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APPLICATION OF RISK MANAGEMENT IN DAY-TO-DAY OPERATION OF SEA-GOING VESSELS

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Purpose: reasons for writing the paper is to present, the optimal procedure to manage of risk and Risk Assessment procedures on board sea-going vessels.
Design/methodology/approach: an analysis of implemented Risk Assessment procedures on board sea-going vessels various shipping companies.
Findings: found that approach to risk management and requirements to perform Risk Assessment are varied between shipping companies and sometime varied between vessels in the same shipping company.
Research limitations/implications: management of risk based on Risk Assessment to be simplify and unified.
Practical implications: suggestion is given to unify procedures for Risk Assessment.
Social implications: reduction of risk to happen undesired events and mitigations of hazards associated with day to day operation of sea-going vessels.
Originality/value: recommendation to shipping companies for modification of Risk Assessments procedures where is necessary to improve safety on board.

Keywords: Risk Management, Risk Assessment, Safety Management System.

Category of the paper: research and viewpoint paper.

1. Introduction

Accidents happened Maritime industry are very complex and caused by a combination of events or processes that might ultimately result in the loss of human and marine life, and irreversible ecological, environmental and economic damage or damage property as vessel itself or cargo (Balmat, Lafont, Maifret, Pessel, 2009, pp. 1278-1286; Goerlandt, Montewka, 2015, pp. 115-134; Puisa, McNay, Montewka, 2021, p. 105151). The operation of a sea-going vessels is associated with risk-taking in the case of routine operations related to the routine operations as: cargo operations, manoeuvres and sea passage, emergency situations, repairs and maintenance works and non-routine jobs performed on board sea-going vessels as: hot works,

maintenance of critical equipment, non-routine repairs after breakdown. Human error as one of the main contributing factors in more than 85% of cases of maritime accidents. Furthermore, experts estimate that 30-50% of oil spills are caused directly or indirectly by human error (Dominguez-Péry, Narasimha Raju Vuddaraju, Corbett-Etchevers, Tassabehji, 2021; Puisa, McNay, Montewka, 2021; p. 105151; Zhang, Pedersen, Villavicencio, 2019). The global shipping industry is responsible for transporting as much as 90% of world trade (Dominguez-Péry, Narasimha Raju Vuddaraju, Corbett-Etchevers, Tassabehji, 2021). Over the past decade, improved ship design, technology, regulation and risk management systems have contributed to a 70% drop in reported shipping losses (Dominguez-Péry, Narasimha Raju Vuddaraju, Corbett-Etchevers, Tassabehji, 2021). Until 2010, the main and predominant risk management route has been through formalized procedures in the form of a Safety Management System (SMS) document compliant with the ISM Code (International Safety Management Code) (ISM Code, 1998; SOLAS Convention, 1998). The ISM Code is applicable to seagoing ships of more than 500 GT engaged on international voyages and was introduced to provide an international standard for managing the safety and performance of ships (Code…, 2000; ISM Code, 1998; Standard OHSAS 18001:2007). The shipping company in this document prescribes the application of well-developed procedures to risky tasks and jobs on board associated with the operation of the ship in the broad sense (Goerlandt, Montewka, 2015, pp. 115-134; Haugen, Ventikos, Teixeira, Montewka, 2016, pp. 313-321). These procedures address situations that the company identifies as critical or hazardous to the crew, the environment or property (ship itself and cargo).

International regulations and codes that have a decisive influence on "Risk Management" in the operation of merchant ships are:

- SOLAS 1960 Convention.
- MARPOL 73/78 Convention.
- ISM Code 1998.
- STCW 78/95 Convention.
- ISPS Code 2003.

The Company SMS is also influenced by the regulations of the maritime administration of the flag state under which the ship is sailing and other maritime administrations, e.g.:

- Great Britain – Maritime and Coastguard Agency (MCA).
- USA – United States Coast Guard (USCG).

It is important to note that these standards are minimum requirements for a shipping company and their ships do not guarantee “accident-free” vessels. Flag state, port state, classification society and the shipping company's own internal inspections are used to confirm that the minimum safety standards are met. Some risks arise from events outside the company and are beyond its influence or control. Sources of these risks include e.g. ecological disasters External risks require yet another approach. Because companies cannot prevent such events

from occurring, their management must focus on identification (they tend to be obvious in hindsight) and mitigation of their impact (Montewka, Goerlandt, Kujala, 2014, pp. 77-85; Kaplan, Mikes, 2012; Risk Assessment Training Manual, 2006). Multiple studies have found that people overestimate their ability to influence events that, in fact, are heavily determined by chance. We tend to be overconfident about the accuracy of our forecasts and risk assessments and far too narrow in our assessment of the range of outcomes that may occur (Dominguez-Péry, Narasimha Raju Vuddaraju, Corbett-Etchevers, Tassabehji, 2021; Tchankova, 2002). Risk managers need to do more than identify and mitigate potential risks. They can, for example, tap into external data sources to identify digital signals that provide early indicators of potential future problems. Compliance with legal requirements does not eliminate lower-risk incidents. However, it eliminates the highest risk accidents with low or very low probability of occurrence as shown in Figure 1.

