

ANNEX 1: PROBLEM DEFINITION AND BACKGROUND INFORMATION

1. Definition of the problem

1.1 Definition of the problem

SOLAS Chapter XII requires safety measures to those bulk carriers of length of 150 m and over and which carry high-density bulk cargo. The Committee is discussing questions whether safety measures are necessary for bulk carriers to which Chapter XII does not apply. This FSA study is intended to give assistance, by FSA methodology, for verifying and analyzing the safety of bulk carriers to which Chapter XII does not apply. For this purpose, this evaluation needs to compare the safety of various types of bulk carriers that comply with SOLAS Chapter XII or does not comply with that.

1.1.1 Ship category

1.1.1.1 Definition of Bulk Carriers

There are several definitions of bulk carriers. These are:

- .1 A definition of bulk carriers is given in SOLAS Chapter IX; that is,
“Bulk Carrier means a ship which is constructed generally with single deck, *topside* tanks and hopper side tanks in cargo spaces, and it intended primarily to carry dry cargo in bulk, and includes such types as ore carriers and combination carriers. “
- .2 Another definition has been developed during the SOLAS Conference and is given in the Conference Resolution 6; that is,
“Ships constructed with single deck, topside tanks and hopper side tanks in cargo spaces and intended primarily to carry dry cargo in bulk; or
ore carriers; or
combination carriers”
- .3 The other definition has been proposed by MSC 70/4/Add.1 which has proposed FSA study on bulk carriers; that is,
“A bulk carrier is any ship designed, constructed and/or used for the carriage of solid bulk cargo.”

For the purpose of this study as mentioned in 2.1.2, a wider definition should be used. Therefore, the study is based upon the third definition (mentioned in 3.1.1.1.3).

In relation to these definitions, “solid bulk cargo” should be defined and this is given in SOLAS Chapter XII Regulation 1.4 as follows;

“Solid bulk cargo means any material, other than liquid or gas, consisting of a combination of particles or larger pieces of material, generally uniform in composition, which is loaded into cargo spaces of a ship, generally without any intermediate form of containment.”

1.1.1.2 Type of Bulk Carriers , Ship Size and Ship Age

A preliminary investigation on type of bulk carriers and their categorization method was carried out. APPENDIX A “DEFINITION AND IDENTIFICATION OF BULK CARRIERS FOR FSA” of this report shows the investigation results. Based on this investigation results, it was decided that Table A.1.2 of

APPENDIX A would be used for categorization of bulk carriers.

Types of bulk carriers, which meet the definition given in 3.1.1.1.3 and categorization in Table A.1.2 of APPENDIX A, have been derived from ship register of Nippon Kaiji Kyokai (ClassNK). Actual possible sizes of bulk carriers of each type are also selected. These types and their size are shown in APPENDIX B “Type Distribution of NK registered Ships Carrying Solid Bulk Cargo”. APPENDIX B illustrates the typical mid-ship section of the hold of each type of bulk carriers. APPENDIX B also gives possible cargoes to be carried in the column of “purpose of ship”.

Types of (1’), (4’) and (5’) has been deleted from the consideration because actual number of the ships of these types are very small, and ships of such types are no longer built.

APPENDIX C gives a general plan of hull construction of bulk carriers. APPENDIX C also gives detail of components and elements of construction and structure, as well as fundamental equipment, of bulk carrier type (1), (2) and (3). Hazard relating to these components and elements should be identified in FSA Step 1 hazard identification process.

Ship age will be considered at casualty data analysis and taken into consideration in analysis in FSA STEP 1 to STEP 5. Tentatively, two class of ship age is chosen as;

- (1) from 0 up to 15; and
- (2) from 15 and over.

1.1.1.3 Type of Cargo

APPENDIX D describes the types of cargo that are intended to be carried by each type of bulk carriers which is categorized in APPENDIX B. Actual practice of cargo carriage by each size of bulk carrier is surveyed and the results are given in Table-D.2 of APPENDIX D. These data should be considered in FSA Step 1 hazard identification process.

1.1.2 Ship functions and features

This study deals with problems particular to bulk carriers. Therefore, in general, this study deals with cargo area and forecabin of bulk carriers, and does not deal with machinery spaces and accommodation spaces, because arrangements in machinery spaces and accommodation spaces of bulk carriers are almost the same of those of other type of cargo ships. Detail of components and element of construction and structure, as well as major equipment, of typical bulk carriers are shown in APPENDIX C.

However, following functions, facilities and items have been tabled to the discussion of the Committee at its 69th and 70th session, and may be considered as risk control options (RCO):

- Redundancy of steering systems
- life-saving appliances including evacuation systems and free fall lifeboat
- means of communication of alert signal to rescue parties
- hatch cover (operation, maintenance and strength)
- access to fore end spaces (necessity of consideration, safety)
- communication systems between bridge and fore end spaces (necessity of consideration)

- loading computer
- facilities and equipment mentioned in the report of Derbyshire (bulge alarm, lighting in fore end spaces;)
- tank sounding systems, bilge alarm systems, emergency pumping in fore end spaces
- facilities and equipment particular to bulk carriers

1.1.3 Operating Condition

Operating conditions of bulk carriers have been categorized. Table 3.1 gives the selected operating conditions that should be considered in this study.

Table 1.1 Operating conditions to be considered

| Loaded voyage | Ballast voyage | others |
|--|--|--------------------------------------|
| voyage with condition of - homogeneous loading - homogeneous loading of high density cargo - alternate loading of high density cargo - loading for two port unloading (there are many pattern of loading) or partial loading/unloading - irregular alternate loading (block loading) - slack loading | voyage with condition of: - normal ballast - heavy ballast (Ballast exchange at sea in these cases should be included.) | loading at port unloading at port |

Reference: Bulk Carriers Guidance and Information on Bulk Cargo Loading and Discharging to Reduce the Likelihood of Over-stressing the Hull Structure, IACS

1.1.4 Human Factors

Safety management of operation of bulk carriers is regulated by SOLAS Chapter IX and ISM Code. This study uses an assumption that the safety management of bulk carrier is kept in good condition according to the SOLAS regulations and ISM Code.

However, following items should be considered in this study, because these may affect on safety in case of various operation conditions.

- (1) On-board human factor, such as on board maintenance, navigation and operation in normal condition and emergency condition
- (2) Ship management, manning management and navigational management, and
- (3) Safety management.

APPENDIX E illustrates typical chartering system and voyage patterns.

3.1.5 External Influences on the ship

Weather and sea conditions

Weather and sea conditions affect directly the safety of bulk carries. Techniques for prediction of sea conditions have been developed and available world wide, e.g. in Proceedings of the 13th International Ship and Offshore Structure Congress (ISSC 1997). Then, it is anticipated that height of wave or green water coming on deck as well as consequential water load can be calculated. These techniques will be used on this study.

3.1.6 Accident category

The scope of the study is to deal with safety of bulk carriers. Therefore, accident particular to bulk carriers should be considered. Accidents of bulk carriers have been classified into two categories;

- (1) Casualties to be dealt with, because these are particular to bulk carriers, and
- (2) Casualties not to be dealt with, because these are not particular to bulk carriers.

Table 3.2 show the results of categorization.

Table 1.2 Categorization of Casualties

| Casualties to be considered in this study | Casualties not to be considered |
|--|--|
| - Fire and explosion in cargo hold and fore end spaces | - Personnel accident |
| - Flooded | - Fire and explosion in machinery and accommodation spaces |
| - List and capsize | - Collision and contact |
| - Founder | - Ground and strand |
| - Damage and break down of construction and facilities in cargo hold and fore end spaces | |

1.1.7 Risk associated with consequences

Scope of this study is safety of bulk carriers, and particularly safety of life on bulk carries. Therefore, risk for life is the major concern. This study does not deal with business risk and risk to environment.

1.2 Reference to the Regulations

- (1) International Convention for the Safety at Sea, 1974 as amended (SOLAS 1974) and the relative Protocol, especially,
 - (a) Chapter XII - Safety Measures for Bulk Carriers, including IACS Unified Requirements S12 and S17 to S24
 - (b) Chapter XI - Enhanced Survey, and IMO Resolution A.744(18)
 - (c) Chapter IX - International Safety Management Code (ISM Code)
 - (d) Chapter III - Life-Saving Appliances and Arrangements
 - (e) Chapter II-2, VI and VII - Code of Safety Practice for Solid Bulk Cargoes as amended (BC Code)
 - (f) Chapter II-2 and VII - International Maritime Dangerous Goods Code as amended (IMDG Code)
- (2) International Convention on Load Line, 1966 (ILL 66) and the relative Protocol
- (3) International Convention for the Prevention of Pollution from Ships, 1973 as amended (MARPOL 73) and the relative Protocol
- (4) International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1995 as amended (STCW)

1.3 Definition of the generic model

Generic bulk carriers are described in 3.1.1 and APPENDIX B and C.

2. Background information

Background information regarding ship types, cargoes and operation is given in APPENDIX A, B, C, D and E. Additional information is described in following paragraphs.

2.1 Lessons learned from recent studies

Investigation results regarding safety of bulk carriers have been presented to IMO and/or published. Ship Research Institute of Ministry of Transport of Japan, Nippon Kaiji Kyokai (Class NK), Shipbuilding Research Association of Japan, and other organization have conducted many studies on safety of bulk carriers. Literatures of these studies were corrected. Literature of these study and investigation has been corrected.

