3-4 Contents of the Project

3-4-1 Conditions of Ports of Call

The outlines of planned ports of call of the Project are as follows. (Refer to Appendices for major ports.)

11 fishing ports located in various areas along the Mozambican coastline are, from north to south, Mocimboa da Praia, Pemba, Nacala, Ilha de Mozambique, Angoche, Quelimane, Beira, Vilankulo, Inhambane, Xai-xai and Maputo (underlined ports are for the industrial fishery). In regard with the Project vessel, 5 ports, Pemba, Nacala, Quelimane, Beira and Maputo, will be main ports of call because of their demand for cargo.

The vessel will enter the port of Angoche and others by time when the tide condition is favorable.

Number of fishermen, name of port and small scale fisheries combinats by province for the above ports are given below.

Table 22 Number of Fishermen, Name of Port and Small Scale Fisheries Combinats by Province

Name of Province	Number of fishermen	Name of port	Name of combinat
Cabo Delgado	6,800	Mocimboa da Praia, Pemba	Ibo, Pemba
Nampula	8,000	Nacala, Ilha de Mozambique, Angoche	Moma, Ilha de Mozambique
Zambezia	7,800	Quelimane	Sofino
Sofala	5,200	Beira	Beira
Inhambane	10,500	Vilankulo, Inhambane	Inhambane
Gaza	550	Xai-xai	-
Maputo	3,200	Maputo	Maputo, Inhaca (Sulpesca)
Niassa (inland)	1,500	-	Metangula
Tete (inland)	1,000	-	Nova Chicoa
Manica (inland)	250	-	-
Total 10 provinces	44,800		

Note: Among all fishermen, 17,500 are affiliates of combinats according to the statistics of 1987.

Industrial Fishery;	Emopesca (National)	Bases: Beira, Quelimane, Angoche
	Efripel (Japan-Mozambique)	Quelimane
	Pescamar (Spain-Mozambique)	Beira
	Mosopesca (Soviet-Mozambique)	Maputo

The landed catches by port are as follows:

Table 23 Landed Catches by Port (Industrial Fishery, Combinat)

(Unit: ton)

Name of Base	1983	1984	1985	1986	1987
Maputo	8,699	7,190	8,141	10,807	12,501
Beira	4,384	4,547	4,119	9,140	7,338
Quelimane	3,847	3,943	4,054	4,000	3,710
Nacala	688	496	732	646	857
Pemba	317	205	178	193	140
Angoche	523	527	196	124	50
Others	237	647	337	335	267
Total	18,695	17,555	17,657	25,245	24,682

Note: The above catch excludes catch of 20,000 tons by non-organized fishermen and catch of 5,000 tons implemented by licensed fishery.

(1) Maputo

① Landed Catches

A Soviet-Mozambique joint company (MOSOPESCA) and a small scale fishery combinat (SULPESCA) are based at this port.

The landed catch of this port is 12,501 tons (1987) as shown in Table 23.

The almost all import fisheries products of the country are landed on this port (about 10,000 tons a year).

This port is used for collection of equipment and materials for fishing that the EQUIPESCA supplies as well as for import and export of fishing products.

When the Project vessel will be operated, this port will be the mother port of that vessel. The Project vessel will serve for

transporting fishing products and equipment and materials for fishing to consumers' areas and processing plants on the northern part of the country. It will be also used for carrying fishing products for export and consumers' areas around Maputo from the northern part of the country.

② Natural Conditions

Maputo is located at lat. 25° 55' S and long. 32°54' E Vessels of 12 m draft or less have no navigational problem within fairway in calling port.

However, the depth at the entrance of EMANA dockyard (located in fishing port) is 3.5 m deep and requires some cares for navigation. The current of river is slow enough to pose no problem in navigation.

The meteorology and marine meteorology of Maputo is as follows:

Maximum Temperature:	40°C	average:	27°C
Minimum Temperature:	10°C	average:	18°C
Average atmospheric pressure:			1,017 mb
Annual sunlight hours:			2,748 h (62%)
Annual precipitation:			767 m/m
Days with more than 1m/m of precipitation:			67 days (18%)
Average wind direction/average wind speed:			East - Southeast
			3.9 m/s
Highest tide:			3.9 m
Lowest tide:			0.3 m

Wind sometimes develops swell in the port. The wave high will be 1 m by Southeast wind of 8.3 m/s, and Northeast wind of 11.1 to 22.2 m/s develops wave with height of 2 m to 4 m. This fact should be considered in calling Maputo port.

③ Quay

This quay for fishing is 180 m long and 8 m deep. This quay is

provided with a 15 ton and a 40 ton electric cranes and fueling and freshwater loading facilities, too. Therefore, there is no obstacle for the Project vessel to use this quay. There also are cold storages (800 tons), processing shops (air burst type) and ice making machine (50 tons/day). EMANA dockyard is located at the back end of this fishing port.

There are two quays for commercial use with length 3,036 m and 536 m. Water depth is from 8 m to 12 m. There are 71 electric 3-80 ton cranes and 45 2-12 ton crane trucks. Maputo is the largest commercial port in Mozambique with fueling and freshwater loading facilities.

(2) Beira

① Landed Catches

A national corporation (EMOPESCA BEIRA), a Spain-Mozambique joint company and Beira Combinat are based at this port. A fishing products processing factory is also operated at this port under the control of the Fisheries Bureau of Province Sofala.

The landed catches of boats based at this port is 7,338 tons (1987) as shown in Table 23.

According to the Project, this port will be used for supplying raw materials for processed marine products from the other fishing stations and equipment and materials for fishing from the port of Maputo. Equally processed marine products will be carried from this port to consumers' areas and exporting ports.

② Natural Conditions

Beira is located at lat. 19°49' S and long. 34°50' E. To call this port, one has to obey marks at the mouth of PUNGUE river and come through channel.

The water depth in port is from 8 m to 10 m. However, the depth near the channel opening is 3.2 m. This shallowness poses no problem for fishing boats, but the Project vessel must wait high tide for entering.

The meteorology and marine meteorology of Beira is as follows:

Maximum Temperature:	38°C	average:	29°C
Minimum Temperature:	12°C	average:	21°C
Average atmospheric pressure:			1,015 mb
Annual sunlight hours:			2,883 h (62%)
Annual precipitation:			1,428 m/m
Days with more than 1m/m of precipitation:			83 days (18%)
Average wind direction/average wind speed:			East - Southeast
			3.8 m/s
Highest tide:			7.3 m
Lowest tide:			0.4 m

The highest tide of 7.58 m was recorded under the influence of river flooding and weather condition. As the difference between high tide and low tide is very large, the quay is designed to withstand the high tide of 8.0 m.

This port has the largest difference between high and low tide among the ports the Project vessel is planned to call. The design of cargo work facilities of the Project vessel shall consider such condition of the port of Beira.

Wind is mainly east-southeast. The frequency of east wind - south-southeast wind is 47%, and southwest wind - northwest wind is almost not observed.

③ Quay

The quay of fishing port is 176 m long. The fishing port is separated from the commercial port with a fence. The fishing port, however, is located at the south end of the commercial port. Water

depth is 8 m. There are three 3.5 ton electric cranes and fueling and fresh water loading facilities. There are no obstacle for the Project vessel to use this quay. However, special cares has to be taken for the cargo work when the difference between high and low tide is large.

This port is provided with a cold storage (800 tons), processing facilities (air blast type), and ice making machine (50 tons/day).

The length of quay for commercial use is 1,680 m. Water depth is from 8 m to 10 m. There are fifty-two 3 to 20 ton electric cranes, thirty 2 to 12 ton crane trucks, and fueling and fresh water loading facilities. Beira is the second largest commercial port in Mozambique. From this port a railway and oil pipeline is installed to link Harare, the capital of Zimbabwe. Beira is also the trading station of Zimbabwe.

(3) Quelimane

① Landed Catches

A national corporation (EMOPESCA QUELIMANE) and a Japan-Mozambique joint company (EFRIPEL) are based at this port. In Province of Zambezia, Sofino Combinat is established.

The landed catches of boats based at this port is 3,710 tons (1987).

According to the Project, this port will be used for transporting from the port of Maputo fishing products for consumers' areas around this port and equipment and materials for fishing station. Equally fishing products will be carried from this port to exporting ports and processing places.

Moreover, the Secretariat of State for Fisheries has a plan for priority promotion of this port by establishing the Fisheries Bureau of Quelimane.

② Natural Conditions

Quelimane is located at lat. 17°53' S and long. 36°53' E, and its port facilities at about 30 km up from the river-mouth of DOS BONS SINAIS.

The water depth at the river-mouth is shallow as from 1.80 to 2.20 m. At the high tide, a vessel with 5.5 m draft can navigate through the river-mouth, and at the low tide, a vessel with 3.7 m draft can enter the port. The fishing boats used to call Quelimane by passing the river-mouth about 2 hours before the high tide and using the rising tide.

As the banks around the mouth-river are low, there are no on land visible target of position identification, but in night time a vessel can confirm its position by watching a lighting buoy situated at 5 m deep off the river-mouth and come into the river-mouth with this first buoy and the on land auxiliary mark. There are no problems for navigation in the river when piloting by following the marks. The current of the river is 1.4 m/s on the low tide and 0.9 m/s on the high tide.

The meteorology and marine meteorology of Quelimane is as follows:

Wind direction :	Mainly East and Southeast
Average wind speed:	4.2 m/s
Maximum average wind speed:	12.5 m/s
Average Temperature (Rain Season November - April):	27°C
Average Temperature (Dry Season May - October):	23°C
Highest tide:	5.1 m
Lowest tide:	0.6 m

(Tide is measured at the river-mouth, Morupune. The high/low tide of Quelimane is 30 minutes later from Morupune.)

The swell developed by the wind will be considerably high at the river-mouth. This swell, however, is reduced by the shallows and gives no special influence to the river. The bottom soil conditions

are sand and mud at the river-mouth and mostly mud at the port.

③ Quay

The wharf of this port for fishing is a floating pier of 80 m long and 10 m wide. (Constructed in 1986 by the Japan's grant aid) This pier is connected to the bank with 100 long semi-mobile type wharf. A platform is added on the fixed wharf on which management office, cold storages, and ice making machine are installed. This port is also provided with fueling and freshwater loading facilities.

Cold storages are used for the small scale fishery as the industrial fishery companies (EFRIPEL, EMOPESCA) and the marine products distribution corporation (PESCOM) have their own cold storages in the city.

The length of quay for commercial use is 210 m and water depth is 5 m. There are five 40 ton electric cranes and three 3.2 to 8 ton crane trucks. This port is provided with fueling and freshwater loading facilities. The draft limitation at the river-mouth does not allow large vessel to call this port.

(4) Nacala

① Landed Catches

All fishing boats based at this port are belonging to small scale fishery combinats of the Province of Nampula (Moma, Ilha Mozambique), and no industrial fishery company is based at this port.

The landed catches of boats based at this port is small as 857 tons in 1987, as shown in Table 23, but about 8,000 fishermen are acting in this province and those fishing products are not calculated. Therefore, the catch to be transported by the Project vessel will be increased when dealing with the above fishing products.

According to the Project, this port will be used for transporting

from the port of Maputo fishing products for consumers' areas around this port and equipment and materials for fishing station. Equally fishing products will be carried from this port to exporting ports and processing places.

Moreover, the Secretariat of State for Fisheries has a plan for priority promotion of this port by establishing the Fisheries Bureau of Nacala.

② Natural Conditions

Nacala is located at lat. 14°32' S and long. 40°40' E. Nacala is at the east bank of FERNO bay opening to northeast. The water is deep to the bank. Nacala is a natural good port and have no problem for large size vessel to call.

The meteorology and marine meteorology of Nacala is as follows:

Maximum Temperature:	37°C	average:	31°C
Minimum Temperature:	14°C	average:	21°C
Average atmospheric pressure:			1,014 mb
Annual precipitation:			938 m/m
Annual sunlight hours:			2,823 h
Average wind direction/average wind speed:			
			Southwest - Southeast
			1.6 m/s (1961-1970)
			2.4 m/s (1971)
Highest tide:			4.3 m
Lowest tide:			0.3 m

The frequency of developing swell over 3 m in the port is under 10 percent. There are influences from northeast wind and east wind. The condition of anchorage is good.

③ Quay

Nacala is the third largest port in Mozambique. There are old

quay (700m) and new container quay (300m) for commerce. Water depth is from 16.0 m to 17.0 m. There are fifteen 5 to 25 ton electric cranes and eight 5 to 6 ton truck cranes. There are fueling and freshwater loading facilities.

However, no infrastructure for fishing is provided on the fishing quay. The Government of the country requested a refrigerated truck, a truck crane and a tank lorry as onshore transport supporting facilities for the fishing port where the Project vessel is planned to call.

(5) Pemba

① Landed Catches

Fishing boats based at this port are belonging to small scale fishery combinats of Ibo and Pemba. There is no base for the industrial fishery.

The landed catch in 1987 of the port is small as 140 tons as shown in Table 23, but about 6,800 fishermen are acting in this province and those fishing products are not calculated. Therefore, the catch to be transported by the Project vessel will be increased when dealing with the above fishing products.

② Natural Conditions

Pemba is located at lat. 12°58' S and long. 40°28' E. Pemba port is located at the southeast shore Pemba bay opening to east. The water depth is over 10 m. Pemba is a natural good port.