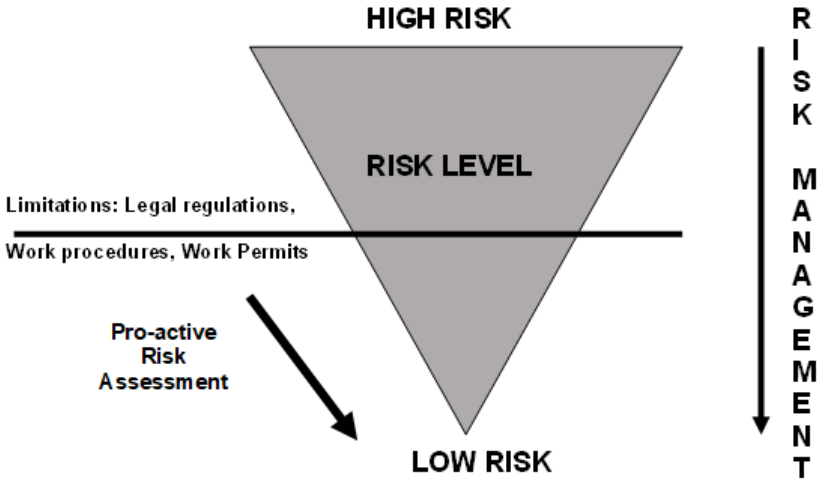


Figure 1. Possibility of Risk Management (Montewka, Goerlandt, Kujala, 2014, pp. 77-85).

The realisation of any potential risk involves a large financial outlay and it is the policy of any rational shipping company to identify and assess the risks involved in ship operations. Risk identification enables appropriate action to be taken to control identified risks by reducing the possibility of their occurrence or minimising their consequences, i.e. "Risk Management". The OHSAS 18001:2007 standard (ISM Code, 1998; Standard OHSAS 18001:2007), which has been introduced into the SMS (management system) of many shipping companies, requires the introduction of procedures for "Risk Management". Shipboard management teams are required to identify and assess risks in the planning of routine, non-routine, planned, unplanned and emergency shipboard operations and activities. It is obvious that if the risks of the work to be done are not identified, there can be no "management" in the broad sense.

Risk can be defined as undesirable events or as the probability of an unfavourable hazardous situation or an accident occurring. Thus, a risk is a combination of the probability or frequency of occurrence of a defined hazardous situation and the multiplicity of consequences resulting from its occurrence-BS 4778 (British Standards…). Risk Management based on Risk Assessment consists of a detailed analysis of the activity that involves risk and the activities or

supporting measures employed to mitigate the risk. Risk Assessment is an integral part of the SMS - Safety Management System based on ISM Code, the purpose of which is to protect against identified threats whose risk level has been determined (Code…, 2000; ISM Code, 1998; Risk Assessment Training Manual, 2006).

Risk management is the decision-making process of accepting the assessed and analysed risks and the actions applied to reduce the negative consequences of undesirable events or the likelihood of their occurrence (Embrechts, Frey, McNeil, 2005; Goerlandt, Montewka, 2015, pp. 115-134).

2. SMS requirements to mitigate high risk

Compulsory implemented on board sea-going vessels Safety Management System requires to perform by ships crew procedures described as "work permits" as a minimum to mitigate high risk for specified jobs or operations. Work Permits are confirmation that application of proper preparation procedure is fulfilled. Work Permit Most Shipping Companies implemented for this purpose e.g. (Code…, 2000; ISM Code, 1998; Safety Management System, 2015; Safety Management System, 2017; Safety Management System, 2018):

- Hot work Permit.
- Cold work Permit.
- Working aloft – Overside Permit.
- Electrical Circuit Work Permit.
- Harmful substances Work Permit.
- Critical Equipment &System Shut Down Permit.
- Enclosed Spaces Work Permit.

Forms of "Work Permit" are only formal confirmation that procedure for preparation for particular job have been fulfilled and minimum safety standards has been followed. Work Permits can mitigate high risk accidents and are staring step for management of risk.

Good examples of "Work permits" have been shown in Figures 2-4. Presented examples have been chosen among many of applied forms in shipping as a best examples obtained all spectrum of specific jobs (Safety Management System, 2017; Safety Management System, 2018; Safety Management System, 2020).

WORK PERMIT FOR ELECTRICAL CIRCUITS

*The issue of a permit **does not**, by itself, make a job **SAFE***

Sections 1 to 4 of the Permit must be manually completed. Computerized completion is prohibited.

1st Copy : For Display at the Work Area M/T: _____
2nd Copy: For Ship's Records

This permit is to be completed by the person in charge of the work team (Head of Department concerned) before commencing the Work involving Electrical Circuits. ***Equipment shall be Tagged out as required.***

GENERAL

This Permit is valid From _____ hrs Date _____
(Not to exceed 12 hours) To _____ hrs Date _____
Location of Work _____
Has an Enclosed Space **ENTRY PERMIT** been issued ? YES / NO

Type of Work _____
Person in charge of the work team (Name and Rank) _____

Personnel carrying out the work _____
(Name or Position / Sign) _____

Section 1- GENERAL CHECKS

1. 1	Is the scope of the job discussed with all persons concerned at the Tool Box meeting?	YES / NO
1. 2	Is the proper work force & equipment assigned to carry out the job ?	YES / NO
1. 3	Are all persons carrying out the work wearing the correct P.P.E ?	YES NO
	Additional P.P.E. required is : _____	
1. 4	Has the communication procedures been established among the work team?	YES / NO
1. 5	Are the procedures established for checking items on completion ?	YES / NO

