Technical and Organization Security of Bulk Carriers, Tankers and Crew

Technické a organizační zabezpečení nákladních trajektů a posádky

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Rozsah příloh:

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1. **FAKULTA APLIKOVANÉ INFORMATIKY. Bezpečnostní technologie, systémy a management: Teorie a praxe ochrany majetku a fyzické bezpečnosti. 1. vyd. Zlín: VeRBuM, 2011. ISBN 978-80-87500-05-7.**
2. **FAKULTA APLIKOVANÉ INFORMATIKY. Bezpečnostní technologie, systémy a management II: Teorie a praxe ochrany majetku a fyzické bezpečnosti. 2. vyd. Zlín: VeRBuM, 2012. ISBN 978-80-87500-19-4.**
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7. **Ó-Sensei: Morihei Uešiba. Adamov: Temple, 1999. ISBN 80-901641-6-1.**

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ABSTRACT

This work introduces about technical and organizational security at bulk carriers. Security on ships in general is a very important issue. This means more for bulk carriers and tankers, which usually transport dangerous substances.

Even the smallest mistake can cause a big disaster for such ship, which would mean losses of human lives and also unpredictable losses for the environment.

The theoretical part shows the importance of this issue and its purpose is to describe devices assuring the safe work environment for crew as well as to anticipate unexpected events. The beginning describes construction of bulk carriers, which provides a base for another description of other devices mounted on these ships. The issue of Somali pirates is also described in this part.

The practical part brings the whole theory into practice. It employs itself with cases, which had appeared in the past and deals with their solutions. The purpose of this work is to discover potential improvements, which will improve a defence of single ships. For this reason, the biggest part is dedicated to protection against an attack from the sea. An organization structure and various ways of self defence are also included in this part.

Key words: Bulk carrier, oil tanker, organization, prevention, attack, defence, technology

ABSTRAKT

Tato práce se zabývá technickým a organizačním zabezpečením provozu trajektů. Bezpečnost obecně je na lodích velmi důležitá a o to více na obchodních lodích převážejících nebezpečné látky. I ta nejmenší chyba může na takovémto dopravním prostředku stát život celé posádky a způsobit nevyčíslitelné škody na životním prostředí.

Teoretická část poukazuje na důležitost bezpečnostních opatření a charakterizuje zařízení, které zajišťuje bezpečné pracovní prostředí pro posádku a zároveň předchází nebezpečným událostem. Na začátku je popsána konstrukce nákladních plavidel, což poskytuje čtenáři základní znalosti pro pochopení dalšího popisu a výběru umístění bezpečnostních zařízení. Konec teoretické části je věnován popisu příčin a důsledků útoků somálských pirátů.

Praktická část zavádí tuto teorii do praktického prostředí a využití. Zabývá se mimo jiné případy, které již v minulosti nastaly, a všímá si jejich řešení. Cílem této práce je tedy nalézt případné možnosti pro zefektivnění této činnosti. Z tohoto důvodu je významná část věnována ochraně lodí proti napadení zvenčí. Zde je kladen důraz zejména na organizační strukturu obrany a ukázané jsou zde také možné obranné techniky.

Klíčová slova: Trajekt, organizace, prevence, útok, obrana, technologie

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INTRODUCTION

Bulk carriers are huge, heavy and sophisticated ships able to carry thousands of tons of cargo as well as plenty of other devices needed for their daily traffic. This means big demands for the boat´s construction as well as for their crew.

Due to tankers daily charge, a high demand is required for their construction as well as for the whole manufacturing process of these structures, which includes plenty of controls and analyses. The purpose is to make sure, that the whole production is being kept in given standards and principles.

Very important is to make sure that all devices are in a good condition and are not being damaged or broken down during their lifetime. Therefore each functional device must be under control, which is being watched by mechanical and electronic security systems.

Security systems in general are an entire part of vehicles transporting people as well as dangerous substances. Their work is to detect an uncommon routine, which can negatively affect functions of devices important for a safety voyage.

The sea traffic in general is a sophisticated branch, which needs to be operated by skilled captains and skilled crew. It is not just about keeping the boat in a right direction, but also about keeping of a precise timing. A big danger can also wait under the water, where a cliff or any other object can hit the bottom. A collision with another ship is not uncommon either. Therefore navigation systems are necessary for the sea transportation, mainly for ships traveling long directions to complete their journey safely, in time and with no damage.

As mentioned before, the sea itself can bring many situations, which can have an unwelcome impact on a boat´s construction as well as on its crew or cargo. Therefore, bulk carriers need to be under still control. An eventual engine failure can cause a big disaster meanwhile the sea leads an uncontrolled ship. Such incontrollable ship becomes to be a potential source of an ecological disaster.

The sea transport is spread all around the world which brings plenty of business possibilities, but also perils to the industry. One of the most fearing situations brings the area around Gulf of Aden in Somalia. Somalia had been an unruled country which had not been let by a proper government for many years and piracy is very potential source of

incoming. Piracy by itself is not anything new in this country. It had started long ago before the first tanker had been hijacked. Previously fishing boats were attacked and robbed. After the first ship transferring food to development countries had been attacked and some another followed afterwards, governments of interested countries had started to solve this problem.

The sea industry is the International business therefore it needs rules, which are equitable to all countries connected to the business. It is covered by the International Maritime Organization (IMO). This organization includes several other committees, where each of these is responsible for a different issue.

I. THEORY

1 BULK CARRIER, TANKERS AND THEIR CONSTRUCTION

Bulk carriers also called freighters, or bulkers are types of merchant ships, which are specially designed to transport unpackaged bulk cargo, such as grains, coal, ore, and cement in cargo holds. Since the first specialized bulk carrier was built in 1852, economic forces have fuelled the development of these ships, causing them to grow up in size and sophistication. Nowadays, bulkers are specially designed to maximize their capacity, safety, efficiency, and also to be able to withstand the rigors of their work.

Today, bulkers make up about 40% of the world's merchant fleets and range in size from single-hold mini-bulkers to mammoth ore ships able to carry 400,000 metric tons of deadweight (DWT). A number of specialized designs exist: some are able to unload their own cargo, some depend on port facilities for unloading, and some even package the cargo as it is loaded. Over half of all bulkers have Greek, Japanese, or Chinese owners and more than a quarter are registered in Panama. Korea is the largest single builder of bulkers, and 82% of these ships were built in Asia.

A bulk carrier's crew participates in the cargo loading and unloading, navigating the ship, and keeping its machinery and equipment properly maintained. Loading and unloading the cargo is quite difficult, dangerous, and can take up to 120 hours on larger ships. A number of crews can be over 30 on largest ships.

Bulk cargo can be very dense, corrosive, or abrasive, which can present safety problems: cargo shifting, spontaneous combustion, and cargo saturation can threaten a ship. [1]

There are two different types of ships used to transport commodities depending on the type of cargo.

Bulk carriers transported variety of solid cargoes including:

- iron ore
- coal
- grain
- steel products
- bauxite/alumina

Oil tankers carried liquid cargoes including:

- crude oil
- fuel oil
- diesel oil
- gasoline
- liquid caustic [2]

I *Bulk Carrier and Tanker*, [3]

1.1 Bulk Carriers and Tankers

The difference between bulk carriers and tankers is about cargo they carry. Bulk carriers carry products in bulk quantities. For example: Edible commodities finished steel products, raw materials. It is not necessary to be equipped by cargo gear for bulk carrier, because those without cargo gear use the shore gear for cargo operation.

Tankers are design to carry liquid cargo in bulk quantities depending on their size. The entire cargo operation goes through pipe lines. It is necessary to provide berths fitted with chicksen or hoses for carrying cargo operation. [2]

Structural Feature	Bulk Carrier	Oil Tanker
Cargo Hold openings.	Large cargo holds openings	Small opening to enter cargo hold
Cargo Operation	By Ship/Shore gear, Sling, suit or conveyor	By pipe line
Appearance	Pipelines all around deck	Comparatively less pipelines
Cargo gear when fitted	Cranes, Derricks	Usually one or two mid ship cranes
Extra Machinery	Does not require extra machinery	Inert Gas, Separate pump room
Construction of Hull	Not Compulsory	Double Hull Compulsory
Cat Walks	Fitted Athwart ship	Fitted longitudinally
Cargo Tank Cleaning	Easy	Comparatively different and COW washing
Company´s Permission	No need to obtain permission to enter in cargo hold. (Risk Assessment Carried out)	Permission from company is mandatory (Risk Assessment Carried out)

TAB. 1 *Bulk Carrier and Tanker* [3]

1.2 Description of Tanker

The whole ship is basically divided into two parts. Accommodation and cargo and both of these parts contain number of devices necessary for everyday´s routine.

To describe the ships in general the Bona Bay tanker has been used for the introduction.

The ship had been produced in 1990 and its length is 228.6 meters, the beam 32.4 meters and the draft 12.5 meters with 75,000 MT (metric ton) displacements.

This ship has double hull and double deck. Her main engine has 5 cylinders and 19,900 HP (horse power) with 84 RPM (rapes per minute). The diameter of each cylinder is 840 mm.

The speed is 14.5 knots with a Heavy Fuel Oil consumption of 32 MT.

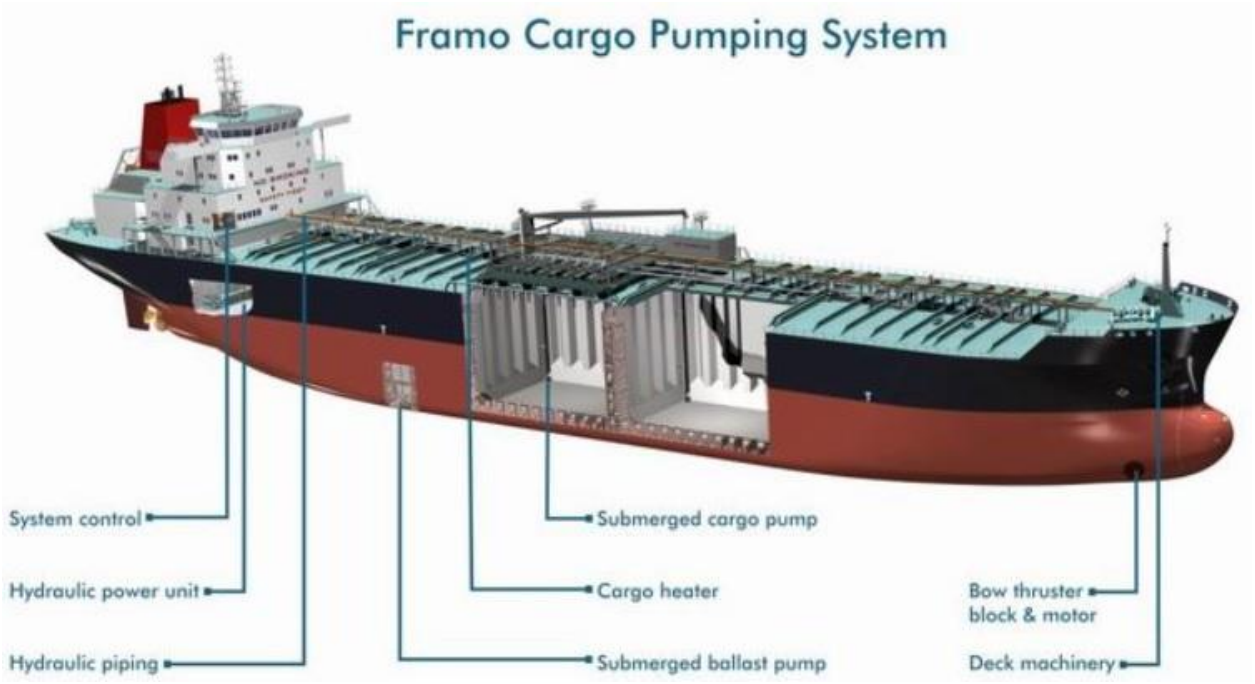
The propeller pitch is 5,640 mm and weight 20,380 kg.

Every anchor weights 11 MT and every anchor chain 91.3 MT

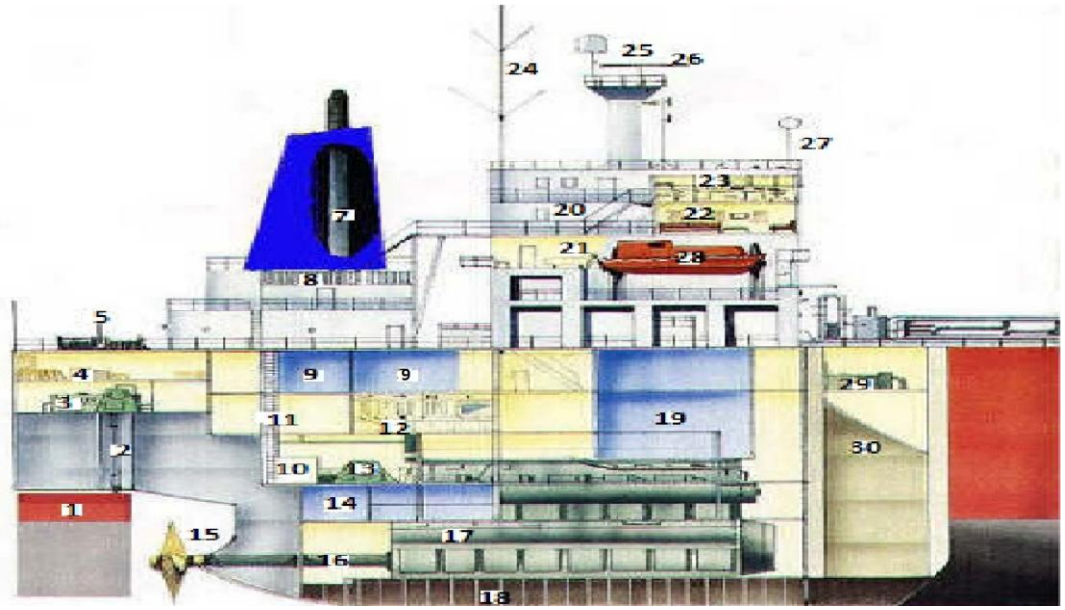
Cargo tanks capacity is 90,439 m^3 and the Diesel-Oil 426 m^3.

