BE AWARE

Bonn Agreement
Accord de Bonn

Technical Sub Report 2: Oil Cargo Model

Bonn Agreement
Accord de Bonn

Co-financed by the EU -
Civil Protection Financial Instrument

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DOCUMENT TITLE: Oil cargo model
TASK: E3
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PUBLISHED ON: 25 March 2014

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The Greater North Sea and its wider approaches is one of the busiest and most highly used maritime areas in the world. With the ever-increasing competition for space comes an increased risk of accidents that could result in marine pollution.

Currently the area has no overall risk assessment for marine pollution; risk is mapped with a variety of national risk assessments which are undertaken with differing methodologies; thus reducing comparability.

The BE-AWARE project is therefore undertaking the first area-wide risk assessment of marine pollution using a common methodology that allows the risk to be mapped and compared under different scenarios.

The project outcomes will improve disaster prevention by allowing North Sea States to better focus their resources on areas of high risk.

The project is a two year initiative (2012-2014), co-financed by the European Union, with participation and support from the Bonn Agreement Secretariat, Belgium, Denmark and the Netherlands, with co-financing from Norway.

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Executive Summary

The main objective of the BE-AWARE project is to conduct a risk assessment for the spillage of oil and HNS for the Bonn Agreement area. The approach followed in this project is described in the Method Note (BE-AWARE, 2013). The risk assessment was performed for the years 2011 and 2020.

Input for the risk calculation is the "cargo model". This model describes the probability that a certain ship type and ship size sailing on a specific route is loaded with a certain type of oil. To determine these probabilities the following steps were followed:

- Determine main transport routes;
- Determine a list of substances and oil types;
- Determine per port the total number of ships (per type and size) with a certain oil type on board on a certain route;
- Determine the total number of ships (per type and size) on a certain route (based on AIS and the traffic database created by COWI);
- Determine the percentage of ships (per type and size) that were loaded with a certain type of oil on a certain route.

To carry out this analysis transport data were requested from ports in the area. Data were received from various ports. However, for the final analysis the data from Antwerp, Rotterdam, Mongstad and Hamburg were used. The data received from other ports were used to verify the results. To process the data the port data have been combined with the ships database, the port area list and the substances list. This resulted in the aggregated port data which has been compared with the AIS traffic database. The combination of these two databases results in the cargo model which was then used for the risk calculations.

1. Introduction

The main objective of the BE-AWARE project is to conduct a risk assessment for the spillage of oil and HNS for the Bonn Agreement area. The approach followed in this project is described in the BE-AWARE Methodology Note. The risk assessment is performed for the years 2011 and 2020. The final risk in a certain area is the result of several steps:

1. Determination of the traffic intensity and composition in ship type and size classes;
2. Determination of the substances carried by the ships;
3. Determination of the probability of all possible incidents;
4. Determination of the probability of a spillage of oil or HNS given a certain type of incident;
5. Impact of the spillages on the environment.

The first four steps are addressed in the BE-AWARE project. The last step will be addressed in the BE-AWARE II project.

This sub-report describes the work carried out to determine the oil carried by ships, step 2.

Main objective of the cargo-modelling
An accident can “only” result in a spill if the ship is indeed carrying oil or another hazardous substance. Therefore an important input factor for the risk modelling is the probability that a ship is loaded with a certain substance. Main goal of the cargo-modelling is to determine the percentage of ships that are loaded per main transport route, per ship type and ship size and per substance type.

2. Approach and assumptions

The main goal of the "cargo model" is to determine the probability that a certain ship type and ship size is loaded with a certain type of oil. Thus for example 85% of all tankers of size 7 sailing on a route from the Atlantic to Rotterdam are loaded with a certain type of oil in the cargo tank.

To determine these probabilities 5 main steps were followed:

1. Determine main transport routes;
2. Determine a list of substances and oil types;
3. Determine per port the total number of ships (per type and size) with a certain oil type on board on a certain route;
4. Determine the total number of ships (per type and size) on a certain route (based on AIS and the traffic database created by COWI);
5. Determine the percentage of ships (per type and size) that were loaded with a certain type of oil on a certain route (point 3/point 4).

In the following paragraphs more details are given about the five different steps. The results of the modelling are given in Chapter 3.

2.1 Main transport routes

In preparation for the data request note the relevant ports in the Bonn Agreement area were selected by analysing the GT of oil and chemical tankers of all ports in the region. Through selecting the ports that together contribute 70 % of the oil and HNS GT respectively for the entire Bonn Agreement area the following list of ports was created (alphabetical order):

- Amsterdam The Netherlands
- Antwerp Belgium
- Brofjorden Sweden
- Cork Ireland
- Coryton Great Britain
- Dunkirk France
- Falmouth Great Britain
- Fawley Great Britain
- Ghent Belgium
- Gothenburg Sweden
- Hamburg Germany
- Hound Point Great Britain
- Immingham Great Britain
- Le Havre France
- London Great Britain
- Milford Haven Great Britain
- Mongstad Norway
- Rotterdam The Netherlands
- Sture Norway
- Tees Great Britain
- Wilhelmshaven Germany

The detailed transport data was requested for these ports. To ensure a high quality analysis the detailed data needed to include the individual dangerous goods reports for 2011 (e.g. date, IMO/MMSI, substance name, amount, last port, next port).

The detailed information was not available for all ports/countries. The main transport routes were therefore selected based on the data received. An overview is given in Figure 2-1 of the different selected port areas. These areas were selected based on the analysis of the transported GT and the received information. For example Amsterdam is one of the relevant ports based on the transported GT, however no detailed information was received from Amsterdam so this port area was not selected separately.

Also the ships leaving the Bonn Agreement area were grouped into three “destinations”:

- North: ships passing the Norwegian coast line toward Murmansk;
- Baltic: ships passing Skagerrak and sailing to or from a port in the Baltic area;
- Other: ship leaving or entering the area at other locations.