Section 2 - SPECIAL REQUIREMENTS / PRECAUTIONS FOR WORK ON ELECTRIC CIRCUITS

2.1	Have necessary protective outfits such as Rubber Gloves & Boots for insulation been made ready to use (they shall be used while the work takes place)?	YES / NO
2.2	Have the Electric Circuits related to the work area been cut?	YES / NO
2.3	Have the Tags / Signs to prohibit turn ON the Switches been posted in position?	YES / NO
2.4	Has a Safety Watchman been arranged?	YES / NO
2.5	Have the Insulation Sheets been placed at the work place to prevent electric shock.	YES / NO
2.6	Have all possible alternate energising / start points been checked and tagged out?	YES / NO
2.7	List any special conditions, precautions or procedures that should be followed:	

_____

Section 3 - AUTHORITY TO PROCEED WITH THE WORK

In the circumstances noted, it is considered safe to proceed with the work for which this Permit is issued.

Signed _____ Person in charge of the work team

_____ Safety Officer _____ Master

Section 4 - CONFIRMATION OF COMPLETION OF WORK

The work for which this Permit was issued has been completed and all persons, materials and equipment have been withdrawn / Tags removed, and the work area has been left in a clean and safe condition.
Tags used for this permit should be attached to the permit and filed.

Signed _____ Person in charge of the work team

_____ Safety Officer _____ Master

Figure 2. Example of Work Permit for Electrical Circuit (Safety Management System, 2017; Safety Management System, 2018; Safety Management System, 2020).

The issue of a permit, does not, by itself,make a job SAFE

The Permit must be manually completed. Computerized completion is prohibited.

WORKING ALOFT, OVERSIDE PERMIT

(For any Height above 2.0 **meters** without Handrail & Platform - a Permit is Required)

Vessel:_____ Date & Time _____ Checked by _____

1. Preparation

(1) Has a Tool Box meeting been held with all crew members involved in the work & working procedure been discussed and understood? Risk Assessment Done?	YES /	NO
(2) Has a responsible person been placed in charge of the work team ?	YES /	NO
(3) Are crew members sufficiently experienced to perform the job at hand ? *(Personnel with less than 12 months experience at Sea are not permitted aloft)*	YES /	NO
(4) Are the weather conditions / vessel's movement considered suitable for the work to proceed ?	YES /	NO
(5) Have the persons doing the work, been advised of any additional personal protective equipment they must wear when carrying out this work ?	YES /	NO
(6) Has any required staging / bosun's chairs, etc. including ropes and shackles been thoroughly inspected before use ?	YES /	NO
(7) Has a deck rating been appointed to continuously support the work team from deck level ?	YES /	NO
(8) Have all the necessary tools and equipment been prepared ?	YES /	NO
(9) Is a bucket and heaving line available for the hoisting / lowering of tools ?	YES /	NO
(10) If necessary, have communications been established and tested ?	YES /	NO

Signed by Persons going Aloft or/and Overside _____ _____

SIGNATURE SIGNATURE

Jobs to be done: _____

_____

Location of Job: _____ _____ _____

SIGNATURE SIGNATURE

2. Working aloft

(1) Have all crew been provided with and are they wearing a safety belt / harness ?	YES /	NO
(2) Has the area been roped off and wearing signs placed, below the work place ?	YES /	NO
(3) Have the crew members been advised to keep both hands free when climbing ladders and also not to carry tools in their pockets ?	YES /	NO
(4) If the work is being carried out at night, is the work area adequately illuminated ?	YES /	NO

