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Enclosed Space Entry and Rescue drills mandated by SOLAS and their implementation in practice

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<p>Abstract</p> <p>The objective of this thesis was to conduct a research on enclosed space entry and rescue among the crew of two shipping companies operating under the Finnish flag, and the maritime students at Satakunta University of Applied Sciences.</p> <p>The first part was to study the current legislations and requirements regarding enclosed space entry and rescue set by SOLAS, to establish the minimum bar to which the survey participants would meet. The second part was conducting the survey and analyzing the results.</p> <p>Apart from a couple of concerning and repetitive observations, the results were mainly positive due to the high level of training and valuable safety culture that exists in the Finnish maritime education system and on vessels sailing under the Finnish flag.</p> <p>The approaches to conducting enclosed space entry and rescue training on Finnish vessels vary greatly in these two companies from vessel to vessel. On some vessels, the training exercises are conducted so that they meet the minimum legal requirements regarding the testing of equipment, training of the personnel with enclosed space entry responsibilities, and then hold the exercise verbally among the crew. On some vessels the training exercises followed a pre-planned rescue scenario with an intended action of rescuing someone from an enclosed space in addition to the minimum legal requirements. These differences are caused by several factors. The attitude of the participants is a huge factor in the contents of the enclosed space entry and rescue training drills they hold on their vessels.</p> <p>The confidence, that an individual possesses the needed skills to rescue another person from an enclosed space among the crew on Finnish vessels is high and increases the longer they work on vessels as everything regarding safety and security becomes more familiar and second nature.</p> <p><u>Key words</u> Enclosed Space, Rescue, Entry, SOLAS, Drill, Emergency Training</p>		

CONTENTS

1 INTRODUCTION	5
1.1 What is an enclosed space.....	5
1.2 Dangers of enclosed spaces.....	6
2 THEORETICAL BACKGROUND	8
2.1 SOLAS	8
2.2 Legislative Requirements.....	8
2.2.1 Regulation 19.....	9
2.2.2 ISM Code.....	11
2.2.3 STCW	12
2.3 Emergency training objectives.....	13
3 PRACTICAL RESEARCH.....	15
3.1 Research plan	15
3.2 Results of the survey	16
3.2.1 Vessel types	16
3.2.2 Rank of person in charge during drill	18
3.2.3 Frequency of drills.....	19
3.2.4 Duration of the drill	20
3.2.5 Combining with other drills.....	21
3.2.6 Time of day	22
3.2.7 Drill contents	24
3.2.8 What happens during debriefing.....	25
3.2.9 Confidence to respond to an actual emergency	26
3.2.10 Personal skills	27
3.2.11 Negative impact	28
3.2.12 Rank of participant	30
3.2.13 Open-ended question	30
4 ANALYSIS	32
4.1 Conclusions	32
4.2 Safety improvement onboard	33
4.3 Future research	34
REFERENCES.....	36
APPENDIX 1	37

LIST OF TERMS

SOLAS	International Convention for Safety of Life at Sea
IMO	International Maritime Organization
SOLAS Vessel	A vessel of 500 GT or more, or any passenger vessel, operating in international waters.
FFLB	Free Fall Lifeboat
EPIRB	Emergency Position Indicating Radio Beacon
SAR	Search and Rescue
SART	Search and Rescue Transponder
GMDSS	Global Maritime Distress and Safety System
LSA	Life-saving Appliances
STCW	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers
ISM	The International Safety Management Code
ISPS	International Ship and Port facility Security Code
MRO	Mass Rescue Operations
IAMSAR	The International Aeronautical and Maritime Search and Rescue Manual
GT	Gross Tonnage
MEDEVAC	Medical evacuation

1 INTRODUCTION

The topic of the thesis is to conduct a survey about enclosed space entry and rescue. The main goals are to get a better understanding on how the crew members of two shipping companies operating under the Finnish flag and the maritime students from Satakunta University of Applied Sciences, later referred as trainees, feel about enclosed space entry and rescue training, and compare the answers given by these two groups. Do they feel confident in their own knowledge and abilities on enclosed space entry and rescue, or is there a lack of training on the subject in the Finnish maritime sector?

A survey was sent to the vessels of two Finnish shipping companies for their crew to fill out. The shipping companies, vessels and the participants' names will be kept anonymous in the thesis.

The survey was also sent to all maritime students at Satakunta University of Applied Sciences. The survey was also 100% anonymous for the students since the research was focused entirely on percentages about the thesis' subject.

1.1 What is an enclosed space

An enclosed space on a vessel is defined as a space which *“is not used for day to day activity and which has any of the following characteristics: limited opening for entry and exit, inadequate ventilation or is not designed for continuous worker occupancy”* (Kaushik, 2021). Enclosed spaces are frequent, especially on vessels designed for cargo transportation. Training and education about enclosed spaces are vital in the safe

day to day operations of crew members. Failure to recognize an enclosed space could have catastrophic consequences.

1.2 Dangers of enclosed spaces

Enclosed spaces possess various dangers on the human body without the necessary safety equipment. These dangers may vary from a concussion or other personal injury such as slips and falls which may lead to death. Enclosed spaces generally have restricted space to move around, inadequate lighting, insufficient ventilation, and an atmosphere which is not safe for human inhalation. Hazardous vapours or the general lack of oxygen may be enough to make a person go unconscious from just a single inhalation. (Kaushik, 2021)

“More than 50% of workers who die in enclosed spaces do so in the course of attempting to rescue other workers” (Spencer, 2012). An unfortunately common theme for enclosed space fatalities is that also the first rescuer loses their life, not because of safety equipment failure but rather the failure to identify an enclosed space.



Figure 1. Safe enclosed space entry (source: myseatime.com)

The most dangerous factor in an enclosed space is the lack of oxygen. It is important to note that the oxygen levels in an enclosed space are extremely prone to change. An oxygen depleted space can form in a place where it normally would not on its own due to the work being carried out in that space. Work such as welding, cutting, and brazing can cause the oxygen levels in that specific space to decrease to dangerous levels. The oxygen levels can decrease due to chemical reactions occurring in that space. Rusting, paint drying, or thorough bacterial action are common oxygen depleting chemical reactions on vessels. The normal breathable atmosphere contains 21% oxygen. (Spencer, 2012)

% oxygen content	Effect
23.5%	Oxygen enriched atmosphere. Disorientation, breathing problems, vision
19.5%	Absolute minimum acceptable oxygen level
15–19%	Impaired coordination. Decreased ability to work strenuously
12–14%	Respiration increases. Poor judgement
10–12%	Respiration increases. Lips blue
8–10%	Mental failure. Fainting. Nausea, unconsciousness, vomiting
6–8%	8 min: fatal. 6 min: 50% fatal. 4–5 min: possible recovery
4–6%	Coma in 40 seconds. Death in 3 minutes

Figure 2. Oxygen content effects on humans (source: iims.org.uk)



Figure 3. Warning signs for enclosed spaces

2 THEORETICAL BACKGROUND

2.1 SOLAS

The term SOLAS abbreviates from Safety of Life at Sea. It is an international maritime treaty, which establishes the minimum for safety measures in the construction, equipment, and operation of merchant ships (Wankhede, 2021). The first version of the SOLAS convention was adopted in 1914 in response to the Titanic disaster, the second in 1929, the third in 1948, the fourth in 1960, and the latest in 1974 (International Maritime Organization, 2021). The 1974 version includes the tacit acceptance procedure which provides that an amendment shall enter into force on a specified date unless, before that date, objections to the amendment are received from an agreed number of parties. As a result, the 1974 Convention has been updated and amended on numerous occasions. The Convention in force today is sometimes referred to as SOLAS, 1974, as amended. (International Maritime Organization, 2021)

2.2 Legislative Requirements

Each vessel meeting the standards for a SOLAS vessel must comply with the legislations covered in chapters 2.2.1, 2.2.2, and 2.2.3. These legislations are set by the International Maritime Organization under the SOLAS 1974 international maritime treaty. SOLAS sets the minimum requirements for safe operation, equipment onboard, and the construction of SOLAS vessels.

2.2.1 Regulation 19

Chapter III of the 1974 SOLAS convention sets the regulations for life-saving appliances and arrangements. Chapter III covers in total 38 different regulations. Regulation 19 sets the requirements for the organization of onboard emergency training drills. Regulation 30 also covers emergency training drills, but is used more as an addition to regulation 19 with the emphasis purely on passenger vessels. Regulation 19 states: “*1 This regulation applies to all ships. 2 Familiarity with safety installations and practice musters. 2.1 Every crew member with assigned emergency duties shall be familiar with these duties before the voyage begins*” (International Maritime Organization, 2021). This means every SOLAS vessel must comply with the standards set by regulation 19 when in operation. Each crew member must be familiarized with their duties in case of an emergency and have the competency to operate different safety equipment and procedures.