Hydraulic Framo pumps are mainly used for cargo discharging in number of one pump for each tank. Pumps producing the pressure are in the Engine room and are driven by three diesel engines, two of 1 500 KW and one of 750 KW.

To produce an inert gas needed to refill cargo tanks up, in order to avoid a danger, an independent generator is used. [4]



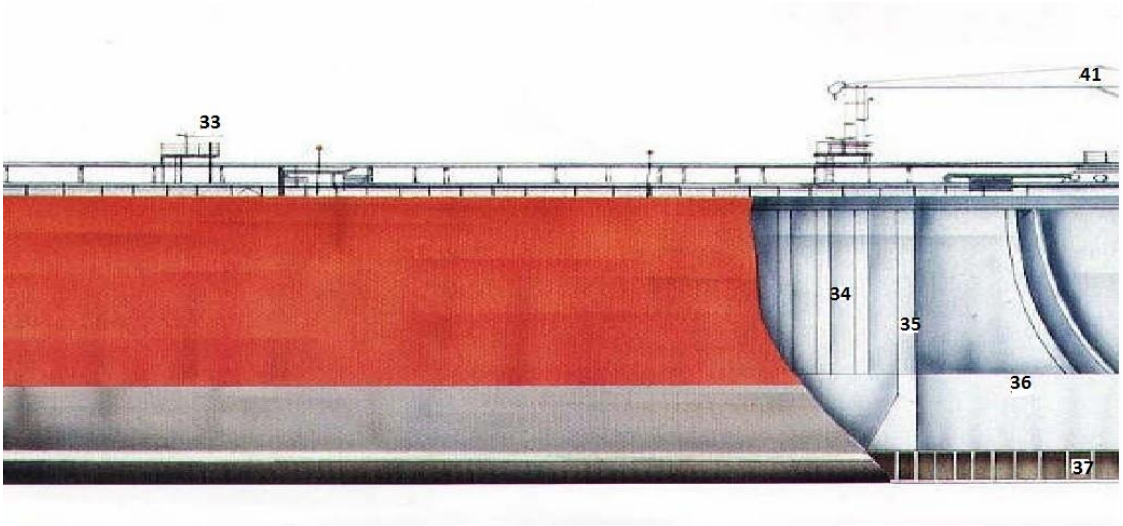
II *Framo Cargo Pumping System*, [5]



III *Accommodation and Engine room*, [4]

1	Rudder	11	Emergency ladder	21	Mess room
2	Rudder shaft	12	Engine control room	22	Day room
3	Steering gear	13	Auxiliary Engine room	23	Wheelhouse
4	Rope store	14	Diesel-Oil store tank	24	Radio antenna
5	Aft winches	15	Propeller	25	Satellite dome
6	Funnel	16	Propeller shaft	26	Radar
7	Main Engine exhaust gas pipe	17	Main Engine	27	Direction finder
8	Engine Room fans	18	Double bottom	28	Lifeboat
9	Fuel and Lub oil tanks	19	Heavy Fuel Oil store tank	29	Pump room
10	Emergency Exit	20	Cabing	30	Slop tank

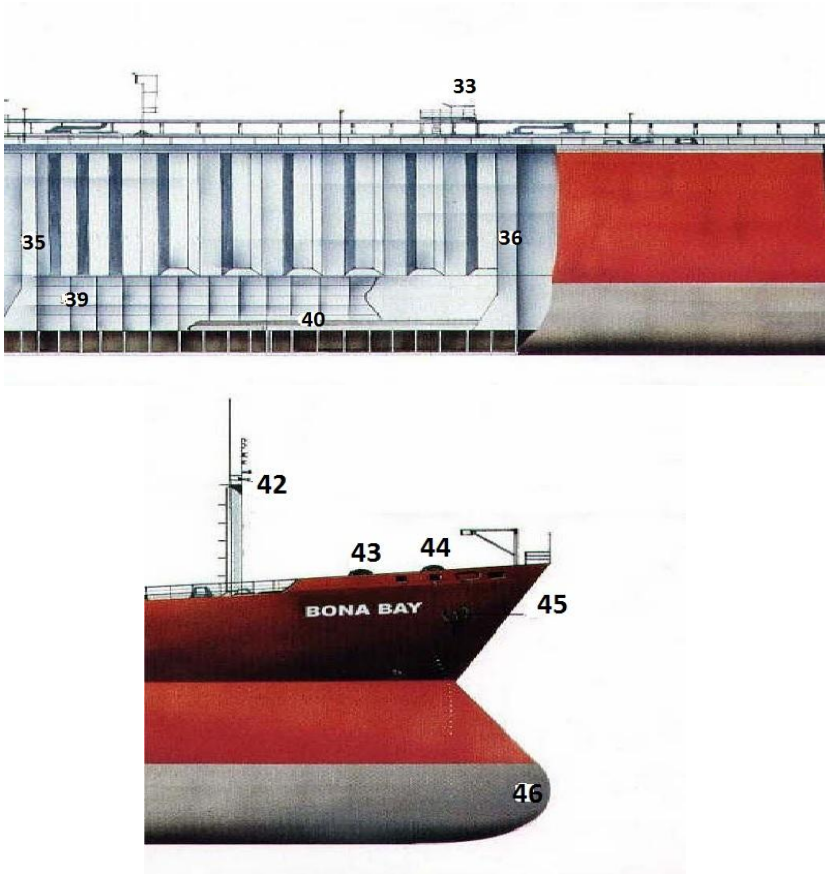
TAB. 2 *Accomodation and Engine room* [4]



IV *Hull*, [4]

31	Cargo pipes	37	Double bottom
32	Bilge keel	38	Cargo pump
33	Firefighting cannon (foam)	39	Cargo tank lower area
34	Inner hull	40	Pipes tunnel
35	Cargo tank bulkheads	41	Hose crane
36	Cargo tanks		

TAB. 3 *Hull* [4]



V *Hull and fore,* [4]

42	Navigation light and fog whistle forward mast
43	Winch
44	Anchor windlass
45	Anchor
46	Bulb

TAB. 4 *Hull and fore,* [4]

1.3 Construction

The most seafaring nations have established classification societies which review standards for the construction of cargo vessels. Classification societies publish construction guidelines and stability and operating standards to ensure vessel safety and standardization of ship construction and other marine equipment.

All ships are designed with limitations imposed upon their operability to ensure that the structural integrity is maintained according to classification society guideline. Therefore, exceeding these limitations may result in over-stressing of the ship's structure which may

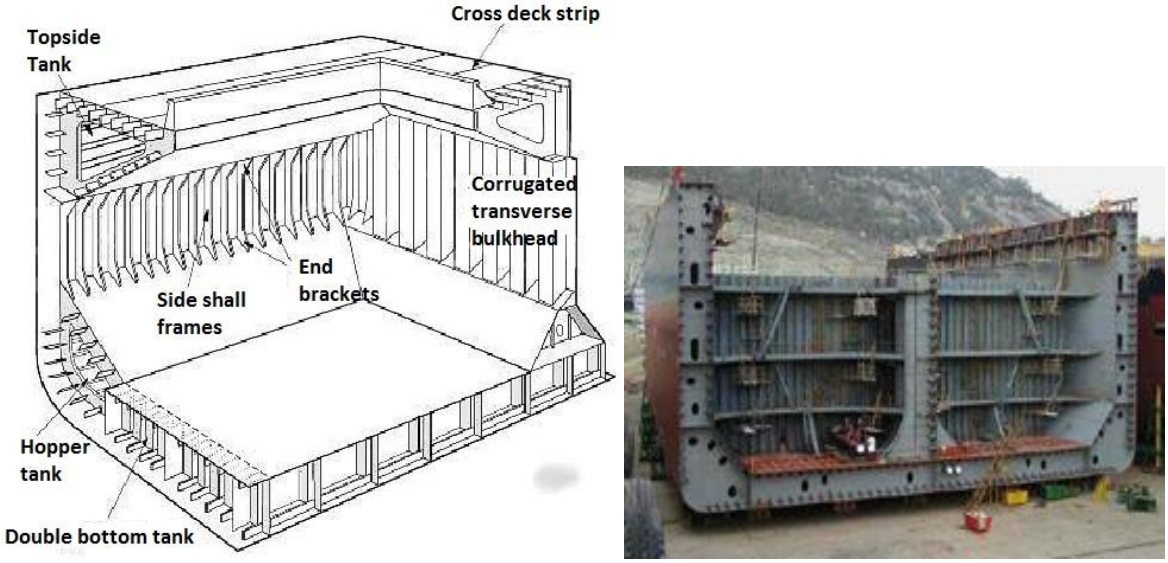
lead to catastrophic failure. The ship's approved loading manual provides a description of the operational loading conditions upon which the design of the hull structure has been based. The loading instrument or vessels approved loading software provides a means to readily calculate the still water shear forces and bending moments, in any load or ballast condition, and assess these values against the design limits.

A ship's structure is designed to withstand the static and dynamic loads likely to be experienced by the ship throughout its service life. [6]

1.3.1 Double hull construction

A double hull tanker can be defined as a ship designed for the carriage of oil in bulk where the cargo spaces are protected from the environment by a double hull consisting of double aide and double bottom spaces dedicated to the carriage of ballast water. These ballast spaces extend for the full length of the cargo carrying area. [6]

Single hull oil tankers had been phased out worldwide by 2010, five years before previously planned. Single hull tankers are more likely than double hull vessels to rupture and brake up, spilling oil into the sea. [7]



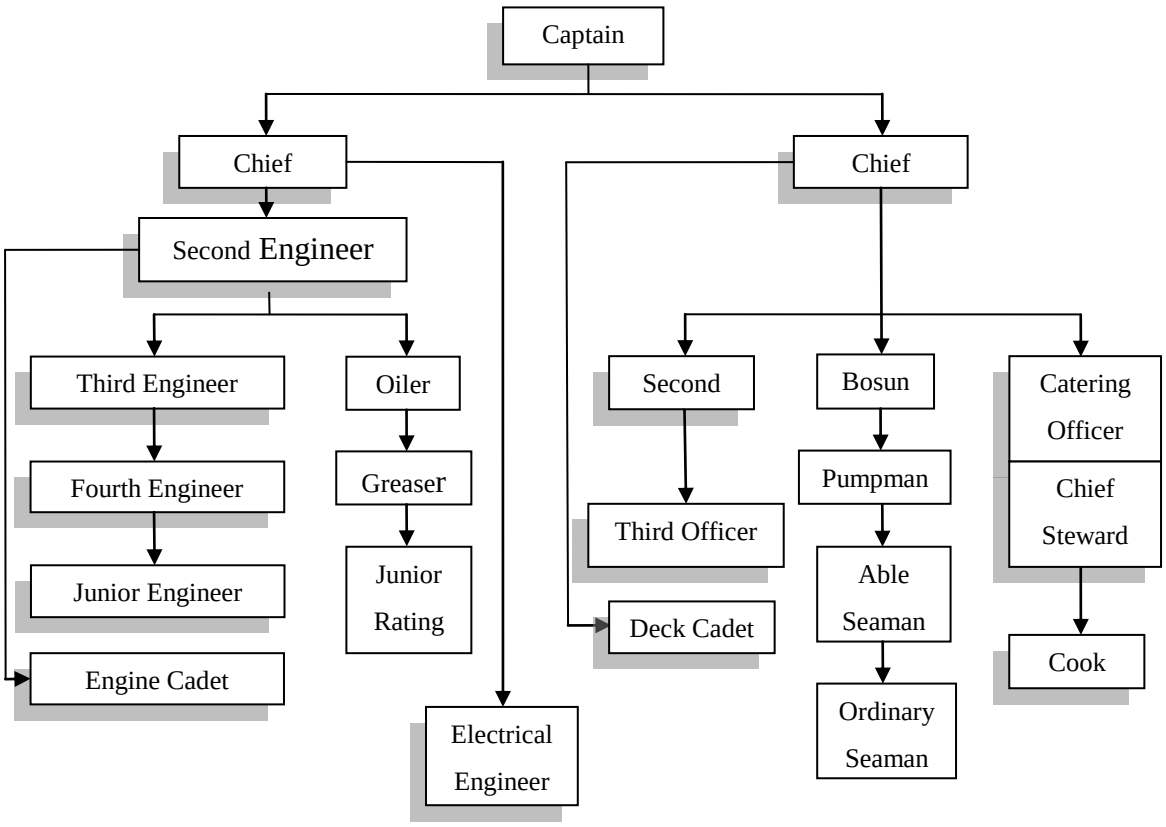
VI *Double hull*, [6]

1.4 Crew

The standard bulker crew consists of 20 to 30 crewmembers, although smaller carriers can have about 8 people on board. The crew will include the captain or master, the deck department, the engineering department, and the steward's department. The once universal practice of taking passengers aboard of cargo ships is very rare today especially on bulk carriers. [8]

Typical Bulk Carrier Crew		
Captain/Master		
Deck department	**Engine department**	**Steward's department**
1 - Chief Officer	1 - Chief Engineer	1 - Chief Steward
1 - 2nd Officer		1 - Chief Cook
1 - 3rd Officer	1 - 1st Asst. Engr.	1 - Steward's Asst
1 - Boatswain		
2 - 6 - Able Seamen	1 - 2nd Asst. Engr.	
0 - 2 - Ord. Seamen	1 - 2 - 3rd Asst. Engr.	
	0 - 2 - QMED/Jr. Engr.	
	1 - 3 - Oiler	
	0 - 3 - Greaser/s	
	1 - 3 - Entry-level	

TAB. *5 Crew* [8]



VII *Hierarchy of merchant vessel*, [8]

2 OPERATIVE & SECURITY DEVICES

Operative devices like Navigation, Communication, Weather Monitoring and Tracking ensure the fluent ship traffic. Their work is about to keep the ship in the right course and to prevent a collision with unseen objects or even with other ships.

