REPORT ON BASIC DESIGN STUDY FOR FISHERIES DEVELOPMENT PROJECT IN THE UNITED REPUBLIC OF TANZANIA

SEPTEMBER 1981

JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

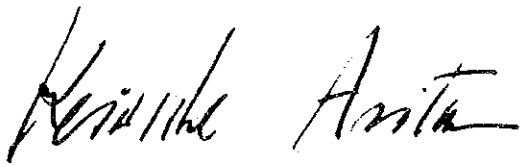
In response to a request of the Government of United Republic of Tanzania, the Japanese Government decided to conduct a survey on the Basic Design for Fisheries Development Project and entrusted the survey to the Japan International Cooperation Agency. The J.I.C.A. sent to Tanzania a survey team headed by Mr. Eiji Saito from June 21 to July 9, 1981.

The team had discussions on the project with the officials concerned of the Government of Tanzania and conducted a field survey. Ater the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of Tanzania for their close cooperation extended to the team.

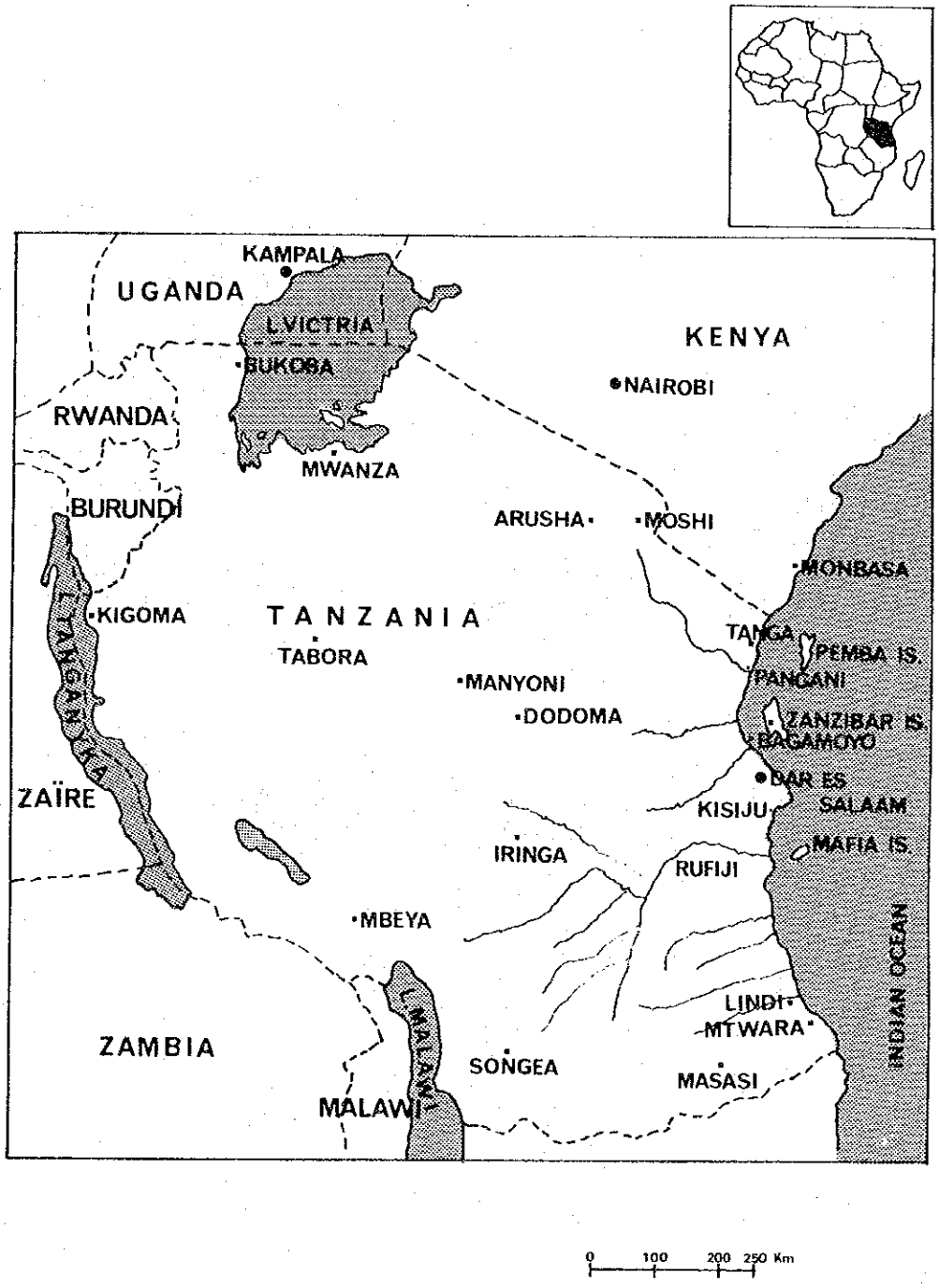
September, 1981



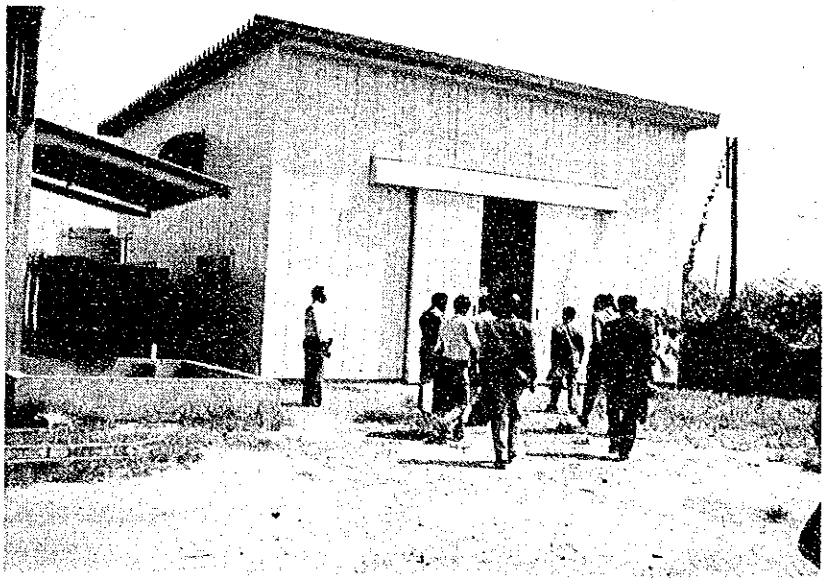
Keisuke Arita
President
Japan International Cooperation Agency