VALIDITY FROM / TO _____ MASTER'S AUTHORISATION : _____

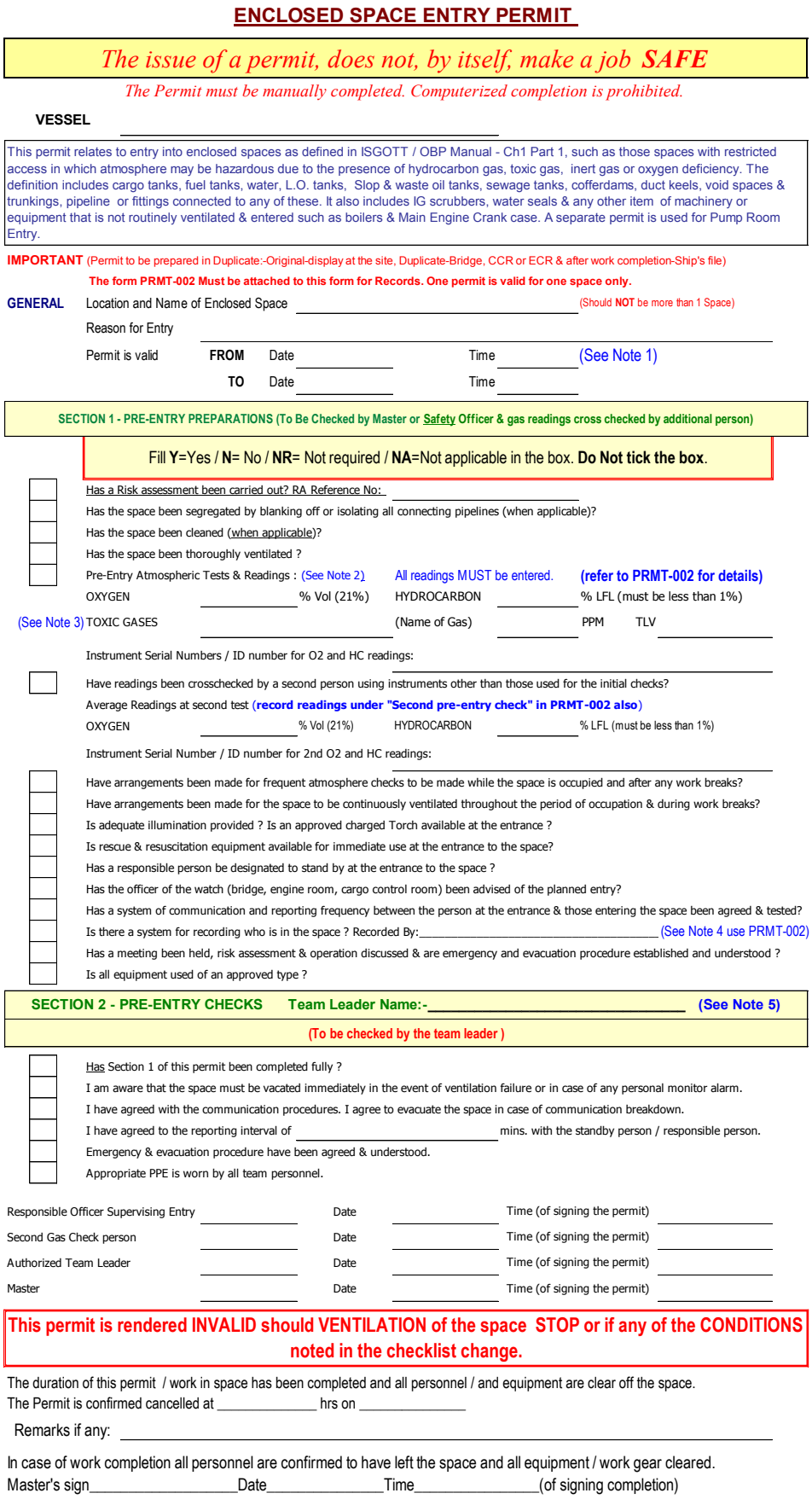
PERMIT CANCELLED AT _____ RESPONSIBLE PERSON : _____

3. Working over the ship's side

(1) Has it been confirmed that the ship is **not** underway ?	YES /	NO
(2) If above is "NO", are the safety measures mentioned in OBP Ch.I Part1 7.2(2)(c) are taken?	YES /	NO
(3) Has a jacob's ladder been rigged to provide a means of getting to and from the work area ?	YES /	NO
(4) Have all crew been provided with and are they wearing a working lifejacket and a safety belt / harness ?	YES /	NO
(5) Has the Officer of the Watch been advised of the on going work / the time persons are outboard and the time all persons are back inboard ?	YES /	NO
(6) Has a lifebuoy, self igniting light and buoyant line been prepared close to the work area ?	YES /	NO
(7) If the work is being carried out a night, is the work area adequately illuminated ?	YES /	NO

VALIDITY FROM / TO _____ MASTER'S AUTHORISATION : _____

Figure 3. Example of Working Aloft, Overside Work Permit (Risk Assessment Training Manual, 2006; Safety Management System, 2021; SOLAS Convention, 1998).



ENCLOSED SPACE ENTRY PERMIT

The issue of a permit, does not, by itself, make a job ***SAFE***

The Permit must be manually completed. Computerized completion is prohibited.

VESSEL _____

This permit relates to entry into enclosed spaces as defined in ISGOTT / OBP Manual - Ch1 Part 1, such as those spaces with restricted access in which atmosphere may be hazardous due to the presence of hydrocarbon gas, toxic gas, inert gas or oxygen deficiency. The definition includes cargo tanks, fuel tanks, water, L.O. tanks, Slop & waste oil tanks, sewage tanks, cofferdams, duct keels, void spaces & trunkings, pipeline or fittings connected to any of these. It also includes IG scrubbers, water seals & any other item of machinery or equipment that is not routinely ventilated & entered such as boilers & Main Engine Crank case. A separate permit is used for Pump Room Entry.

IMPORTANT (Permit to be prepared in Duplicate:-Original-display at the site, Duplicate-Bridge, CCR or ECR & after work completion-Ship's file)

The form PRMT-002 Must be attached to this form for Records. One permit is valid for one space only.

GENERAL Location and Name of Enclosed Space _____ (Should **NOT** be more than 1 Space)

Reason for Entry _____

Permit is valid **FROM** Date _____ Time _____ (See Note 1)

TO Date _____ Time _____

SECTION 1 - PRE-ENTRY PREPARATIONS (To Be Checked by Master or Safety Officer & gas readings cross checked by additional person)

Fill **Y**=Yes / **N**= No / **NR**= Not required / **NA**=Not applicable in the box. **Do Not tick the box**.

☐ Has a Risk assessment been carried out? RA Reference No: _____

☐ Has the space been segregated by blanking off or isolating all connecting pipelines (when applicable)?

☐ Has the space been cleaned (when applicable)?

☐ Has the space been thoroughly ventilated ?

☐ Pre-Entry Atmospheric Tests & Readings : (See Note 2) All readings MUST be entered. **(refer to PRMT-002 for details)**

OXYGEN _____ % Vol (21%) HYDROCARBON _____ % LFL (must be less than 1%)

(See Note 3) TOXIC GASES _____ (Name of Gas) _____ PPM TLV _____

Instrument Serial Numbers / ID number for O2 and HC readings: _____

☐ Have readings been crosschecked by a second person using instruments other than those used for the initial checks?

