4.2.1 Natural Conditions with respect to Occurrence of Marine Accidents

(1) Geography

Along coasts of the archipelago, there exist many coral reefs in the shallow waters, tremendous efforts need to be maintained in order to ensure the safety of navigation. Also in such areas as Surabaya, Belawan, Palembang and Banjarmasin etc., it is required to make entry into harbours, and it often takes much effort in identifying the entrance or the bar into these channels.

(2) Climate

The climate in Indonesia is influenced by monsoon, the prevailing pattern of which differs depending on the location whether it is north or south of the equator or whether it is closer to the Asian Continent or to Australian continent. During months from November to December and from February to March, the western monsoon will carry wet air through Indian Ocean and bring rain onto South Sumatera, Jawa and small Sunda Islands. During months of June and from August to September, the southeastern monsoon will carry dry air from Australian continent and bring dry season to the south of the equator. This southeastern monsoon changes to wet southwestern wind when it crosses over the equator and brings rain to North Sumatera, central and north Kalimantan and north Sulawesi. Therefore, in these areas there hardly exists dry season except that the volume of rainfall decreases slightly in July to August.

In rainy season it rains in violent shower associated with thunder but it seldom lasts long. Therefore, the rainy season in Indonesia does not seem to have large impact on the occurrence of marine accidents to be caused by poor visibility.

(3) Wind

The greater part of Indonesia is situated within the windless zone of the equator, where low pressure associated with a line of discontinuity does not develop, and the passing of tropical low pressure is also very seldom (see Notes below), so that it is very seldom that wind blows at the Beaufort scale 8 (17.2 - 20.7 m/s) and the rate of wind to below at the Beaufort scale 7 (13.9 - 17.2 m/s) is 1% or less throughout the country.

Notes: In april 1920, the tropical low pressure developed in 5°S and 127°E (off southwest of Ambon harbour), advanced in southwestern direction and passed through the island of Flores.

In seems to be generally considered by crew of the motorized sailing and sailing ships, as the mainstay of the traditional shipping, that the maximum windspeed expected within their navigation ranges is 27 knots (approx. 14 m/s). There obviously exist latent dangers in occurrence of 'flooding' and 'sunk' accidents due to the gust caused by violent shower during rainy season.

(4) Wave

The wave height prevailing in Jawa Sea, Banda Sea and the Strait of Malacca where are surrounded by large islands is lower than the average in Sulawesi Sea, and the swell is also considered to be smaller in those sea areas. Therefore, they are considered to be under the favorable conditions from the viewpoint of occurrence of marine accidents. However, since the afore-mentioned motorized sailing and sailing ships normally have free-board height of only about 20 cm, there is a risk of encountering 'flooding' and 'sunk' accidents when wave height develops due to the gust associated with strong shower during rainy season.

(5) Ocean Current and Tidal Current

When ocean current is considered by taking Jawa Sea for example, the current is waited by the wind flowing wastward during southeastern monsoon and eastward during northwestern monsoon with its maximum speed at approx. 0.6 knots. The maximum flowing speed of ocean current in Indonesian waters as a whole is approx. 0.8 knots. The tidal current is weak over the ocean and it may be ignored when compared with the above ocean current. With respect to the tidal current in shallow sea areas, the inequality of daily tide is seen in the western part of Jaws Sea and the eastern coast of Sumatera. As stated above, the ocean and tidal current in oceans is slow and will not cause remarkable impact on occurrence of accident. Among the narrow channels, Lombok has the fastest current reaching as fast as 8 knots during southeastern monsoon with its flowing direction to south to southwest. The strongest tidal current in the opposite direction occurs during the period of northwestern monsoon with its maximum speed reaching 4 to 5 knots. The next fastest area is the Bali Strait reaching as fast as 7 knots. In other narrow channels, the tidal current reaches 3 knots in Singapore St., 2.3 knots in Bangka St. and 0.8 knots in Sunda St. The tital current in narrow channels may cause difficulties in navigation.

4.2.2 Analysis of Marine Accidents

(1) Analysis on Marine Accidents by Kind

The analysis is made on marine accidents by kind classifying the area distribution, category and size of ship and month of occurrence.

(i) Maritime Traffic Accidents

The maritime traffic accidents are those of collisions and strandings which occur in relation to maritime traffic. Collisions may be classified into the single collision, which is referred to collision with such structures as wharf, bridges and other fixed objects, and the ship-to-ship collision. The number of collisions in Indonesia during 1982 to 1986 are listed in Table 4-2-1, which shows 61 (23%) of single collisions and 205 (77%) of ship-to-ship collisions. It is widely known that collisions generally occur in traffic dense areas, narrow channels such as straits, waterways, rivers, harbours, etc. and under the conditions of poor visibility such as fog, shower, etc. In addition, strandings are affected by the existence of shoal, reefs and so on. Taking the above into account, the analysis is made in terms of occurrence area of accident and category and size of ship.

a) Collisions and Strandings by Area

The collisions and strandings occurred during the five years of 1982 to 1986 are plotted as shown in APPENDIX-IV/4. The main collisions areas are: mid-Jawa Sea, along the coasts of Western Jawa and Sunda St. and the ports and their vicinity waters of Semarang, Cilacap, Surabaya, Samarinda, Banjarmasin, Ujung Pandang, Palembang and Pankalang Sesu in Malacca St. The main strandings areas are: Kalimunjawa islands, Bawean Islands, north coast of Jawa, Cilacap, Bali, Ujung Pandang, east coast of Kalimantan, Bangka St., and Singapore St. As seen above, the main collision areas are generally overlapped with the stranding areas. The accidents in those water areas may be attributed to the busy traffic routes run through for both ocean going and domestic shipping, a number of fishing vessels operating, narrow and bent channels, shoals and reefs, insufficient availability of navigation aids, and so on.

b) Collisions and strandings by category and size of ship

The collisions and strandings by category and size of ship are analyzed as shown in Table 4-2-2 and Table 4-2-3. The collisions by category of ship gives cargo ships the highest occurrences of 74 (27.8%), followed by motor ships at 71 (26.7%). The by-size analysis gives that the occurrence of collisions is averaged over the various sizes of 10,000 G/T and downwards. The by-category and by-size analysis on collisions indicates that the cargo ships of 1,000 - 3,000 G/T rank highest at 17 (6.4%), followed by the motor ships of 1,000 - 3,000 G/T at 16 (6.0%), and then by the cargo ships of 3,000 - 10,000 G/T at 15 (5.6%). As regards strandings, the ships of 100 - 300 G/T rank highest at 75 (33.2%) followed by those of 30 - 100 G/T and 1,000 - 3,000 G/T in such order.

The by-category and by-size analysis on strandings gives the motorized sailing of 100 - 300 G/T the highest figure of 33 (14.6%), followed by the motor ships of the same size. The specific features of collisions and strandings are that comparatively large ships of 1,000 - 10,000 G/T occupy a considerable part, and accordingly it may be assumed that the occurrence rate of medium to large sized ships will be very high taking into account the existing number.

c) Collisions and strandings by month

The collisions and strandings by month are analyzed as shown in APPENDIX-IV/5, which indicates that collisions and strandings seem not to be largely affected by the season in Indonesia due to the natural conditions having no significant climatic changes throughout a year.

(ii) Flooding and Sunk

The general classification of marine accidents may not specify 'sunk' because it happens as a result of any occurrences. The DGSC log book defines the 'sunk' in the three kinds of (a) Flooded sunk (b) Bad weather sunk (c) Sunk. The total number of 'sunk' occurred from 1982 to 1986 counted 492, out of which the high number of 92 are in 1982 due to bad weather. It may be assumed from this that the abnormality might have happended in weather in 1982. Fig. 4-2-1 indicates the 'sunk' by year. 'Flooding' may be attributable to such causes as bad weather, improper cargo loading, consequence of collisions and strandings and so on, and it may be assumed as previously stated that in majority of the cases 'sunk' occurs as the results of 'flooding' and 'capsized' caused by bad weather and collisions, and fires on board. Taking into account the above, the analysis is made on the locations and month of occurrence, and category and size of ship.

a) Flooding and sunk by area

The 'flooding' accidents occurred mostly in the mid-Jawa Sea, followed by south-western cost of Sulawesi. 'Sunk' occurred in the central part of Jawa Sea, east coast of Sumatera and north of Bangka Is. As described above, the area distribution of both 'flooding' and 'sunk' is in a similar pattern except the east coast of Sumatera where abnormally high figure of 'sunk' is recorded, and accordingly it may be assumed that there exists a strong connection between them.

The last five years occurrences of 'flooding' and 'sunk' are shown in APPENDIX-IV/4.

Table 4-2-1 Number of Collisions by Category of Ship (1982-86)

Type / Kind	Cargo	Tanker	Passenger Ship	Tug Boat	Barge	Fishing Vessel	Pleasure Boat	Motor Ship	Motorized Sailing Ship	Sailing Ship	Unknown, Others	Total
Collision against Structure	54	16	2	25	4	16	2	57	18		11	205
Collision against Other Ship	20	6	3	3	1	3	2	14	3		6	61
Total	74	22	5	28	5	19	4	71	21		17	226

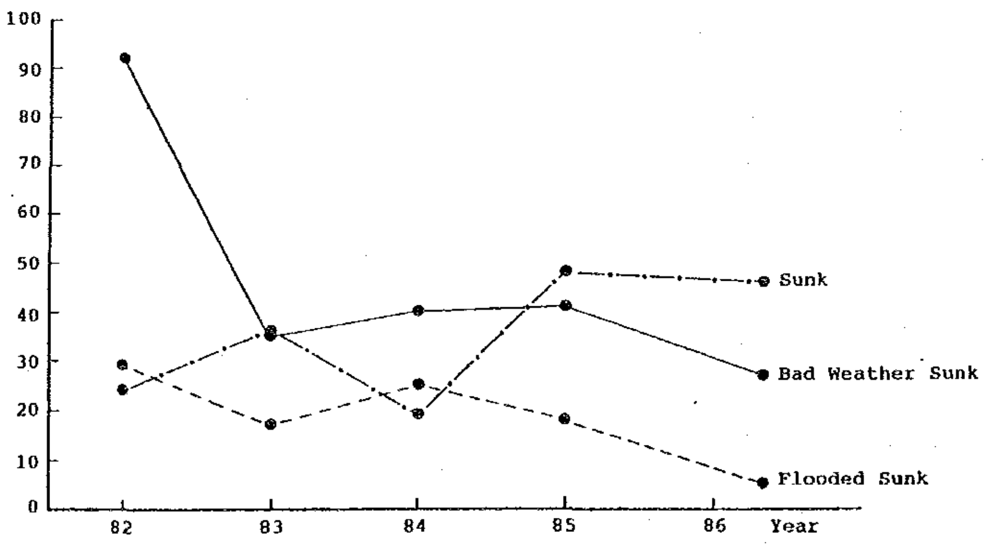


Fig. 4-2-1 Marine Accidents by "Sunk" (1982-86)

Table 4-2-2 Number of Collision Accidents by Size and Category of Ship (1982–86)

Tonnage / Kind	0 ~ 30	30~100	100~300	300~500	500~1000	1000~3000	3000~10000	10000~20000	20000~	Unknown, Others	Total
Cargo	5	4	11	7	13	17	15	1		1	74
Tanker		1		2	6	7	4	2			22
Passenger Ship		1	1		1	1		1			5
Tug Boat	4	13	9		1			1			28
Barge		1	1	1		1	1				5
Fishing Vessel	11	4	1			1				2	19
Pleasure Boat	4										4
Motor Ship	12	6	13	6	10	16	7		1		71
Motorized Sailing Ship	2	7	11							1	21
Sailing Ship											
Others, Unkown	3	2	1	1	3	4	1			2	17
Total	41	39	48	17	34	47	28	5	1	6	266

Table 4-2-3 Number of Stranding Accidents by Size and Category of Ship (1982~86)

Tonnage / Kind	0 - 30	30~100	100~300	300~500	500~1000	1000~3000	3000~10000	10000~20000	20000~	Unknown, Others	Total
Cargo	1	7	13	3	6	12	7				49
Tanker			1	2	4	5	1	2			15
Passenger Ship		1		1		1					3
Tug Boat	2	4	4								10
Barge		1	2	1	1					1	6
Fishing Vessel	9	2	3			1					15
Pleasure Boat											
Motor Ship	6	4	16	9	6	10	6	3			60
Motorized Sailing Ship	6	11	33							1	51
Sailing Ship			1								1
Unknown, Others	3	3	2		4	2	1			1	16
Total	27	33	75	16	21	31	15	5		3	226

b) Flooding and sunk by category and size of ship

The ships of 100 - 300 G/T stands highest in 'Flooding' by size of ships at 63 (48.8%), followed by those of 30 - 100 G/T at 28 (21.7%), and then by those of 30 G/T and downwards at 16 (12.4%). The by-category and by-size analysis shows that the motorized sailing ships of 100 - 300 G/T stands highest at 38 (29.5%), followed by those of 30 - 100 G/T at 16 (12.4%), and then by the motor ships of 100 - 300 G/T at 12 (9.3%). The last five years occurrences of 'flooding' and 'sunk' classified by category and size of ship are given in Tables 4-2-4 and 4-2-5. As regard 'sunk', the ships of 100 - 300 G/T stand highest at 234 (47.6%) followed by those of 30 - 100 G/T at 155 (31.5%), and then by those of 30 G/T and downwards at 77 (15.7%), totalling in all 95% of the whole 'sunk' accidents. The by-category and by-size analysis gives that the motorized sailing ships of 100 - 300 G/T stands highest at 148 (30.1%), followed by those of 30 - 100 G/T at 99 (20.1%), and then by the motor ships of 100 - 300 G/T at 42 (8.5%) in such order. The analysis by the category and size for both 'flooding' and 'sunk' apparently indicates that both cases are on a similar trend in occurrence; the smaller the size is the more 'sunk' increases.

The 'flooding' and 'sunk' accidents occurred during the last five years are given in APPENDIX-IV-7.

c) Flooding and sunk by month

Indonesian geography of windless zone in the equator provides the tranquil climate throughout the year. However, the monthly analysis on 'flooding' and 'sunk' proves that they frequently occur during monsoon seasons; June to August during southeast monsoon and January to March during northwest monsoon. Taking into account this prevailing weather factor and the fact that the motorized ships of average gross tonnage of about 30 tons operate with the freeboard of only about 20 cm, the impact of weather and sea conditions over the 'flooding' and 'sunk' is assumed to be considerable.

The 'flooding' and 'sunk' by month occurred during the last five years are detailed in APPENDIX-IV/5.

(iii) Engine, Propeller and Rudder Troubles

The troubles in engine, propeller and rudder endanger the normal navigation of ships, and situations latently exist where such troubles may be easily created as the maintenance of on board equipment in poorly carried out or ships are aged. In consideration of the above, the analysis is made on the occurrence areas and month, and category and type of ship.

a) Engine, propeller and rudder troubles by area

The accident dense areas where troubles occurred in engine, propeller and rudder are northeast and east coasts of Sumatera, around Bangka Is., north coasts of Jawa, mid-Jawa Sea, east coast of Kalimantan, and the ports of Tg.Priok, Cilacap and Ujung Pandang. The distribution pattern is similar to that of the 'flooding' and 'sunk' mentioned above, and it is thus presumed that possibilities exist to develop into the secondary accidents of 'flooding' and 'sunk'.

The area distribution of troubles occurred in engine, propeller and rudder during the last five years is shown in APPENDIX-IV/4.

Table 4-2-4 Number of Flooding Accidents by Size and Category of Ship (1982-86)

Kind \ Tonnage	0 - 30	30-100	100-300	300-500	500-1000	1000-3000	3000-10000	10000-20000	20000-	Unknown	Total
Cargo		5	8		1	2	2			1	19
Tanker					1		2				3
Passenger Ship		1	1		1						3
Tug Boat		4									4
Barge			2	1							3
Fishing Vessel	6										6
Pleasure Boat					1						1
Motor Ship	7	1	12		2	2	3				27
Motorized Sailing Ship	2	16	38							3	59
Sailing Ship											
Unknown, Others	1	1	2								4
Total	16	28	63	1	6	4	7			4	129

Table 4-2-5 Number of Sunk Accidents by Size and Category of Ship (1982-86)

Kind \ Tonnage	0 - 30	30 - 100	100 -300	300- 500	500-1000	1000-3000	3000-10000	10000-20000	20000-	Unkown, Others	Total
Cargo	4	13	33	2	3		1				56
Tug Boat		1				1					2
Passenger Ship	1	1									2
Tug Boat	2	5	2		1						10
Barge	2	2	1	3	1						9
Fishing Vessel	22	1	3								26
Pleasure Boat	1	1									2
Motor Ship	25	28	42	3		1				4	103
Motorized Sailing Ship	14	99	148	1						3	265
Sailing Ship	1		1								2
Unknown, Others	5	4	4		1	1					15
Total	77	155	234	9	6	3	1			7	492

Table 4-2-6 Number of Trouble Accidents in Engine, Propeller and Rudder by Size and by Category of Ship (1982-86)

Tonnage / Kind	0 - 30	30 - 100	100-300	300-500	500-1000	1000-3000	3000-10000	10000-20000	20000-	Unknown	Total
Cargo	3	3	12	2	11	5	2				38
Tanker	1			2	10	2	1	1			17
Passenger Ship		1	2		1	1		1			6
Tug Boat	3	23	13	2							41
Barge	1										1
Fishing Vessel	6	6	1		1					1	15
Pleasure Boat	2									1	3
Motor Ship	8	8	16	5	5	3	3			1	49
Motorized Sailing Ship	1	10	27								38
Sailing Ship											
Unknown, Others	1	4	4	2	3	1					15
Total	26	55	75	13	31	12	6	2		3	223

Table 4-2-7 Number of Human Loss and Injury Accidents by Size and by Category of Ship (1982-86)

Tonnage / Kind	0 - 30	30-100	100-300	300-500	500-1000	1000-3000	3000-10000	10000-20000	20000-	Unknown, Others	Total
Cargo	5	6	7	2	3	9	8				40
Tanker					1		1		1		3
Passenger Ship	1			1			2				4
Tug Boat	1	4	3	1							9
Barge				1		1	1				3
Fishing Vessel	19	25	6								50
Pleasure Boat	1										1
Motor Ship	11	4	12	1	5	3	4	1		1	42
Motorized Sailing Ship	5	12	15							1	33
Sailing Ship		1	1								2
Others, Unknown	5	2	3		1		2	1			14
Total	48	54	47	6	10	13	18	2	1	2	201

b) Engine, propeller and rudder troubles by category and size of ship

There occurred 223 troubles of those during the last five years, and among them the motorized sailing ships of 100 - 300 G/T stand highest in number at 27 (12.1%), followed by the tug boats of 30 - 100 G/T at 23 (10.3%), and then by the motor ship of 100 - 300 G/T at 16 (7.2%). The number of engine, propeller and rudder troubles seemingly tends to be on its decreasing trend, as shown in APPENDIX-IV/5, due to the metalization of old wooden ships and motorized sailing ships. The troubles in engine, propeller and rudder occurred during the period of 1982 to 1986 are listed in Table 4-2-6 with their classification by category and size of ship.

c) Engine, propeller and rudder troubled by month

The occurrences of engine, propeller and rudder troubles are considered not to be related with yearly seasons, and those occurred during the last five years are rather on a similar level except the monsoon period of December to January when the number of occurrences is slightly high.

APPENDIX-IV/5 shows the monthly occurrence of such troubles.

(iv) Other Kinds of Marine Accidents

The analysis is made on other kinds of marine accidents; capsized, fire and drifting except human loss and injury.

a) Capsized, fire and drifting by area

During the last five years, there occurred 41 'capsized' occupying only 2.3% of the total number of accidents, and no specific areas are identified. The fires occurred are in the areas mainly of Belawan port, north coast of Jawa, Surabaya port, Lombok Is., southwest coast of Kalimantan and Makassar St. Fire accidents tend to occur in the port vicinity areas and near coasts. 'Drifting' accidents occurred in the areas of north coast of Bangka Is. through Gaspar St., southeast coast of

Sumatera through Sunda St., north coast of Jawa, mid-Jawa Sea, Lombok St. southwest coast of Sulawesi. As seen above, the area distribution of 'capsized' and 'fire' totally differs from that of other accidents. However, the 'drifting' distribution has a similar trend to 'flooding' and 'sunk', and some correlation among them may be assumed to exist as in case of troubles in engine, propeller and rudder.

The last five years occurrences of 'capsized', 'fire' and 'drifting' by area are shown in APPENDIX-IV/4.

b) Capsized, fire and drifting by category and size of ship

The number of 'capsized' during the last five years amounted to 41, among which the motor ships of 30 G/T and downwards stand highest at 7 (17%), followed by the cargo ships of 30 - 100 G/T and the motor ships of 100 - 300 G/T respectively at 4 (9.8%). The number of 'fire' during the same period counted 101, among which the motorized sailing ships of 100 - 300 G/T are highest at 16 (15.8%), followed by the cargo ships of 100 - 300 G/T at 10 (9.9%), and then by the motorized sailing ships of 30 - 100 G/T at 9 (9.8%) in such order. 'Drifting' numbered 47, among which both the cargo ships and motorized sailing ships of 100 - 300 G/T stand respectively at 7 (15%), followed by the cargo ships of 30 G/T or less at 4 (8.5%).

The last five year occurrences of 'capsized', 'fire' and 'drifting' by category and size of ship are shown in APPENDIX-IV/6.

c) Capsized, fire and drifting by month

'Capsized' occurred most during the height of monsoon season, June and July and the motor ships of 30 G/T and downwards stand highest in number. 'Drifting' occurred in January and June of monsoon season, and the motorized sailing and motor ships of 100 - 300 G/T are most effected. 'Fire' indicates the occurrence tendency in June to August period when dry season of southeast monsoon prevails. As described above, 'capsized' and 'drifting' are seen during the height of monsoon season same as in case of 'flooding' and 'sunk'. 'Fire' is assumed to be affected by season especially during dry season.

The last five years occurrences of 'capsized', 'fire' and 'drifting' are shown in APPENDIX-IV/5.

(v) Human Loss and Injury

The human loss and injury analyzed here refer to those recorded in the DGSC log book as death or injury of persons due to falling overboard, missing or inside-ship accidents. There should be many other cases whereby human loss or injury may be involved due to other marine accidents. However, they are not included in this analysis, but referred to in Section 4.2.2, (4).

a) Human loss and injury by area

The by-area analysis on human loss and injury shows that they frequently occurred in the areas of Belawan port, Singapore St., south coast of Bangka Is., Tg.Priok port, Sunda St., north coast of Jawa, Surabaya port, mid-Jawa Sea and east coast of Kalimantan. The last five years occurrences of human loss and injury are plotted as shown in APPENDIX-IV/4.

b) Human loss and injury by category and size of ship

The total number of human loss and injury occurred during the last five years reached 201, among which the fishing vessels of 30 - 100 G/T stand highest at 25 (12.4%), followed by those of 30 G/T and downwards at 19 (9.5%), then by the motorized sailing ships of 100 - 300 G/T at 15 (7.5%) in such order. The by-size analysis shows that the small ships of 300 G/T or less occupy 74% of the total, reaching at 149 accidents. The specific features of human loss and injury may be said that those of fishing vessels occupy 25% despite that only 8% of the total number of accidents are those involving fishing vessels, and that they are on an increasing trend during the last five years, especially high rise in 1985 to 1986. The last five years occurrences of human loss and injury are detailed in Table 4-2-7, and graphed in APPENDIX-IV/5.

c) Human loss and injury by month

The analysis on human loss and injury by month shows that their frequent occurrences are observed during June of southeast monsoon and November to January of northwest monsoon season.