Construction of bulk carriers as described in chapter one is the main element of the whole ship. It holds everything else on it from the biggest devices to the smallest ones. All of them are necessary for daily routine of a crew no matter whether it is for their private or professional life.

For this reason the whole unit is controlled by Security and Measuring systems, which informs about a possible failure of a single device or a whole system. These transfer information to the bridge, where a captain or another mariner can take an action.

Reliability of security devices is obviously a very important issue for bulk carriers. Therefore a choice of such equipment needs to be highly considered. Firstly, it must to fulfill requirements set by IMO Organization and Maritime Safety Committee.

These devices must assure a non problematic function in extreme environments like freezing or hot weather. These requirements are usually set for concrete environment, but generally, systems used on boats must be able to work in extreme conditions. A general requirement for temperature is about -40 to 75 Degree C. [9]

Model		ISW-800T-M12	ISW-804PT-M12
Product Series	Product Image		
Hardware	10/100Base-TX	8 x 12 D-coding 4-pin socket	
	100Base-FX	-	-
	Power over Ethernet	-	4-Port 802.3af PoE PSE
	Switch Farbic	1.6Gbps	
Mechanical	Dimension (W x D x H)	163 x 103 x 53 mm	163 x 103 x 53 mm
	Weight	976 g	990 g
	Enclosure	IP67 Aluminium	
	Mounting	DIN-Rail, Wall-mountable	
Power	Inputs	Dual 12~48v DC	Dual 48V DC
	Connector	M12 A-coding 5-pin socket	
	Consumption	4Watts	65Wats
Environment	Operating Temperature	. -40~75 Degree C	
	Operating Humidity	5% to 95%RH (Non-condensing)	
Regulatory	Emission	FCC Class A, CE Certification Class A	
	Stability	IEC60068-2-32(Free Fall), IEC60068-2-27(Shock), IEC60068-2-6(Vibration)	

TAB. 6 *Extreme conditions* [9]

2.1 Navigation, communication & broadcast

Navigation is a very important part of all ships, especially those traveling long directions.

The system ensures that a ship reaches its destination safely, in right time with no damage during the journey.

It uses GPS systems for its accuracy.

Although bulk carriers are mostly led by experienced captains, there can always appear a situation, when even such a “sea wolf” would need a help to handle a critical situation or just to get some information to prepare himself for an action.

Interactive communication between a bridge and other ships or an office is very important to make a voyage as fast and secure as possible.

It provides information about weather, other ships crossing around and as well as about a potential danger of a pirate attack.

These information are not able to be obtained just from the radio, therefore the whole influence system used on the bridge contains number of other subsystems and functions.

The description of the system is not possible to start by just saying “the most important is...” because all devices involved in the influence system are very important for ships.

It would not have been possible to make a voyage with no navigation system as well as there is no way how a crew would overview the whole bulk carrier just themselves to detect an uncommon event.

Because bulk carriers are often facing extreme atmospheric impacts, it is very important to choose systems, which are able to work in such environment. This will provide a precaution against an interference of devices due to low or high temperatures, high moisture level, chattering, etc.

2.2 Engine breakdown

An engine breakdown can bring a big disaster to a vessel, for there is no another way how to control such a huge ship. In this case, the danger can be for example a collision with other objects, ships or land.

An example of such accident is described below.

Source: Australian Transport Safety Bureau.

Investigation Number: 294-MO-2012-005

At 1218 on 17 May 2012, about 600 kilometers NE from Cairns, the bulk carrier *ID Integrity* suffered a main engine breakdown in the Coral Sea while it was on passage from China to Townsville, Queensland. The crew could not repair the main engine and the ship drifted in a westerly direction towards the Great Barrier Reef. [10]

General details			
Date:	17 May 2012	Investigation status:	Active
Time:	1218(UTC+10)	Investigation type:	Occurence Investigation
Location:	Coral Sea, 600 kilometers NE from Cairns	Occurence type:	Disabled
State:	QLD		
		Occurence category:	Serious Incident
Report status:	Pending	Highest injury level:	None
Expected completion:	Apr 2013		

TAB. 7 *General details* [10]

2.3 Fire

Generally, fire is one of the most common types of danger, which can happen in any environment or industrial branch. It can be started in a physical or chemical way. Mostly depends on environment, substances and processes appearing close to each other, but a

blaze can be also caused by a human element. Even, there are very strict rules on ships and it can hardly happen that somebody from crew would start a fire intentionally, the possibility itself should not be underestimated. Even so, there are crews to be trusted on ships, it is important to consider the fact, that accidents happens. Therefore, even everything is set under control and guarded by rules, a possibility of an unintentional accident needs to be also watched.

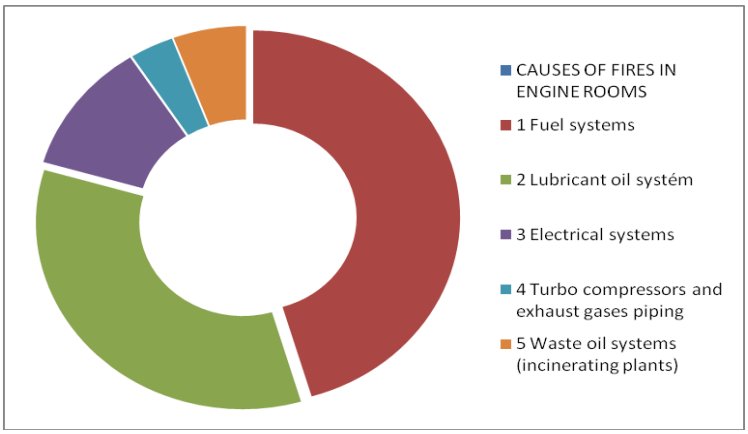
This is very important to mention the danger of a fire to understand, what a disaster can this mean to ships, especially these, which transport burnable type of gods. Therefore there are very strict rules, which purpose is to minimalize a possibility of a wildfire.

Even the prevention of such events is on a very high level, there are also another, very sophisticated systems on bulk carries. Their purpose is not just about the prevention, but their job is to provide a very elaborate way of firefighting. One of the most important areas is an engine room, where a wildfire can cause a big disaster.

The engine room contains extremes conditions, which are able to cause an uncontrolled fire. In such cases the fire fighting is dangerous, therefore a concrete system (Co2 & HALON, described in chapter 6.7.1) has been developed for this occasion. [11]

CAUSES OF FIRES IN ENGINE ROOMS		
1	Fuel systems	40,00%
2	Lubricant oil system	30,00%
3	Electrical systems	10,00%
4	Turbo compressors and exhaust gases piping	3,00%
5	Waste oil systems (incinerating plants)	5,00%

TAB. 8 *Couses of fires in Engine rooms* [11]



VIII *Causes of fires in Engine rooms*, [11]

2.4 Water Ingress

Water ingress is obviously very supervised issue on vessels, for there would always be a potential danger of leaking. Although, production process itself is very strict and there are plenty of controls and tests before ships goes onto the sea and afterwards, it is not possible to underestimate it. Such accident can fairly happen during a collision or even by a careless cargo operation.

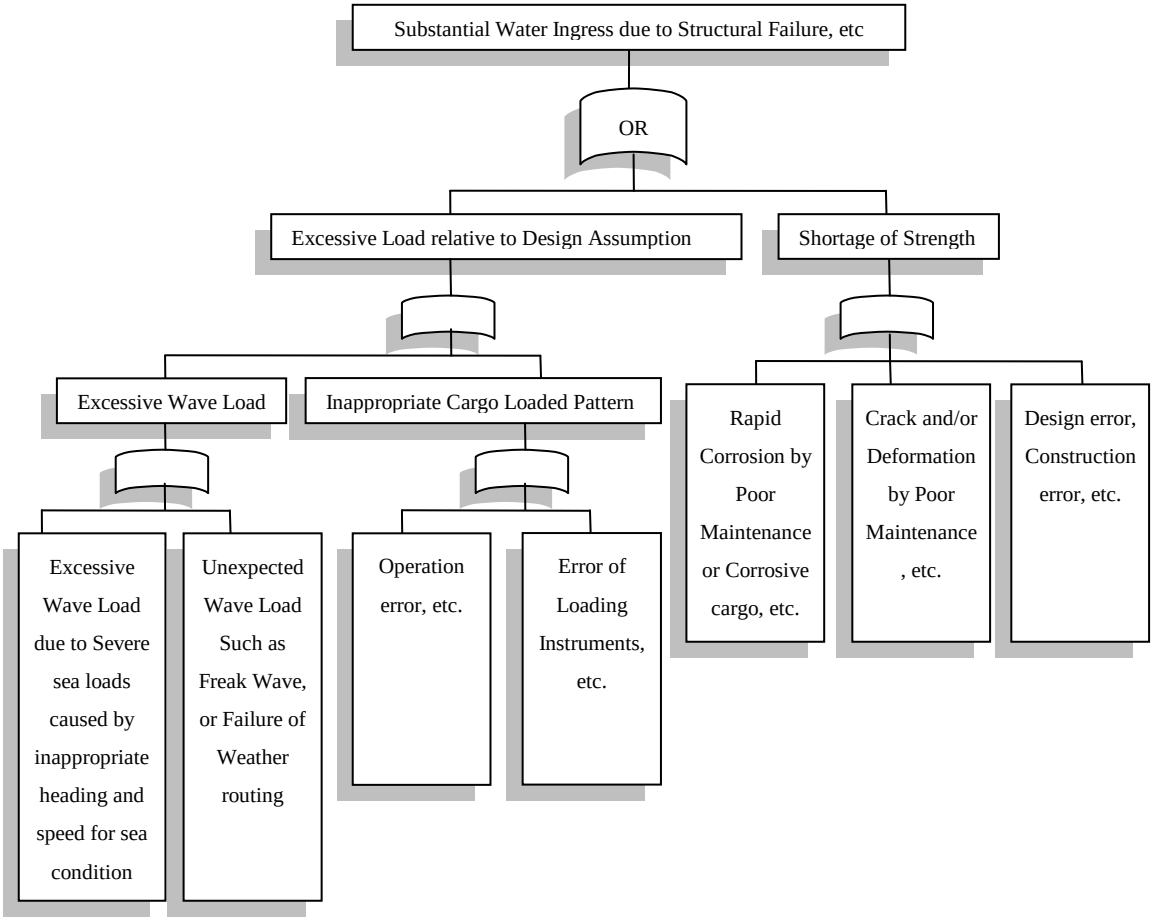
2.4.1 Description of Scenarios

The scenarios considered in the investigation consist of the following events:

1. Significant water ingress through holes due to side shell failure. Under conditions that the holes are opened under or near watherline, the cargo hold may be copletely flooded rapidly.
2. In some of the cases there are progressive flooding of cargo holds due to bulkhead failure, leading to total loss of ship and in most cases fatalities.
3. In the remaining cases the flooding is limited, resulting in serious casualty and not total loss, and few, if any, fatalities.

Different Hazard Identification studies have been conducted, e.g. by IACS, Japan and MCA.

Causes of water ingress and major contributors. [12]



IX *Substantial Water Ingress due to Structural Failure, etc.*, [12]

Number of Fatalities with regard to water ingress or structural failure				
Scenario	Accident Groups	Number of Fatalities due to Serious Casualty		
		Total Loss	Others	Sum
n. 1	1. Flooding into cargo holds due to structural failure	529	4	533
	2. Possible water ingress (Detail unknown)	33	0	33
	(Sub total)	562	4	566
	3. Flooding not into cargo holds due to structural failure	6	0	6
	(Total for Accident Scenario n.1)	568	4	572
n. 2	4. Flooding due to failure of deck fittings, etc.	44	0	44
n. 3	5. Flooding due to hatch covers or their secure failure	232	2	234
	(Total for Accident Scenario n.2 and 3)	276	2	278
none	6. Water ingress however excluded from the study	63	0	63
	Total	907	6	913

TAB. 9 *Number of Fatalities* [12]

3 NORMS AND REGULATIONS

Norm and Regulations are being set by different organizations, where each of these is in charge of a different issue.

3.1 IMO (the International Maritime Organization)

The United Nation specialized agency with responsibility for the safety and security of shipping and the prevention of marine pollution by ships. [13]

3.1.1 SOLAS (Safety of Life at Sea)

The International Convention for the Safety of Life at Sea (SOLAS) is one of the oldest conventions of its kind. The first version is adopted in 1914 following the sinking of the R.M.S. "TITANIC" with the loss of more than 1500 lives.

A protocol of 1978 (SOLAS Protocol 1978) dealing with safety matters relating to tankers was adopted by the International Conference of Tanker Safety and Pollution Prevention, and came into force in 1981. Over the last 20 years there have been several amendments to both treaty documents. These amendments are not just to correct the spelling. Since 1974 the amendments have added extra chapters to SOLAS, for GMDSS, ISM, etc., and in 1988 a new SOLAS Protocol replaced the Protocol of 1978. [14]

3.1.2 FSA (Formal Safety Assessments)

Is a structured and systematic methodology, aimed at enhancing maritime safety, including protection of life, health, the marine environment and property, by using risk analysis to cost benefit assessment. [15]

3.1.3 IACS common structural rules

On 14 December 2005 the Common Structural Rules for Tankers and Bulk Carriers were unanimously adopted by the IACS Council for implementation on the 1st. April 2006. The council was satisfied that the new rules have been based on sound technical grounds, and achieve the goals of more robust and safer ships. [16]

3.1.4 ISM (International Safety Management)

The purpose of this Code is to provide an international standard for the safe management and operation of ships and pollution prevention. [17]

3.1.5 MSC (Maritime Safety Committee)

Is a subsidiary body of the Council. MSC, which consists all Member States, is the highest technical body of the Organization. The functions of the Maritime Safety Committee are to „consider any matter within the scope of the Organization concerned with aids to navigation, construction and equipment of vessels, manning from a safety standpoint, rules for the prevention of collisions, handling of dangerous cargoes, maritime safety procedures and requirements, hydrographic information, log-books and navigational records, marine casualty investigations, salvage and rescue and any other matters directly affecting maritime safety“. [18]

3.1.6 MARPOL International convention for the prevention of pollution from ships

MARPOL 73/78 is an international convention for the prevention of pollution.