Average Readings at second test (**record readings under "Second pre-entry check" in PRMT-002 also**)

OXYGEN _____ % Vol (21%) HYDROCARBON _____ % LFL (must be less than 1%)

Instrument Serial Number / ID number for 2nd O2 and HC readings: _____

☐ Have arrangements been made for frequent atmosphere checks to be made while the space is occupied and after any work breaks?

☐ Have arrangements been made for the space to be continuously ventilated throughout the period of occupation & during work breaks?

☐ Is adequate illumination provided ? Is an approved charged Torch available at the entrance ?

☐ Is rescue & resuscitation equipment available for immediate use at the entrance to the space?

☐ Has a responsible person be designated to stand by at the entrance to the space ?

☐ Has the officer of the watch (bridge, engine room, cargo control room) been advised of the planned entry?

☐ Has a system of communication and reporting frequency between the person at the entrance & those entering the space been agreed & tested?

☐ Is there a system for recording who is in the space ? Recorded By:_____ (See Note 4 use PRMT-002)

☐ Has a meeting been held, risk assessment & operation discussed & are emergency and evacuation procedure established and understood ?

☐ Is all equipment used of an approved type ?

SECTION 2 - PRE-ENTRY CHECKS **Team Leader Name:-**_____ **(See Note 5)**

(To be checked by the team leader)

☐ Has Section 1 of this permit been completed fully ?

☐ I am aware that the space must be vacated immediately in the event of ventilation failure or in case of any personal monitor alarm.

☐ I have agreed with the communication procedures. I agree to evacuate the space in case of communication breakdown.

☐ I have agreed to the reporting interval of _____ mins. with the standby person / responsible person.

☐ Emergency & evacuation procedure have been agreed & understood.

☐ Appropriate PPE is worn by all team personnel.

Responsible Officer Supervising Entry _____ Date _____ Time (of signing the permit) _____

Second Gas Check person _____ Date _____ Time (of signing the permit) _____

Authorized Team Leader _____ Date _____ Time (of signing the permit) _____

Master _____ Date _____ Time (of signing the permit) _____

This permit is rendered INVALID should VENTILATION of the space STOP or if any of the CONDITIONS noted in the checklist change.

The duration of this permit / work in space has been completed and all personnel / and equipment are clear off the space.

The Permit is confirmed cancelled at _____ hrs on _____

Remarks if any: _____

In case of work completion all personnel are confirmed to have left the space and all equipment / work gear cleared.

Master's sign_____Date_____Time_____(of signing completion)

Figure 4. Example of Enclosed Space Entry Permit (Safety Management System, 2017; Safety Management System, 2018; Safety Management System, 2020).

3. Objectives of Risk Management on board sea-going vessels

Objectives of Risk Management is to assess potential and actual risks on board vessels, to ensure the safety of vessels personnel, relevant onboard parties, vessels, cargo, by establishing appropriate procedures and reducing Risk to As Low as Reasonably Practical (ALARP) levels.

Risk Management Program must consists of the following elements as shown on Figure 5:

- Hazard Identification and Risk assessment.
- Risk Mitigation & Action plan to avoid & minimize risk.
- Execution of risk management measures.
- Confirmation of risk management measure execution.
- Review and improvement of risk management measures.

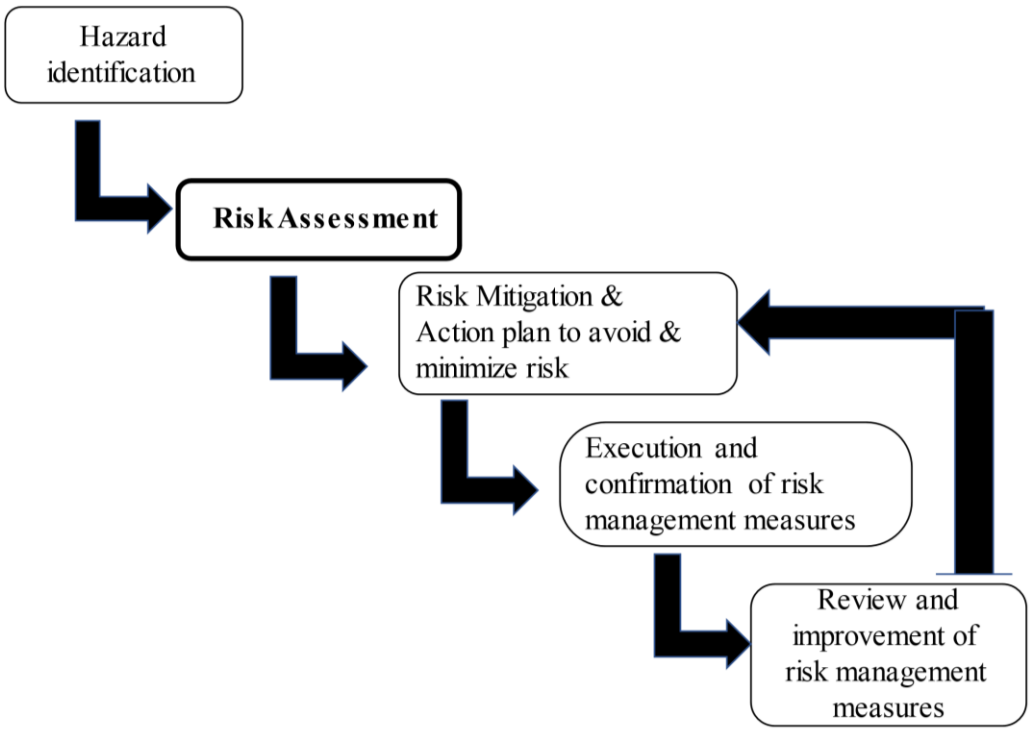


Figure 5. Model of Risk Management (Kaplan, Mikes, 2012).