(2) Analysis on Area Distribution of Marine Accidents

The analysis is made on the marine accidents occurred in the specific port and strait areas and also by classification of category of ship. Fig. 4-2-2 describes the overall picture of the accidents occurred in the major ports.

(i) Marine Accidents in Major Ports

The marine accidents occurred in and around the following six major ports are analyzed. Their occurrences are slightly different in kind from the overall occurrences in Indonesia to show that collisions, strandings and fire accidents in those areas are higher in occurrence tendency than others.

- Belawan
- Palembang
- Tg.Priok
- Surabaya
- Banjarmasin
- Ujung Pandang

a) Belawan port

The total of 18 accidents occurred during the last five years (annual average of 3.8), and 9 of them are due to collisions and strandings. Further analysis shows that 8 out of 9 are ship-to-ship collisions leaving one by stranding. As above, maritime traffic accidents especially ship-to-ship collisions dominate in Belawan. Although the causes of accidents are not identified in the DGSC log book, they may be considered to be attributable to the geographical factors, i.e. river port, long narrow channel where comparatively large ships come in and go out. As regards the category of ship, the total of accidents by cargo ships and motor ships numbered 13 and tankers accidents numbered 2. There are no records of accidents of motorized sailing and fishing vessels.

The average gross tonnage of accident ships is 2,465 tons, while small ships of motorized sailing and fishing vessels were unidentified. This shows that the accidents occurred over fairly large sized ships as compared with the average tonnage of Indonesian ships as a whole.

b) Palembang port

There occurred 12 accidents (annual average of 2.4) during the last five years, out of which 10 are by collisions and strandings. Further analysis shows that among 10 above, 8 are due to collisions; 6 ship-to-ship, 2 with other structures, and 2 are due to strandings.

The causes of accidents and the locations are not identified in the DGSC log book. It may be reasonably assumed that maritime traffic accidents of collisions and strandings dominate in Palembang in view of the fact that the channel reaching the port extends as long as about 53 miles in Musi River having extremely narrow, bent and shallow waters.

To the contrary, it may be considered that the number of accidents occurred in the area has been rather small in the light of the restricted geographical conditions. The average gross tonnage of ship-to-ship accident is 78.2 tons, to which attention could be paid in terms of its small size.

c) Tg.Priok port

During the last five years, 7 accidents occurred (annual average of 1.4), out of which 2 are by maritime traffic accidents, 1 each respectively by ship-to-ship collision and by stranding. The accidents by category of ship show 4 tankers, 1 each of cargo, motor and motorized sailing ships. Though tankers number highest, serious disasters seemingly did not occur since there are no records of damage found. The average gross tonnage of accident ships is 2,965 tons, which indicates that Large size of vessels were involved in accidents as in case of other major ports.

Tg.Priok is the largest port in Indonesia in terms of port facilities, number of ships call and port scale, and from this point of view special remarks should be made to the extremely small number of accidents occurred. While the other major ports are natural ports utilizing river and straits, Tg.Priok is the man-made and well planned fully taking into account the safe and efficient operation.

d) Surabaya port

Among the six major ports, Surabaya has the highest number of accidents. 32 (annual average of 6.4) accidents occurred during the last five years, out of which 16 are by maritime traffic accidents and 8 by fire. Out of the 16, collisions dominantly numbered 13; 11 ship-to-ship and 2 with other structure, and 3 strandings.

As regards the locations, 7 accidents occurred in channel and 7 at anchorages. The collisions by area show that 5 occurred in channel and 5 at anchorages. In Surabaya, there are two channels of west and east. East Channel is very shallow and only small ships like fishing vessels may go through. Therefore, the description of "channel" in the DGSC log book has been interpreted as the West Channel.

With regard to the anchorage, there seem to refer to the one near the entrance to the West Channel and the other near entrance to Tg.Perak. The analysis by category of ship gives that the total of cargo ships and motor ships numbered 21, 2 of tankers, 6 of motorized sailing and sailing ships, 3 of barge and other size of ship. The average gross tonnage of accident ships is 2,690 tons, large similarly to the other ports.

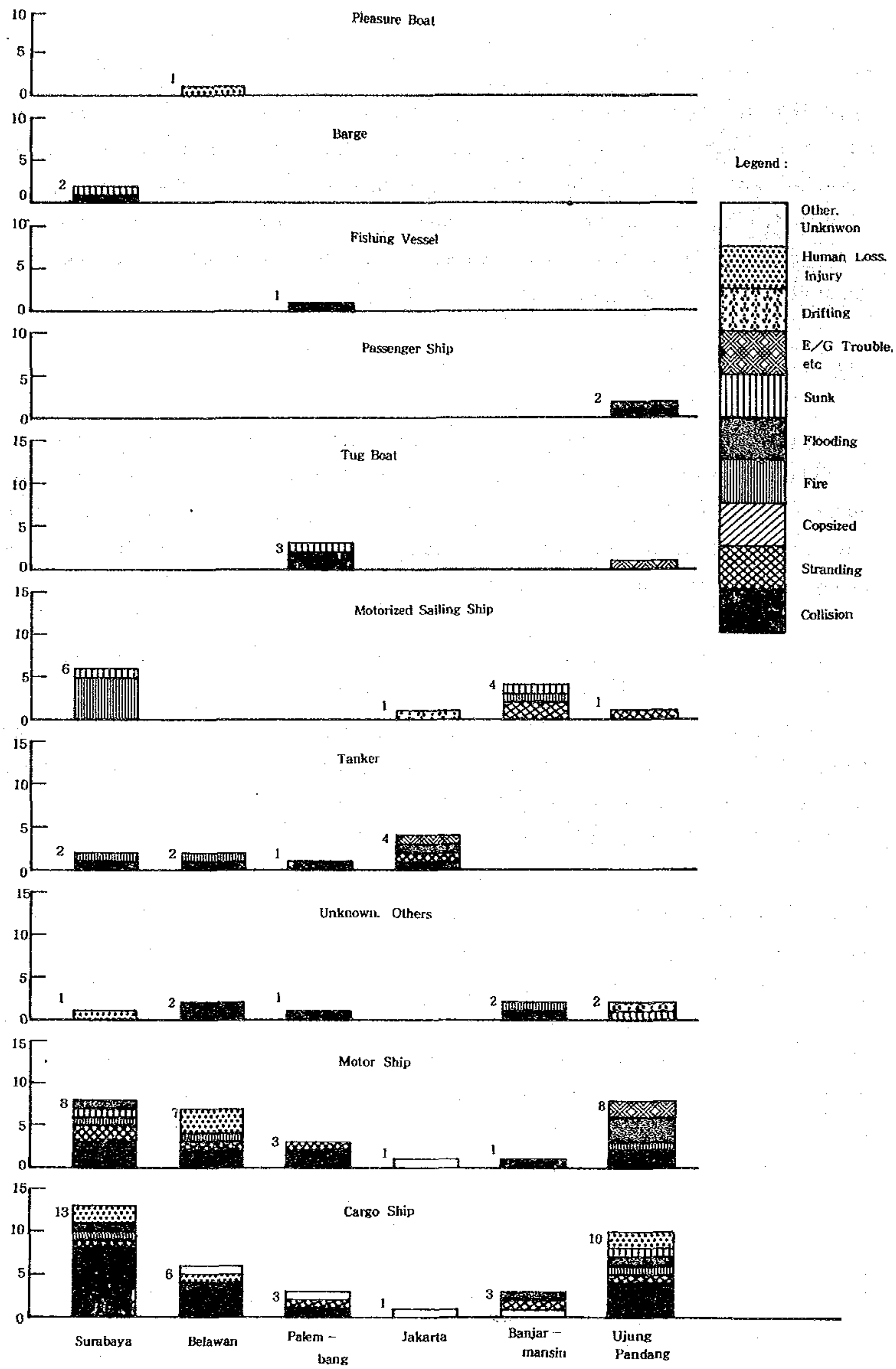


Fig. 4-2-2 Overall Picture of Marine Accidents in Major Ports (1982-86)

e) Banjarmasin

There occurred 10 accidents during the last five years, and 6 of them are by collisions and strandings. Out of the 6 traffic accidents, 3 are by ship-to-ship, 3 other by strandings. The areas of occurrences are near the mouth of Barito River except one strandings. The causes of accidents are not identified in the DGSC log book. It is, however, assumed that the areas near the bar of Barito River is extremely shallow and narrow and in addition there is always alluvial sand floating, and proper maintenance of the channel seems not to be caught up with.

Regarding the accidents by category of ship, cargo and motor ships numbered 4 in total, motorized sailing 4, other ships 2. The average gross tonnage of accident ships is 373 tons, smaller as compared with the other major ports but larger than the overall average in Indonesia.

f) Ujung Pandang

There occurred 24 (annual average of 4.8) accidents during the last five years, and 9 are due to collisions and strandings. Out of the 9, collisions numbered 7; 3 by ship-to-ship collisions and 4 with other structures, and strandings 2. As seen above, it may be said that collision accidents are less in number in reference to the other major ports although the total number ranked second among the six major ports. This may be assumed to be attributable to the facts that there are 3 fairways and the number of ships call to the Port is comparatively small. The locations of accidents are inside the Port except one case. It is assumed that there should be latent maritime traffic accidents in the areas not recorded in the log book since the areas are shallow and extensively covered by reef.

The average gross tonnage of accident ships is 1,326 tons, while that of those involved in only collisions and strandings is 2,473 tons and that involving other kinds averages at 590 tons.

The analysis by category of ship shows that cargo and motor ships number 18 in total, passenger ship 2, motorized sailing 1, tug boat 1, and other ships 2. There is no specific description on the accidents of passenger ships, and it is accordingly presumed that the damages are considered not to be serious.

(ii) Marine Accidents in Main Straits

The analysis is made on the marine accidents occurred in the main straits given below:

- Sunda Strait
- Lombok Strait
- Bangka Strait
- Singapore Strait

The occurrence tendency in the above areas shows a similar pattern to that observed in the whole Indonesian waters.

a) Sunda Strait

The Marine accidents occurred during the last five years in the areas of Sunda St. and off Jakarta are listed in APPENDIX-IV/7. There occurred 77 accidents during the period of 1982 to 1986, out of which 21 (27.3%) are 'sunk' of motorized sailing ships, followed by the motor ships at 7 (9.1%), and then by cargo ships at 5 (6.5%) in such order. The number of 'sunk' accidents occurred more in the areas north of Sunda St. and western coast off Jakarta.

b) Bangka Strait

The marine accidents occurred in the areas of Bangka St. and in its vicinity are listed in APPENDIX-IV/7. The total number of 100 accidents occurred in those areas during the last five years, and 28 (28%) of them are by 'sunk' of motorized sailing, followed by 5 (5%) respectively of 'collision' and 'sunk' of cargo ships and 'flooding' of motorized sailing ships.

c) Lombok Strait

The marine accidents occurred in the areas of Lombok Strait are listed in APPENDIX-IV/7. There occurred 26 accidents in total in the areas during the last five years, and 5 (19.2%) out of them are by 'sunk' of motorized sailing ships, followed by other kinds of strandings, fire and so on. The number of accidents in this area is less as compared with the other strait areas.

d) Singapore Strait

The marine accidents occurred in the areas of Singapore Strait are listed in APPENDIX-IV/7. There occurred 36 accidents in the areas off Batam Is. through to Singapore Strait, and 5 (13.9%) of them are 'stranding' of motor ships, followed by 4 (11.1%) of 'sunk' and then by 3 (8.3%) of 'human loss and injury' of motor ships. The number of accidents by motorized sailing ships in this area of Singapore Strait is extremely low as compared with that of all over Indonesia, and it may be assumed from this that the traffic of motorized sailing ships in the area is small. The waters extending from off Batam Is. to Singapore Strait are the international traffic areas, and there might be duplicated areas to be covered by the two countries depending on the accident locations. There are some serious accidents occurred in the areas confirmed in the Lloyd Register but not recorded in the Indonesian data.

(iii) Marine Accidents by Category of Ship

The area distribution of marine accidents by category of ship is shown in APPENDIX-IV/8. The following describe the accidents classified by category of ship, i.e., cargo ships, tankers, passenger ships, fishing vessels, motor ships and motorized sailing ships.

a) Cargo ships

The total number of 328 accidents occurred over cargo ships, as shown in Fig. 4-2-3, occupying 18.4% of the total occurrences.

a. By kind

'Collision' stands highest at 74 (22.6%) followed by 'sunk' at 56 (17.1%) and then by strandings. The occurrence pattern is similar to that of overall trend in Indonesia except 'sunk'.

b. By area

The high density accident areas are Belawan Port, Bangka St., Surabaya Port, east and south coasts of Kalimantan and Ujung Pandang Port. The areas of 'stranding' occurrences are those around Bangka St., Bangka Is., south coast of Kalimantan and Ujung Pandang port.

b) Tanker

The total number of 67 accidents occurred over tankers, as shown in Fig. 4-2-4, occupying 3.8% of the total occurrences.

a. By kind

'Collision' ranks highest at 22 (32.8%), followed by 'engine troubles', etc. at 17 (25.4%), and then by 'stranding' at 15 (22.4%).

b. By area

The high density accident areas are northwest coasts of Sumatera, Bangker St., Sunda St. through southwest coasts of Jawa, Cilacap port, Surabaya port, east coasts of Kalimantan and mid-Jawa Sea. Especially Cilacap areas are high in the density.

c) Passenger ships

The total number of 23 accidents occurred over fishing vessels, as shown in Fig. 4-2-5, occupying 1.3% of the total occurrences.

a. By kind

'Engine troubles, etc.' rank highest at 6 (26.1%), followed by 'collision' at 5 (21.7%), and then by human loss and injury.

b. By area

The accidents areas are north coast of Sumatera, Kundur Is., Sunda St., Bali St. an Ujung Pandang.

d) Fishing Vessels

The total number of 142 accidents occurred over fishing vessels, as shown in Fig. 4-2-6, occupying 8% of the total occurrences.

a. By kind

'Human loss and injury' rank highest at 50 (35.2%), followed by 'sunk' at 26 (18.3%).

b. By area

The high density areas of human loss and injury are north coasts of Jawa through to mid-Jawa Sea. The 'sunk' accidents are high in Malacca St., sunda St., and mid-Jawa Sea.

As previously referred, the number of accidents by fishing vessels is quite low in Indonesia. The reason for this may be due to the fact that 98.5% of the powered fishing vessels are less than 30 G/T.

On the other hand, out of the total number of 142 accidents by fishing vessels, 84 (59%) are by those of less than 30 G/T and 58 (41%) are by 30 G/T and upwards. It has also been recognized in Indonesia that smaller size of ships have more accidents than large ones regardless of category of ship.

Accordingly, from the statistic point of view, the powered fishing vessels of 30 G/T and upwards, occupying only 1.5% in number of the total registration, had 41% (58 accidents) of the total accidents, and on the other hand those of less than 30 G/T, occupying 98.5% in number of the total registration, had only 51% (84 accidents) of the total. The above view results in a conflicting outcome.

Taking such situations into consideration, although the accidents are to be reported to the relevant Harbour Masters, all the accidents have not necessarily been reported since most ports for the powered fishing vessels of less than 30 G/T are small and very local. In other words, a possibility of occurring unreported accidents largely exists in Indonesian waters.

Table 4-2-8 gives the number of fishing vessels. Marine accidents by non-powered fishing vessels have not been recorded in the DGSC loss book. However, most of them are considered to be a sailing type. It is, accordingly, presumed that there should be latent accidents by those small fishing vessels.

Table 4-2-8 Number of Marine Fishing Vessels (1982-84)

Type \ Year	1982	1983	1984
Non-powered ship	215,466	220,706	219,929
Out board motor	55,265	57,490	61,789
In board motor	29,818	28,861	31,922
Total	300,549	307,057	313,640

Source: Statistical Yearbook '86

e) Motor ships

The total number of 422 accidents occurred over motor ships, as shown in Fig. 4-2-7, occupying 23.7% of the total occurrences.

a. By kind

'Sunk' ranks highest at 103 (24.4%), followed by 'collision' at 71 (16.8%), and then by 'stranding' at 60 (14.2%). The occurrence pattern is similar to that of overall Indonesia.

b. By area

The high density 'sunk' areas are Bangka Is., east coast of Sumatera, mid-Jawa Sea, east and south coast of Kalimantan and Makassar St. The high density 'collision' areas are Belawan port, Bangka St. east coasts of Sumatera, mid-Jawa Sea, Surabaya port. The high density 'stranding' areas are Singapore St., Bangka St., Cilacap port and east coasts of Kalimantan.

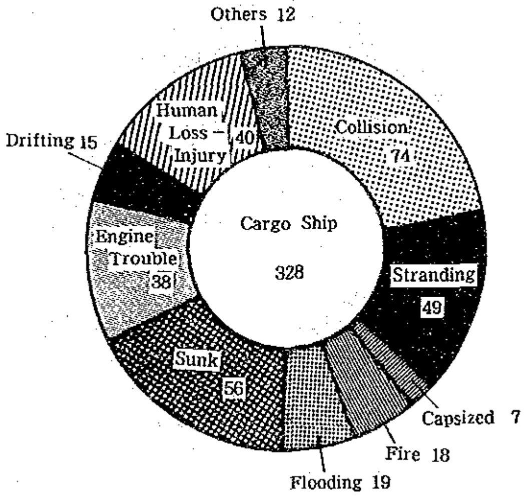


Fig. 4-2-3 Marine Accidents of Cargo Ships by Kind

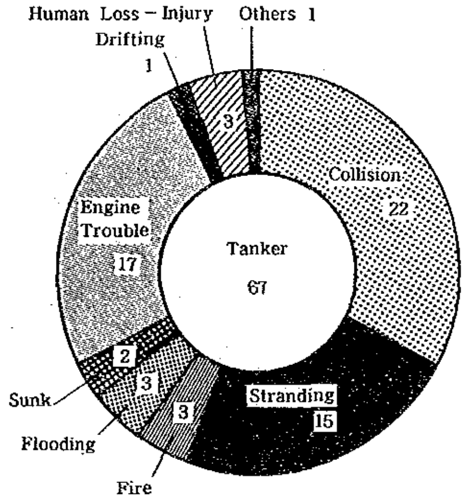


Fig. 4-2-4 Marine Accidents of Tanker by Kind

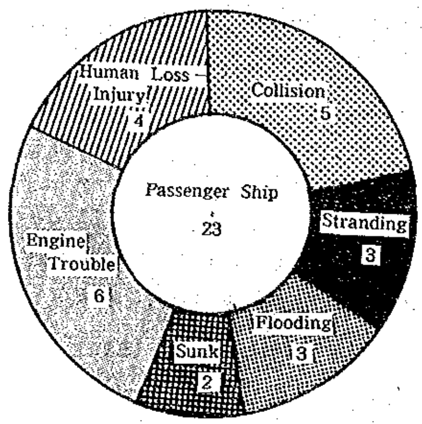


Fig. 4-2-5 Marine Accidents of Passenger Ships by Kind

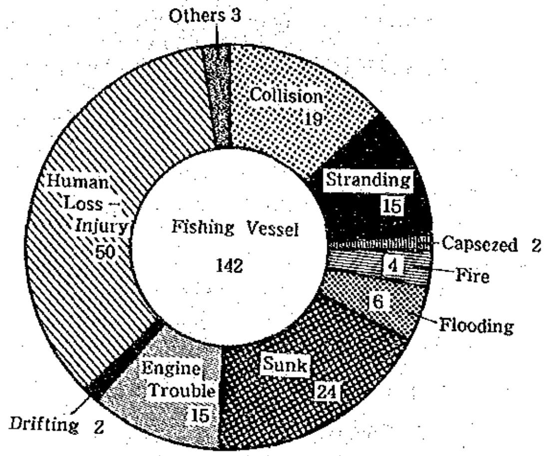


Fig. 4-2-6 Marine Accidents of Fishing Vessels by Kind

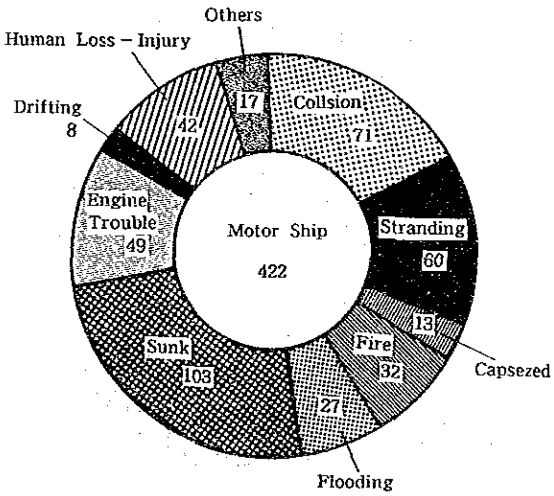


Fig. 4-2-7 Marine Accidents of Motor Ships by Kind

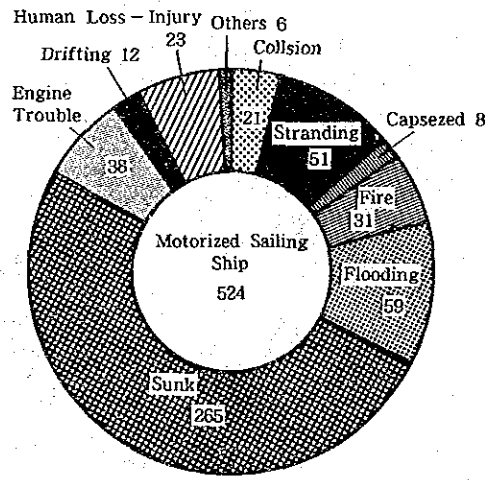


Fig. 4-2-8 Marine Accidents of Motorized Sailing Ships by Kind

f) Motorized sailing ship

The total number of 524 accidents occurred over motorized sailing ships, as shown in Fig. 4-2-8, occupying 29.4% of the total occurrences.

a. By kind

'Sunk' ranks highest at 265 (50.6%), followed by 'flooding' at 59 (11.3%), and then by 'stranding' at 51 (9.7%).

b. By area

The high density 'sunk' areas are Bangka St., Bangka Is. east coast of Sumatera, mid-Jawa Sea and south coasts of Kalimantan. The high density 'flooding' areas are west coasts of Kalimantan, mid-Jawa Sea and east and west parts of Jawa Sea.

(3) Marine Accidents involving Death and Injury

The analysis is made on the death and missing due to collisions, strandings, floodings, sunk and capsized i.e., other than those analyzed in Section 4.2.2 (1), (v). There occurred 231 accidents involving death and missing during the last five years of 1982 to 1986. The total number of dead and missing persons counted 804, out of which 261 (32.5%) are by motor ships, 185 (23%) by cargo ships, and 174 (21.6%) by motorized sailing ships. As regards accidents by kind, 330 persons (41%) dead by 'sunk'. A trend in the occurrences shows that the number of death and missing per accident is increasing.

Table 4-2-9 shows the number of dead and missing persons.

