

ENCLOSED SPACE MANAGEMENT SYSTEM

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Introduction

Of all those who board ships and enter enclosed spaces, the surveyors are most at risk. In many cases the spaces they are about to enter are an unknown quantity, therefore they are totally dependent on the ships management team having these spaces properly prepared with a trained rescue party adequately equipped and standing by.



It is now a matter of record that ships have more incidents, accidents and fatalities involving enclosed spaces than any other component of the marine sector. These accidents and subsequent fatalities are

predominantly the result of people entering, working in or ironically attempting rescue from those spaces. This unacceptable situation is no longer tolerable and concerted efforts to address the safety aspects of entry and rescue from these spaces is currently under way. The first step toward this change process began with the identification, (and acceptance), that a problem existed. Many reputable organisations have written about the problem and suggested potential solutions but until legislation is enacted governing purposeful training and dedicated equipment, the problems and accidents will continue.

The Mines Rescue Service, a non- profit organisation, was formed over 100 years ago by Government Legislation to provide rescue and guidance to the mining industry in the UK. Through this, mines rescue became the

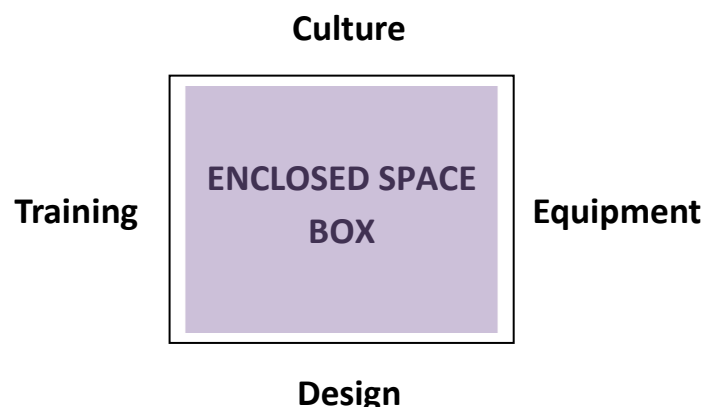
UK authority on enclosed space problems. In recent years mines rescue were allowed by the Government to use that accumulated knowledge to the benefit of Industry ashore not just in the UK but in many other countries.

Five years ago it was brought to our attention about the growing casualty rate in enclosed spaces in the marine industry and that, at that time, they had no expertise in dealing with this particular problem. Mines rescue responded by agreeing to set up a specialist division to assist the marine industry and Mines Rescue Marine was established.

Since that time, while engaged in a systematic work and study programme of the often extremely complex enclosed space problems within ships and in the Offshore oil and gas industry, Mines Rescue Marine defined our results in a series of papers on what we saw as the immediate problems with suggestions for improvements to assist in coping and reducing the accident rate.

Our findings were that basically, the contributory causes of enclosed space accidents and fatalities may be seen as a four sided dilemma which may be shown graphically and termed as the 'enclosed space box.'

The Enclosed Space Box



Design

We make no excuse for leading with design as it is not only the most neglected part of the problem but we feel it is from this that all other problems originate.

Basically, it is our contention that if human beings have to enter those spaces, work in them and, if things go wrong, have to be rescued from them, they should be designed in such a way to allow personnel adequate room for entry and rescue. In industry ashore, entry, work and rescue problems are a major consideration in the design of any such space (CDM regulations). If the aforementioned can be accepted as the criterion, then when applied to ships at sea today, many spaces would fail to meet what would be termed as acceptable standards, certainly by shore standards.

So why should ship design be different?

Of course it is recognised that a ship is in itself an enclosed space and that the size, and the structural strength in certain cases will limit what can be achieved but it would seem that at the present time there is no consideration for human activity within enclosed spaces, either in legislation or in the design phase of a ship's construction.