This international treaty was adopted by the International Maritime Organization (IMO) in 1973, and later updated 1978 after several severe tanker accidents. [19]

3.1.7 IMB (International Maritime Bureau)

The ICC International Maritime Bureau is a special division of the International Chamber of Commerce (ICC). The IMB is a non-profit making organization, established in 1981 to act as a focal point in the fight against all types of maritime crime and malpractice. [20]

3.2 Marine Accident Investigation

The statutory obligation to investigate marine casualties is in all main IMO/ILO conventions. [21]

4 SOMALIA AND PIRACY

Somalia has been without an effective central government since President Siad Barre was overthrown in 1991.

In 2004, after protracted talks in Kenya, the main warlords and politicians signed a deal to set up a new parliament, which later appointed a president.

The long-standing absence of authority in the country led to Somali pirates becoming a major threat to international shipping in the area, and prompted NATO to take the lead in an anti-piracy operation. International efforts were seen to bear fruit in 2012, when pirate attacks dropped sharply.

In 2011, the plight of the Somali people was exacerbated by the worst drought in six decades, which left millions of people on the verge of starvation and caused tens of thousands to flee to Kenya and Ethiopia in search of food.

After the collapse of the Siad Barre regime in 1991, the north-west part of Somalia unilaterally declared itself the independent Republic of Somaliland. The territory, whose independence is not recognized by international bodies, has enjoyed relative stability. [22]

X *Somalia*, [22]

4.1 Analysis of Human Cost of Somali Piracy in 2011

Piracy as defined in the United Nation Convention on the Law of the Sea is:

(a) Any illegal acts of violence or detention, or any act of depredation, committed for provide ends by the crew or the passengers of a private ship or a private aircraft, and directed:

(i) On the high seas, against another ship or aircraft, or against person or property on board such ship or aircraft;

(ii) Against a ship, aircraft, person or property in a place outside the jurisdiction of any State;

(b) Any act of voluntary participation in the operation of a ship or an aircraft with knowledge of facts making it a pirate ship or aircraft.

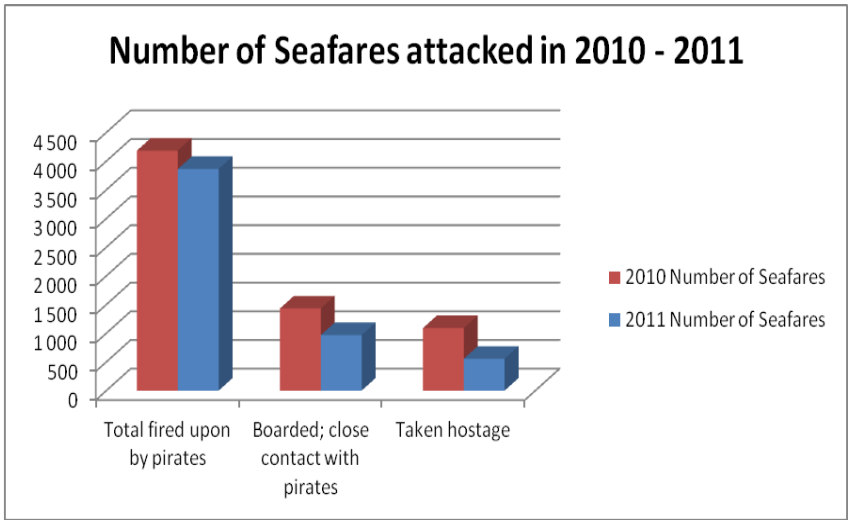
(c) Any act of inciting or of intentionally facilitating an act described in subparagraph (a) or (b).[1]

4.1.1 Number of Seafarers subjected to armed attack

The following graph shows numbers of seafarers, which had been attacked by pirates in 2010 and 2011. Although, there was a depression in 2011 it is still a big number. [23]

Seafarers Attacked in 2010 v. 2011			
2010		2011	
Cases	Number of Seafarers	Cases	Number of Seafarers
Total fired upon by pirates	4 185	Total fired upon by pirates	3 863
Boarded; close contact with pirates	1 432	Boarded; close contact with pirates	968
Taken hostage	1 090	Taken hostage	555

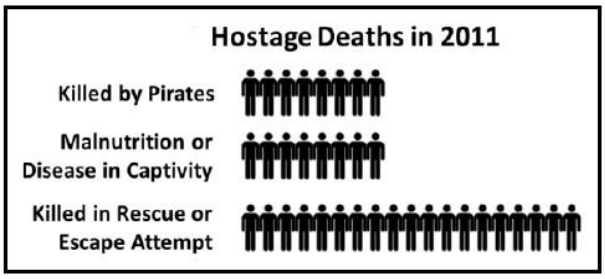
TAB. 10 *Seafarers Attacked in 2010 v. 2011* [23]



XI *Number of Seafarers attacked in 2010 v. 2011*, [23]

4.1.2 Hostage Fatalities

The year of 2011 was about to report an increase of hostage deaths. These were many cases of death, including being killed by pirates either in the initial attack or after being taken captive, disease or malnutrition, failed escape attempts, or getting caught in crossfire during a rescue effort by a naval vessel. [24]



XII *Hostage Deaths in 2011*, [24]

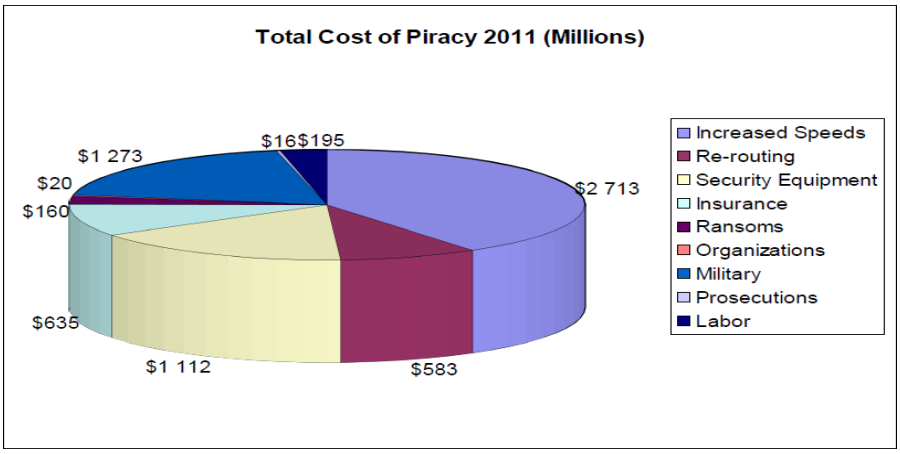
4.2 The Economic Cost of Somali Piracy

This report is One Earth Future Foundation´s (OEF) second assessment of the Economic Cost of Piracy. It estimates that Somali piracy cost between $6.6 and $6.9 billion in 2011.

The previous report on the Economic Cost of Piracy in 2010, estimated that piracy cost the world $7 - $12 billion. [25]

Total Cost of Piracy 2011 (Millions)	
Increased Speeds	$2 713
Re-routing	$583
Security Equipment	$1 112
Insurance	$635
Ransoms	$160
Organizations	$20
Prosecutions	$16
Labor	$195
Military	$1 273
Industry	80,50%
Government	19,50%

TAB. 11 *Total Cost of Piracy 2011* [24]



XIII *Total Cost of Piracy 2011*, [24]

II. PRACTICAL PART

5 PRODUCTION

Production itself is a wide process including a number of other processes. Each of these is very important and every operation must be considered with a big responsibility.

Generally, there are International companies, which cover the whole manufacturing process from construction to accessories installation as well as the whole progress supervision.

5.1 Production process

To help to understand the whole construction and its responsibility for security in general, the description starts with introduction of manufacturing process. The manufacturing of a ship named “CLIPPER” produced at Cochin Shipyard Limited in Kerala India has been chosen for the purpose.

Boat production by itself is an engineering challenge and bulker make up 40% of the world's Merchant fleets. It is able to carry about 400 000 tons of a death weight.

Construction of bulk carriers comments with the Production Engineering Process.

I Section

The team of experts, engineerers and skilled draughtmen are producing detailed engineering drawings to ship.

Meanwhile the construction is being processed, side shell has expended a stockyard spread across a thousands of square meters of land.

In process, these steel plates run through of several activities.

The 1st : Leveling machine provides inner distortions alignment.

The 2nd : Short blasting.

BP / HGP steel sheet shot blasting machine is mainly used to clean the surface of steel sheet and small profile beam. After cleaning by steel shots, the rust, dust, oxidated skin can be removed, the material anti-wear strength is improved, the surface and inside quality is promoted. This equipment is widely used for chemical, ship yard, metal structures, steel products, rail vehicles, engineering machinery and bridge industry.

The 3th : Inorganic zinc, silicon prema

After that, the plates go through cutting and fabrication. The cutting is into various geometries by CNC and plasma arc cutting machines. Afterwards, press machines are making different shapes before the plates are sent to the welding section and rejoined together and begin bigger and bigger.

The welding technology is the major part in the whole process.

Bulk carriers have a numeral piping system of various types and purposes, therefore it is each treated. Bent in different ways to get their shapes and tested in the end.

II Section

This section is called ERECTION BLATZ

Each part is unique, specially designed for a special part of a ship.

Ship building division contains a number of cranes of various capacity and utility.

Transporting these huge sections requires specially designed flatbed tracks. All heavy parts are mounted together by these devices into the one big shape and welded. Then after an inspection, whole exterior is blasted and then painted.

After the hull has been done an engine and a propeller with a rotor are fixed inside and fitted.

An accommodation part goes afterwards and then, the ship is ready to be moved onto the sea and checked.

Now, the whole interior is being made including auxiliary boiler meanwhile the engine room is also finishing, including auxiliary system.

In the end, there is the accommodation arranged for everyday needs, including everything from kitchen, laundry to gym.

Upper the bridge, navigation, communication and an influence system are getting completed.

Hutch covers are tested for water tightness and weather integrity. The propeller system is tested to every detail before the vessel leaves for seas trails.

The final painting is finished and the vessel is taking under control of the crew, which is making to be familiar with the ship. [25]

The whole production process must follow rules made by International Maritime Organization, which is particularly controlled by MSC and IACS common structural rules.

6 OPERATIVE & SECURITY DEVICES

The whole system inbuilt into vessels needs to be under control. As well as in most of other objects, there is a big possibility of a wildfire on ships. As already mentioned in this work the wildfire can mainly appear in operational areas, like for example engine rooms, auxiliary engine room, but also in an ordinary living room. Vessels, in general are also in a potential danger of water ingress caused by a collision with another object.

The most important for the safe voyage is prevention, which can be mainly provided by proper security systems with valid attests and certifications.

6.1 Navigation

6.1.1 Autopilot

Self-Tuning Adaptive Heading Control System, which direction is controlled by a Gyrocompass. [26]

6.1.2 Gyrocompass

A type of non-magnetic compass which is based on a fast-spinning disc and rotation of the Earth (or another planetary body if uses elsewhere in the universe) to automatically find geographical direction.

Gyrocompass provides the following data: heading relative to geographical meridian. [27]

6.1.3 Radars

An object detection system which uses radio waves to determine the range, altitude, direction or speed of objects. [28]

6.1.4 GPS Compass / Electronic Compass

Global Positioning System. Compasses working on GPS interface.

6.1.5 EDIS (Electronic Chart Display and Information System)

A paperless navigation, efficient route planner and effective support for the operator in maneuvering. [29]

6.1.6 GPS Chart plotter

Integrates GPS data with an electronic navigational chart (ENC). [30]

6.1.7 Echo Sounder (Hydrographic Survey)

Uses sonar to collect highly accurate water depth and bottom contour information. [31]

6.2 Communication

6.2.1 GMDSS (Global Maritime Distress and Safety System)

The international radio safety system mandated by the International Maritime Organization (IMO) for ships at sea. [32]

6.2.2 VHF / FM DSC Marine Radio

Marine VHF radios are primarily for short and medium-range, two way voice and data communication. VHF radio waves are line-of-sight and follow the earth´s surface. Typically best for communications up to 50 nautical miles. [33]

6.2.3 Radio Telex (NBDP)

A message is composed on the sending Radio Telex. [34]

6.2.4 Marine Satellite Broadband

Global Telesat Communications. Two-way satellite broadband internet service for use on private boats and commercial ships throughout European waters.

6.2.5 Battery less Telephone

An emergency telephone system without the requirement for any external power supply. [35]

6.2.6 Explosion-proof speaker

Voice Alarm ceiling loudspeaker is designed for flush in suspended ceiling and ideal for even sound distribution. [36]

6.3 Weather Monitoring & Tracking

6.3.1 Wind Monitor

Wind detector. Rugged, corrosion – resistant construction for a wide range.

6.3.2 Wind Tracker / Indicator

Displays wind Speed in a choice of units: KNOTS, MPH, KM/H, M/S. Maximum speed is also shown.