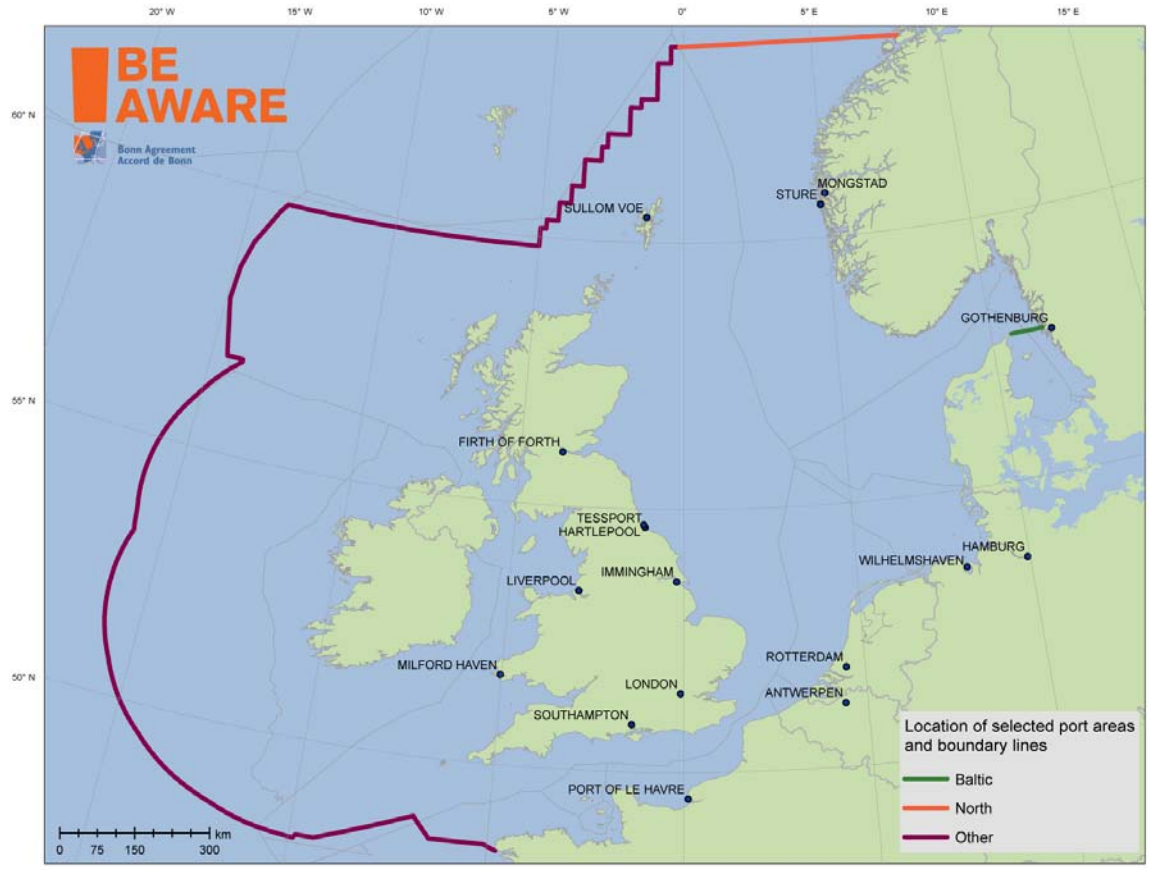

Figure 2-1 Overview of the selected port areas and boundary lines for the transport routes

Finally the level of detail of the received information varied for the different port areas. For the further analysis the information from the following ports was used:

- Antwerp
- Rotterdam
- Mongstad
- Hamburg

However, the information received from all the other ports and countries have been used to verify the final results and thus were indispensable. Data was also received from the SafeSeaNet database. This was the first time that SafeSeaNet data had been released for use in this type of project, although unfortunately, due to the format of the data, it could not be included in the cargo model.

2.2 List of different oil types

Based on the data from the ports for which the detailed information had been received, a list of reported substances was created (containing more than 3000 goods). For all these goods it was determined whether or not it was oil and if so which type of oil. Based on their physical behaviour in

a spill at sea, four substances were selected to be modelled representing oil. An overview is given in Table 2-1.

Only substances and cargo types that are known supposed to have a significant impact upon the environment are included in the model. Type 0 (bunker oil including lubricants) is not a cargo type but represents the oil products used for propulsion and maintenance on all vessels. This means that this type of substance can be released from any vessel involved in an accident at sea. Categorising these substances alongside substances that can be transported as actual cargo leads to an advantageous data structure with regard to the further spill analysis process.

A list of different descriptions of the substances categorized as oil is given in Annex 1.

Table 2-1 List of substances used in the modelling of vessel cargo and bunker oil

Type	Representative substance
0	Bunker oil, lubricants
19	Crude oil
20	Fuel oil
21	Gasoil, diesel, petroleum, jet fuel and light fuel oil
22	Gasoline

2.3 Total number of ships with oil on board on a certain route.

The detailed data from the four port areas contained inter alia the following items:

- IMO number
- Date of the report
- Last port
- Next port
- Activity (load/unload/transit)
- Substance name
- Amount of reported substance

In addition to the data received from the port (port data) three other databases were used when analysing the data:

- *Ships database:* this database contains the ship type and ship size of each IMO number. The database is based on the AIS data and the traffic database developed during the project. This means that throughout the whole project the same ship type and ship size categories are used for the same ship.
- *Port areas list:* the port of origin and destination given are the “port data”. It is a list of various port names. These names were “assigned” to the different defined port areas as shown in Figure 2-1.
- *Substance list*: states whether or not the substance is oil and if so which type of oil it is (see also 2.2, Table 2-1).

By combining these three additional lists with the original port data, a processed port data set was created (see also Figure 2-2). Example: a 30.000GT tanker calling at Rotterdam reports that it has unloaded crude oil and that its previous port was a port in the Middle East. This means that this ship carried crude oil on the route starting in the English Channel to Rotterdam.

From this processed port data the aggregated port data could be created. This last dataset contained per ship type and ship size the total number of ships in 2011 that carried a certain type of oil on a certain route to or from the port.

