YRKESHÖGSKOLAN
NOVIA

Cargo operations on RoRo vessels

Portfolio

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Abstract

The purpose of this portfolio is to provide clear and practical information about Cargo operations on RoRo vessels. Portfolio begins with a brief explanation about RoRo shipping in general, and then moving to more advanced topics such as segregation of cargo. In the end of this portfolio, I present my conversation with Chief Officer about safety risks on our vessel during cargo operations. For instance, we discuss about the current and upcoming risks and how to avoid these incidents from happening.

The portfolio was created while I was working on a Finnish RoPax vessel as an Ordinary Seaman. All pictures in this portfolio are taken by me during my work period in 2021.

Language: English
Key Words: RoRo shipping, Cargo handling, IMDG

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Nimike: Lastioperaatiot RoRo laivoilla.

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Tiivistelmä

Tämän portfolio-opinnäytetyön tarkoituksena on luoda selkeä ja käytännönläheinen lukukokemus siitä, miten lastioperaatiot toteutetaan RoRo aluksilla. Portfolio alkaa lyhyellä tutustumisella RoRo laivoihin yleisesti, ja etenee siitä haastavampiin aiheisiin, kuten lastinerotteluun. Portfolion lopussa esitän keskusteluni yliperämiehen kanssa, mikä käsittelee aluksen turvariskejä lastioperaatioiden aikana. Puhumme esimerkiksi nykyisistä ja tulevista riskeistä, ja miten näiden tapahtumista voidaan välttää.

Tämä portfolio valmistui kun työskentelin vahtimiehenä Suomalaisella RoPax aluksella. Portfolion kuvat on otettu työjaksoni aikana vuonna 2021.

Kieli: Englanti
Avainsanat: RoRo alukset, Lastinkäsittely, IMDG

Abbreviations:

RoRo = Roll on – Roll off

RoPax = RoRo + Passengers

ConRo = Container + RoRo

GenRo = General Cargo + RoRo

RoLo = Roll-on – Lift Off

IMDG = International Maritime Dangerous Goods

ELE = Electric Unit

CTU = Cargo Transport Unit

Mafi = Mobil loading platform

Table of Contests

1 Introduction

RoRo ships are one of the most successful ship types operating today. Their flexibility, speed efficiency, and ability to integrate with other transport systems, have made RoRo ships very popular on many shipping routes. Especially RoPax vessels carry an important role on shorter sea routes.

In this portfolio I briefly introduce RoRo shipping in general and then focuse more on the main topic “Cargo operations on RoRo vessels”. Portfolio is written from RoPax vessel’s standpoint, but the same procedures apply to most RoRo vessels in general.

2 General

RoRo is short for “Roll-on Roll-off”, which is the description of how cargo is loaded and discharged from a RoRo vessel. Cargo rolls on and off the vessel, instead of being lifted with cranes. Self-propelled cargo, such as cars, trucks, buses roll on and off the vessel on their own wheels. For cargo, that is not self-propelled, the cargo is placed on handling equipment with wheels. The cargo then remains on the handling equipment for the whole sea voyage.

A RoRo ship is different from a LoLo (lift on-lift off) ship, which uses cranes to load the cargo. In RoRo ships, cargo is loaded and unloaded via built-in ramps, usually from the stern part of the ships, but sometimes they have ramps in the bow and sides also. Inside a RoRo vessel, it works like a parking house, with ramps connecting the decks.

The main benefits of RoRo transport are speed and time saving.

Figure 1: RoRo Vessel in a port.

2.1 RoRo vessel types

There are different types of RoRo vessels, depending on cargo and the way how the cargo is loaded or unloaded onboard. Some of the most popular RoRo vessel types are listed below.

RoPax is a short for “Roll-on Roll-off passenger”. It is a RoRo vessel, which carries both commercial cargo and passenger with their private vehicles. RoPax vessels are mostly designed for shorter voyages, and they have gained popularity during the recent years, especially in Europe. RoPax vessels reduce the traffic on land, and can provide a smoother way for transport without traffic jams.

ConRo is a combination of a container vessel and a roro vessel. It’s possible to load containers on weather deck with a crane, and the area below the weather deck is used for traditional roro cargo.

GenRo is a normal cargo vessel, equipped with a roro facility. Capable of carrying loads with deadweight between 2,000 to almost 30,000.

RoLo is a short for “Roll on-Lift off”. It is a hybrid vessel, that has decks for roro cargoes, but also has other decks where a crane needs to be used in order to get cargo on and off the ship.

Car Carriers are RoRo vessels that transport cars exclusively, also known as Pure Car Carriers (PCC).

2.2 Cargo on RoRo vessels

The idea that RoRo shipping is only good for transporting cars, is outdated. It had an important role in the initial development of RoRo vessels in 1960s, but modern RoRo vessels are capable of carrying a very diverse mix of breakbulk, from complex machine tools to heavy power generation equipment and large rail cars et cetera.

Even though the cargo can be very diverse, the way how they are loaded or unloaded to the ship remains the same. Cargo units can be transported in trailers and trucks or on top of handling equipment like Mafi (Mobil loading platform) or Cassette. Typically cargo units are transported in and out of the ship with terminal tractors and then lashed with chains or cargo straps to the cargo deck. Truck drivers and passengers drive their vehicles in and out of the ship themselves with the guidance of stevedores and the ship's crew.

Storo cargo (Stowable roll on – roll of) is loaded and unloaded to the ship using roro transport methods, but then lifted up from the handling gear and stowed on the cargo deck for the voyage. This saves space, and it's commonly used for example for transporting paper rolls.

Semi-trailers are the most common cargo transport units onboard this RoPax vessel.

Figure 2: Cargo unit on top of a Mafi.

Figure 3: Paper loaded on cassettes.

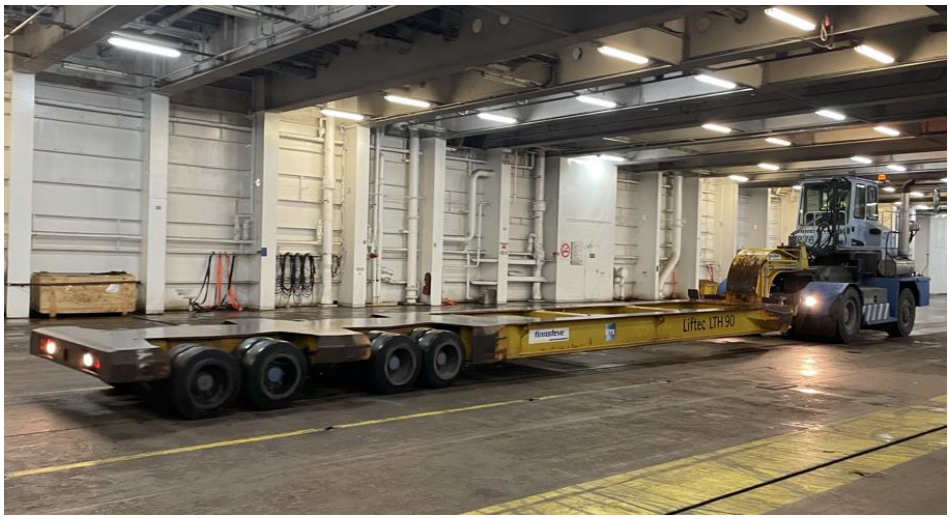


Figure 4: Rolux system connected to a terminal tractor. Rolux is used for stowing cassettes.