Paragraph 3 of Regulation 19 gives further insight into the regulations concerning onboard emergency drills. Paragraph 3.1 states: “*Drills shall, as far as practicable, be conducted as if there were an actual emergency*” (International Maritime Organization, 2021). Because this statement can be found as quite vague, it may be interpreted with ill intentions, but if taken with appropriate seriousness and a want for self-preservation it can be a great addition to the usefulness of emergency training. When both the organizing and participating parties treat emergency training drills with paragraph 3.1 in mind, the effectiveness of the exercise can be maximized and preparedness for actual emergencies develops.

Paragraph 3.3 of Regulation 19, defining the intervals for enclosed space entry and rescue drills for crew members, states: “*Crew members with enclosed space entry or rescue responsibilities shall participate in an enclosed space entry and rescue drill to be held on board the ship at least once every two months*” (International Maritime Organization, 2021). Paragraph 3.3 does not follow the same 25% rule as the abandon ship drills or fire drills defined in Paragraph 3.2, which states: “*Every crew member shall participate in at least one abandon ship drill and one fire drill every month. The drills of the crew shall take place within 24 h of the ship leaving a port if more than*

25% of the crew have not participated in abandon ship and fire drills on board that particular ship in the previous month”. (International Maritime Organization, 2021)

Regulations for enclosed space entry and rescue drills are provided in paragraph 3.6 of Regulation 19.

3.6 Enclosed space entry and rescue drills

*3.6.1 Enclosed space entry and rescue drills should be planned and conducted in a safe manner, taking into account, as appropriate, the guidance provided in the recommendations developed by the Organization**.*

3.6.2 Each enclosed space entry and rescue drill shall include:

- .1 checking and use of personal protective equipment required for entry;*
- .2 checking and use of communication equipment and procedures;*
- .3 checking and use of instruments for measuring the atmosphere in enclosed spaces;*
- .4 checking and use of rescue equipment and procedures; and*
- .5 instructions in first aid and resuscitation techniques.*

Paragraph 4 of Regulation 19 covers regulations on onboard training and instructions regarding life-saving appliances such as fire extinguishers, life-rafts, and other survival craft equipment. Paragraph 4.2.5 states: *“risks associated with enclosed spaces and onboard procedures for safe entry into such spaces which should take into account, as appropriate, the guidance provided in recommendations developed by the Organization**”* (International Maritime Organization, 2021).

Paragraph 5 mandates legitimate record keeping of emergency training, musters, and training. These records shall be filled in the ship’s logbook with an appropriate description of the training conducted. If emergency training drills are not conducted as regulation 19 states, actions stated in paragraph 5 must be taken: *“If a full muster, drill or training session is not held at the appointed time, an entry shall be made in the log-book stating the circumstances and the extent of the muster, drill or training session held.”* (International Maritime Organization, 2021).

2.2.2 ISM Code

After the tragic events of the Herald of Free Enterprise on the 6th of March 1987, the International Maritime Organization saw necessary the development and introduction of the International Safety Management Code, short for ISM Code. It has a goal “*to provide an international standard for the safe management and operation of ships and for pollution prevention*”. The entry into force happened on the 1st of July 1998, as chapter IX in the SOLAS convention. Further amendments to the ISM code were entered in 2002, 2006, 2009, 2010, and the latest in 2015. (International Maritime Organization, 2021)

Paragraph 7 of the ISM Code states: “*The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks should be defined and assigned to qualified personnel.*” (International Maritime Organization, 2021)

Paragraph 8 of the ISM Code covers the requirements for emergency preparedness.

8 EMERGENCY PREPAREDNESS

8.1 The Company should identify potential emergency shipboard situations, and establish procedures to respond to them.

8.2 The Company should establish programmes for drills and exercises to prepare for emergency actions.

8.3 The safety management system should provide for measures ensuring that the Company's organization can respond at any time to hazards, accidents and emergency situations involving its ships.

2.2.3 STCW

STCW, abbreviation for International Convention on Standards of Training, Certification and Watchkeeping for Seafarers was adopted on the 7th of July 1978, with entry into force on the 28th of April 1984, and “*was the first to establish basic requirements on training, certification and watchkeeping for seafarers on an international level.*” (International Maritime Organization, 2021). Before the STCW Convention was adopted, the standards for training, certification and watchkeeping of officers and ratings were the responsibility of the country who’s flag the vessel operated under. Because of this, the “*standards and procedures varied widely, even though shipping is the most international of all industries*” (International Maritime Organization, 2021).

A major revision of the code was made to the STCW Convention known as the 1995 amendments, “*in response to a recognized need to bring the Convention up to date and to respond to critics who pointed out the many vague phrases -- which resulted in different interpretations being made.*” (International Maritime Organization, 2021). The 1995 amendments were entered into force on the 1st of February 1997.

On the 25th of June 2010, the “*Manila amendments to the STCW Convention and Code*” were adopted, and entered into force on the 1st of January 2012. The emphasis was on “*bringing the Convention and Code up to date with developments since they were initially adopted and to enable them to address issues that are anticipated to emerge in the foreseeable future.*” (International Maritime Organization, 2021). This version of the STCW Code is the latest one adopted and is the one currently in force.

Section A-VI/1 of Chapter VI of the STCW Manila 2010 sets the “*Mandatory minimum requirements for safety familiarization, basic training and instruction for all seafarers*”. Some of the minimum requirements covered in Section A-VI/1 directly impact enclosed space entry and rescue. To mention from paragraph 1, safety familiarization training: “*Before being assigned to shipboard duties, all persons employed or engaged on a seagoing ship, other than passengers, shall receive approved familiarization training in personal survival techniques or receive sufficient*

information and instruction”, “communicate with other persons on board on elementary safety matters and understand safety information symbols, signs and alarm signals”, and “take immediate action upon encountering an accident or other medical emergency before seeking further medical assistance on board”. (International Maritime Organization, 2021)

2.3 Emergency training objectives

The first objective of enclosed space entry and rescue training is personnel training. Mastering the individual skills in enclosed space entry and rescue training with repetitive exercises maximizes the crew’s ability to react to real emergencies with best possible efficiency and safety. The proper usage of personal protective equipment in a real enclosed space rescue must be second nature for crew members with the enclosed space entry and rescue responsibilities. Because rescuing a person from an oxygen depleted atmosphere is a minute game, when an unconscious person is found, it is not the time to start remembering how exactly the personal protective equipment is used and deployed.

The second objective is communication and teamwork. Improving communication, coordination, and cooperation between personnel onboard with planned exercises is essential for a quick and efficient reaction to a real emergency. Drills help personnel to identify possible mishaps with each other. The participants learn to synchronize their efforts to achieve the best possible outcome. With enclosed space entry and rescue a rapid response means the death or survival of another crew member.

The third objective is the testing of equipment. Because some emergency and personal protective equipment have expiration dates, for example oxygen bottles or fire extinguishers, the regular testing and documenting of these equipment is indispensable. This is covered in paragraph 3.6 of Regulation 19 of the 1974 SOLAS Convention. These checks are mostly done by visual inspections and quick tests, but planned enclosed space entry and rescue drills make the prolonged usage of the

personal protective equipment possible for the crew members to maximize their familiarity.