APPENDIX**A: DEFINITION AND IDENTIFICATION OF BULK CARRIERS FOR FSA****B: Type-Distribution of NK-Registered Ships Carrying Solid Bulk Cargo****C: DETAIL OF CONSTRUCTION AND EQUIPMENT****D: SOLID BULK CARGO****E: TYPICAL VOYAGE PATTERN OF BULK CARRIERS**

APPENDIX A
DEFINITION AND IDENTIFICATION OF BULK CARRIERS FOR FSA

This consideration to definition and identification of bulk carriers for FSA is constituted of two parts,
Part A.1: Definition and identification of bulk carriers, and
Part A.2: Definition and identification of bulk cargoes which terms are defined in A.1.

A.1 Definition and identification of bulk carriers

A.1.1 (Option 1) Definition based on SOLAS regulation IX/1.6

Definition of bulk carriers would be derived, based upon SOLAS regulation IX/1.6 and related interpretation given by SOLAS/CPNF. 4/25 as follows:

Bulk Carrier means a ship that is intended primarily to carry dry cargo in bulk,
(1) which has single deck, topside tanks and hopper side tanks in cargo spaces,
(2) which has single deck, double bottom and two longitudinal bulkhead in cargo spaces and carries bulk ore cargo in the center holds, or
(3) ore-oil combination carrier defined in SOLAS regulation II-2/3.27 as

NOTE 1): SOLAS Chapter IX/1.6:

Bulk Carrier means a ship which is constructed generally with single deck, topside tanks and hopper side tanks in cargo spaces, and it intended primarily to carry dry cargo in bulk, and includes such types as ore carriers and combination carriers.

NOTE 2): Interpretation given by SOLAS/CONF.4/25:

Ships constructed with single deck, topside tanks and hopper side tanks in cargo spaces and intended primarily to carry dry cargo in bulk; or

- ore carriers *; or
- combination carriers **;

* "Ore carrier" means a sea-going single deck ship having two longitudinal bulkheads and a double bottom throughout the cargo region and intended for the carriage of ore cargoes in the centre holds only.

** "Combination carrier" has the same meaning as in SOLAS regulation II-2/3.27.

The bulk carriers defined as above include those ships that carry bulk cargo in a part of the cargo spaces. Table A.1.1 shows bulk carriers defined as above and other types of ship. It should be noted that Table A.1.1 show representative of types of ship but does not show them exhaustively.

A.1.2 (Option 2) Definition on the view point of carrying bulk cargo

Another definition of bulk carriers may be derive from the view point of carrying bulk cargoes as follows:

Bulk Carrier means a ship that is intended primarily to carry dry cargo in bulk.

The bulk carriers defined as above include those ships that carry bulk cargo in a part of the cargo spaces. Table A.1.2 shows bulk carriers defined as above and other types of ship. It should be noted that Table A.1.2 show representative of types of ship but does not show them exhaustively.

Table A.1.1

Examples of Ships included in, and excluded from, the definition of a Bulk Carrier

| Ships Included | Ships Excluded |
|---|------------------------------|
| Bulk Carrier | Box Hold Carrier |
| Ore Carrier | General Cargo Ship |
| Combination Carrier or Bulk/Oil Carrier | Lumber Carrier |
| Combination Carrier or Bulk/Oil Carrier | General Cargo/Lumber Carrier |
| Bulk/Container Carrier | Chip Carrier |
| Bulk/Vehicles Carrier | Cement Carrier |
| | Container Carrier |
| | Vehicles Carrier |
| | Refrigerated Cargo Carrier |
| | Ro-Ro Cargo Ship |
| | Livestock Carrier |
| | Module Carrier |
| | Fishing Vessel |
| | Dredger |
| | Barge |
| | Passenger/General Cargo Ship |
| | Passenger/Vehicles Ferry |

NOTE: Ships to which SOLAS does not apply are excluded.

Table A.1.2**Examples of Ships included in, and excluded from, the definition of a Bulk Carrier**

| Ships Included | Ships Excluded |
|---|------------------------------|
| Bulk Carrier | General Cargo Ship |
| Ore Carrier | Container Carrier |
| Combination Carrier or Bulk/Oil Carrier | Vehicles Carrier |
| Combination Carrier or Bulk/Oil Carrier | Refrigerated Cargo Carrier |
| Bulk/Container Carrier | Ro-Ro Cargo Ship |
| Bulk/Vehicles Carrier | Livestock Carrier |
| Box Hold Carrier | Module Carrier |
| Lumber Carrier | Fishing Vessel |
| General Cargo/Lumber Carrier | Dredger |
| Chip Carrier | Barge |
| Cement Carrier | Passenger/General Cargo Ship |
| | Passenger/Vehicles Ferry |

NOTE 1): Ships to which SOLAS does not apply are excluded.

NOTE 2): "Ships having self-dischargers" is included in "bulk carriers" in the document MSC 70 Informal paper ANNEX A paragraph 6 prepared by United Kingdom for discussion. In Table A.1.2 above, "Ships having self-dischargers" does not appear, because such ship is one of ships mentioned in the left column of the table.

A.2 Definition and identification of bulk cargoes

Solid bulk cargo would be defined as in SOLAS CONF. 4/25 ANNEX for regulation 1.4 as follows:

“Solid bulk cargo” is any material, other than liquid or gas, consisting of a combination of particles, granules or larger pieces of material, generally uniform in composition, which is loaded directly into the cargo spaces of a ship without any intermediate form of containment.”

Solid bulk cargo defined as above includes “Heavy break bulk cargo” as proposed by BIMCO by MSC 69/2/1/Add.4. Table A.2.1 shows categorization of cargoes according to the definition above. It should be noted that Table A.2.1 show representative of types of cargoes but does not show them exhaustively.

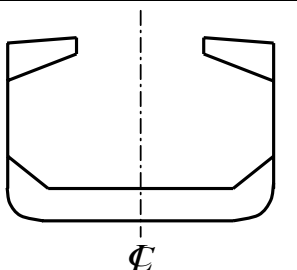
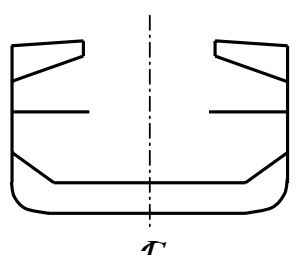
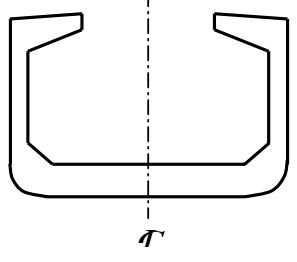
Table A.2.1

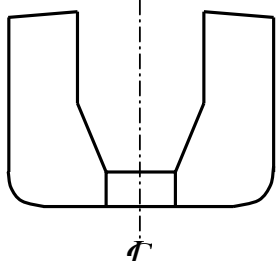
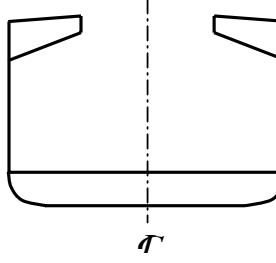
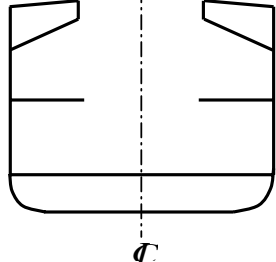
Examples of Cargoes included in, and excluded from, the definition of Solid Bulk Cargo

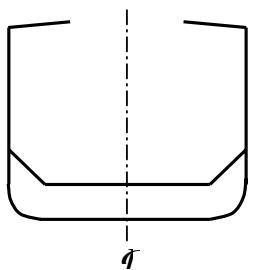
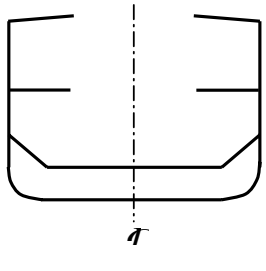
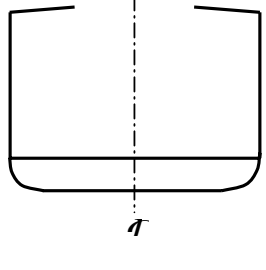
| Cargoes Included | Cargoes Excluded |
|--|---------------------------|
| Ore, notably iron ore Coal Grain and other Foodstuffs Fertilizers Wood and Wood Products Minerals such as Sulphur Metals Steel Products Lumber | Liquid Gas Unitized |