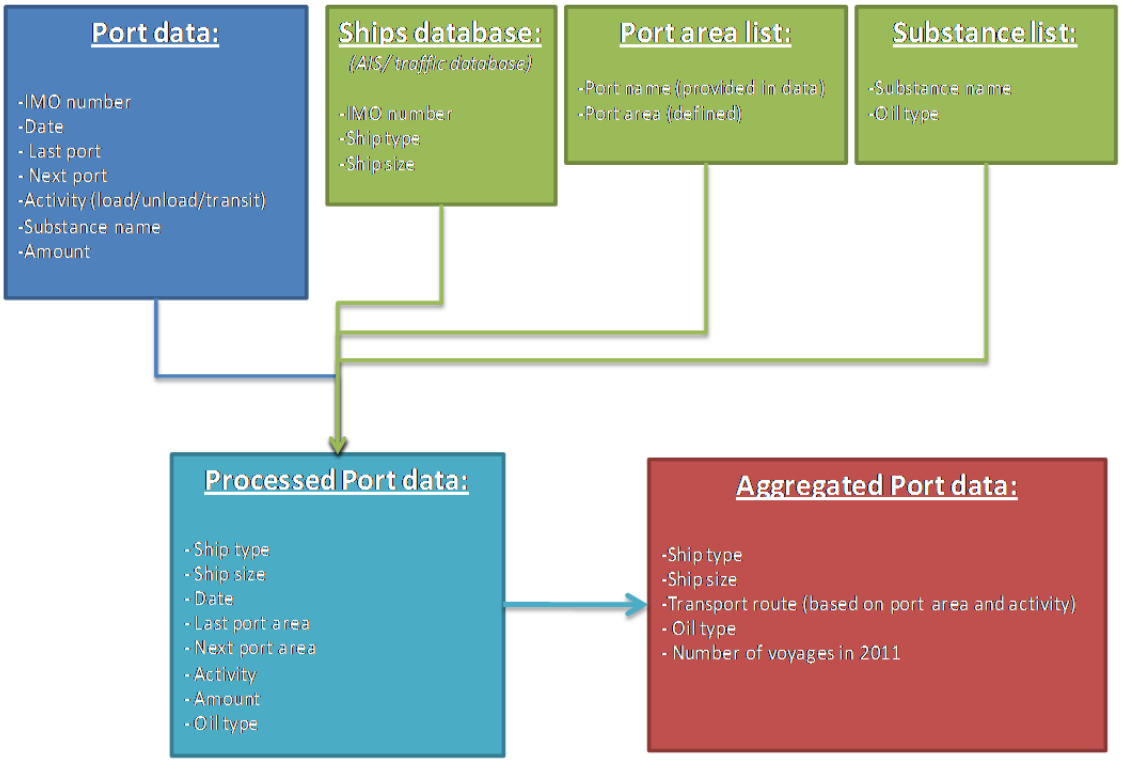

Figure 2-2 Overview of the process of analysing the port data

2.4 Overall total number of ships on a certain route

Based on the traffic database created from the AIS data for 2011, the total number of ships (per type and size) per transport route is known. These numbers were based on the AIS analysis performed by the project and outlined in Technical Sub report 1: Ship traffic.

2.5 The percentage of ships that are loaded with oil

Finally the aggregated port data and the traffic data from AIS are combined to determine the actual percentage of the voyages per ship type and ship size that are loaded with oil.

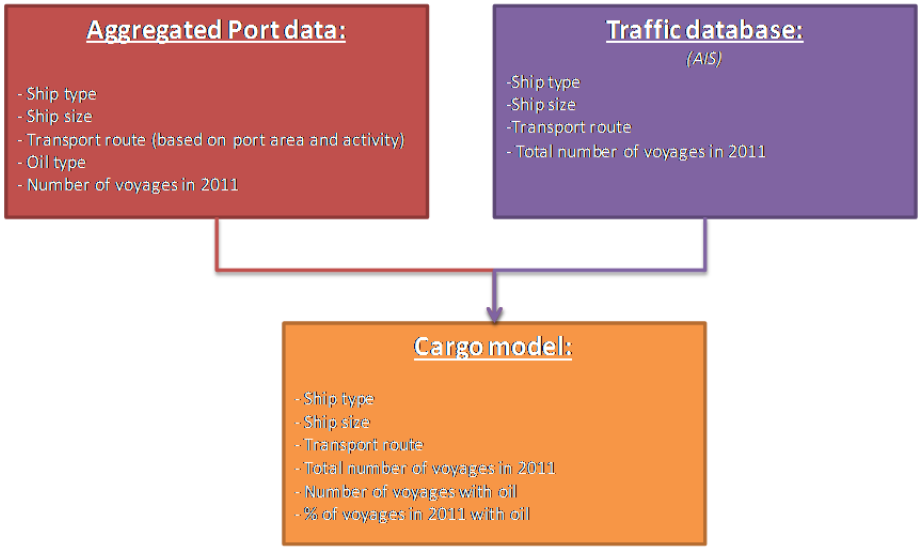

Figure 2-3 Overview of the process of determining the percentage of loaded tankers.

Distribution between oil types

First the percentage of ships that actually carried any oil was determined. In a second step the distribution between the different oil types was determined based on the substance description given and the amount of substance transported. Therefore two types of percentage are determined:

1. The percentage of ships (per type and size) carrying oil on a certain route.
2. The distribution of the different oil types per ship type/size on a certain route, given the fact that a ship is carrying oil.

Example:

Based on the information received from Hamburg it could be concluded that 47% of all Chemical/Product tankers between 5000 and 10000GT on the route from outside the Bonn Agreement area (Atlantic) to Hamburg were carrying oil. 9% of these loaded tankers carried a substance classified as crude oil (type 19), 35% carried fuel oil (type 20), 33% carried light fuel oil (type 21) and finally 23% carried gasoline type of oil (type 22).

2.6 General remark

The described general approach can only fully be applied for the routes to and from Antwerp, Hamburg, Rotterdam and Mongstad, as the necessary detailed information was available only for these ports. For the other transport routes the percentages were based on the average loading percentages per ship type and ship size taken over the results for the four ports.

3. Results

This chapter contains some of the detailed results for Mongstad and Rotterdam and in the final paragraph the overall results are presented. Furthermore all detailed results were provided to COWI as input for the risk assessment model from which the results are presented in Technical Sub Report 8: Maritime Oil Spill Risk Analysis.

3.1 Mongstad

The overall results for the tankers sailing to and from Mongstad are given in Table 3-1. In the table the total numbers of journeys for the different databases are given. The last rows contain the results, i.e. the percentage of ships that carried oil. For some categories the percentage is more than 100%. This is caused by some uncertainties in the data. It could be that some voyages were not observed in the AIS data. Also the data from Mongstad did not contain the actual IMO number of the ships, but only a ship type. This means that there can be some discrepancy between the ship's type in the AIS data and the cargo data.

Summary of the results

- In total 1690 tankers departed from Mongstad in 2011 (based on AIS);
- In total 1606 tankers reported loading oil in Mongstad;
- This means that 95% of all tankers on a route departing from Mongstad are carrying oil;
- In total 1705 tankers arrived in Mongstad in 2011 (based on AIS);
- In total 152 tankers reported unloading oil in Mongstad;
- This means that 9% of all tankers on a route to Mongstad are carrying oil (91% of all tankers arrived with no oil on board but loaded oil in Mongstad);

Since Mongstad is an oil-exporting port these overall results are in line with what could be expected.