Table 4-2-9 Number of Dead and Missing Persons by Marine Accidents (1982-86)

Year / Kind	1982		1983		1984		1985		1986		Total	
	Number of casualty	Deaths & missing	Number of casualty	Deaths & missing	Number of casualty	Deaths & missing	Number of casualty	Deaths & missing	Number of casualty	Deaths & missing	Number of casualty	Deaths & missing
Collision	1	3	3	3	1	2	6	48	6	8	17	64
Stranding							2	47	1	1	3	48
Capsized			3	5	3	17	5	45	4	75	15	142
Fire	2	6	7	14	1	1	3	8	3	12	16	41
Flooding	2	6	2	14					3	17	7	37
Sunk	6	31	10	80	7	39	10	68	14	112	47	330
Engine Propeller Rudder Troubles							2	11	1	5	3	16
Drifting					1	1	1	7	1	3	3	11
Human Loss Injury			11	11	3	9	6	6	5	5	25	31
Others Unknown			5	17	3	3	8	9	10	55	26	84
Total	11	46	41	144	19	72	43	249	48	293	162	804

(4) Summarized Result of Analysis

The analysis has been made in the preceding sub sections on the total number of 1,781 accidents occurred during the last five years. The following gives a summarized result of analysis.

(i) Maritime traffic accidents

a) The area distribution of both 'collisions' and 'strandings' is on a similar trend, and their high density occurrence areas are near ports and channels.

b) The accidents of medium to large ships are very high in the maritime traffic accidents.

(ii) Flooding and Sunk Accidents

a) The area distribution of both 'flooding' and 'sunk' is quite similar in occurrence trend, and their high density occurrence areas are mid-Jawa Sea and east coast of Sumatera.

b) 'Sunk' accidents occupy high percentage in the total marine accidents, and especially 'sunk' accidents of motorized sailing ships are dominantly high.

c) Small ships of less than 300 G/T dominate the 'flooding' and 'sunk' accidents.

d) 'Flooding' and 'sunk' accidents frequently occur during the height of monsoon and are affected by seasons.

e) 'Sunk' accidents often occurred through 'flooding' caused by bad weather.

(iii) Engine, Propeller and Rudder Troubles

a) The area distribution of 'engine troubles, etc.' is similar in trend to that of 'flooding' and 'sunk', and such possibility may be assumed that secondary accidents of 'flooding' and 'sunk' may be developed if the rescue would be delayed.

b) The small ships of less than 300 G/T among cargo ships, tug boats, motor ships and motorized sailing ships occupy high percentage of occurrences in the 'engine troubles, etc.'.

(iv) Other Marine Accidents

a) 'Capsized' and 'fire' accidents differ in the area distribution from other accidents. 'Drifting' accidents show a similar trend to 'flooding' and 'sunk'.

b) High percentage of 'capsized', 'fire' and 'drifting' is occupied by the small ships of less than 300 G/T.

c) 'Capsized' and 'drifting' accidents are affected by monsoon in the same way as 'flooding' and 'sunk', and 'fire' slightly by season.

(v) Human loss and injury

a) Falling overboard accidents are dominated by fishing vessels, and many such accidents occurred centering on Jawa Sea.

b) Death and missing caused by other accidents are dominantly by 'sunk' and 'capsized' accidents. The number of death and missing per accident is increasing year by year.

As summarized above, the causes of marine accidents may be estimated as described hereunder:

The causes are classified into the three factors of navigational environment, operation of on-board facilities and human elements as stated below:

The first factor of navigational environment may be referred to congested maritime traffic, existence of reefs, shallows and narrow channels and also to the insufficient aids to navigation established. The second factor of operation of abroad facilities may be related to poor installation of navigational equipment on board unmodernized vessels such as motorized sailing ships, insufficient maintenance of engine and lack of communication equipment as well as improper and excessive loading, ignorance of load line, etc. Thirdly in terms of human factor, it is presumed that the matters may be referred to negligence of navigational watch-out, improper steering and carelessness of weather and sea conditions, as well as lack of maritime knowledge and even unappropriate assignment of crew.

Furthermore, with reference to problems observed from the viewpoint of administration, it is necessary to substantiate in basic data collection on the realities of marine accidents as well as in the efficiency of rescue operation. For instance in this survey, the analysis was made on the data contained in the DGSC Log Book. However, considering the possibility of partially failing to collect data on small fishing vessels and also the facts that it takes at least one month or nearly half to a year at the longest to inform DGSC of marine accidents after their occurrences, it is also required to try to improve the rescue system and secure its communications means.

4.2.3 Time Distribution of Marine Accidents

The occurrence distribution of such phenomenon as marine accidents normally follow the Poisson Distribution, and the time interval of their occurrences are said to be in conformity with an index distribution. Based on the data on actual occurrence of marine accidents in Indonesia during the last five years of 1982 to 1986, the time distribution has been examined and analyzed as to their occurrences, and the result is given in Table 4-2-10.

Assumed that the occurrence probability of marine accidents approximately follows the Poisson distribution, then any accidents occur at random so that the occurrence of marine accidents at a certain point of area is not related with that at other points, and accordingly the occurrence frequency of marine accidents within a certain time interval symbolized as "P" is given as follows.

Table 4-2-10 Average Number of Accidents and Average Time Interval of Occurrences

	Total No. of accidents during 5 years	Average No. of accidents/day	Average time interval of occurrences (day)
Total No. of accidents	1,781	0.9754	1.0253
Accidents involving human loss & injury	231	0.1265	7.9048
Tanker accidents	67	0.0367	27.2540

Notes: Total number of days from 1982 to 1986: 1,826

$$P(r) = \frac{e^{-m} \cdot m^{r}}{r!}$$

where,

"m" is the daily average occurrence probability of marine accidents; the expected number of occurrence of accidents within a unit of time.

"r" is the probability of no nonoccurrence, occurrence of one accident, simultaneous occurrence of 2 accidents, 3 accidents .... etc.; i.e., the occurrence probability of "r" occurrences within a unit of time.

The result of study on the time distribution of marine accidents are graphed in Fig. 4-2-9 to show the probability distribution of theoretical occurrence of accidents, and in Fig. 4-2-10 to show the probability distribution of theoretical time interval of accident occurrences. As a result, it is evident that the occurrences of marine accidents approximately follow the Poisson distribution.

As seem above, in order to cope with marine accidents occurring at random, necessary rescue system need to be established.

4.2.4 Advice on Countermeasures for Preventing Marine Accidents

The analysis is made in the preceding section on the accidents based on the realities of occurrences of marine accidents in Indonesia.

(1) Safety Measures to be Taken for Maritime Traffic Accidents

The geographial distribution of maritime traffic accidents, i.e. collisions and strandings, shows that the high density areas of their occurrences are concentrated in Jawa Sea and in and around the major ports and channels, where heavy traffic runs through, and reefs, shallows and narrow meandering water exist.

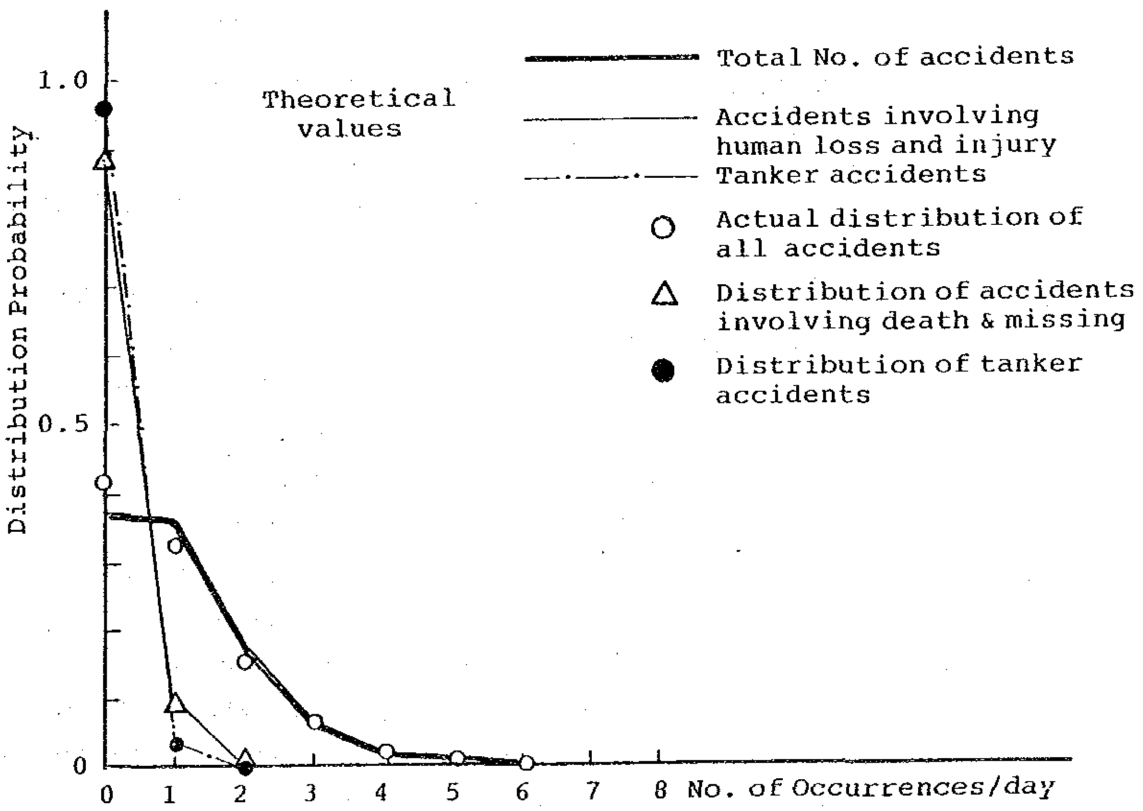


Fig. 4-2-9 Probability Distribution of Number of Accident Occurrences per Day

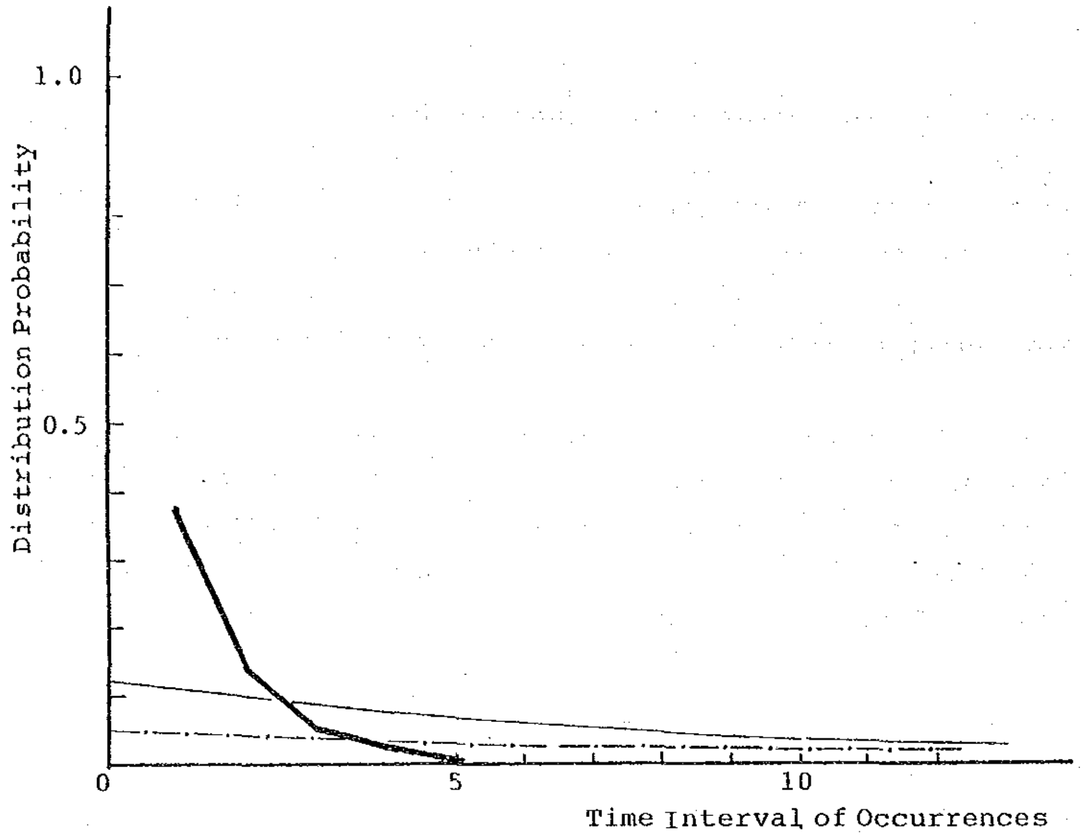


Fig. 4-2-10 Probability Distribution of Time Interval of Accident Occurrences

The safety measures to be taken under these conditions should be to develop and improve the aids to navigation, and in the congested narrow waters it is necessary to take measures to develop a traffic control system or information advisory system. From the standpoint of the installation and operation of on-board equipment, it is considered appropriate that the RADAR and ARPA should be equipped on board the vessels of less than those mandatory under the SOLAS Convention. It is also advisable that radar reflector or metal plate of the sort be fitted with the wooden vessels to improve the recognition since the small-size wooden vessels can not be displayed vividly on radar screen. In terms of human elements, the education and guidance system should be thoroughly planned for maritime personnel. In case of limited visibility or at night when a risk of collisions and stranding substantially increases, the International Regulations for Preventing Collisions at Sea should be strictly observed.

(2) Safety Measures for the Other Maritime Accidents

There are a number of 'sunk' accidents of Motorized sailing ships of less than 30 G/T navigating with the free board of about 20 cm, and in most cases they are flooded and sunk as a result of encountering stormy weather. On the other hand, a research study made in Japan around 1965 showed that the open sea accident rate of wooden fishing vessels was higher in almost all kinds of accidents than that of steel fishing vessels of the same size. It was conslusively found as a result of this study that the higher rate of engine troubles had been attributed to its less stiffness nature of main structure in case of powered wooden vessels.

In the light of above situations, safety measured need to be taken are advised. From the stand-point of operational human elements, the collection and dissemination of information on weather and sea conditions should be thoroughtly executed. For instance, in case of incremental weather to be expected, there are presently services available at some ports for the re-checking of safety devices by Harbour Masters before departure, and notes on weather forecasts are handed over. It is recommended that these kinds of services be made available at all relevant areas. Also, with reference to maritime accidents such as engine troubles, the measure should possibly be taken to let the people concerned know through education and guidance of the fact that the accident rate is even potentially high for motorized sailing ships and also of modernization and improvement of the facilities. The motorized sailing ships have been making a great contribution to maritime transportation in Indonesia as a means of low-cost transportation, and securing their safety is a matter of great concern in the national shipping.

(3) Safety Measures for the Accidents involving Human Life

In order to cope with the accidents involving human life such as falling overboard or those caused by marine accidents, it is advised in the first place to make the rescue arrangements by preparing life jackets and life buoys, etc. as well as to consider improved installation of communications equipment for small ships of less than 300 G/T whose means of communications so far is limited to a simple level of transceivers.

(4) Advice on Improving Efficiency of Rescue of Marine Accidents

In order to improve efficiency of rescue of marine accidents, it is not only necessary to study proper arrangement and operation of rescue boats, aircraft and manpower, but also it is primarily important to persue maritime safety organization and system to acquire quick and accurate information on marine accidents. Moreover, in order to study efficient rescue system for marine accidents as well as effective measures to prevent them from their occurrences, it will be necessary to firmly grasp the actual situations and make analytical and statistical evaluations for optimum countermeasures to be taken.

4.3 Forecast of Marine Accidents

4.3.1 Forecast of Marine Accidents

(1) Forecast Method

A fundamental approach, as regards the forecasting of maritime traffic, should be such that the number of voyages at each point in the relevant waters is to be calculated for estimation of the traffic density of shipping and then a correlation with the number of accidents is to be pursued. However, the application of such approach has not been possible due to the vastness of Indonesian waters. Accordingly, the method applied to this study is a macro-approach to assume that the currently available area distribution of marine accidents will be remain in its pattern in the future.

(2) Forecasting Formulae for Year 2005

The forecasting formulae are applied to the forecast for the number of marine accidents in 2005 based on the number of accidents occurred in 1986.

The number of accidents other than collisions indicates a slightly increasing trend according to the records of accidents from KANWIL IV for the recent few years, and the future increase in number of voyages leads to the forecast of a slight increase in number of the accidents. On the other hand, the forecast is based that the collision accidents will increase in proportion to the power 2.1 of the number of voyages.

(3) Forecast of marine accidents in year 2005

The estimation is made applying the formulate 1 and 2 to show the result as given in Table 4-3-1.

Tables 4-3-2 gives the forecast number of marine accidents by kind of accident and size of ship. The forecast by kind of accident and category of ship is as given in Table 4.3.1 (refer to Final Report).

The preconditions are made for the collision accidents that the area distribution of ships by category and size will stay in the same pattern, and a constant increase rate is applied throughout the period of 1986 to 2005.

In 2005, the collision accidents will occupy 33% of the total occurrences.

From the SAR viewpoint, a possibility will be expected that in the case of collisions the crew on board a ship in distance may be rescued by the collided ship. From the viewpoint of preventing marine accidents, the installations of radar, anti-collision device and radar reflector for wooden ships will be furthered, and remarkable effects deriving therefrom may be anticipated.

4.3.2 Forecast of Marine Accidents in the Major Ports

The forecast for 6 main ports is made referring specifically to the collisions and strandings, which should be examined for planning a traffic control system in those ports. Those two kinds of accidents in Surabaya are forecast to increase about 4 times those averaged in 1982 to 1986. Belawan also shows high increase of more than 3 times during the same period.

Table 4-3-1 Past Records and Forecast of Number of Voyages and Marine Accidents

Item / Year	Number of Voyages (No-organization)	Number of Marine Accidents: In KANWIL IV: Other than collisions	Collisions	Total	Whole Indonesian Waters: Other than collisions	Collisions	Total
1977	258,396	91	8	99			
78	268,463	115	17	132			
79	278,923	84	24	108			
80	289,790	150	16	166			
81	320,745	73	29	102			
82	322,583	123	43	166	390	77	467
83	325,848	94	39	133	299	59	358
84	337,674	126	29	155	262	41	303
85	350,843	76	14	90	304	49	353
86	363,123	115	27	142	260	40	300
1995	493,004				286	76	362
2005	701,590				320	160	480

Table 4-3-2 Forecast Number of Marine Accidents by Kind and by Size

Kind \ Tonnage	0 - 100	100 - 500	500 - 1,000	1,000 - 3,000	3,000 - 10,000	10,000 - 20,000	20,000 -	Total	%
Collision	60	18	18	43	20	5		160	33
Standing	10	21	3	4	1			39	8
Capsized	8	2						10	2
Fire	9	7	5		2			23	5
Floading	13	17		1	3			34	7
Sunk	49	43	4					95	20
Engine Propeller Rudder Troble	21	8	9	1	2			41	9
Drifting	7	1	1	1				10	2
Human Loss-Injury	36	10	6		1			53	3
Others	6	1	3	1	3			14	3
Total	219	126	47	51	32	5	0	480	100
%	25	26	10	11	7	1	0	100	

5 Maritime Safety and Search and Rescue System

5. 1 Present Situation

5. 2 Analysis

5. 3 Long-term Development Plan

Section 5 Maritime Safety and Search and Rescue System

5.1 Present Situation

5.1.1 Responsible Operation Areas

The responsible operation areas of KANWILs are defined, while those for the individual KPLP units are not clear. The locational establishment of KPLP units is initially based on the following legal foundations:

- Minister Environment Ordinance 1938
- Government Regulation as Substitution of Laws No. 4 of year 1960 regarding Indonesian waters

However, the above provisions do not define the responsible areas of operation.

The responsible operation areas of KPLP units cover from the port areas to the outer buoy areas. These areas include inner waters and land as well. Description may be exampled in case of KPLP unit Surabaya, where the operation areas extend from West Channel buoy No. 1 to East Channel buoy No. 1, and also in case of KPLP unit in Banjarmasin where they extend from Trisakti to outer buoy No. 0 area.

The field surveys found that the responsible operational areas for each base of KPLP unit are apparently defined but not clearly designated to the bases of each local operational unit.

5.1.2 Allocation of KPLP Unit Bases

Maritime safety rescue ships are geographically allocated to the total number of 44 bases throughout the country placing strategical emphasis on the areas alongside the coasts facing Jawa Sea, Riau and north of Irian Jaya.

The areas represent important operational waters for maritime traffic, maritime safety law enforcement and search and rescue.

The number of bases for each KANWIL is as given in Table 5-1-1 and the base allocation chart is shown in APPENDIX-V/1.

Table 5-1-1 Number of KPLP Unit Bases per KANWIL

KANWIL	No. of KPLP Base	KANWIL	No. of KPLP Base
I	4	VI	3
II	5	VII	3
III	9	VIII	2
IV	7	IX	6
V	5	Total	44

5.1.3 Allocation of Maritime Safety Rescue Ships and Aircraft

A list of KPLP ships in given in APPENDIX-V/2 together with the details.

5.1.4 Maritime SAR Operational Activities

The execution of maritime SAR operations is one of the prime responsibilities of the local operational units, namely KPLP units, and in conducting the actual operations of SAR, the ships belonging to other units of DGSC such as District of Navigation, Harbour Master as well as Perumpel's are to be mobilized to extensively support the activities as necessities exist.

The coordination of SAR in any relevant regions is to be carried out through BASARNAS and its subordinate organizations, i.e. KKR which is responsible for coordinating all the available SAR potentials within its responsible area, and SKR which is responsible for managing the cooperation of all SAR potentials in its area. The SAR potentials to be mobilized include those belonging to other government and private sectors, more specifically such as Indonesian Armed Forces, Customs, Pertamina and so on.

If there was any ship declared missing or in emergency status, initial search will be conducted by ships of DGSC or other ships situated nearby or aircraft currently of the Navy, and at the same time notice will be made to any ships nearby through broadcasting via the SAR coastal radio stations.

FKSD, Regional SAR Coordination Forum, is now being established throughout Indonesia in order for the Regional Governors to direct local initiative for the area coordination and to mobilize their locally available SAR potentials and resources for the activities. The basic maritime SAR organization chart is given in Fig. 5-1-1.

The ships and equipment presently owned by KPLP units as the prime maritime SAR task force, are limited both in capacity and number and in performance as well. The nine Class II vessels, belonging to the KPLP Fleet may be regarded to a realistic extent as the SAR potentials of DGSC to be arranged for such mission, while the ships of other classes of III to V are suited in a practical sense only for limited area operations. The reality of executing SAR activities by DGSC is that the ships are not sufficient enough to owe with the operations in terms especially of the quality and performances, and that only Class II ships have the operational capabilities, while other classes of ships, particularly some of the old ones, may not be deployed for the operations.

The SAR operation and coordination organizational systems themselves in Indonesia are reasonably established. However, lack of the available means and facilities hampers the actual implementation of the system established. The crucial importance lacking is the maritime safety and SAR experts. Under such conditions, it may be said that the present SAR situations in Indonesia have led to the reliance on the Navy to a certain extent. This can be referred specifically to the cases where long and wide range search and rescue operations are required.

5.1.5 Private Search and Rescue Organization

The participation in and support to the search and rescue operations from the non-government organizations may be expected from the following in the form of cooperation and/or active participation:

- Shipping companies recruiting their vessels to support the activities
- Fishing association
- Indonesian amateur radio association (ORARI)
- Diving club

It has been found during the field surveys that only one organization set up for exclusive SAR is a volunteer and charitify organization established in 1981 in Banjarmasin called 'Banjarmasin Rescue (BR)', which is under the supervision of KPLP unit in Banjarmasin for the operations. BR consists of about 100 volunteers in the area and actively engages in this humanitarian work of SAR.