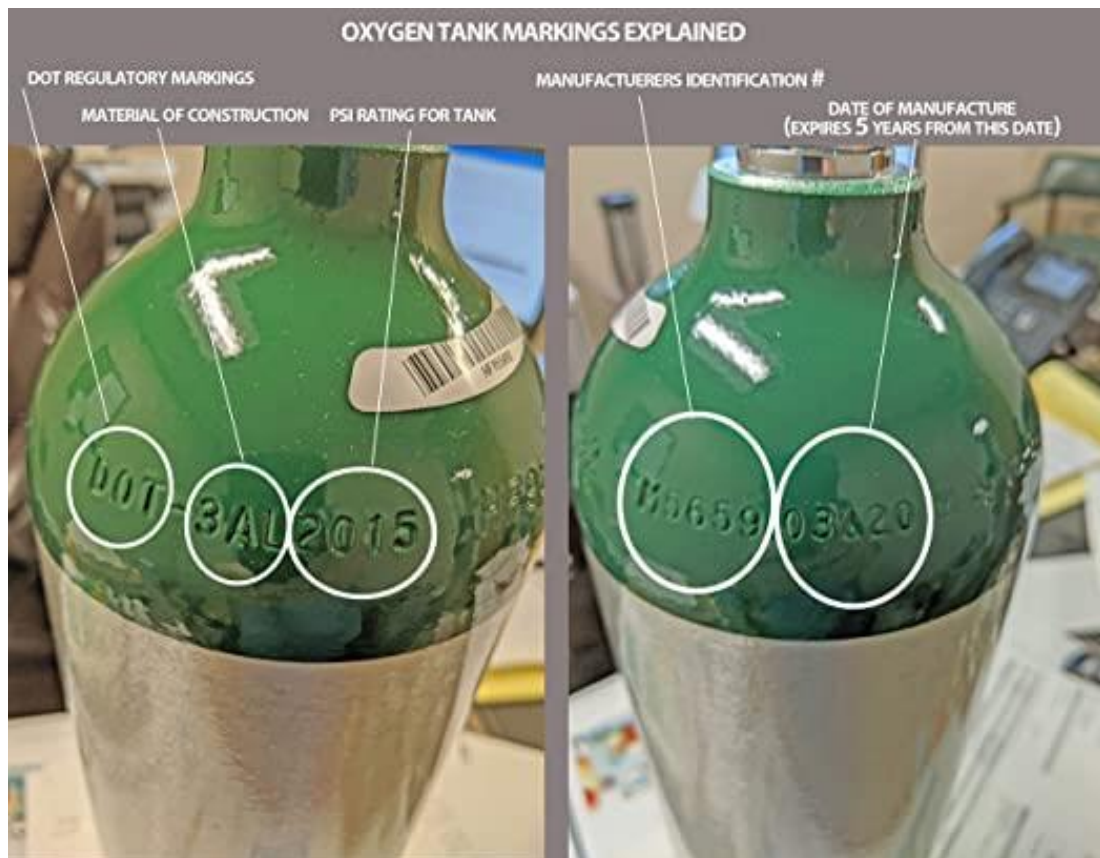


Figure 4. Oxygen bottle markings explained

The fourth objective is the fulfilling of the legislative requirements. Ultimately enclosed space entry and rescue training exercises are completed because they are required by law. Not fulfilling the legal obligations covering enclosed space entry and rescue training will cause, if caught, very sincere consequences for the shipping company and the personnel in charge of making sure the minimum legal standards are met on their vessel. The easiest way to avoid legal complications regarding safety training is to comply with the regulations of the 1974 SOLAS Convention and keep sufficient documentation of the regulation standards being met onboard.

3 PRACTICAL RESEARCH

3.1 Research plan

The ultimate purpose of the research was to gather data on enclosed space entry and rescue proficiency of the crew members of two shipping companies operating under the Finnish flag, and maritime students at Satakunta University of Applied Sciences, and how well the skills learned in the maritime education programmes are maintained and advanced in the working environment.

To get accurate data on enclosed space entry and rescue training in the current working environment, the survey was sent to two anonymous shipping companies operating under the Finnish flag for their crew to fill out. One of the goals was to find out if there were anomalies between the students in the maritime programmes and the people currently working at sea. The other goal was to find out how the students in the maritime programmes feel about their know-how skills while they are still studying compared to crew members with years of sailing experience?

In the survey was also a section where the participants could choose to agree with a pre-written statement if they had experienced negative aspects on safety training onboard Finnish vessels. These pre-written negative statements ranged from “my co-workers don’t care about safety training” to “I don’t feel safe in the current working environment”. The goal in this section was to find out how common negative attitudes and un-trustworthiness towards the common safety skills and equipment were onboard vessels sailing under the Finnish flag.

The hypothesis is that because safety and security is a very high priority on Finnish vessels and in the Finnish maritime education programmes, the overwhelming majority will be more than pleased in their training and knowledge on enclosed space entry and rescue and in general other safety related themes. Of course, some negative answers are expected, but these events are far more likely to occur because of rare

individuals causing negative effects and not because of the education and working system itself.

3.2 Results of the survey

The survey consisted of 13 questions, of which two were not asked from the onboard trainees. The questions absent from the onboard trainees were about the frequency of the drills, and the contents of debriefing, which were question numbers three and eight respectively. The reasons for this are disclosed in their corresponding chapters.

3.2.1 Vessel types

Question number one was done to map out the different types of vessels the answers come from. This was done because the results may vary between different types of vessels even if they are sailing under the same flag, even though the regulations of the 1974 SOLAS Convention must be complied with on every SOLAS vessel no matter under which flag they are operating under nor what type of vessel they are. The same rules and regulations regarding enclosed space entry and rescue training exercises apply on all vessels which desire to be classified as SOLAS vessels. The International Maritime Organization classifies a SOLAS vessel as: *“A vessel of 500 GT or more, or any passenger vessel, operating in international waters”* (International Maritime Organization, 2021).

The answers from crew members were quite predictable since the clear majority portion of vessels operating under the Finnish flag are either general cargo, RORO/Ropax, or other cargo vessels. Fourteen out of twenty-three answers came from general cargo vessels, four answers came from RORO/Ropax and other cargo vessels each, and one answer coming from a service ship.

Your vessel type
23 vastausta

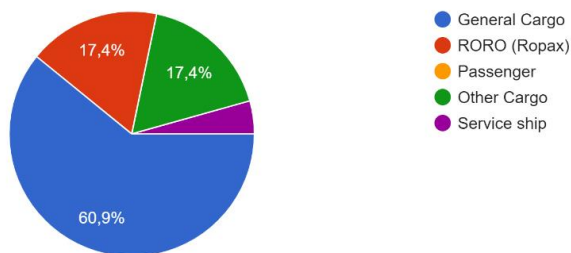


Figure 5. Vessel type (crew)

The answer discrepancy with onboard trainees follows closely with crew members. Since the onboard training periods are completed on multiple vessels, the onboard trainees were given the option to choose multiple answers. Out of eighteen participants, fifteen had been on general cargo vessels, thirteen at RORO/Ropax vessels, four on passenger vessels, and four on cargo vessels. The onboard trainees also had the option to type out the types of vessels they had been on, hence the answers for the different types of vessels, even if they belong to one of the three most common options mentioned before.

I have been on onboard training on the following type of vessels (can check multiple)
18 vastausta

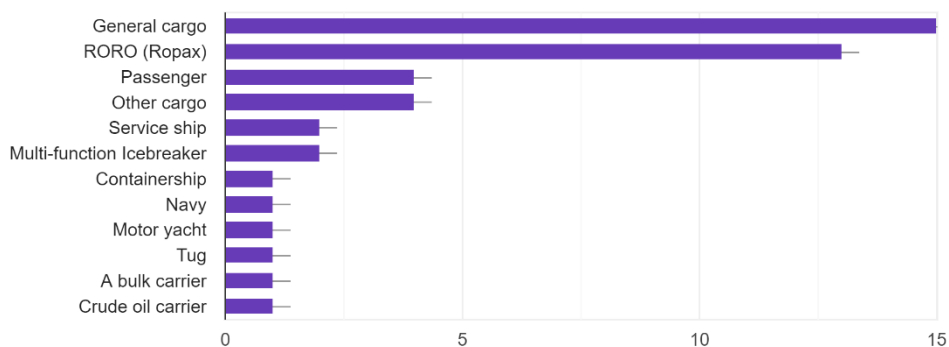


Figure 6. Vessel types (onboard trainees)

3.2.2 Rank of person in charge during drill

Question two was about the rank of the person in charge of holding and organizing the enclosed space entry and rescue training exercises on their vessel. Regulation 19 of the 1974 SOLAS Convention does not specify that a certain officer or engineer must be the one holding the enclosed space entry and rescue training, and as such the answers from crew members and onboard trainees vary from vessel to vessel. Out of twenty-three crew members, sixteen answered that the person in charge on their vessel was either the 2nd or 3rd officer, followed by four answering the chief engineer, and lastly two answering the chief officer. With onboard trainees the results vary considerably. This is because the onboard trainees were given the choice to choose multiple answers because onboard training periods consist of training on multiple vessels. Out of eighteen participants, fourteen said that the chief officer had been in charge of the enclosed space entry and rescue training exercises, followed by nine answering the 2nd or 3rd officers, and lastly five answering chief engineer.

Rank of person in charge of enclosed space entry and rescue drills on your vessel
23 vastausta

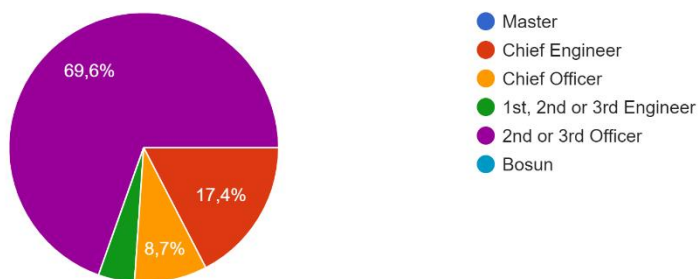


Figure 7. Rank of person in charge (crew)

Rank of person in charge of enclosed space entry and rescue drills on vessels I have been (can check multiple)

18 vastausta

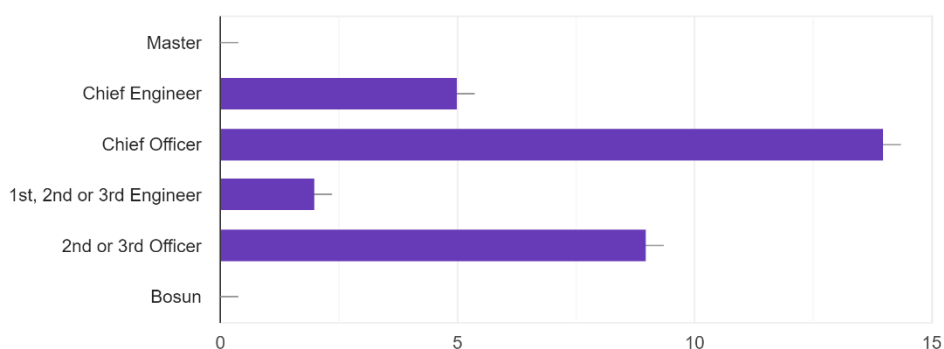


Figure 8. Rank of person in charge (onboard trainees)

3.2.3 Frequency of drills

As mentioned earlier, paragraph 3.2 of Regulation 19 states: “*Crew members with enclosed space entry or rescue responsibilities shall participate in an enclosed space entry and rescue drill to be held on board the ship at least once every two months*” (International Maritime Organization, 2021). This question was aimed to figure out if the minimum requirements set by the 1974 SOLAS Convention are met on the vessels of these two companies currently sailing under the Finnish flag which the survey was sent to.