CONTENTS

MAP OF TANZANIA

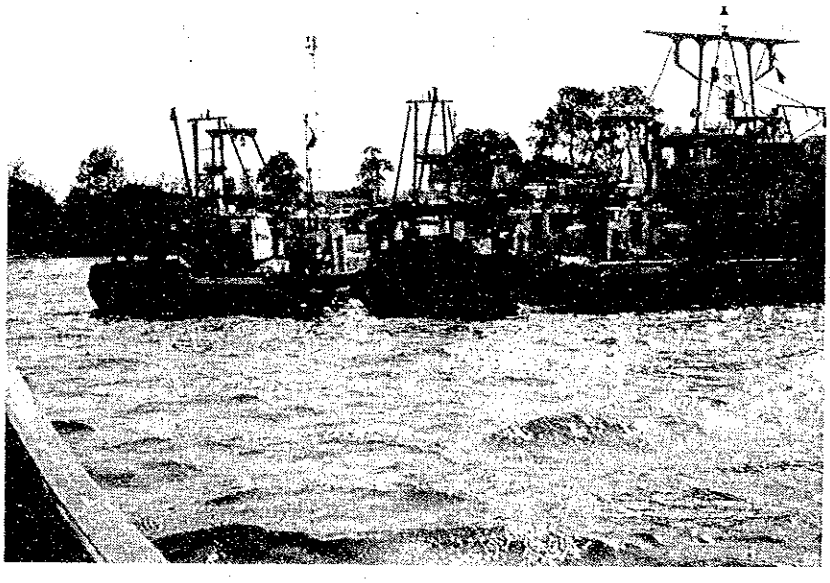


Boats, facilities and equipment granted by Japan



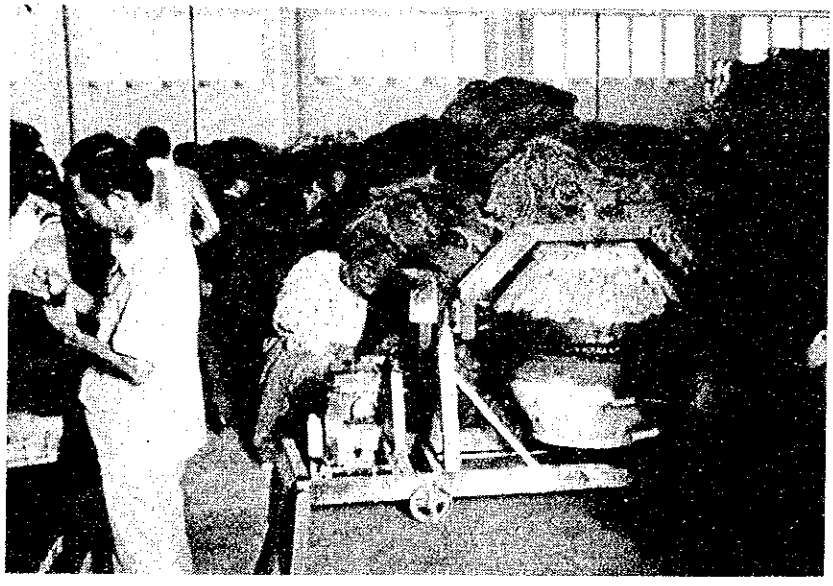
Ice-making facilities, 3 tons/day

(Kurasini)



Small trawlboats
(Dar es Salaam)

The ships with white sterns have been donated by Japan.

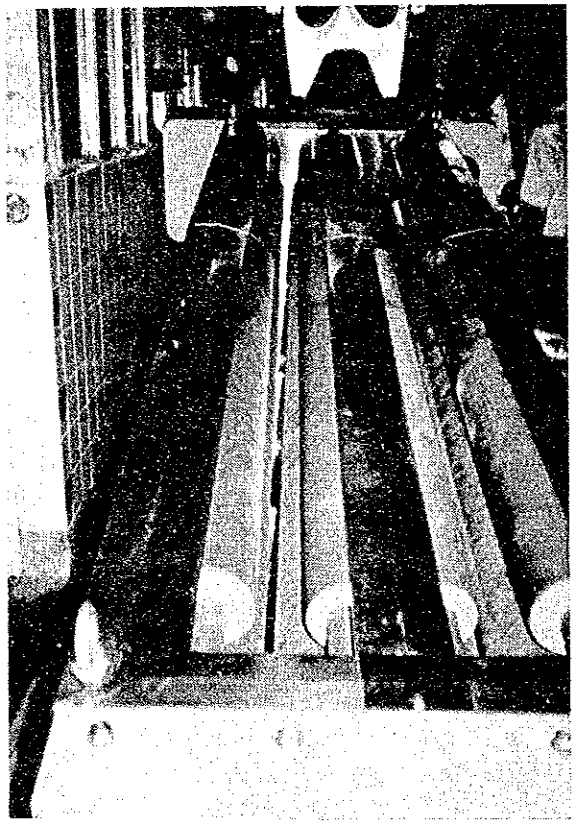


Fishing gear

(Kurasini)

Insulated truck

(Dar es Salaam)