Figure 5: Animal transport also known as “Live Stock”.

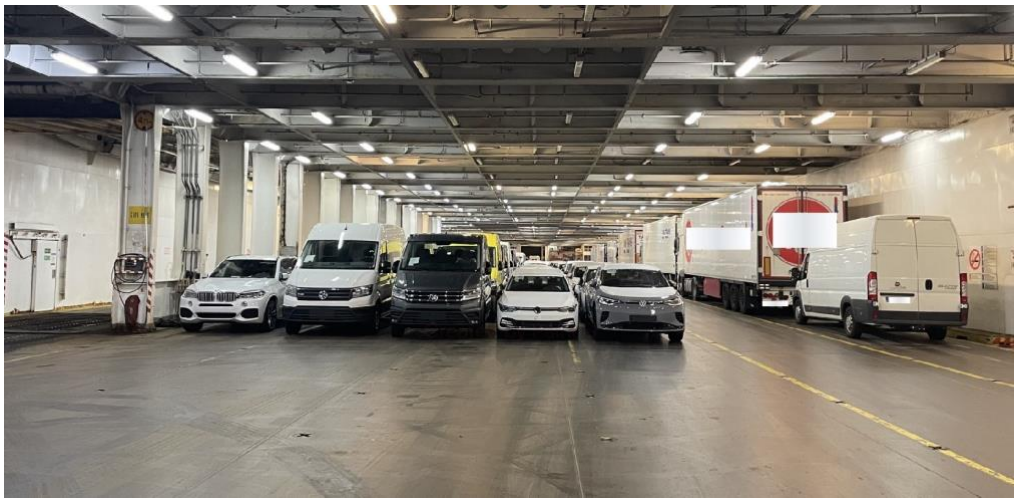


Figure 6: Self-propelled cargo, cars and trucks, loaded on deck five.

2.2.1 Electric units

Electric units (ELEs) form a significant part of the container and semi-trailer traffic in the Baltic Sea region. ELE-unit is temperature sensitive cargo unit that has refrigeration or heating unit and it can be connected to vessel´s electric network. These units can be for example containers, tank containers and semi-trailers.

Common temperature-controlled cargo types are fresh foods such as fruit, meat, fish, vegetables, dairy products, et cetera. Also flowers, plants and pharmaceuticals, are often shipped in ELE-units.
Temperature sensitive cargo units require constant monitoring, and that's why there's a "four to six-hour rule" onboard for temperature checks, performed by the watchman. This applies during loading and discharging as well. Wrong information in temperature settings or malfunctions in the machinery can damage sensitive cargo.

For safety reasons, it is not allowed to use the ELE-units' diesel engines onboard because of the risk of fire. All lorries containing hazardous cargo that are connected to ship's electrical network are to be checked by the ship's crew as any other ELE-unit.

Figure 7: ELE-units connected to ship's electricity.

Figure 9: ELE-unit control panel.

If the watchman finds that something is not correct during temperature checks, for example inadequate temperatures or alarms, these findings must be reported to the officer of the watch, who will then contact the shipper's representative, for example lorry driver and discusses about the procedures, that shall be taken with that cargo unit.

In typical cases, the customer wants to change the setpoint, or just shut down the heating or refrigeration system, depending on the situation.

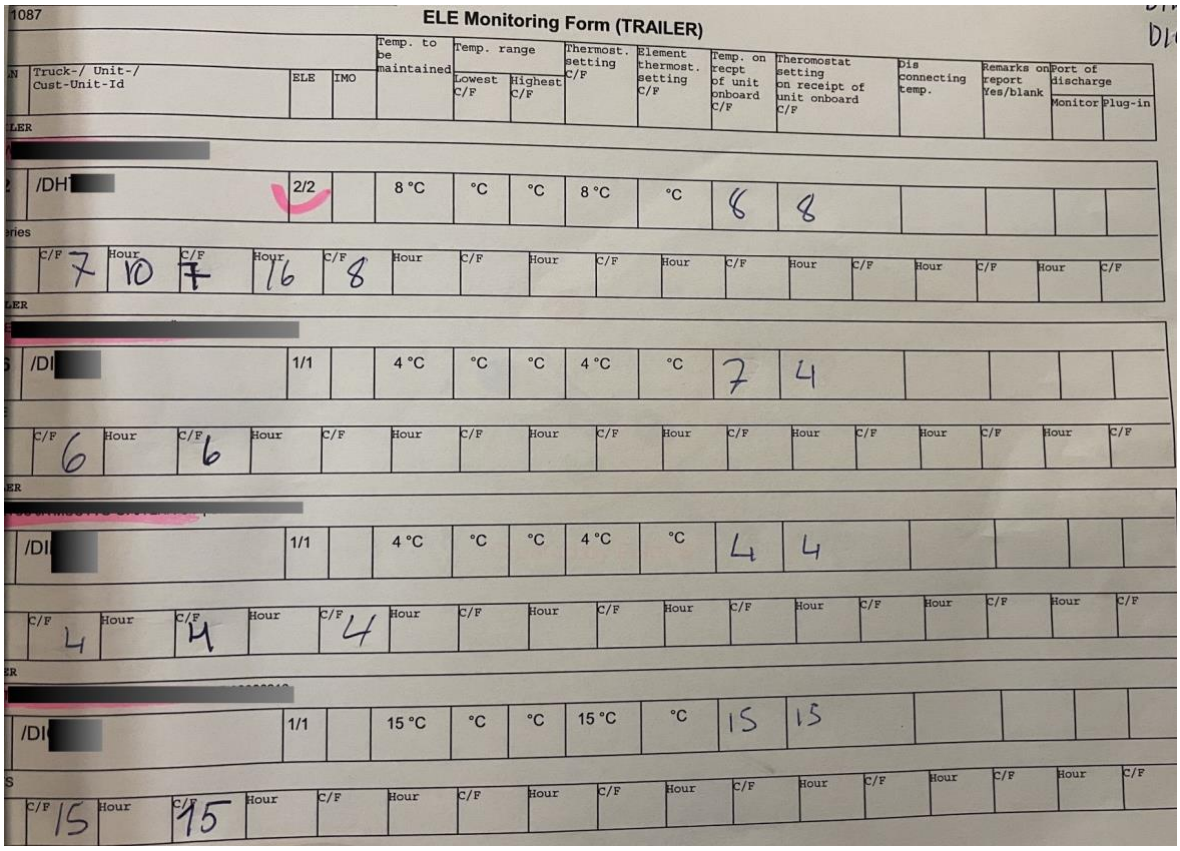


Figure 8: ELE Monitoring form. Temperature checks are performed every four to six hours.

2.2.2 Driverless units

All driverless cargo units must be handled by the stevedoring company, which means that the crew may not move or drive export trucks or driverless trucks on or off, either onboard or on the quayside.

3 Cargo Handling

The Chief Officer is responsible for cargo planning, loading, unloading in co-operation with the stevedores and the deck crew. The chief officer makes stability calculations observing all stability and stress instructions. The stability of the vessel is to be observed throughout loading and unloading.