The Space

When considering human activity in these spaces, the design factors



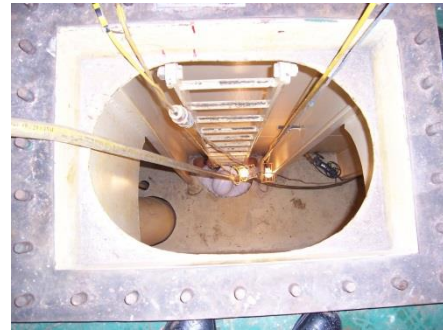
which affect human survivability are;

- Ease of access into the space
- Ease of movement within the space
- Rescue Capability

If at the earliest stages of the design process, these factors could be assessed, and where possible, a standard established, then undoubtedly many improvements can be made to the present situation.

As a prime example, manhole design has hardly any legislation beyond a brief mention that tankers and bulk carriers should have accessibility to allow entry of a man wearing a BA set and should therefore be a minimum size of 60cm x 80cm. It is quite incredible that there is no specific requirement for ALL ships. This lack of minimum requirements for access manholes into tanks and spaces on ships has led to entry into

and movement within these spaces becoming extremely difficult even without wearing a breathing apparatus. In such circumstances, any attempt by the ship at rescue from these spaces becomes virtually impossible as even if any rescuer could get in, getting a casualty out on a stretcher would ultimately test the abilities of even highly trained personnel, from this we can see that we appear to be still designing ships with spaces that people cannot be rescued from.



Equipment

This is where the unofficial motto of the worldwide marine industry '*It's not required by SOLAS*' is often repeated as currently there is no specific requirement for enclosed space entry or rescue equipment. For this reason, in the majority of cases, the protection of enclosed space entrants is wholly reliant upon equipment used for fire control. Too often, enclosed space rescue equipment consists of a length of rope and a breathing apparatus drawn from the fire equipment store with which the wearer cannot effect an enclosed space entry wearing the BA to attempt a rescue.

Case studies have shown that the use of such equipment, which is not designed for enclosed space use, has been instrumental in several deaths and accidents.

There are many manufacturers and suppliers of excellent equipment, designed to do whatever the buyer requires of it, but before purchasing, always ask yourself two questions:

- *Is it the correct equipment for the job?*
- *Is the equipment 'Fit for Purpose'?*

To be able to answer these questions a high degree of subject knowledge is required. Undoubtedly one of the main considerations will be cost, but the quality of the equipment, ease of use, ease of maintenance and the

safety of the people using it, should always be the main drivers in this process.

Enclosed space equipment falls into two categories;

Entry Equipment (in addition to standard PPE)

1. *An Oxygen/Gas detector*
2. *Proven communications*
3. *Hands free lighting*
4. *An EEBD*
5. *Rescue harness*

Rescue Equipment.

The worst case scenario during any enclosed space entry is to have to effect a rescue of casualties. To ensure this happens quickly, efficiently and effectively dedicated rescue equipment is essential. In selecting rescue equipment, three key features should be considered:

- *Is it 'fit for purpose'*
- *Can it be easily operated*
- *Can it be easily maintained*

This additional equipment should be immediately available at the point of entry and include;

1. *Breathing Apparatus* (that can fit through the entry point whilst being worn)
2. *A tripod or quadpod.*
3. *A man riding winch arrangement.*
4. *A resuscitator*
5. *A first aid kit*
6. *A dedicated rescue stretcher*

In consideration of the number of casualties which continue to occur in enclosed spaces, there must come a time, in line with industry ashore, when enclosed space working and rescue equipment becomes mandatory. Fire fighting equipment is for fighting fires, enclosed space equipment is for enclosed space entry and rescue. They are very different disciplines and should be seen as such.

Training

On the majority of dry cargo ships, those entering the tanks and spaces have to rely on fellow crewmembers who have had no formal training to rescue them and those directing the attempt also having had no formal training in enclosed space rescue management. Regrettably, even on Tankers and Gas carriers, where there is far more concern and knowledge of the problems, there is too often only basic training carried out by unqualified personnel.