How often do you take part in an enclosed space entry and rescue drill?

23 vastausta

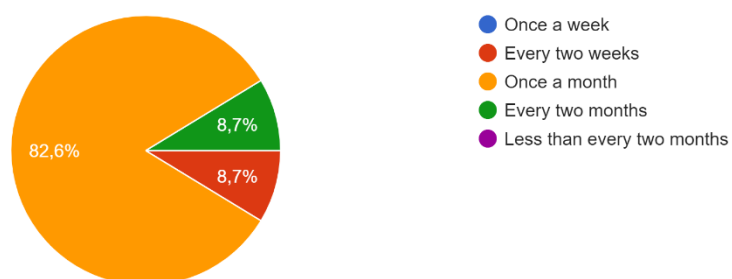


Figure 9. Frequency of drills (crew)

This question was not asked from the onboard trainees for two reasons. First, the most common duration of onboard training is under two months, which is the maximum allowed interval between enclosed space entry and rescue training exercises. Second, it is very atypical for onboard trainees to have enclosed space entry and rescue responsibilities but as the survey later shows, many onboard trainees have in fact regularly taken part in enclosed space entry and rescue drills during their training periods.

3.2.4 Duration of the drill

The purpose of this question was to find out how lengthy the enclosed space entry and rescue drills were. This question was asked both from crew members, and onboard trainees. Regulation 19 of the 1974 SOLAS Convention does not set a specific time limit for enclosed space entry and rescue drills, but states that all personal protective equipment, communication equipment, atmospheric measuring instruments, and rescue equipment must be tested, along with instructions in first aid and resuscitation.

Duration of the enclosed space entry and rescue drills on your vessel
23 vastausta

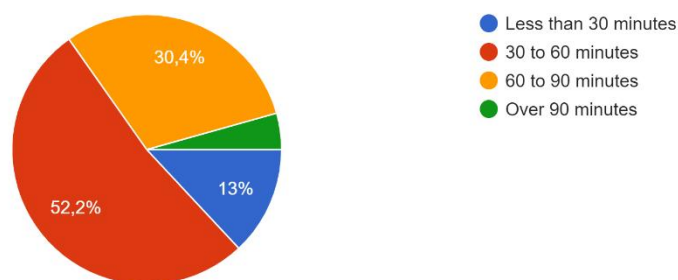


Figure 10. Duration of drill (crew)

As the data shows, the duration for the majority of equipment testing and first aid instructions takes 30 to 60 minutes. The option for 60 to 90 minutes has over a quarter of the answers at second place and only 13% have less than 30 minutes. This was a very expected result since safety and security have a very high priority on vessels operating under the Finnish flag and in the Finnish education curriculum.

Duration of the enclosed space entry and rescue drills on your vessels (can check multiple)
17 vastausta

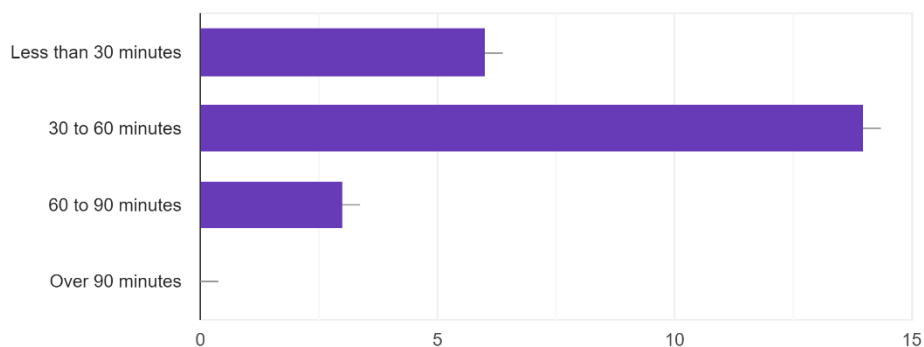


Figure 11. Duration of drill (onboard trainees)

The answers from onboard trainees follow a sort of similar pattern with 30 to 60 minutes being the overwhelming majority. However, the 60 to 90 minutes gets the third most answers with the less than 30-minute option overtaking it as second place, which could be a result of the lack of responsibilities onboard trainees have when it comes to enclosed space entry and rescue, hence the subject is not covered as much.

3.2.5 Combining with other drills

The question whether the enclosed space entry and rescue drills were combined with other emergency training drills had quite varied answers between crew members and onboard trainees. Regulation 19 of the 1974 SOLAS Convention does not give instructions or advisories on enclosed space entry and rescue training being held in combination with other emergency training drills.

Since combining with other emergency training drills requires large cooperation from different departments onboard, holding the enclosed space entry and rescue drills as a separate exercises is in theory the more efficient option in terms of time consumption, but combining them with other exercises may prepare the participants better for real emergencies.

Are the enclosed space entry and rescue drills on your vessel conducted in combination with other training exercises or as it's own entity

23 vastausta

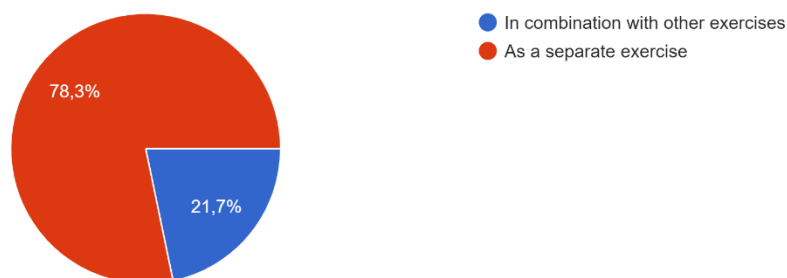


Figure 12. Combining with other drills (crew)

Were the enclosed space entry and rescue drills on your vessels conducted in combination with other training exercises or as it's own entity

17 vastausta

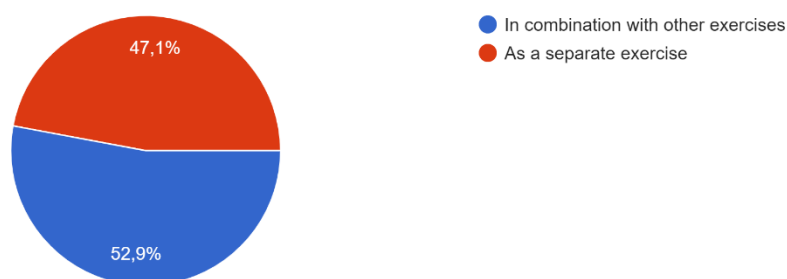


Figure 13. Combining with other drills (onboard trainees)

3.2.6 Time of day

The purpose of asking the time of day during the emergency exercises was to find out how common or uncommon it was to hold emergency training exercises in non-ideal conditions such as poor visibility and crew tiredness. As the results show, the overwhelming majority of answers were selected between 1200 and 1600 hours. Regulation 19 of the 1974 SOLAS Convention does not mandate that enclosed space entry and rescue training should be held at different times of day to better prepare the crew members with enclosed space entry responsibilities for real emergencies that may occur outside of the most common time of day during training. Holding the enclosed

space entry and rescue training drills only at the most ideal conditions may leave a hole in the know-how skills for the crew members when a real emergency suddenly occurs, for example during night-time when suddenly the aid of sunlight and other awake crew members is cut off.

Out of twenty-three crew members only one answered that the most common time of day for their emergency training exercises was between 1600 and 2000 hours, and the rest answered between 1200 and 1600 hours. Out of eighteen onboard trainees, two answered that the most common time of day for emergency training exercises has been between 0800 and 1200 hours, and the rest answered between 1200 and 1600 hours.