Figure 9: Terminal tractor loading a semi-trailer onboard.

3.1 Preparing for cargo

After the shipping company has received all the bookings for the next loading, cargo planning can begin. Company's agent will compile a list of bookings and then create a cargo plan for the upcoming voyage. These two documents show us how much and what kind of cargo is going to be loaded onboard, and their positions on deck. Size of cargo, stowing method, and other special requirements have an effect how the cargo plan is made. For instance if there's need for electricity.

The Chief Officer will go through those documents and inserts the cargo plan into Napa loading program. If the plan is adequate and doesn't show any faults for instance with stability or IMDG regulations, then the chief officer will accept that plan, and the loading can commence at the upcoming port as planned.

LLN	TRUCK/UNIT-ID	TYPE	E	R	C	W	B. PARTY	MET BOOK-TON	BOOK-CBM	NoP	PACKAGE	CLS	DRI	STC	BOOKING-ID	REMARKS
435	DGN349	TRAILER		N			CEMTTKOK	14.00	10.000 7.000	1		0			SF-02344048	Trailer-Full - FROZEN GOODS El.Conn.: 1/1 |Prod. Termost.: -25° C LOI:ELE

TRAILER SUMMARY

Item Count	216	Meters total	3014.60
Released for Loading Count	197	Net Weight Total	3283.27
Not Released for Loading Count	19	Gross Weight Total	4801.27
Checked In Count	0		
Wait Listed Count	18		
IMO OK Item Count	21		
Ele Item Count	73		
Cancelled Item Count	0		
Driver Count	0		

Figure 10: Booking list for trailers

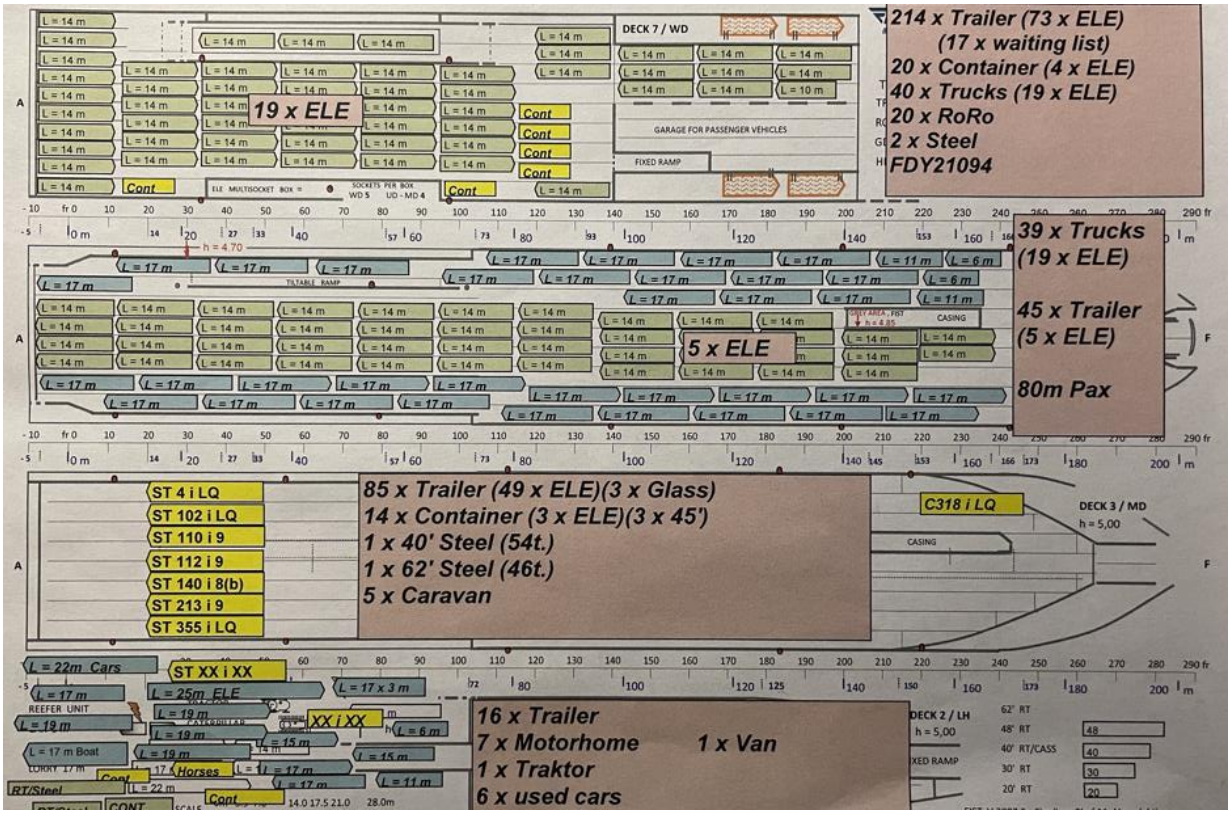


Figure 11: Cargo Plan

4 International Maritime Dangerous Goods

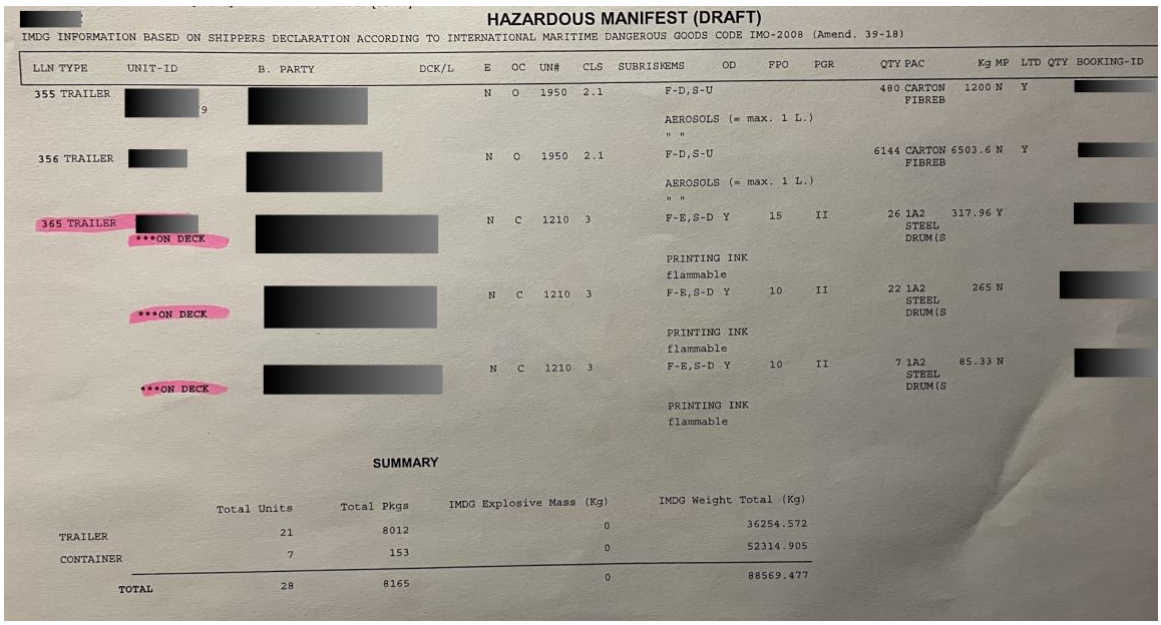
Cargo, which is classified as dangerous, must be stowed, segregated, labeled and documented adequately in accordance with the IMDG Code. Local authorities monitor the compliance of the code and in Finland this is Traficom. If the cargo unit doesn't comply with the current IMDG regulations, it can't be loaded onboard. For instance, if the unit is broken or defective.