6.3.3 Meteorological Translator

Provides Meteorological data measurement, recording and display. [37]

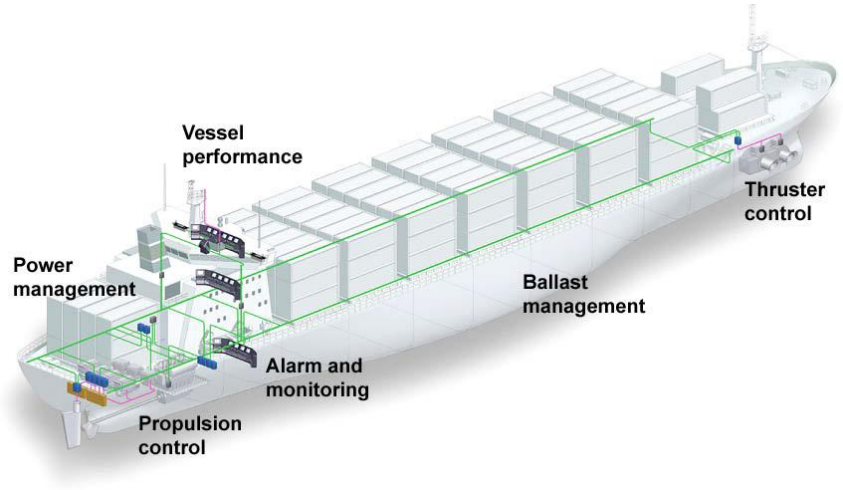
6.4 Marine Engine Control & Automation

6.4.1 Engine Control

An engine and Helm control unit.

To describe functions of the system, Konsberg K-Chief 600 Marine Automation System is used. This application included in typical bulk carrier delivery are:

- Alarm and Monitoring
- Ballast and service tanks valve and pumps control
- Control of air compression and automatic unloading systems
- Power management
- Auxiliary Engine control
- Switchboard control
- Ballast control [38]



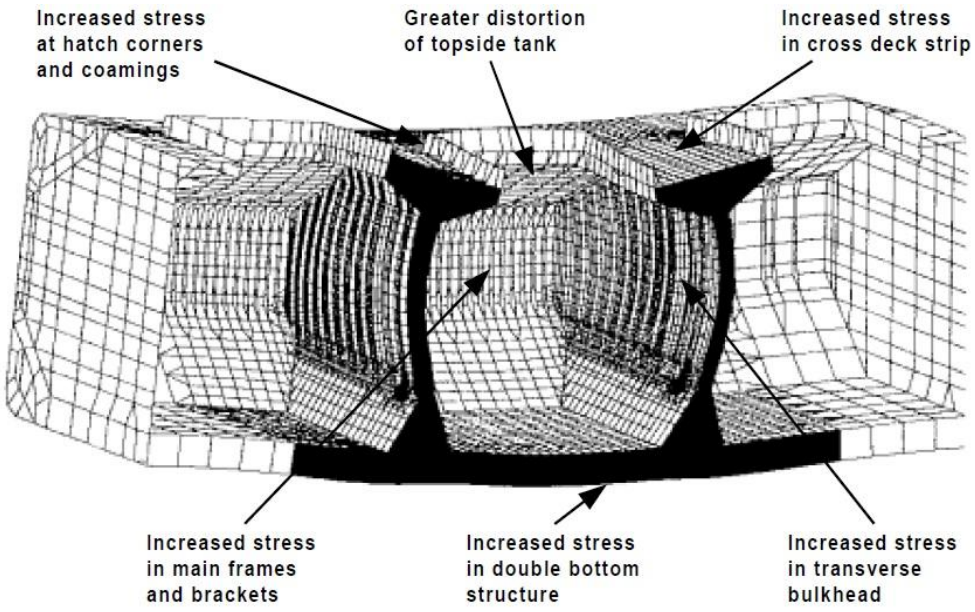
XIV *Engine Control*, [38]

6.4.2 Engine Room Monitoring System

Analog and digital field devices are monitored and displayed in real time and alert operation of alarm condition. [39]

6.4.3 Computer Loading System

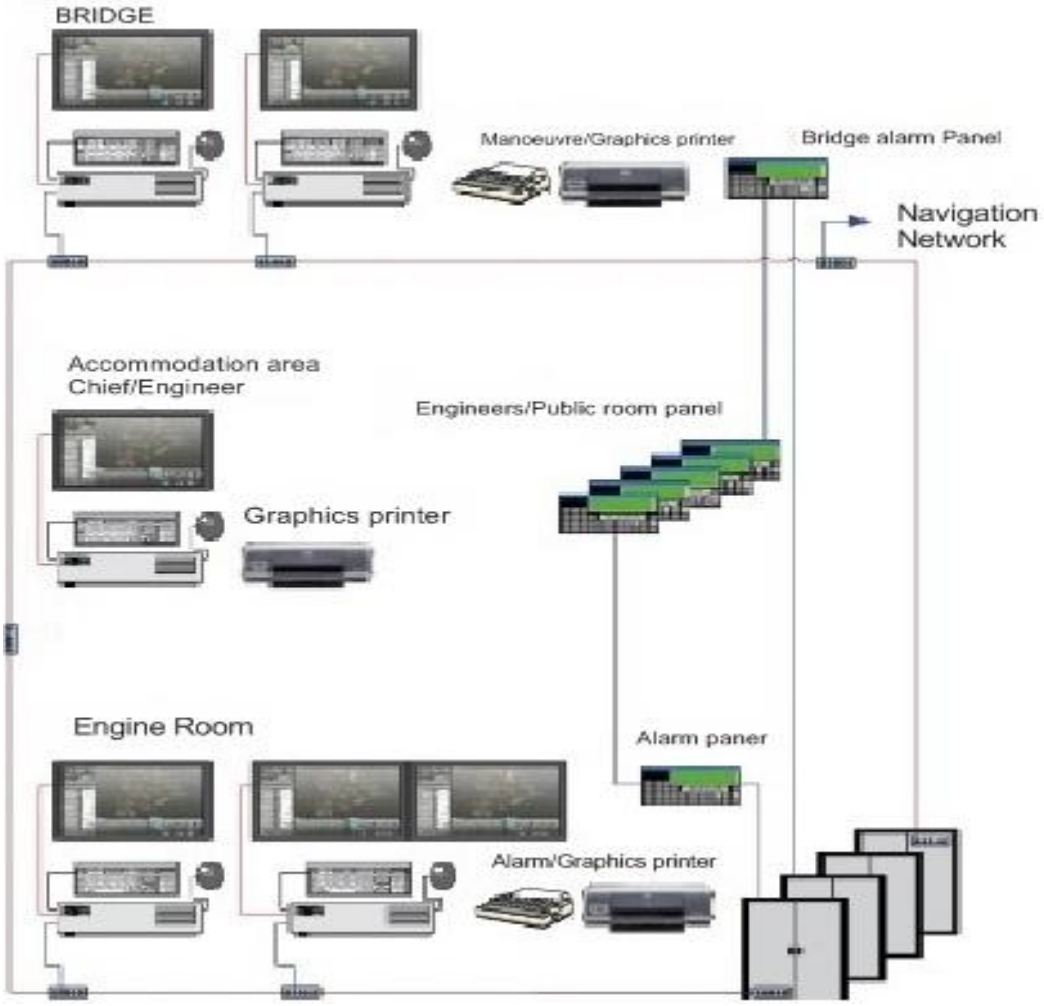
A loading calculator system to realize all problems within the scope of the loading process according to the requirements of the IMO and of practice (fleet). [40]



XV *Deformation*, [40]

6.4.4 Monitoring and Control System

Its purpose is to improve ships operations via increased safety and reliability. [41]



XVI *Monitoring and Control System*, [41]

6.5 Security & Safety

6.5.1 VDR / S-VDR

Voyage Data Recorder / Simplified Voyage Data Recorder.

VDR records data important for other processing.

6.5.2 Emergency Position Indication Radio Beacon (EPIRB)

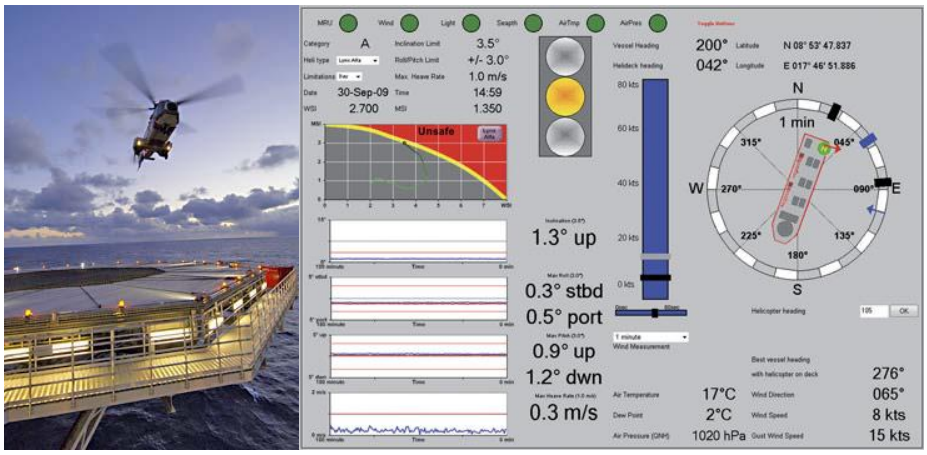
EPIRB are devices, which are designed to save a human life by alerting rescue authorities and indication a ship´s location.

6.5.3 Long-range identification and tracking (LRIT)

System provides the global identification and tracking of ships. [42]

6.5.4 Helideck Monitoring System

Used to analyze helideck motion during helicopter landings to improve safety in hostile weather conditions. [43]



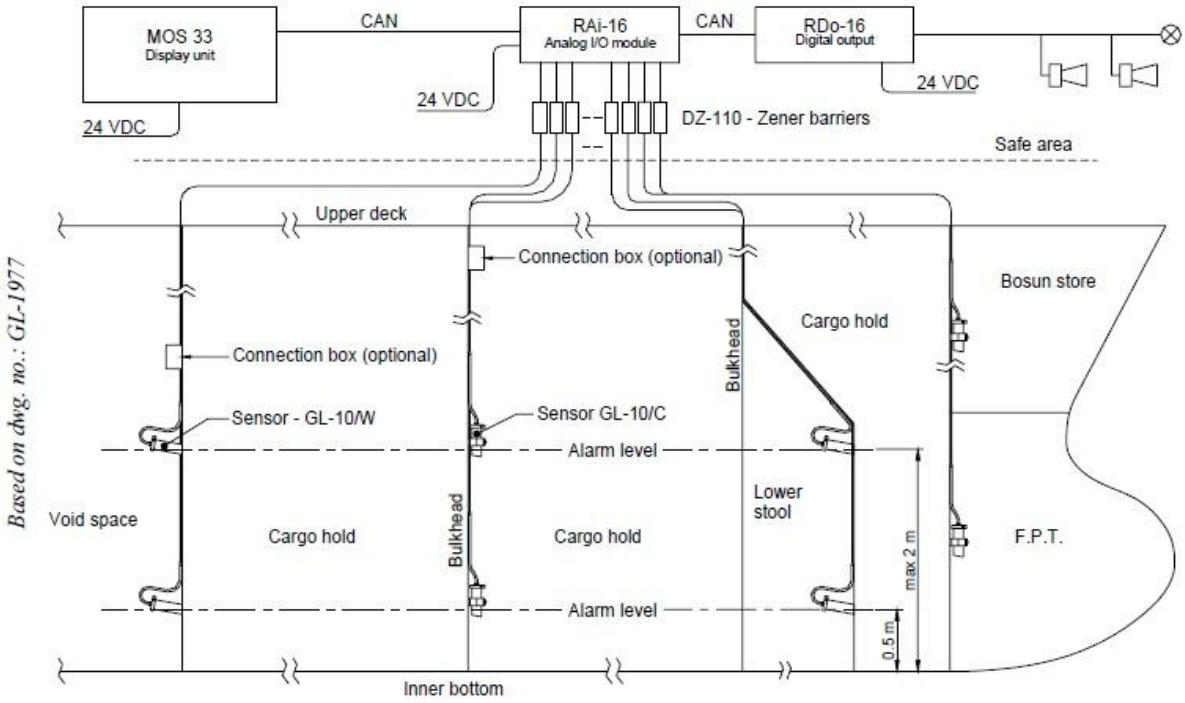
XVII *Helideck Monitoring System*, [43]

6.6 Water Ingress Detection

The Water Ingress Detection System for Bulk Carriers, C20/MOS is designed to meet the requirement under SOLAS Chapter XII Reg. 12.

The system includes operator panel, water detector detectors GL-10 and Zener-barriers. [44]

XVIII *Water Ingress Detector*, [44]



XIX *Scheme of water Ingress Detectors*, [44]

The scheme shows the water ingress detectors function. The system contains water detectors (Sensors – GL-10/W, Sensors – GL – 10 – 10/C) and Zener-barriers, which provide information about detected areas to a display unit (MOC 33) through an analog 0/I module (RAi-16).

6.7 Wildfire prevention

Wildfire prevention is a basic demand for every industry. Rules for installation of these systems are very strict and under Periodic Inspection and Testing.