The meteorology and marine meteorology of Pemba is as follows:

Pemba is located in the northern region of Mozambique. Low atmospheric pressure and tropical cyclone are developed in this region. There are possibilities of strong wind because of extreme low pressure. The wind direction is not one fold. The wind speed sometimes goes over 13.9 m/s. The wind direction during rain season (October to February) is northeast, east and northwest. The wind direction during dry season (March to September) is just opposite to that of rain season: southeast, south, and southeast; in those direction, southeast and northeast are most frequent. The average maximum wind speed is 6.4 to 6.9 m/s (southeast, south, southwest). The coastline where the port faces the sea on the south.

The waves developed by the west, southwest and southeast wind affects the port. When wind of these direction continues more than one hour at wind speed 10 m/s, high waves of 1 m high are sometimes developed.

Highest tide:	4.4 m
Lowest tide:	0.2 m

③ Quay

The pier of this port is 182.5 m long and 22 m wide. This pier is connected to the shore with another semi-mobile type pier of 80 m long and 20 m wide. Water depth is 9 to 15 m. There are no crane for exclusive use. Cargo work is conducted by two 5 ton truck cranes.

There are fueling and freshwater loading facilities. However the fueling facility is not in operation in many times because of no fuel stock available. Also the condition of freshwater supply is bad and need time to load water.

There is no problem for this vessel to go along pier. But there will be problems for the fueling and freshwater loading .

(6) Angoche

① Landed Catches

Fishing boats based at this port are belonging to the EMOPESCA ANGOCHE.

The landed catches on this port in 1987 is very small as 50 tons as shown in Table 23. It is because of age deteriorated fishing boats of the corporation. Those boats are now reconstructed at Beira. Therefore, such small catch is mainly due to low rate of boats operation. It can be expected that the catch to be increased after the above reconstruction work and from recovery of operation rate and production activities.

② Natural Conditions

Angoche is located at lat. 16°14' S and long. 39°54' E. Angoche is at the north side of QUILUA channel. To call Angoche, enter QUILUA channel at the east end (lat. 16°13' S and long. 40°04' E) by adopting west-southwest course. There are shoal of 2.2 m depth near the entrance. One has to be careful to side wave as the vessel has to navigate parallel to the shore. This port requires skilled navigation to call. The depth in the channel is from 5.6 m to 21.0 m. Therefore, there is some limitation regarding this port that a large vessel cannot call at high tide if draft is high.

Highest tide: 4.6 m
Lowest tide: 0.3 m

③ Quay

There is a plan to construct pier with 5 m water depth. The schedule of construction is not yet decided. Presently a scraped vessel is merged in the water to be used as quay.

The depth, however, is shallow as 3 m. It is dangerous for the Project vessel to go along this quay. The depth of anchorage is,

however, from 6 m to 14 m. Therefore cargo work has to be conducted at anchorage places by using EMOPESCA boats and small-sized fishing boats of the small scale fishery.

EMOPESCA ANGOCHE possesses a refrigerating storehouse (150 tons) and ice making machine (3 tons/day). However, the catch is mainly consumed locally. The shrimps are directly sent to Beira by trawlers. Therefore, those facilities are scarcely used at the time of survey.

3-4-2 Plan for Transportation of Fishing Products

(1) Operation Plan

For establishing the operation plan, the cruising speed and loading facilities of the Project vessel are set as follows:

① Setting of Cruising Speed

The requested cruising speed of the Project vessel was 12.5 knots. However, for the characteristics of a coastal transport vessel, "No need for continuous long distance cruising" and "Cruising time shares less than 50% of whole operation time", 10 knots was set to the Project vessel as it is the most economical speed (main engine 1,000 PS). (The reduction of cruising speed from 12.5 knots to 10 knots results in an economy of fuel cost by 51%. In order to make 12.5 knots cruising, 1,950 PS is required, that means to increase the cruising speed by 25% requires about double horse power. Therefore, it is not economic.)

② Setting of Loading Facilities

The requested loading facilities was a crane of 20 tons. However, there is no reasons to need a heavy loading equipment when taking planned cargo items into consideration, there is no way for compensating the leaning of vessel on weight hanging time (if a crane hangs a weight of 20 tons, the vessel will lean by 18 degrees) because

of its small size, and no cost merit is found for such a small vessel. Two 3 tons cranes of derrick type will be provided for shortening stay days through effective loading works.

③ Operation Plan by Voyage

Assuming that the Project vessel will start at 18:00 from the port of Maputo, a voyage plan is set with the conditions below to calculate the cruising time and stay time. Navigation days and stay days will be as shown in Table 24 and a voyage will be 24.5 day.

Conditions: A. Cruising speed 9.5 knots (10 x 0.95)
Ordinary speed reduced by 5%
B. No night entrance or departure is planned because of insufficient port guiding facilities.
C. No onshore cargo receiving facilities makes night loading impossible.
D. About 10 m^3 of cargo will be loaded/unloaded per hour.(6 minutes/sling x 10 slings)
E. Stay days calculates 5% loss. (multiplied by 1.05)

Table 24. Operation Plan per Voyage

Port	Distance Total	Cruising time	Anchorage time
(Outward)	(nautical mile)	(hours)	(hours)
Maputo			
Beira	520	54.7	42
Quelimane	190	20.0	55
Nacala	325	34.2	32
Pemba	125	13.2	29
Sub Total	1,160	122.1	158
(Homeward)			
Pemba			
Nacala	125	13.2	36
Quelimane	325	34.2	50
Beira	190	20.0	50
Maputo	520	54.7	50
Sub Total	1,160	122.1	186
Total	2,320	244.2 (10.2 days)	344 (14.3 days)
		Average cruising speed: 9.47 knots	

In order to calculate the anchorage days of the Project vessel, the following conditions must be taken into considerations.

1) There are many river ports, and shallow channels are unavoidable. So some ports could be navigated only at the full tide. So this vessel has to wait the turning of the tide.

2) Most of the ports do not possess sufficient marks and buoys, so the possibility of port call and departure in night time is limited.

3) The efficiency of cargo work could be low, as some ports have not sufficient land transport facilities or as the Project vessel has to wait the fishing boats to come back.

Therefore, 1.5 days shall be counted for reserve. Accordingly, 10.2 days for navigation and 15.8 days (14.3 days for anchorage and 1.5 days for reserve) for anchorage, totally 26 days are set for necessary days of a voyage.

(Hereinafter, roughly 10 days for navigation and 16 days for anchorage will be adopted for counting a voyage.)

④ Annual Operation Plan

As the Project vessel requires once a year docking and inspection which counts 25 to 30 days. Therefore, possible number of voyages a year is 13 as shown in Table below.

Table 25 Operation Plan per Year

Item	Days/Voyage x Times/Year	Annual days
Voyage	10 days x 13 times	130 days
Anchorage	16 days x 13 times	208 days
Dockyard/Inspection	27 days x 1 time	27 days
Total		365 days

(2) Plan for Cargo Booking

The following cargo booking plan is determined considering the transport record and the transport plan discussed and confirmed at the field with the Secretariat of State for Fisheries.

① Fishing products

The fishing production of Mozambique is about 50,000 tons in 1987 as shown in Table 14. Among that 25,000 tons representing the fishing products excluding that of licensed fishery and non-organized fishermen together with 10,000 tons of imported products, totally 35,000 tons is subject to distribution. The actual coastal transport demand of the country is 2,950 tons (5,900 m^3) equivalent to 8.4% of the above total distribution quantity.

The cargo transport plan of the Secretariat of State for Fisheries says for the beginning of the provision of the Project vessel that the fishing products to be transported from the port of Maputo, booking port of the fishing products, to the northern region of the country such as Beira, Nacala, Pemba, etc. where the fishing products will be processed is estimated to be 3,000 m^3 (approx. 1,500 tons) and the fishing products from Quelimane and Angoche, fishing bases, to Beira and Maputo, processing places and export ports, to be 2,900 m^3 (approx. 1,450 tons), totaling 5,900 m^3 (2,950 tons). Assuming that the cargo will be evenly transported by 13 times navigation per year, because there is no significant seasonal change in the catch of the country, the transport amount of the fishing products of the Project vessel for the beginning should be 230 m^3 for outward and 223 m^3 for homeward.

According to the Fisheries Development Plan of the country, as shown in Table 19, the total fishing production of the industrial fishery and the combinats is planned to be increased by 2.8% a year. Therefore, at three years after the provision of the Project vessel, in 1993, it is estimated to realize an annual increase in the fishing production by approx. 5,000 tons. Accordingly, the annual increase of demand for transport is estimated as 5,000 tons multiplied by 8.4% (ratio of demand against whole fishing products) to be approx. 400 tons (800 m^3) for the purpose of planning.
The details of booking and landing of fishing products and fishing equipment and materials by port are given in (3) Space Demands.

② Equipment and Materials for Fishing

The equipment and materials for fishing (dry cargo) is planned to be 5,815m^3 per year based on the mean value of the past two year record of 1987 and 1988. The calculation is made taking into the consideration the condition of transport demand which has become normal with the improvement of national economy due to economic aids from Western European countries. Therefore, the past two year record is good for statistic data.

Among the above-mentioned demand, only 18.3% was transported by the existing transport vessel, RIGEL 2. The total dry cargo should initially be transported that vessel as it is specialized transport vessel for the fisheries section. However, because it is not operable due to aging, that cargo was transported by chartering space of NAVIK's vessel which is a coastal transport vessel. There are several deficiencies as follows:

A. The cargo ready to cope with the vessel's call which is non-regular is difficult. Moreover, planned distribution of materials to fishing boats and stations is impossible.

B. The required space could not always be guaranteed on the transport vessel.

C. Fishing boat should operate according to the schedule of cargo transport vessel when needing to receive equipment and materials from that transport vessel, and others.

This caused not only in activation of fishing or temporary shortage of equipment and materials but also damaged the efficiency of fishing boats by forcing them to receive a large amount of equipment and materials for fishing at one time. This hinders the fishing productivity, then increases the unnecessary expense caused by the loss of productivity.

The demand to transport the fishing products and the equipment and materials for fishing would increase with the progress of the fishing promotion. So the provision of the Project vessel is indispensable.

For the planned transport amount 5,815 m^3 based on the past two year average, the composition of cargo in volume is estimated as follows.

Package materials (carton case, plastic sac, etc.)	55% - 65%
Fishing gears and nets	20% - 30%
Bombe and drums (lubricant, coolant, oxygen, etc.)	5% - 10%
Parts, others (parts for vessels and fishing equipment)	5% - 10%

Package materials that accounts for the greatest component ratio of the equipment and materials for fishing is normally stored in the refrigerated cargo hold of fishing boats. Those materials are used to pack fishing products and those packed fishing products is also stored in the refrigerated cargo hold. If a fishing boats has to store a large volume of package materials at a time, this will give an adverse effect on the fishing products processing capacity and cargo holding capacity. So the package materials should be supplied periodically by small volume to fit the volume of fishing products.

As fishing gear and nets are also kept on the deck of fishing boat, if a large volume of fishing gear and nets are supplied to a fishing boat, it will limit the working space on the deck and damage the work efficiency. Especially on shrimp trawlers where large-sized machines such as winch, conveyer, etc. are placed on the deck, it will not only affect the work efficiency but also increase danger of work accident.

For parts, if even a small part is not promptly supplied, it will cause to stop the operation of fishing boat or factory. (Parts are often to be lost and not delivered.) So it is desirable to transport parts by a vessel for exclusive use.

From the above viewpoints, it is considered that the transport amount planned by the Secretariat of State for Fisheries, 5,815 m^3 is recommended to be fully transported by the Project vessel. Adding to approx. 450 m^3 (5,815 m^3 x 1/13 voyages), the demand for equipment and materials should also be calculated by considering increase after the provision of the Project vessel. Equally the following matters should be taken into consideration.

A. The dry cargo hold should be designed to make vessel balance (hull strength, trim, stability, etc.) with the refrigerated cargo hold.

B. It is not possible to enlarge the refrigerated cargo hold to match the dry cargo hold because of future estimation of cargo booking.

C. Some of cargo items could be transported by cargo vessel of the other sections to fill the shortage of transport space.

D. Fishing gear and nets could be loaded on the deck or in the refrigirated cargo hold together with refrigerated cargoes provided to space available.

From the above reasons, the cargo booking plan is established to satisfy 67% of the transport plan made by the Secretariat of State for Fisheries, 3,900 m^3 per year and 300 m^3 per voyage (3,900 m^3 x 1/13 voyages).

Therefore, the cargo booking plan of the Project vessel is established as follows.

Table 26 Cargo Booking Plan

(Unit: m^3)

Item	Booking Plan for Year		Cargo Plan for Voyage	
	Beginning	Future	Beginning	Future
Fishing Products				
Outward	3,000	3,800	230	290
Homeward	2,900	2,900	223	223
	5,900	6,700	453	515
Equipment and Materials for Fishing				
Outward	3,900	3,900	300	300
Homeward	-	-	-	-
	3,900	3,900	300	300
Total	9,800	10,600	753	815

Cargo amount for a voyage = Booking plan for a year x 1/13 voyages (a year)

Satisfying ratio to the transport of equipment and materials for fishing planned by Secretariat of State for Fisheries (67%)

(Note)

Future: Three years after the provision of the Project vessel (same hereinafter)

(3) Space Demands

The cargo plan by loading port and unloading port is as shown in Table 26. According to the plan, the maximum space demand required to the Project vessel is calculated as follows.