Most common time of day for your emergency drills
23 vastausta

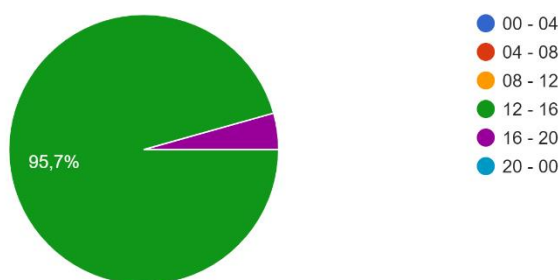


Figure 14. Most common time of day (crew)

Most common time of day for your emergency drills
18 vastausta

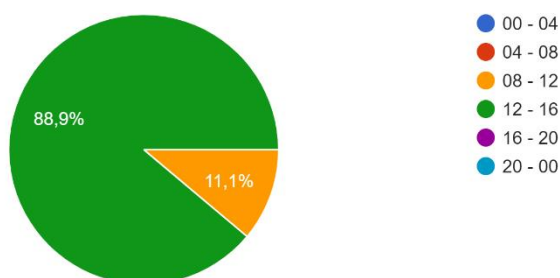


Figure 15. Most common time of day (onboard trainees)

3.2.7 Drill contents

Very interesting deviations between answers from crew members and onboard trainees appear when it come to the contents of their enclosed space entry and rescue training. The overwhelming majority of the crew agree that their entry and rescue training exercises follow a specific scenario on top of the equipment testing. A specific scenario was given as an example in the survey as “unconscious person in a known enclosed space”. With onboard trainees the most common option was that the enclosed space entry and rescue training exercises they took part in had no specific scenarios to practice but rather the exercises were conducted verbally, and the mandatory equipment was tested.

Which of the following statements best describes enclosed space entry and rescue drills on your vessel

23 vastausta

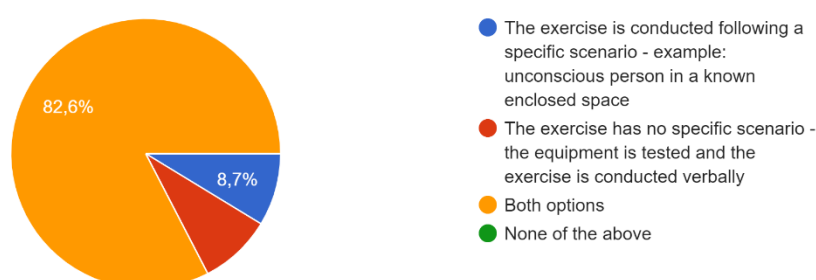


Figure 16. Contents of drill (crew)

Which of the following statements best describes enclosed space entry and rescue drills you have taken part in

18 vastausta

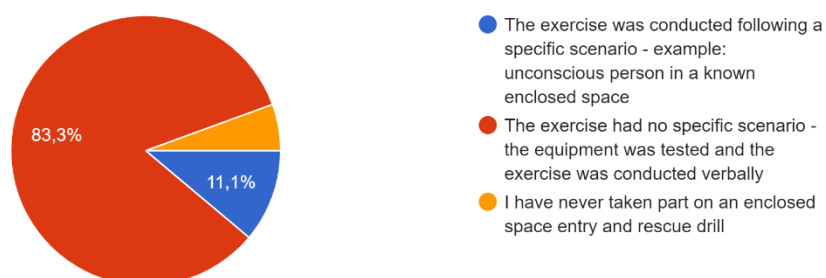


Figure 17. Contents of drill (onboard trainees)

3.2.8 What happens during debriefing

Question number eight, which was asked only from crew members, was about the contents of the debriefing meetings regarding safety or emergency training in general on their vessel. This question was not asked from the onboard trainees since unless of an exception, they do not partake in multiple debriefings on the same vessel. This could distort the data since the debriefings they do attend may be conducted differently from usual. Debriefing after emergency training exercises is profoundly important in both the general safety onboard and the improvement of the crew, and their personal skills regarding emergencies. Without debriefing meetings, the aspects on what went wrong and what could be done better are completely ignored. Mistakes are the best teacher when it comes to experience. If mistakes are made during emergency training exercises, they need to be addressed so the participants will learn from them when it is just a training exercise and not a real emergency where human lives are at stake.

Out of twenty-three answers, everyone agreed that their debriefing contains at least the evaluation of the crew's overall performance. Twenty agreed that they have had discussions about suggestions for improving procedures during a real emergency. Seventeen had suggestions for future exercises and only fifteen had discussions about mistakes made during the exercise. Ten answered they discussed concerns about the contents of the exercise just completed.

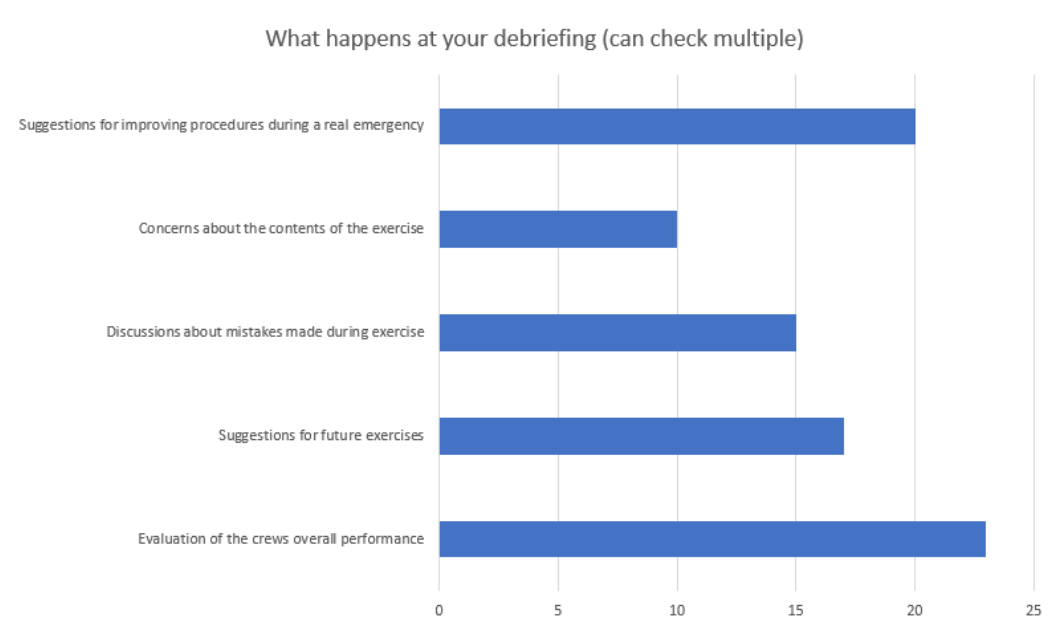


Figure 18. Contents of debriefing (crew) (23 answers)

3.2.9 Confidence to respond to an actual emergency

The ninth question in the survey is about the individual's confidence whether they could save an unconscious person from an enclosed space. In my opinion this is one of the most important questions in the survey since it is the reason why studying and training for real emergencies is completed. Question is, do they feel they possess the needed skills to save an unconscious co-worker from a suspected enclosed space in such timely manner that the victim does not get permanent damage to their health or worst-case die, and in a safe manner so that the rescuer themselves does not get injured or die in the process.

On a scale from 1 to 10, how confident are you that you could save an unconscious person from an enclosed space, 10 - absolutely confident, 1 - not confident at all

23 vastausta

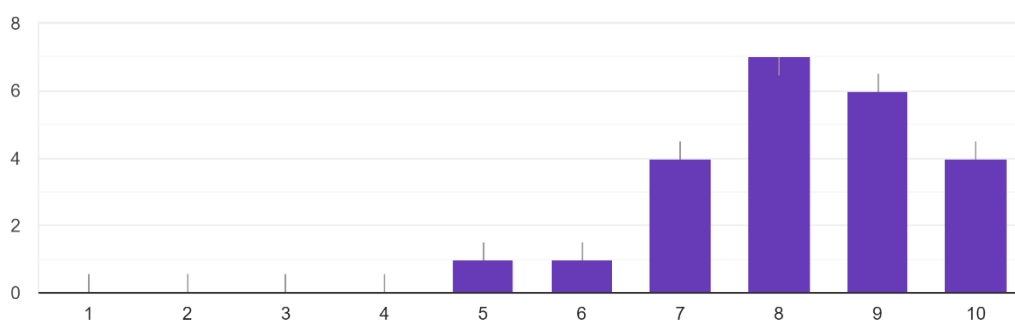


Figure 19. Confidence in own abilities (crew)

On a scale from 1 to 10, how confident are you that you could save an unconscious person from an enclosed space, 10 - absolutely confident, 1 - not confident at all

18 vastausta

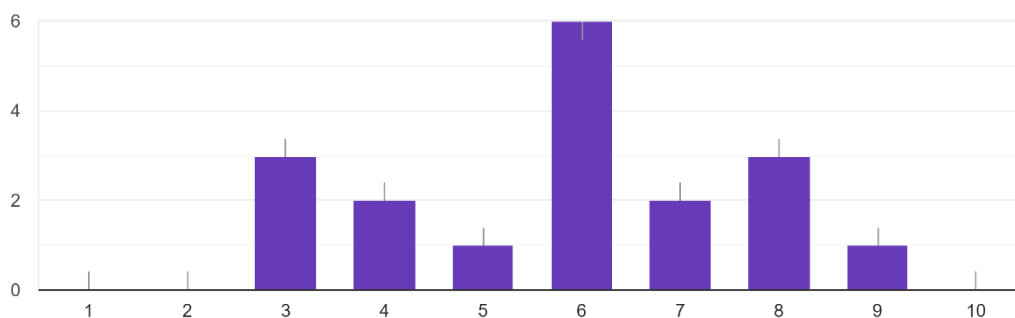


Figure 20. Confidence in own abilities (onboard trainees)

3.2.10 Personal skills

The personal skills statement agreement question was done to map out how extensive an individual's personal skills regarding safety in enclosed space entry is and comparing the answers between crew members and onboard trainees.