Specific Training

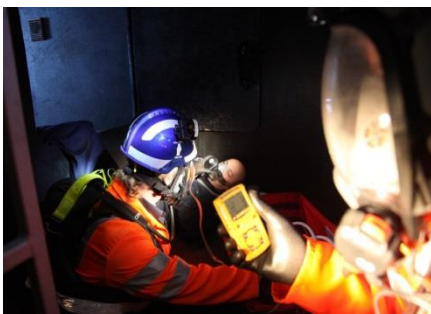
Although required in many industries ashore, formal training in enclosed space entry and rescue is as yet not required for seamen on ships other than tankers and chemical carriers. Yet the Marine Accident Investigators' International Forum have found that of the 93 deaths that have occurred at sea since 1997, 76% of these are on ships that were not tankers or chemical carriers.

In their findings, which will not come as any surprise to those at sea, they list amongst the areas of concern;

- 1. Lack of knowledge, training and understanding of the dangers of entering enclosed spaces.*
- 2. Personal Protective Equipment or rescue equipment not being used, not available of appropriate type, improperly used, or in disrepair.*

In essence, this meant that any enclosed space skills and knowledge is being taught on board often by those with no experience.

In Industry ashore, (in the UK), legislation was enacted to protect all persons when entering, working in and exiting a confined space (enclosed space) in the event of an emergency situation developing. This legislation is reasonably comprehensive and governs all aspects of confined space entry from the



identification off a confined space to emergency arrangements. The common thread throughout, remains that adequate training should always be undertaken prior to entry. It also highlights the need for personal protection, in that entrants should be aware of the environment before they enter the confined space, monitor the air quality continuously, communicate frequently and carry escape breathing apparatus. Additionally, rescue equipment and manpower should be 'available for immediately deployment' in the event of an emergency. Rescue equipment should include breathing apparatus, rescue stretcher, mechanical winch and anchorage point (tripod, quad-pod, etc.), oxygen resuscitator, first aid equipment and any other specialist equipment deemed necessary for that particular entry.



At sea, before any entry is made into an enclosed space, it is essential that all crew members entering the space ask themselves, are they adequately:

- trained.
- equipped.
- protected in the event of an emergency.

If the answer to any of the three questions is no, then those spaces should not be entered until a positive answer can be given.

Culture

Changing the inherent views (culture) of people within the marine industry, toward the problems of enclosed space entry is a formidable undertaking, however as stated earlier in this paper 'the change process' is already underway with the industry generally now acknowledging that there is a serious problem.

Too often, those at sea in senior positions tend to dwell on the past and how they behaved and were trained. 'It was good enough for me when I was learning the job so why change'? There also exists a macho type culture. 'We're seamen, we don't need these shore attitudes out here on the ships'.

Even with those coming on board. Surveyors impatient to get on with the job, limited time to check that the ship has made all the proper arrangements, the pressure on people to get on with the job as the ship is only in port for a short time or there is another ship waiting.

The culture of safety, like water, flows down. If the Captain is concerned, then those under him will be. If the Chairman of the Company and board are concerned, then the Captains will be. If the owners of the survey company require all necessary procedures to be taken before entry, they will be.

In the majority of shipping companies and marine administrations, the shore culture is still welded to SOLAS. As the ships continue to modernise and change, ports and shore industry keep a pace with that change, unfortunately the various requirements of SOLAS regarding enclosed space training and equipment have not and are being left behind, often now to the endangerment of those it is designed to protect.

Increasingly in the shipping industry, as crews become smaller and ships become larger, the employment of shore labour at sea as well as in port is becoming more common. In the oil and gas fields, on the FPSOs and installations, this type of labour employment is quite normal. Strangely, responsibility for the safety of contractors or shore workers, whether the ship is at sea or in port or dry dock is a grey area in the marine industry.

Responsibilities for Shore Personnel

A recent judgement in the High Court of the Hong Kong special administrative region was made concerning the death of a surveyor and

an assisting crew member from oxygen depletion in an enclosed space on board a ship. The following is an extract;

'A harsher criterion was applied to the conduct of the Master who was found to be 50 per cent to blame. The court started from the premise that the Master is in overall charge of the vessel and responsible for the safety of all persons on board, including lawful visitors. The relevant safety codes provided for a planned entry into any enclosed space with a competent officer or other person appointed specifically for that operation. There was no such operation planned in this case. The fact that the Master had offered the services of the Chief Officer whose presence might have avoided the accident, and that the Surveyor rejected this offer, did not detract from the overriding responsibility of the Master.'