Figure 12: Orange placard informs that the truck is carrying IMDG cargo in a packed form.

After the chief officer has received the cargo plan, he or she will check the information in the code, and inserts it to the IMDG Cargo database and to the Napa loading program, where this information on units is saved on the server and is accessible at workstations onboard for example on the bridge.

After loading is completed, an IMDG manifest is printed and saved. It's the final list of all IMDG cargoes onboard. It shows the location of dangerous substances on each deck, and details of substances and net weights.

After departure, the IMDG data is transferred to the authorities with an electronic reporting program National Single Window (NSW).



HAZARDOUS MANIFEST (DRAFT)

IMDG INFORMATION BASED ON SHIPPERS DECLARATION ACCORDING TO INTERNATIONAL MARITIME DANGEROUS GOODS CODE IMO-2008 (Amend. 39-18)

LLN	TYPE	UNIT-ID	B. PARTY	DCK/L	E	OC	UN#	CLS	SUBRISKEMS	OD	FPO	PGR	QTY	PAC	Kg	MP	LTD QTY	BOOKING-ID
355	TRAILER	[redacted]	[redacted]		N	O	1950	2.1	F-D,S-U AEROSOLS (= max. 1 L.) " "				480	CARTON FIBREB	1200	N	Y	[redacted]
356	TRAILER	[redacted]	[redacted]		N	O	1950	2.1	F-D,S-U AEROSOLS (= max. 1 L.) " "				6144	CARTON FIBREB	6503.6	N	Y	[redacted]
365	TRAILER	[redacted]	[redacted]	***ON DECK	N	C	1210	3	F-E,S-D PRINTING INK flammable	Y	15	II	26	1A2 STEEL DRUM(S	317.96	Y		[redacted]
			[redacted]	***ON DECK	N	C	1210	3	F-E,S-D PRINTING INK flammable	Y	10	II	22	1A2 STEEL DRUM(S	265	N		[redacted]
			[redacted]	***ON DECK	N	C	1210	3	F-E,S-D PRINTING INK flammable	Y	10	II	7	1A2 STEEL DRUM(S	85.33	N		[redacted]

SUMMARY

	Total Units	Total Pkgs	IMDG Explosive Mass (Kg)	IMDG Weight Total (Kg)
TRAILER	21	8012	0	36254.572
CONTAINER	7	153	0	52314.905
TOTAL	28	8165	0	88569.477

Figure 13: Booking list of IMDG cargoes, also known as IMDG/Hazardous manifest

4.1 Segregation

Segregation is the process of separating two or more substances, which are considered to be mutually incompatible, and placing them too close to each other, could result in hazards or any kind of accident. Separation between goods can be achieved by increasing the distance between the goods or loading them in different cargo decks.

Since this is a RoPax vessel, we have to transport smaller amounts of IMDG cargoes than a regular RoRo ship. In addition, IMDG cargoes should be segregated away from the living quarters and also away from live stocks (animals) if possible.

The segregation process begins by determining whether there is any need for segregation. To determine the segregation for two classes, you would pick 2 dangerous goods, check their classes, and look where they intersect in the IMDG segregation table. You will either find the letter X or a number. Those numbers will explain to you, how far apart you need to segregate those dangerous goods.

1. Normally at least 3 meters apart
2. Normally at least 6 meters apart
3. Separated by complete compartment or hold
4. Separated longitudinally by an intervening complete compartment or hold from

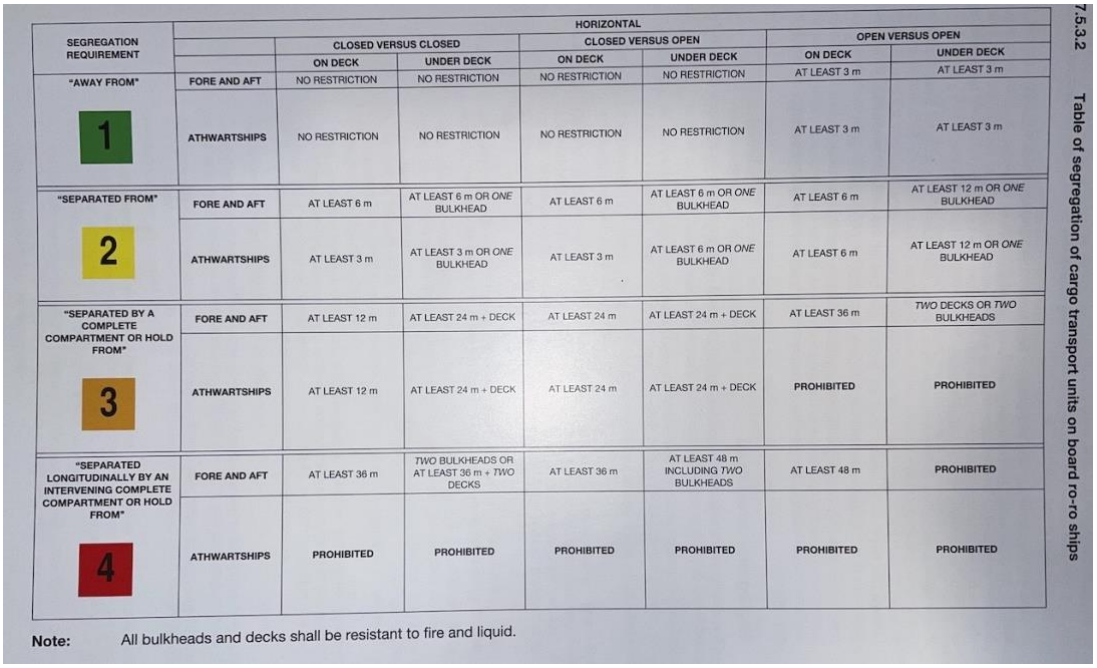
X. No need for segregation, unless mentioned otherwise in the code.

		Dangerous goods in packaged form															
Bulk materials (classified as dangerous goods)	CLASS	1.1 1.2 1.5	1.3 1.6	1.4	2.1	2.2 2.3	3	4.1	4.2	4.3	5.1	5.2	6.1	6.2	7	8	9
Flammable solids	4.1	4	3	2	2	2	2	X	1	X	1	2	X	3	2	1	X
Substances liable to spontaneous combustion	4.2	4	3	2	2	2	2	1	X	1	2	2	1	3	2	1	X
Substances which, in contact with water, emit flammable gases	4.3	4	4	2	1	X	2	X	1	X	2	2	X	2	2	1	X
OXidizing substances (agents)	5.1	4	4	2	2	X	2	1	2	2	X	2	1	3	1	2	X
ToXic substances	6.1	2	2	X	X	X	X	X	1	X	1	1	X	1	X	X	X
Radioactive material	7	2	2	2	2	2	2	2	2	2	1	2	X	3	X	2	X
Corrosive substance	8	4	2	2	1	X	1	1	1	1	2	2	X	3	2	X	X
Miscellaneous dangerous substances and articles	9	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Materials hazardous only in bulk (MHB)		X	X	X	X	X	X	X	X	X	X	X	X	3	X	X	X

1 - "Away from"
2 - "Separated from"
3 - "Separated by a complete compartment or hold from"
4 - "Separated longitudinally by an intervening complete compartment or hold from"
X - The segregation, if any, is shown in the Dangerous Goods List in this Code or the individual entries in the Code of Safe Practice for Solid Bulk Cargoes.