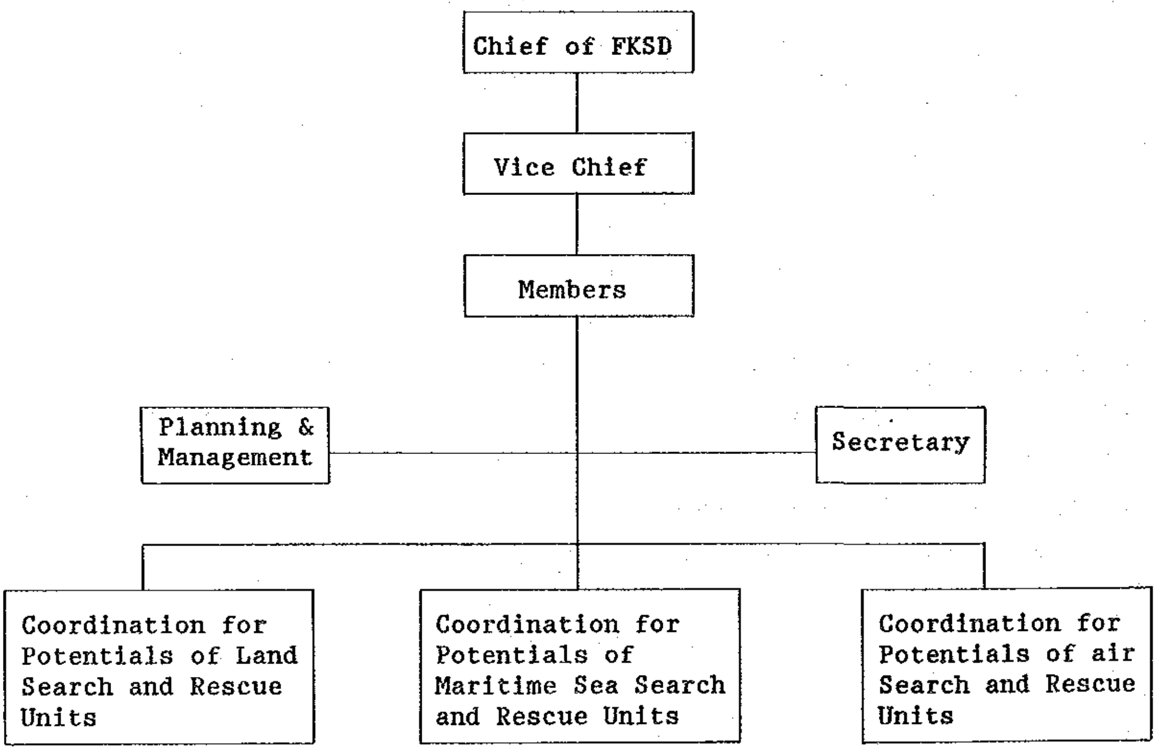


Fig. 5-1-1 Organization Chart of FKSD
(Local SAR Coordination Forum)

5.2 Analysis

5.2.1 Method

The analytical method of the "Waiting Line Theory" has been applied to the study on optimum number of maritime safety rescue ships and aircraft to be allocated to the on-shore bases to establish the prompt response system for search and rescue. For this purpose, the preconditional verification has been made on the distribution of both the occurrence probability of accidents and the rescue efficiency. The analytical method is as described hereunder.

(1) Probability Distribution of Accident Occurrences and Rescue Efficiency

In order to study on the allocation plan of maritime safety rescue ships and aircraft through the application of the "Waiting Line Theory", it is necessary to examine the probability distribution of accident occurrences and the rescue efficiency distribution, which jointly constitute the parameters of this theory. Consequently, an attempt was made to verify such data based on the actual records of marine accidents occurred in Indonesia in the years from 1982 to 1986.

(i) *Probability Distribution of Accident Occurrences*

It has been proved through various studies made in the past on marine accidents that they do not occur at a regular time interval but do in general at random. In other words, "the probability distribution of marine accident occurrences" follows approximately the Poisson distribution.

Assuming that the daily occurrence probability of marine accidents, i.e., average number of daily occurrences, is "m", it is given in the following formula.

$m = N/365$ (number of accidents/day)

where,

N: Number of marine accidents occurred in one year
And, the time interval of occurrence of marine accidents becomes 1/m.

Since the occurrence probability of marine accidents approximately follows the Poisson distribution, then any accidents occur at random so that the occurrence of marine accidents at a certain point of area is not related with that at other points, and accordingly the occurrence frequency of marine accidents within a certain time interval symbolized as "P" is given as follows.

$$P(r) = \frac{e^{-m} \cdot m^{r}}{r!}$$

where,
"m" is the daily average occurrence probability of marine accidents; the expected number of occurrence of accidents within a unit of time.

"r" is the probability of no non-occurrence, occurrence of one accident, simultaneous occurrence of 2 accidents, 3 accidents ... etc; i.e., the occurrence probability of "r" occurrences within a unit of time.

(ii) Rescue Efficiency

The rescue efficiency for marine accidents symbolized as "μ means the efficiency of providing rescue for one accident to be performed by either one maritime safety rescue ship or one aircraft, and it is shown in the following formula when the average distance up to the accident scene "D" is used as a parameter.

$$\mu = 24 \cdot V/2.2D \text{ (No. of accidents/day)}$$

where,

"V" is the speed of a maritime safety rescue ship or aircraft, and if, for instance, the speed of a maritime safety rescue ship mobilized for rescue operations is averaged at 10kn as an average of 13kn for directing to the scene and 7kn for returning (assuming towing for return), and then the rescue capability per day is as long as 240 miles.

"2.2D" shows the 10% error in distance of the round trip and locating the accident position.

(2) Locations of Accidents and Distance from On-shore Bases

The locations of marine accidents are identified by plotting the data from the DGSC Log Book for the period from 1982 to 1986. The locations identified are about 70% of the total number recorded due to the difficulties encountered in their identification for the rest.

Regarding the distance up to the accident sites, there is one method of measuring it by showing the distance in miles from coast, and there is another of measuring it from the on-shore bases for maritime safety rescue ships and aircrafts. The latter is more in accordance with this particular study. Accordingly, this study has employed a method of measuring the distance from the on-shore bases showing it in a concentric circle in stead of measuring miles off coast lines. At the same time, the cruising capacity is identified for the different types of maritime safety rescue ships or aircraft.

The on-shore bases for maritime safety and SAR in Indonesia are scattered around the country, each belonging to the relevant KANWILs. The nine Class II maritime safety rescue ships principally attached to each KANWIL cover the entire waters.

1 to 5 Class III maritime safety rescue ships respectively belonging to each KANWIL cover up to about 50 miles. 5 to 28 Class IV/V maritime safety rescue ships respectively belonging to each KANWIL cover up to about 12 miles.

As a consequence, the occurrence probability "m" and the average distance up to occurrence sites "D" are calculated for each KANWIL. With regard especially to the average distance, the classification is made by considering the rescue capability of maritime safety rescue ships and aircraft to divide into the three levels in distance from the on-shore bases, i.e. 50 miles and over ('D1'), 12 - 50 miles ('D2') and nearer than 12 miles ('D3'), and the weighted average"'D'" is obtained for each level of the distance categories.

(3) Application of 'Waiting Line Theory' to Allocation of Maritime Safety Rescue Ships and Aircraft

The analytical output to be made available from the "Waiting Line Theory" in this study is the probability status of vessels to wait, i.e. the average working ratio for maritime safety rescue ships or aircraft and the probability of waiting as for rescue requiring vessels. The optimum allocation of maritime safety rescue ships or aircraft is calculated based on the probability of receiving plural number of requests for rescue operations by maritime safety rescue ships or aircraft. The parameters, with which the required number of maritime safety rescue ships or aircraft is to be calculated by type for each KANWIL through actual application of the "Waiting Theory", are the average rescue efficiency ('μ') and the average ratio of rescue requests ('λ') as previously described. The average ratio of rescue requests ('λ') should correspond with the occurrence ratio ('m'), provided that rescue requests would be made whenever marine accidents occur.

Following gives the probability status of rescue requiring ships to wait:

(i) In the Case of One Maritime Safety Rescue Ship or Aircraft

In this study a model of the "Waiting Line Theory", has been applied since both the average ratio of rescue requests ('λ') and the average rescue efficiency ('μ'), defined in accordance with the requests, follow the poisson distribution.

The basic formulae regarding the waiting matrix are as given below:

$$P_1 = \lambda/\mu \cdot P_n \ (n \geq S + 1)$$

$$P_n = \frac{\lambda + S\mu}{S\mu} \cdot P_{n-1} - \frac{\lambda}{S\mu} \cdot P_{n-2}$$

where,

n : the unit number in the waiting matrix during time 't' including the number of units under service, and the total number of marine accidents with which an on-shore base is involved.

Pn : the probability that the number of accidents concerned falls in 'n'.

S : the number of maritime safety rescue ships or aircraft

Po : the probability of non-existance of the accidents, with which an on-shore base is to be involved.

u : average rescue efficiency of a maritime safety rescue ship

λ : average ratio of making rescue requests

λ/μ : rescue load ratio

Assumption is made in the basic formulae above that S=1 and $n \geq 2$ when two or more rescue requests are simultaneously made, and then the following is given:

$$Po = 1 - \lambda/\mu \text{ ---------------------------- } 1$$

$$Pn = \left(\frac{\lambda}{\mu}\right)^n \left(1 - \frac{\lambda}{\mu}\right) \text{ ------------------- } 2$$

where, $\lambda/\mu<1$ is applied when S=1.

(ii) In the Case of Two or More Maritime Safety Rescue Ships or Aircraft

The waiting in the case of two or more maritime safety rescue ships or aircraft may be classified into the two cases; the number of rescue requests ('n') at a certain point of time exceeds that of maritime safety rescue ships or aircraft ('S') or is less than that.

a) In the case of $n \leq S$

In this case the maritime safety rescue ships or aircraft are able to simultaneously cope with all the accidents (number: n) and the rescue efficiency would be 'nμ'. Based on the basic equation of waiting matrix, the following is given:

$$Pn = \frac{1}{n!} \left(\frac{\lambda}{\mu}\right)^n \cdot Po \quad \text{------------------------} \quad 3$$

b) In the case of $n \geq S$

Since the number of rescue requests ('n') in this case exceeds that of maritime safety rescue ships or aircraft ('S'), it is only possible to respond to 'S' number of accidents, and for the rest of ('n-S') cases of rescue requests, they have to be in waiting status. The rescue efficiency under such circumstance is given as 'Sμ'.
Based on basic formula of waiting is matrix, the following is given:

$$Po = \frac{1}{\left[\sum_{n=o}^{s-1} \frac{1}{n!} \left(\frac{\lambda}{\mu}\right)^n\right] + \frac{1}{S!} \left(\frac{\lambda}{\mu}\right)^S \left(\frac{S\mu}{S\mu-\lambda}\right)} \quad \text{---------------} \quad 4$$

$$Pn = \frac{1}{S! \cdot S^{n-S}} \cdot \left(\frac{\lambda}{\mu}\right)^n \cdot Po \quad \text{----------------------------} \quad 5$$

5.2.2 Calculation of Number of Maritime Safety Rescue Ships

Based on the data analyzed for the one year of 1982, calculations are made on the number of maritime safety rescue ships according generally to the present allocation of the Class II ships for each KANWIL and focusing on the main ports for Class III or lower classes ships. The preconditions are established for the calculation on allocation of the Class II ships that provisionally one each of the Class II ships is allocated to each KANWIL and that they are to be mobilized from the bases nearest to the respective KANWILs.

5.2.2.1 Calculation of Number of Maritime Safety Rescue Ships presently Allocated

(1) Basic Data

(i) Average Rate of Rescue Request

The number of accidents occurred in 1982 in the areas of 50 miles or Over, to be coped by the Class II ships, is given in Table 5-2-1 together with the average rate of rescue request (average rate of accident occurrences).

Table 5-2-1 Marine Accidents by KANWIL and Distance of 50 miles or over from On-shore Bases, 1981 (#1)

KANWIL		Distance (#2) 50 NM or over	(#3) 12 to less than 50 NM	(#4) Inland Water Area
I	N	22	2	
	λ	0.072		
II	N	14	8	2
	λ	0.046		
III	N	85	14	2
	λ	0.277		
IV	N	59	22	3
	λ	0.192		
V	N	13	14	
	λ	0.042		
VI	N	30	5	1
	λ	0.098		
VII	N	11	2	1
	λ	0.036		
VIII	N	18	7	
	λ	0.059		
IX	N	1	4	
	λ	0.003		

Notes

#1: The total number of marine accidents occurred in 1982 is 467, out of which 394 (84.4%) are identified in locations. Therefore, the correction rate of 1.19 is included in the respective average ratio of rescue requests ('λ') on the assumption that the occurrence trend of accidents as a whole will not be affected.

#2: 50 miles or over:
The number of accidents occurred in the areas of 50 miles or over from the on-shore bases excluding inland water areas such as river, etc. (the accidents to be dealt by the Class II ships)

#3: 12 miles to less than 50 miles:

The number of accidents occurred in the areas of on-shore bases, to which the Class III ships (maritime safety rescue ship to operate in less than 50 miles) and the Class IV ships (maritime safety rescue ships to operate in less than 12 miles) are allocated, excluding the accidents occurred within less than 12 miles around the mian ports specified in Table 5-2-2.

#4: Inland water areas:

The number of accidents in the areas of 50 miles or over from the on-shore bases occurred only within the inland water areas such as river, etc.

N: Number of the accidents occurred

λ(=m): Average ratio of rescue requests (average occurrence rate of marine accidents); N/365 (No. of accidents/day)

Table 5-2-2 gives the number of accidents occurred in the major port areas (less than 12 miles) and the average ratio of rescue requests (average rate of accident occurrences), for which the Class III or lower classes of maritime safety rescue ships are to cope with.

Table 5-2-2 Marine Accidents by Major Port, 1982

Major Port	No. of Accidents	Average Rate of Rescue requests
Belawan	4	0.013
Palembang	3	0.010
Tg.Priok	14	0.046
Surabaya	23	0.075
Banjarmasin	2	0.007
Ujung Pandang	8	0.026

(ii) Average Rescue Efficiency

The average rescue efficiency is calculated with the parameter of a weighted average of the distance from the on-shore bases nearest to the relevant KANWILs to the accidents scenes for the areas of 50 miles or over with which the Class II ships cope. When the speed of a maritime safety rescue ship to direct to the scene and to return towing to the base is estimated at 13kn and 7kn respectively, giving the average speed of 10kn, then the average rescue efficiency 'μ' is shown by the following formula:

$$\mu = 24\ V/2.2D \text{ (number of accidents/day)}$$

where,

D: Weighted average of distance from an on-shore base to the accident scene

The average rescue efficiency 'μ' for the areas of 50 miles or over covered by the Class II ships is as given in Table 5-2-3.

Table 5-2-3 Average Rescue Efficiency by KANWIL and Distance of 50 miles or Over, 1982

KANWIL	On-shore Base	Distance	Average Rescue Efficiency
I	Belawan	232	0.470
II	Dumai	276	0.395
III	Tg. Priok	184	0.593
IV	Surabaya	149	0.732
V	Banjarmasin	137	0.796
VI	Ujung Pandang	243	0.449
VII	Menado	296	0.369
VIII	Ambon	323	0.338
IX	Jayapura	130	0.839

The average rescue efficiency for the major ports (less than 12 miles) coped with by the Class III or lower classes of ships is given equally as 10.909, provided that the weighted average of distance from an on-shore base to the accident scene D' is 10 miles because of the port vicinity area. Table 5-2-4 shows the responsible areas of KANWILs immediately adjacent to each other as regards the areas of 50 miles or over coped with the Class II ships.

Table 5-2-4 Responsible Areas of KANWILs for Areas of 50 miles or over by Distance

Distance to be halved between		Responsible Area in Distance (n.m.)
On-Shore Base	On-Shore Base	
Belawan	Dumai	105
Dumai	Tg.Priok	285
Tg.Priok	Surabaya	180
Surabaya	Banjarmasin	130
Surabaya	Ujung Pandang	210
Banjarmasin	Ujung Pandang	160
Ujung Pandang	Manado	305
Ujung Pandang	Ambon	270
Manado	Ambon	190
Manado	Jayapura	490
Ambon	Jayapura	375

(2) Calculation for Existing Allocation of Maritime Safety Rescue Ships

The average ratio of rescue requests for the accidents occurred at the distance of 50 miles or over to be covered by Class II ships allocated to KANWIL III and KANWIL IV shows especially high as shown in Table 5-2-1. In this instance, study is focused on the above. The average rescue efficiency (μ) for each regional KANWIL is as given below when the average speed of 10 kn is applied to a maritime safety rescue ship:

$\mu 3 = 0.593$

$\mu 4 = 0.732$

And, the rescue load ratio λ/μ is as given below:

$\lambda 3/\mu 4 = 0.467$

$\lambda 4/\mu 4 = 0.262$

Based on these figures, calculations are made on the probability of waiting status for rescue in case of 1, 2 and 3 maritime safety rescue ships respectively. The equivalent figures calculated for other KANWILs and the main ports are given in APPENDIX-V/3.

(i) In the Case of One Maritime Safety Rescue Ship (S=1)

The probability of waiting is calculated applying the formulae 1 and 2 to KANWIL III and KANWIL IV respectively as given below:

KANWIL III	KANWIL IV
P0 .... 0.532884	P0 .... 0.737705
P1 .... 0.248919	P1 .... 0.193496
P2 .... 0.116274	P2 .... 0.050753
P3 .... 0.054313	P3 .... 0.013312
P4 .... 0.025371	P4 .... 0.003492
P5 .... 0.011851	P5 .... 0.000916
-	-
-	-

Here, P0 indicates the probability of maritime safety rescue ships not to be mobilized for rescue operations. In other words, it shows the probability of non-occurrences of such marine accidents that require rescue operations, while P1 is the probability of one case of rescue request to be made and, P2 for two cases and so on. In this case, study is made on the assumption that only one maritime safety rescue ship is available so that with respect to P2, P3 and so on, where the plural number of rescue requests comes in simultaneously, requests for their other accidents must be in a waiting line until arrival of the rescue ship after completion of the first rescue operations.

(ii) In the Case of Two and Three Maritime Safety Rescue Ships (S=2&3)

The probability of waiting status is calculated applying the formula 3 - 5 to KANWIL III and KANWIL IV respectively as given below:

KANWIL III		KANWIL IV	
P0	0.621326	P0	0.768116
P1	0.290232	P1	0.201473
P2	0.067786	P2	0.026423
P3	0.015832	P3	0.003465
P4	0.003698	P4	0.000454
	-		-
	-		-
	-		-

The way to evaluate the above results is the same as in case of (i) above, and since in this instance an assumption is made to allocate 2 maritime safety rescue ships, one of the three requests, if made simultaneously, must be in a waiting line in the case of P3 and thereafter.

The probability of waiting status in the case of 3 maritime safety rescue ships is also calculated similarly for KANWIL III and KANWIL IV as given below:

KANWIL III		KANWIL IV	
P0	0.626435	P0	0.769237
P1	0.292618	P1	0.201767
P2	0.068343	P2	0.026461
P3	0.010641	P3	0.002314
P4	0.001657	P4	0.000202
	-		-
	-		-
	-		-

The above shows that if 3 or 4 requests for are to be made simultaneously, they have to be in a waiting status, since in this case an assumption is made that 2 and 3 maritime safety rescue ships are allocated.

(iii) Interpretation on the Result of Calculations for Allocation of Maritime Safety Rescue Ships

It will be ideal that the vessels in distress or requiring rescue would all be rescued. However, it is presumed that the necessary number of maritime safety rescue ships and aircraft to accomplish it could be nearly infinite according to the probability calculated theoretically. Thus, if the number of the rescue requests exceeding that of the maritime safety rescue ships or aircraft allocated would be less than 10% in possibility, then the optimum figure could be selected from the result of calculations made in (i) and (ii) above within the range which exceeds 90% in the cumulated frequency of status probability but does not exceed the number of maritime safety rescue ships or aircraft allocated. In such away of interpretation, an appropriate allocation of the Class II ships will be 2 ships for KANWIL III and 1 ship for KANWIL IV respectively.

As regards the allocation of the Class II ships to the other KANWILs and the major ports, the result of analysis shows that one each Of them will be optimum as given in APPENDIX-V/3.

5.2.2.2 Calculation of Future Allocation of Maritime Safety Rescue Ships

(1) Basic Data

(i) Average Rate of Rescue Requests

The overall increase rate of the occurrences of marine accidents in the year of 2005 is forecast at approximately 1.6 times the accident occurrences in 1986. Accordingly, the average rate of rescue requests in the year 2005 respectively by KANWIL in the areas of 50 miles or over, to be covered by the Class II ships, and by the major ports (less than 12 miles), to be covered by the Class III ships, is as given in Table 5-2-5.

Table 5-2-5 Average Rate of Rescue Requests by KANWIL and Major Port in 2005

KANWIL	λ	Major Port	λ
I	0.115	Belawan	0.021
II	0.073	-	-
III	0.443	Palembang	0.016
		Tg. Priok	0.073
IV	0.308	Surabaya	0.120
V	0.068	Banjarmasin	0.010
VI	0.156	Ujung Pandang	0.042
VII	0.057	-	-
VIII	0.094	-	-
IX	0.005	-	-

λ (=m): Average rate of rescue requests (average rate of accident occurrences)

(ii) Average Rescue Efficiency

The average rescue efficiency in the year 2005 will remain the same as the present situations, when an assumption is made that the at-random occurrences of marine accidents of the currently prevailing pattern will similarly follow in the future. Therefore, the average rescue efficiency 'μ' in the areas of 50 miles or over covered by the Class II ships is the same as that given in Table 5-2-3, and that in the major ports specified (less than 12 miles) covered by the Class III or lower classes of ships is given equally as 10.909.

(2) Calculation of Future Allocation of Maritime Safety Rescue Ships

The average rate of rescue requests for the accidents in 2005 in the areas of 50 miles or over covered by the Class II ships to be allocated to KANWIL III and KANWIL IV shows especially high, as shown in Table 5-2-5. Study is focused here on those two *KANWILs*, and the average rescue efficiency 'μ' and the rescue load rate 'λ'/'μ' are as given below:

$\mu 3 = 0.593$	$\lambda 3/\mu 3 = 0.747$
$\mu 4 = 0.732$	$\lambda 4/\mu 4 = 0.421$
$\mu 6 = 0.449$	$\lambda 6/\mu 6 = 0.347$

Based on these figures, calculation is made on the probability of status waiting for rescue in the respective cases of 1, 2 and 3 maritime safety rescue ships. The equivalent figures calculated for other KANWILs and the specified major ports are given in APPENDIX-V/4.

(i) In the Case of One Maritime Safety Rescue Ship

The probability of waiting status is calculated applying the same formulae as applied in Section 5.2.2.1, (2), (i) for KANWIL III, KANWIL IV and KANWIL VI respectively as give below:

KANWIL III	KANWIL IV	KANWIL VI
P0 ... 0.252951	P0 ... 0.579235	P0 ... 0.652561
P1 ... 0.188967	P1 ... 0.243722	P1 ... 0.226725
P2 ... 0.141167	P2 ... 0.102550	P2 ... 0.078773
P3 ... 0.105459	P3 ... 0.043149	P3 ... 0.027369
P4 ... 0.078783	P4 ... 0.018156	P4 ... 0.009509
P5 ... 0.058855	P5 ... 0.007639	P5 ... 0.003304
P6 ... 0.032846	P6 ... 0.003214	P6 ... 0.001148
P7 ... 0.024537	P7 ... 0.001352	P7 ... 0.000399

Here, P0 indicates the probability of maritime safety rescue ships not to be mobilized for rescue operations. In other words, it shows the probability of non-occurrences of such marine accidents that may require rescue operations, while P1 is the probability of one case of rescue request to be made and, P2 for two cases and so on. In this case, study is made on the assumption that only one maritime safety rescue ship is available so that with respect to P2, P3 and so on, in which the plural number of rescue requests comes in simultaneously, the rescue requests for the other accidents mube be in a waiting position until arrival of the rescue ship after completion of the first rescue operations.