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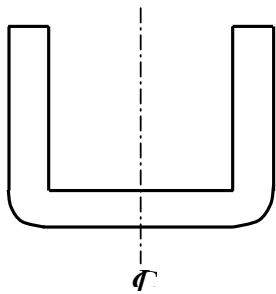
APPENDIX B Type-Distribution of NK-Registered Ships Carrying Solid Bulk Cargo

| Type | Mid-ship Section | Number of Ships | Sum of DWT | Ship Length L_f (m) | | Ship Age (years) | | Registered Purpose of Ship | |
|------|---|------------------|-----------------------|---|--------------------|------------------|--------------------|-----------------------------|-------------|
| (1) |  | 1,224 (48.2%) | 65,898,492 (74.9%) | $L_f < 100$ | 2 (0.2%) | $A < 5$ | 442 (36.1%) | Bulk Carrier | 722 (59.0%) |
| | | | | $100 \leq L_f < 130$ | 31 (2.5%) | $5 \leq A < 10$ | 206 (16.8%) | Bulk/Lumber Carrier | 463 (37.8%) |
| | | | | $130 \leq L_f < 150$ | 190 (15.5%) | $10 \leq A < 15$ | 208 (17.0%) | Bulk/Vehicles Carrier | 2 (0.2%) |
| | | | | $150 \leq L_f < 200$ | 603 (49.3%) | $15 \leq A < 20$ | 241 (19.7%) | Ore/Bulk Carrier | 30 (2.5%) |
| | | | | $200 \leq L_f < 230$ | 254 (20.8%) | $20 \leq A < 25$ | 112 (9.2%) | Ore/Bulk/Lumber Carrier | 1 (0.1%) |
| | | | | $230 \leq L_f < 270$ | 74 (6.0%) | $25 \leq A$ | 16 (1.3%) | Ore/Coal Carrier | 1 (0.1%) |
| | | | | $270 \leq L_f$ | 70 (5.7%) | | | Coal Carrier | 2 (0.2%) |
| | | | | | | | | General Cargo Carrier | 1 (0.1%) |
| | | | | | | | | G.Cargo/Lumber Carrier | 1 (0.1%) |
| | | | | | | | | Chip Carrier | 1 (0.1%) |
| | | | | | | | | Limestone Carrier | 1 (0.1%) |
| (1') |  | 8 (0.3%) | 138,725 (0.2%) | $L_f < 100$ | 0 (0%) | $A < 5$ | 0 (0%) | Bulk Carrier | 4 (50.0%) |
| | | | | $100 \leq L_f < 130$ | 0 (0%) | $5 \leq A < 10$ | 0 (0%) | Bulk/Lumber Carrier | 1 (12.5%) |
| | | | | $130 \leq L_f < 150$ | 8 (100%) | $10 \leq A < 15$ | 0 (0%) | General Cargo Carrier | 2 (25.0%) |
| | | | | $150 \leq L_f < 200$ | 0 (0%) | $15 \leq A < 20$ | 0 (0%) | Multi-purpose Cargo Carrier | 1 (12.5%) |
| | | | | $200 \leq L_f < 230$ | 0 (0%) | $20 \leq A < 25$ | 8 (100%) | | |
| | | | | $230 \leq L_f < 270$ | 0 (0%) | $25 \leq A$ | 0 (0%) | | |
| | | | | $270 \leq L_f$ | 0 (0%) | | | | |
| (2) |  | 17 (0.7%) | 1,418,452 (1.6%) | $L_f < 100$ | 0 (0%) | $A < 5$ | 6 (35.3%) | Bulk Carrier | 12 (70.6%) |
| | | | | $100 \leq L_f < 130$ | 0 (0%) | $5 \leq A < 10$ | 4 (23.5%) | Bulk/Lumber Carrier | 1 (5.9%) |
| | | | | $130 \leq L_f < 150$ | 0 (0%) | $10 \leq A < 15$ | 2 (11.8%) | Oil/Ore/Bulk Carrier | 2 (11.8%) |
| | | | | $150 \leq L_f < 200$ | 1 (5.9%) | $15 \leq A < 20$ | 4 (23.5%) | Coal Carrier | 2 (11.8%) |
| | | | | $200 \leq L_f < 230$ | 10 (58.8%) | $20 \leq A < 25$ | 1 (5.9%) | | |
| | | | | $230 \leq L_f < 270$ | 6 (35.3%) | $25 \leq A$ | 0 (0%) | | |
| | | | | $270 \leq L_f$ | 0 (0%) | | | | |

| Type | Mid-ship Section | Number of Ships | Sum of DWT | Ship Length L_f (m) | | Ship Age (years) | | Registered Purpose of Ship | |
|------|---|-----------------|---------------------|--|---|--|--|----------------------------|--|
| (3) |  | 27 (1.1%) | 4,768,474 (5.4%) | $L_f < 100$ 0 (0%) $100 \leq L_f < 130$ 0 (0%) $130 \leq L_f < 150$ 0 (0%) $150 \leq L_f < 200$ 2 (7.4%) $200 \leq L_f < 230$ 0 (0%) $230 \leq L_f < 270$ 7 (25.9%) $270 \leq L_f$ 18 (66.7%) | $A < 5$ 2 (7.4%) $5 \leq A < 10$ 0 (0%) $10 \leq A < 15$ 11 (40.7%) $15 \leq A < 20$ 4 (14.8%) $20 \leq A < 25$ 8 (29.6%) $25 \leq A$ 2 (7.4%) | Ore Carrier 23 (85.2%) Ore/Coal Carrier 2 (7.4%) Oil/Ore Carrier 1 (3.7%) Bauxite Carrier 1 (3.7%) | | | |
| (4) |  | 53 (2.1%) | 942,571 (1.1%) | $L_f < 100$ 0 (0%) $100 \leq L_f < 130$ 20 (37.7%) $130 \leq L_f < 150$ 23 (43.4%) $150 \leq L_f < 200$ 10 (18.9%) $200 \leq L_f < 230$ 0 (0%) $230 \leq L_f < 270$ 0 (0%) $270 \leq L_f$ 0 (0%) | $A < 5$ 0 (0%) $5 \leq A < 10$ 0 (0%) $10 \leq A < 15$ 6 (11.3%) $15 \leq A < 20$ 21 (39.6%) $20 \leq A < 25$ 23 (43.4%) $25 \leq A$ 3 (5.7%) | Bulk Carrier 1 (1.9%) Bulk/Lumber Carrier 9 (17.0%) General Cargo Carrier 6 (11.3%) G.Cargo/Lumber Carrier 36 (67.9%) Heavy Cargo Carrier 1 (1.9%) | | | |
| (4') |  | 6 (0.2%) | 120,822 (0.1%) | $L_f < 100$ 0 (0%) $100 \leq L_f < 130$ 0 (0%) $130 \leq L_f < 150$ 5 (83.3%) $150 \leq L_f < 200$ 1 (16.7%) $200 \leq L_f < 230$ 0 (0%) $230 \leq L_f < 270$ 0 (0%) $270 \leq L_f$ 0 (0%) | $A < 5$ 0 (0%) $5 \leq A < 10$ 0 (0%) $10 \leq A < 15$ 1 (16.7%) $15 \leq A < 20$ 1 (16.7%) $20 \leq A < 25$ 4 (66.7%) $25 \leq A$ 0 (0%) | General Cargo Carrier 3 (50.0%) G.Cargo/Container Carrier 1 (16.7%) Multi-purpose Cargo Carrier 2 (33.3%) | | | |

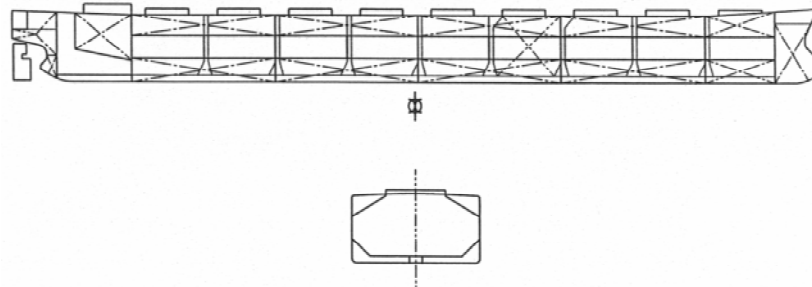
| Type | Mid-ship Section | Number of Ships | Sum of DWT | Ship Length L_f (m) | | Ship Age (years) | | Registered Purpose of Ship | |
|------|---|-----------------|---------------------|---|--|--|--|----------------------------|--|
| (5) |  | 146 (5.7%) | 5,016,369 (5.7%) | $L_f < 100$ 30 (20.5%) $100 \leq L_f < 130$ 6 (4.1%) $130 \leq L_f < 150$ 5 (3.4%) $150 \leq L_f < 200$ 91 (62.3%) $200 \leq L_f < 230$ 14 (9.6%) $230 \leq L_f < 270$ 0 (0%) $270 \leq L_f$ 0 (0%) | $A < 5$ 43 (29.5%) $5 \leq A < 10$ 29 (19.9%) $10 \leq A < 15$ 44 (30.1%) $15 \leq A < 20$ 14 (9.6%) $20 \leq A < 25$ 8 (5.5%) $25 \leq A$ 8 (5.5%) | Chip Carrier 108 (74.0%) General Cargo Carrier 22 (15.1%) G.Cargo/Lumber Carrier 9 (6.2%) G.Cargo/Container Carrier 1 (0.7%) Coal Carrier 6 (4.1%) | | | |
| (5') |  | 7 (0.3%) | 38,463 (0.04%) | $L_f < 100$ 7 (100%) $100 < L_f < 130$ 0 (0%) $130 < L_f < 150$ 0 (0%) $150 < L_f < 200$ 0 (0%) $200 < L_f < 230$ 0 (0%) $230 < L_f < 270$ 0 (0%) $270 < L_f$ 0 (0%) | $A < 5$ 0 (0%) $5 < A < 10$ 1 (14.3%) $10 < A < 15$ 4 (57.1%) $15 < A < 20$ 2 (28.6%) $20 < A < 25$ 0 (0%) $25 < A$ 0 (0%) | General Cargo Carrier 7 (100%) | | | |
| (6) |  | 283 (11.1%) | 1,511,700 (1.7%) | $L_f < 100$ 216 (76.3%) $100 < L_f < 130$ 67 (23.7%) $130 < L_f < 150$ 0 (0%) $150 < L_f < 200$ 0 (0%) $200 < L_f < 230$ 0 (0%) $230 < L_f < 270$ 0 (0%) $270 < L_f$ 0 (0%) | $A < 5$ 44 (15.5%) $5 < A < 10$ 42 (14.8%) $10 < A < 15$ 29 (10.2%) $15 < A < 20$ 101 (35.7%) $20 < A < 25$ 44 (15.5%) $25 < A$ 23 (8.1%) | General Cargo Carrier 129 (45.6%) G.Cargo/Lumber Carrier 143 (50.5%) G.Cargo/Vehicles Carrier 1 (0.4%) G.Cargo/Container Carrier 5 (1.8%) Multi-Purpose Cargo Carrier 3 (1.1%) Sand Carrier 1 (0.4%) Bulk (others) 1 (0.4%) | | | |