With no surprises, seven out of nine statements received maximum possible answers from the crew with only two people not being sure what carbon monoxide poisoning feels like and one person not feeling strong enough to move an unconscious person from point A to point B.

Answers from onboard trainees were more scattered across the board compared to the crew. Out of eighteen possible answers, the only full marks were knowing how to raise an alarm and knowing how to resuscitate someone who is not breathing. Interesting observations were that seven people out of eighteen knew what carbon monoxide poisoning feels like, eleven out of eighteen knew how to identify an expired oxygen bottle, and the most alarming one was that only two out of eighteen knew how to operate the emergency oxygen system in their vessels hospital.

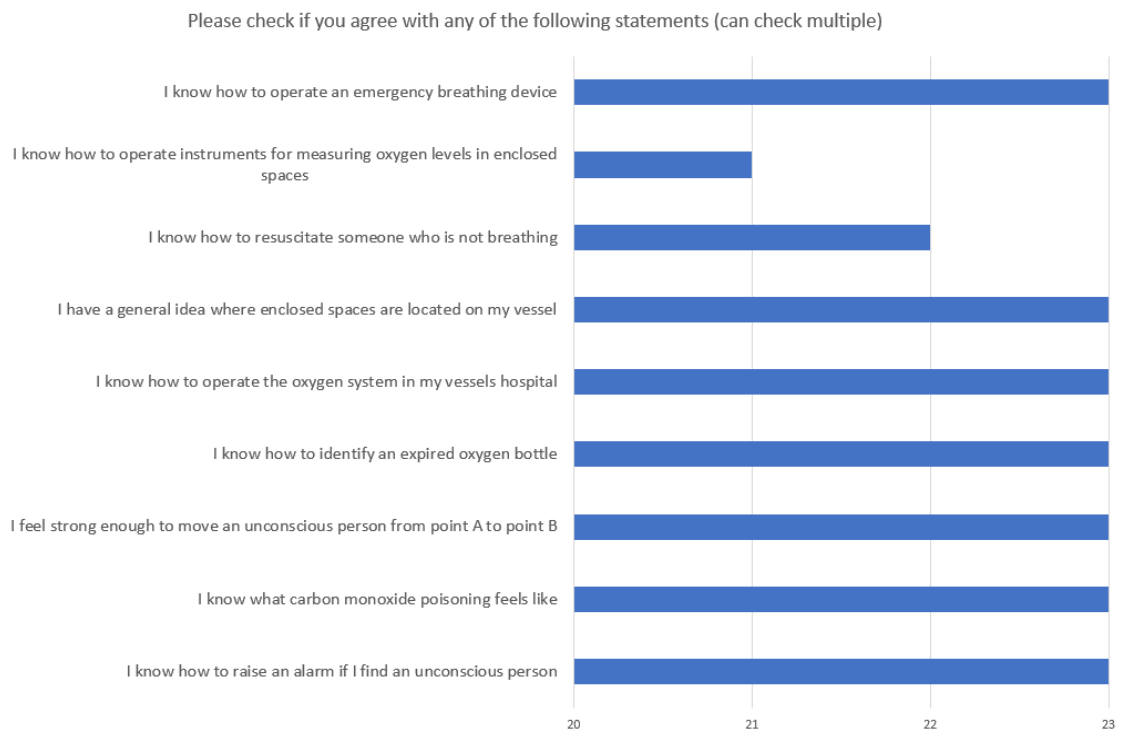


Figure 21. Personal skills (crew) (23 answers)

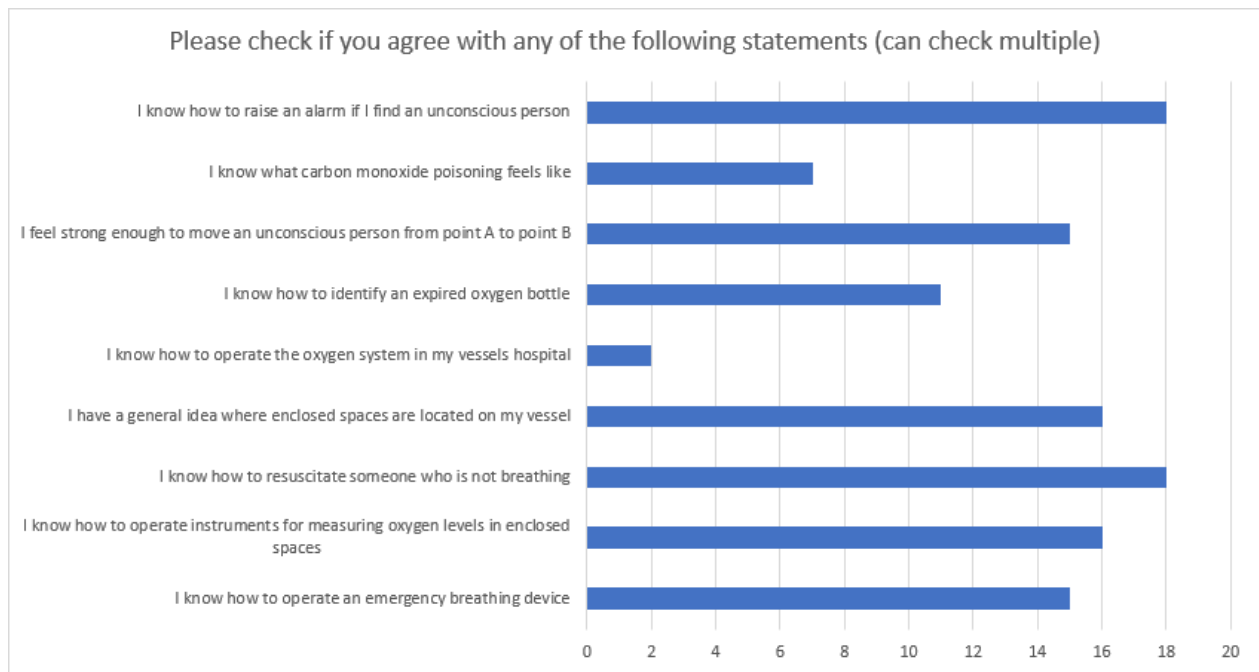


Figure 22. Personal skills (onboard trainees) (18 answers)

3.2.11 Negative impact

In this question the participants were asked to check a box if they had experienced the negative statement written in it. The purpose was to map out percentages on how many seafarers under the Finnish flag do experience difficulties regarding emergency training and emergencies in general. From crew members, four out of twenty-three had at some point felt like other participants could not care less for the exercise, and three agreed with the statement that their co-workers have a know-everything attitude. Two answered that they have been at some point too tired to follow the contents of the emergency training exercises with proper intent.

Out of eighteen onboard trainees, very alarmingly, seven answered that they do not feel like they have gotten enough training for enclosed space entry and rescue, and that they felt like the other participants could not care less for the emergency training exercise. Three out of eighteen answered that they had never trained for enclosed space entry and rescue.