Table 3-1 Overview of results for Mongstad

	Total number of journeys ***departing from*** Mongstad in the different databases			Total number of journeys ***arriving in*** Mongstad in the different databases		
	Size class [GT]			Size class [GT]		
	<10.000	>10.000	Total	<10.000	>10.000	Total
Traffic database / AIS						
Tanker, Crude	0	208	208	0	208	208
Tanker, Product/Chem/Other	930	552	1482	944	553	1497
Tanker total	930	760	1690	944	761	1705
Aggregated Port Cargo Data (journeys transporting oil)						
Tanker, Crude	0	57	57	0	59	59
Tanker, Product/Chem/Other	875	674	1549	24	69	93
Tanker total	875	731	1606	24	128	152
Cargo model: %loaded with oil						
Tanker Crude	--	27%	27%	--	28%	28%
Tanker, Product/Chem/Other	94%	122%	105%	3%	12%	6%
Tanker total	94%	96%	95%	3%	17%	9%

When considering the overall results in Table 3-1 and the division between the different oil types in Table 3-2, it can be concluded that the crude tankers (Tanker, crude) only transported crude oil. For the other tankers (Tanker, product/Chem/Other) the results are given in Table 3-2. From the table it can be seen that the tankers arriving in Mongstad carrying oil (thus unloading oil), mostly carried crude or fuel oil. The tankers leaving Mongstad with oil on board carried mostly the lighter type of oils (Gasoil, diesel and gasoline).

Table 3-2 Overview of the division between the different types of oil transported to and from Mongstad.

Type of oil	Division of the types of oil for the journeys that carried oil		
	Load (present in journeys from Mongstad)	**Unload** (present in journeys to Mongstad)	**Overall**
19: Crude oil	5.2%	29.4%	6.4%
20: Fuel oil	5.3%	68.2%	8.6%
21: Gasoil, diesel light fuel oil	58.9%	2.4%	55.9%
22: Gasoline	30.6%	0.0%	29.0%
Total	100.0%	100.0%	100.0%

3.2 Rotterdam

An overview of the detailed results for Rotterdam is given in Annex 2. A summary is presented in Table 3-3. The results show that 85% of the crude tankers arriving in Rotterdam are loaded with oil and that almost 50% of these tankers are also loaded when leaving the port again. Overall 46% of all chemical, product and crude tankers arriving in Rotterdam are loaded with a substance that has been categorized as oil. And 32% of these tankers have oil on board on the transport route leaving Rotterdam.

Table 3-3 Summary of the results for Rotterdam.

Ship type	**% of ships loaded with oil arriving in Rotterdam**	**% of ships loaded with oil departing from Rotterdam**
Bulk	0%	0%
Bulk/oil	20%	17%
Tanker, chemical incl. Tanker, others	2%	1%
Tanker, chemical/prod.	39%	29%
Tanker, crude oil	85%	49%
Tanker, food	0%	0%
Tanker, gas	2%	1%
Tanker, product	82%	62%
Total	34%	24%
Total Tankers (chem., prod, crude)	46%	32%

Figure 3-1 shows the division between the various types of oil for the different tanker types, based on the information from Rotterdam. The figure shows clearly that more than 60% of the oil transported by crude tankers has been of the type “crude oil”, as expected. For the other types of tanker this percentage is much lower at below 15%. The division has been determined on the basis of the number of reports for a certain type of oil and the amount that has been reported.

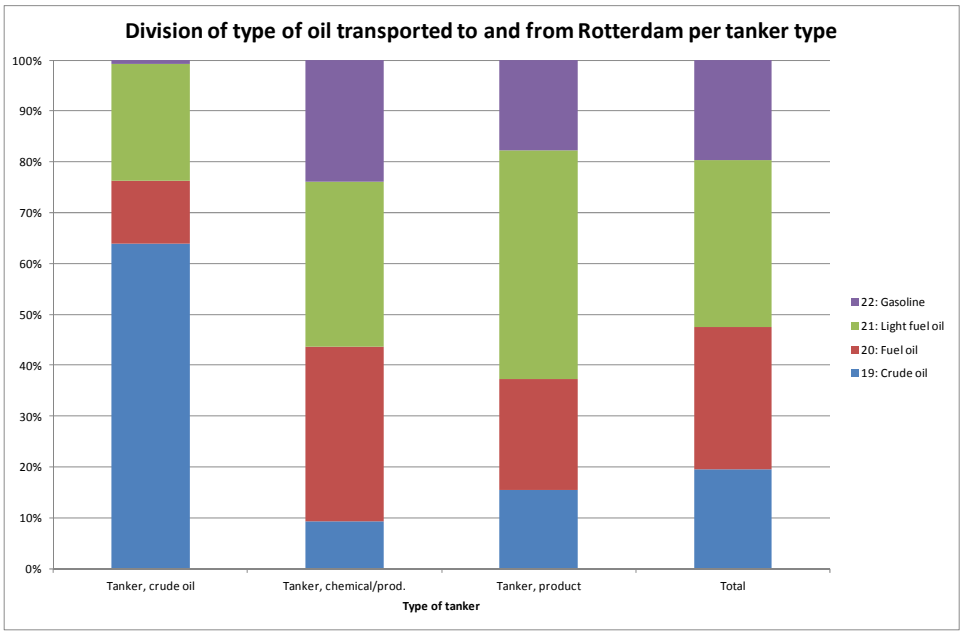

Figure 3-1 Overview of the division per type of oil for Rotterdam.

3.3 Overall cargo model

The overall cargo model consists of loading percentages and distributions of oil types for the different transport routes per ship type and ship size. The percentages for the ships sailing to and from Antwerp, Hamburg, Rotterdam and Mongstad were determined based on the provided detailed information. For the other transport routes these percentages are based on the average of the known overall percentages for those four ports.

3.3.1 Average loading percentages

A detailed overview of these results is given in Annex 3. Table 3-4 shows the summary of these results. The percentages given in the table are the percentages of tankers that are loaded with a substance classified as oil, e.g. on average 45% of all product tankers of size class 6 are loaded with oil.

The percentages for chemical and gas tankers appear to be low. However the numbers only show the results for oil, so this does not automatically mean that the tankers are sailing empty but that they are not loaded with oil.

Table 3-4 Overview of the average loading percentages for the different tanker types.