Figure 14: IMDG Segregation table

On RoRo vessels, we use 2 different segregation tables. The first one in figure 8, and also RoRo vessels' own segregation table, shown in figure 9. There's no need for vertical segregation, since the vertical distance depends automatically on heights of the decks.



7.5.3.2 Table of segregation of cargo transport units on board ro-ro ships

SEGREGATION REQUIREMENT		HORIZONTAL					
		CLOSED VERSUS CLOSED		CLOSED VERSUS OPEN		OPEN VERSUS OPEN	
		ON DECK	UNDER DECK	ON DECK	UNDER DECK	ON DECK	UNDER DECK
"AWAY FROM" 1	FORE AND AFT	NO RESTRICTION	NO RESTRICTION	NO RESTRICTION	NO RESTRICTION	AT LEAST 3 m	AT LEAST 3 m
	ATHWARTSHIPS	NO RESTRICTION	NO RESTRICTION	NO RESTRICTION	NO RESTRICTION	AT LEAST 3 m	AT LEAST 3 m
"SEPARATED FROM" 2	FORE AND AFT	AT LEAST 6 m	AT LEAST 6 m OR *ONE* BULKHEAD	AT LEAST 6 m	AT LEAST 6 m OR *ONE* BULKHEAD	AT LEAST 6 m	AT LEAST 12 m OR *ONE* BULKHEAD
	ATHWARTSHIPS	AT LEAST 3 m	AT LEAST 3 m OR *ONE* BULKHEAD	AT LEAST 3 m	AT LEAST 6 m OR *ONE* BULKHEAD	AT LEAST 6 m	AT LEAST 12 m OR *ONE* BULKHEAD
"SEPARATED BY A COMPLETE COMPARTMENT OR HOLD FROM" 3	FORE AND AFT	AT LEAST 12 m	AT LEAST 24 m + DECK	AT LEAST 24 m	AT LEAST 24 m + DECK	AT LEAST 36 m	*TWO* DECKS OR *TWO* BULKHEADS
	ATHWARTSHIPS	AT LEAST 12 m	AT LEAST 24 m + DECK	AT LEAST 24 m	AT LEAST 24 m + DECK	PROHIBITED	PROHIBITED
"SEPARATED LONGITUDINALLY BY AN INTERVENING COMPLETE COMPARTMENT OR HOLD FROM" 4	FORE AND AFT	AT LEAST 36 m	*TWO* BULKHEADS OR AT LEAST 36 m + *TWO* DECKS	AT LEAST 36 m	AT LEAST 48 m INCLUDING *TWO* BULKHEADS	AT LEAST 48 m	PROHIBITED
	ATHWARTSHIPS	PROHIBITED	PROHIBITED	PROHIBITED	PROHIBITED	PROHIBITED	PROHIBITED

Note: All bulkheads and decks shall be resistant to fire and liquid.

Figure 15: Segregation table for RoRo ships

3077 III

Substance: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S.		
(1) UN No: 3077	(2) PSN: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S.	
(3) Class: 9	(4) Subsidiary Hazards: -	(5) Packing Group: III
(6) Special Provisions: 274 335 966 967 969	(7a) Limited Quantities: 5 kg	(7b) Excepted Quantities: E1
Flashpoint:		(15) Emergency Schedule: F-A, S-F
	Instructions	Provisions
Packing	(8) P002 LP02	(9) PP12
IBCs	(10) IBC08	(11) B3
Tanks	(13) T1 BK1 BK2 BK3	(14) TP33
(16a) Stowage and Handling		(16b) Segregation
Category A, SW23		-
(17) Properties and Observations		
Labels/Marks/Signs: For further information on the use of labels, marks and signs, see part 5 of the IMDG Code.		

For example, we had Environmentally Hazardous Substance, Solid, N.O.S (Not otherwise specified) UN 3077 onboard, which belongs to class 9 “Miscellaneous dangerous substances and articles”.

UN 3077 hits the letter X on segregation table, meaning that there is no need for segregation if not otherwise mentioned. UN 3077 belongs to stowage category A, which means we can place the unit on deck or under deck, as shown in figure 10.

Stowage categories for classes 2 to 9

Dangerous goods of classes 2 to 9 and division 1.4, compatibility group S, packed in limited quantities shall be stowed as indicated in column 16a of the Dangerous Goods List in accordance with one of the categories specified below:

Stowage category A	
Cargo ships or passenger ships carrying a number of passengers limited to not more than 25 or to 1 passenger per 3 m of overall length, whichever is the greater number	ON DECK OR UNDER DECK
Other passenger ships in which the limiting number of passengers transported is exceeded	ON DECK OR UNDER DECK
Stowage category B	
Cargo ships or passenger ships carrying a number of passengers limited to not more than 25 or to 1 passenger per 3 m of overall length, whichever is the greater number	ON DECK OR UNDER DECK
Other passenger ships in which the limiting number of passengers transported is exceeded	ON DECK ONLY
Stowage category C	
Cargo ships or passenger ships carrying a number of passengers limited to not more than 25 or to 1 passenger per 3 m of overall length, whichever is the greater number	ON DECK ONLY
Other passenger ships in which the limiting number of passengers transported is exceeded	ON DECK ONLY
Stowage category D	
Cargo ships or passenger ships carrying a number of passengers limited to not more than 25 or to 1 passenger per 3 m of overall length, whichever is the greater number	ON DECK ONLY
Other passenger ships in which the limiting number of passengers transported is exceeded	**PROHIBITED**
Stowage category E	
Cargo ships or passenger ships carrying a number of passengers limited to not more than 25 or to 1 passenger per 3 m of overall length, whichever is the greater number	ON DECK OR UNDER DECK
Other passenger ships in which the limiting number of passengers transported is exceeded	**PROHIBITED**

Figure 16: Stowage categories

UN 3077 has stowage code 23, which tells us that “When transported in BK3 bulk container, see 7.6.2.12 and 7.7.3.9.

SW20	For uranyl nitrate hexahydrate solution stowage, category D applies.
SW21	For uranium metal pyrophoric and thorium metal pyrophoric stowage, category D applies.
SW22	For AEROSOLS with a maximum capacity of 1 L: category A. For AEROSOLS with a capacity above 1 L: category B. For WASTE AEROSOLS: category C, clear of living quarters.
SW23	When transported in BK3 bulk container, see 7.6.2.12 and 7.7.3.9.
SW24	For special stowage provisions, see 7.4.1.3 and 7.6.2.7.2.
SW25	For special stowage provisions, see 7.6.2.7.3.
SW26	For special stowage provisions, see 7.4.1.4 and 7.6.2.11.1.1.
SW27	For special stowage provisions, see 7.6.2.7.2.1.
SW28	As approved by the competent authority of the country of origin.
SW29	For engines or machinery containing fuels with flashpoint equal or greater than 23°C, stowage Category A.
SW30	For special stowage provisions, see 7.1.4.4.5.