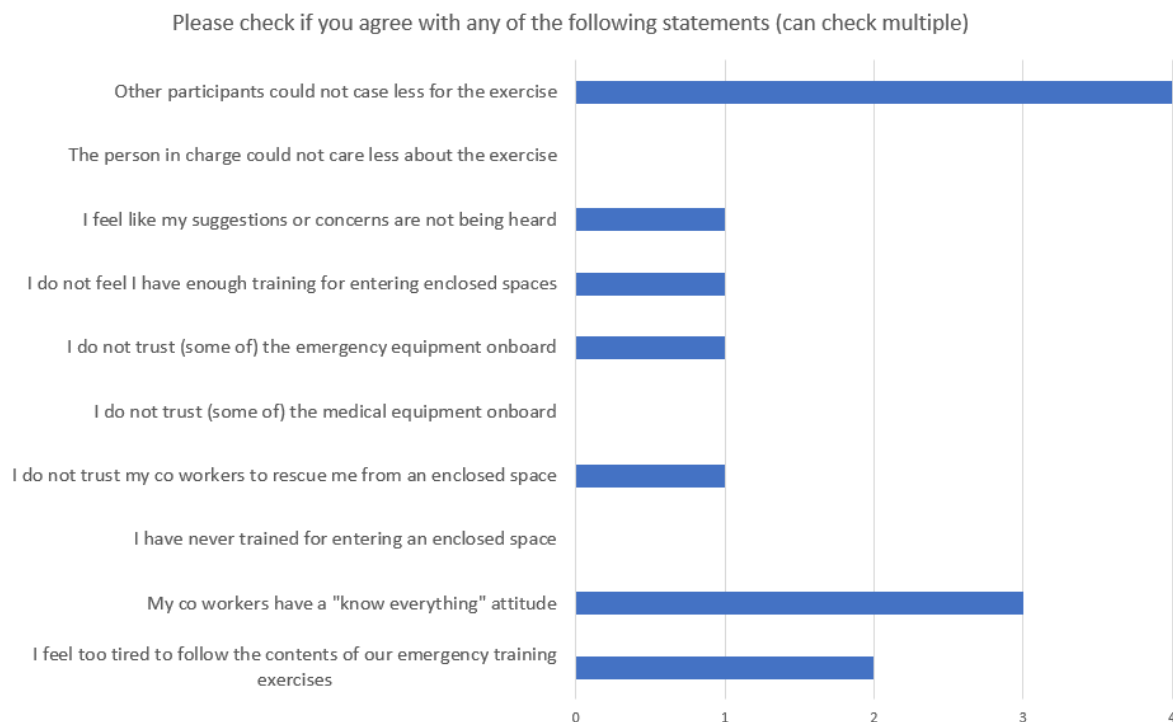


Figure 23. Negative experiences (crew) (23 answers)

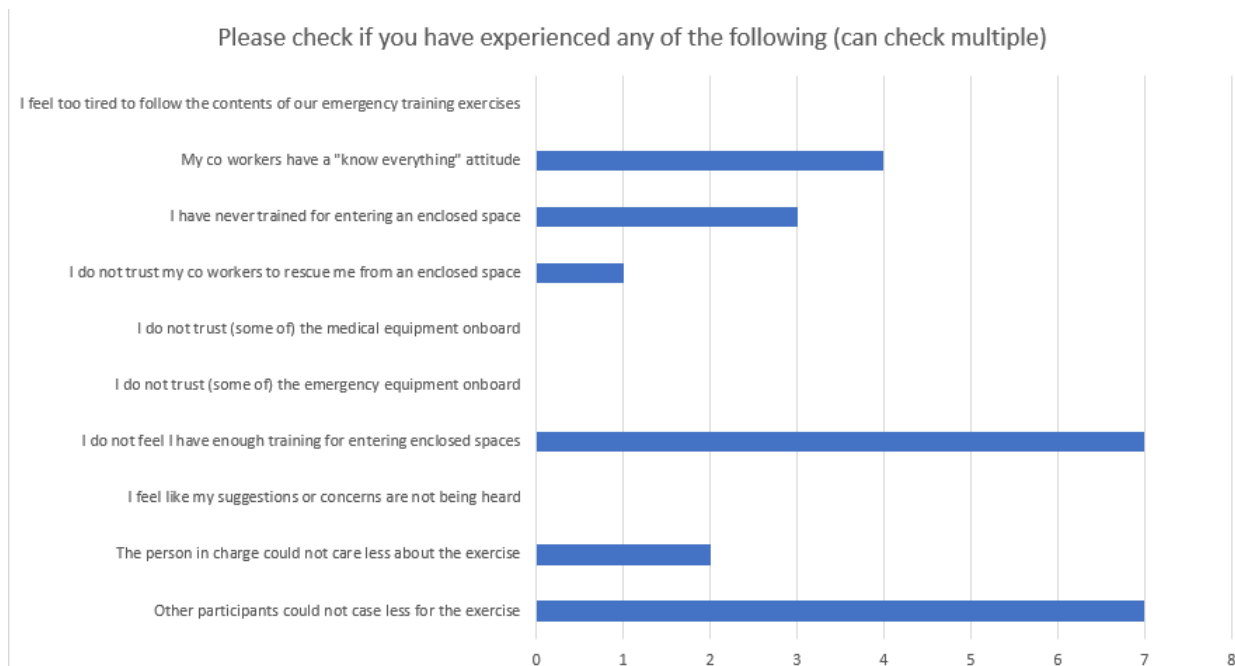


Figure 24. Negative impacts (onboard trainees) (18 answers)

3.2.12 Rank of participant

The final question for the crew members was to answer their position onboard. The majority of answers from crew members came from the deck department. The distribution of participants represented in the graph below.

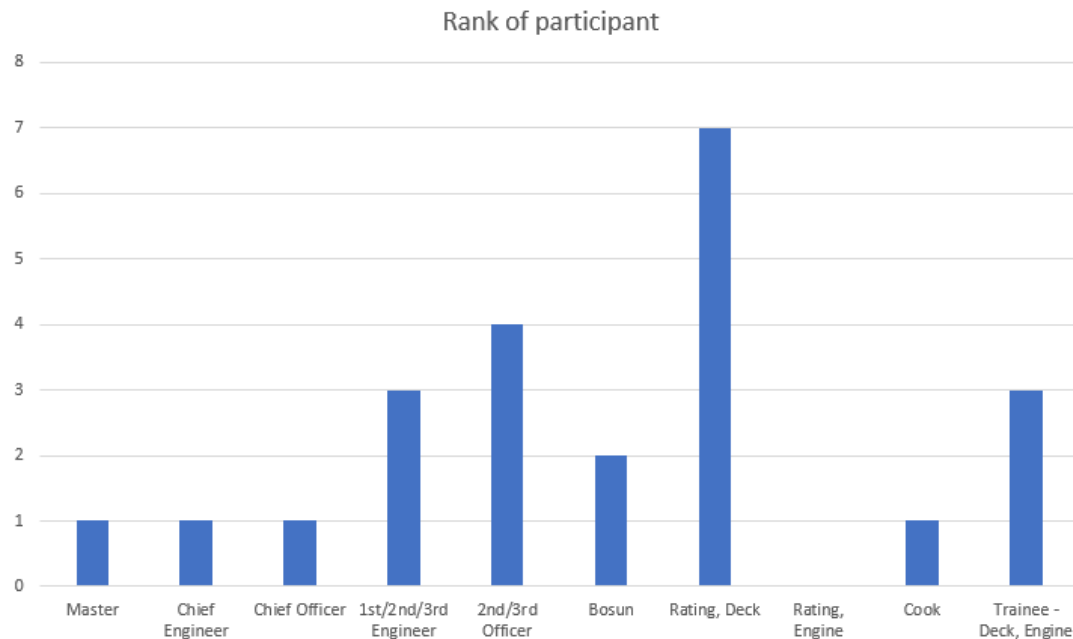


Figure 25. Rank of participant (crew) (23 answers)

3.2.13 Open-ended question

The last question in the survey was an open-ended question, which was not mandatory to answer. One anonymous individual said: *“I would like to train more handling of safety equipment. They could save expired equipments and use those for training because they don’t want to open packages. Filipinos even doesn’t understand finnish labels from medicines...”*

The second open-ended answer was in Finnish quoted: *“Ropax aluksilla oli huomasi erityisesti, että osa henkilökuntaa ei ollut kiinnostunut harjoittelemaan, kokivat hyvinkin vieraaksi pelastautumisharjoitukset. Olivat enemmän asenteella, kyllä kansikonepuoli hoitaa verrattuna ravintola/hytti puolen ihmisiin. Harjoitusten jälkeen pitäisi olla aina jonkinlainen palautekeskusteluhetki eli mitä opittiin mikä meni pieleen ym.”*, which translates to: On Ropax vessels especially noticed that some of the crew

members were not interested to train at all and felt emergency training exercises as very strange. Some had an attitude that the deck-engine departments will take care of it compared to restaurant/cabin department personnel. After emergency training exercises there should always be a feedback debriefing session for what was learned and what went wrong etc.

The latter answer shows that not all vessels hold a debriefing after enclosed space entry and rescue training exercises.

4 ANALYSIS

4.1 Conclusions

In my opinion, the survey on enclosed space entry and rescue succeeded. The number of answers to the surveys were sufficient. The answers came from crew members with different ranks, and they were diverse enough to form a relatively accurate dataset on the subject of the thesis. The shipping companies that were asked to participate in the survey were willing to send the survey out to their vessels for their crew to fill out. The answers from onboard trainees were detailed and the feedback on the open-ended question, where the participants could comment on anything they wished, was useful for this survey. The participants could share their thoughts on their own experiences and suggestions for improvement.

Apart from a couple of concerning and repetitive observations, the results were mainly positive due to the high level of training and valuable safety culture that exists in the Finnish maritime education system and on vessels sailing under the Finnish flag. Based on the answers on this survey and the theoretical materials on hand, the following conclusions can be made.