Tanker type	Size class [based on GT]							
	1	2	3	4	5	6	7	8
Tanker, chemical incl. Tanker, others	31%	0%	16%	5%	22%	0%	0%	0%
Tanker, chemical/prod.	29%	7%	27%	30%	40%	25%	0%	0%
Tanker, crude oil	0%	0%	0%	0%	30%	21%	41%	29%
Tanker, gas	0%	6%	8%	10%	9%	0%	0%	0%
Tanker, product	36%	22%	41%	34%	68%	45%	57%	0%

3.3.2 Division of oil types

Based on the detailed information for Rotterdam, Antwerp and Hamburg an average division of oil types could be determined. An overview is given Figure 3-2. 65% of all loaded crude oil tankers carry actual crude oil. For both other type of tankers (chemical and product) less than 10% carried crude oil, when loaded.

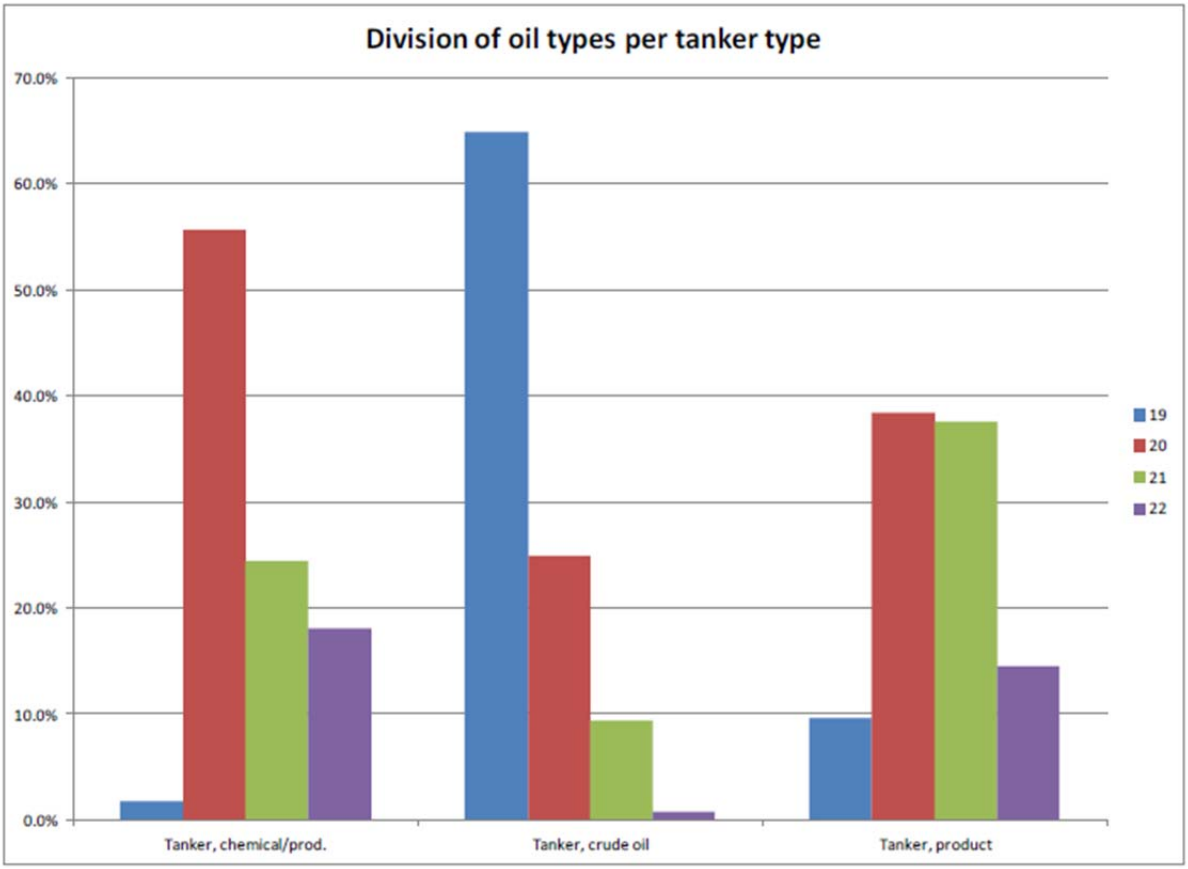

Figure 3-2 Overview of the average division between oil types given the fact that a tanker is loaded

4. Conclusions

The purpose of this task was the development of a cargo model for the risk calculations within the BE-AWARE project. From the work carried out the following can be concluded:

1. The oil cargo model prepared is based on information from the ports of Antwerp, Rotterdam, Mongstad and Hamburg. This information was sufficient to build a representative database of the oil transported in the Bonn Agreement area. The information received from other ports was used for the verification of the database.
2. The various databases received were built up differently and information on the substances included in the databases was not standardised. This means that databases contained spelling mistakes and also that for identical substances different names were used. This complicated the analyses. It is recommended developing a standardised database for the storage of this information, preferably combining the names of substances with the UN-number.

Glossary of Definitions and Abbreviations

HNS	**H**azardous and **N**oxious **S**ubstances
IMO	**I**nternational **M**aritime **O**rganization
MMSI	**M**aritime **M**obile **S**ervice **I**dentity, number to identify a ship
GT	**G**ross **T**onnage
UN number	This is a four digit number that identifies hazardous substances and articles

Overview of ship size classes

Ship size class	GTmin	GTmax
1	100	999
2	1000	1599
3	1600	4999
4	5000	9999
5	10000	29999
6	30000	59999
7	60000	99999
8	100000	300000