Since there’s no additional segregation requirements, we can place this unit freely, according to the segregation table.

4.2 IMDG Report

After loading an IMDG report is printed out from the Napa program and delivered to fire stations and to the bridge, so firefighters and watch officers, will know where these IMDG units are located and what safety procedures shall be taken in case of a emergency.

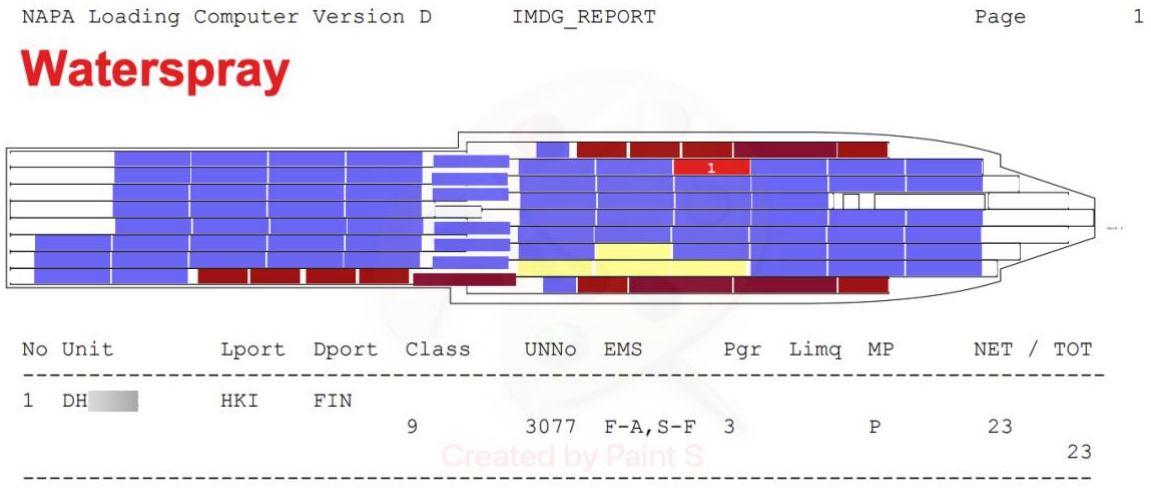


Figure 17: IMDG Report

In a case of emergency, following actions will be taken regarding to EMS (Emergency Response Procedures for Ships Carrying Dangerous Goods). The EMS Guide will be found in the IMDG Code book onboard.

For example, for UN 3077, EMS letters are F-A and S-F.

This means that for this substance, we use Fire Schedule Alfa, and Spillage schedule Foxtrot.

FIRE SCHEDULE Alfa

F-A
GENERAL FIRE SCHEDULE

General comments		In a fire, exposed cargoes may explode or their containment may rupture. Fight fire from a protected position from as far away as possible.
Cargo on fire on deck	**Packages**	Create water spray from as many hoses as possible.
	Cargo Transport Units	
Cargo on fire under deck		Stop ventilation and close hatches. Use cargo space fixed fire-extinguishing system. If this is not available, create water spray using copious quantities of water.
Cargo exposed to fire		If practicable, remove or jettison packages which are likely to be involved in fire. Otherwise, keep cool using water.
Special cases: **UN 1381, UN 2447**		After extinguishing the fire, treat immediately as for spillage (see relevant EmS SPILLAGE SCHEDULE).

SPILLAGE SCHEDULE Foxtrot

S-F
WATER-SOLUBLE MARINE POLLUTANTS

General comments		Wear suitable protective clothing and self-contained breathing apparatus. Stop leak if practicable. Substances covered under this schedule will present a hazard to the marine environment. Try to avoid disposal overboard. The use of inert absorbent material, as used in machinery spaces, is appropriate in all cases. For sticky liquids, shovels may be used. Discharge of spilled substance overboard will damage the marine environment, including living resources of the sea. In this case, contact coastal authorities. Report discharge overboard according to MARPOL reporting requirements.
Spillage on deck	**Packages (small spillage)**	***Liquid:*** Smother spillage with inert absorbent material. Collect spillage in oil drums, metal boxes or salvage packagings. **Solid:** Collect material.
	Cargo Transport Units (large spillage)	Restrict flow of leakage to an enclosed area (e.g., by barricading with inert material or cement if available). **Liquid:** Collect spillage in empty tanks, oil drums, metal boxes or salvage packagings. You may use inert absorbent material. **Solid:** Collect spillage in oil drums or metal boxes.
Spillage under deck	**Packages (small spillage)**	***Liquid:*** Smother spillage with inert absorbent material. Collect spillage in oil drums, metal boxes or salvage packagings. **Solid:** Collect material.
	Cargo Transport Units (large spillage)	Restrict flow of leakage to an enclosed area (e.g., by barricading with inert material or cement if available). **Liquid:** Collect spillage in empty tanks, oil drums, metal boxes or salvage packagings. You may use inert absorbent material. **Solid:** Collect spillage in oil drums or metal boxes. Otherwise, wash down to the bottom of the hold. Use copious quantities of water. Treat effluent according to Shipboard Oil Pollution Emergency Plan.
Special cases: None.		

5 Loading

The Chief Officer is responsible for loading and unloading in co-operation with the stevedores and the deck crew.

Loading operation proceeds on one or more decks at the same time, usually on the main deck and weather deck, according to the cargo plan. Decks 2, 3 and 7 carry diverse mix of cargoes. On deck 5 there are mainly trucks, trailers, and larger passenger vehicles like motorhomes. Decks 7 and 8 (Garage) is mainly used for passengers' private cars. However, exceptions happen and often times there will be changes to the original cargo plan, which then require flexibility when loading and stowing the cargo or passengers.

Real time data of the loading situation is held on a Cargomap website, where the Chief Officer, stevedores and agent can follow the situation and make sure that cargo has been loaded to the correct place.

The Chief Officer will enter cargoes on the Napa loading program, to see, where the cargos are located, how the current cargo situation is affecting the ship's stability and to see if there are any redundant stresses and torsions in the hull.