(ii) In the Case of Two and Three Maritime Safety Rescue Ships (S=2 & 3)

The probability of waiting status is calculated applying the same formulae as applied in Section 5.2.2.1, (2), (ii) for KANWIL III, KANWIL IV and KANWIL VI respectively as given below:

KANWIL III	KANWIL IV	KANWIL VI
P0 ... 0.456108	P0 ... 0.652370	P0 ... 0.703985
P1 ... 0.340735	P1 ... 0.274495	P1 ... 0.244592
P2 ... 0.127273	P2 ... 0.057749	P2 ... 0.042490
P3 ... 0.047540	P3 ... 0.012149	P3 ... 0.007381
P4 ... 0.017757	P4 ... 0.002556	P4 ... 0.001282
P5 ... 0.006633	P5 ... 0.000538	P5 ... 0.000223
-	-	-
-	-	-
-	-	-

The probability of waiting status in the case of 3 maritime safety rescue ships is also calculated similarly applying the same formula as given in Section 5.2.2.1, (2), (ii) for KANWIL III, KANWIL IV and KANWIL VI as given below:

KANWIL III	KANWIL IV	KANWIL VI
P0 ... 0.472006	P0 ... 0.656285	P0 ... 0.706364
P1 ... 0.352612	P1 ... 0.276142	P1 ... 0.245418
P2 ... 0.131709	P2 ... 0.058095	P2 ... 0.042634
P3 ... 0.032798	P3 ... 0.081482	P3 ... 0.004938
P4 ... 0.008167	P4 ... 0.001143	P4 ... 0.000572
P5 ... 0.002034	P5 ... 0.000160	P5 ... 0.000066
-	-	-
-	-	-
-	-	-

The above shows that if 3 or 4 or more requests for rescue are to be made simultaneously, then they have to be in a waiting status, since in this case the an assumption is made that 2 and 3 maritime safety rescue ships are allocated.

(iii) Interpretation of the Result of Calculation on Allocation of Maritime Safety Rescue Ships

Same as in the case of present allocation, if the number of the rescue requests exceeding that of the maritime safety rescue ships or aircraft allocated would be less than 10% in possibility, then the optimum allocation of the Class II ships will be 2 ships respectively for KANWIL III, KANWIL IV and KANWIL VI. Note should, however, be made that 2 ships for KANWIL III are estimated from the higher range of 2 - 3 ships while 2 for KANWILs IV and VI are from the lower range of 1 - 2 ships. As regards the allocation of the Class II ships to the other KANWILs and the major ports, the result of analysis shows that one each of them will be optimum as given in APPENDIX-V/4.

5.2.2.3 Analytical Review of Future Allocation of Maritime Safety Rescue Ships

The result of calculation of future allocation of maritime safety rescue ships shows that 2 each of the Class II ships are to be allocated to KANWILs III, IV and VI to cope with the operations in the areas of 50 miles or over. This is due to the facts that the high density accident areas of extensive Jawa Sea are covered by those three KANWILs, and that the responsible areas of KANWILs III and IV are fairly wide. In the light of the above, an alternative study is made to review the preconditions, applied to the study made in Section 5.2.2.2, that the Class II ships are always based at the locations adjacent to each KANWIL.

(1) Basic Data

For the purpose of reducing the high work Load, i.e. high rate of rescue requests for the Class II ships, to be allocated to KANWILs III, IV and VI, in the areas of 50 miles or over in the year 2005, and also be establishing efficient search and rescue setup, analytical review is made on the alternative locations of on-shore bases and the responsible areas deriving therefrom.

In order to lessen the high rescue request rate in KANWILs III and IV, the locations of on-shore bases need to be relocated thus reducing the range of responsible areas:

KANWIL II: Dumai base is to be relocated at Tg. Uban
KANWIL V : Banjarmasin base is to be relocated at Balikpapan

In this way, the responsible coverages of the relevant KANWILs to be coped with by the Class II ships are narrowed in range, i.e.

KANWIL	Coverage by Existing Allocation (miles)	Coverage by Alternative Allocation (miles)
II & III	285	220
V & VI	180	140

Table 5-2-6 gives the average rate of rescue requests and the average rescue efficiency calculated as the result of relocation of the on-shore bases.

Table 5-2-6 Average Rate of Rescue Requests and Average Rescue Efficiency based on Relocation of On-shore Bases of Dumai to Tg.Uban and Banjarmasin to Balikpapan

KANWIL	λ	μ	D
II	0.125	0.611	179
III	0.391	0.618	177
IV	0.355	0.690	158
V	0.078	0.946	115
VI	0.099	0.550	198

Notes: λ: Average rate of rescue requests
μ: Average rescue efficiency
D: Average distance (miles)

(2) Calculation of Reviewed Allocation of Maritime Safety Rescue Ships

The following describes the result of calculation made for KANWILs III, IV and VI on relocation of the Class II ships to be mobilized for the operations in the areas of 50 miles or over.

(i) In the Case of One Maritime Safety Rescue Ship

The probability of waiting status is calculated for KANWILs III, IV and VI as given below:

KANWIL III	KANWIL IV	KANWIL VI
P0 ... 0.367314	P0 ... 0.485507	P0 ... 0.820000
P1 ... 0.232394	P1 ... 0.249790	P1 ... 0.147600
P2 ... 0.147033	P2 ... 0.128515	P2 ... 0.026568
P3 ... 0.093026	P3 ... 0.066120	P3 ... 0.004782
P4 ... 0.058856	P4 ... 0.034018	P4 ... 0.000861
P5 ... 0.037237	P5 ... 0.017052	P5 ... 0.000155
P6 ... 0.023560	P6 ... 0.009005	P6 ... 0.000028
P7 ... 0.014906	P7 ... 0.004633	P7 ... 0.000005
–	–	–
–	–	–

P0 indicates the probability of maritime safety rescue vessels not to be mobilized for rescue operations. In other words, it shows the probability of non-occurrences of such marine accidents that may require rescue operations, while P1 is the probability of one case of rescue request to be made and, P2 for two cases and so on. In this case, study is made on the assumption that only one maritime safety rescue ship is available so that with respect to P2, P3 and so on, in which the plural number of rescue requests comes in simultaneously, the rescue requests for the other accidents must be in a waiting position until arrival of the rescue ship after completion of the first rescue operations.

(ii) In the Case of Two and Three Maritime Safety Rescue Ships (S=2 & 3)

The probability of waiting status is calculated for KANWILs III, IV and VI as given below:

KANWIL III	KANWIL IV	KANWIL VI
P0 ... 0.519361	P0 ... 0.590778	P0 ... 0.834862
P1 ... 0.328592	P1 ... 0.303851	P1 ... 0.150275
P2 ... 0.103948	P2 ... 0.078190	P2 ... 0.013525
P3 ... 0.032883	P3 ... 0.020114	P3 ... 0.001217
P4 ... 0.010402	P4 ... 0.005174	P4 ... 0.000110
P5 ... 0.003291	P5 ... 0.001331	P5 ... 0.000010
-	-	-
-	-	-

The above shows that if three of four or more requests for rescue are to be made simultaneousLy, they have to be in a waiting status, since in this case the assumption is made that 2 and 3 maritime safety rescue ships are allocated.

(iii) Interpretation of the Result of Calculations on Allocation of Maritime Safety Rescue Ships

Same as in the other study cases, if the number of the rescue requests exceeding that of the maritime safety rescue ships or aircraft allocated would be less than 10% in possibility, then the optimum allocation of the Class II ships will be 2 ships respectively for KANWIL III, KANWIL IV and KANWIL VI. As compared with the optimum allocation calculated in Section 5.2.2.2, the work load of Class II ships under KANWIL III is lessened to effectuate their efficient operations through the relocation of on-shore bases.

The calculation results for KANWILs II an V are given in APPENDIX-V/5.

5.2.2.4 Allocation Policy of Maritime Safety Rescue Ships

The optimum allocation of maritime safety rescue ships in Indonesia is analytically studied in the preceding sections in the three stages of existing, future and reviewed situations, based on the 'Waiting Line Theory'. The requirements for the Class II maritime safety rescue ships to cover the areas of 50 miles or over are summarized as given in Table 5-2-7.

Table 5-2-7 Summary of Analysis on Optimum Allocation of Class II Maritime Safety Rescue Ships by KANWIL
(unit: Number of ships)

KANWIL	Optimum Allocation of Class II ships		
	Existing Requirement	Future #1 Requirement in 2005	Revised #2 Requirement in 2005
I	1	1	1
II	1	1	1
III	2	2	2
IV	1	2	2
V	1	1	1
VI	1	2	1
VII	1	1	1
VIII	1	1	1
IX	1	1	1
Total	10	12	11

Notes: #1 ... Based on the increase rate of 1.6 in accidents in 2005

#2 ... On-shore bases are relocated
from Dumai to Tg.Uban
from Banjarmasin to Balikpapan

As shown in the above, the relocation of on-shore bases from Dumai and Banjarmasin respectively to Tg.Uban and Balikpapan brings the effective result of allocating two ships each for KANWILs III and IV and one for KANWIL VI.

As regards the Class III or lower classes of maritime safety rescue ships, the result obtained shows that one ship for each major port will suffice the needs both at present and in the future. However, in view of the occurrence status of marine accidents, allocation of such classes of maritime safety rescue ships to other on-shore bases will lessen the work load of the Class II ships having the extensive operational coverages, and facilitate speedy and effective search and rescue operations.

In future planning of the development of maritime safety rescue ships, it is desirable to consider the coordination and joint operations with airplanes and helicopters as well as the various supporting factors pertinent to the operation and maintenance, based on the analytical study made herein.

Mention should also be made that this study is based primarily on the data analyzed for the marine accidents. The missions of maritime safety rescue ships under DGSC are not limited to the search and rescue services only, but cover the wide range of maritime safety activities, which should also be taken into account in the future planning.

5.2.3 Calculation of Optimum Allocation of Aircraft

Based on the data on marine accidents analyzed, for the one year of 1982, calculation is made on the optimum allocation of airplanes and helicopters applying the 'Waiting Line Theory' in the same way as for the calculation of optimum allocation of maritime safety rescue ships.

5.2.3.1 Calculation of Number of Aircraft under Present Conditions

(1) Basic Data

The types of aircraft to be mobilized for search and rescue operations in Indonesia and their air bases are planned as given below under the consideration of the topography, the locations of existing air bases, the status of marine accident occurrences and so forth.

a. Helicopter

Type : HEL-M (Medium helicopter - maximum capacity for evacuating 15 persons/endurance up to 3-3.5 hours))

Cruising range; 450 miles

Operational Radius in the case of half an hour search flight; Approx. 175 miles

Cruising speed; 135 miles/hr.

Air Base:	KANWIL I	Medan
	" II	Tg. Uban
	" III	Jakarta
	" IV	Surabaya
	" VI	Ujung Pandang
	" VIII	Ambon

Operational Area and Missions:

Search and rescue missions within the radius of 175 miles from the relevant air bases except the in-port areas

b. Airplane (fixed wing)

Type : VLR (Very long range - radius of action of more than 1,000 NM, plus 2.5 hours search remaining)

Cruising range; 2,700 miles or over

Operational Radius in the case of 2.5 hours search flight; Approx. 1,000 miles or over

Cruising speed; Approx. 250 miles/hr.

Air Base:	KANWIL III	Jakarta
	" VI	Ujung Pandang

Operational Area and Missions:

Search and rescue missions in all areas except the areas of less than 50 miles to be covered by the maritime safety rescue ships locally allocated.

(ii) Average Rate of Rescue Requests

The number of marine accidents requiring rescue by aircraft is identified based on the data on marine accidents occurred in 1982, and calculation is made for the average rate of rescue requests (average occurrence rate of marine accidents). They are as given below:

Table 5-2-8 Marine Accidents Requiring Rescue by Aircraft, 1982

Air Base		Marine Accidents requiring Rescue by:	
		Airplane	Helicopter
Medan	N	–	21
	λ	–	0.063
Bintan	N	–	25
	λ	–	0.082
Jakarta	N	154	66
	λ	0.502	0.215
Surabaya	N	–	76
	λ	–	0.248
Ujung Pandang	N	108	20
	λ	0.352	0.065
Ambon	N	–	13
	λ	–	0.042

Notes: N : Number of marine accidents
λ(=m): Average rate of rescue requests (average occurrence rate of marine accidents) N/365 (number of accidents/day).
λ includes the correction rate of 1.19 equally applied.

In the case of airplane "VLR", all the accidents of 262 occurred in all areas except the areas of 50 miles or less may be fully covered by the two air bases specified.

In the case of helicopter "HEL-M", the accidents of 221 occurred within the radius of 175 miles excluding the in-port areas will be covered by the six air bases specified with the response rate of 2/3 to the rescue requests.

(iii) Average Rescue Efficiency

The average rescue efficiency for aircraft may be calculated with the parameters of the weighted average value ('D') of the distance between an air base and accident scenes and the speed of aircraft, in the same way as for the maritime safety rescue ships. However, the operational performance of aircraft are limited in the cruising range and supply of oil, and furthermore checkings need to be carried out at a regular time interval. The actual on-site surveys recently conducted in Japan for the aircraft belonging to the relevant authorities have proved that application of the working rate of around 2/3 sufficiently covers such services as may limit the mission performances. Accordingly, the average rescue efficiency is given by the following formula:

$$\mu = 24 \cdot V \cdot 0.6666/2.2D \text{ (number of accidents/day)}$$

where,

D: Weighted average distance between an air base and accident scenes

0.6666: Working rate

Thus, the average rescue efficiency calculated is as given below:

Table 5-2-9 Average Rescue Efficiency for Aircraft by Air Base

Type	Air Base	Average Mileage	μ
Helicopter	Medan	99	7.699
	Tg.Uban	93	8.070
	Jakarta	110	7.100
	Surabaya	113	6.952
	Ujung Pandang	84	8.700
	Ambon	73	9.617
Airplane	Jakarta	311	3.690
	Ujung Pandang	370	3.295

Note: μ average rescue efficiency

(2) Calculation of Number of Aircraft under Present Conditions

The average rescue efficiency 'μ', shown in Table 5-2-8, gives high figures for the helicopters at Surabaya and Jakarta and for the airplane at Jakarta, i.e.

μs (Helicopter) = 0.248

μj (Helicopter) = 0.215

μj (Airplane) = 0.502

Accordingly, the rescue load rate 'λ/μ' is as given below:

$\lambda s/\mu s$ (Helicopter) = 0.036

$\lambda j/\mu j$ (Helicopter) = 0.030

$\lambda j/\mu j$ (Airplane) = 0.136

Based on these figures, calculation is made on the probability of status waiting for rescue in the case of one and two helicopters. The equivalent figures calculated for the other air bases are as given in APPENDIX-V/6.

(i) In the Case of One Helicopter/Airplane

The status of waiting is given as follows:

Surabaya(Helicopter)	Jakarta(Helicopter)	Jakarta(Airplane)
P0 ... 0.964327	P0 ... 0.969718	P0 ... 0.863957
P1 ... 0.034401	P1 ... 0.029365	P1 ... 0.117536
P2 ... 0.001227	P2 ... 0.000889	P2 ... 0.015990
P3 ... 0.000044	P3 ... 0.000027	P3 ... 0.002175
-	-	-
-	-	-

P0 indicates the probability of aircraft not to be mobilized for rescue operations. In other words it shows the probability of non-occurrences of such marine accidents that may require rescue operational, while P1 is the probability of one case of rescue request to be made and, P2 for two cases and so on.

In this case, study is made on the assumption that only one aircraft is available so that with respect to P2, P3 and so on, in which the plural number of rescue requests comes in simultaneously, the rescue requests for the other accidents must be in a waiting position until arrival of the aircraft after completion of the first rescue operations.

(ii) In the Case of Two Helicopters/Airplanes

The status of waiting is given as follows:

Surabaya(Helicopter)	Jakarta(Helicopter)	Jakarta(Airplane)
P0 ... 0.964952	P0 ... 0.970170	P0 ... 0.872621
P1 ... 0.034423	P1 ... 0.029378	P1 ... 0.118714
P2 ... 0.000614	P2 ... 0.000445	P2 ... 0.008075
P3 ... 0.000011	P3 ... 0.000007	P3 ... 0.000549
-	-	-
-	-	-

The above shows that if three or more requests for rescue are to be made simultaneously, they have to be in a waiting status, since in this case the assumption is made that two aircraft are allocated.

(iii) Interpretation of the Result of Calculations on Allocation of Aircraft

It will be ideal that the vessels in distress or requiring rescue would all be rescued. However, it is presumed that the necessary number of maritime safety rescue ships and aircraft to accomplish it could be nearly infinite according to the probability calculated theoretically. Thus, if the number of the rescue requests exceeding that of the maritime safety rescue ships or aircraft allocated would be less than 10% in possibility, then the optimum figure could be selected from the result of calculations made in (i) and (ii) above within the range which exceeds 90% in the cumulated frequency of status probability but does not exceed the number of maritime safety rescue ships or aircraft allocated. In such way of interpretation, the allocation of one aircraft respectively to the relevant air bases will be considered appropriate, and the allocation of one aircraft will sufficiently meet the requirements at the waiting status rate even of 97%. As shown in APPENDIX-V/6, the result of calculation gives that the allocation of one each of aircraft at the relevant air bases will be appropriate.

In the case of aircraft, the average rate of rescue requests becomes high due to their wide coverage. However, due consideration should be given to the operational factors because of the fairly high theoretical value of average rescue efficiency due to derive from the high speed of aircraft. Otherwise, the theory will produce the impractical situations of allocation to show that only one airplane may suffice all the requirements.

5.2.3.2 Calculation of Number of Aircraft to be Required in the Future

(1) Basic Data

(i) Average Rate of Rescue Requests

In the same way as in the case of the calculation for number of maritime safety rescue ships to be required in the year 2005, the increase rate of 1.6 is applied to the marine accidents in the same target year. Accordingly, the number of marine accidents and the average rate of rescue requests (average occurrence rate of marine accidents) are summarized in Table 5-2-10.

Table 5-2-10 Marine Accidents Requiring Rescue by Aircraft in 2005

Air Base		Marine Accidents requiring Rescue by:	
		Airplane	Helicopter
Medan	λ		0.110
Bintan	λ		0.130
Jakarta	λ	0.803	0.344
Surabaya	λ		0.396
Ujung Pandang	λ	0.563	0.104
Ambon	λ		0.068

Notes: λ(=m): Average rate of rescue requests (average occurrence rate of marine accidents) N/365 (number of accidents/day).
λ includes the equal correction rate of 1.19.

(ii) Average Rescue Efficiency

An assumption is made that the occurrence status of marine accidents in the future will follow the same pattern as at present. Accordingly, the average rescue efficiency is given by the following formula:

$$= 24 \cdot V \cdot 0.6666/2.2D$$

(number of accidents/day)

where,

D: Weighted average distance between an air base and accident scenes

0.6666: Working rate

Thus, the average rescue efficiency of aircraft calculated as given in Table 5-2-9.

(2) Calculation of Number of Aircraft to be Required in the Future

As in the case of the calculation under the present conditions, study is made on the air bases having the high request rate as given below:

Surabaya: μs (Helicopter) = 0.396

Jakarta : μj (Helicopter) = 0.344

Jakarta : μj (Airplane) = 0.803

Accordingly, the rescue load rate 'λ/μ' is as given below:

Surabaya: $\lambda s/\mu s$ (Helicopter) = 0.057

Jakarta : $\lambda j/\mu j$ (Helicopter) = 0.048

Jakarta : $\lambda j/\mu j$ (Airplane) = 0.218

Based on these figures, calculation is made on the probability of status waiting for rescue in the case of one and two helicopters. The equivalent figures calculated for the other air bases are given in APPENDIX-V/6.

(i) In the Case of One Helicopter/Airplane

The status of waiting is given as follows:

Surabaya(Helicopter)	Jakarta(Helicopter)	Jakarta(Airplane)
P0 ... 0.943038	P0 ... 0.951549	P0 ... 0.782385
P1 ... 0.053717	P1 ... 0.046103	P1 ... 0.170259
P2 ... 0.003060	P2 ... 0.002234	P2 ... 0.037051
P3 ... 0.000174	P3 ... 0.000108	P3 ... 0.008063
-	-	-
-	-	-

P0 indicates the probability of aircraft not to be mobilized for rescue operations. In other words, it shows the probability of non-occurrences of such marine accidents that require rescue operations, while P1 is the probability of one case of rescue request to be made and, P2 for two cases and so on.

In this case, study is made on the assumption that only one aircraft is available so that with respect to P2, P3 and so on, in which the plural number of rescue requests comes in simultaneously, the rescue requests for the other accidents must be in a waiting position until arrival of the aircraft after completion of the first rescue operations.

(ii) In the Case of Two Helicopters/Airplanes

The status of waiting is given as follows:

Surabaya(Helicopter)	Jakarta(Helicopter)	Jakarta(Airplane)
P0 ... 0.944615	P0 ... 0.952695	P0 ... 0.803740
P1 ... 0.053807	P1 ... 0.046159	P1 ... 0.174906
P2 ... 0.001532	P2 ... 0.001118	P2 ... 0.019031
P3 ... 0.000044	P3 ... 0.000027	P3 ... 0.002071
-	-	-
-	-	-

The above shows that if three or more requests for rescue are to be made simultaneously, they have to be in a waiting status, since in this case the assumption is made that two aircraft are allocated.

(iii) Interpretation on the Result of Calculations on Allocation of Aircraft

It will be ideal that the vessels in distress or requiring rescue would all be rescued. However, it is presumed that the necessary number of maritime safety rescue ships and aircraft to accomplish it could be nearly infinite according to the probability calculated theoretically. Thus, If the number of the rescue requests exceeding that of the maritime safety rescue ships or aircraft allocated would be less than 10% in possibility, then the optimum figure could be selected from the result of calculations made in (i) and (ii) above within the range which exceeds 90% in the cumulated frequency of status probability but does not exceed the number of maritime safety rescue ships or aircraft allocated.

In such way of interpretation, an allocation of one aircraft respectively to the relevant air bases will be considered appropriate, and the allocation of one aircraft will sufficiently meet the requirements at the waiting status rate even of 97%. As shown in APPENDIX-V/7, the result of calculation gives that the allocation of one each of aircraft to the relevant air bases will be appropriate.

In the case of aircraft, same as for the calculation under the present situations the average rate of rescue requests becomes high due to their wide coverage. However, due consideration should be given to the operational factors because of the fairly high theoretical value of average rescue efficiency due to derive from the high speed of aircraft. Otherwise, the theory will produce the impractical situations of allocation to show that only one airplane may suffice all the requirements.

As previously started, in future planning of the development of maritime safety rescue ships, it is desirable to consider the coordination and joint operations with airplanes and helicopters as well as the various supporting factors pertinent to the operation and maintenance, based on the analytical study made herein.

Mention should also be made that this study is based primarily on the data analyzed for the marine accidents. The mission of aircraft under DGSC are not limited to the search and rescue services only, but cover the wide range of maritime safety activities, which should also be taken into account in the future planning.

