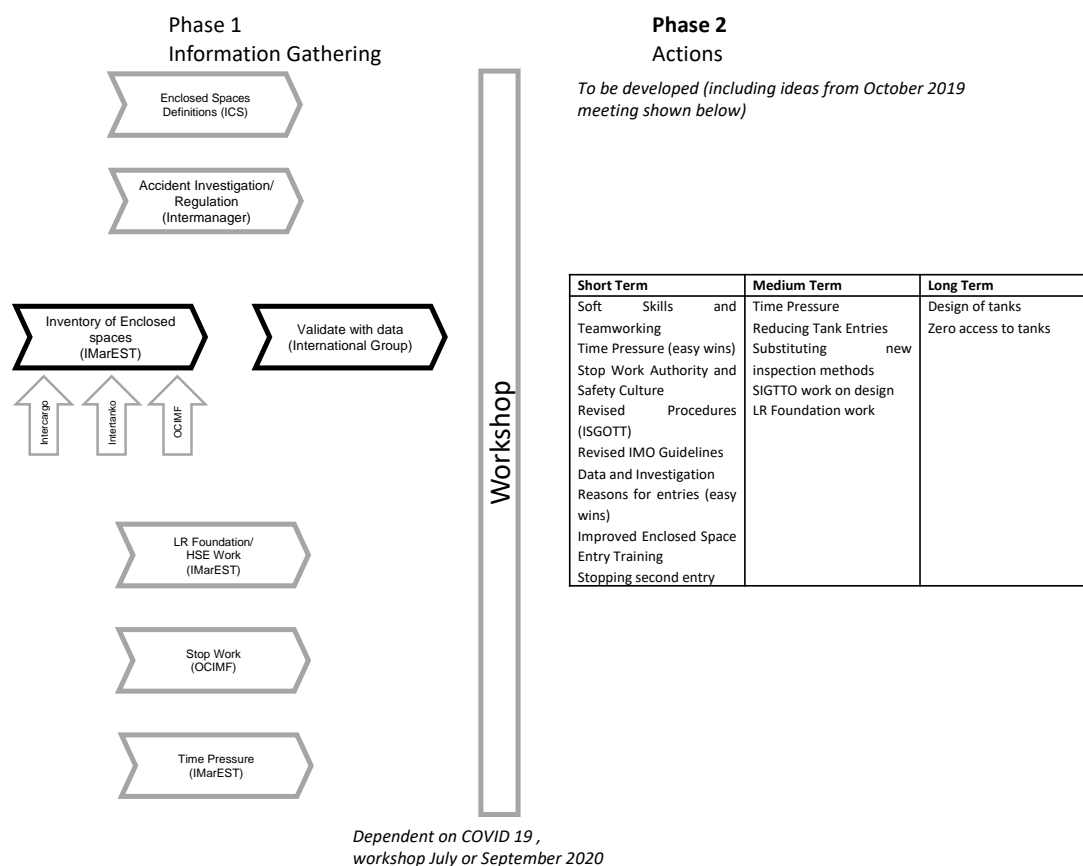


Figure 1 Process

As per the figure above

Phase 1

The purposes of this document and the associated spreadsheet are: -

1. To produce an inventory of spaces aboard ship that may require entry.
2. To classify the spaces to identify common characteristics.
3. To identify the regulatory and non-regulatory reasons for enclosed space entry.
4. To describe the specific risk related to the space, the frequency of entry and the methods of controlling the hazard.
5. To create a qualitative risk matrix to aid in prioritising
6. To validate quantitatively the risk matrix using accident data.

Phase 2

Analysis of this data to identify if, using an ALARP model: -

1. The frequency of entry can be reduced thus reducing overall risk

2. Entry can be eliminated
3. If entry cannot be eliminated are substitute technical methods an option?
4. What engineering controls can be improved?

Phase 1 Inventory of Enclosed Spaces Data Gathering

This paper and attached spreadsheet contain an inventory of enclosed spaces

Types of Spaces

The figure below indexes the types of spaces described in the 'Inventory' Spreadsheet.