① Fishing Products

(Outward)

Loading Port: Maputo

		Beginning	Future
Unloading Port:	Beira	1,800 m^3	2,300 m^3
	Beira, Nacala, Pemba	1,200	1,500
	Total	3,000 m^3	3,800 m^3

Space demand : Beginning 3,000 x 1/13 = 230 m^3

Future 3,800 x 1/13 = 292 m^3

(Homeward)

Loading Port: Quelimane, Angoche

		Beginning	Future
Unloading Port:	Beira	1,700 m^3	1,700 m^3
	Beira, Maputo	1,200 m^3	1,200 m^3
	Total	2,900 m^3	2,900 m^3

Space demand :	Beginning	2,900 x 1/13 = 223 m^3
	Future	2,900 x 1/13 = 223 m^3

② Equipment and Materials for Fishing

(Outward)

Loading Port: Maputo

		Beginning	Future
Unloading Port:	Beira, Quelimane (60% of all)	2,340 m^3	2,340 m^3
	Nacala, Pemba (40% of all)	1,560	1,560
	Total	3,900 m^3	3,900 m^3

Space demand :	Beginning	3,900 m^3 x 1/13 = 300 m^3
	Future	3,900 m^3 x 1/13 = 300 m^3

(Note) Increase of the transport demand of equipment and material for fishing in future is not estimated for the reasons described in ② Equipment and materials for fishing, (2) Cargo Booking Plan.

(Homeward)

Although miscellaneous goods for cities other than the equipment and materials for fishing could be booked at the unloading ports, it is not calculated in the plan.

(On maximum space demand time)

From the above-mentioned reasons, for the Project vessel, on the time when it will leave from Maputo to Beira, it is the maximum space demand. Equally the equipment and materials for fishing, is transported from Maputo to production sites. Even in the future, the loading ports and unloading ports will not be changed. Accordingly, the maximum space demand is always on the departure from Maputo.

From the above reasons, the maximum holding capacity of the Project vessel is as shown in Table 27.

Table 27 Maximum Holding Capacity

(Unit: m^3)

Item	Year Cargo Booking Plan		Cargo Capacity by Voyage	
	Beginning	Future	Beginning	Future
Maximum Holding Capacity				
Fishing products (Outward)	3,000	3,800	230	292
Equipment and Materials for Fishing (Outward)	3,900	3,900	300	300
Total	6,900	7,700	530	592

(4) Setting of Project Vessel Holding Capacity

① Refrigerated Cargo Hold

According to Table 27, for the beginning the holding capacity (230 m^3) of the Project vessel will have a reserve of 70 m^3 (approx. 35 tons). However, by counting the future demand (after three years) 292 m^3, the holding capacity is set to be 300 m^3.

② Dry Cargo Hold

According to Table 27, the holding capacity is set to be 300 m^3. However, it requires to ensure deck strength and restoring force by taking into consideration the loading of equipment and materials for fishing on the deck.

(5) Space Demand Plan

As calculated in (4) Setting of Project Vessel Holding Capacity, the space demand for a voyage of the Project vessel is as follows.

Table 28 Space Demand Plan per Voyage

(Unit: m^3)

	Refrigerated cargo hold		Dry Cargo Hold		Total	
	Beginning	Future	Beginning	Future	Beginning	Future
Outward fishing products	230	292			230	292
Equipment & Materials for Fishing			300	300	300	300
Total	230	292	300	300	530	592
Homeward fishing products	223	223			223	223
Equipment & Materials for Fishing			-	-	-	-
Total	223	223			223	223
Total	453	515	300	300	753	815

1. In case where any not planned cargo booking is required on outward, reserve of refrigerated cargo hold or space on deck will cope with it.
2. No plan for dry cargo booking on homeward is presumed, but there is a large possibility of miscellaneous goods booking for cities other than fisheries section.

3-4-3 Implementation Organization

The Project vessel will be operated by the EQUIPESCA, a corporation under the control of the Secretariat of State for Fisheries.

(1) Business of EQUIPESCA

The corporation is established for promoting fisheries under the control of the Secretariat of State for Fisheries for the purpose of supply of equipment and materials for fishing. It has its own share of foreign currencies for importing equipment and materials for fishing. It has its head office in Maputo and three branch offices in Maputo, Beira and Nacala and is engaged in acquisition and supply of equipment and materials for fishing.

(2) Organization of EQUIPESCA

① Position of EQUIPESCA in Secretariat of State for Fisheries

The EQUIPESCA is one of 6 corporations established under the control of Secretariat of State for Fisheries and shares charge of supply of equipment and materials for fishing. In response to the request of the Secretariat of State for Fisheries (Bureau of Industrial Fishery, Bureau of Small Scale Fishery and Bureaus in several provinces), it acquires and supplies equipment and materials for fishing for the purpose of promoting the fisheries.

② Organization and Personnel Assignment of EQUIPESCA

A. Onshore

As shown in the Appendices, the employees of the EQUIPESCA counts 110. However, as it has no experience in transport vessel operation, three experienced persons will be additionally assigned for the control of operation on the implementation of the Project.

B. Vessel

As the EQUIPESCA has no experience in transport vessel operation, vessel's crew members are planned to be recruited as shown in Table 30.

(3) Business Revenue and Expenses of EQUIPESCA

The business revenue and expenses and assets and liabilities ratio of the corporation for 1986 to 1988 are as follows.

Table 29-1 Business Revenue and Expenses

(Unit: thousand meticais)

Item	1986	1987	1988 (first half)	1989 (budget)
Turnover	694,153	2,024,028	3,750,000	12,295,325
Net Profit	53,395	9,904	36,280	46,325

Table 29-2 Assets and Liabilities Ratio

Item	1986	1987
Current ratio (Cash, deposit/short term floating liabilities)	3.07	0.36
Floating ratio (Cash, deposit, receivable/ short term floating liabilities)	7.65	4.68
Assets ratio (Assets/liabilities)	1.48	1.12

The EQUIPESCA is a highly reputed corporation in Mozambique by its business results. It is a corporation under the control of Secretariat of State for Fisheries (100% invested by Secretariat of State for Fisheries).

The EQUIPESCA planned to achieve the turnover, 12,295,325 thousand Maticais for 1989 (164% of that in 1988). It is because of economic aids from international organizations based on the National Economy Rehabilitation Plan for fishing boats rehabilitation, repair of fishing facilities and enlargement of fishing size and expansion of dealing quantity as well as visible increase due to devaluation of currencies.

3-4-4 Operation System

As the EQUIPESCA possesses no transport vessel, no vessel's crew members are employed at present. However, until the provision of the Project vessel, the following number of crew will be recruited by targeting mainly experienced people on board of the industrial fishery boats (EMOPESCA, EFRIPEL, MOSOPESCA, PESCAMAR).

Also the operation of the Project vessel requires technical assistance on navigation and engine maintenance by four foreign officers and engineers. In the Project early technology transfer is planned to be conducted to four Mozambican staffs as counterparts (within three years).

The recruiting plan of crew for the operation of the Project vessel is as follows.

Table 30 Vessels Officer & Crew Recruiting Plan

	Foreigner	Mozambique	Total
(Officer)			
Captain	1	1	2
Chief Engineer	1	1	2
First Officer	1	1	2
First Engineer	1	1	2
(Crew)			
Deck Crew		12	12
Engine Crew		2	2
Cooking Crew		2	2
Sub Total	4	16	16
Total	4	20	24

Ten out of twelve deck crew are embarked on board for cargo work at each port of call. Therefore those personnel are on board as deck crew to eliminate the operation loss, such as impossibility of cargo work due to no cargo workers are found, low efficiency of cargo work because of inexperienced workers, etc. and to prevent cargo damage.

It is equally for training the workers and hull maintenance during navigation (simple work like hammering but requiring labour). It is also more effective in economical point of view as compared below than using cargo service of the port workers.

(A) Port cargo worker
@ 400 Meticais/hr x 8 x 148 hr = 473,600 Meticais/voyage

(B) Planned crew on board
@ 24,500 Meticais/month x 10 x 26/30 days = 212,333 Meticais/voyage

Accordingly the cargo work by the Project vessel is expressed (A)-(B). (A)-(B) = 261,267 Meticais/voyage is saved.

Note 1. Cargo work time (148 hr) per voyage is a total work time based on the operation plan.
Note 2. When considering the port cargo workers, it is planned to have 8 workers/watch. (minimum persons)

3-4-5 Fueling and Water Loading Plan

As many of planned fishing ports of call of the Project vessel are insufficiently provided with fueling and water loading facilities, the Project vessel will be required to supply fuel and fresh water to fishing boats. Therefore, the Project vessel should be designed to have fuel oil tank and fresh water tank for own consumption and supply to fishing boats up to the limit not to affect whole design.

3-4-6 Provision Plan of Onshore Supporting Equipment

As the Project vessel will conduct cargo work at fishing ports with insufficient port loading/unloading facilities, the following onshore supporting equipment will be supplied on each port of call for improving the operation efficiency.

(1) **Refrigerated Truck** **4 ton x 2**

These two trucks will be assigned for transporting the fishing products to Pemba and Nacala where refrigerated cargo strages are not available. The maximum carrying capacity of truck will be 4 tons for required carrying weight.

(2) **Fork Lift** **2 ton x 2**

These two fork lifts will be assigned for transporting the fishing products and equipment and materials for fishing to Beira and the Project vessel. Its maximum lifting capacity 2 tons is set according to the maximum weight per one sling of the Project vessel. That assigned on board of the vessel will be used for moving cargo on the loading wharf of each port.

(3) **Truck Crane** **1**

This will be placed on the wharf of Nacala fishing port where no heavy weight lifting equipment is available. The maximum lifting weight in the initial request was 25 ton crane following to the loading equipment of the Project vessel.

As a result of study, the transport plan of the Project vessel does not require a large capacity, but there will be a possibility of transport a heavy weight in the future. So the crane will be of 15 to 20 ton maximum lifting capacity.

(4) **Tank Lorry** **1**

It will be provided at Nacale to be used for transporting fuel oil supplied by the Project vessel to hold tanks and small scale fishing combinats. The capacity of the lorry will be 4 to 5 tons to match with the receiving capacity of the port.

(5) **Uncovered Truck 2**

These trucks will be used at Maputo and Beira for carrying equipment and materials for fishing to small scale fishing combinats. The carrying weight will be 4 tons for their weight to carry.

3-5 Necessary Conditions for Transport Vessel

Based on the study described in 3-4-2 Project for Transportation of Fishing Products, the principal particulars for the basic design of the Project vessel are as follows.

(1) Cruising speed: 10 knots
(2) Main engine PS: 1,000 PS
(3) Refrigerated hold: 300 m^3
(4) Dry cargo hold: 300 m^3
But cargo loaded on deck should be taken into consideration for designing deck strength.
(5) Fuel oil tank: Capacity to allow supply of fuel oil to other fishing boats is to be ensured in the limit not to affect the hull design.
(6) Fresh water tank: Same as above
(7) Loading/unloading facilities: Derrick Boom, winch type, 3 ton 2
(8) Complement: 24
(9) Draft: 3.9 m (to be as short as possible because in some ports shallow bottom limits the entrance.)
(10) Spare parts: for two year of normal operation
(11) Onshore supporting equipment:

①	Refrigerated truck	4 ton	2
②	Fork lift	2 ton	2
③	Truck crane	15 to 20 ton	1
④	Tank Lorry	4 to 5 ton	1
⑤	Uncovered truck	4 ton	2

3-6 Technical Assistance

Regarding the technical assistance by foreign officers and engineers, from the beginning of this project Mozambique has requested its realization. The project-site survey of the basic design study team confirmed that the operation of the Project vessel by only Mozambican crew is difficult and the technical assistance by foreign officers and engineers, smooth operation of vessel and early technology transfer is necessary.

As described in 3-4-4 Operation System, the EQUIPESCA plans to assign four Mozambicans to be counterparts to four foreign officers and engineers for early technology transfer. Equally the corporation will additionally assign three experienced onshore operation controllers for arranging necessary operation and management organization. It is considered that the technical assistance from Japan is desirable.

CHAPTER 4 BASIC DESIGN

CHAPTER 4 BASIC DESIGN

4-1 Policies for Basic Design

The team determined the followings as the principles for the basic design for this fishing products coastal transport vessel and equipment and materials.

(1) Study sufficiently the contents of the request of Mozambique, and make a basic design on the bases of the result obtained by the basic design study. In order that the vessel, equipment and materials will fit the objectives and demonstrate their performance as much as possible.

(2) Take the principles so that the coastal transport vessel will be excellent in safety, sea kindness and seaworthiness. Equally take into consideration energy saving, labor saving and maintenance cost saving as for the Project vessel. The Project vessel will be provided with the most appropriate navigation equipment and cargo gear for the Project.

(3) Take the principles for design to reduce the management and implementation cost of the Project vessel which will be charged by the operation agency, EQUIPESCA, as little as possible.

(4) In selecting equipment and materials, those are limited to the bare necessity of the Project plan, put importance on the easy handling and the durability as much as possible. The spare parts should be available as easily as possible.

(5) Design the Project vessel by taking into consideration the laws, regulations, status of fisheries, route conditions, sea

conditions, weather conditions in Mozambique, and further the social status of the country.

(6) Take the rust and dust prevention measures for improvement of the durability of the vessel because the vessel will operate in tropical region.

4-2 Study on Conditions for Basic Design

(1) Vessel Size

Since the Project vessel is a transport vessel, the priority is given to the cargo hold capacity and cargo work equipment. The type and size of the Project vessel is decided from the required cargo hold capacities.

① Study of Cargo Hold Capacity

Based on the previous Chapter "Plan for Transportation of Fishing Products" the cargo capacity for one voyage is decided as follows.