During assessment of risk process on board vessels the following must be taken into account (Dominguez-Péry, Narasimha Raju Vuddaraju, Corbett-Etchevers, Tassabehji, 2021; Embrechts, Frey, McNeil, 2005; Goerlandt, Montewka, 2015, pp. 115-134; Haugen, Ventikos, Teixeira, Montewka, 2016, pp. 313-321):

- Routine and non-Routine Tasks.
- Risks recognized as undesirable operations.
- Infrastructure, equipment and materials at the workplace.

- Routine and non-routine maintenance of critical equipment or systems that should be shut down when the maintenance is executed.
- Non-routine repairs (following equipment breakdown or arising from the potential for breakdown).
- Temporary or permanent changes of shipboard equipment, activities or materials.
- Potentially hazardous operations.
- New or non-routine tasks that may be done in the future.
- Temporary or permanent change in the risk management system (manual, etc.).
- Emergencies operations.
- Activities of contractors and visitors.
- Work area design, equipment operating procedures and their adaptation to human capabilities.
- Significant safety problems that cannot be rectified by shipboard personnel.
- Human behavior, capabilities and other human factors.
- Hazards identified outside the workplace capable of adversely affecting the safety and health of persons within the workplace.
- Other possible situations that may significantly affect safety, health, environment, or quality.

4. Developing of Mitigating measures and controls of hazards

Measures to mitigate hazards, shall be developed using the Risk Assessment Evaluation-Action Plan according to the following procedures:

- Establish measures to **decrease** the "likelihood of risk occurrence".
- Establish mitigating measures to **decrease** or **eliminate** the "consequence of Risk". Risk to be reduced to **A**s **L**ow **A**s **R**easonably **P**ractical (**ALARP**) level.
- Determining controls the following hierarchy shall be considered (Kaplan, Mikes, 2012; Safety Management System, 2015):
  - Elimination.
  - Substitution.
  - Engineering controls.
  - Signage/warning signs/administrative controls.
  - Personal protection equipment.

The idea behind this hierarchy is that the control methods at the top of the list are more effective than those at the bottom.

Elimination and substitution, while most effective at reducing hazards, also tend to be the most difficult to implement in an existing process. If the process is still at the design or development stage, elimination and substitution of hazards may be inexpensive and simple to implement. For an existing process, major changes in equipment and procedures may be required to eliminate or substitute for a hazard.

Engineering Controls involve changes in the physical features of the workplace. As an example, engineering controls might include changing the weight of objects, changing work surface heights, or purchasing lifting aids. When engineering solutions are not feasible, administrative controls offer methods to reduce the exposure of workers to the identified hazard.

Administrative controls are workplace policy, procedures, and practices that minimize the exposure of workers to risk conditions. They are considered less effective than engineering controls in that they do not usually eliminate the hazard. Rather, they lessen the duration and frequency of exposure to the risk condition.

If administrative controls are not available, work practice controls should be considered and finally personal protective equipment (PPE).

The preferred method for controlling ergonomics hazards is through engineering techniques. When the design of the workplace reduces the magnitude of risk factors, the likelihood of injury/illness is lessened. On Figure 6. is shown an example of Risk Assessment Form. At the “Stage 1” Hazards and consequences to be identified and Risk Assessment with existing already controls (safeguards) to be ranked. In “Stage 2” Risk to be re-ranked after application additional hazard controls (safeguards).

4.1. Guidance for Mitigation

When controlling risks, apply the principles below, if possible, in the following order:

1. less risky option (e.g. switch to using a less hazardous chemical) to be tried,
2. access to the hazard (e.g., by guarding) to be prevented,
3. work to be organised to reduce exposure to the hazard (e.g., put barriers between personnel and hazard source),
4. Personal Protective Equipment to be used,
5. backup facilities (e.g., first aid and washing facilities for removal of chemical) to be provided.

4.2. Guidance for Likelihood

Likelihood is based mainly on crew estimation of the chance of it happening under the conditions existing at the time of the work and does not depend upon Industry Statistics.

For Example: if we question as to what is the likelihood of having a Ship to Ship collision?

The Likelihood will change according to the situation that the ship is in for which the risk is assessed.

Case 1 – If the vessel is in the middle of the Pacific Ocean - the Likelihood will be more towards Possible but Unlikely.

Case 2- If the vessel is in the Singapore Straits the Likelihood will be more towards Quite Possible.

Case 3 – If the vessel is in Dry Dock the likelihood will be Unlikely.

The description and percentage given in available "determination charts" for estimating the chances of it happening, for that particular case are not representing a percentage of past industry statistics. Therefore, selection of the expression for likelihood to be done which most applies to the hazard when conducting the Risk Assessment.

The following should be used as a guidance when establishing the Likelihood of Risk:

- number of personnel exposed,
- frequency and duration of exposure to the hazard,
- effects of failure of power supply,
- effects of failure of plant, machinery and safety devices,
- exposure to the elements – weather, cold, heat etc.,
- protection given by PPE and its limitations,
- possibility of unsafe acts by personnel (internal or external parties) who:
    - may not know what the hazards are,
    - may not have the knowledge, physical capacity, or skills to do the work,
    - underestimate risks to which they are exposed.
    - underestimate the practicality and utility of safe working methods.
    - think that nothing has happened so far therefore never will.