First, the approaches to conducting enclosed space entry and rescue training on Finnish vessels in these two companies vary greatly from vessel to vessel. On some vessels, the training exercises are conducted so that they meet the minimum legal requirements regarding the testing of equipment and training of the personnel with enclosed space entry responsibilities and then hold the exercise verbally among the crew. On some vessels the training exercises followed a pre-planned rescue scenario with an intended action of rescuing someone from an enclosed space in addition to the minimum legal requirements. On some vessels the enclosed space entry and rescue training exercises are combined with other emergency training drills, such as a fire drill. These differences could be caused by several factors. Quite a lot of participants agreed with the statement: “other participants could not care less for the exercise” which is quite

worrying. The attitude of the participants is a huge factor in the contents of the enclosed space entry and rescue training drills they hold on their vessels.

The second conclusion is on the effectiveness, quality, and frequency of enclosed space entry and rescue training on Finnish vessels and in the Finnish maritime education system. The answers from crew members on the self-confidence question on the survey ranged from 5 to 10 with the average being 8.2 on a 1 to 10 scale. In conclusion, the confidence that an individual possesses the needed skills to rescue another person from an enclosed space is very high among crew members, and the self-confidence increases the longer they work on a certain vessel as everything regarding safety becomes more familiar and second nature. The answers to the confidence question among the onboard trainees had lower answers and more of a range, with the average being 5.63 out of 10. This is one of the very reasons why holding proper emergency training exercises is so important in the maritime sector. Constantly improving one's own skills is a necessity, especially when it comes to safety. From 18 onboard trainees, 7 answered that they have not gotten the amount of training on enclosed space entry and rescue they would want. When students graduate from the Finnish maritime education system, they are not perfect sailors. Continual training and improvement are a necessity if vessels sailing under the Finnish flag intend to hold their reputation of excellent competency. In the maritime sector, no one is too experienced.

4.2 Safety improvement onboard

To maintain the sufficient continual improvement from emergency training exercises onboard for future generations, the person in charge should keep the following points in mind.

The legislative requirements and obligatory elements regarding the holding of enclosed space entry and rescue training onboard from Regulation 19 of the 1974 SOLAS Convention are the absolute minimum requirements and should not be seen as a mental checklist that must be done from top to bottom and nothing more.

The drills should be organized with thoughtful planning and intent. The objectives should be defined clearly to the crew, and the maximum effectiveness is established when an assertive scenario is followed. If the coordinator is incapable of holding drills with scenarios which reflect the dangers and risks of entering an enclosed space and rescuing an unconscious person, they are to seek assistance from other personnel.

The drills for enclosed space entry and rescue should be practical for the participants regarding the usage of emergency equipment that would be used to rescue a person from an enclosed space, and the skills needed to give medical care for a person who has been rescued from an enclosed space. The drills should not be rushed and hurried, and the effectiveness of an enclosed space entry and rescue drill is lost if a proper debriefing is not conducted.

The person in charge of holding the emergency training drill must pay attention during the debriefing session. The concerns and suggestions of the participants should be taken with appropriate attention, and they should be encouraged to share these concerns or suggestions vocally to everyone else taking part in the drill and not hold these to themselves.

The contingency plans for enclosed space entry and rescue drills onboard their vessel should be regularly checked and improved based on the feedback received from the participants after holding these drills. The ultimate goal regarding safety training onboard Finnish vessels is to encourage and reward a safety-orientated working culture among all the crew members, and when negative attention and feedback to emergency training onboard is noticed or received, it should be taken care of.

4.3 Future research

For future research topics on enclosed space entry and rescue the following can be recommended. First, since a number of participants in the survey agree with the statements: *“other participants could not care less for the exercise”* and *“my co-*

workers have a know everything attitude”, a great addition would be to conduct research into the factors that cause this type of attitude and behaviour towards emergency training exercises, and how this could be eliminated onboard Finnish vessels.

The second would be to conduct further research into how the effectiveness and quality of the enclosed space entry and rescue training exercises could be maximized for the participants who are eager to learn and gain more experience as a seafarer, to make responding to an emergency a second nature in which the crew is a controlling component and not a purely reactive one. Should more training be done during the studies? Is holding an enclosed space entry and rescue drill every two months enough if the drill consists of mandatory equipment testing and nothing more?

REFERENCES

- International Maritime Organization. (2021). International Convention for the Safety of Life at Sea (SOLAS), 1974. *imo.org*.
- International Maritime Organization. (2021). International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW). *International Maritime Organization*.
- International Maritime Organization. (2021). The International Safety Management (ISM) Code. *International Maritime Organization*.
- International Maritime Rescue Federation. (2021). The International Maritime Rescue Federation Mass Rescue Operations Project: *international-maritime-rescue.org*.
- Jassal, R. (2016). Risks Involved in Enclosed Spaces and How These Can Be Mitigated. *MySeaTime*.
- Kaushik, M. (2021). Procedure for Entering an Enclosed Space on a Ship. *Marine Insight*.
- Marine Gyaan. (2016). What is the meaning of enclosed space on ships. *marinegyaan.com*.
- Maritime Executive. (2017). Remembering the Herald of Free Enterprise. *The Maritime Executive*.
- Spencer, C. (2012). A master's guide to: enclosed space entry. *The International Institute of Marine Surveying*, 60.
- Wankhede, A. (2021). Safety of Life at Sea (SOLAS) – The Ultimate Guide. *Marine Insight*.

APPENDIX 1

Enclosed Space Entry and Rescue Training Survey

Hello! My name is Santeri Uski. I am collecting data about enclosed space entry and rescue for the thesis of my bachelor's degree at SAMK Rauma.

This survey is 100% anonymous, your name, vessel name nor shipping company name will be revealed. You are able to skip a question if need be. All questions answered takes only about 4 minutes. Questions are multiple choice.

1. Your vessel type
 - General Cargo
 - RORO (Ropax)
 - Passenger
 - Other Cargo
 - Service Ship
 - Other (please specify)
2. Rank of person in charge of enclosed space entry and rescue drills on your vessel
 - Master
 - Chief Engineer
 - Chief Officer
 - 1st / 2nd / 3rd Engineer
 - 2nd / 3rd Officer
 - Bosun
 - Other (please specify)

3. How often do you take part in an enclosed space entry and rescue drill?
 - Once a week
 - Every two weeks
 - Once a month
 - Every two months
 - Less than every two months
 - Other (please specify)
4. Duration of the enclosed space entry and rescue drills on your vessel
 - Less than 30 minutes
 - 30 to 60 minutes
 - 60 to 90 minutes
 - Over 90 minutes
5. Are the enclosed space entry and rescue drills on your vessel conducted in combination with other training exercises or as it's own entity
 - In combination with other exercises
 - As a separate exercise
6. Most common time of day for your emergency drills
 - 00 – 04
 - 04 – 08
 - 08 – 12
 - 12 – 16
 - 16 – 20
 - 20 – 00
7. Which of the following statements best describes enclosed space entry and rescue drills on your vessel
 - The exercise is conducted following a specific scenario - example: unconscious person in a known enclosed space
 - The exercise has no specific scenario - the equipment is tested and the exercise is conducted verbally
 - Both options
 - None of the above

8. What happens at your debriefing (can check multiple)
 - Evaluation of the crews overall performance
 - Suggestions for future exercises
 - Discussions about mistakes made during exercise
 - Concerns about the contents of the exercise
 - Suggestions for improving procedures during a real emergency
 - Other (please specify)
9. On a scale from 1 to 10, how confident are you that you could save an unconscious person from an enclosed space, 10 - absolutely confident, 1 - not confident at all
10. Please check if you agree with any of the following statements (can check multiple)
 - I know how to operate an emergency breathing device
 - I know how to operate instruments for measuring oxygen levels in enclosed spaces
 - I know how to resuscitate someone who is not breathing
 - I have a general idea where enclosed spaces are located on my vessel
 - I know how to operate the oxygen system in my vessels hospital
 - I know how to identify an expired oxygen bottle
 - I feel strong enough to move an unconscious person from point A to point B
 - I know what carbon monoxide poisoning feels like
 - I know how to raise an alarm if I find an unconscious person
11. Please check if you have experienced any of the following (can check multiple)
 - Other participants could not care less for the exercise
 - The person in charge could not care less about the exercise
 - I feel like my suggestions or concerns are not being heard
 - I do not feel I have enough training for entering enclosed spaces
 - I do not trust (some of) the emergency equipment onboard
 - I do not trust (some of) the medical equipment onboard
 - I do not trust my coworkers to rescue me from an enclosed space
 - I have never trained for entering an enclosed space
 - My coworkers have a "know everything" attitude
 - I feel too tired to follow the contents of our emergency training exercises

12. Rank of the participant (yourself)

- Master
- Chief Engineer
- Chief Officer
- 1st, 2nd or 3rd Engineer
- 2nd or 3rd Officer
- Bosun
- Rating, Deck
- Rating, Engine
- Cook
- Trainee - Deck, Engine
- Other (please specify)

13. Thank you for your time. Feel free to comment below about anything. Missing questions, suggestions for improvement etc. (can leave empty)