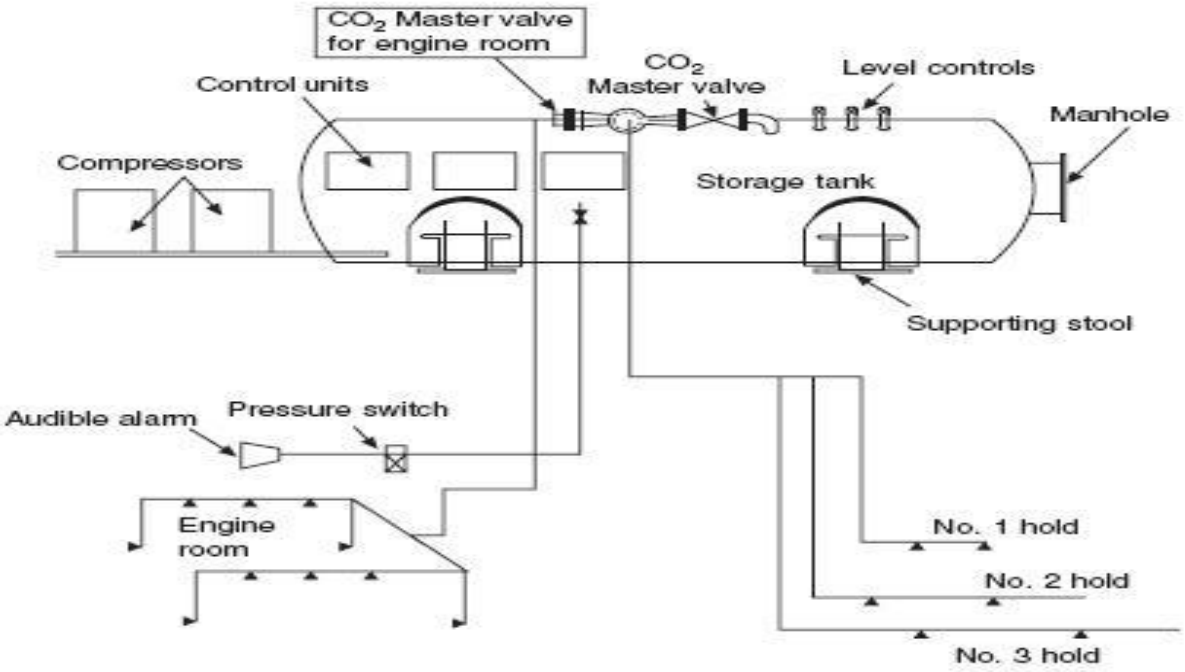
A fire can appear in all parts of a vessel, therefore it is necessary to choose a proper fire fighting system, which capabilities will be suited for a particular demand.

There are two different ways of a fire extinguishment, which depend on whether the fire has appeared indoor or outdoor.

6.7.1 Indoor (Engine room) Co_2 & HALON system

Co2 & HALON is the most uses fixed fire extinguishing system in Engine rooms. It is a sophisticated system, which is designed to extinguish the whole fire set in the room.

In case of a fire, the whole room must to be totally closed down, all ventilation fans must be stopped and fire flaps also closed. After all of these steps have been ensured, the Co2/HALON can be released. [45]

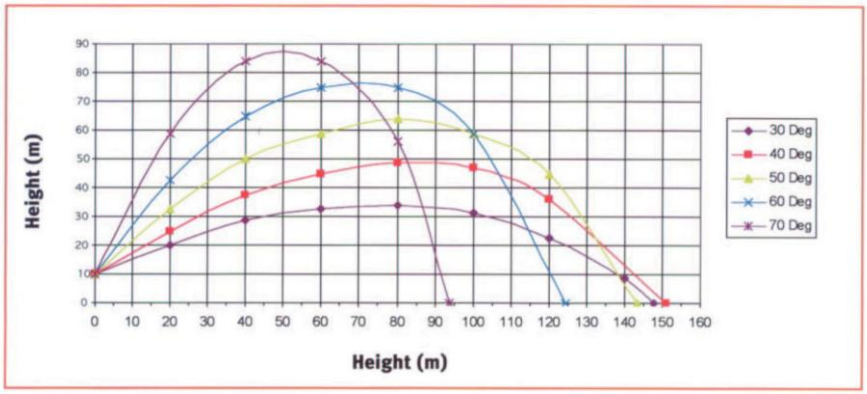


XX *Typical System Configuration*, [45]

The system contains a storage tank filled of CO_2. The tank is huge equipment fixed by supporting tools and controlled by level controls and other control units. Compressors provide pressure for the gas transfer to the engine room.

6.7.2 Outdoor (Fire Pump System)

There are plenty of aspects, which are necessary to consider for a good choice of Fire Pump System. One of the most important is a ship´s size. [46]



XXI *Cannon´s range*, [46]

FIRE SYSTEM CLASSIFICATION SOCIETY REQUIREMENTS						
Class Notation	I		II		III	
No. of Monitors	2	2(DnV)	3	4	3(DnV)	4
Cap. Of monitors in m3/hr	1200	3600	2400	1800	3200	2400/2500
No. of pumps	1 – 2	2	2 – 4		2	4
Total pump cap. In m3/hr	2400	7200	7200		9600	9600/1000
Length of throw in meters	120	180 (from bow)	150		180 (from bow)	150
Height of throw in meters	45	110 at 70m	70		110 at 70m	70
Fuel Oil capacity in hours	24	96	96		96	

TAB. 12 *Fire System Classification Society Requirements* [46]

Fire pumps are very powerful devices used for firefighting mechanically controlled.

The system can be provided in the various arrangements:

- Diesel Engine – Hydraulic Fire Pump System
- Direct Diesel Engine Driven Fire Pump System
- Diesel Engine / Electric Fire Pump System
- Direct Electric Fire Pump System

6.8 Pollution Control

6.8.1 Sewage Treatment System

Waste water treatment systems. The system is refines used water for another use. [47]

6.8.2 Oil Discharge Monitoring and Control System

A monitoring system for the control of discharge ballast water from tankers and chemical tankers. The system is certified by the marine authority, as well as several different classification societies. [48]

6.8.3 Ballast Water Treatment

A clean Ballast System for simple treatment of ballast water and reliably remove of organisms, sediments and suspended solid in. [49]

7 EVACUATION

Evacuation is the last possible solution in case of an accident, after there is no another way of a ship is to be saved. It has rules to be obeyed as well as priorities for leaving the ship. To assure the safe crew transfer it is necessary for every ship to be equipped by lifeboats.

7.1 Lifeboats

Lifeboats must fully compliant with the latest SOLAS regulation, LSA code & IMO Resolution for providing major classification certificates. [50]

XXII *Lifeboat*, [50]

7.2 Free Fall Lifeboats

Free Fall Lifeboats are mandatory for the installation only at Bulk Carriers. Installation of these lifeboats is easy on the ship´s Deck House. [51]

XXIII *Free Fall Lifeboat*, [51]

8 PROTECTION AGAINST APROXIMATE ATTACK

Piracy is a potential source of a great income for a Somali citizen. It had started long ago before the first attack on tankers had been announced by taking fishing boats and ships transporting foods in hostage. How their experience and capabilities had grown up, the pirates had taken the first big ship. Tankers are in property of big companies, which are expected to pay lots of money for them. There is also anger in Somali people for pollution and other contamination, which bulk carriers have brought into their country. For this reason the hijacking of these ships is not always considered as a crime but in some way as a satisfaction for Somali people.

Protection against these attempts is obviously very important to companies providing the sea transportation. It had forced them to work with this issue and to invest lots of money to find a solution. It contains everything from diplomatic dwells, installations of new security and defending systems to the cooperation with armies and private security agencies.

Most of crew is depended mainly on armies securing the area, but there is still quite a big possibility of an attack. Therefore many tankers are under security of independent armed groups, which are responsible for the fluent voyage.

International shipping laws prevented the possession of handgun on deck and many ports did not allow entry to vessel with weapons on board “The community is strongly against private militias as it is likely to promote more violence.” The carrying of arms was also likely to invalidate most insurance policies. There is a believe that existing piracy prevention forces in the region – including NATO, Indian, Russian and EU forces – would be more effective if co-ordinates from a single centralized command.

8.1 Technical devices

To locate a potential pirate boat as soon as possible, it is necessary to use radars, which will detect an approaching object. This will provide detection during nights or in a less visible climates as well as more time to prepare for an attack and for calling a Navy for help.

Generally, it is much harder to board a big ship, then a small one for there are always ladders needed for it.

After the pirates will manage to come closer to a ship, there are some ways how to force them back, with no use of guns yet.

Anti-piracy water cannon system is able to send a water stream of high pressure into a big distance. Pipes of the system are controlled by remote controls, therefore there is no need an operator on board. This is very important, for it provides the safe operation of the system.

8.2 Arming

It is obvious, that pirate are using guns for their attacks, therefore is it important for crew to be equipped by guns too. There is no much other choices how to protect against an armed robbery. Guns used by pirates are provided from the black market, therefore it is not difficult to get a gun in Somalia.

For this reason it should have been considered at least to provide guns to a crew, which can protect the ship before pirates get on board and still after they will manage to get on board. Obviously, not everybody feels comfortable with guns nearby. Therefore it is not necessary everybody should wear a gun on him and just those who are able to use it and are determined to protect the ship have to be in charge of protection. Otherwise, there would be more harm even before a potential attack would has started.

8.3 Pirate´s organization

Basically, there is no much organization used by pirates during their attacking attempts. The basic idea is just about to kidnap a ship. The most potential victim is about to be a middle size commercial ship transporting commercial gods of food to a development country. Even, attackers are equipped by ladders, these are usually not long enough to reach a top of such ship. The bigger ship is about to be attacked the bigger danger for pirates is about to appear during the action. Therefore, even there would be a great prize demanded for a large bulk carrier, it needs to be considered whether it is possible to success the attempt.

However, pirates usually work in groups using about three boats. In such a case, there is a main boat and two auxiliary. The responsibility of these two smaller boats is to occupy a ship, meanwhile the main pirate´s boat is going to set a strike.

A bigger ship pirates have, more possibilities this can provides to them. It can mean more room for more man, guns, food etc.

Unfortunately for pirates, there is not many opportunities to use modern technology like radars for searching or other sophisticated machines for an attack yet.

There is also cooperation with armies of different nations as well as with military private organizations, which are in charge of bulk carrier's protection.

These are much better equipped than pirates and are able to react very fast.

The purpose of the army is not only about to secure particulars ships, but also about to secure whole trading area and to search for potential attackers.

For this reason, many of pirate´s attempts for kidnapping were destroyed already.

8.3.1 Guns used by pirates

There is not a law or organization controlling gun market and it is not uncommon to buy a gun on a street of Mogadishu. Guns used by pirates are not modern, but are easy to operate and are also known for their credibility. These are usually AK-47, Colt m16, SAR-80, CETME which are automatic rifles, but also another types, which can cause a bigger damages to ships. These can be for example RPG-7, SPG-9 and so one.

For this reason it is very important not to allow pirates to get close to a ship, because it is very dangerous to fight to them afterwards. [52]

XXIV *Range of Flow Power*, [52]

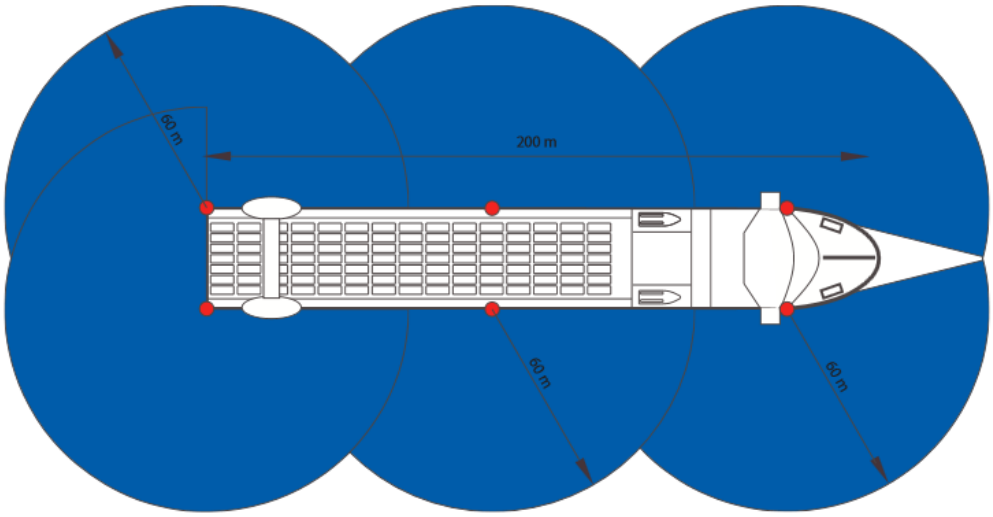
8.4 Anti-pirate water cannon

Is the efficient equipment for keeping pirates in a long distance from a vessel.

Installation

- 200 m x 30 m (length x height)
- 6 X FORCE80 flow power of 3 500 liter per minute by 5 bars
- Accuracy ensured in range of 60 meters, acceptable in range of 90 meters
- 2 control stations
- Containing CCTV [53]

XXV *Anti-Pirate Water Cannon*, [53]



XXVI *Range of Flow Power*, [53]

8.5 Army interest

NATO started to provide escorts to UN World Food Programme (WFP) vessel transiting through these dangerous waters under Operation Allied Provider (October-December 2008) on request of UN Secretary-General Ban Ki-mon. In addition of providing close protection to WFP chartered ships NATO conducted deterrence patrol and prevented for instance, vessels from being hijacked and their crew being taken hostage during pirate´s attacks. The operation was succeeded by Operation Allied Protector (March-August 2009), which continued to contribute to safety of commercial maritime routes and international navigation. This operation evolved in August 2009 in Operation Open Shield.

Operation Open Shield also contributes to providing maritime security in the region and is helping to reduce the overall pirate attack success rate.

The March 2012 Strategic assessment highlighted the need to erode the pirate´s logistic and support base by, among other things, disabling pirate vessels or skiffs, attaching tracking beacons to mother ships and allowing the use of force to disable or destroy suspected pirate or armed robber vessels. [54]

9 PROPOSALS FOR IMPROVEMENT AND PROSPECTIVE MOVEMENT OF THIS DOMAIN

To bring a technical improvement is not quite possible to make for a single person therefore it is usually responsibility of a team of professionals. Such a team is educated and has experience with the system or devices connected to this kind of industry and is able to find a solution for a particular issue. A communication with operators can also bring information about device´s ability in progress and report its benefits or handicaps.

From the commercial point of view, it is reasonable to deal with big companies, which are able to deliver complete products and services. In this case it is about building of the whole ship and providing a long term guarantee and maintenance works. This also includes training provided to a customer and to his employee.

The contractor shall provide transparent information about himself and his suppliers including references from previous customers. Not only positive references can be provided. In case of a negative reference, the contractor can show a solution which he brought up to solve the problem out.