ANNEX 1: List of substances

SubstanceName	SubstanceName
AARDGASCONDENSAAT	INSULATING OIL
AARDGASCONDENSATE	JET A-1
AARDOLIE	JET FUEL
AARDOLIE PRODUKTEN	KEROSINE
ACRYLIC ACID CRUDE	KIRKUK CRUDE
ALKANES (C10-C26)	LA BLEND STOCK (DOW)
ALKANES (C6-C9)	LIAV 200
ALKYL (C18+) TOLUENES	LIAV 230
ALKYL (C3-C4) BENZENES	LIAV 270
ALKYL (C5-C8) BENZENES	LIGHT CYCLE OIL
ALKYL (C7-C9) NITRATES	LIGHT CYCLE OIL (STATOIL)
ALKYL (C9) BENZENES	LINEAR ALKYL (C12-C16) PROPOXYAMINE ETHOXYLATE
ALKYL (C9+) BENZENES	LOW SULPHER FUEL OIL
ALKYL BENZENE DISTILLATION BOTTOMS	LOW SULPHUR FUEL OIL
ALKYL BENZENES	LOW SULPHUR VACUM GAS OIL
ALKYL TOLUENE SULPHONIC ACID	LSFO
ALKYL(C9+) BENZENES	LSVGO
ALKYL(C9+)BENZENES	LUBEOIL - BASE OIL SN 600
ANILINE	LUBOIL
ANILINE MARINE POLLUTANT	LUBRICANTS
ANILINE MARINE POLLUTANT	LUBRICATING OILS AND BLENDING STOCKS
ANILINE - MARINE POLUTANT	MARCOL 82 (ESSO)
ANILINE MARINE POLLUTANT	MEDIUM SULPHUR FUEL OIL
ANLINE MARINE POLLUTANT	MINERALE OLIEN
AP/E CORE 100 (EXXONMOBIL)	MVIN 170 (SHELL)
AP/E CORE 150 (EXXONMOBIL)	MVIN 40 (SHELL)
AP/E CORE 2500 (EXXONMOBIL)	MVIN170
AP/E CORE 600 (EXXONMOBIL)	NAFTA
AUTOMOTIVE DIESEL OIL	N-ALKANES (C10+)
AVGAS	NAPHTA
AVIATION GASOLINE	NAPHTHA
BASE OIL	NAPHTHALENE CRUDE OR NAPHTHALENE REFINED
BASE OIL SN150	NEXBASE-3030
BASE OIL SOLVENT NEUTRAL SN 150	NEXBASE-3043
BASE OIL SOLVENT NEUTRAL SN 500	NEXBLT RENEWABLE DIESEL
BASE OIL SOLVENT NEUTRAL SN 900	NEXBTL RENEWABLE DIESEL
BENZEEN	NYNAS BT12
BENZENE	NYNAS T110
BENZENE AND MIXTURES HAVING 10 PERCENT BENZENE OR MORE	NYTEX 4700
BENZENE AND MIXTURES HAVING 10% BENZENE OR MORE	NYTEX 810 (NYNAS NAPHTHENICS AB)
BENZENE AND MIXTURES HAVING 10% BENZENE OR MORE (I)	OLEFIN MIXTURE (C7-C9)
BENZINE	OLEFIN MIXTURE (C7-C9) C8 RICH
BENZINE (GASOLINE)	OLEFIN MIXTURE (C7-C9) C8 RICH STABILISED
BENZINE UN 1203	OLEFIN MIXTURES (C5-C15)
BIO DIESEL	OLEFIN MIXTURES (C5-C7)
BIO ETHANOL	OLEFIN MIXTURES (C7-C9) C8 RICH
BIO FUEL OF GASOLINE AND ETHYL ALCOHOL	OLEFIN MIXTURES (C7-C9) C8 RICH STABILIZED
BIODIESEL	OLEFINS (C13+ ALL ISOMERS)
BIODIESEL – RME	OLOA 760 J
BIO-FUEL BLENDS OF GASOLINE AND ETHYL ALCOHOL	OSEBERG CRUDE
BITUMEN	PARA XYLENE
BK REFORMED/PLATFORMED GASOLINE	PARAFFIN SYNTHETIC
BREGA CONDENSATE	PARAFFIN WAX
BRIGHTSTOCK	PARRAFFIN WAX
BRIGHTSTOCK 150 (KPE)	PHENOL
BUTANE	PHENOL SOL.
BUTANE-PROPANE MIXTURES	PRIMOL 352 (ESSO)
BUTANOL	PRIMOL 382 (ESSO)
BUTANOLS	PRIMOL 542 (ESSO)

SubstanceName	SubstanceName
CARBON BLACK FEEDSTOCK (DOW)	PROPYLENE
CARBON BLACK FEEDSTOCK (HCGO/CLO)	PYGAS
CASTOR OIL	PYGAS - AROMATIC MIXTURE
COAL TAR	PYGAS CONTAINING BENZENE
COAL TAR OIL (CARBOM BLACK FEEDSTOCK)	PYROLISIS GASOLINE
COKER GASOIL	PYROLYSIS GASOLINE
COKER HEAVY GASOIL (STATOIL)	PYROLYSIS GASOLINE (CONTAINING BENZENE)
COKER NAPHTA	RBHC (EXXON MOBIL)
CONDENSAAT	REFORMATE BENZENE HEART CUT
CONDENSATE	REFORMATE BENZENE HEARTCUT
CONDESATE	REFORMATE TX
CPC	REGULAR UNLEADED GASOLINE
CRUDE	RENEWABLE DIESEL
CRUDE BENZENE	RUSSIAN BLEND CRUDE OIL
CRUDE C4	RUWE AARDOLIE
CRUDE OIL	RUWE OLIE
CRUDEOIL	SHELLSOL 100/120
CUMENE	SHELLSOL A (SHELL)
DIESEL	SHELLSOL A100 (SHELL)
DIESEL OIL	SHELLSOL A150 (SHELL)
E90	SHELLSOL D100 (SHELL)
E90 (FUELSTREAMERS	SHELLSOL D40 (SHELL)
ETHYLENE	SHELLSOL D60 (SHELL)
EXXOL D110	SHELLSOL D70 (SHELL)
EXXOL D60	SHELLSOL D90 (SHELL)
EXXOL D60(S)	SHELLSOL DMA (SHELL)
EXXON D60	SHELLSOL DSC (SHELL)
EXXSOL D 220/230	SHELLSOL H
EXXSOL D 40	SHELLSOL HF250D
EXXSOL D 80	SHELLSOL T
FATTY ACID METHYL ESTERS (M)	SHELLSOL TD
FATTY ACIDS (C12+)	SLACK WAX
FATTY ACIDS (C16+)	SMEER OLIE
FATTY ACIDS 12+	SMEEROLIE
FATTY ACIDS C16+	SN 100 (KPE)
FATTY ACIDS C8-C10	SN 150
FATTY ACIDS ESSENTIALLY LINEAR (C6-C18) 2-ETHYLHEXYL ESTER.	SN 300 (KPE)
FUEL OIL	SN 500
FUEL OIL SLURRY	SN 600
FUELOIL	SOLVENT NEUTRAL 150 (ESSO)
FUELOIL.	SOLVENT NEUTRAL 150 (MOBIL)
GAS CONDENSATE	SOLVENT NEUTRAL 600 (ESSO)
GAS OIL OR DIESEL FUEL OR HEATING OIL LIGHT	STABILIZED CONDENSATE
GASCONDENSATE	STOOK
GASOIL	STOOK OLIE
GASOIL 50PPM	STOOKOLIE
GASOLIE	STOOKOLIE HIGH SULPHUR FUEL OIL
GASOLINE	STYRENE MONOMER
GOFINATE VACUM GASOIL	SYRIAN HEAVY CRUDE OIL
GTL FUEL (SHELL)	T4000 BASE OIL
HEAVY AROMATICS (AROMATICS MALAYSIA)	T9 BASEOIL (NYNAS NAPHTHENICS)
HEAVY AROMATICS (NAPHTHA DISTILLATE)	TALL OIL CRUDE
HEAVY CYCLE OIL	TOLUENE
HEAVY GASOIL HS	ULSD
HEAVY NAHPHTA	ULTRA LOW SULPHUR DIESELOIL
HEPTANE (ALL ISOMERS)	UNLEADED GASOLINE
HEPTANOL (ALL ISOMERS) (D)	UREA SOLUTION
HEPTENE (ALL ISOMERS)	VHVI 5.4 (SHELL)
HEXANE (ALL ISOMERS)	VHVI 6
HEXANES	VLIEGTUIGBENZINE
HEXENE (ALL ISOMERS)	YUBASE 3 (SK CORPORATION)
HIGH SULFUR FUEL OIL	YUBASE 4
HIGH SULPHER FUEL OIL	YUBASE 4 (SK CORPORATION)
HIGH SULPHER VACUUM GASOIL	YUBASE 4 (SK CORPORATION) PLUS