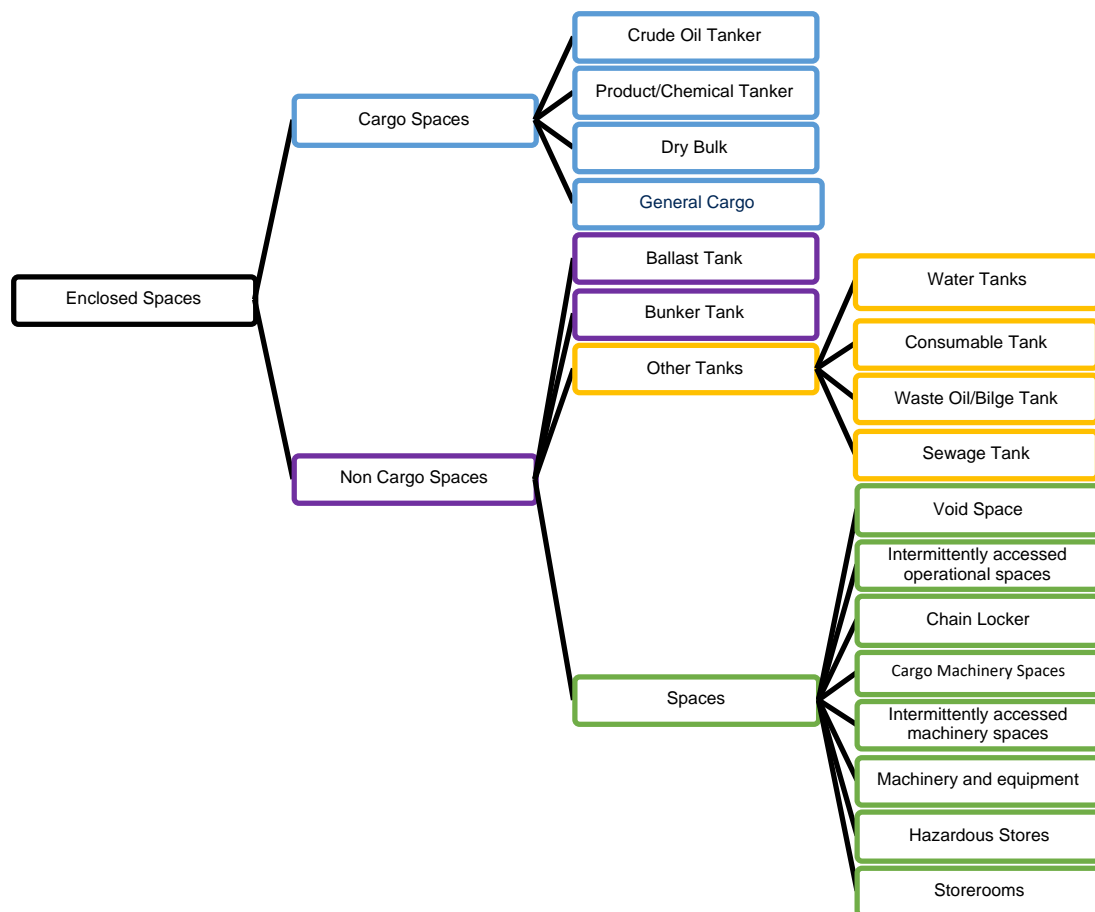


Figure 2 Types of Enclosed Spaces

Further details can be found in the appendix

Phase 2 Strategy

Entry to enclosed spaces has traditionally been controlled by 'administrative controls' such as Permits to Work supported by monitoring and PPE in the event of an emergency. Enclosed space fatalities have increased over recent years after a long period where, at least in the tanker industry, the risk seemed to be well controlled.

Use of the long established 'hierarchy of hazard controls' may offer alternatives. It should be stressed that any strategy would have to pass the 'as low as reasonably practicable' cost/benefit test.