To give another example Likelihood of a situation occurring in a Cargo Tank would be higher on a product tanker than a Crude Tanker since the number of times (and therefore the exposure) tank entry is made on a Product Tanker may be higher than that on a Crude Tanker. Therefore, the frequency of the exposure is also an important factor when determining the likelihood (Culp, 2020; Kaplan, Mikes, 2012; Standard OHSAS 18001:2007).

Name of Vessel: M/T xxxxxxx

Date: 14-Aug-20

Reference No: E-055-20

Detail of Work Activity:

WELDING ON E/R 3nd DECK PS
Opened space - instalation of chemical
locker cage fabricated in workshop

Refer to 'Criteria of Risk' Sheet for guidance towards evaluation criteria		Likelihood				
		1: Unlikely	2: Possible	3: Quite Possible	4: Likely	5: Very Likely
Consequence	1: Negligible	Low Risk	Low Risk	Low Risk	Medium Risk	Medium Risk
	2: Slight	Low Risk	Low Risk	Medium Risk	Medium Risk	Medium Risk
	3: Moderate	Low Risk	Medium Risk	Medium Risk	Medium Risk	High Risk
	4: High	Medium Risk	Medium Risk	Medium Risk	High Risk	High Risk
	5: Very High	Medium Risk	Medium Risk	High Risk	High Risk	High Risk

All Risks must be made As Low As Reasonably Practicable (ALARP) before commencing the job

STAGE 1

Sr. No	Routine or Non -routine work (R / NR)	1. RISK ASSESSMENT: Hazards Identified — *What can go Wrong?* Hazard is something with the potential to cause harm. Three Questions to ask:- *1. Is there a source of harm? 2. Who (or what) could be harmed? 3. How could Harm occur?*	1. RISK ASSESSMENT: Consequence — *What will happen due to the hazard?* Consequence is the loss associated if the hazard happens.	2. RISK MANAGEMENT STAGE 1: Existing safeguards — [For Example] 1. Work Permit System - Specify which is applicable 2. Safety Checklists - Specify Checklist & use. 3. PPE - specify which all PPE will be used 4. Lock Out & Tag out System- specify what will be locked & tagged out and at which locations. 5. SMS Procedures - specify which procedures.	Risk Ranking: Consequence	Likelihood	Risk
1	N/R	Fatique	Personal injury	personel involved should be well rested with requirements of STCW & MLC	Moderate	unlikely	Low
2	N/R	Lack of training in welding operations	personal injury, damage of property	trained welder aware of hazard involving hot work is to perform task with supervising senior officer	Moderate	unlikely	Low
3	N/R	Poor communications between individualsand /lack of understending procedures	Personal injury	Communications must be agreed between personel, pre job briefing to be carry out. Concept Take 5 to be used. Senior officer responsible for operation should brief all involved abt. precautions to safely complete the operation	High	unlikely	Medium Risk
4	N/R	Inadequate PPE/ safety equipme	Personal injury	Proper PPE to be worn by all personel involved (ref Company PPE requirements Annex 1), welder and assistant must use proper welder 's gear	Moderate	unlikely	Low
5	N/R	Inadequate preparation of work lokation and adjoining spaces	personal injury, damage of property	The work site to be free from oil and oil residues. Surface area and adjoining space must be prepared in accordance with ISGOTT requirements	High	Possible	Medium Risk
6	N/R	Flamable materials in vicinity of the hot work location	personal injury, damage of property	All flamable materials including oil residues, chemicals, rags must be removed from site of hot work location	High	Possible	Medium Risk
7	N/R	Faulty arc welding equipment, cable and electrode holder	personal injury, damage of property	Prior and on completion of arc welding equipment must be inspected by senior officer for any damage	Moderate	unlikely	Low
8	N/R	Explosive atmosphere	personal injury, damage property	Atmosphere in work location must be continously monitored by proper instruments	High	unlikely	Medium Risk
9	N/R	Welding flush and fumes , hot del	Personal injury	Area to be kept well wentilated and outlets of smoke escape to be maintained. Hot debris to be extinguished by small water hose. After surface to be wiped.	High	Possible	Medium Risk
10	N/R	Hot surfaces/ hot spots	personal injury, damage property	Temperature of surfaces in vicinity of hot work to be monitored by infrared temp.gage on top and down under surface.	High	Possible	Medium Risk
11	N/R	In appropriate weather conditions	Personal injury	Work must not be carred out if weather condition are not suitable for the operation	Moderate	unlikely	Low
12	N/R	High ambient temperature at hot work place	Personal injury	Personel involved must make frequently brakes to drink water and get rest, back up personel to be designated.	Moderate	unlikely	Low