| Type | Mid-ship Section | Number of Ships | Sum of DWT | Ship Length L_f (m) | | Ship Age (years) | | Registered Purpose of Ship | |
|------|------------------|-----------------|---------------------|----------------------------------|------------|---------------------------------------|------------|------------------------------|-------------|
| (6) | | 264 (10.4%) | 1,677,658 (1.9%) | $L_f < 100$ | 243 | $A < 5$ | 44 (16.7%) | General Cargo Carrier | 236 (89.4%) |
| | | | | $100 \leq L_f < 130$ | (92.0%) | $5 \leq A < 10$ | 57 (21.6%) | G.Cargo/Lumber Carrier | 14 (5.3%) |
| | | | | $130 \leq L_f < 150$ | 18 (6.8%) | $10 \leq A < 15$ | 64 (24.2%) | G.Cargo/Vehicles Carrier | 1 (0.4%) |
| | | | | $150 \leq L_f < 200$ | 3 (1.1%) | $15 \leq A < 20$ | 85 (32.2%) | G.Cargo/Container Carrier | 7 (2.7%) |
| | | | | $200 \leq L_f < 230$ | 0 (0%) | $20 \leq A < 25$ | 10 (3.8%) | Multi-Purpose Cargo Carrier | 5 (1.9%) |
| | | | | $230 \leq L_f < 270$ | 0 (0%) | $25 \leq A$ | 4 (1.5%) | Limestone Carrier | 1 (0.4%) |
| | | | | $270 \leq L_f$ | 0 (0%) | | | | |
| | | | | | | | | | |
| (7) | | 227 (8.9%) | 2,296,119 (2.6%) | $L_f < 100$ | 118 | $A < 5$ | 90 (39.6%) | General Cargo Carrier | 144 (63.4%) |
| | | | | $100 \leq L_f < 130$ | (52.0%) | $5 \leq A < 10$ | 52 (22.9%) | G.Cargo/Lumber Carrier | 13 (5.7%) |
| | | | | $130 \leq L_f < 150$ | 45 (19.8%) | $10 \leq A < 15$ | 22 (9.7%) | G.Cargo/Vehicles Carrier | 7 (3.1%) |
| | | | | $150 \leq L_f < 200$ | 19 (8.4%) | $15 \leq A < 20$ | 27 (11.9%) | G.Cargo/Container Carrier | 6 (2.6%) |
| | | | | $200 \leq L_f < 230$ | 45 (19.8%) | $20 \leq A < 25$ | 35 (15.4%) | Heavy Cargo Carrier | 13 (5.7%) |
| | | | | $230 \leq L_f < 270$ | 0 (0%) | $25 \leq A$ | 1 (0.4%) | Multi-Purpose Cargo Carrier | 39 (17.2%) |
| | | | | $270 \leq L_f$ | 0 (0%) | | | Bulk/Multi-Purpose Carrier | 1 (0.4%) |
| | | | | | | | | Bulk/Vehicles Carrier | 2 (0.9%) |
| | | | | Limestone Carrier | 1 (0.4%) | | | | |
| | | | | Bulk (others) | 1 (0.4%) | | | | |
| (8) | | 149 (5.9%) | 1,103,319 (1.3%) | $L_f < 100$ | 65 (43.6%) | $A < 5$ | 25 (16.8%) | Cement Carrier | 129 (86.6%) |
| | | | | $100 \leq L_f < 130$ | 61 (40.9%) | $5 \leq A < 10$ | 42 (28.2%) | Limestone Carrier | 14 (9.4%) |
| | | | | $130 \leq L_f < 150$ | 14 (9.4%) | $10 \leq A < 15$ | 27 (18.1%) | Red Mud Carrier | 2 (1.3%) |
| | | | | $150 \leq L_f < 200$ | 9 (6.0%) | $15 \leq A < 20$ | 16 (10.7%) | Slag Powder Carrier | 2 (1.3%) |
| | | | | $200 \leq L_f < 230$ | 0 (0%) | $20 \leq A < 25$ | 18 (12.1%) | Bulk (others) | 2 (1.3%) |
| | | | | $230 \leq L_f < 270$ | 0 (0%) | $25 \leq A$ | 21 (14.1%) | | |
| | | | | $270 \leq L_f$ | 0 (0%) | | | | |
| | | | | | | | | | |

| Type | Mid-ship Section | Number of Ships | Sum of DWT | Ship Length L_f (m) | | Ship Age (years) | | Registered Purpose of Ship | |
|------|---|-----------------|----------------------|----------------------------------|------------|---------------------------------------|------------|-----------------------------|------------|
| (9) |  | 112 (4.4%) | 2,521,296 (2.9%) | $L_f < 100$ | 14 (12.5%) | $A < 5$ | 65 (58.0%) | Bulk Carrier | 46 (41.1%) |
| | | | | $100 \leq L_f < 130$ | 18 (16.1%) | $5 \leq A < 10$ | 16 (14.3%) | Bulk/Lumber Carrier | 24 (21.4%) |
| | | | | $130 \leq L_f < 150$ | 19 (17.0%) | $10 \leq A < 15$ | 10 (8.9%) | Bulk/Container Carrier | 2 (1.8%) |
| | | | | $150 \leq L_f < 200$ | 61 (54.5%) | $15 \leq A < 20$ | 11 (9.8%) | General Cargo Carrier | 15 (13.4%) |
| | | | | $200 \leq L_f < 230$ | 0 (0%) | $20 \leq A < 25$ | 10 (8.9%) | G.Cargo/Lumber Carrier | 7 (6.3%) |
| | | | | $230 \leq L_f < 270$ | 0 (0%) | $25 \leq A$ | 0 (0%) | G.Cargo/Container Carrier | 3 (2.7%) |
| | | | | $270 \leq L_f$ | 0 (0%) | | | Heavy Cargo Carrier | 2 (1.8%) |
| | | | | | | | | Multi-Purpose Cargo Carrier | 4 (3.6%) |
| | | | | | | | | Limestone Carrier | 8 (7.1%) |
| | | | | | | | | Coal Carrier | 1 (0.4%) |
| | Others | 17 (0.7%) | 357,930 (0.4%) | - | | - | | - | |
| | Total | 2540 (100%) | 87,925,413 (100%) | - | | - | | - | |

APPENDIX C DETAIL OF CONSTRUCTION AND EQUIPMENT

C.1 An example of bulk carrier hull plan



A typical general plan of hull of a bulk carrier is shown in Figure C.1.1 to Figure C.1.4

Figure C.1.1 general plan of hull of bulk carrier (1) Single side skin

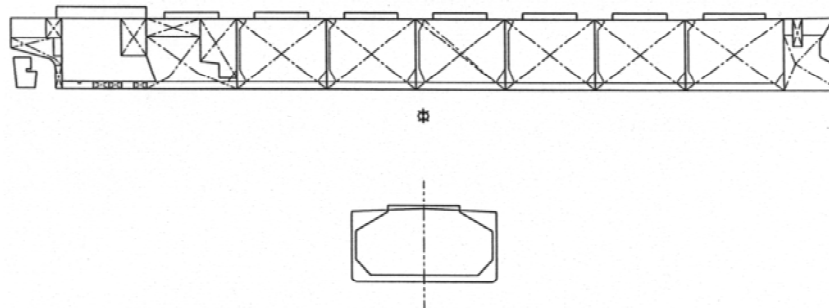


Figure C.1.2 general plan of hull of bulk carrier (2) Double side skin

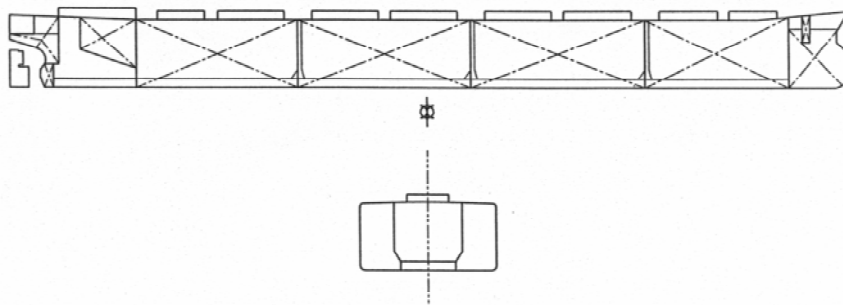


Figure C.1.3 general plan of hull of bulk carrier (3) Ore carrier

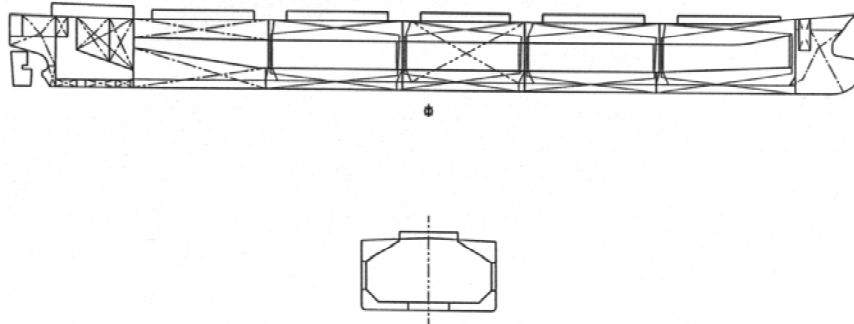


Figure C.1.4 general plan of hull of bulk carrier (2) Double skin Bulk carrier

C.2 Detail of components of construction of bulk carriers

Construction of bulk carriers is broken down in some parts. These are aft end part, engine room part, accommodation part, cargo hold part and fore end part. Spaces in each of the parts are identified. Then, components of structure of each space are identified. The identified spaces in each part and components of structure of each space of bulk carrier type (1), (2) and (3) * are listed in Figure C.2.1 through C.2.6. Detail of arrangement, facilities and equipment in the spaces of single-side skin bulk carrier is shown in Table C.2.1.