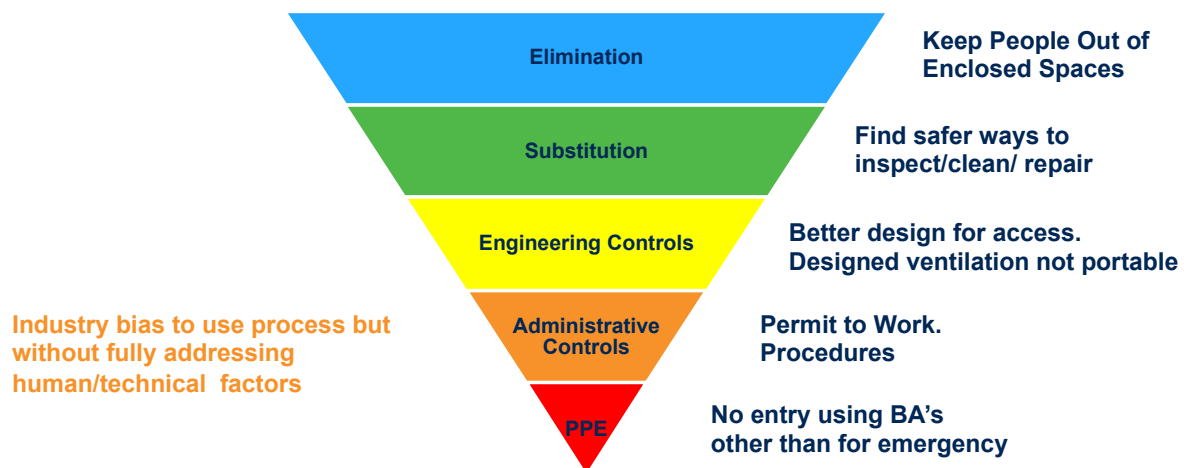


Figure 3 Hierarchy of Hazard Controls

Elimination

In simple terms an elimination strategy could result from two alternatives: -

1. Designing out enclosed spaces.
2. Removal of the need for seafarers to enter spaces during the operation phase by design, operational and maintenance strategies

Substitution

Substitution accepts that the space needs to be 'serviced' during operations but that alternatives may be available to inspect, clean or repair the tanks.

Engineering Controls

If entry is required by seafarers and others how can access, ventilation etc. be improved.

Administrative Controls

These include procedures, permits to work, signage, procedures and the training required for them.

PPE

The least effective control although consideration needs to be given to whether ships which routinely require cargo tank/hold entry should have an increased scale of CABA's, personal monitors etc.

Appendix One - Explanation of Inventory Spreadsheet

Enclosed Spaces

Appendices two-four explain the 'enclosed spaces' considered. A broad definition has been used for this, down to and including store-rooms.

Column Headings

Class/Flag Requirements

This column records the origin, and frequency, of regulatory requirements for entry.

Industry Requirements

This column records the origin and frequency of industry requirements for entry.

Reasons for Normal Access

This column records the reasons for normal access to tank such as inspection, cleaning and routine maintenance which would be recorded in a planned maintenance system.

Reasons for abnormal/emergency access

This column records the reasons for abnormal/emergency access such as for repairs to the structure or contained equipment.

Risk

This column records the risk whether of oxygen starvation or from toxicity of vapours (or retained liquids)

Control of Hazard

This column describes the controls in place to safely manage entry

Procedural Guidance

This column lists procedural guidance available to manage entry

Risk Matrix

The initial version of the risk matrix is 'qualitative' and subject to discussion at the workshop. The intention is to gain some level of validation from industry data analysis if possible.

X Axis-Frequency

The frequency is based on the most onerous requirement whether flag/class, industry or owner/SMS.

The timescales used are listed below. In some cases, decimal points are used to either denote exceptional cases such as daily checks when cargo operations are underway. Decimal points may also be used to improve the clarity of the diagram.

- 1 Drydock to drydock
- 2 Annual
- 3 Half Yearly
- 4 Quarterly
- 5 Monthly
- 6 Weekly
- 7 Daily

Y Axis-Severity

The 'severity' is a qualitative judgement based on: -

- 1 The inherent risk of the compartment whether it be lack of oxygen, toxic vapours. The risk is seen as different for where the space contains a liquid/gas or whether enclosed by machinery, drums etc.
- 2 Control of the hazard including: -
 - a. Hierarchy of controls, however the bulk are procedural and PPE
 - b. Whether the space is subject to 'engineering controls' such as ventilation or gas monitoring.
 - c. Origin of procedures
 - d. Presence of PPE differentiating between the scale of PPE (CABA's, personal monitoring) carried by tankers and non-tankers.

Appendix Two - Cargo spaces

Cargo space are used for the carriage of bulk dry and liquid cargo. They may require access for cleaning, inspection or cargo handling. In general, these tanks are structural but may be protected by double hull ballast tanks. They are integral to the structural strength of the vessel. The following sub types are considered: -

Crude Oil Tankers

Crude oil is not sensitive to cross contamination. For this reason, to avoid pollution, the tanks are crude oil washed on discharge to control slops and the need for tank entry for cleaning is limited to pre-drydock and repairs. Double hull vessels have clean internals which are easily cleaned. Good practice includes coating deckheads and tank bottoms to avoid pitting damage due to moisture.

Specific risk may be lack of oxygen and toxic fumes such as H₂S

Product and Chemical Tankers

May require tank entry for cleaning inspection, repair and equipment repair. Tanks are often coated or may be stainless steel and generally clean internals. The combination of strict cleaning requirements and short voyages may create a high risk of incidents.

Specific risks may be lack of oxygen and toxic fumes

Entry is determined by the cleaning requirements which are laid out in various industry practices.