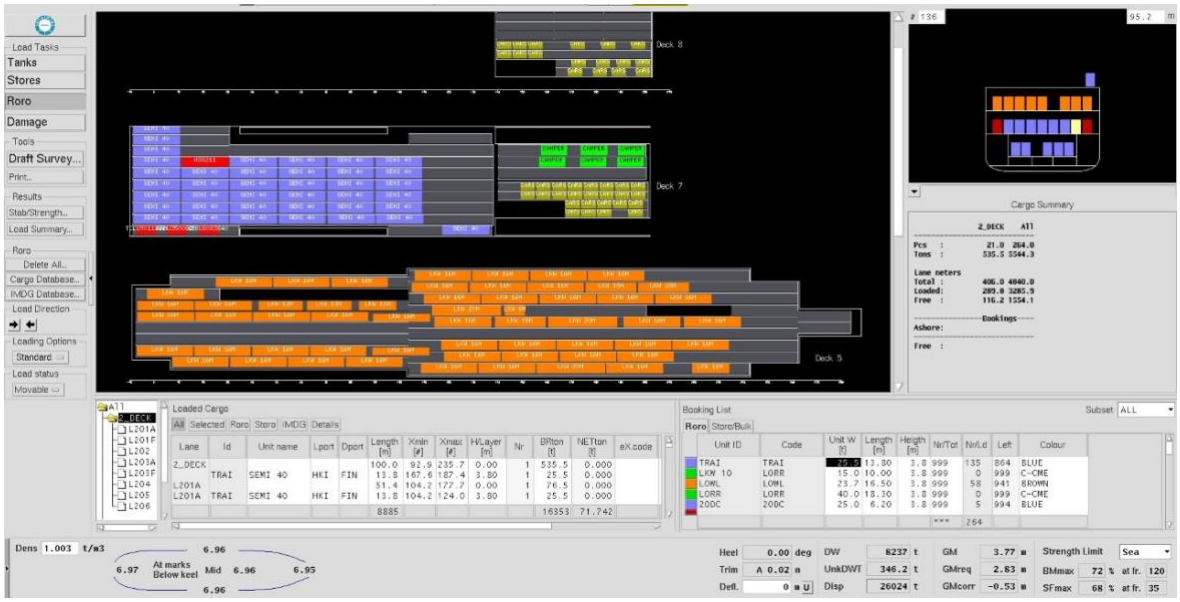


Figure 18: Napa loading program.

Figure 19: CCTV helps Chief Officer to follow real time situation of the loading.

After the loading is done, Cargo manifest and IMDG manifest is made, which shows the quantity and details of all cargo onboard.

The times of commencement and termination of loading and unloading, the amount of cargo and GM will be noted in the ship's logbook.

5.1 Stability

The Chief Officer shall maintain adequate status of ship's stability during cargo operations. He or she makes sure that the ship is loaded in a way that it desired trim is achieved for the voyage.

The Chief officer enters the cargo in the NAPA program and performs stability calculations (draft survey) and makes sure that the ship complies with the damage stability requirements and enters the GM in the ship's log book before departure.

The Chief Officer is responsible for ensuring, that the ship is loaded in accordance with conditions in stability books and is not overloaded and floating deeper than the summer draft mark. The load condition file from Napa program is sent to the office at departure.

The chief officer ensures that the content of the ballast and heeling tanks are known. The ship shall carry the minimum amount of ballast required for the voyage. The free liquid surfaces shall be reduced to minimum.

Only containers loaded onboard have an accurate weight. With other types of cargo, we have to rely on the information what the customer have given to us, this means that the numbers shown in the Napa program are estimates, so to get real information about ship's draught and trim, the Chief Officer must observe ship's draught marks at the quay side before departure.

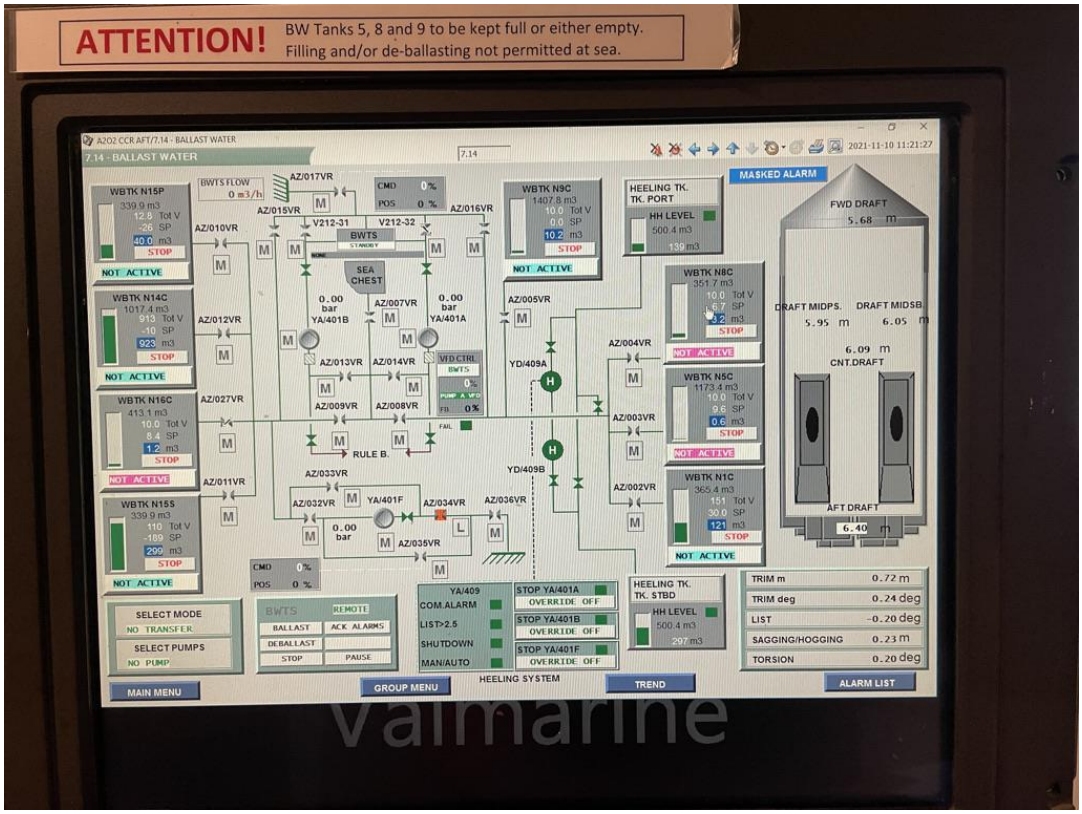


Figure 20: CAE Valmarine system for adjusting water amount in ballast tanks.

Figure 21: Anti-heeling system, automatically or manually adjusting ship's transverse stability.

5.2 Electrical connection of cargo units

The ship is responsible for supplying power to the unit. The Driver is responsible for ensuring that the power unit works. Practically this means that electric cables on deck 5 are brought next to trucks with green “ELECTRIC” sign in the windshield. These are not connected by the crew, since the driver is responsible for connecting electricity to the unit. The deck crew will connect semi-trailers and driverless units to ship’s electricity network.

Temperatures in semi-trailers and IMDG trucks are marked down in the ELE monitoring form by the ship’s deck crew. If temperatures in the units are different from what the customer has reported in the booking, these findings and other concerns must be reported to the Chief Officer, who will decide what actions will be taken concerning the unit.

About 30 minutes before reaching the port, the deck crew will remove electrical connections from trucks. Trucks marked with “Sensitive” marking, will stay connected, and will be removed by the driver him/herself, in order to minimize the time being disconnected.

Figure 22: Marking for sensitive cargo units

5.3 Passengers

Passengers drive their vehicles into “Garage” which is the “parking house” next to the living quarters on deck seven and eight. If garage decks become full, rest of the vehicles will be placed on deck five among trucks and larger vehicles.