5.3 Long-term Development Plan

5.3.1 Responsible Areas of Operation

The operational functions of KPLP units should cover:

- Enforcement of maritime law and regulations in terms of maritime safety and security
- Maritime SAR activities
- Marine disaster control operations
- Fire fighting
- Marine pollution combatting

These functions, which can not necessarily be said 'working' at present, could only be accomplished provided that the mobile task forces would be efficiently available in high state of operational readiness and performances together with the responsible operation areas to be clearly defined. The availability of competent maritime safety officers is the vital factor integrated with the task forces. The organizational structure of KPLP units may not be effectuated as the working forces without clear identification of each responsible area for their operational activities.

The responsible areas of operation for the respective KPLP units are established as described in Table 5-3-1 and Fig. 5.3.1 (refer to Final Report). There are 30 responsible areas of operation.

The coordination and operational arrangements among the relevant KPLP units shall be carried out by the KANWIL concerned. The joint responsible areas of operation are established for some areas. Out of the total number of 30 areas, there are joint responsible areas of operation.

Where the geographical conditions do not favor small segments of areas for the effective operations, it is more advantageous to establish the joint areas covered by two or more KPLP units from the stand point of practical efficiency. As regards the operation procedures, the had of the Directorate of Sea and Coast Guard will request the heads of relevant KANWILs to issue the operational manuals describing the individual sub-coverages operation by the KPLP units in the joint area, mutual operation or attachment of maritime safety rescue ships, command and control system for joint and cooperative activities, procedures for dealing with accidents and so forth as well as internal regulations pertinent to independent operations by each unit in the joint area.

Table 5-3-1 Responsible Areas of Operation for KPLP Units (1/9)

No.	KANWIL	KPLP Unit	Responsible Area of Operation
1*	I	Belawan Tg. Balai Asahan	The water areas surrounded by: - the administrative area of KANWIL I - the limited line of EEZ (Exclusive Economic Zone) - a line extending in the direction of 37° from the cross point at the coast of the border between Kabpaten Aceh Timur and Kabpaten Aceh Utara to the cross point with the EEZ line - the coastal line along Belawan
2	I	Ulee Lheue	The water areas surrounded by: - the administrative area of KANWIL I - the line along EEZ - a line extending in the direction of 247° at the coast of the border between Kabpaten Aceh Timur and Kabpaten Aceh Utara to the cross point with the EEZ line - a line extending in the direction of 37° from the cross point at the coast of the border between Kabpaten Aceh Timur and Kabpaten Aceh Utara to the cross point with the EEZ line - the coastal line along Ulee Lheue
3	I	Sibolga	The water areas surrounded by: - the administrative area of KANWIL I - the line along EEZ - a line extending in the direction of 247° at the coast of the border between Kabpaten Aceh Timur and Kabpaten Aceh Selatan to the cross point with the EEZ line - the coastal line along Sibolga
10*	III	Jambi Palembang	The water areas surrounded by: - the administrative area of KANWIL III, - a line extending from the cross point at the coast of the border between Propinsi Lampung and Propinsi Sumatera Selatang to Discovery East Bank LH (S 3° 35.0'/E 109° 10') - a line extending from Discovery East Bank to Pulau Rakit LH (N 0° 15'/E 108° 02') the coastal line along mouth of Sungai Musi and Sungai Batanghari and the water surface along Sungai Musi and Sungai Batanghari

Table 5-3-1 Responsible Areas of Operation for KPLP Units (2/9)

No.	KANWIL	KPLP Unit	Responsible Area of Operation
11	III	Bengkulu	The water areas surrounded by: - the administrative area of KANWIL III, - the line along EEZ - a line extending from the cross point at the coast of the border between Propinsi Bengkulu and Propinsi Lampung to Enggano LH (S 5° 29'/E 102° 23') - a line extending in the direction of 225° from Enggano LH to the cross point with the EEZ line - the coastal line along Bengkulu
12	IV	Surabaya	The water areas surrounded by: - the administrative area of KANWIL IV, - a line extending in the direction of 0° from the cross point at the coast of the border between Propinsi Propinsi Jawa Tenga and Jawa Timur to the cross point with the KANWIL IV line - a line extending from the top of Gunung Baluran (1248m above sea level: S 7° 50'/E 114° 21') to Gs.Sekmoi LB (S 7° 51'/E 117° 12')
4*	II	Dumai Pekanbaru	The water areas surrounded by: - the administrative area of KANWIL I - the line along EEZ - a line extending from the cross point at the coast of the border between Kabpaten Kampar and Kabpaten Bengkalis to the cross point of the EEZ line through Iyu Kecil LH (N 1° 11.5'/E 103° 21.0') - the coastal line along Belawan and the surface of the water along Sungai Siak
5*	II	Tg.Uban Tg.Pinang	The water areas surrounded by: - the administrative area of KANWIL II, - the line along EEZ - a line extending from the cross point at the coast of the border between Kabpaten Kampar and Kabpaten Bengkalis to the EEZ line via Iyu Kecil LH (N 1° 11.5'/E 103° 21.0') - the coastal line along Propinsi Pekanbaru

Table 5-3-1 Responsible Areas of Operation for KPLP Units (3/9)

No.	KANWIL	KPLP Unit	Responsible Area of Operation
6	II	Teluk Bayur	The water areas surrounded by: - the administrative area of KANWIL II, - the line along EEZ - the coastal line along Teluk Bayur
7*	III	Tg.Priok Sunda Kelapa Panjang Melak	The water areas surrounded by: - the administrative area of KANWIL III, - the line along EEZ - a line extending from the cross point at the coast of the border between Propinsi Bengkulu and Propinsi Lampung to Enggano LH (S 5° 29'/E 102° 23') - the coastal line along Belawan and the surface of the water along Sungai Siak - a line extending in the direction 225° from Enggano Lighthouse to the cross point with the EEZ line - a line extending from Discovery East Bank LH to Tg.Indramayu via P.Rakit LH (S 5° 56.5'/E 108° 23.0') - the coastal line along Tg.Priok and Panjang
8	III	Cirebon	The water areas surrounded by: - the administrative area of KANWIL III, - the line along EEZ - a line extending in the direction of the point at Pulau Rakit LH (S 5° 56.5'/E 108° 23.0') from the point of Discovery East Bank LH (S 3° 35.0'/E 109° 10.0') to the Point of Tanjung Indramayu. - a line extending from Discovery East Bank LH to Tg.Indramayu via Pulau Rakit LH (S 5° 56.5'/E 108° 23.0') - the coastal line along Cirebon
9	III	Pointianak	The water areas surrounded by: - the administrative area of KANWIL III, - the line along EEZ - a line extending from the point where three administrative lines of KANWILs III, IV, and V meet together to Discovery East Bank LH (or L.B) (S 3° 35.0'/E 109° 10.0') - a line extending from Discovery East Bank LH (or L.B) to Pulau Rakit LH (N 0° 15'/E 108° 02') - the coastal line along Pontianak - a line extending in the direction of 35° at the border between Kabpaten Lombok Barat and Kabpaten Lombok Timur to the cross point with the KANWIL IV line - the coastal line along Surabaya

Table 5-3-1 Responsible Areas of Operation for KPLP Units (4/9)

No.	KANWIL	KPLP Unit	Responsible Area of Operation
13*	IV	Benoa Lember	The water areas included Benoa surrounded by: - the administrative area of KANWIL IV, - the limited line of EEZ - a line extending in the direction of 190° from the cross point at the southern coast of the border between Propinsi Jawa Tenga and Jawa Timur to the cross point of the EEZ line - a line extending in the direction of GS. Sekmoi LB. (S 7° 51'/E 117° 12') from the top (1248 m above sea level: S 7° 51'/E 117° 12') of Gunung Baluran to the cross point with a line extending in the direction of 35° from the cross point at northern coast of the border between Kabpaten Lombok Barat and Kabpaten Lombok Timur to the cross point with KANWIL IV line - A line extending in the direction of 35° from the cross point at the line extending from Gunung Baluran to Gs.Sekmoi LB to the cross point with the KANWIL IV line via cross point cross point at the northern coast of the border between Kabpaten Lombok Barat and Kabpaten Lombok Timur - a line extending in the direction of 0° from the cross point at northern coast of the border between Kabpaten Manggarai and Kabpaten Ngada to the cross point with the KANWIL IV line - a line extending in the direction of 190° from the cross point at the southern coast of the border Kabpaten Sumba Barat and Kabpaten Sumba Timur to the cross point with the EEZ line - the coastal line along Kabata - the coastal line along Kabpaten Manggarai - the coastal line along Kabpaten Sumba Barat - a line extending from the cross point at southern coast of the border between Kabpaten Manggarai and Kabpaten Ngada to the cross point at the northern coast of the border between Kabpaten Sumba Barat and Kabpaten Sumba Timur

Table 5-3-1 Responsible Areas of Operation for KPLP Units (5/9)

No.	KANWIL	KPLP Unit	Responsible Area of Operation
14	IV	Semarang	The water areas surrounded by: - the administrative area of KANWIL IV, - a line extending in the direction of 0° from the cross point at the coast of the border between Propinsi Jawa Tengah and Propinsi Jawa Timur to the cross point with the KANWIL IV line - the coastal line along Semarang
15	IV	cilacap	The water areas surrounded by: - the administrative area of KANWIL IV, - a line extending in the direction of 190° from the cross point at the southern coast of the border between Propinsi Jawa Tengah Propinsi Jawa Timur to the cross point with the EEZ line - the coastal line along Cilacap
16*	IV	Kupang Dilli	The water areas surrounded by: - the administrative area of KANWIL IV, - the line along EEZ - a line extending in the direction of 0° from the cross point at the northern coast of the border between Kabpaten Manggarai and Kabpaten Ngada - a line extending from the cross point at southern coast of the border between Kabpaten Manggarai and Kabpaten Ngada to the cross point at the northern coast of the border between Kabpaten Sumba Barat and Kabpaten Sumba Timur - a line extending in the direction of 190° from the cross point at the southern coast of the border Kabpaten Sumba Barat and Kabpaten Sumba Timur to the cross point with the EEZ line - the coastal line along Kabpaten Ngada - the coastal line along Kabpaten Sumba Timur - the coastal line along Kabpaten Sumba Barat
17*	V	Banjarmasin Sumpit	The water areas surrounded by: - the administrative area of KANWIL V, - a line extending to Pular Keremian LB (S 5° 06'/E 114° 36') from Tanjung Selatan LH (S 4° 10.5'/E 114° 39.0') to the cross point with the KANWIL V line - the coastal line along mouth of Sungai Sumpit and Sungai Barito and the water surface along Sungai Sumpit and Sungai Barito

Table 5-3-1 Responsible Areas of Operation for KPLP Units (6/9)

No.	KANWIL	KPLP Unit	Responsible Area of Operation
18*	V	Samarinda Balikpapan	The water areas surrounded by: - the administrative area of KANWIL V, - a line extending to Pular Keremian LB (S 5° 06'/E 114° 36') from Tanjung Selatan LH (S 4° 10.5'/E 114° 39.0') to the cross point with the KANWIL V line - a line extending in the direction of Pular Tinguan LH (N 0° 35'/E 119° 48') from Tanjung Mangkalihat LH (N 0° 59'/E 119° 48') from Tanjung Mangkalihat LH (N 0° 59'/E 118° 59') to the cross point of KANWIL V line - the coastal line along mouth of Sungai Makaham and the water surface along Sungai Makaham
19	V	Terakan	The water areas surrounded by: - the administrative area of KANWIL V, - the line along EEZ - a line extending in the direction of Pular Tunguan LH (N 0° 35'/E 119° 48') from Tanjung Mangkalihat LH (N 0° 59.5'/E 118° 59.0') to the cross point with KANWIL V line - the coastal line along Tanjungredeb
20*	VI	Ujung Pandang Kendari	The water areas surrounded by: - the administrative area of KANWIL VI, - a line extending in the direction of Kunyit LH (S 4° 05.5'/E 116° 02.5') from the cross point with the KANWIL VI line - the coastal line along Kendari and Ujung Pandang
21	VI	Pare Pare	The water areas surrounded by: - the administrative area of KANWIL VI, - a line extending in the direction of Kunyit LH (S 4° 05.5'/E 116° 02.5') from the cross point at the coast of the border between Kabpaten Barru and Kabpaten Kepulauan to the cross point with the KANWIL VI line - the coastal line along Pare Pare

Table 5-3-1 Responsible Areas of Operation for KPLP Units (7/9)

No.	KANWIL	KPLP Unit	Responsible Area of Operation
22*	VII	Manado Bitung	The water areas surrounded by: - the administrative area of KANWIL VII, - the line along EEZ - a line extending in the direction of 340° from the cross point at the northern coast of the borden between Propinsi Sulawesi Tengah and Propinsi Sulawesi Utara to the cross point with the KANWIL VII line - the coastal line along Bitung
23	VII	Donggala	The water areas surrounded by: - the administrative area of KANWIL VII, - the line along EEZ - a line extending in the direction of 340° from the cross point at the northern coast of the borden between Propinsi Sulawesi Tengah and Propinsi Sulawesi Utara to the cross point with the KANWIL VII line - the coastal line along Donggala
24	VIII	Ambon	The water areas surrounded by: - the administrative area of KANWIL VIII, - the line along EEZ - a line extending from the cross point at latitude 2 degree north of the borden between the KANWIL VIII and the KANWIL IX to the point where three administrative lines of KANWILs VI, VII and VIII meet together - at the same time the water areas including Pular Ambon
25	VIII	Ternate	The water areas surrounded by: - the administrative area of KANWIL VIII, - the line along EEZ - a line extending from the cross point at latitude 2 degree north of the borden between the KANSIL VIII and the KANWIL IX to the point where three administrative lines of KANWILs VI, VII and VIII meet together - at the same time the water areas including Ternate

Table 5-3-1 Responsible Areas of Operation for KPLP Units (8/9)

No.	KANWIL	KPLP Unit	Responsible Area of Operation
26	IX	Jayapura	The water areas surrounded by: - the administrative area of KANWIL IX, - a line extending in the direction of 0° from the cross point at the coast of the border between Kabpaten Jayapura and Kabpaten Yapenwaropena to the cross point with the EEZ line - the coastal line along Jayapura
27*	IX	Biak Manokwari	The water areas surrounded by: - the administrative area of KANWIL IX, - a line extending in the direction of 0° from the cross point at the coast of the border between Kabpaten Jayapura and Kabpaten Yapenwaropena to the cross point with the EEZ line - a line extending in the direction of 0° from the cross point at the northern coast of the border between Kabpaten Sorong and Kabpaten Jayawijaya to the cross point with the EEZ line - the coastal line along Manokwari
28	IX	Sorong	The water areas surrounded by: - the administrative area of KANWIL IX, - a line extending in the direction of 0° from the cross point at the northern coast of the border between Kabpaten Sorong and Kabpaten Jayawijaya to the cross point with the EEZ line - a line extending in the direction of 230° from the point at Tanjung Winsop to the cross point until the KANWIL IX line - the coastal line along Sorong
29	IX	Fak Fak	The water areas surrounded by: - the administrative area of KANWIL IX, - a line extending in the direction of 230° from the point at Tanjung Winsop (near Teluk Tamuloi in Kabpaten Sorong) to the cross point of the KANWIL line - a line extending in the direction f the point from the cross point at the coast of the border between Kabpaten Fak Fak and Kabpaten Merauke to the cross point with the KANWIL IX line - the coastal line along Fak Fak

Table 5-3-1 Responsible Areas of Operation for KPLP Units (9/9)

No.	KANWIL	KPLP Unit	Responsible Area of Operation
30	IX	Merauke	The water areas surrounded by: - the administrative area of KANWIL IX, - the line along EEZ line - a line extending in the direction of the point (S 6°/E 136°) from the cross point at the coast of the borden between Kabpaten Fak Fak and Kabpaten Merauke to the cross point with the KANWIL IX line - the coastal line along Merauke

Notes: * shows the joint responsible area of operation (total 12)

5.3.2 Allocation of Maritime Safety Rescue Ships

(1) Number and Allocation of Maritime Safety Rescue Ships

(i) Class I Ships

The Class I ships are to belong to the DGSC Fleet. they are strategically and predominantly important for overall maritime safety and SAR operations including international SAR. The Class I ships will operate to provide the wide coverage either doubled with the Class II's or to complement their operational coverage fulfilling the possible gaps in area. The helicopter carrying features of this type of ship will have considerable advantages in SAR operations.

(ii) Class II Ships

The Class II ships are to be allocated based on the analytical study made in Section 5.2. 11 ships are to be required. The Class II ships are also belong to the DGSC Fleet. There should need at least one Class II ship to be allocated to the individual KANWILs for the preparedness of maritime safety and SAR activities, and two for the specific KANWILs, i.e. Tg.Priok and Surabaya.

(iii) Class III Ships

The total number of 33 ships is to be required. The Class III ships will be allocated in principle one each for the individual bases.

(iv) Classes IV/V Ships

The total number of 32 for Class IV and 53 for Class V is to be respectively required.

The Class IV/V ships will be allocated in principle one pair each for the individual bases, and two pairs for the main bases.

(2) **Development of Maritime Safety Rescue Ships**

The development of maritime safety rescue ships is planned according to the following:

(i) Total number of maritime safety rescue ships required for each class

(ii) Scrapping and replacement plan to be adjusted up to the year 2005

(iii) The balance number of (i) and (ii) above to be developed

The number of maritime safety rescue ships by class is decided based on the analytical study and also on the strategical and operational requirements. The total number required in 2005 is 133 ships of various classes. The number existing maritime safety rescue ships is 123 in total, and some of them are fairly old.

The government regulations for ship scrapping, MOC Decree KM.57/HK.404/Phb-84, March 29 '84 and DGSC Implementing Decree A1.59/1/13-84, Dec. 31 '84, for ship scrapping should be considered for the overall plan. The number of 8 ships out of the total existence should be scrapped by the year 2005. The balance number of ships in conformity with the scrapping plan should, therefore, be replaced. The details of scrapping plan is given in APPENDIX-V/8.

The balance number of ships to be required in 2005 is 28 in total, which will be allocated to the relevant bases.

5.3.3 Allocation of Aircraft

The number of aircraft required is estimated based on the calculations. Those should be strategically allocated.

(1) Major Requirements for and Performances of Maritime Safety Rescue Aircraft

The major performances required for the aircraft to be used for search and rescue and patrol missions should have the capabilities enumerated below:

a. Airworthiness should be maintained for flight operations under adverse weather conditions.
b. Loading capacity should be secured enough to be for rescue equipment and devices, victims and other necessary items.
c. Cruising capacities should have possible long range and time of SAR activities.
d. Range of flying speed should be wide to be able to fly fast to the scene and to fly slow for the operations.

As regards the on board installation, the following requirements need to be met:

- Navigation equipment for all weather operations.
- Communications equipment to link with ships and other aircraft besides the ordinary radio installations.
- Necessary provision of rescue facilities and equipment on board.

(2) Type of Aircraft and Operation Range

The aircraft to be used for search and rescue missions may be divided into the two types in terms of operational range:

a. Long range endurance airplane
   This type of airplane should have a cruising capacity of covering the radius of over 1,000 miles.
b. Medium to short range endurance helicopter
   This type of helicopter should have cruising capacity of covering the radius of up to about 170 miles, equipped with lifting capability for rescue operations.

The functions stated above are carefully examine for the optimum selection together with the reliability, and expenses for maintenance and logistic including supply of parts.

(3) Number and Allocation of Aircraft

The number of aircraft to be required is analyzed in Section 5.2, and based on this together with strategical considerations taken into consideration, the allocation of aircraft is made. 2 aircraft are to be based at each station for both types for their operational readiness of 24-hour activities. Consideration is also paid to the practical maintenance aspect since fairly long time will be required for the checking and maintenance of aircraft.

6 Marine Disaster Prevention

6.1 Present Situation

6.2 Analysis

6.3 Long-term Development Plan

Section 6 Marine Disaster Prevention

6.1 Present Situation

6.1.1 Actual Status of Tanker Accidents

(1) Indonesian Flag Tankers

(i) Number of Tankers

The number of tankers in Indonesia shows the continuous growth for the past 8 years from 1979 to 1986, as given in Fig. 6-1-1 giving the annual average growth rate of about 7%.

(ii) Average Gross Tonnage

The average gross tonnage of Indonesian flag tankers also grew by about 6% during the same period of 8 years as shown in Fig. 6-1-1.

(iii) Tankers Call

As regards tankers call to the main oil ports in Indonesia, Balikpapan ranks first in number followed by Dumai, the largest port for crude oil export, and then by Cilacap. The details are as given in APPENDIX-VI/1.

(iv) Tankers Belonging to Pertamina

Pertamina possesses and operates the total number of 146 tankers as of 1987 for their oil activities reaching about 2.96 million DWT as detailed in APPENDIX-VI/2.

(2) Tanker Accidents

(i) According to the data issued by BASARNAS on accidents, the number thereof shows an increasing trend during the past five years from 1981 to 1985 as given in Fig. 6-1-1.

On the other hand, the data on tanker accidents extracted from the DGSC Log book on marine accidents indicates that the accidents for the recent three years from 1984 to 1986 show a decreasing trend as given in Fig. 6-1-1.

(ii) The accidents involving Indonesian tankers occurred during the three years from 1981 to 1983 are graphed in Fig. 6-1-2 and Fig. 6-1-4 classified by type of accident and area and distance based on the data from BASARNAS for the 3 years from 1981 to 1983. The accidents by kind indicate that over 60% of the total number is due to collisions, engine troubles, strandings and floodings in such order, and that an increasing trend is observed in engine troubles, strandings and floodings. The accidents by area and distance indicate that the in-port occurrence has the highest number, followed by the less than 12 miles except the port area and then by the 12 miles or over, occupying 80% of the total occurrences. An increasing trend is seen in the accidents occurred in 3 - 12 miles areas.

The accidents by kind based on the DGSC data are graphed in Fig. 6-1-3 for the past five years, and their occurrences are in the order of collisions, troubles of engines, propeller and rudder, and strandings, which in all occupy over 80% of the total. The area-wise analysis specifies Cilacap, Surabaya and Palembang as the high occurrence areas.

(iii) Two cases of tanker accidents occurred in 1987 are introduced in APPENDIX-VI/6, as the examples of records, in which actions were taken to recover the spills.