A. Cargo Volume per Voyage

Table 31 Cargo Volume per Voyage

(Unit: m^3)

Discription of Cargo	Outward		Homeward
	Beginning	Future (3 years after)	
Equipment and Materials for Fishing	Loaded at Maputo 300	Loaded at Maputo 300	
Refrigerated Fishing Products	Loaded at Maputo 230	Loaded at Maputo 292	Loaded at Quelimane and Angoche 223
Total	530	592	223
Designed Hold Capacity	600		600

B. Setting of Cargo Hold Capacity

The maximum cargo demand of the Project vessel will be achieved at the departure of outward voyage from Maputo port as described in the operation plan. Since the loaded volume is 592 m^3, the demanded volume should be 592 m^3 to 600 m^3.

C. Division of Cargo Hold

The demanded volume becomes the highest at the departure from Maputo as described in the operation plan. And based on the volume as a standard value, the capacity of dry cargo hold and refrigerated hold shall be decided each to 300 m^3, totally 600 m^3 taking into consideration of improvement of the hull balance and cargo work efficiency.

(2) Vessel Type

The Project vessel is decided to a after bridge with long poop and single deck type which is a standard type for small transport vessel.

(3) General Arrangement

General arrangement of the Project vessel shall be decided as follows.

① Set a fuel oil tank and ballast water tank or ballast tank in front of the cargo holds (dry cargo hold and refrigerated cargo hold) and in the lower side of them, set a section where bow thruster and its driving equipment are installed.

② Lower side of the cargo hold is double bottom and used as fuel tank and ballast water tank.

③ Install cargo gears on the deck and secure a place for a handling of cargo on the deck and apply under-deck stringers and pillers

having enough strength for enduring the load on the deck including cargo.

④ Accommodation space is arranged on the engine room at the stern and the space shall be as wide as equipment for 24 persons is installed. The space shall be wide for installation of the lifesaving equipment enough to satisfy SOLAS Convention (Safety of Life at sea).

⑤ Store, fuel oil tank and fresh water tank, etc. are to be arranged behind the engine room.

(4) Basic Outfit

Basic outfit of the Project vessel shall be as follows.

① Propeller shaft is simple single propulsion type and double propulsion type shaft is not equipped.

② In order to secure the turning performance in harbors, the rudder should have optimum area and secure the controllability of the vessel by bow thruster. Flap rudder is not equipped.

③ Install box keel with appropriate depth under the flat plate keel and prevent the failure of sonar.

④ On the ship's bottom, attach enough bilge keels to reduce the rolling due to cross wind and beam sea in cruising near the coast as low as possible.

⑤ For navigation instrument, equip NNSS and other necessary electronic equipment and form an all weather vessel. Select the easy handling instrument, and also they have enough actual results.

(5) Cargo Work Equipment

As described in detail in (1) Operation Plan of the Chapter 3, 3-4-2, Plan for Transportation of Fishing Products, two 3 ton burtoning type derrick booms will be equipped.

(6) Ship Classification

The Project vessel should take the international classification to guarantee the quality and for future maintenance. Most of Mozambique vessels take the French classification BV (Bureau Veritas) for the vessel structure and equipments to guarantee safety. The Mozambique Government suggests that one of six international classifications which can be converted to BV classification is acceptable. The Project vessel is designed to qualify to the NK (Nihon Kaiji Kyokai) classification.

(7) Laws and Regulation to apply and refer

As the registry of the Project vessel will be Mozambique, it will be governed by the Mozambique internal laws and regulations. However the internal laws and regulations are not yet fully prepared for the safety on the sea. Therefore, SOLAS and other international convention shall be applicable.

① International Convention for the Safety of Life at Sea (SOLAS)
② International Load Line Convention
③ International Convention for the Prevention of Pollution
④ International Regulations for Tonnage Measurement of Ships

4-3 Basic Design

4-3-1 Details

Principal dimensions of the Project vessel are decided by the volume under the deck, i.e., cargo hold volume, tank volume, engine room volume, etc.

Cargo hold volume is decided by the demand of cargo. Fuel tank volume is decided by main and auxiliary engine outputs and fuel consumption per voyage. Fresh water tank volume is decided by maximum boarding crew members and fresh water consumption per voyage. Ballast tank volume is decided by trimming and securing of stability. Engine room volume is determined by main and auxiliary engine outputs.

(1) Volume of Cargo Hold Inside Structural Steel Materials

① Refrigerated cargo hold

As described in the Chapter 3, the required cargo hold capacity calculated from the cargo demand is 300 m^3 of refrigerated cargo hold (bale). The volume inside structural steel materials to ensure this capacity is calculated as follows.

When V_S expresses the volume inside the structural steel materials (including beams, frames and stringer) and V_R the bale volume of refrigerated cargo hold, then V_R/V_S is equal to 0.66 from the past results.

Therefore, the volume inside the structural steel materials of refrigerated cargo hold is 300 $m^3/0.66 = 454\ m^3$.

② Dry cargo hold

In this case, less space is lost because of no heat insulation or cooling coil than the refrigerated cargo hold.

In case of grain loading, as even the space between frames can be used for loading, the loading space is almost equal to the volume inside the structural steel materials. However, for ordinary cargo, the volume shall be calculated as bale.

Similar to the refrigerated cargo hold, V_S represents the volume inside the structural steel materials and V_R the bale volume, then V_R/V_S is equal to 0.80 from the past results.

Therefore, the volume inside the structural steel materials of dry cargo hold is 300 $m^3/0.80$ = 375 m^3. Accordingly, required volume inside the structural steel materials of cargo hold is 454 m^3 for refrigerated cargo and 375 m^3 for dry cargo, totaling 829 m^3. This volume is to be designed.

(*) Bale: The space actually utilized as refrigerated cargo hold, in other words, by deducting the volume used for cooling coils, sparlings, etc. from the real heat insulated hold volume.

(2) Required Outputs of Main and Auxiliary Engines

It is to design the required outputs of main and auxiliary engines and fuel consumptions as follows. These are setting conditions for fuel oil tank volume and engine room volume.

① Assumption of cruising speed

When taking into consideration the energy saving, the economically reasonable cruising speed of the Project vessel based on the past results should be nearly 10 knots.

If the main engine output is increased to 2,000 to 2,500 PS, the speed of 12 to 13 knots is obtained. Nevertheless, it is not economical to increase output in twice for achievement of 20% speed-up.

Therefore, the normal cruising speed of the Project vessel will

be 10 knots and the required main engine output is designed based on this cruising speed.

② Output of main engine

The main engine output to guarantee the 10 knots of cruising speed is influenced from several factors like the vessel length, breadth, propulsion efficiency, vessel type (under waterline), draft, trim, etc. Generally some of the most important factors are used as factor to calculate the resistance and propulsion efficiency, then calculate output from the below equation;

$$\frac{\text{Resistance x Speed}}{\text{Propulsion efficiency}} = \text{Output}$$

Then multiply this value by some sea margin to obtain the main engine output to sustain the certain cruising speed.

The required output described above is treated as the factor of speed, and displayed in tables or drawings. However values required to calculate the above equation are not yet decided in this stage of project. So the output of the Project vessel is calculated by easy method using dimensions determined provisionally at the field discussion.

The following is main engine output and related speed calculated by one of such easy methods.

When

Length overall (L_{OA}): = 55.00 m
Length waterline (L_{WL}): = 52.00 m
Length P. P. = 50.00 m
Displacement: (Δ) = 1,100 tons

then,

Main Engine Output (PS)	500	700	1,000	1,500	1,950
Cruising Speed (knots)	9.5	10.5	11.0	12.0	12.5

This shows that the cruising speed of the Project vessel with 1,000ps output will be ten (10) knots at normal navigation condition taking into consideration 10% of sea margin. Therefore, the main engine output of the projected vessel is decided to 1,000 PS.

③ Fuel Consumption Ratio of Main Engine

The fuel consumption ratio of this type of main engine with comparatively small output and high power like that rigged on the Project vessel is from 140 gr/ps hr to 150 gr/ps hr. This is the fuel consumption ratio at test operation. The longer the engine is operated, the worse the fuel consumption ratio become as the result of efficiency deterioration caused by the abrasion and the accumulation of carbon and dust. Such secular change of fuel consumption ratio differs by the quality of engine maintenance work. The ability of engine maintenance of Mozambique is taken and the average fuel consumption ratio to be used for calculation is set to 150 gr/ps hr.

④ Output and Fuel Consumption Ratio of Auxiliary Engine

Same is applicable to the auxiliary engine.

First the output of auxiliary engine is examined.

It is to estimate the load of auxiliary engine before deciding the output. However, since no details of auxiliaries in engine room are decided, it is only to estimate the main loads and to decide the other middle and small loads with margin from the experiences gained from same type of vessels.

A. Main Loads

1. Load of Refrigerator

Ability of quick freezing is not required to the Project vessel. The Project vessel only transport cargo that are already frozen or almost frozen at other vessels or facilities. The required cooling load is comparatively small.

The capacity of refrigerated cargo hold is 300 m^3 and the hold temperature is -30°C. The external temperature is estimated to reach up to 50°C at the part exposed to the direct sun shine. But assuming that the temperature of heat receiving surface is 40°C, the temperature difference between the outdoor and the hold is 70°C.

Supposed that cargo hold height is 3.7 m, heat insulation surface area will be 408 m^3 from volume inside structural steel materials of refrigerated cargo hold of 454 m^3, an suppose that the areas such as heat insulation surface area of cooling pipes is 5%, the surface area is:

408 m^3 x 1.05 = 428.4 m^3

Assuming that heat rate K (coefficient of overall heat transmission) passing through the heat insulation surface is 1 Kcal/m^2.hr. °C,

Heat transmission rate (applying refrigerating load) = 428.4 m^3 x 1 Kcal x 70°C = 29,988 Kcal/Hr.
(In Japanese tons of refrigeration, 9.03 Rtons)

Freon 22 (R22) is selected for the coolant as it is relatively easy to acquire in Mozambique. Then if the sea water temperature is 30°C (condensate temperature is 35°C), and the coolant evaporation temperature is -40°C, then the required refrigerating compressor capacity is approx. 2.8 KW/Rton by ratio curve of R-22 refrigerator's required brake horsepower and refrigeration capacity (from Refrigeration Handbook). Therefore the required compressor capacity is calculated as follows:

9.03 x 2.8 KW = 25.3 KW

And considering mechanical efficiency of 0.85%, the input to the compressor of 25.3 x 1/0.85 = 29.8 ≒ 30 KW is required.

When required input for refrigerating compressor is 30 KW, total input to the refrigerating equipment is calculated as 35 KW counting

required input for pumps and fans, etc.

ii. Bow thruster Load

Bow thruster is rigged at the stem of the Project vessel to facilitate the access to port and other fishing vessel. This load should be included in the calculation. The wind pressure side area of the Project vessel is estimated to be approx. 240m^2. If wind velocity is 10 m/s, the wind pressure on this side (F) would be described by

F= 1.0 (resistance coefficient) x 240 (vessel side area) x 0.1245 (air density) x 10 (wind velocity) = 1,494 kg ≒ 1.5 ton

Therefore, the thrust of bow thruster shall be 1.5 tons. Since the propeller circle per thrust of 1 ton is calculated as 1/4 m^2, the bow thruster will be 1.5 x 1/4 = 0.375 m^2 (dia. 0.7 m).

Here the propeller (bow thruster) will create 1 ton of thrust force per 100 PS, therefore, the required input is, supposing mechanical efficiency of 80%,

1.5 x 100 x 1/0.8 = 187.5 ≒ 190 PS (≒140 KW)

This load temporally occur at the operation in ports, but 140 KW is the biggest load of the vessel.

iii. Other Loads

The required input for other auxiliaries in engine room and pumps is estimated 40 KW by the past results and the input for steering mechanism, machines on the deck and lighting equipment is estimated 25 KW.

B. Auxiliary Engine Output

From above load calculation, maximum required output at an operation of refrigerator and use of bow thruster is 240 KW as shown

below.

i.	Refrigerator	35 KW
ii.	Bow thruster	140 KW
iii.	Engine room	40 KW
iv.	Steering mechanism	25 KW
	Total	240 KW (330 PS)

The required engine output supposing that two generators operate simultaneously on the maximum load time to share the load is calculated as follows.

Assuming that mechanical efficiency of generator engine is 85%, maximum load of the generator is 80%, taking into consideration a compensation of starting current of bow thruster and a compensation of secular change, the required engine output will be:

330 PS x 1/2 unit x 1/0.85 (efficiency) x 1/0.80 (load factor)
= 243 PS ≒ 250 PS

If an engine of 250 PS is selected, momentary current load by operation stop of pumps or secular change due to maintenance and control will not cause an overload trip and the vessel is kept safe from the viewpoint of maintenance and control because the load factor in the operation of one generator is estimated nearly 60 to 65% during a voyage in which refrigerator is operating.

From the above consideration, two 250 PS engines will be provided.

In Mozambique, the frequency of shore electricity is 50Hz. Therefore, the Project vessel is equipped with 50Hz power generators taking into consideration the situation that electricity is supplied from shore. If engines and generators are directly connected, the revolution is 120 x 50/number of poles, and the revolution of 1,000 rpm or 1,500 rpm is concluded to be appropriate.

C. Fuel Consumption of Auxiliary Engine

Fuel consumption of auxiliary engine is 160 gr/PS.hr and the following consumption will be appropriate considering an increase of consumption due to secular change or smudge as same as main engine.