Similar figure and table for structural components and arrangements as well as facilities/equipment should be made for each type of bulk carrier, and hazard identification should be done for each structural components, arrangement and facilities/equipment in each space.

NOTE *: Type of bulk carrier is defined in APPENDIX B.

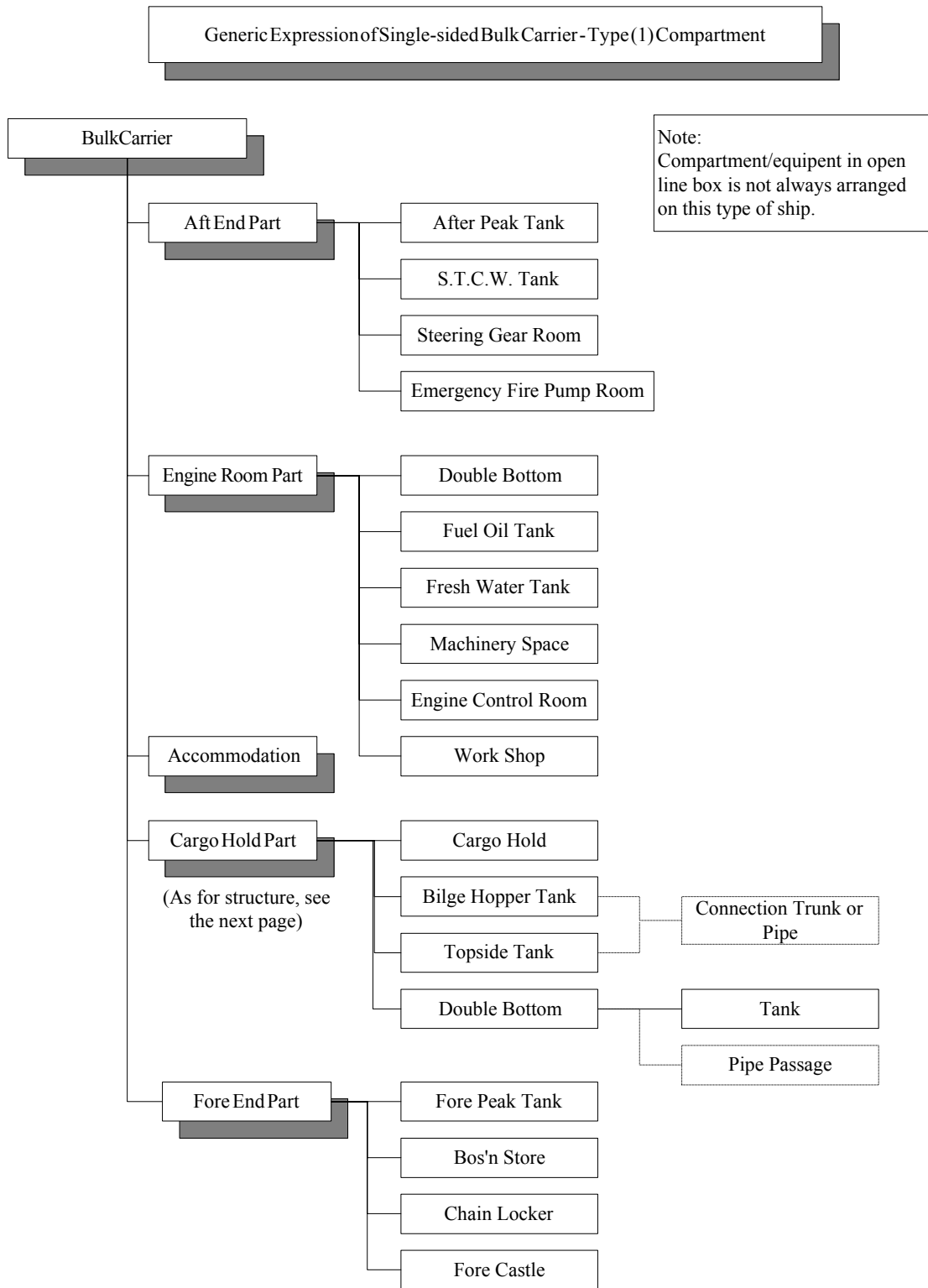


Figure C.2.1 Generic Expression of Single-sided Bulk Carrier - Type (1) - Compartment

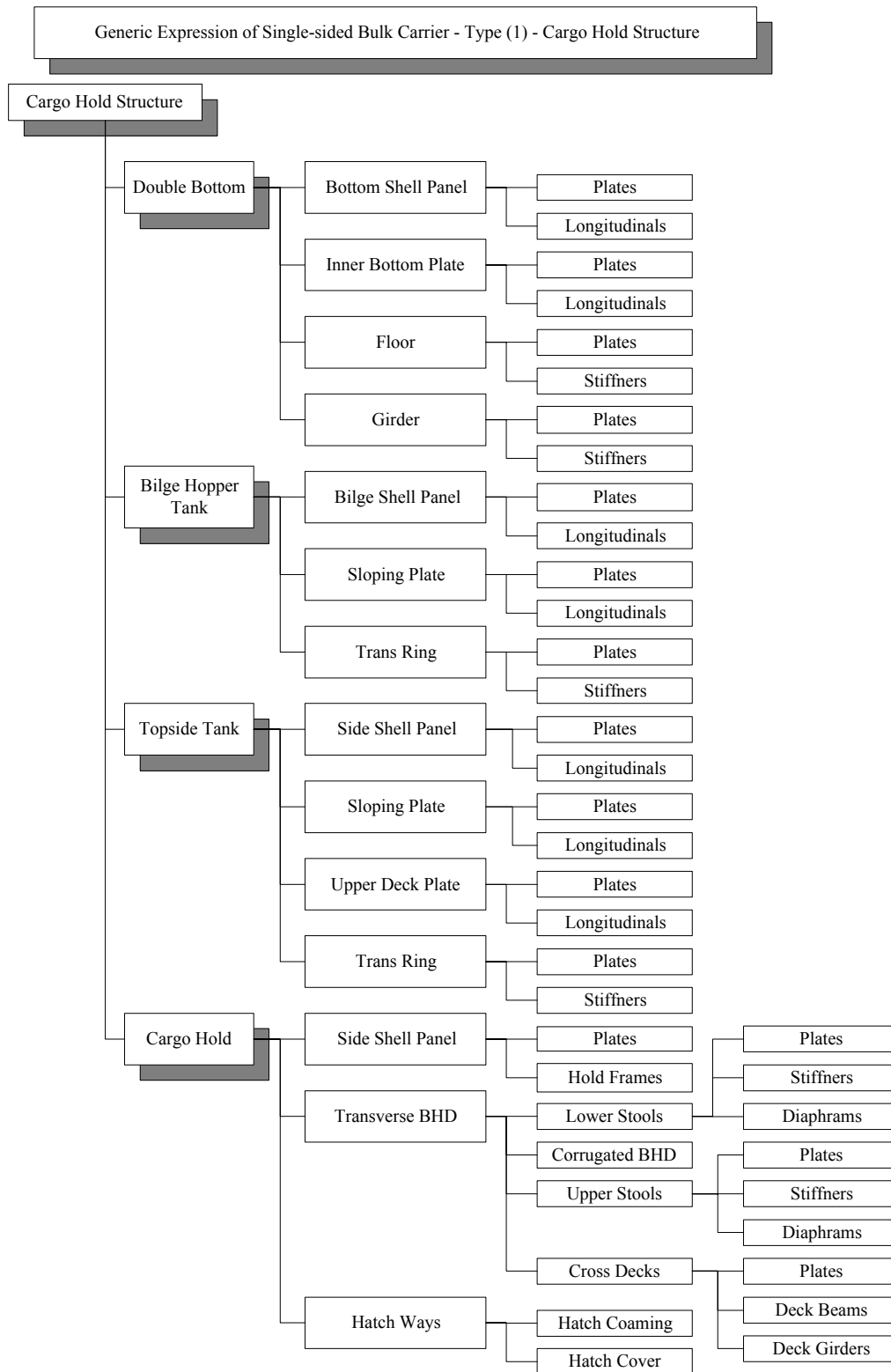


Figure C.2.2 Generic Expression of Single-sided Bulk Carrier - Type (1) - Cargo Hold Structure

| | | | | | | | | | | | | |
|--------------------|--------------------|-------------------------------|---|--|------------------|--|--|--|--|--|--|--|
| | | -hatch ways | -hatch coamings -hatch covers (side rolling, folding) | | | | | | | | | |
| | -other spaces | | -sounding pipes -air pipes/ventilators | | | | -intra-ship comm. equip | -(mooring winch) -bollards/ bits/chocks | | -a fire main line -an emergency generator | | -deck store(s) |
| Fore End Part | -fore peak tank(s) | -ballast tank(s) | -pipings/valves -level gauges | | | | | | | | | |
| | -bos'n store | -stores/lockers | | | | | -intra-ship comm. equip | | | | | |
| | -chain lockers | | -chain pipes | | | | | | | | | |
| | -other spaces | -mooring space (on deck) | | | | | | -windlasses -anchors/chains -mooring winches -bollards/ bits/chocks | | | | |
| | | -others | | | -(side thruster) | | -navigation light | | | | | |
| Accommodation Part | -private space | -private cabin | | | | | -intra-ship comm. equip | | | -living equipment | | -life jackets |
| | -public space | -dining room -meeting room | | | | | | | | -furniture | | |
| | -offices | -wheel house | | | | -navigation console -radar(s)/auto pilot -other navigation equip | | | | -furniture | | -EPIRB -life jackets |
| | | -radio office | | | | | -radio equipment -tele-comm. equip -intra-ship comm. Equip | | | | | |
| | | -ship's office | -ballast control panel -loading computer | | | | -intra-ship comm. equip | | | -furniture | | -life jackets |
| | -other spaces | -galley | | | | | | | | -cooking equipment | | |
| | | -machine rooms | | | | | | | | -air conditioning plant -mechanical vent. plant -refrigerating plant | | |
| | | -stores/lockers | | | | | | | | -food refrigerator -food locker | | |
| | | -others | | | | | -navigation light | | | -lift(s) -stair ways -laundry equipment | | -life boats/life rafts -accommodation ladders -fire extinguishers -fire detectors |