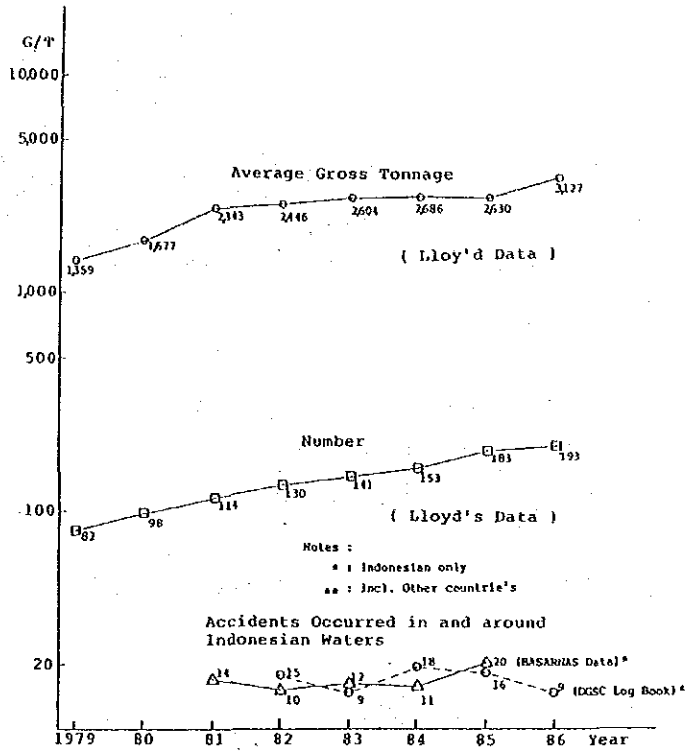


Fig. 6-1-1 Number of Tankers in Indonesia

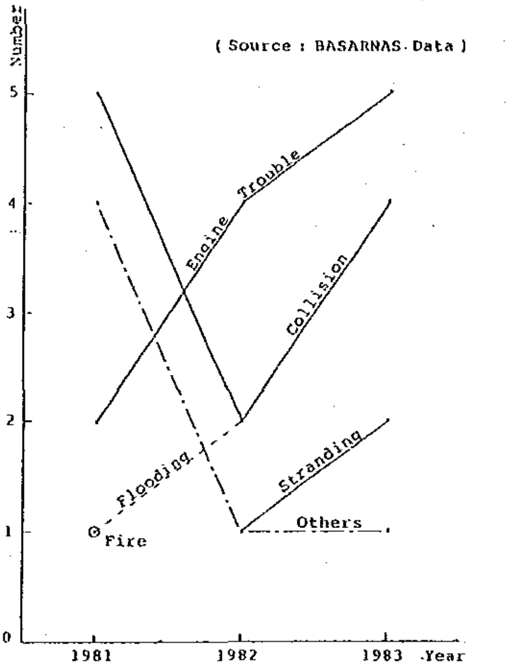


Fig. 6-1-2 Kind of Accidents by Tanker (BASARNAS)

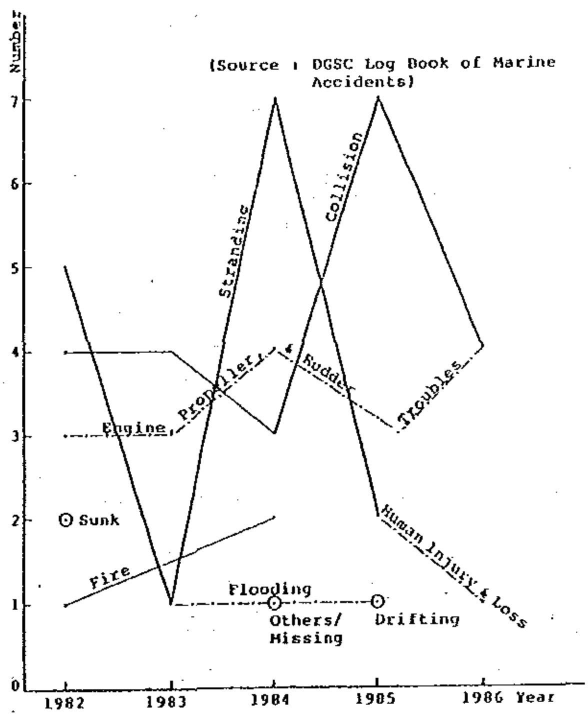


Fig. 6-1-3 Kind of Accidents by Tanker (DGSC)

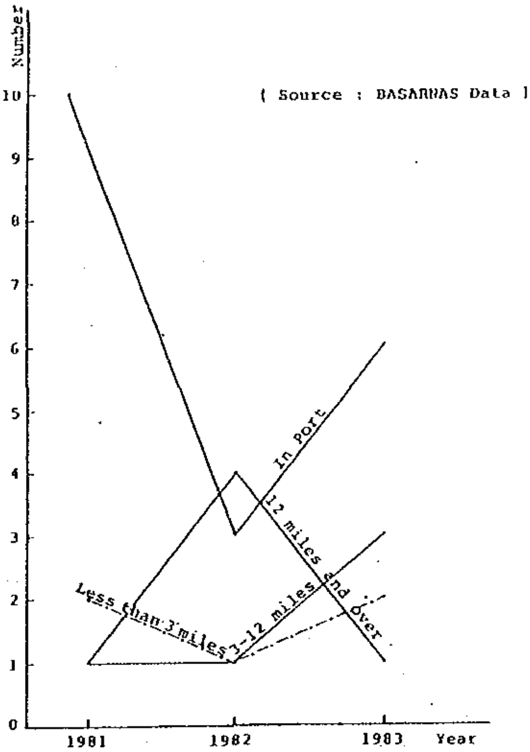


Fig. 6-1-4 Tanker Accidents by Distance

6.1.2 Organization for Prevention of Marine Disasters

(1) National Organization (Central)

(i) The marine environment protection in Indonesia is under the responsibilities of the Ministers of Communications, Mining and Energy, and Environment for the policy making. As regards the prevention of marine disaster, the Minister of Communications has the responsibility.

(ii) The Directorate General of Sea Communications represents the Ministry of Communications for the management, supervision, administration and execution of the prevention of marine disasters and pollution.

(iii) The Director General of Sea Communication has the authority as the General Controller.

(iv) The Directorate of Sea and Coast Guard is responsible for the planning and execution of the combatting services, and the Directorate of Marine Safety is responsible for controlling sea and coast pollution.

(2) National Organization (Regional and local)

(i) The Heads of KANWILs are responsible for the control and operation of the local operational units for marine disaster prevention as the Mission Coordinators. The Mission Coordinators also coordinate the equipment and materials for marine disaster prevention owned by Pertamina, Navy, private companies and so on.

(ii) The Port Administrators are those who have responsibilities for the operations the the On-scene Coordinators. The On-scene Coordinators carry out the operational coordinations for the equipment and materials to be used for the execution of services.

The On-scene Coordinators are also responsible for mobilizing and allocating the combatting ships.

(iii) The On-scene Commanders are to be appointed from staff of KPLP Unit or Captains of the Maritime Safety Rescue Ships to assume the operational responsibilities on the scene.

The On-scene Commanders are responsible for commanding the operations directing the combatting ships and mobilizing the equipment and materials.

(3) Other Organizations such as Pertamina, Private Co., etc.

(i) Pertamina, under the exclusive right granted by the Government of Indonesia, has been exploring and producing oil and gas under the contracts with oil companies overseas.

(ii) Pertamina is a giant national enterprise operating under the management and operation committee with the Minister of Mining and Energy appointed as its Chairman, and the Board of Directors consists of the President and six Directors.

(iii) The Directorate of Shipping and Communications among the total of six Directorates is responsible for the marine disaster prevention. Pertamina has the branches in the main ports throughout. The Directorate of Shipping and Communications and the local branches are the technical support bodies to provide the equipment and materials for combatting marine pollution and disasters.

(iv) Pertamina has the 6 associated companies and 22 joint venture companies, and those which engage in marine disaster prevention are PT Arun and PT Badak.

(v) The overseas companies contracted with Pertamina are Caltex, Iiapco, Mobil, Acro, Huffco, etc.

(4) Organizational Structure at the Time of Occurrence of Large Scale Accidents

If and when large scale oil spills or fires occur, the Directorate General of Sea Communication, namely the Directorate of Sea and Coast Guard is to primarily control the operations mobilizing the equipment and materials from Pertamina (Perusahaan Pertambangan Minyak dan Gas Bumi Negara: State-owned oil company) and other sources under the coordination of BASARNAS whenever necessary. The organizational chart is shown in Fig. 6-1-5.

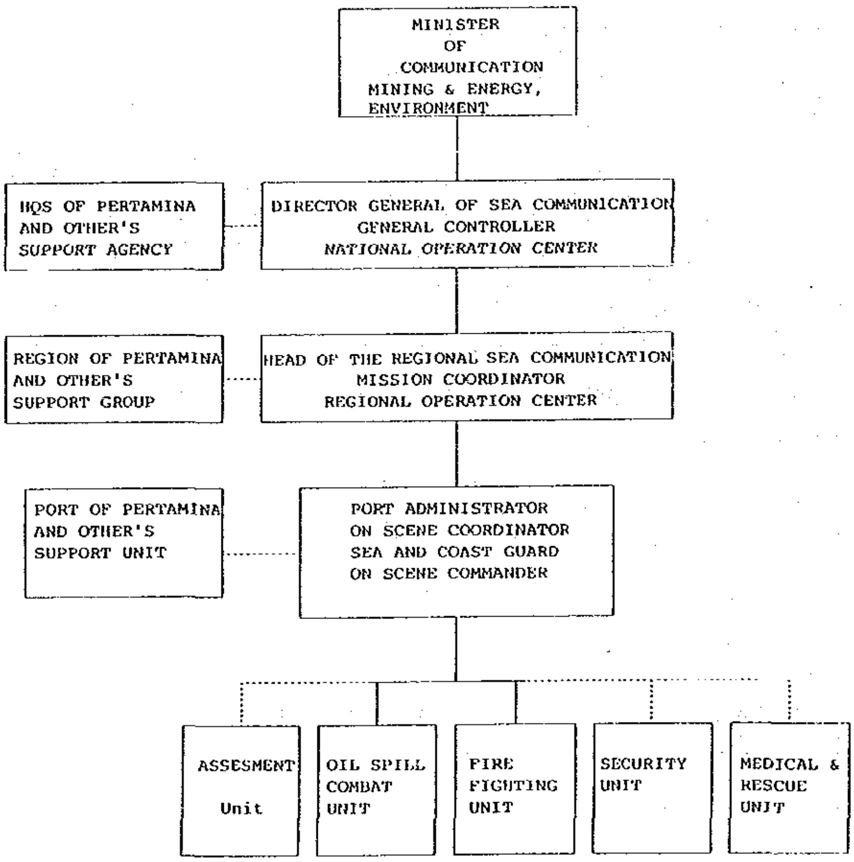


Fig. 6-1-5 Organizational Structure of Marine Disaster Prevention in Indonesia

6.1.3 Marine Disaster Combatting Ships, Equipment, Materials and Specialists

(1) Marine Disaster Combatting Ships

(i) Exclusive-use Spilled Oil Recovery Ships

There are no exclusive use ships for recovery of spilled oil (oil recovery ships, oil boom expansion barges) owned by DGSC, Pertamina or any other private companies in Indonesia.

(ii) Ships with Spilled Oil Recovery Capability

a) Maritime Safety Rescue ships belonging to KPLP units

The maritime safety rescue ships Class II belonging to the KPLP Fleet and those of Class III to V belonging to KPLP units, number 123 in total, and if they would be allocated properly they may possibly be included in the recovery mission forces, provided that their operational performances would be reasonable. However, the situation is such that most of them may operate within limited water areas including ports and rivers, and only 9 Class II ships are operative in oceanic waters.

b) Ships belonging to Public Port Corporation (Perumpel)

The tug boats and oil barges owned by Perumpel may be used for recovering spilled oil. A list of those ships is given in APPENDIX-VI/7.

c) Ships belonging to Public Dredging Corporation (Perumpen)

The dredgers owned by Perumpen may be utilized for recovering spilled crude oil of high pour point (Arimbi, Cinta, Handil, Jatibarang, Lirik, Sangatta, South Palembang, Sumatran Light, Talang Akar Perudopo, etc.). A list of the dredgers is given in APPENDIX-VI/8.

d) Ships belonging to Pertamina

The tug boats, workships, oil barges belonging to Pertamina may be utilized as the useful means of recovering spilled oil. APPENDIX-VI/9 shows the details.

(iii) Fire-fighting Ships

There are 13 fire-fighting ships owned by Pertamina, and their performances are as given below:

Table 6-1-1 Main Performances of Fire-fighting Ships Owned by Pertamina

No. of ships	Horse power	Gross tons	Fire fighting capability		
			1 Unit (m^3/min)	No. of Fire gun	Total (m^3/min)
13	12,480	2,046	2	91	182

(iv) Ships with Fire-fighting Facilities

The 9 Class II maritime safety rescue ships are equipped with the fire-fighting facilities. The ships are in about 3 months rotational operation attached to other KANWILs except one or two ships based at Tg.Priok in KANWIL III. the gives the Table 6-1-2 fire-fighting capabilities.

There are 10 ships equipped with fire-fighting facilities, owned by Perumpel, and their performances are as given in APPENDIX-VI/10.

(v) Ships as Supporting Forces for Disaster Combatting

A list of the ships which may be mobilized for combatting disasters is given in APPENDIX-VI/11 extracted from the Lloyd's List of Ships (1986 - 1987).

Table 6-1-2 Fare Facilities of Maritime Safety Rescue Ship Class II, DGSC

Maximum Capacity of dicharging Water rate (m^3/min)	No. of Vessel	Total (m^3/ Min)	Foam water type				Powder type		
			Maximum Capacity of discharging Foam water rate (m^3/min)	Height of thheighest discharger above sea level (m)	No. of Vessel	Toatl (m^3/ Min)	Maximum Capacity of discharging powder (kg/sec)	No. of Vessel	Total (kg/ sec)
2	9	18	2	17	9	18	2 (Portable)	9	18

The total number gives 580 ships, among which the ships over 100 gross tons are included in 1) to 5) above.

(2) Equipment and Materials for Oil-pollution Combatting

(i) Equipment and Materials for Recovery of Spilled Oil

Almost all of the equipment and materials currently available belong to Pertamina, while only minor portion is owned by foreign oil companies and DGSC. The allocation list of equipment and materials for anti-pollution combatting by port is given in APPENDIX-VI/12.

(ii) Fire-fighting equipment and materials

The fire-fighting equipment and materials are owned respectively by KPLP, Perumpel, Pertamina and private companies. There are 50 asbestos clothes and 70 fire extinguishers in total as detailed in APPENDIX-VI/13, and the 18 clothes and 54 extinguishers are fitted on board out of them.

In Perumpel, there are a number of equipment and materials allocated to the respective ports of Belawan, Tg.Priok, Tg.Perak and Ujung Pandang including fire engines in their disposition at the warves. APPENDIX-VI/14 shows those available at Tg.Priok as an example. The main items are 12 asbestos clothes, 40 fire extinguishers and so on.

Pertamina and private companies have their own equipment and materials ready for any incidents, and they are allocated to each port site.

(3) Specialists

(i) Supervisors and machine operators and the personnel who received special training courses.

a) In DGSC, there are 28 supervisors who completed the anti-pollution training courses overseas; Japan, France and the Philippines including the on site training course held in Davao city.

There are also 50 machine operators who completed the special training course held in Indonesia. In KPLP, 25 persons completed the special courses for marine pollution, and 18 persons for fire-fighting.

b) In Pertamina, there are 15 supervisors qualified for anti-pollution activities, and they are based at each oil terminal.

(ii) Personnel Who will be in Charge of Disaster Combatting upon Occurrence

a) Crew of maritime safety rescue ships

The crew on board KPLP ships to talling 123 ships of Classes II to V may be mobilized as the manpower for combatting forces. The total number of crew in 1986/87 counted 506 consisting of:

- National officers and personnel	227
- Engine officers and personnel	155
- Radio officers and personnel	24
- Others	100

b) Personnel of KPLP units

On-shore personnel working for KPLP units may also be mobilized, whenever necessary, as the combatting forces.

(iii) Supporting manpower

a) The crew of ships belonging to Districts of Navigation and Harbour Masters will provide the support. The personnel of Public Port Corporation and Public Dredging Cooperation will also provide the support.

b) Personnel of Pertamina

The personnel of Pertamina engage in handling the anti-pollution equipment and materials stockpiled by them at the relevant ports under the control of on-scene commmander. Pertamina has formed the groups of personnel organizing one to three of them at the relevant terminals, each consisting of:

Equipment and materials	No. of personnel
Oil boom (300 m)	4
Oil skimmer (1 unit)	2
Dispersing pump (1 unit)	2
Dispersing sprayer (2 units)	2
Oil containment bag or drum cans	4
Total	14

6.2 Analysis

6.2.1 Forecast for Tankers in 2005

(1) Number of Indonesian Flag Tankers

Based on the data on the number of Indonesian flag tankers stated in Section 6.1.1, the following formula is given applying a straight line representing the method of least squares:

Y = 65.5 : 15.8x ... 1

where,

Y: number of tankers

x: figure of the year to be applied deducted by 1978

The above formula indicates the annual increase of 7%.

(2) Average Gross Tonnage of Indonesian Flag Tankers

On the basis of the data on the average gross tonnage of Indonesian flag tankers stated in Section 6.1.1, the following formula is given applying a straight line representing the method of least squares:

$$Y = 1,377 + 218x \quad \ldots \quad 2$$

where,

Y: average gross tonnage of tankers

x: figure of the year to be applied deducted by 1978.

The above formula indicates the annual increase of 6%.

(3) Accidents of Tankers in and around Indonesian Waters

The forecast is made in Table 6-2-1 for the number of accidents by oil tankers in the year 2005 at 23. This figure is estimated by a formula with a variable of the number of voyages by tankers along the coastal waters and based on the number of accidents analyzed from the 'DGSC Log Book of marine accidents'. Similarly, the estimated number of tanker accidents in 1990 results in 11.

(4) Result of Forecast

The result of the forecast in 1990 and 2005, made according to the formula 1 and 2 given above, and the forecast made in (3) above, is as given in Table 6-2-1, and graphed in Fig. 6-2-1.

Table 6-2-1 Forecast for Number and Average Gross Tonnage of Indonesian Flag Tankers and Number of Accidents thereof

Item \ Year	1990	2005
Number of tankers	255	492
Average gross tonnage	3,993	7,263
Number of tanker accidents (including other nationals)	11	23

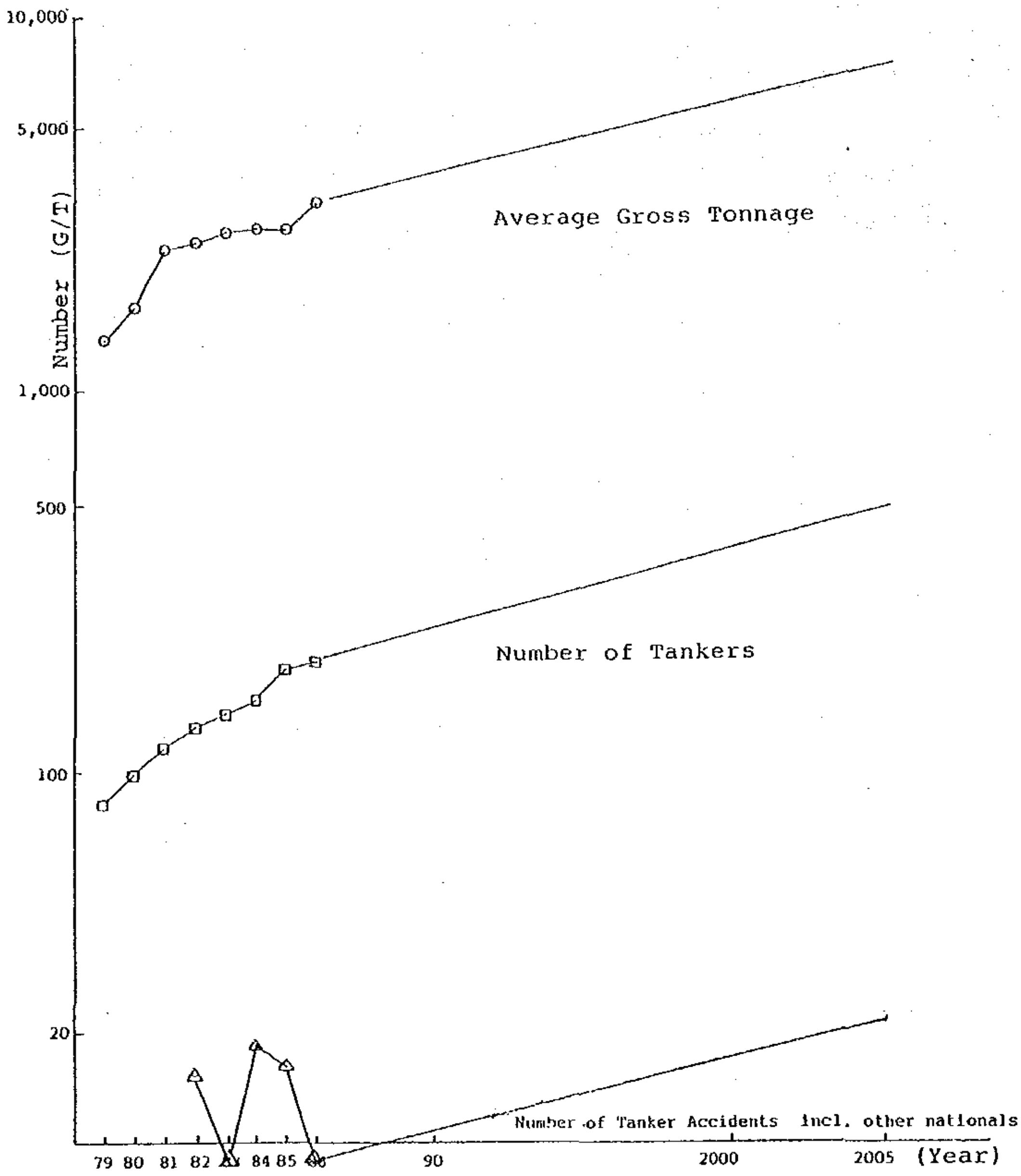


Fig. 6-2-1 Forecast for Indonesian Tankers

6.2.2 Hypothetical Occurrence of Tanker Accidents

(1) Hypothetical Model Ship

A hypothetical model ship is assumed based on the forecast of average gross tonnage made for Indonesian flag tankers in 2005 described in Section 6.2.1, through selection of a standard type of tanker from the Pertamina tankers dominating in number in Indonesia. The type of Pertamina tankers, the largest in number, is G.P.I (General Purpose I), and as of 1987, 23 of this type of tankers were in operation. A model type tanker, the latest model meeting the above requirements, is selected from G.P.I, and the drawing and the main performances of the model type of tanker are given in Fig. 6-2-2 and Table 6-2-2.

(2) Hypothetical Accident Area

The tanker accidents by area are analyzed in Section 6.1.1, which shows that over 80% of the tanker accidents occurred within 12 miles off shore, and that the number of accidents in the 3 - 12 miles range indicates an increasing trend. Also, large type tankers normally operate in the areas of 10 - 12 miles off shore. Therefore, a hypothetical accident is assumed to have occurred 10 miles off shore outside port.

(3) Hypothetical outflow of oil by tanker accidents

(i) MARPOL 1978

The Protocol of 1978 relating to MARPOL 1973 provides for the standards on the structures of cargo tanks and their arrangements for the purpose of preventing a volume of outflow into sea or bringing it under control, when tankers are damaged due to collisions, strandings and so on. The Protocol was ratified by the Government of the Republic of Indonesia on 21 Oct., 1986, and has been effect since 21 Jan., 1987. It is, accordingly, considered appropriate to make an assumption of the hypothetical outflow of oil based thereupon.