Stage 2

2. RISK MANAGEMENT STAGE 2		3. EXECUTION		
	Additional Safeguards	Residual Risk		
Sr No	What can be done about the hazards? Consider the following: 1). Removal of the Hazard. 2). Substitution of the Hazard - reduce the Likelihood 3). Mitigation of the Hazard - reduce the Consequence 4) Use a combination of technical & procedural controls. 5). Ensure emergency arrangements are in place.	Consequence	Likelihood	Risk
1 to 10	Hot work permit PRMT -003 & 003A to be issued and strictly followed	High	Unlikey	Low Risk
1 to 10	Company approval of hot work to be obtained	High	Unlikey	Low Risk
3	Tool box meeting to be performed to. All aspects of work to be discused and clearified . Full specific informations to be given to OOW on Bridge	High	Unlikey	Low Risk
4	Senior oficer have to make inspection of PPE	Moderate	Unlikey	Low Risk
5,6	Proper preparation of area of hot work to be inspected and accepted by senior officer	High	Unlikey	Medium Risk
8,9	Area to be kept well wentilated, atmosphere to be permanently monitored	High	Unlikey	Medium Risk
10	Person designated to monitor hot spots to be cleary quided by senior officer	High	Unlikey	Medium Risk
1 to12	Person in charge of hot work operation have to apply proper management of work	Moderate	Unlikey	Low Risk
Add 1	Portable fire fighting equipment to be standing by close to work place. Fire lines to be pressurised . Nozzles to be ready to use	Moderate	Unlikey	Low Risk
Add 2	Portable fire fighting equipment to be standing by close to work place. Fire lines to be pressurised . Nozzles to be ready to use	Moderate	Unlikey	Low Risk
Add 3	Emergency action to be discused during tool box meeting , evacuation roots to be marked and all personel involved in hot work to be acquinted with	Moderate	Unlikey	Low Risk

For Non Routine Jobs: Have involved personnel understood the Risks and implementation of safeguards and measures? Enter details below.

Name	Rank	Signature
	2A/E	
	3A/E	
	No.1 Oiler	
	Oiler A	
	Oiler B	
	Wiper	

Stage 3

Recovery and Mitigation procedures: *(in case of undesired outcomes: List procedures and contingency plans that must be referred to for limiting the impact of any unplanned occurrences. E.g. in case of RA for enclosed space entry, contingency for Rescue from Enclosed Spaces and Emergency Medical Treatment will apply.)*

List Applicable Contingencies & Procedures: OBP I - Part 1 (7.3.3) and OBP I Annex 2 (3)

In case of undesired outcomes: OBP VI- Contingency-Shopboard -Section 3 - 3.2 Fire in Engine Room

For Routine Jobs - This form is valid till: _____ (Maximum of 6 months)
(unless reviewed due to an incident or when there is a change in the work conditions or additional hazards associated with the work have been identified.) For Routine jobs the form must be referred to and the Control measures understood and implemented. An entry to this effect must be made in the Daily work Plan form RECO-004.

1A/E xxxxxx — Safety Officer (Name & Signature)

Capt. Xxxxx — Master: (Name & Signature)

C/E Kaminski Wlodzimierz C. — Other Officer incharge (Name, Rank & signature)

Figure 6. Example of Risk Assessment Form (Safety Management System, 2015).

4.3. Guidance for Consequence

Generally, consequences are unlikely to change between Stage 1 and Stage 2 of the Risk Assessment. Therefore, the consequence entered in Stage 1 should be that after the Existing Safeguards of Stage 1 have been put in. This will usually remain the same in Stage 2 and should not be changed.

For example: working aloft on a Mast – the consequence will depend upon how high the work location is. Low height – possible sprain, medium height – fracture, High up – multiple fractures possible death. If the person follows the work permit system, uses a safety harness properly etc. the fall will be arrested therefore in Stage 1 the consequence should be Moderate (would be high if person goes aloft without informing/no PPE etc.).

This consequence will no longer change even with the usual additional safeguards – the Likelihood will however decrease further due to the additional Safeguards. If however we were to place a good amount of mattresses/air pillows etc. all around the mast (like is done by stuntmen in movies) then and only then the consequence of his fall from the mast would change.

5. Action plan to counter risk

The action Plan to counter Risk shall be implemented and confirmed.

To confirm implementation of the action plan as determined using the Risk Assessment-Action Plan the following steps should be involved:

- Confirmation of implementation status.
- Confirmation of implementation results on completion target date.
- Review the “Risk” and “Action Plan” if countermeasures have not been completed by the completion target date.
- Confirmation the results, when the countermeasures were completed.

Action plan undertaken by vessel to perform safely any task or operation should be assessed, reviewed, and improve, if necessary, by Safety Management of Shipping Company. This assessment should consist of the followings:

- Evaluation of implemented measures.
- Review of implemented measures and examination of improvement points.
- Necessity of lateral spread to other vessels and in other divisions.
- Incorporation of implemented measures to manuals and procedure manuals.

Conclusion

1. Procedures for risk assessment on board sea going vessels are quite complicated for most crew on board sea-going vessels. Research done by authors on Risk management showed that approach to risk assessment to be simplify and unified. Suggestion is given to unify procedures for risk assessment.
2. Risk Management and associated with it Risk Assessment is a new topic which ship crews must, first of all, become familiar. If the understanding of the problem is not correct, risk management becomes a worthless process.
3. Ships crew require intensive training in Risk Management and Risk Assessment and these training must be taken as a priority.
4. Research done by authors on Risk Management showed that approach to risk management and requirements to perform Risk Assessment are varied between shipping companies.
5. Implementation in real practice Risk Management based on simplified, well understood, clear procedure for Risk Assessment will reduce of risk to happen undesired events and mitigations of hazards associated with day-to-day operation of sea-going vessels.
6. Research done by authors on Risk management in shipping companies showed that modification of risk assessments procedures must be recommended to some shipping companies to improve safety on board.

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