There are technical devices designed to protect crew against pirate´s attacks on ships. These are very helpful during the attack and also their fitting into ships can bring a respect to attackers. But there is a danger of visible devices for it can inform pirates about the system or provide their easier destruction.

9.1 Discouragement

To discourage pirates from their plan to attack is not easy for they are ready to use every possibility to take an action. Days spent on the sea are more than convictive to try their luck. Although, there is a fear of a single life, which can each attempt take, the prize is worth of it. Nevertheless, to bring a fear to an attacker can at least unbalance him and cause disturbance to their strategy. Such inorganization will help to protect a ship which can at least to provide more time to crew. The discouragement is possible to make by a visible security devices or by other stuff, which will inform a potential attacker about a danger in case he will get close to the ship.

It would probably not be very effective for a long time to use a figure of soldiers, for example. This could scare an attacker for some time, but if he will examine the shape for a while he would realize its purpose. But such statue can bring more time to crew for the defence preparation.

XXVII *Soldiers*, [56]

As mentioned in capture 8, there is criticism on crew arming and even insurance associations do not support such form of protection. Therefore an arrangement of a machine replica may also bring some benefit. For example a functional replica of a machinegun can be placed on deck. By "functional" can be meant firing pointless ammo. To assure, that real ammo is not possible to be used can be in a structural interference with the machine, which should be also attested by paperwork for insurance companies, etc.

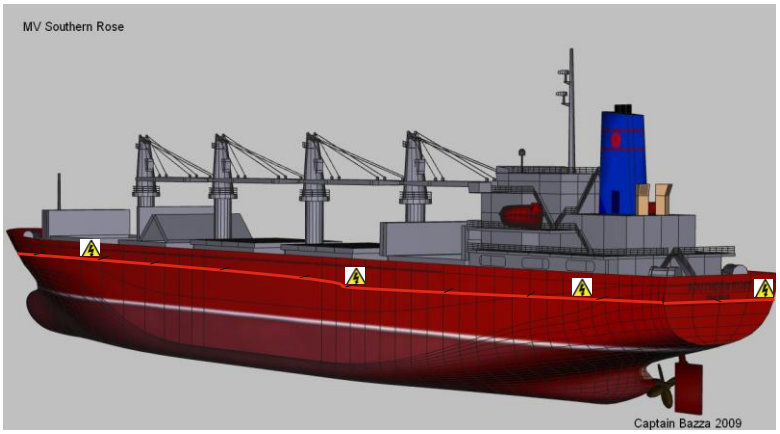
9.2 Pirates on board

There is an obvious fear of a single life during a piracy attack, which will multiple in case, that invaders will manage to get on board. If just one of attackers climbs on board it is easier to overpower him but more invaders get on top, the defense becomes more difficult.

To avert pirates boarding is very difficult and dangerous, which should have been supported by a security mechanism.

9.2.1 Electric barriers

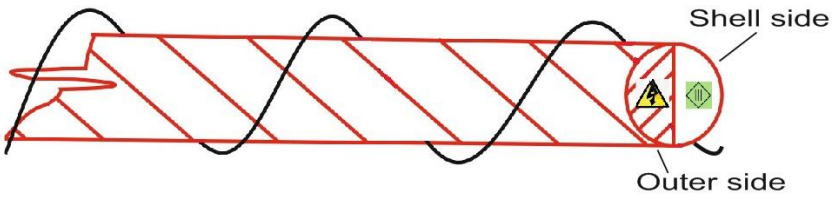
One of solutions can be an electrical barrier led around a boat´s side. Such barrier would not let attackers to cross its circuit for its electric current.



XXVIII *Electric barrier*,

The picture shows the circuit of the electric current guidance, which should be strong enough to stop attackers in their attempt. The amount of used power as well as the system´s construction shall be specified by IMO organization in range, which will not kill an invader.

It is more than likely, that there will be rules set on the mechanism for its possible danger for crew as well as for port workers. To anticipate a possible ban of such system the secure service must be assured. The system´s should not have been under still intensity, but it should be turn on just during an attack. There are couple ways how the system´s supplying can be made. The energy can be provided form the vessel´s main supply device as well as from an independent diesel generator. In case of the independent generator, there should be two switches inbuilt. One for the generator, other for the current transfer into the barrier. After the generator is on, another switch will bring the electric energy into the circle. Such system will must to abide rules, given by insurance associations as well as to follow rules set by laws of countries, whose ports the ships are using.



XXIX *Power line*,

The power line would contain a cable providing the current for the outer side. The inner side (shell side) is isolated not to bring the electricity to it. Even a distance between the line

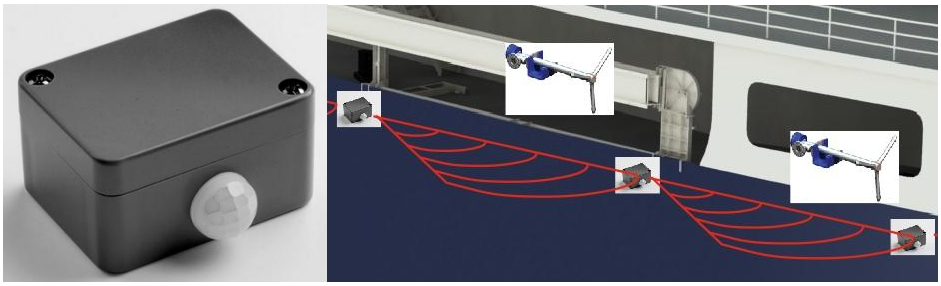
and the shell will not allow their contact of each other. Insulation stripes will has to be placed onto the side shell too.

9.2.2 PIR detectors

A solution of PIR detectors can by also considered for ships protection. Such used technology would be quite bounded for its sensitivity. For example PIR detectors detect human temperature, which would be acceptable for attacker´s detection. The problem is about another effects happening around, like waves or sun shining. For this reason the system would be eventually active in night time far enough from the water level.

XXX *PIR detectors*,

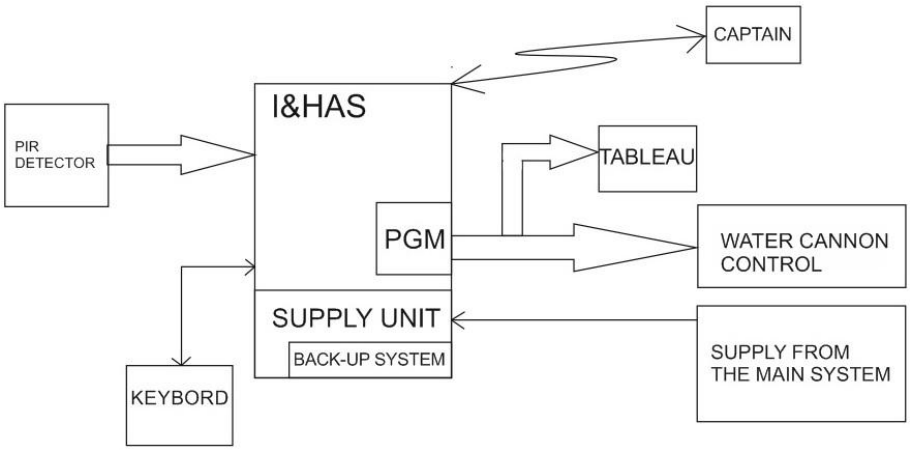
A single or more waterproof PIR (Passive Infra Red detector) detectors are mounted serially in line to detect invaders boarding the ship in a particular part and turn on a water cannon covering the area. In the same time an alert is sent to the bridge to inform captain about the intrusion. Each ship is individual therefore a concrete type of the detector should have been chosen. Also direction of the detection should be considered individually. One of the most important issues is a height of a deck from the water.



XXXI *Waterproof PIR detectors*, [57]

There is a number of water cannon type´s which can be use. To make the system easier it would be better to use rotate water cannons.

XXXII *Rotate water cannons*, [58]



XXXIII *Diagram of the system*,

The diagram shows the way of I&HAS system structure. In case of an intrusion, the PIR detector will detect an object of a human temperature and will send a signal to the control

unit (I&HAS). This unit will alert the bridge, where other actions will be made. More importantly, the I&HAS unit will send an information about the concrete barrier disturbance, which will active a concrete water cannon.

9.3 Attacker´s (pirate´s) psychology

Even the most sophisticated security system cannot always assure the safe voyage and a possible attacker´s success can appear. Such occasion is very stressful for hijacked crew. Therefore there should be an educational program, which will deal with ways of crew´s behavior during captivity. The program should obtain information about how to deal and cooperate with pirates and also how to keep a health environment. The purpose of such course would be about to teach crew how to survive captivity.

9.4 Defending techniques

Defending techniques are very important at least to make the crew more confident, but it mainly increases a possibility of an efficient self defense.

The crew is in a relative safety until attackers are out of the boat in case of acceptable technical accessories, which can keep aggressors in sufficient distance. This can also safe some time, which would be needed for associated troop's arrival. These are trained for fighting on the sea and much better equipped to deal with pirates.

However, there can always occur a situation, which will not provide a fast reaction on an incoming attack and will cause pirate´s boarding. In such cases it is mostly brighter not to oppose any more, but to start cooperate with them. However, there still can be a last possibility to handle the situation in case than not all pirates are boarded yet and there is still favorable strategic position kept by the crew. The right decision about when it is still "safe" to fight with such aggressive invaders is not easy to take, but it is always necessary to know the crew´s possibilities of protection and to be aware, that in a case of failing of the defense, the consequences can be much harder afterwards.

For this reason, it is always necessary to consider these possible consequences and lead the fighting in a real view of its success. Do it as fast as possible, as hard as possible and with no hesitation. A defender should be aware, that there is no another chance anymore and in a case of a failing an attacker will take the opportunity to win.

A defense itself is not always easy to make, especially against a stronger, more experienced or better trained opponent, which led many warriors to improve their fighting techniques, based on their existing experiences thousands years ago. Nowadays, there are hundreds of martial arts, which purpose is to protect against an attack or even to paralyze the opponent.

Considering the basic idea, the whole defense is about taking-over an attacker´s control. The most techniques are about changing the attacker´s purpose and turn it back into his direction. Although, it is quite easy to speak of techniques, its practical use is much harder to apply.

Techniques showed bellow are about to help to understand their purpose and mainly their way of application. However, it is important to know, that a real fight is not previously prepared and its successful control can be achieved by intensive trainings and fighting experience. This leads to the mental balance, which is necessary for the calm accepting of the challenge. [55]

9.4.1 Knife attack

9.4.1.1 Attacker´s purpose

An attacker´s purpose is to stab a knife into a potential victim

XXXIV *The purpose of the attack*

9.4.1.2 Beginning of the technique

Beginning of the technique is to deflect the knife off its direction

XXXV *Beginning of the technique*

9.4.1.3 Kotegaeshi

Turning back to the previous position by using rotation to cause the attacker´s deflection from his balance. The attacker´s wrist is being used for this technique (Kotegaeshi)

XXXVI *Kotegaeshi*

9.4.1.4 Fall

The kotegaeshi technique will force the attacker to fall down. Then, it is a good position to turn the attacker around on his belly again by using his wrist.

XXXVII *Fall*

9.4.1.5 Disarmament

After the attacker has been turned around, there is an option of his disarmament

XXXVIII *Disarmament*

9.4.2 Machete attack

9.4.2.1 Attacker´s attempt

The attempt is to gash a victim

XXXIX *Attempt*

9.4.2.2 Counterstrike

Counterstrike including a blocking of the strike and the attacker´s deflection

XL *Counterstrike*

9.4.2.3 Opponent´s deflection

Another fast strike by a knee this time, which will employ the attacker and will provide more time to complete the technique.

XLI *Knee*

9.4.2.4 Disarmament

Leading the opponent on the floor, where his disarmament can be finished

XLII *Disarmament*

9.4.3 Armed attack

Even the previous attack, where the machete had been used is very difficult, the armed attack is totally different of both of previous. It is necessary to be aware, that if anybody will drug his gun out, he is about to use it. Therefore it is not wise to risk, but in case of any opportunity for defense it is important to use it as good as possible. Any fail in this case will be punished by the attacker.

9.4.3.1 Pointing of a gun on a potential victim

XLIII *Pointing of a gun*

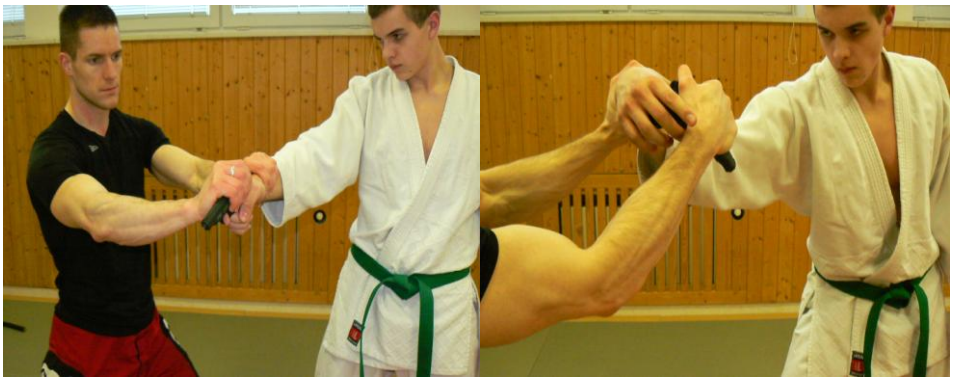
9.4.3.2 Gun deflection

Very fast deflection of the gun´s axis

XLIV *Gun deflection*

9.4.3.3 Disarmament

Taking control of the gun by its dislocation from the attacker´s hand. A construction of hand is used for the dislocation. It is quite possible, that the gun will fire in this part, which is not dangerous for a defender any more, safe of eventual small skin injury. Therefore it is important to stay calm if such thing will happen.