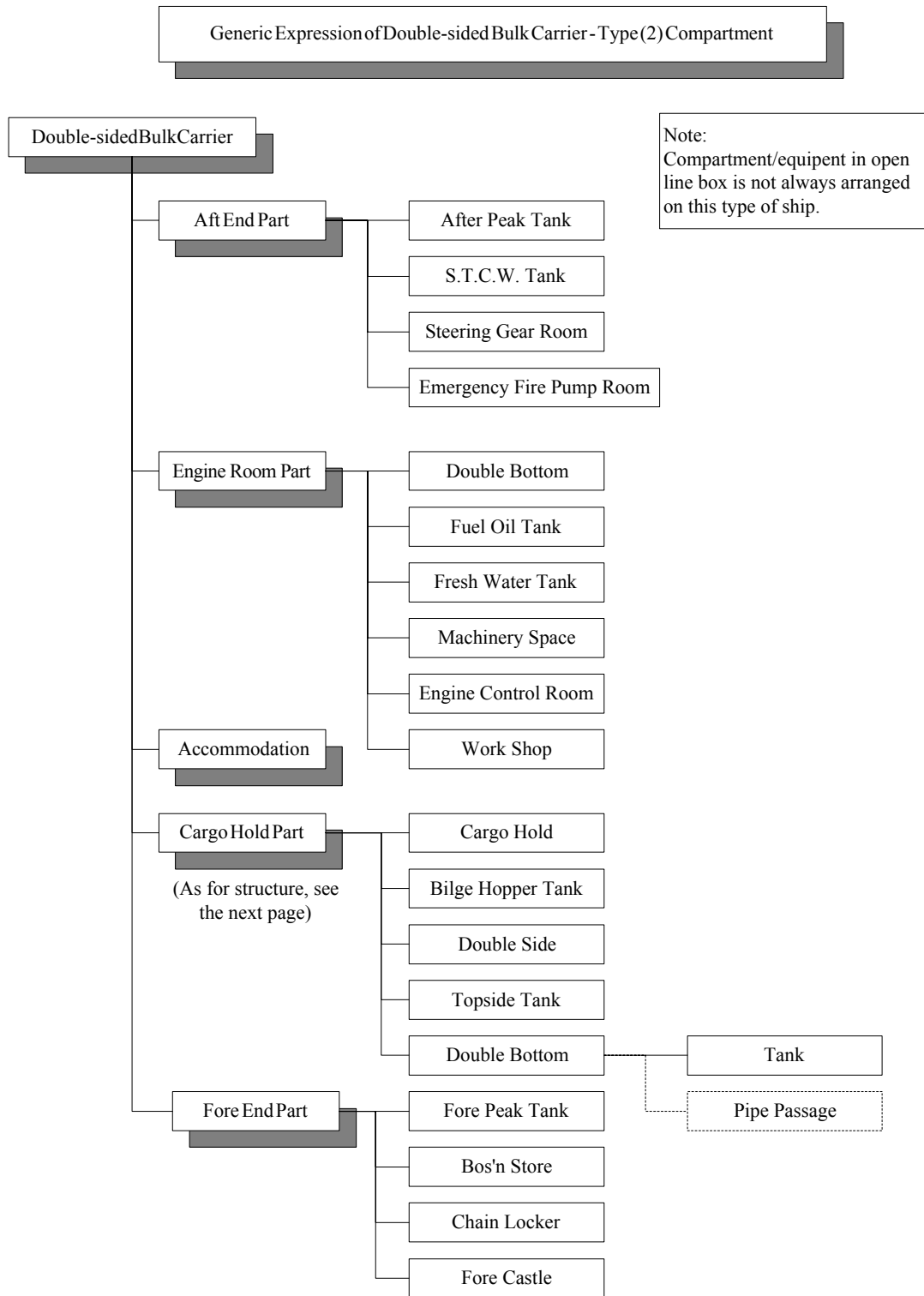


Figure C.2.3 Generic Expression of Double-sided Bulk Carrier - Type (2) - Compartment

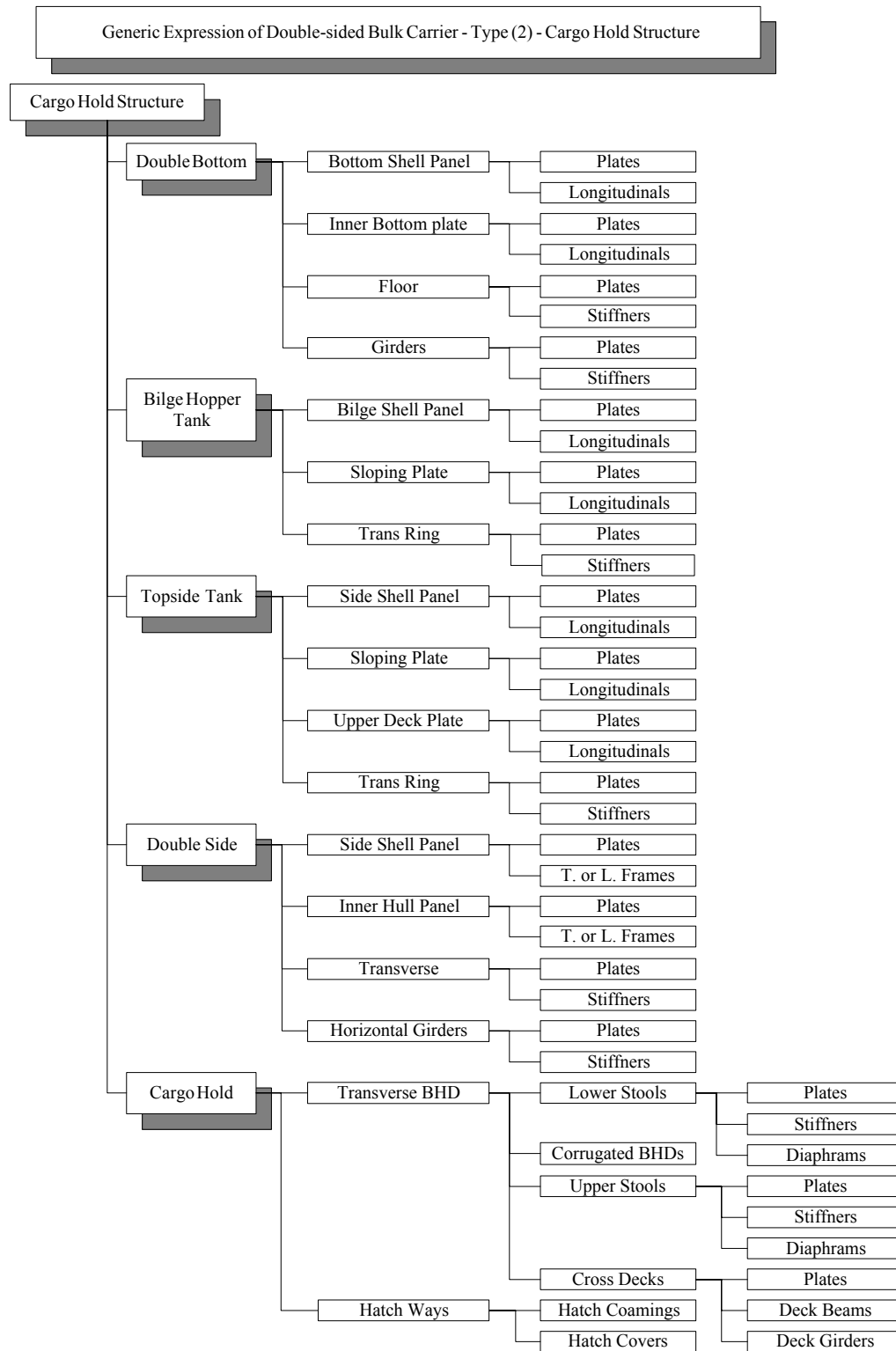


Figure C.2.4 Generic Expression of Double-sided Bulk Carrier - Type (2) - Cargo Hold Structure