SubstanceName	SubstanceName
HIGH SULPHUR FUEL OIL	YUBASE 4 PLUS (SK CORPORATION)
HIGH SULPHUR VACUM GASOIL	YUBASE 6
HIGH SULPHUR VACUUM GAS OIL	YUBASE 6 (SK CORPORATION)
HIGH SULPHUR VACUUM GASOIL	YUBASE 8 (SK CORPORATION)
HMD	ZWARE VACUUM GASOLIE
HS VACUUM GASOIL	
HSFO	
HVI 105 (SHELL)	
HVI 160B (SHELL)	
HVI 60 (SHELL)	
HVI 65	
HVI 650 (SHELL)	
HVI 65B (SHELL)	
HYDOCARBON GAS MIXTURE LIQUEFIED N.O.S. (MIXTURE OF HYDROCARBONS 20	
HYDROCARBON GAS MIXTURE LIQUEFIED N.O.S.	
HYDROCARBON GAS MIXTURE LIQUIFIED N.O.S.	
HYDROCARBON GAS MIXTURE LIQUIFIED N.O.S.	
HYDROCARBONOUS LIQUID	
HYDROCARBONS LIQUID N.O.S.	
HYDROCRACATE (ESSO)	

Annex 2: Detailed results Rotterdam

Overview of the total number of journeys in the different traffic and cargo databases for Rotterdam. The last rows (orange) show the overall loading percentages for the different ship types and ship sizes.

	Total number of journeys ***departing from*** Rotterdam in the different databases								
	Size class [based on GT]								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total**
Traffic database COWI									
Bulk			475	14	403	249	245	78	1464
Bulk/oil						3	11		14
Tanker, chemical incl. Tanker, others	8	9	462	88	65				632
Tanker, chemical/prod.	12	13	1775	1117	1811	196			4924
Tanker, crude oil			14	17	70	703	187	98	1089
Tanker, food		55	134		25				214
Tanker, gas		56	444	94	40	14			648
Tanker, product	13	11	151	35	102	80	69		461
Total	**33**	**144**	**3455**	**1365**	**2516**	**1245**	**512**	**176**	**9446**
Cargo database Rotterdam									
Bulk			21	0	0	0	0	0	21
Bulk/oil						2	0		2
Tanker, chemical incl. Tanker, others	0	0	1	12	0				13
Tanker, chemical/prod.	8	2	587	419	629	8			1653
Tanker, crude oil			0	0	37	90	35	43	204
Tanker, food		0	0		0				0
Tanker, gas		5	15	3	11	1			34
Tanker, product	11	10	112	8	115	33	9		296
Total	**19**	**16**	**736**	**442**	**791**	**133**	**44**	**43**	**2224**
Pload (Cargo/Traffic)									
Bulk	--	--	4%	0%	0%	0%	0%	0%	1%
Bulk/oil	--	--	--	--	--	67%	0%	--	14%
Tanker, chemical incl. Tanker, others	0%	0%	0%	14%	0%	--	--	--	2%
Tanker, chemical/prod.	64%	14%	33%	38%	35%	4%	--	--	34%
Tanker, crude oil	--	--	0%	0%	52%	13%	19%	44%	19%
Tanker, food	--	0%	0%	--	0%	--	--	--	0%
Tanker, gas	--	8%	3%	3%	26%	7%	--	--	5%
Tanker, product	85%	88%	74%	21%	113%	41%	12%	--	64%
Total	**56%**	**11%**	**21%**	**32%**	**31%**	**11%**	**9%**	**24%**	**24%**
Total Tankers (chem, prod,crud)	***56%***	***35%***	***29%***	***35%***	***38%***	***13%***	***17%***	***44%***	***30%***