Review of these practices could reduce the frequency of entry [Help required from OCIMF and Intertanko]

Dry Bulk

[Help Required from Intercargo]

General Cargo

[Help Required from Intercargo]

Appendix Three - Non-Cargo Spaces

Ballast Tanks

Spaces used for ballasting the vessel to maintain vessel equilibrium and control shear forces and bending moments. Ballast tanks may be double hull spaces, double side spaces, double bottoms or forepeak and aft peak tanks. Regular ballasting and de-ballasting create the conditions for general corrosion in uncoated tanks and pitting in coated tanks.

Specific risk is lack of oxygen

Entry is required for inspection, survey, repair, equipment repair.

Frequency of access is to some degree determined by the quality of protection either coatings, anodic or cathodic and guidance in IACS and TSCF documents.

Bunker Tanks

Spaces used for the storage of fuel which may be distillate, HSFO or LSFO. In the latter cases tank heating will be required. The quality of fuel is variable and may have contaminants following the refining process, sulphur and entrained water. These combinations mean that the tank structure may be prone to corrosion, particularly pitting.

Specific risk may be lack of oxygen and toxic fumes such as H₂S

Entry may be required for inspection, survey, repairs and equipment repair,

Frequency of access is to some degree determined by the type of fuel, quality of protection either coatings, anodic or cathodic and guidance in IACS and TSCF documents.

Other Tanks

Water Tanks

Tanks used for storage of potable or distilled water. These may be large body tanks, sections of aft peaks etc. or smaller tanks such as header tanks and drain tanks. Tanks may be coated.

Entry may be required for inspection, cleaning and repair.

Frequency is driven by survey requirements but also MLC requirements for fresh water.

Consumable Tanks

Tanks used for storage of consumables such as oils, hydraulic oils etc. The consumables may be corrosion inhibitors. These tanks are generally non-structural and, in some cases, too small for entry.

Entry may be required for inspection cleaning and repair.

Frequency may be driven by owners PM system or consumable supplier recommendations.

Waste Oil/Bilge Tanks

Tanks used for retention of lube oil and fuel oil wastes and sludge from purifiers. Also includes bilge holding tanks and oily water separator tanks. Will contain water and be subject to corrosion. Likely to be non-structural tanks and in some cases too small for entry.

Entry required for inspection and cleaning and to avoid blocking of suction.

Frequency may be driven by owners PM system

[Sewage Tanks](#)

Sewage tanks form part of the sewage system. They contain effluent and water and may be subject to corrosion. They are generally non-structural and may be too small for entry.

Entry may be required for inspection, cleaning including removal of obstructions and repair.

Appendix Four - Spaces

Void Spaces

Enclosed spaces of varying sizes that may partition volume for stability and watertight integrity purposes. May also contain hull penetrations for equipment such as speed logs, echo sounders and draft gauges.

Entry may be required for inspection and repair of the space or equipment within the space.

Frequency driven by class requirements, PM Systems including maintenance of included equipment.

Intermittently Manned Operations Spaces

Spaces that are not normally manned such as escape trunks and duct keels.

Entry may be required for routine access, repairs and in an emergency.

Frequency driven by operational reasons but could be weekly.

Chain Locker

Stowage for anchor chain. Subject to physical damage and corrosion.

Entry may be required for inspection and repair within the space or dealing with anchor chain problems.

Frequency driven by class requirements, PM Systems.

Cargo Machinery Spaces

Spaces that contain cargo equipment which contain hydrocarbon or chemical vapours. May be structural or non-structural. Spaces will have forced ventilation and may have gas monitoring. Procedural requirements for entry.

Regular entry for inspection while cargo operations underway and for repairs when not.

Frequency can be daily.

Intermittently Accessed Machinery Spaces

Spaces that contain equipment but are not permanently manned. These include thruster machinery rooms, emergency generator rooms. They may be structural or non-structural. Spaces have forced ventilation but this may not always be running.

Entry may be required for inspection and routine maintenance.

Frequency driven by SMS and PM systems but likely to be daily

Machinery and Equipment

Equipment of such size that entry can be required for inspection, maintenance and survey. These include boilers, main engine crankcases, scavenge spaces and boilers both water and air/exhaust side.

Frequency can vary from quarterly to annual to twice per special survey period

Hazardous Stores

Store which contains items which, in the event of leakage, may result in a hazard such as an oxygen deficient atmosphere or toxic vapours.

This includes CO₂, chemicals and paints.

Frequency may vary from daily to weekly

Storerooms

Spaces that contain consumable stores. In some cases, these may be chemicals or gases. They are likely to be non-structural.

Frequency may be daily.