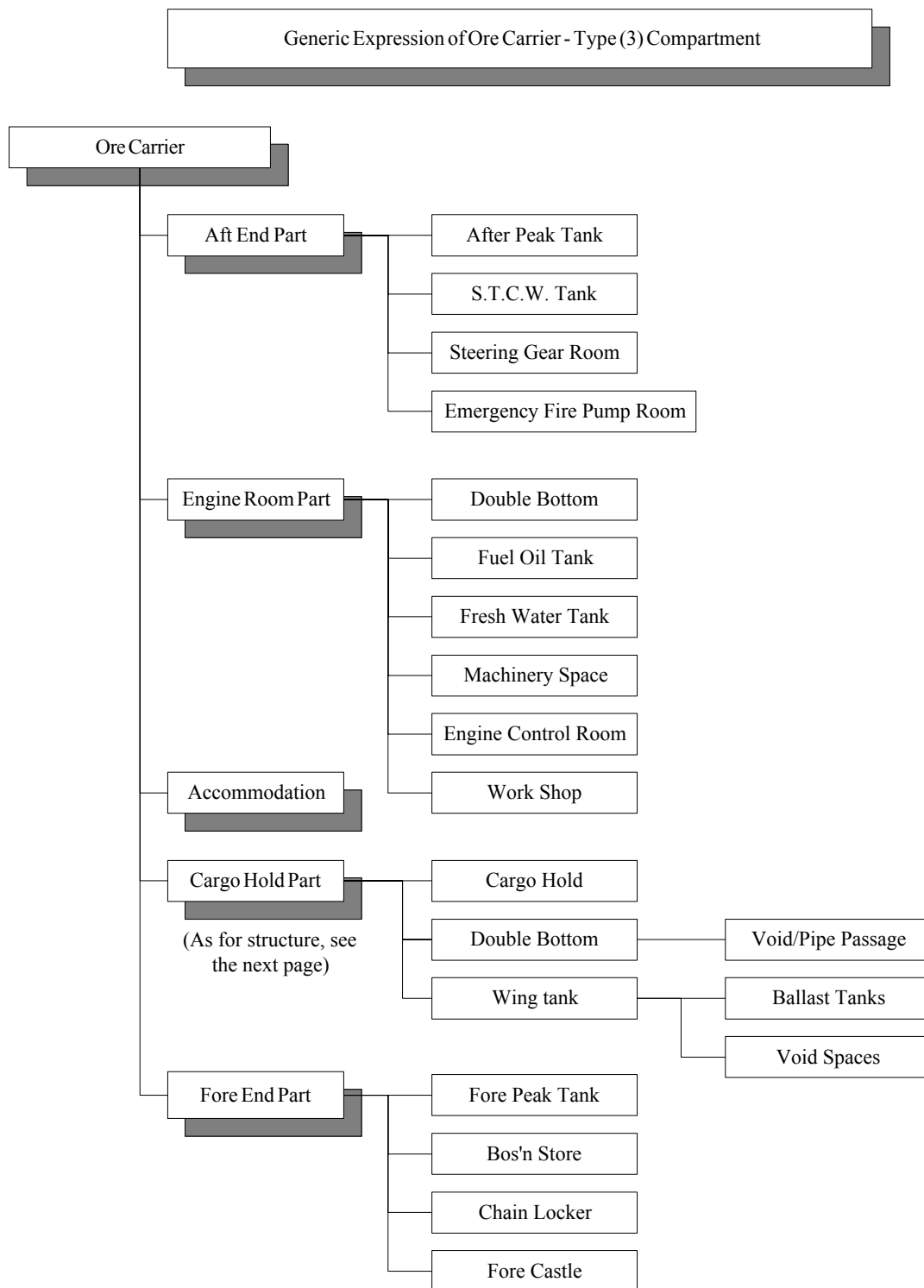


Figure C.2.5 Generic Expression of Ore Carrier - Type (3) - Compartment

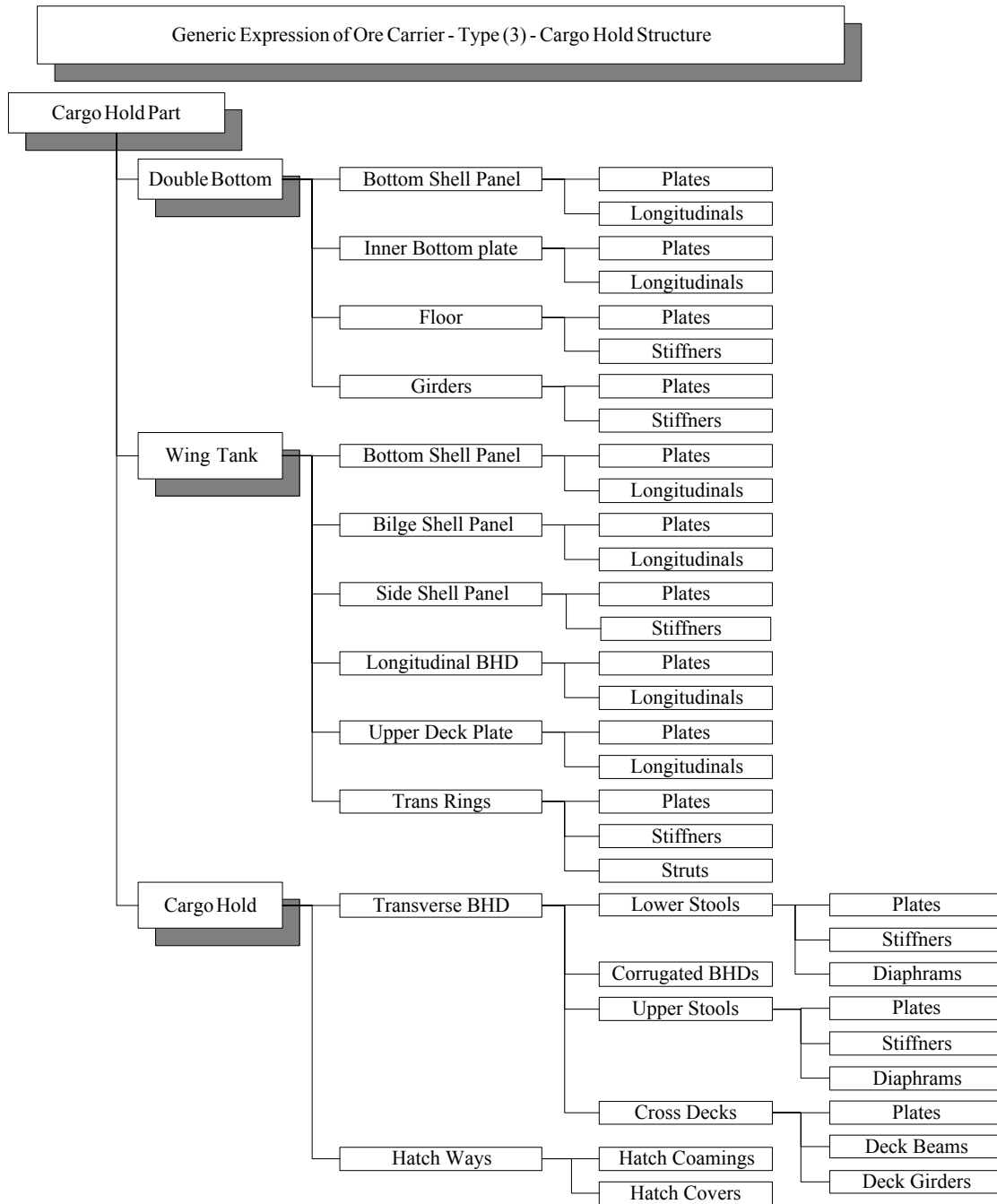


Figure C.2.6 Generic Expression of Ore Carrier - Type (3) - Cargo Hold Structure

APPENDIX D SOLID BULK CARGO

Table D.1 Cargo Density and Carriage by bulk carriers

| Cargo | Density (kg/m ³) | Ship type (as indicated in APPENDIX B) and Carriage of bulk cargo | | | | | | | | | |
|--------------------------|---------------------------------|---|-----|-----|-----|-----|-----|------|-----|-----|-----|
| | | (1) | (2) | (3) | (4) | (5) | (6) | (6') | (7) | (8) | (9) |
| Bauxite | 1190-1390 | Y | Y | | Y | Y | Y | U | Y | | Y |
| Coal | 650-1270 | Y | Y | | Y | Y | Y | U | Y | | Y |
| Copper concentrate | 1750-3030 | Y | Y | U | U | Y | Y | U | Y | | Y |
| Zinc concentrate | 1990-2390 | Y | Y | U | U | Y | Y | U | Y | | Y |
| lead concentrate | 1990-2990 | Y | Y | U | U | Y | Y | U | Y | | Y |
| Iron ore | 1250-3450 | Y | Y | Y | Y | Y | Y | U | Y | | Y |
| Iron pellet | 1890-4170 | Y | Y | Y | U | Y | Y | U | Y | | Y |
| Cold rolled steel hoop | 2990 | Y | Y | | Y | Y | Y | Y | Y | | Y |
| Black spring steel wire | 1710 | Y | Y | | Y | Y | Y | Y | Y | | Y |
| Black steel sheet | 3590 | Y | Y | | Y | Y | Y | Y | Y | | Y |
| Lead ore | 1490-4170 | Y | Y | | U | Y | Y | U | Y | | Y |
| Limestone | 1190-1490 | Y | Y | | Y | Y | Y | U | Y | | Y |
| Maize(Corn) | 620-800 | Y | Y | | Y | Y | Y | U | Y | | Y |
| Nickel ore | 1090 | Y | Y | | U | Y | Y | U | Y | | Y |
| Salt | 890-1230 | Y | Y | | U | Y | Y | U | Y | | Y |
| Sand | 1020-2000 | Y | Y | | U | Y | Y | U | Y | | Y |
| Phosphate rock | 1120 | Y | Y | | Y | Y | Y | U | Y | | Y |
| Petroleum cokes | 600-800 | Y | Y | | Y | Y | Y | U | Y | | Y |
| Soya bean | 780-820 | Y | Y | | Y | Y | Y | U | Y | | Y |
| Cement | 1000-1490 | Y | U | | U | U | U | U | U | Y | U |
| Rice | 720-760 | Y | Y | | Y | Y | Y | U | Y | | Y |
| Wheat | 730-760 | Y | Y | | Y | Y | Y | U | Y | | Y |
| Phosphate rock calcined | 790-1560 | Y | Y | | Y | Y | Y | | Y | | Y |
| Phosphate rock uncalined | 1430 | Y | Y | | Y | Y | Y | | Y | | Y |

U: Cargo can be carried by the type of bulk carrier, but actual practice of carriage is unknown.