Automatic prawn grader

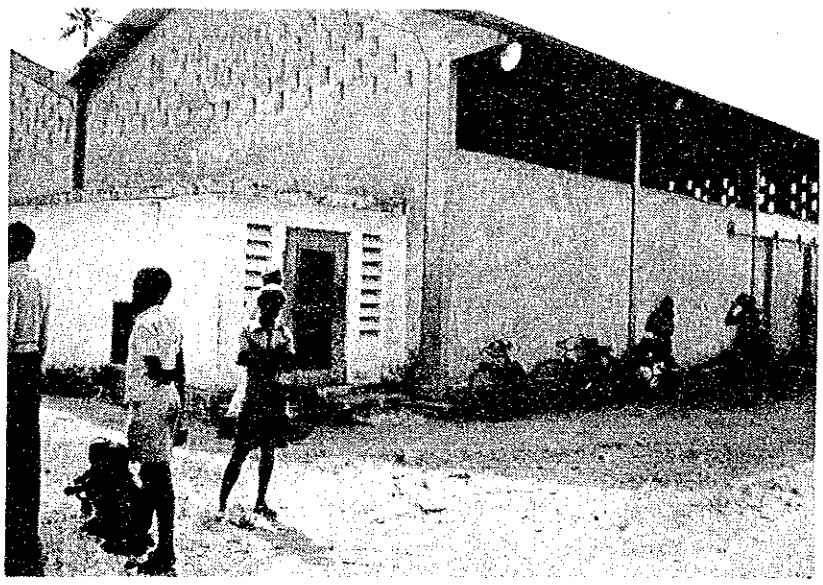
(Kurasini)

Local fishing-related facilities

Processing plant of TAFICO

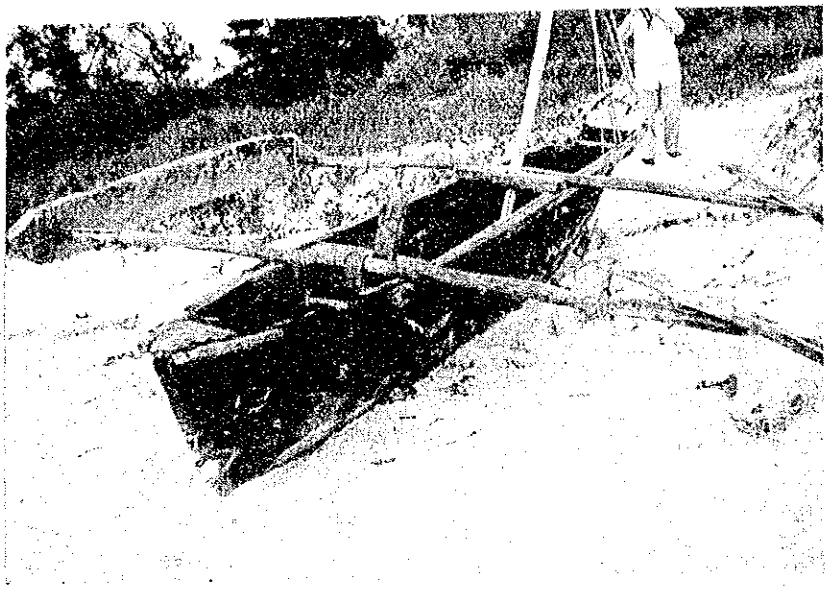
(Kurasini)

Equipped with ice-making plant, ice store, shrimp grader.



Ice-making facilities

(Pangani)

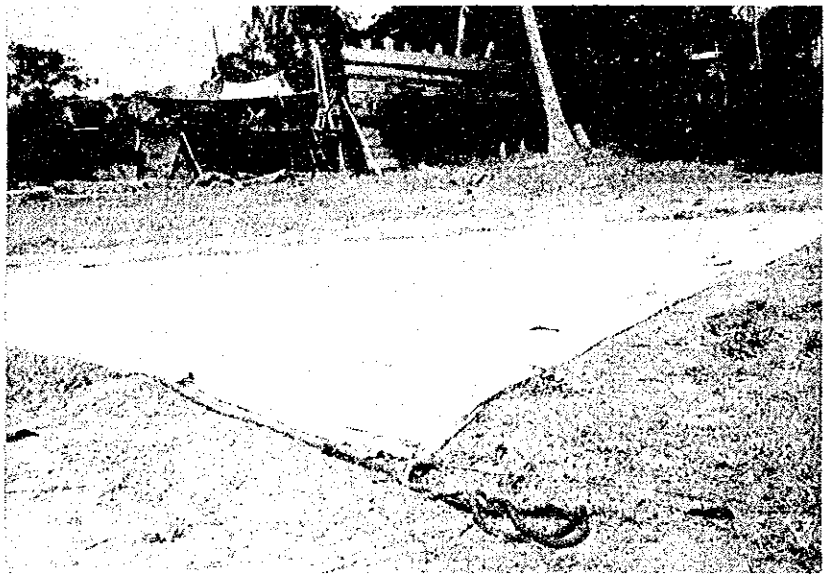


Canoe, 4 to 5 m long

(Bagamoyo)