Some passengers transport their pets onboard. In shipping terms that’s called “live stock”. Dogs, cats and horses are the most common animals we transport, but sometimes there can be more exotic animals as well, which might need to be segregated from other species.

If passengers request to have electricity connected to their private vehicles during voyage, an electric transformer will be used to convert ship’s local electricity 440 volts to 220 volts which is suitable for household electric goods.

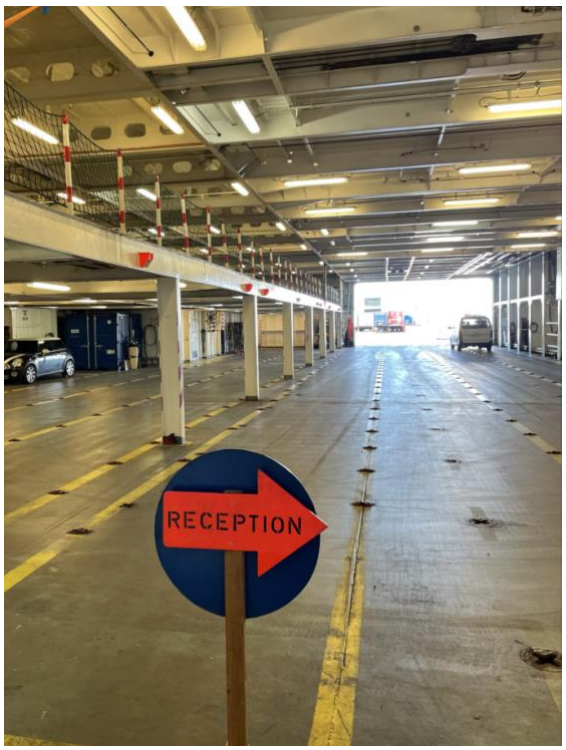


Figure 23: “Garage” mainly for passengers’ private vehicles.

6 Cargo safety

Cargo units that do not meet the requirements for sea transport must be rejected for loading. For example If a cargo unit doesn’t have lashing mounts, has an inadequately secured load or is damaged in a way that it creates a safety risk.

Cargo units must be lashed according to Cargo Securing Manual with chains, cargo straps or other methods.

For instance, cargoes that are placed sideways on the cargo deck require extra methods to avoid cargo shifting, since those cargoes are more vulnerable to ship’s rolling. For example wedges are used to block cars and trucks from moving.

This RoPax vessel is equipped with fin stabilizers. Fin stabilizers are located underwater on both sides of the vessel, and they work with the same principle as an airplane wing, which keeps the ship more stable during the voyage. This decreases the chance of cargo shifting and allows more pleasurable voyage for the passengers.

Deck watchman performs fire patrolling at night and walks through all the main spaces in the ship and looks for safety hazards whether it's related to the ship itself, cargo, or passengers.

Figure 24: Truck wedges

Cargo units are usually lashed with 4 chains, but If adverse weather conditions are expected, the master decides if extra lashings are needed to prevent cargo shifting, which could result in damage to cargo or the ship.

Any concerns about cargo safety must be reported to the master.

7 Unloading

Figure 25: Foreman unloading the vessel

Unloading cargo and passengers on this RoPax vessel is usually very similar to loading, but in reverse order. Unloading happens usually on two or three decks simultaneously. The main principle is that passengers and trucks are unloaded as soon as possible, and after that other cargo units.

Trucks are placed in a way that they can drive easily and efficiently out of the ship. After the trucks are out, the tilting ramp can be lowered, and then we have access to the weather deck.

Cargo units on weather deck that are stowed on the tilting ramp and in front of the garage are unloaded first. This creates a traffic line for cars which allows passengers to drive their cars out of the ship. Cargo operations are stopped on weather deck during the unloading of passengers. After passengers are left, cargo operations will continue on weather deck.

The Chief Officer will make sure that the cargo is unloaded in such a way that extreme trim, list, draught, bending moment and shearing forces are avoided. The angle and position of

the ramps must also be checked to make sure that the maximum angle of ramps is not exceeded in order to minimize damage to ramps and cargo.

Semi-trailers with electric connections are disconnected in a way, that the time being disconnected is minimized. Practically this means that deck crew member, will disconnect one or two rows of ELE-units at once, then waiting for terminal tractors to unload them, until disconnecting few more rows. Disconnecting temperature is marked down in the ELE monitoring form.

8 Safety risks during cargo operations

I interviewed the Chief Officer about safety risks during the cargo operations on our vessel. We also discussed what are the most efficient ways to avoid these incidents onboard.

1. What are the most common risks on this RoPax vessel currently, and how to avoid these accidents from happening?

Stevedores are affected with affected by bad visibility, difficulty to hear and confined spaces. These factors combined with fast pace of work and tight schedule will inevitably create a safety risk.

There's also a lot of traffic on the cargo decks. Terminal tractors, trucks and other vehicles driving at the same time. This increases risk of collisions and other incidents like vehicle capsizing. The best way to avoid these from happening is simply by avoiding all the unnecessary movements on cargo decks. If it's necessary to go walking on cargo decks, then it's important to not to hurry, and look around before moving around. It's also mandatory to use colored attention vest.

If cargo transport unit capsizes, it can cause damage to the ship and cargo. This is especially dangerous when there's IMDG cargoes inside the unit. If the IMDG unit leaks out toxic gases and chemicals, it can create a serious emergency situation, and the whole cargo operation will be stopped.

In addition, shipboard personnel and stevedores mainly know how to make lashings correctly, but we can't

be sure how the customer has lashed the cargo inside the unit. because that's the customer's responsibility to take care of. This is a risk especially with cargo units which covers are made of tarpaulin. It's easier to rip off and open during the voyage than hard covers, especially in bad weather conditions.

Figure 26: Inadequate lashings inside the unit.

2. What about winter conditions? Does it create a safety risk?

Bad weather conditions, such as rain and snow increase risks. Cargo decks become more slippery, and visibility decreases. The whole cargo operation might temporarily stop if there's a heavy snowfall. To increase safety and efficiency in winter time we use road salt on ramps and cloverleaf sockets. This removes and prevents icing. In very icy conditions, we can also use glycol to prevent icing on the cloverleaf lashing sockets.

Figure 27: Cloverleaf lashing socket

3. Are there any upcoming risks developing in the future?

Yes, the increase of electric vehicles is a major safety risk onboard. Electric vehicles are quite new thing, and there is little experience about emergency situations regarding to them. When heated the battery may catch fire and produce intense heat and toxic fumes. These incidents are firstly treated with massive amounts of water.

In addition, it's good to bear in mind that ELE-units work with electricity, so they create a risk for electrical accidents as well.

9 Conclusion

Cargo operation is a sum of many factors and the outcome depends on the performance of the ship's crew, stevedores, office, truck drivers and passengers. Flexibility is often required and changes to the original cargo plan are common.

For instance in the cargo plan shown in Figure 12, one trailer was rejected and left ashore due to leakage in the unit and two passenger cars were moved from deck 7 to deck 5, because those two passengers had given misinformation about the size of their cars and in real life those cars were too tall to be loaded inside the garage.

In the end a successful cargo operation is based on good communication and teamwork among ship's crew and other employees. These factors enable a smooth and efficient transport of cargoes, which makes RoRo shipping so popular and attractive today.

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