The most important finding of the court was on the question of whether the Master was entitled to assume that the Surveyor was qualified and competent to carry out the tasks expected of him and to follow safety procedures, in particular those relating to entry into enclosed spaces.

'The court held that the Master was not in possession of sufficient information to make a decision about the ability of the Surveyor to deal with any dangerous situation that might arise. The Master could make no assumptions in this respect.'

This confusion was even more apparent when, in conversations with ship owners and dockyard managers, it was revealed that there was a practice in place of the yards, 'giving a letter', stating that they now assumed responsibility for the safety of workers on ships and installations, even though these were still under the command of Masters or the responsibility of the installation managers.

This assumption in many companies that contractors are responsible for the safety of their workers or that a port or dry dock can issue an indemnity stating they accept responsibility for safety of shore workers while on board the ship or installation is very unsafe, especially when considered internationally, as many countries are quite definite in their legal interpretation that, while the ship or installation is under

management, in other words, not a 'dead ship', then the Captain or manager, of that ship or installation is responsible.

Fifty years ago, Hopkins in 'Business and Law for the Shipmaster' wrote;

'Stevedores and other contractors who board a ship as invitees and persons who come on board as licensees for their own private purposes or as guests, are all entitled to adequate provision against pitfalls and traps. Apart from specific regulations, the Master has a common law duty to provide such protection.'

Certainly there is no confusion by Hopkins!

The 'Enclosed Space Management System'

During the course of our studies into enclosed space problems in the Marine Industry it became apparent that the methods for coping with enclosed spaces on ships and installations are in many cases based around a risk assessment system that can be very flawed. These systems range from, 'a risk assessment created for every space' to just 'one generic risk assessment created regardless of the space'. It is very rare that any assessments exist which give consideration to design problems or particular areas of concern relating to the degree of difficulty to enter and work in that space. It would seem that in the majority of cases, intimate knowledge of particular spaces rests with the that gained experientially by those on board and when they leave, that knowledge goes with them leaving the relievers to start from the beginning again. It can be said that on the majority of ships, regardless of their safety regimes, there appears to be little consistency in the overall control and protection of these spaces.

The situation is worse for any shore workers who are required to enter these spaces as they will have no previous knowledge of any of the design or pitfalls, risk assessments, (if one exists for that particular space), or indeed rescue procedures and equipment availability to get them out if things go wrong.

For these reasons, two years ago we began developing an enclosed space management system that would attempt to deal with these problems whilst at the same time deal with changing the culture on board.

We started with simple aims, they were that the system must.

- *Offer protection to all on board.*
- *Provide knowledge for the initial entry of all enclosed spaces regardless of their type.*
- *Provide the ability to contain all relevant information.*
- *Deal with the responsibility issues.*
- *Cope with a disparity of ships, installations and their procedures.*

Once in place, the system must;

- *Provide the ship/installation with a definitive guide to all of the enclosed spaces.*
- *Be a living document that can be improved and added to as required.*
- *Attempt to reduce existing paperwork.*
- *Be easy to access and understand.*
- *Provide a protection system for all who may enter any enclosed space.*
- *Be able to be implemented in any fleet or collective of installations regardless of their disparity in size or type.*
- *Provide both ship/installation and office ashore with instant information regarding any space.*
- *Deal with the responsibility issue between the ship/installation, company and outside contractors.*
- *Most importantly, cope with a continuous change of crewing while providing the same protection.*

Enclosed Space Audit Methodology

Whilst recognising that the audit process will undoubtedly be time consuming, once completed, it will not have to be repeated, unless major modifications to the space have been made.

Although comprehensive in design it is relatively simple to implement with downloadable audit sheets as well as Hints & Tips to support the auditor.