(ii) Regulations for Structure and Arrangements of Cargo Tanks Specified in MARPOL 73/78

The regulations for the structure and arrangements of cargo tanks provided for in MARPOL 73/78 consist of the limitation in volume of any one cargo oil tank and the limitation in hypothetical outflow of oil of an oil tanker, and other items.

a) Limitation in volume of one cargo oil tank

The volume of any one wing cargo oil tank of an oil tanker shall not exceed seventy-five percent of the limits of the hypothetical oil outflow (outflow limit). Also, the volume of any one center cargo oil tank shall not exceed 50,000 cubic meters.

b) Limitation in length of cargo tank

The length of each cargo tank shall not exceed 10 meters or one of the following values, whichever is the greater:

a. where no longitudinal bulkhead is provided: 0.1L
b. where a longitudinal bulkhead is provided at the centerline only: 0.15L
c. Where two or more longitudinal bulkheads are provided:
    (a) for wing tanks: 0.2L
    (b) for center tanks:
        i) if $\frac{bi}{B}$ is equal to or greater than $\frac{1}{5}$: 0.2L
        ii) if $\frac{bi}{B}$ is less than $\frac{1}{5}$:
            - where no centerline longitudinal bulkhead is provided: $(0.5\frac{bi}{B} + 0.1)L$
            - where a centerline longitudinal bulkhead is provided: $(0.25\frac{bi}{B} + 0.15)L$

where,

L : length of ship (m)

B : width of ship (m)

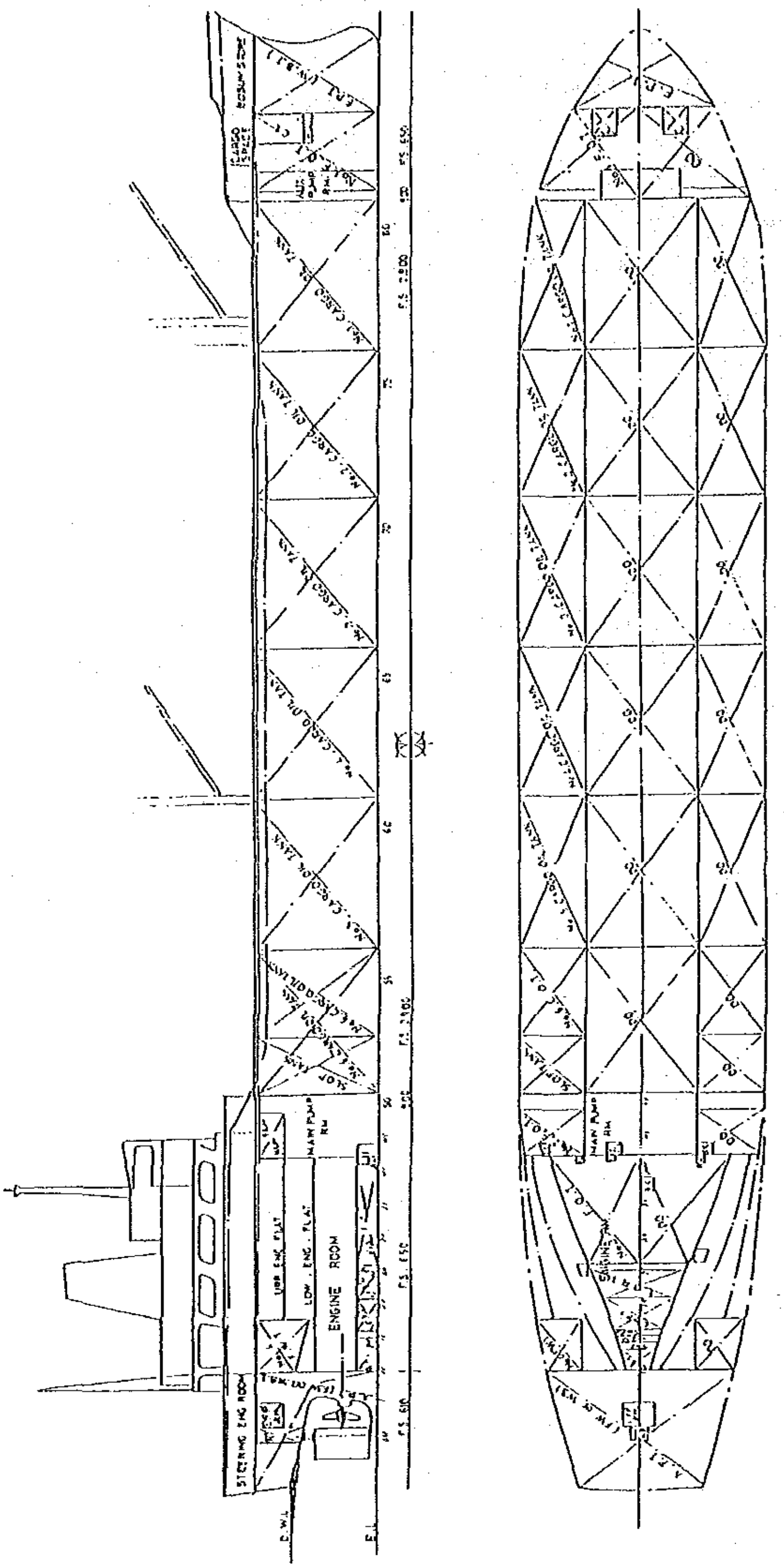
bi: width of wing tank (m)

c) Limitation in hypothetical outflow of oil

The length and arrangements of cargo tanks shall be such that hypothetical outflow of oil shall not exceed the limitation defined in Fig. 6-2-3. Calculation, in the case of damages, needs to be done for the hypothetical outflow of oil from an oil tanker to be based on the extent of damages suffered.

a. Damage assumption

The three dimensions of the extent of damages of a parallelepiped on the side and bottom of the ship is assumed. The conditions given hereunder represent the maximum conceivable damages, and shall be individually applied to the combinations under the worst conditions in all conceivable locations of the oil tanker.



PRINCIPAL PARTICULARS

LENGTH	(PP)	135M00
BREADTH	(MLD)	21M00
DEPTH	(MLD)	10M30
DRAFT	(MLD) (DESIGNED)	7M30
GROSS TONNAGE		9,491T03
SPEED	(SERVICE) (ab)	12.4 KNOTS
SPEED	(MAX)	14.064 KNOTS
DEAD WEIGHT TONNAGE		12,862T80

Fig. 6-2-2 A model Type of Oil Tanker for Hypothetical Study

Table 6-2-2 Cargo Oil Tank Capacity of Model Tanker

Name	Location		Capacity (m^3)		G (M)	KG (M)
	Side	Frame	100% Full	98% full		
No. 1 C. O. T.	P	76 - 81	724.61	710.12	44.72F	5.39
No. 1 C. O. T.	S	76 - 81	724.61	710.12	44.72F	5.39
No. 1 C. O. T.	C	76 - 81	1,531.76	1,501.12	45.25F	5.32
No. 2 C. O. T.	P	71 - 76	848.31	831.34	30.75F	5.23
No. 2 C. O. T.	S	71 - 76	848.31	831.34	30.75F	5.23
No. 2 C. O. T.	C	71 - 76	1,521.30	1,500.67	30.75F	5.32
No. 3 C. O. T.	P	66 - 71	847.97	831.01	16.25F	5.23
No. 3 C. O. T.	S	66 - 71	847.97	831.01	16.25F	5.23
No. 3 C. O. T.	C	66 - 71	1,530.06	1,499.46	16.25F	5.32
No. 4 C. O. T.	P	61 - 66	848.40	831.43	1.75F	5.23
No. 4 C. O. T.	S	61 - 66	848.40	831.43	1.75F	5.23
No. 4 C. O. T.	C	61 - 66	1,530.06	1,499.46	1.75F	5.32
No. 5 C. O. T.	P	56 - 61	848.37	831.40	12.75A	5.23
No. 5 C. O. T.	S	56 - 61	848.37	831.40	12.75A	5.23
No. 5 C. O. T.	C	56 - 61	1,528.83	1,498.25	12.75A	5.32
No. 6 C. O. T.	P	53 - 56	503.90	493.82	24.33A	5.27
No. 6 C. O. T.	S	53 - 56	503.90	493.82	24.33A	5.27
No. 6 C. O. T.	C	51 - 56	1,524.66	1,494.17	27.25A	5.32
TOTAL			18,409.79	18,051.37		
SLOP T	P	51 - 53	315.82	309.50	31.56A	5.46
SLOP T	S	51 - 53	315.82	309.50	31.56A	5.46
TOTAL			631.64	619.00		

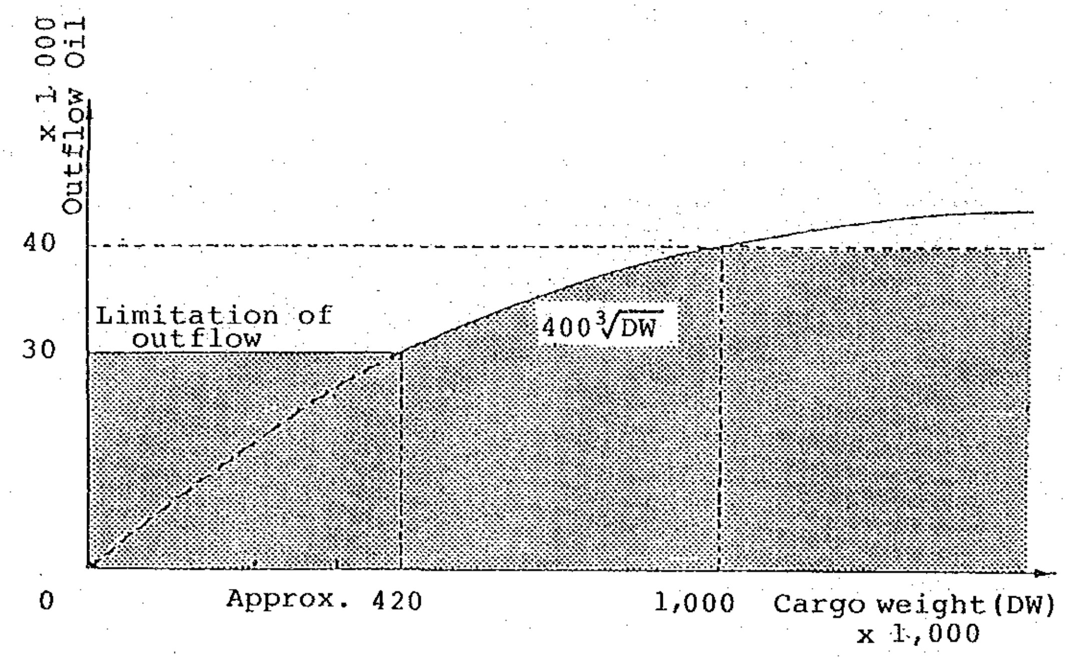


Fig. 6-2-3 Limitation in Hypothetical Outflow of Oil

(a) Side damage

Hypothetical side damages are as follow:

i) Longitudinal extent (lc):

$\frac{1}{3}L^{\frac{2}{3}}$ or 14.5 meters, whichever is less

ii) Transverse extent (tc):

$\frac{B}{5}$ or 11.5 meters, whichever is less

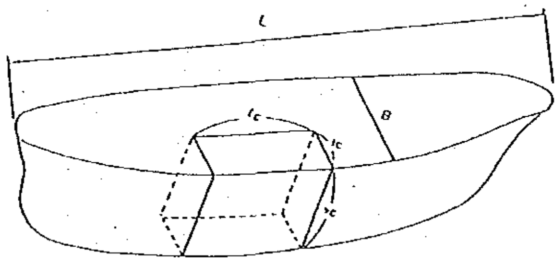
iii) Vertical extent (Vc):

from the base line upwards without limit

where,

L: length of ship (m)

B: width of ship (m)

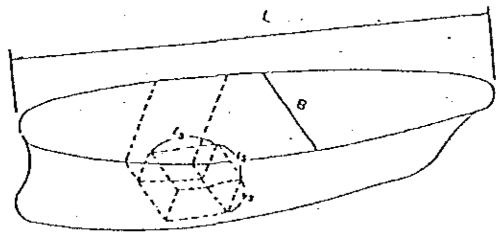


$lc = \frac{1}{3}L^{\frac{2}{3}}$ or 14.5 (m)

$tc = \frac{B}{5}$ or 11.5 (m)

Vc = from the base line upwards

Side Damage



$ls = \frac{L}{10}$ or 5 (m)

$ts = \frac{B}{5}$ or 5 (m)

$Vs = \frac{B}{15}$ or 6 (m)

Bottom Damage

(b) Bottom damage (Stranding)

Hypothetical bottom damages are as follows:

	For 0.3L from the forward perpendicular of the ship	Any other part of the ship
i) Longitudinal extent (ls):	$\frac{L}{10}$	$\frac{L}{10}$ or 5 meters, whichever is less
ii) Transverse extent (ts):	$\frac{B}{6}$ or 10 meters, whichever is less but not less than 5 meters	5 meters

iii) Vertical extent from the base line (Vs):
$\frac{B}{15}$ or 6 meters, whichever is less

where,

L: length of ship (m)

B: width of ship (m)

b. Calculation of hypothetical outflow of oil

The hypothetical outflow of oil in the case of collisions and strandings shall be calculated by the following formulae with respect to compartments branched by damage to all conceivable locations along the length of the ship to the extent as defined in a. above.

$$Oc = \Sigma\, Wi + \Sigma\, KiCi$$

$$Os = A\, (\Sigma\, ZiWi + \Sigma\, ZiCi)$$

where,

Oc: hypothetical outflow of oil by side damages (m^3)

Os: hypothetical outflow of oil by bottom damages (m^3)

Wi: volume of a wing tank (m^3)

In calculating Oc, if a void space where no oil cargo is to be loaded is located between the two wing tanks adjacent to side of a ship (li is smaller than lc and only the wing tanks immediately adjacent to side of a ship), Wi may be substituted by the volume to be calculated by the following formula multiplied by the volume of the smaller of the two tanks:

$(1 - \frac{li}{lc})$

li ... longitudinal length of the void space (m)

lc ... $\frac{1}{3}L^{\frac{2}{3}}$ or 14.5 meters, whichever is less

Ki: $Ki = 1 - \frac{bi}{tc}$ or 0

(in the case of bi > tc)

bi ... width of wing tank (m)

tc ... $\frac{B}{5}$ or 11.5 meters, whichever is less

Ci: volume of a center tank assumed to be breached by the damage (m^3)

A : $A = \frac{1}{3}$ (if 4 or more center tanks are assumed to be breached by the damage, $A = \frac{1}{4}$, except under a certain condition)

Zi: $Zi = 1 - \frac{hi}{Vs}$ or 0 (in the case of hi > Vs)

hi ... minimum depth measured in board from the ships bottom at right angles to the outer bottom surface of the double bottom (m) except that the double bottom extends only for a part of the tank under consideration.

Vs: $\frac{B}{15}$ or 6 meters, whichever is less

As the result of calculations made respectively for the side damages of Model Ships No. 4 and No. 5 and for the bottom damages of central cargo tanks of Model Ships No. 3 and 4, the following is given:

- Hypothetical outflow of oil by side damages ... 1,696 m^3
- Hypothetical outflow of oil by bottom damages.. 1,585 m^3

(4) Hypothetical scale of fire

No provisions and regulations are referred to the scale of fires in international conventions.

It is widely known in general that possibility of igniting the oil immediately after spilling started due to the skin frictional heat caused between steel plates of structures. In such case, it may be regarded that fires extend to the oil surfaced over sea water and the oil in damaged cargo tanks is to be flamed upon contact with air.

The fire on sea surface may burn itself out in reasonably short time, while the fire on oil in cargo tanks may last long in general though it depends on the volume of oil left stored, the size, position, and shape of opening breached by damages.

The area of fire in the case of two cargo tanks damaged is the surface area of two cargo tanks. Therefore, the maximum surface area of two wing tanks positioned side by side is calculated to be given as 166 m^2, which will last long in flame.

6.2.3 Necessary Quantity of Equipment and Materials

(1) Basic assumption for oil spill

Based on the hypothetical tanker accidents assumed in Section 6.2.2, the anti-disaster combatting ships or towed barges loaded with the necessary equipment and materials are to be mobilized upon receipt of the information on tanker accidents spilling the maximum volume of up to 1,696 m^3 of crude oil, in order to restrictedly surround the accident area by oil booms. The time required from receipt of the information to arrival of the ships at the scene is estimated at three hours, within which 80% of the spilled oil are to be recovered and the rest of 20% will be chemically dispersed. All the works will be carried out in two days.

(2) Calculation of necessary quantity for oil spill

(i) Range of oil spill

The range of oil spill three hours after the occurrence of accident is to be represented by a formula of spreading. An assumption is made on the prevailing conditions at the areas where sea is calm and there are no impacts by current, tide and wind, since the weather and sea conditions in coastal areas in Indonesia are comparatively tranquil in general. Following gives the formula of spreading areas a few hours after oil spill started:

$$R(t) = 2 \times \left(\frac{16 \cdot g \cdot V^3 \cdot t}{\pi^3 \cdot c^2 \cdot \gamma} \right)^{\frac{1}{8}}$$

where,

$V = Vo\ (1 - Po/Ps)$

R(t): Diameter of spilled area
't' hours after spill started (m)

V : Volume of oil spills above sea surface (m^3)

Vo: Total volume of oil spills (m^3)

Po: Specific gravity of oil

Ps: Specific gravity of sea water (1.025)

C : Coefficient of average speed gradient of oil (0.1)

r : Stoke of oil (m^2/s)

g : Acceleration of gravity (9.8 m/sec^2)

π : Circular constant

t : time (sec)

In the above case, when Arjuna crude oil will be applied, the relevant variables are: P:0.8414; $r=5.27 \times 10^{-6}$; the pour point at 21.1°C; and the temperature of sea waters in and around Indonesian waters ranges 26° - 28°C, while the temperature of 21° - 38°C prevails in Indonesia. Therefore, under such conditions as described above, the oil spilled will not be solidified within two days after the spillage started.

When, all the relevant variables are applied to the above formula 1, the result obtained is as follows forming a concentric circle:

Diameter of spilled area	568 m
Circumference of spilled area ..	1,784 m
Total area of spill	253,388 m^2

(ii) Oil booms

The quantity of oil booms to be required will be dependent on the spreading conditions of oil spills and the deployment method of oil booms. It may also be considered that large volume of oil spills over at one time under calm conditions, and accordingly, the basic method of deploying oil booms will require the total length of 1,784 m, as calculated in (i) above.

(iii) Oil recovery ships and oil skimmers

It is not possible to completely recover the spilled oil, and even under ideal recovery conditions it is likely that at least 20% of the total will be left spreading over. In order to clear the volume of 1,696 m^2 of crude oil spread over before it will be emulsified, the recovery operations should be completed within two days after the accidents. When the actual working hours for recovery operations will be 24 hours, then the total recovery capacity of about 120 m^3/hour will be required.

It should be remarked that the capabilities and performances of spilled oil recovery ships and the relevant devices specified in the documentation generally describe the maximum values to be obtained under the most favorable conditions, and therefore that the recovery efficiency under normal prevailing conditions will be halved or less than that.

(iv) Oil barges, etc.

The volume of spilled oil recovered according to (iii) above needs to be temporality stored, and for this purpose, oil barges and such are required. The spilled oil recovered contains water in it. If the water would be removed from oil by an oil-water separator to store the oil in a tank of oil barge, etc., the maximum recoverable volume of oil per day (about 12 hours) will be around 700 cubic meters. Thus, an oil barge of such capacity will be required.

(v) Chemical dispersant

It is not recommendable to use dispersant in large quantities, because it harms the natural environment. When about 20% of the total spills left unrecovered after the recovery operations need to be chemically dispersed, about 70 kℓ of chemical dispersant are to be required if the spraying density of about 20% would be considered in relation to the quantity of spilled oil left unrecovered.

(vi) Discharging ratio for chemical dispersant

The discharging ratio of the minimum performance of about 50 ℓ/min. is required for effective and speedy discharging of chemical dispersant. They will be co-used with the proportioner of a Disaster Combatting Ship. The water discharging capacity of at least 1,700 ℓ/min. for a Disaster Combatting Ship will be necessary when the mixture ratio of chemical dispersant and sea water should be 0.03.

(3) Basic assumption for fire-fighting

Based on the model ship study made in Section 6.2.2, (4), the fires occurred should be extinguished or put under control by the fire-fighting ships and/or ships with fire-fighting facilities installed on board due to arrive, after fires broke out, at the scene two hours later, when the fires are still in flame in the two largest cargo tanks located at the both sides of the model tanker damaged.

(4) Calculation of necessary quantity for fire-fighting

(i) Fire area

The fire area estimated is 166 m^2 according to Section 6.2.2 (4).

(ii) Foam concentrate

Foam discharging is an effective means to extinguish fire of crude oil. The volume of foam concentrate required as its minimum for emergency use is given by the following formula:

$$Ve = \frac{Af \cdot m \cdot d \cdot 10}{s \cdot e}$$

where,

Ve: Volume of foam concentrate (ℓ)

m : Mixture ratio of foam concentrate and water, and it is given 0.03 or 0.06

S : Expansion ratio which is the magnification of foam expanded from the foam, and it is usually 5 - 10 times

e : Effective ratio, which acts effectively in application. This will vary due largely to fire conditions, discharging sprinkling technic and so on, and ranges 1/2 - 1/5 in general

d : Thickness of foam, which usually needs 15 cm or over

A_f: Area to be extinguished (m^2)

Accordingly,

The volume of foam concentrate is calculated as 1,992 liters. Where, the following are applied:

m = 0.06	S = 5
e = 1/5	d = 20 cm
A_f = 166 m^2	

(iii) Discharging capability of fire-fighting ship

a) Foam discharging capability

The foam discharging capability required for a fire boat may be provided for so that the foam discharge may be ensured for a unit area of fires within a unit of time. In general, it is assumed that the required foam discharge over crude oil fires per one square meter is 5 ℓ/min. If the successful hit ratio were set at 1/3, then the discharging capability of foaming water of 2,490 ℓ/min. would be required to extinguish the fire areas of 166 m^2. The time required in this case extinguishing fires over 166 m^2 would be about 13 minutes, when 6% foam concentrate will be used.

b) High pressure direct discharging capability

The high pressure direct water discharging is an effective means to control the fires, when oil spreading over sea surface from storage tanks is in flame.

c) Water sprinkling capability

The water sprinkling is effective to cool down the storage tanks adjacent to the tank in fire.

(iv) Fire-fighting devices

The fire-fighting devices needed for nozzlemen and other personnel are those items such as smoke-helmets, fire suits, shoes and globes, gas masks, life lines, destruction tools and so forth.

6.3 Long-term Development Plan

6.3.1 Allocation of On-shore Bases

Establishment of On-shore Bases needs to consider the criteria concerning traffic activities of super-tankers from the Pacific to the Persian Gulf or vice versa. Similarly also concerning activities of LNG vessels and vessels transporting chemicals, both liquid as well as cargo. Additionally, offshore oil exploration and exploitation and oil refinery activities.

Based on the available data, the above mentioned activities are substantial in the Malacca Strait Area, the Singapore Strait and South China Sea, which forms the shortest route from the Pacific Ocean to the Persian Gulf and vice versa.

For this purpose it is considered necessary to prepare operational units and its equipment, known as On-shore Bases in various certain harbours.

In Belawan to cover the Malacca Strait Area, at Tg. Uban to cover the Singapore Strait and the South China Sea Area. Whereas for the Lombok Strait area, Macassar Strait and Sulawesi Sea, which forms the long route from the Pacific Ocean to the Persian Gulf and vice versa, it is necessary to establish an On-shore Base in Surabaya to cover the Lombok Strait area, and at Ujung Pandang to cover the Macassar Strait area and in Bitung to cover the Sulawesi Sea area.

As the Macassar Strait is sufficiently large and along the coast of East Kalimantan from Balikpapan to Tarakan there are substantial offshore oil exploitation and exploration activities and oil refinery activities, therefore an On-shore Base is required in Balikpapan.

Similar considerations apply with the existence of offshore oil exploration and exploitation activities in the Java Sea and the Substantial tanker traffic in the Java Sea, therefore an On-shore Base is required at Tg.Priok/Jakarta.