XLV *Disarmament*

9.4.3.4 Safe direction

Straight away after the gun has been taken from the attacker, it is necessary to build a gap between him and defender.

XLVI *Making of a gap*

9.4.3.5 The attacker´s control

XLVII *Attacker´s control*

10 ESTIMATION OF THE FUTURE TENDENCY

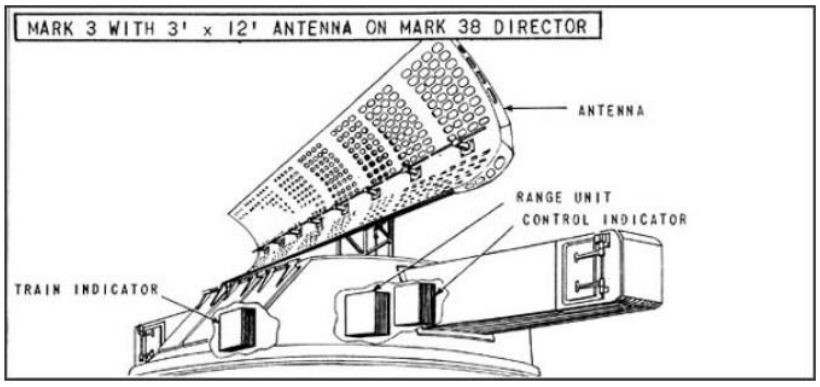
Nowadays, there is not much technology used by pirates, safe of guns reachable on the black market and boats stolen from fishermen or so ones. For this reason there is no need radar detection or any other more sophisticated system to detect approaching armed groups on small boats.

Because there had been millions of dollars already paid to pirates, an attack with use of modern technology would be expected. Also a danger of a terrorist attack should not be underestimated. These are more than likely to be supported by powerful organizations, which are able to provide a large sort of equipment.

What about technical capabilities of commercial ships, there are not much more devices needed for them, for they already have everything necessary to detect an approaching object. The problem would appear in case of an attack from the air by using helicopters for example. Such attack would be very fast and not easily countered by crew with no special arms and training.

Because, there is not an allowance of guns holding on ships, other systems should be proposed. One of these systems would be the already described water cannon, in this case with a construction allowing more upside movement.

The well timed object detection is very important for successful protection against the attack from the air. This will provide radar with flying objects scanning.



XLVIII *Radar*

CONCLUSION

To bring a solution for safer progress of bulk carriers is almost impossible for a single person, therefore nearly everything which needs a change is considered by specialized organizations employing professionals from the branch. These are skilled and qualified seafarers and technicians with large experiences in the maritime branch. Still, even after an understanding of the whole system, it is not always easy to find something new to consider. Obviously, there is still something new to improve in all kinds of industry, not apart from shipping industry. To be able find an improvement, it is important to think beyond of a system and to have a vitality to find something new. Enthusiasm is a character, which moves everybody to do his or her job as good as possible. To build the energy in an employee, it is necessary for an organization to motivate him, which can be made by payment or career advance for more career minded. This is a question of a single company and its motivation policy.

The proper system´s progress is necessary for the safe voyage, therefore periodic maintenances is important for all devices involved in ships. Generally, every producer provides guaranty on his products, which supposes to assure their smooth running, but even the most tested unit can break down in the worst possible time. For this reason, a skilled handyman, who is able to make the device running again as soon as possible, is needed on board. The system by itself is supposed to be affordable, but also functional. Therefore, already proofed systems are being used in this work, designed into more functional devices.

As already mentioned, the modern technology had been design in this work, including single devices, which make a complete unit suited to a particular issue. Generally, it is prosperous to use technology, which fulfills a ratio demand of price versus quality. Because, there is not much room for improvements of monitoring systems, I have made more focus to systems and assets, which purpose is to discourage attackers or to avoid their boarding. There are two system designed to stop the undesirable boarding in this thesis. The first is an electrical barrier, which purpose is to stop the attacker´s boarding. The system is only activated during the attack. The second is more about securing the perimeter during the ship´s progress. This one is capable to find a concrete part of the ship´s perimeter, where the intrusion is being detected, than to immediately alert the bridge and also to active a water cannon in the particular area.

Education trainings generally provide updated information about tasks needed for crew, whether it is about new technological devices or an organization policy. There is usually an improvement in a newly installed device or a whole system as well as in a newly designed organization policy, which follows changes in technological norms or commercial environment. For this reason, is it responsibility of all companies to keep employee´s qualification.

Piracy means danger for commercial and other supply ships. Therefore NATO had started an operation, which purpose is to prevent such attacks. This cooperation does not have to end just by providing of territory surveillance and taking pirates into captivity, but it would also provide some training, which will help to crews of other ships to be more confident with dealing with pirates. Their training and experiences would help to crew to be more prepared for a potential attack and to improve defending strategy. Connection and communication with armies is necessary as well as with another ship browsing the area.

However it is not the intention of this work to convert commercial ships into war vessels, it is necessary for crews of these ships to learn about possible danger and about ways of defense against such occasions. Therefore, it is important to learn about strategy used by pirates, which will help to prepare against it, as well as to arrange own strategy of defence.

To increase the possibility of success, the crew should be trained about how to use guns and self defense too. It can also be provided by troops serving in the area.

ZÁVĚR

Navrhnout zlepšení pro lepší provoz nákladních lodí je pro jednotlivce téměř nemožné. Z tohoto důvodu se inovacemi zabývají specializované organizace zaměstnávající profesionální a zkušené pracovníky v tomto oboru. Ovšem i po nasbírání těchto zkušeností není příliš lehké nalézt vždy něco nového. Nicméně stejně jako v jakémkoli dalším průmyslu je možnost pro vylepšení, tak i v lodním průmyslu je stále velký prostor pro invenci. Aby byl člověk schopný nalézt takovou invenci, je nutné mít nadhled dané problematiky a být pro tuto činnost motivován. Nadšení je charakter, jenž motivuje pro dosažení co nejlepšího výsledku. Toto nadšení může společnost zaměstnávající daného pracovníka přinejmenším podpořit, což může provést různými způsoby. Například adekvátním finančním ohodnocením nebo kariérním postupem. Zvolení takového postupu závisí na politice podniku a rozhodovacích pravomocí.

Bezchybný chod systému je důležitý pro bezpečný provoz. Proto je nutné zajistit pravidelnou údržbu všech systémů zabudovaných v těchto plavidlech, jež mají vliv na jejich provoz. Obecně každý výrobce poskytuje záruku na své výrobky, což je důležité pro zajištění jejich neustálé spolehlivosti v provozu. Nicméně i ta nejvíce otestovaná jednotka může mít poruchu v tu nejnevhodnější dobu. Z tohoto důvodu je nutné mít na lodi schopného pracovníka, který je schopen toto zařízení buďto znovu uvést do chodu nebo alespoň zajistit náhradu po dobu absence poškozeného zařízení.

Pro co nejefektivnější zabezpečení trajektů je v této práci navržena moderní technologie složená z prvků, jež tvoří celek vhodný pro danou problematiku. Obecně je vhodné, aby daná technologie splňovala poměr kvalita versus cena. Jelikož zde již není moc prostoru pro zlepšení z hlediska monitoringu, zaměřil jsem se zejména na techniku a prostředky zastrašující útočníky a zabraňující jejich nežádoucímu vstupu na loď. Toto řeší zaprvé elektrická bariéra, jejímž úkolem je zabránit útočníkovi zdolání překážky. Tento systém se pro obecnou bezpečnost uvádí do provozu pouze při případném útoku. Zadruhé je zde navržen systém, jenž střeží obvod lodi během provozu. Tento dokáže určit konkrétní místo narušení, načež zašle poplach na kapitánský můstek a uvede do provozu konkrétní vodní dělo.

Školení obecně poskytují získání nebo obnovení informací. Ta jsou důležitá pro vykonávání dané činnosti bez ohledu na to, zdali se jedná o technické zařízení nebo

organizační strukturu. Každé nové nařízení sebou většinou přináší vylepšení dané činnosti, které následuje současnou normu, trendy a obchodní prostředí.

Pirátství znamená nebezpečí pro obchodní a jiné zásobovací lodě. Z tohoto důvodu začala NATO operaci, jejímž záměrem je ochrana proti útokům pirátských skupin. V rámci svých možností zajišťují okolí a zatýkají piráty, kteří jsou na moři za účelem hledání potenciálních obětí. Tato pracovní náplň však nemusí končit jen zmíněnými činnostmi, ale mohla by navíc poskytovat různá proškolení nebo také základní znalosti sebeobrany. To by mohlo posádkám zvýšit sebevědomí při obraně před případnými útoky. Zdokonalila by se tak jejich schopnost předcházet nečekaným situacím a zlepšila by se obranná strategie. Velice důležité je také neustálé radiové spojení s armádními jednotkami a ostatními plavidly a tím jejich vzájemná komunikace.

Ačkoli účel této práce není přestavění obchodních lodí do válečných plavidel, i tak je pro posádky důležité osvojení si znalostí o možných útocích a možnostech obrany proti nim. Proto je důležité znát strategii, která je piráty používána, což pomůže při případné obraně proti jejich útokům a zejména při vytváření strategie obrany.

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SCHEDULE OF USED SHORTCUTS AND SYMBOLS

IMO	International Maritime Organization, Mezinárodní námořní organizace
DWT	Deadweight, Vlastní váha
MT	Metric ton, Metrická tuna
HP	Horse power, Koňská síla
RPM	Rapes per minute, Otáčky za minutu
GPS	Global Positioning System, Globální navigační systém
NE	North East, Severovýchod
ID	Indentification number, Identifikační číslo
IACS	International Association of Classification Societies, Mezinárodní asociace sociální klasifikace
MCA	Metal Construction Association, Asociace pro kovové konstrukce
SOLAS	Safety of Life at Sea, Bezpečnost života na moři
GMDSS	Global Marine Distress and Safety System, Obecná námořní rizika a bezpečnostní systémy
ISM	International Safety Management, Řízení mezinárodní bezpečnosti
FSA	Formal Safety Assessment, Formální ohodnocení bezpečnosti
MSC	Maritime Safety Committee, Námořní bezpečnostní komise
IMB	International Maritime Bureau, Mezinárodní námořní úřad
ICC	International Chamber of Commerce, Mezinárodní obchodní sněmovna
ILO	International Labor Organization, Mezinárodní pracovní organizace
OEF	One Earth Future Foundation, Ústav pro jeden svět
CNC	Computer Numerical Control, Numericky řízený počítač
EDIS	Electronic Chart Display and Information System, Elektronický informační a mapový systém
ENC	Electronic Navigation Chart, Elektronická navigační mapa

VHF	Very High Frequency, Velmi vysoká frekvence
FM	Frequency modulation, Tlumení frekvence
DSC	Digital Selective Calling, Digitálně selekční volání
NBDP	Narrow Band Direct Printing, Tiskárna získaných informací
VDR	Voyage Data Recorder, Rekordér cestovních dat
S-VDR	Simplified Voyage Data Recorder, Zjednodušený rekordér cestovních dat
EPIRB	Emergency Position Indicating Radio Beacon, Bezpečnostní hlášení lokalizační
LRIT	Long-range Identification and Tracking, Daleko-rozsahová identifikace a sledování
Co	Carbon dioxide, Oxid uhličitý
LSA	Life Saving Appliances, Přístroje pro záchrana života
CCTV	Closed-circuit television, Uzavřený televizní okruh
NATO	North Atlantic Treaty Organization, Severoatlantická aliance
WFP	World Food Programme, Světový potravinový program
UN	United Nations, Společenství národů
AK-47	Automat Kalashnikova, Automatický kalašnikov
SAR-80	Singapore Assault Rifle, Singapurký útočný samopal
CETME	Centro de Estudios Técnicos de Materiales Especiales, Centre for Technical Studies of Special Materials, Centrum pro technické studie speciálních materiálů
RPG-7	Rocket-propelled grenade, Pancéřová pěst
SPG-9	Recoilless rifle Anti-tank gun, Protitanková pancéřová pěst
PIR	Passive Infrared Detector, Pasivní infračervený detektor
I&HAS	Intrusion and Hold Up Alarm System, Poplachový zabezpečovací tísňový systém

SEZNAM OBRÁZKŮ

SEZNAM TABULEK

ATTACHMENTS

Attachment #1: ABS_Bulk Carrier construction.

Attachment #2: Maritime and Coastguard Agency (Periodic Inspection and Testing of Seamless Steel Pressurised Gas Cylinders).

Attachment #3: Bulk Carriers (loading), IACS_International Association of Classification Societies.

Attachment #4: MCS_Monitoring and Control System.

Attachment #5: BCS Automation (Engine Room Monitoring)

Attachment #6: KONGSBERG (Marine Automation System)

Attachment #7: Bulk Carriers Focus (Technical News and Information on Bulk Carriers)

Attachment #8: Marine Safety Investigation Report

Attachment #9: GMDSS Guide (RADIO TELEX)

Attachment #10: GMDSS (Global Maritime Distress and Safety System)

Attachment #11: SEA 235, 150W HF/SSB Digital Radiotelephone

Attachment #12: SteerMaster (Control System)

Attachment #13: Navigat X MK1 (Microprocessor Controlled Digital Gyrocompass System)

Attachment #14: Magnetic Compass Systems

Attachment #15: ICC International Maritime Bureau

Attachment #16: Economic Cost of Somali Piracy 2011

Attachment #17: Pollution Control – Sewage Treatment Plant

Attachment #18: Helideck Monitoring System

Attachment #19: Fire Fighting System

Attachment #20: IMO (International Safety Organization)

Attachment #21: SOLAS

Attachment #22: ISM (International Safety Management)

Attachment #23: IACS (common structural rules)

Attachment #24: Maritime Safety Committee

Attachment #25: MARPOL

Attachment #26: MSI (Marine Safety Investigation No.188)

Attachment #27: FSA (Formal Safety Assessment)