The audit itself covers an assessment of the Entry Points, the Space Internally and Rescue Requirements, examples being, the physical size of



manholes, difficulty of entry, ability to rig a man riding winch, availability and effectiveness of communications, dimensions of the space, internal design features and the ability to operate whilst wearing a breathing apparatus. The audit also goes on to record all of the manpower and equipment requirements for both entry into and potentially rescue from the space.



On completion of the manual audit the information is uploaded onto the Management



System held on the ships computer which automatically categorises the space based around a simple traffic light warning system already implemented and working successfully in industry ashore. Under this, system the enclosed spaces on

a ship/installations will have one of three categorisations based on the degree of difficulty to get into, operate inside and rescue from each space, they are:

- Green- Low or Very low degree of difficulty
- Amber - Moderate degree of difficulty
- Red - High or Very High degree of difficulty

N. B. Any space from which it is considered there is a degree of difficulty in rescue will be classified as a Red space regardless.

The system also makes provision for uploading current procedural documentation such as risk assessments, action plans, permits and rescue plans. Photographs, relevant ships drawings and notes can also be added as required, making each individual enclosed space record a 'living document'.

The simplicity of the plan should now be apparent. Any worker wanting to enter any enclosed space would be able to refer to the computer for information. That referral will allow the browser to view all available data relevant to that individual space and where necessary, download printed reports to study, use for Tool Box Talks or in some cases email to a third party. As stated earlier, the system should be regarded as a living document providing continuous and permanent (albeit updatable) information regarding all of the enclosed spaces on the ship or facility whilst simultaneously coping with the endemic problems personnel changeovers.

At the same time, the computerised enclosed space system for that particular ship or installation is instantly available to the office ashore, enabling ship/installation - company to view the information together and in real time discuss any problem, all having access to the same information. For the office ashore they will then have a fleet wide enclosed space information system.

Shore Personnel

Increasingly, contractors are being used on ships and installations. The master of a ship or manager of an installation and in particular, their safety officers, are responsible for the safety and safe working practices of these contractors.

In order to help shore personnel, the management system can produce a full printout of information on the space concerned together with procedural documentation, rescue equipment and manpower requirements, they can then be sent directly to the surveyor or

contractor for their attention. They will then have the same information as those working on board. Should they not be satisfied with any aspect of the information provided (risk assessment, action plan, etc.) they can be in a position to contact the office directly and discuss any anomalies prior to boarding the vessel/installation. In this way, everyone, whether from the ship, installation or from ashore has access to comprehensive information regarding the space and will ensure that opportunities are available for an exchange of safety information between the ship or installation, the managing office and the surveyors or contractors.

Think of this management system like a library. Initially empty, but as the various audits take place it gradually becomes populated with relevant information on each of the enclosed spaces and becomes a permanent updatable living comprehensive on board guide. It does not interfere with the ships existing documentation such as risk assessments or ISM guides, rather it incorporates them into the library.

We are pleased to say that in conjunction with VideoTel International Ltd, (world experts on digital marine training and media) the Enclosed Space Management System will be available in DVD format or on line in early September allowing for the very first time, ships/installations to establish their own comprehensive enclosed space library available to all who need to enter enclosed spaces.

Finally it is pleasing to note that a few months ago the IMO issued the following;

SOLAS ENCLOSED SPACE RECOMMENDATIONS

Owners should carry out a risk assessment to identify all enclosed spaces on board the ship. This risk assessment should be repeated periodically to ensure it remains valid. The process of carrying out a risk assessment to identify enclosed spaces should be repeated at regular intervals as circumstances may change.

Competent and responsible persons should be trained in enclosed space hazard recognition, evaluation, measurement control and elimination.

Crew members should be trained, as appropriate, on enclosed space safety, including familiarization with on-board procedures for recognizing, evaluating, and controlling hazards associated with entry into enclosed spaces.

Enclosed space entry and rescue drills are required at least once every two months to ensure that crewmembers are familiar with the actions to be taken. Internal audits by the Owners of the ship's safety management system should verify that the established procedures are complied with in practice

We could not have said it better!