	Total number of journeys ***arriving in*** Rotterdam in the different databases								
	Size class [based on GT]								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total**
Traffic database COWI									
Bulk			465	15	400	245	246	77	1448
Bulk/oil						3	10		13
Tanker, chemical incl. Tanker, others	8	8	460	88	67				631
Tanker, chemical/prod.	12	13	1773	1116	1790	193			4897
Tanker, crude oil			14	17	72	700	192	94	1089
Tanker, food		54	135		24				213
Tanker, gas		53	444	96	40	14			647
Tanker, product	13	11	153	35	100	81	67		460
Total	**33**	**139**	**3444**	**1367**	**2493**	**1236**	**515**	**171**	**9398**
Cargo database Rotterdam									
Bulk			52	0	0	0	0	0	52
Bulk/oil						3	0		3
Tanker, chemical incl. Tanker, others	0	0	6	5	0				11
Tanker, chemical/prod.	6	2	597	504	1089	16			2215
Tanker, crude oil			0	0	69	642	168	69	948
Tanker, food		0	0		0				0
Tanker, gas		23	215	72	18	4			331
Tanker, product	1	0	118	32	145	68	59		423
Total	**7**	**25**	**989**	**613**	**1322**	**732**	**228**	**69**	**3984**
Pload (Cargo/Traffic)									
Bulk	--	--	11%	0%	0%	0%	0%	0%	4%
Bulk/oil	--	--	--	--	--	86%	0%	--	20%
Tanker, chemical incl. Tanker, others	0%	0%	1%	5%	0%	--	--	--	2%
Tanker, chemical/prod.	52%	15%	34%	45%	61%	8%	--	--	45%
Tanker, crude oil	--	--	0%	0%	96%	92%	88%	73%	87%
Tanker, food	--	0%	0%	--	0%	--	--	--	0%
Tanker, gas	--	43%	48%	75%	46%	25%	--	--	51%
Tanker, product	8%	0%	77%	91%	145%	83%	88%	--	92%
Total	**22%**	**18%**	**29%**	**45%**	**53%**	**59%**	**44%**	**40%**	**42%**
Total Tankers (chem., prod,crude)	***22%***	***6%***	***30%***	***43%***	***64%***	***74%***	***88%***	***73%***	***51%***

	Total number of journeys arriving and departure Rotterdam in the different databases								
	Size class								
	1	2	3	4	5	6	7	8	Total
Traffic database COWI									
Bulk			940	29	803	494	491	155	2912
Bulk/oil						6	21		27
Tanker, chemical incl. Tanker, others	16	17	922	176	132				1263
Tanker, chemical/prod.	24	26	3548	2233	3601	389			9821
Tanker, crude oil			28	34	142	1403	379	192	2178
Tanker, food		109	269		49				427
Tanker, gas		109	888	190	80	28			1295
Tanker, product	26	22	304	70	202	161	136		921
Total	**66**	**283**	**6899**	**2732**	**5009**	**2481**	**1027**	**347**	**18844**
Cargo database Rotterdam									
Bulk			74	0	0	0	0	0	74
Bulk/oil						5	0		5
Tanker, chemical incl. Tanker, others	0	0	7	17	0				24
Tanker, chemical/prod.	14	4	1184	923	1718	24			3868
Tanker, crude oil			0	0	106	732	203	112	1152
Tanker, food		0	0		0				0
Tanker, gas		27	230	75	29	5			366
Tanker, product	12	10	230	40	260	100	68		719
Total	**26**	**41**	**1725**	**1055**	**2114**	**865**	**271**	**112**	**6207**
Pload (Cargo/Traffic)									
Bulk	--	--	8%	0%	0%	0%	0%	0%	3%
Bulk/oil	--	--	--	--	--	76%	0%	--	17%
Tanker, chemical incl. Tanker, others	0%	0%	1%	10%	0%	--	--	--	2%
Tanker, chemical/prod.	58%	15%	33%	41%	48%	6%	--	--	39%
Tanker, crude oil	--	--	0%	0%	75%	52%	54%	58%	53%
Tanker, food	--	0%	0%	--	0%	--	--	--	0%
Tanker, gas	--	25%	26%	40%	36%	16%	--	--	28%
Tanker, product	46%	44%	76%	56%	129%	62%	50%	--	78%
Total	**39%**	**14%**	**25%**	**39%**	**42%**	**35%**	**26%**	**32%**	**33%**
Total Tankers (chem,prod,crude)	***39%***	***21%***	***30%***	***39%***	***51%***	***44%***	***53%***	***58%***	***41%***

Annex 3: Overall average loading probabilities

Overview of the different overall loading probabilities for Antwerp, Rotterdam and Mongstad for the Tankers. Last columns provide two options for the assumption of the overall unknown loading conditions (probability for the ships on the routes for which no detailed data is available)

			Average P Load			
VesselID	VesselTxt	GTclass	Rdam	Antwerp	Mongstad	AveragePLoad = Combination
41	Tanker, chemical/prod.	1	58.0%	0.0%	--	29.0%
42	Tanker, chemical/prod.	2	14.8%	0.0%	--	7.4%
43	Tanker, chemical/prod.	3	33.4%	1.0%	47.1%	27.1%
44	Tanker, chemical/prod.	4	41.3%	3.5%	45.2%	30.0%
45	Tanker, chemical/prod.	5	47.7%	4.3%	67.4%	39.8%
46	Tanker, chemical/prod.	6	6.2%	0.0%	69.7%	25.3%
47	Tanker, chemical/prod.	7	--	--	--	0.0%
48	Tanker, chemical/prod.	8	--	--	--	0.0%
51	Tanker, chemical incl. Tanker, others	1	0.0%	--	62.7%	31.3%
52	Tanker, chemical incl. Tanker, others	2	0.0%	0.0%	0.0%	0.0%
53	Tanker, chemical incl. Tanker, others	3	0.8%	0.0%	47.1%	16.0%
54	Tanker, chemical incl. Tanker, others	4	9.5%	0.0%	--	4.8%
55	Tanker, chemical incl. Tanker, others	5	0.0%	0.0%	67.4%	22.5%
56	Tanker, chemical incl. Tanker, others	6	--	--	--	0.0%
57	Tanker, chemical incl. Tanker, others	7	--	--	--	0.0%
58	Tanker, chemical incl. Tanker, others	8	--	--	--	0.0%
61	Tanker, product	1	46.2%	0.0%	62.7%	36.3%
62	Tanker, product	2	43.8%	--	0.0%	21.9%
63	Tanker, product	3	75.6%	0.5%	47.1%	41.0%
64	Tanker, product	4	56.4%	0.0%	45.2%	33.9%
65	Tanker, product	5	128.9%	6.4%	67.4%	67.6%
66	Tanker, product	6	62.1%	4.1%	69.7%	45.3%
67	Tanker, product	7	49.7%	20.0%	100.0%	56.6%
68	Tanker, product	8	--	--	--	0.0%
71	Tanker, crude oil	1	--	--	--	0.0%
72	Tanker, crude oil	2	--	--	--	0.0%
73	Tanker, crude oil	3	0.0%	0.0%	--	0.0%
74	Tanker, crude oil	4	0.0%	0.0%	--	0.0%
75	Tanker, crude oil	5	74.5%	16.1%	0.0%	30.2%
76	Tanker, crude oil	6	52.1%	6.0%	5.7%	21.3%
77	Tanker, crude oil	7	53.7%	0.0%	68.2%	40.6%
78	Tanker, crude oil	8	58.1%	--	0.0%	29.0%