170 gr/PS.hr

(3) Fuel Consumption of the Vessel (per voyage)

During voyages, at least one auxiliary engine will operate constantly 24 hours, and if a little margins is added to the load factors of main and auxiliary engines, the load factors will be respectively 85% and 65%. Then in addition to the fuel consumption of main engine, the total daily consumption will be 3.7 tons/day. Finally the fuel consumption per voyage will be 3.7 tons/day x navigation days of 10 days = 37 tons will be calculated.

Further if load factors of auxiliary engine is supposed at average 40% during anchoring in the ports because the load fluctuates between the high loading state such as cargo handling or opening of refrigerated cargo hold and the low loading state at night, the fuel consumption will be 0.408 tons/day. If the anchoring lasts for 16 days, the total consumption in anchoring per voyage will be 6.5 tons/voyage.

Therefore, the total fuel consumption per voyage will be 43.5 tons (54.4 KL).

(4) Capacity of Fuel Tank

One of the the Project vessel's purpose is to supply fuel to the fishing boats and fishing combinats at the port of call. This supply to the other vessels is for the small fishery operating in the northern area of the country where the fuel supply by tankers is unstable.

For the coutry's fisheries (including the industrial fishery), the fuel supply demand to the Project vessel is very large. However, the maximum supply volume is limited to 50 to 60 tons (60 to 75 KL) from the vessel type as transport vessel for fishing products, and then add 43.5 tons (own consumption ratio). Totally approx. 100 tons will be demanded for fuel volume.

Therefore, although the vessel requires fuel of 100 tons, the following considerations are done to calculate fuel tank volume.

Marine Diesel oil is used as fuel. The oil is similar to the light oil for automobiles in the word of Japanese, and its specific gravity is nearly 0.80 to 0.84. If the specific gravity is 0.80, the *required fuel volume is 100 tons ÷ 0.80 tons/KL = 125 KL.*

Where in order to secure a net fuel tank volume of 125 KL = 125 m^3, dead oil volume which is always remained in the tank and actual storing capacity are to be considered.

That is, since water contained in fuel is loaded into the tank and water in the air is condensated by temperature change in the tank, a lot of water is remained in the fuel tank. Also the fuel contaminated by precipitation of rust or dust which has occurred in fuel supply pipes in the tank exists. It is not usable because of its possible damage to engines. Equally, the fuel under the level of fuel suction pipe is not usable. Therefore, 5 to 10% of fuel is always remained in the fuel tank as dead oil.

Also 10 to 20% margin is to be taken into consideration in order to decide a required fuel tank volume due to the upper beam of tank, actions of air cushion generated by movement of air stayed in complex structural materials such as stringers and the vessel and protection of overflow to the deck and the sea resulting from the measurement error by trim heel change at fuel loading.

Supposed that actual storing capacity of fuel tank is 85%, required fuel tank volume is designed as approx. 150 m^3.

In addition, since the vessel mainly operates in the tropical region, heating coils will not needed and the volume increase because of the coils should not be taken into consideration.

(5) Volume of Freshwater Tank

In case of the Project vessel, freshwater is used only for the living of officer and crew, but not used for the graze of refrigerated goods.

However, similar to the fuel oil, freshwater is also required to be supplied to the other vessels.

The consumption of fresh water is widely different by the habits of the crew. Japanese statistics show that it ranges from 20L per person per day for fishing boat to 400 to 500L for large size coastal vessel.

The Project vessel is a coastal vessel, and transport that has many opportunity to call port, it is considered that the officer and crew has comparatively long free time and has tendency to waste water. 100L per person per day is adopted for calculation purpose.

The Project vessel will operate continuously one of two 250 PS power generators as previously described. Then by mounting desalination equipment using the exhaust heat, it is possible to manufacture about 1 ton of freshwater each day.

However, during anchorage, the water evaporator will not be used for reasons of hygiene.

The consumption for a voyage is set to 26 days x 24 persons x 100L = 62.4 tons. From this value, the volume of water made by the water evaporator 1 tons x 10 days is deducted.

The required freshwater volume of the Project vessel is equal to

Thinking similar to the fuel oil, approx. 50 tons of freshwater will be supplied to the other vessel, the required freshwater tank volume is 52.4 + 50 = 102.4 ≒ 100 tons (100 m^3).

The inner side of tank is cleanly painted from the first, it is possible to use freshwater completely. Also the overflow at loading does not pose any problem. Normally the freshwater tank will be fully filled.

Therefore, the freshwater tank will be designed to be 100 m^3.

(6) Volume of Ballast Tank

① Trimming

The Project vessel has many opportunities to call ports with bad condition. Sometime it has to go over shallows to call port, or it has go to the leeward of island or allows, and receive fishing products from industrial complex vessel, and unload fuel and fishing gears and equipments.

The shallow draft is conditional to the Project vessel, the 3.90m of draft is the requirement.

Generally, the ballast tanks for trimming are desirable to be located at the approximately of stern or stem end of the vessel and vessels by keeping average draft.

The larger the tank capacity is, the easier the trimming would be. Even though loading ballast increases displacement, and the draft is also increased.

For this vessel which operates under severe environment against draft limitation, the fuel tank and the fresh water tank are used for fuel and water consumption and they are not used as ballast tank. Therefore, an installation of sea water ballast tank for exclusive use is separately needed.

In order to determine the ballast tank volume, it is to decide from the past result for trimming use. That is if it is required to trim 1.00 M, 50 m^3 tank is rigged on the stern end or stem.

On the vessel having engine in its stern like the Project vessel, the stern trim tends to be excessive, it is better to install about 50 m^3 ballast tank on the stem end.

② Ensure the Stability

The second purpose of ballast tank is to secure the Vessel's Stavility when loading cargo on deck.

As the Project vessel will allow cargo loading on the deck. It is not recommended as if a heavy weight is loaded, it may cause the lost of stability. However, it is important to take measures in case of cargo loading on the deck.

Regarding the strength of deck plates, it is not required for the Project vessel as the cargo will not be so heavy.

The restoration depends on sea weather conditions. Especially if the cargo is deformed, danger is serious, and it is necessary to provide a sea water ballast tank to lower the center of gravity.

Therefore, the Project vessel will be provided with a sea water ballast tank. The volume of this tank is determined from the experience that about 50 m^3 of tank under lower deck is enough to prevent rising of center of gravity due to load on deck.

Accordingly, for ballast tanks, a 50 m^3 tank on the front and another 50 m^3 tank under the lower deck, totally 100 m^3 is designed.

(7) Volume of Engine Room

In the engine room, not only main engine and reduction gear, propeller shaft and other equipment required for vessel propulsion, but also power generators to supply electricity to whole vessel and their engines, distribution panel, etc. are installed.

Moreover, various kinds of heat exchangers, pumps and filters will be mounted in the engine room. In the Project vessel, adding to those, the refrigeration equipment and water evaporator will be installed.

It is also required to study on the possibility of installing oil separator, incinerator and others for preventing sea water pollution.

As the engine room of the Project vessel will be operated by foreigners, it should be larger than that of conventional Japanese transport vessel.

Considering those factors, the length of the engine room is set 40% of Lpp which is a little longer than ordinary value of vessel of same type and its volume at 24% of whole volume under deck.

(8) Other Volumes

A volume of 40 m^3 is designed for containing bow thruster, lubricant tank and coffer dam.

(9) Design of Hull Dimensions

Based on the above calculations, various volumes required for the Project vessel are:

Cargo Hold inside volume	829 m^3
Fuel Tank volume	150 m^3
Freshwater Tank volume	100 m^3
Ballast Tank volume	100 m^3
Other	40 m^3
Total	1,219 m^3

Other than the above, (V_D) x 0.24 m^3 of engine room volume is needed.

Taking the average value of transport vessels of the same type as the Project vessel, the ratio of Lpp, breadth and depth will be set as follows.

Where:

L (Lpp)/B = 5.0

B/D = 2.22

CN is obtained from the following formula.

$$CN = L \times B \times D = 5.0 \times 2.22\ D \times 2.22\ D \times D = 24.642\ D^3$$

On the other hand, the under deck volume VD is expressed by

VD = L x B x D x Cb x alpha.

Accordingly, Cb of the Project vessel is set as 0.67 from the results of vessels of the same type 0.65 to 0.7 and alpha is set to 1.06.

$$VD = 1603.9$$

$$= 24.642\ D^3 \times 0.67 \times 1.06$$

$D^3 = 91.648$ Therefore, D = 4.509

From the above,

D = 4.509

B = 4.509 x 2.22 = 10.01

L = 10.01 x 5 = 50.05

The rough size of the Project vessel is set as:

Lpp = 50.00 m
Breadth = 10.00 m
Depth = 4.50 m

(10) DW (Dead Weight)

The Mozambique requirement for the dead weight was 800 tons. However, even considering the capacity of refrigerated cargo hold, dry cargo hold, fuel oil tank, freshwater tank, and ballast tank, and in addition to those even if the weight on deck load cargo is taken into consideration, the weight of cargo reaches only around 530 tons. For the Project vessel, there is no need to have dead weight heavier than necessary also from the viewpoint of the draft limitation.

Therefore, based on the major dimensions of the vessel, the draft at the highest time is set to 3.60 m. The displacement of the vessel will be 1,150 tons (L x B x d x Cb x sea water density).

Similarly the displacement at light weight (designed draft 2.09 m) is calculated as 600 tons.

From the above, the dead weight of the Project vessel is:

(Full load) (Light load) (Dead weight)
1150 tons - 600 tons = 550 tons

Then the dead weight of the vessel is designed to be 550 tons.

(11) Complement and Living Quarters

As the Project vessel is designed for a poop vessel, the living quarters for 24 officers and crew members will be installed in the poop or on deck room.

In this size of ordinary transport vessel in Japan the number of crew members is about ten and the space used for living quarters is approx. 10m^2 per person. However, space in the Project vessel limited because of the number of persons on board. Living space for one person is to be limited to approx. 6.0 m^2 to avoid the rise of center

of gravity.

If the space for a person is 6.0 m^2, then

$$24 \times 6.0\ m^2/\text{person} = 144\ m^2$$

Table 32 shows the living space per person (including living room, galley, dining room, food hold room, air conditioner room for living space, toilet, bath room, shower room and amusement room, and excluding office room, store room for deck work and engine work, and carbon dioxide cylinder room) in recent Japanese refrigerated cargo transport vessel and general fishing vessels.

Table 32 Space of Living Quarters

Number	Vessel	$L_{R=m}$	G/ton	Space m^2	Crews	Space m^2 / Crews
1	Reefer	118	5,757	768	20	38.4
2	Reefer	79	994	229	20	11.5
3	Reefer	69	499	154	17	9.1
4	Purse seine Transporter	36	170	48	11	4.4
5	Bonito pole-and-line fishing boat	56	499	119	35	3.4
6	Squid fishing boat	55	299	179	22	8.1
7	North Sea Long-liner	57	349	183	32	5.7
8	Tuna Long Line	47	379	132	21	6.3
9	Ocean trawl	52	279	167	29	5.8
10	Bonito pole-and -line fishing boat	46	329	109	28	3.9
11	Purse seine	35	135	164	30	5.5
12	Salmon Gillnet	32	127	64	18	3.5

4-3-2 Basic Design

The basic design of the Project vessel and onshore suppotring equipment is as follows according to the previously described study.

(1) Coastal Transport Vessel for Fishing Proudcts

Classification	Item	Specifications	Q'ty
General	Type of Vessel	Single deck type, after bridge poop type 1 stern engine, 1 shaft refrigerator and cargo transport vessel	
	Cruising Sea Area	Coastal area of Mozambique (Offshore area)	
	Classification	Nihon Kaiji Kyokai (NK), NS, MNS	
	Applicable Laws and Regulations	SOLAS rules for cargo vessel, International maritime regulations (full draft, sea pollution) Tonnage rules of 1969 international tonnage	

Classification	Item	Specifications	Q'ty
	Principal Particulars	LOA: approx. 55 m Lpp: approx. 50 m Breadth: approx. 10 m Depth: approx. 4.5 m Draft: approx. 3.9 m D/W: approx. 550 tons Ref. C. hold: approx. 300 m^3 D. C. hold: approx. 300 m^3 Fuel oil tank: approx. 150 m^3 Freshwater tank: approx. 100 m^3 Ballast W. tank: approx. 100 m^3 Cruising speed: approx. 10 knots M. engine PS: approx. 1,000 PS Endurance: approx. 7,000 miles (Fuel tank volume x 91%) Complement: 24	
Hull	Ref. Cargo Hold	approx. 300 m^3 (Bale) Ref. temperature -30°C Single layer hold Cooling with direct expansion system of hair pin coil Hold opening to be large as possible for easy cargo work.	1
	Dry Cargo Hold	approx. 300 m^3 (Bale) Single layer hold Protecting materials for hull and cargo provided	1

Classification	Item	Specifications	Q'ty
	Fuel Oil Tank	approx. 150 m^3 Double bottom, placed on stern, Facilities for supply to other vessels and outside tanks No inside heating coil	
	Freshwater Tank	approx. 100 m^3 Placed on stem Facilities for supply to other vessels and outside tanks Tank insde to be painted with pure epoxy and treated for rust prevention	
	Ballast Tank	approx. 100 m^3 Placed on stem and double bottom Corrosion-proof inside for seawater ballast tank	
	Cargo W. Equipment	Derrick boom, burtoning type 3 ton Electric hydraulic winch 5 ton	4
	Anchorage Equipment	Windlass (stem) Capstern (stern) Anchors and others	1 1 1
	Steering Equipment	Bow thruster, Propulsion 1.5 tons Electric hydraulic drive	1

Classification	Item	Specifications	Q'ty
		Room for officers, public space and other rooms provided with air-conditioner Sanitary space other than galley will be separated for officers and other crew members Warehouse for storing some goods to be installed.	
	Living Room for Crew Members	Room assignment	
		Foreign officer:(4) 1 person/room	4
		Mozambique officer:(4) 2/room	2
		Mozambique crew:(16) 4/room	4
		Total 24	10
	Hull Painting, Deck Covering	Painting and rust inhibition to be made for weather conditions of cruising areas. For heat insulation and protection of hull and cargo, wooden deck (main deck 65 mm poop deck 50 mm) to be installed.	