Y: Cargo is actually carried by the type of bulk carrier

Reference:

International Maritime Dangerous Goods Code (IMDG Code)

Stowage Factor Table and Practical Cargo Handling, Kaibundo Publishing Co., Ltd.

APPENDIX D

Table D.2 Actual carriage of bulk cargo by each size of ship

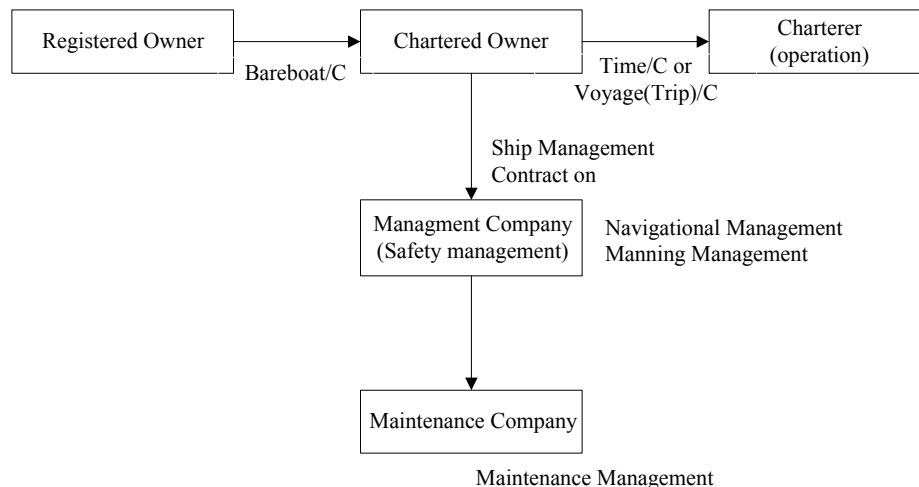
| | ship size | cape size | panamax | handy max | handy | general |
|---------------------------|-----------------------------|-----------|---------|-----------|-------|---------|
| Cargo | Density(kg/m ³) | | | | | |
| Bauxite | 1190-1390 | N | M | M | M | N |
| Coal | 650-1270 | H | H | H | M | L |
| Copper concentrate | 1750-3030 | L | L | L | L | N |
| Zinc concentrate | 1990-2390 | L | L | L | L | N |
| lead concentrate | 1990-2990 | L | L | L | L | N |
| Iron ore | 1250-3450 | H | H | H | M | L |
| Iron pellet | 1890-4170 | M | M | M | L | N |
| Cold rolled steel hoop | 2990 | N | N | N | H | H |
| Black spring steel wire | 1710 | N | N | N | H | H |
| Black steel sheet | 3590 | N | N | N | H | H |
| Lead ore | 1490-4170 | L | L | L | L | N |
| Limestone | 1190-1490 | N | N | L | L | L |
| Maize(Corn) | 620-800 | N | M | M | M | L |
| Nickel ore | 1090 | N | L | | M | N |
| Salt | 890-1230 | N | L | L | L | L |
| Sand | 1020-2000 | N | L | L | L | N |
| Phosphate rock | 1120 | N | N | L | L | N |
| Petroleum cokes | 600-800 | N | N | L | L | L |
| Soya bean | 780-820 | N | M | M | M | L |
| Cement | 1000-1490 | N | L | L | L | N |
| Rice | 720-760 | N | M | M | M | L |
| Wheat | 730-760 | N | M | M | M | L |
| Phosphate rock calcined | 790-1560 | N | N | L | L | N |
| Phosphate rock uncalcined | 1430 | N | N | L | L | N |

Frequency of carriage: H: high frequency, M: Medium frequency, L: Low frequency, N: No case

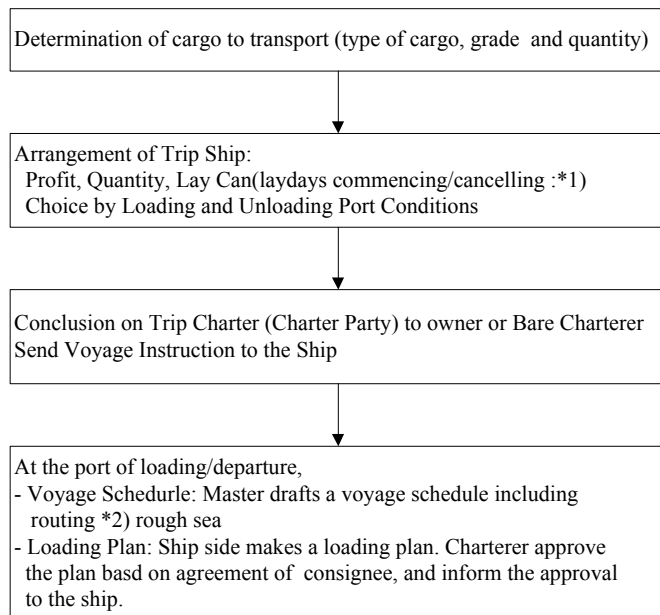
APPENDIX E

TYPICAL VOYAGE PATTERN OF BULK CARRIERS

E.1 Typical Chartering System



E.2 Typical Chartering and Voyage Pattern in Route between Japan and North America



NOTE *1)

Laydays commencing/cancelling:: Commencing and terminating date of anchoring at the port concerned. Ship must arrive at the port in these days.

NOTE *2)

Rough sea management:

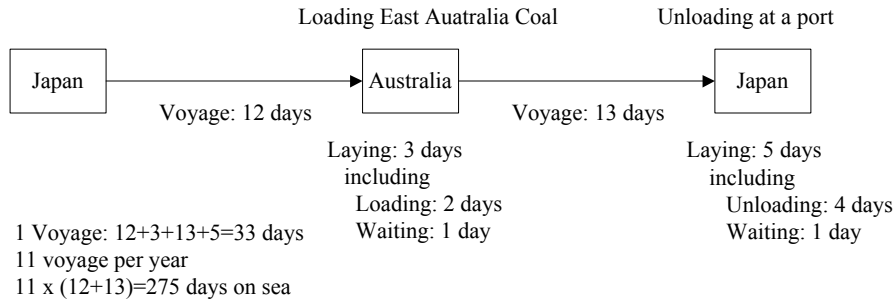
In case of large increase of voyage distance due to avoid rough sea in north Atlantic route (Aleutian route) or Atlantic south route (around 35N parallel sailing), the charterer and the ship (or management company) negotiate and decide the route to be taken. If necessary, arrangement of Ocean Routing may be made by the ship management company or charterer. Nevertheless, the master of the ship should make every effort to keep the voyage safe, considering Ocean Routing and weather at the sea.

Loading Plan:

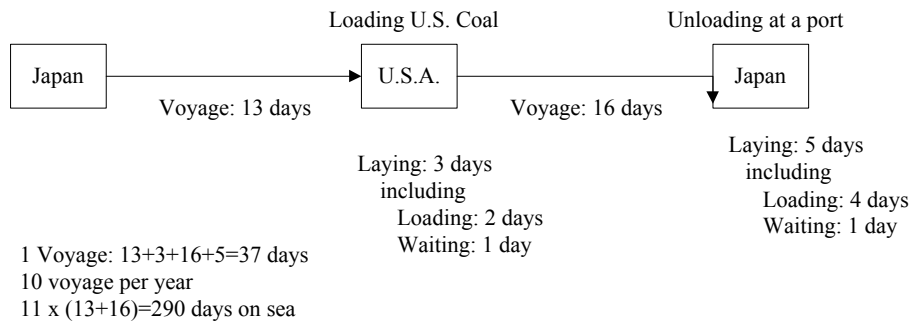
The ship makes a loading plan and informs it to the charterer. The charterer approves the plan based on the agreement with the consignee.

E.3 Annual Voyage Days and Number of Voyages

(1) Japan-Australia Trade



(2) Japan-U.S.A.-Japan Trade



E.4 Escape routing from Typhoon

(1) Ballast Condition

Ballast condition of large bulk carriers is normal ballast condition or heavy ballast condition. Master decides to take one of these conditions based on the expected weather condition on the voyage. However, it is impossible to change ballast condition on the way due to sloshing. Then, the ballast condition on the voyage from Japan is usually heavy ballast condition.

(2) Support from shore (managing company)

Weather forecasting service by FAX is widely available on board. Forecast of wind speed, wave height and direction of wave is also available, and managing company, when a typhoon is expected, sends such information to its ship by FAX to support the navigation of the ship. During weekend and holiday, when a typhoon is expected, managing company takes watch and keeps sending such information to the ship.

(3) Actual escaping from typhoon

The master decides actual route to avoid typhoon based on the information of weather forecast obtained on board directly, weather information sent from the managing company and actual weather condition around the ship. An example of escaping routes is to turn to back of the typhoon and drift until the typhoon passes by. Minimum safety distance from ordinal typhoon may be 200 or 300 miles.