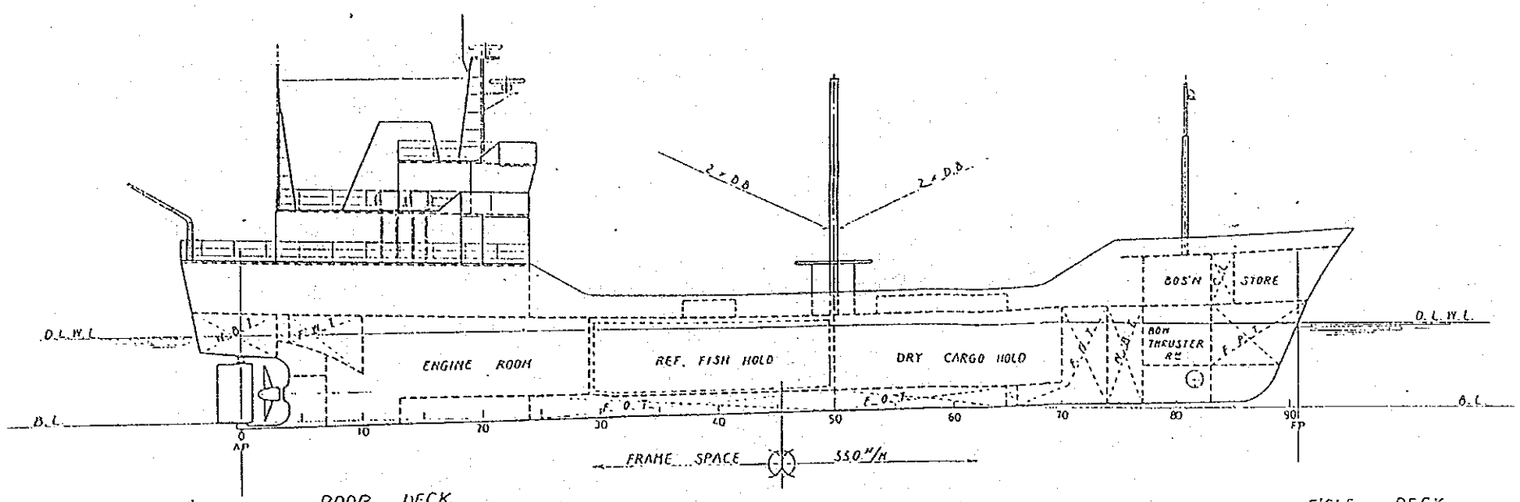
Classification	Item	Specifications	Q'ty
Navigational and Communi-cation Instruments	Navigational Instruments	Gyrocompass, Auto-pilot,	1
		Radar	2
		Direction finder	1
		Acoustic sonder	1
		Doppler log	1
		Magnetic compass	1
		NNSS	1
		SOS bouy	1
		Barometer	1
		Engine telegraph, wind velocity and direction meter, helm indicator, other instruments	1
	Communication Instruments	Main SSB radio (telephone)	1
		Sub SSB radio (telephone)	1
		Meteorological fax.	1
		International VHF telephone	1
		Public addressor	1
		Other necessary instruments	1
Navigation Safety Equipment	Lifesaving, Fire Extingushing, Protective Equipment,	In compliance with SOLAS	1
	Traffic Boat	FRP outboard motor boat of 7 to 8 m	1

Classification	Item	Specifications	Q'ty
Engine	Main Engine	Air starting type 1 middle speed Diesel engine 1,000 PS (with reduction gear)	
	Propeller	Fixed pitch, aerofin type	1
	Auxiliary Engine, Generator	Air starting Diesel engine 250 PS, 225 V, 200 KVA, 50 Hz	2
		Three-phase AC generator	2
	Refrigerator	R-22 directo cooling type (Refrigerating temp. - 30°C)	1
		Compressor 30 KW	2
		Condenser, Liquid receiver	1
		Refrigerator for food for vessel internal use	1
	Evaporator	Evaporator using main and auxiliary engines waste heat approx. 1 ton/day	1
	Other equipment	Air compressor and pumps to be provided according to vessel classification	1
Electrical	Power Source	Main power: AC 220 V, 50 Hz three-phase, receiver and distributor	1
		Emergency power: DC 24 V, single phase, receiver and distributor	1
		Onshore power receiving system	1
Ohters	Spare Parts	for 2 year normal operation	1

(2) **Onshore Supporting Equipment**

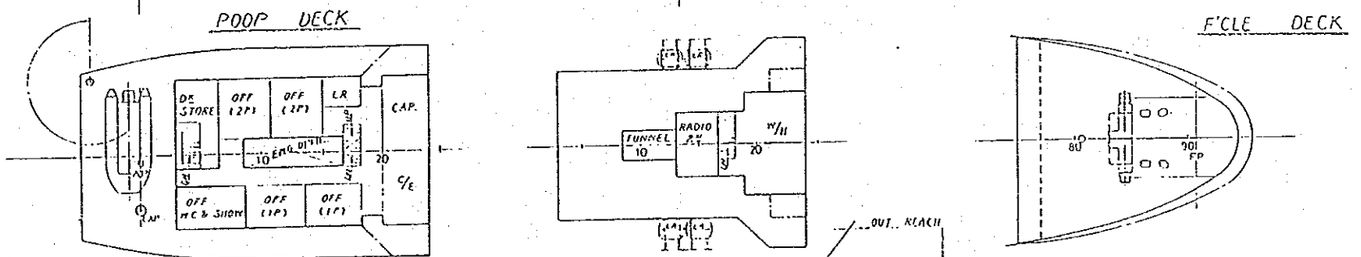
Classification	Item	Specifications	Q'ty
Onshore Supporting Equipment	Refrigerated Truck	Max. carrying weight 4 tons Assigned to Pemba/Nacala 1 to each	2
	Fork Lift	Max. lifting weight 2 tons Assigned to Beira/Vessel 1 to each	2
	Truck Crane	Max. winching weight 15 to 20 ton Standard model Assigned to Nacala	1
	Tank Lorry	Max. carrying weight 4 to 5 tons Standard model Assigned to Nacale	1
	Truck	Max. carrying weight 4 tons Uncovered Assigned to Maputo/Beira 1 to each	2

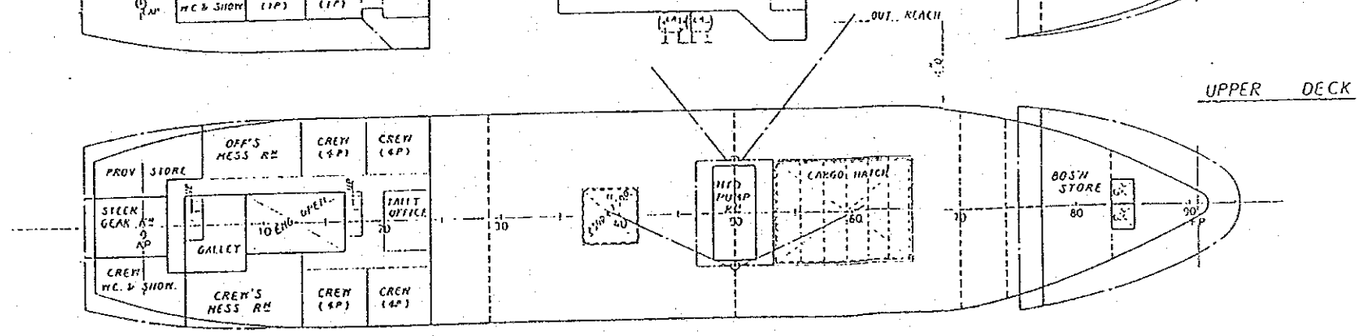
GENERAL ARRANGEMENT



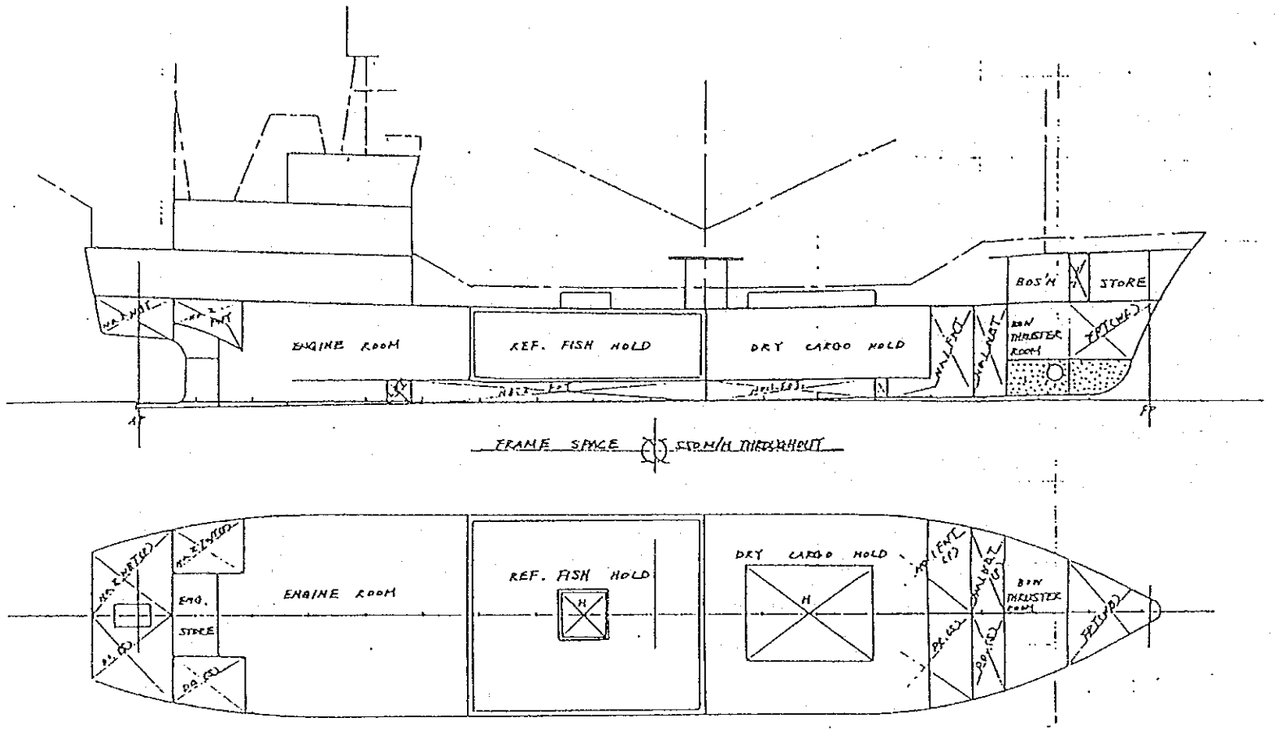
PRINCIPAL DIMENSIONS

LENGTH (O. A.)	abt.	55.0 M
LENGTH (P. P.)	abt.	50.0 M
DEPTH (MLD.)	abt.	10.0 M
GROSS TONNAGE	abt.	640 トン
MAIN ENGINE	abt.	1000 PS
SPEED (SERVICE)	abt.	10 KTS
COMPLEMENT		24 P.





CAPACITY PLAN



PRINCIPAL DIMENSIONS

LENGTH (O.A.)	abt.	55.0 M
LENGTH (P.P.)	abt.	50.0 M
DEPTH (MLD.)	abt.	10.0 M
GROSS TONNAGE	abt.	640 トン
MAIN ENGINE	abt.	1000 PS
SPEED (SERVICE)	abt.	10 KTS
COMPLEMENT		24 P.

REF. FISH HOLD & DRY CARGO HOLD

NAME	POSITION	GRAIN CAPACITY(M3)	BALE CAPACITY (M3)	MG (M)	KG (M)
REF FISH HOLD	F29 - F50	325.0	300.0	3.36	2.67
DRY CARGO HOLD	F50 - F70	325.0	300.0	-7.88	2.81
TOTAL		660.0	600.0	-2.26	2.74

FUEL OIL TANKS — FULL LOADING FACTOR 0.960, SPECIFIC GRAVITY 0.840

NAME	POSITION	WHOLE CAPACITY(M3)	FULL LOAD CAPACITY V (M3)	V (T)	MG (M)	KG (M)
NO.1 FOT (P&S)	F50 - F65	54.0	51.84	45.55	-6.41	0.69
NO.2 FOT (P&S)	F24 - F50	58.0	55.68	46.77	4.27	0.56
NO.2 FOT (C)	F24 - F50	38.0	36.48	30.64	4.91	0.43
TOTAL		150.0	144.00	120.96	0.59	0.57

LUB. OIL TANK — FULL LOADING FACTOR 0.960, SPECIFIC GRAVITY 0.900

NAME	POSITION	WHOLE CAPACITY(M3)	FULL LOAD CAPACITY V (M3)	V (T)	MG (M)	KG (M)
L.O.T.	F22 - F24	3.0	2.88	2.59	12.35	0.41

FRESH WATER TANKS — FULL LOADING FACTOR 1.000, SPECIFIC GRAVITY 1.000

NAME	POSITION	WHOLE CAPACITY(M3)	FULL LOAD CAPACITY V (M3)	V (T)	MG (M)	KG (M)
NO.1 FWT (P&S)	F66 - F77	72.0	72.0	72.0	-14.27	2.55
NO.2 FWT (P&S)	F 3 - F 9	28.0	28.0	28.0	21.60	4.05
TOTAL		100.0	100.0	100.0	4.23	2.98

WATER BALLAST TANKS — FULL LOADING FACTOR 1.000, SPECIFIC GRAVITY 1.025

NAME	POSITION	WHOLE CAPACITY(M3)	FULL LOAD CAPACITY V (M3)	V (T)	MG (M)	KG (M)
F.P.T.	F83 - FE	25.0	25.0	25.63	-22.17	3.62
NO.1 WBT (P&S)	F74 - F77	40.0	40.0	41.00	-16.50	2.94
NO.2 WBT (P&S)	AE - F 3	35.0	35.0	35.88	24.80	4.19
TOTAL		100.0	100.0	102.51	-3.46	3.55

4-4 Building Plan

(1) Basic Policies

The Project vessel is a coastal transport vessel for tranporting the fishing products and the equipment for fishing in Mozambique. However, on the basis of the country's policy, it is required that the Project vessel meets various international treaties concerning the safety.

Therefore, the shipyard to construct the Project vessel has to be experienced in building vessels to which international treaties are applied. In addition to this the refrigerated cargo hold is a refrigerated hold for fishing products, so the piping of this refrigeration is not of air circulation type adopted for cold cargo transporter but the cooling coil type, therefore, the shipyard with the experience of building fishing vessel with such refrigerated hold is desirable.

The Project vessel is also exported to Africa, one of the special region within the developing countries, the shipyard has to have experience of exporting vessel to African nation.

(2) Implementation System of the Project

① Implementaion System

After the E/N of the Project, a selected Japanese consultant has to conduct detailed discussions with implementing organization of both countries for the detailed design, execution of tender specifications, acquisition of facilities and materials and preparation work for accepting the Project vessel of Mozambique based on the policies of the basic design study and establish the implementation plan.

The implementation plan shall indicate an optimal program to complete the delivery of the facilities and materials within the term decided by the E/N.

The Secretariat of State for Fisheries of Mozambique is responsible for the implementation of the Project and has to conduct necessary procedures for signing the consultant agreement, building agreement, opening of bank account based on the contract, proxy for payment. The EQUIPESCA is in charge of operation of the Project vessel and onshore supporting equipment under the control and guidance of the Secretariat of State for Fisheries.

② Control System

The consultant, based on the policies for the Grant Aids of the Government of Japan and the consultant agreement, has to organize a through project team for the detailed design and supervision over the progression of works in accordance with the objectives of the basic design. It shall conduct smoothly the approval of drawings, inspection by assistance, supervision of building work, etc. and give advised and recommendations necessary for the completion of work whithin the term.

(3) Provision Plan

As the contractor will be selected by the tender among the prequalified firms companies for the tender. The all in one tender of the Project vessel and onshore supporting equipment will be made to simplify the work for money saving.

In addition to this, the selected contractor has responsibility to transport and deliver the Project vessel to Mozambique after its completion in Japan.

(4) Share of Charges

① Scope of charges to be borne by the Government of Japan

In case where the Project will be implemented by the Grant Aid of the Government of Japan, the share of charges for Japan is as follows.

A. Building of a coastal transport vessel for fishing products
B. Spare parts for 2 years as for normal operation of the vessel
C. Supply of onshore supporting equipment
D. Sea transportation of the above A., B. and C. to Mozambique and usual insurance premiums.
E. Consultant service such as execution of detailed design, support for tender and supervision of works

② Scope of charges to be borne by the Government of Mozambique

In case where the Project will be implemented by the Grant Aid of the Government of Japan, the Government of Mozambique will share the following charges.

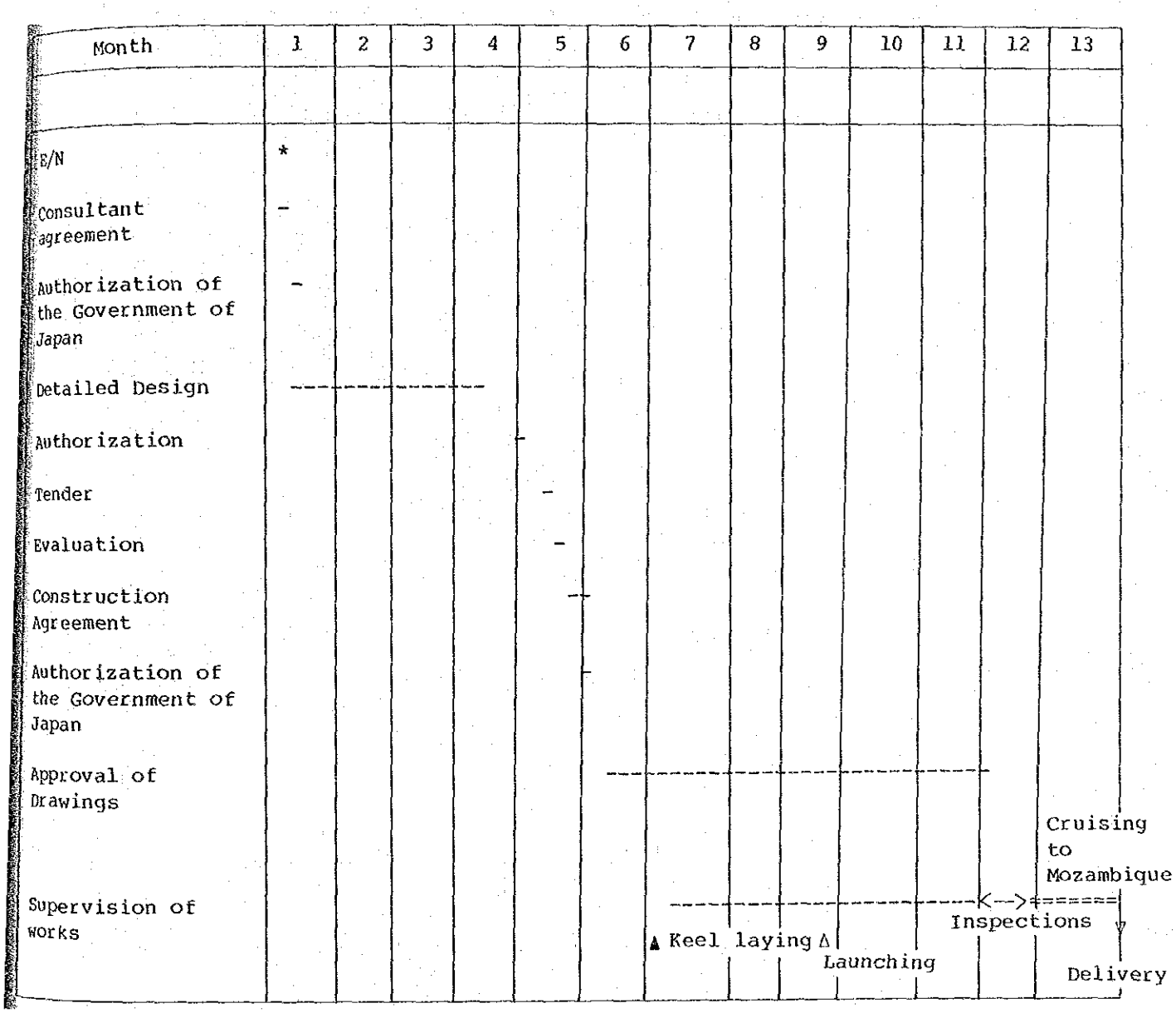
A. Acquisition of all permissions, approvals, licenses, authorizations and others concerning the possession of the coastal transport vessel and onshore supporting equipment and those necessary for the implementation of the Project
B. Smooth custom clearance and tax exemption procedures for all facilities, equipment and materials to be imported to Mozambique in relation with the Project
C. Offer of facilities for Japanese nationals to enter Mozambique and stay in the country for the purpose of the Project
D. Other matters not included in the scope of the charges to be borne by the Government of Japan and necessary for the implementation of the Project.

(5) Process of Building Work

The outline of building and provision process of the Project

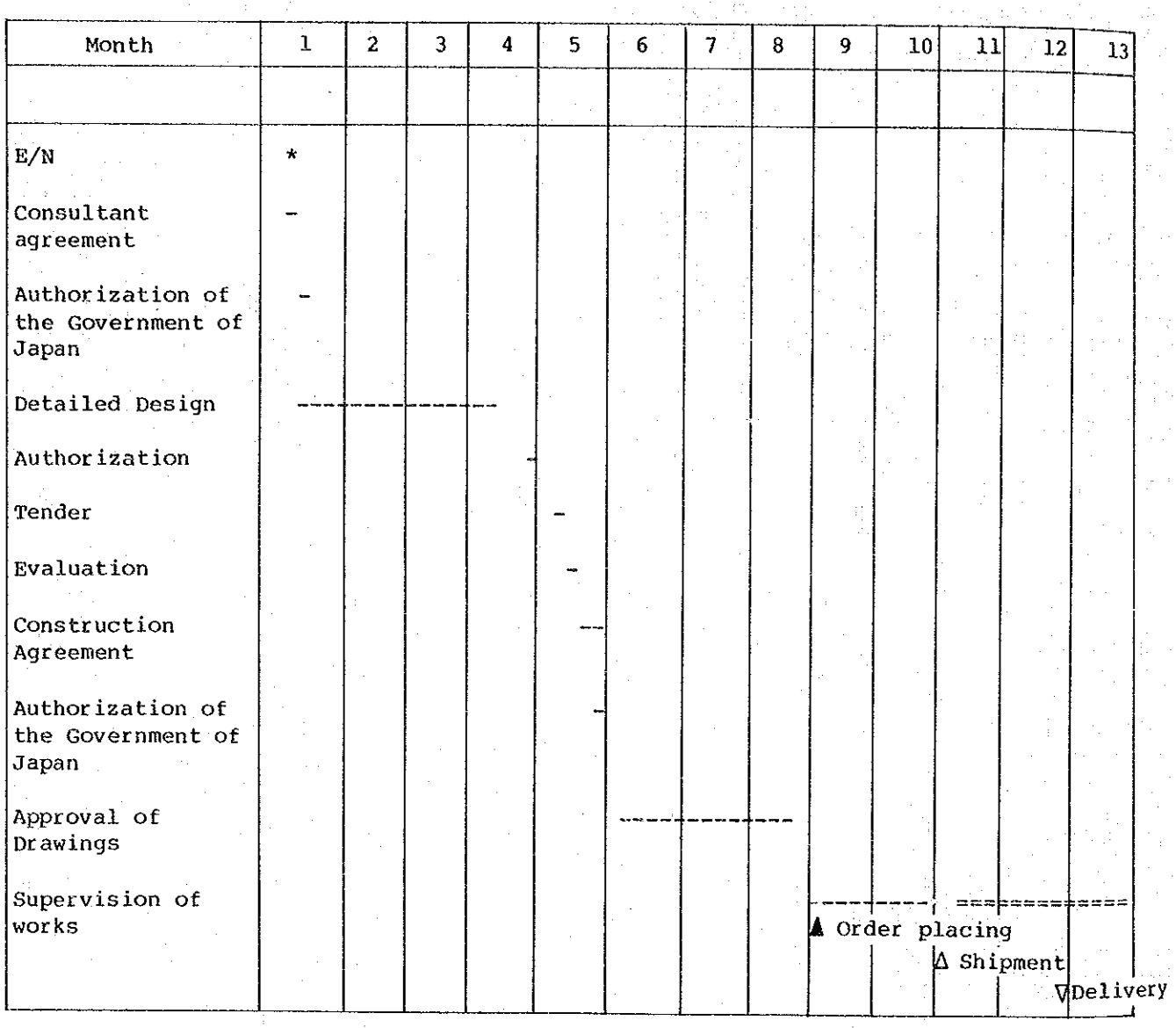
vessel and equipment and materials is as follows. 2 months for the execution of the detailed design, 2 months for the tender and contract with contractor, 8 months for the building, 1 month for cruising, totalling 13 months are estimated for the Project vessel, and 2 months for the detailed design, 4 months for manufacturing or acquisition and 2 months until delivery, totalling 8 months for the onshore supporting equipment.

① Process Chart of Building (Coastal Transport Vessel for Fishing Products)



---- required period ▲ keel laying ▽ launching
Δ delivery <—> inspections
==== cruising to Mozambique

② Process Chart of Acquisition (Onshore Supporting Equipment)



---- required period ▲ order placing Δ shipment ▽ delivery

CHAPTER 5 OPERATION AND MAINTENANCE PLAN

CHAPTER 5 OPERATION AND MAINTENANCE PLAN

5-1 Operation and Maintenance System

The Project will be implemented by the EQUIPESCA under the control of the Secretariat of State for Fisheries. The EQUIPESCA will be in charge of planning and execution of operation and maintenance of the Project vessel.

The corporation will make a proper personnel plan and crew assignment including 4 foreign officers and engineers necessary for the operation of the Project vessel and the technical assistance. It will also make necessary arrangements until the provision of the Project vessel. Therefore, no problem is foreseen concerning the operation and maintenance system.

5-2 Maintenance and Control System

The maintenance plan of the Project vessel will be made and executed by the EQUIPESCA. The equipment and technical level of repair facilities in Mozambique is as follows:

The Project vessel may be maintained by periodical docking in one of the following shipyards or repair facilities at their technical level. Three national shipyards, EMANA, ENAMA and ENABE, and three corporations under the control of the Secretariat of State for Fisheries, NAVIPESCA, TECNIPESCA and TECNABE.

There are three shipyards in Mozambique, two in Maputo (EMANA and ENAMA) and one in Beira (ENABE), where steel made vessels are repaired. These shipyards are now restored by the aids from Soviet Union, Portugal and France and their technique have become equal to international level.

They are capable of repairing coastal vessels, fishing boats, military ships and partly foreign vessels cruising in the country's territorial waters.

No specific problem is presumed also for the maintenance of the Project vessel.

Facilities of shipyards, EMANA, ENAMA, ENABE and NAVIPESCA are listed in the Appendices.

5-3 Operation and Management Cost

(1) Budgetary Measures

The budgetary measures for the operation and management of the Project vessel will be taken by the governmental subsidies of 53,000 thousand Meticais a year. Adding to that, the cost will principally be covered by freight to be paid by beneficiaries by setting proper freight rate. Furthermore, in the event that the revenue and expenses closes in deficit at each end of term, the Secretariat of State for Fisheries plans to demand proportional burdens to beneficiaries of the Project vessel according to utilization rate. Therefore, it will be no problem in regard with the budgetary measures of the Project vessel.

The operation and management cost (after receiving governmental subsidies) and the freight rate after the provision of the Project vessel is estimated as follows.

Item	Average of first 3 years	Average of second 3 years
Operation and management cost (after receiving governmental subsidies)	thousand Meticais 314,572	thousand Meticais 150,473 (311,273)
Freight rate (Based on: Maputo to Beira)	Meticais/m^3	Meticais/m^3
Equipment and materials for fishing	29,700	13,000 (26,800)
Fishing products	41,600	18,100 (37,500)

For the first three years, foreign officers and engineers will be on board, and then the vessel will be operated by only Mozambique officer and crew.

Value in ( ) represents in case foreigners are continuously on board.

Adjusting coefficient by unloading port Maputo to Beira = 1.0
Adjusting coefficient by nature of cargo Fishing products = 1.4

Freight/ton and cost calculation is given in the next page.
The other detail calculations are shown in the Appendices.

Calculation Sheet for Freights/Ton

① First three year plan (first year to third year)

	Cargo transport amount per year (Loading capacity)	Freight/Ton calculation (Standard: Freight of Maputo to Beira)
Going	(1) Equipment and materials for fishing (3,900 m^3) Maputo: Loaded Beira, Quelimane: Unloaded (60% estimated) = 2,340 Nacala, Pemba: Unloaded (40% estimated) = 1,560 Total 3,900 m^3	2,340x(Freight coefficient Beira 1.0+Quelimane 1.11)x1/2x(Loading coefficient 1/1.2 estimated) = 2,057 1,560x(Freight coefficient Nacala 1.38+Pemba 1.45)x1/2x(Loading coefficient 1/1.2 estimated) = 1,840 Total 3,897 m^3
	(2) Refrigerated fishing products Maputo: Loaded Beira: Unloaded = 1,800 Beira, Maputo: Unloaded = 1,200 Total 3,000 m^3	1,800x(Freight coefficient Beira 1.0)x(Coefficient by nature of cargo 1.4) x(Loading coefficient 1/1.2 estimated) = 2,100 1,200x(Beira 1.00+Nacala 1.38+Pemba 1.45)x1/3x1.4x(1/1.2 estimated) = 1,787 Total 3,887 m^3
		Total 7,784m^3
Returning	(1) Refrigerated fishing products Quelimane: Loaded Beira: Unloaded = 1,700 Beira, Maputo: Unloaded = 1,200 Total 2,900 m^3	1,700x(Freight coefficient Quelimane/Beira 0.76)x(Coefficient by nature of cargo 1.4) x(Loading coefficient 1/1.2 estimated) = 1,507 1,200x(Quelimane/Beira 0.76 + Quelimane/Maputo 1.22)x1.4x(1/1.2 estimated) = 1,309 Total 2,816 m^3
	Gross Total 9,800 m^3	Gross Total 10,600 m^3

② Second three year plan (forth year to sixth year)

	Cargo transport amount per year (Loading capacity)		Freight/Ton calculation (Standard: Freight of Maputo to Beira)	
Going	(1) Equipment and materials for fishing (3,900 m^3) Maputo: Loaded			
	Beira, Quelimane: Unloaded (60% estimated)	= 2,340	2,340x(Freight coefficient Beira 1.0+Quelimane 1.11)x1/2x(Loading coefficient 1/1.2 estimated)	= 2,057
	Nacala, Pemba: Unloaded (40% estimated)	= 1,560	1,560x(Freight coefficient Nacala 1.38+Pemba 1.45)x1/2x(Loading coefficient 1/1.2 estimated)	= 1,840
	Total	3,900 m^3	Total	3,897 m^3
	(2) Refrigerated fishing products Maputo: Loaded			
	Beira: Unloaded	= 2,300	2,300x(Freight coefficient Beira 1.0)x(Coefficient by nature of cargo 1.4) x(Loading coefficient 1/1.2 estimated)	= 2,683
	Beira, Maputo: Unloaded	= 1,500	1,200x(Beira 1.00+Nacala 1.38+Pemba 1.45)x1/3x1.4x(1/1.2 estimated)	= 2,234
	Total	3,800 m^3	Total	4,917 m^3
			Total 8,814m^3	
Returning	(1) Refrigerated fishing products Quelimane: Loaded			
	Beira: Unloaded	= 1,700	1,700x(Freight coefficient Quelimane/Beira 0.76)x(Coefficient by nature of cargo 1.4) x(Loading coefficient 1/1.2 estimated)	= 1,507
	Beira, Maputo: Unloaded	= 1,200	1,200x(Quelimane/Beira 0.76 + Quelimane/Maputo 1.22)x1.4x(1/1.2 estimated)	= 1,309
	Total	2,900 m^3	Total	2,816 m^3
	Gross Total	10,600 m^3	Gross Total	11,630 m^3

Cost Freight

Standard Freight (from Maputo to Beira)

Item	1st year	2nd year	3rd year	Average of 3 years	4th year	5th year	6th year	Average of 3 years
(1) Total of maintenance and management cost Value in ( ) represents cost in case of foreigners on board.	thousand meticais 355,619 (355,619)	373,065 (373,065)	374,031 (374,031)	367,572 (367,572)	205,871 (366,671)	203,438 (364,238)	201,109 (361,909)	203,473 (364,273)
(2) Governmental subsidy	53,000	53,000	53,000	53,000	53,000	53,000	53,000	53,000
(3) Net expenses (1)-(2) Value in ( ) represents cost in case of foreigners on board.	302,619 (302,619)	320,065 (320,065)	321,031 (321,031)	314,572 (314,572)	152,871 (313,671)	150,438 (311,238)	148,109 (308,909)	150,473 (311,273)
(4) Cargo freight/ton	F/T 10,600	10,600	10,600	10,600	11,630	11,630	11,630	11,630
(5) Freight rate (3)/(4) Value in ( ) represents cost in case of foreigners on board.	meticais/m^3 28,548 (28,548)	30,195 (30,195)	30,286 (30,286)	29,690 (29,690)	13,145 (26,971)	12,935 (26,762)	12,735 (26,561)	12,938 (26,765)

Item	7th year	8th year	9th year	10th year	Average of 4 years	Average of 10 years
(1) Total of maintenance and management cost Value in ( ) represents cost in case of foreigners on board.	thousand meticais 198,882 (359,681)	196,861 (357,661)	194,943 (355,743)	193,231 (354,031)	195,979 (356,779)	249,705 (362,265)
(2) Governmental subsidy	53,000	53,000	53,000	53,000	53,000	53,000
(3) Net expenses (1)-(2) Value in ( ) represents cost in case of foreigners on board.	145,882 (306,681)	143,861 (304,661)	141,943 (302,743)	140,231 (301,031)	142,979 (303,779)	196,705 (309,265)
(4) Cargo freight/ton	F/T 11,630	11,630	11,630	11,630	11,630	11,321
(5) Freight rate 3 / 4 Value in ( ) represents cost in case of foreigners on board.	meticais/m^3 12,545 (26,370)	12,370 (26,196)	12,205 (26,031)	12,058 (25,884)	12,294 (26,120)	16,913 (27,318)

(2) Personnel Plan

For the beginning of the operation of the Project vessel, 4 foreign officers and engineers will be employed by the Secretariat of State for Fisheries for the technical assistance on operation and navigation. Therefore, the Project vessel will be operated by 24 members including 20 Mozambicans. The technology transfer from the foreigners to the counterparts of Mozambique will be completed within 3 years, and then the vessel will be operated by 20 Mozambicans. No crew assignment problem is foreseen concerning the operation of the Project vessel. Furthermore, regarding the onshore operation control, as previously described, three experienced persons will be newly employed. Therefore, no problem is found also in this matter.

The operation and management cost in relation with the operation and personnel plan is given in the Appendices.

CHAPTER 6 EVALUATION OF THE PROJECT

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6-1 Effects Expected from the Implementation of the Project

The fisheries as an industry consists of three factors, fishing products, carry and sell (process). The Project is to resolve a problem of carry of the fisheries in Mozambique. Effects to be expected by the Project are as follows.

(1) Increase in fishing production and activation of fisheries by smooth carrying and transport of fishing products and equipment for fishing

As previously described, the country's fisheries suffer from loss in production because of shortage of the means of transport for fishing products which results in their transport by fishing boats themselves to exporting ports or consumers' area or stop of operation due to late arrival of fishing gear and materials. The implementation of the Project will improve such situation and diminish loss in production to lead to the increase in production.

When estimating the effects to be brought by the implementation of the Project, if it will diminish loss of 2 days per year for 84 fishing boats belonging to the industrial fishery and that of 2.5 days (or 1.1%) of about 17,500 fishermen affiliated to combinats of various regions, it will result in the increase in sales of 270 million Meticais and 50 million Meticais respectively. Therefore, it will bring an additional 320 million Meticais turnover in total.

(2) Increase of opportunities for manpower training

It is planned to assign 20 Mozambicans including 4 trainees for officers and engineers on board. Therefore, there will be widen place for training. Especially, for the beginning of the Project, 4 foreign

officers and engineers will give technical assistance on navigation of the Project vessel. The crew members who will get the navigational techniques with the Project vessel will be major crew members of Mozambique and contribute to the development and promotion of the fisheries in the country.

(3) *Supply of animal protein to people*

The implementation of the Project will allow the transport of fishing products to more consumers' areas, especially to northern regions of the country where presently no distribution route is available from the fishing stations. It will lead to enlargement of domestic market for fisheries and assure the supply of animal protein to regional residents.

(4) Improvement in quality of processed marine products

The Project vessel will allow the regular carrying in and carrying out of raw materials for processed marine products. It will not only lead to prevent deterioration of quality due to fluctuation of preserving time of raw materials and products at fishing production base, fishing boats and processing places, but also permit to control always quality of processed products on fixed conditions. Therefore, improvement and equalization in quality of processed products.

Equally, the cold transport of processed products with the Project vessel to exporting ports and consumers' areas will eliminate deterioration of products freshness and permit the transport of good products to end consumers.

6-2 Appropriateness of the Project

There are 11 main fishing ports in Mozambique. The industrial fishery including three national corporations and foreign joint ventures and the small scale fishery where about 43,000 fishermen are engaged are carried out. In order to further develop and promote the fisheries of the country, a transport vessel as the means of transport is necessary to ameliorate the important factor of the fisheries "Carrying". The implementation of the Project is expected to bring various effects as described in 6-1. Since the EQUIPESCA, implementing organization of the Project, will take proper budgetary measures and make personnel arrangement, and the country possesses sufficient repair and maintenance facilities and engineers, the Project is highly appropriate.

CHAPTER 7 CONCLUSION AND SUGGESTIONS

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7-1 Conclusion

Since the Project shows a high expectation to the economic development of the country, the Government of Mozambique gives the highest priority to the Project. The objectives of the Project are to resolve the problem of transport of fishing products and further to develop and promote the fisheries by replacing the RIGEL 2, which is only one existing transport vessel for fishing products and no more repairable due to its high age, with a new vessel.

The scope of the Project covers the building of a coastal transport vessel for fishing products and the consolidation of supporting equipment for improving the operation efficiency of the Project vessel. The transport vessel is equipped with both refrigerated cargo hold for fishing products and dry cargo hold for equipment for fishing. It is also for supplying fuel oil and fresh water to fishing boats. This multi-purpose transport vessel is designed to be optimal for the fisheries of the country also by taking into consideration of the transport demand alteration in future. Moreover, the onshore supporting equipment are also designed to be optimal.

It is evaluated that the Project as a highly public enterprise. Because the implementation of the Project will not only contribute to the development and promotion of fisheries by realizing regular vessel assignment between fishing stations and consumers' areas and exporting ports, but also will serve as the means of supply of food and other living goods to regional residents.

The existing transport vessel is severely deteriorated even giving possibility of operation stop. Therefore, a emergent measures shall be taken. Since proper maintenance and maintenance system is

established and necessary budgetary measures are taken, and any problems have not exist in administrative aspect, demonstrate no problems concerning the control of the Project, it is considered that the Grant Aid of the Government of Japan for the Project is appropriate.