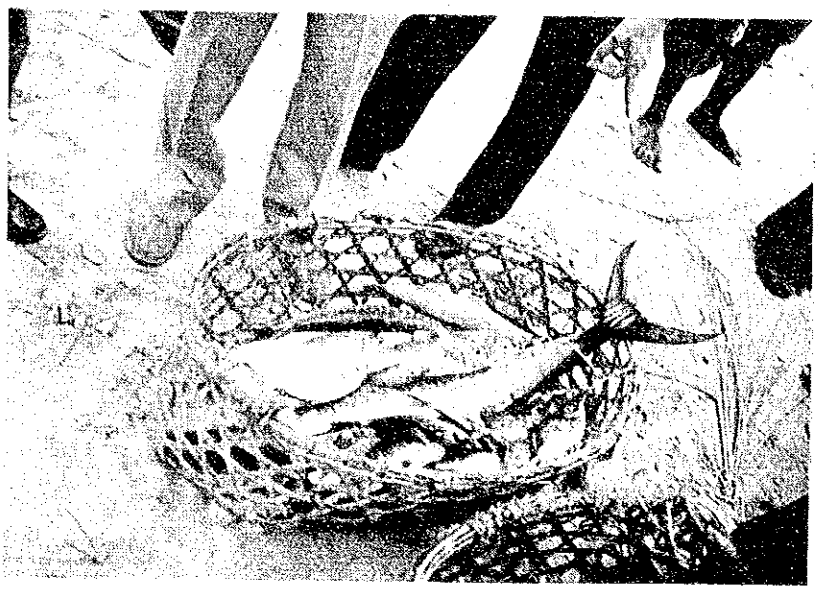
Traditional boats,
7 to 8 m long

(Bagamoyo)



Fishing boats
under construction
and a sail

(Bagamoyo)



Fish on the local market

(Bagamoyo)

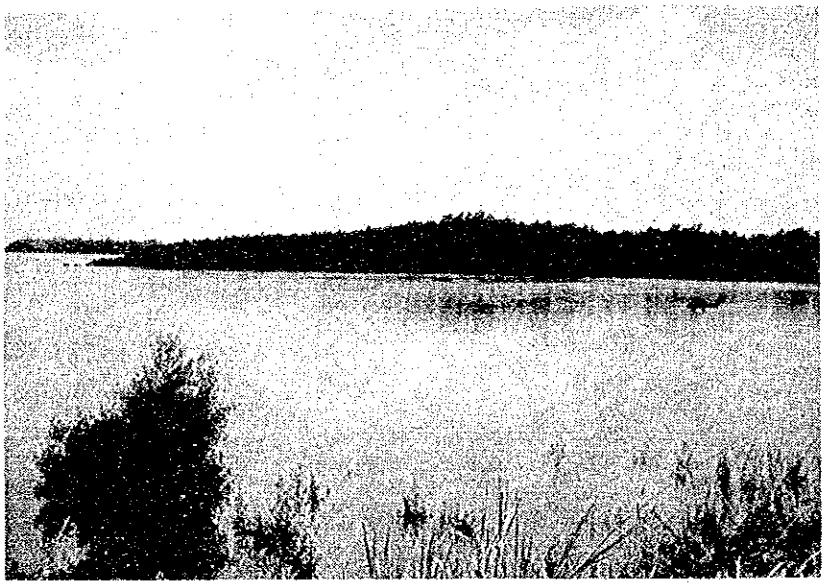
A haul of fish by a small trawlboat

(Pangani)

About 50 kg of catch, including 15 kg of prawns, the reward for an hour of towing.

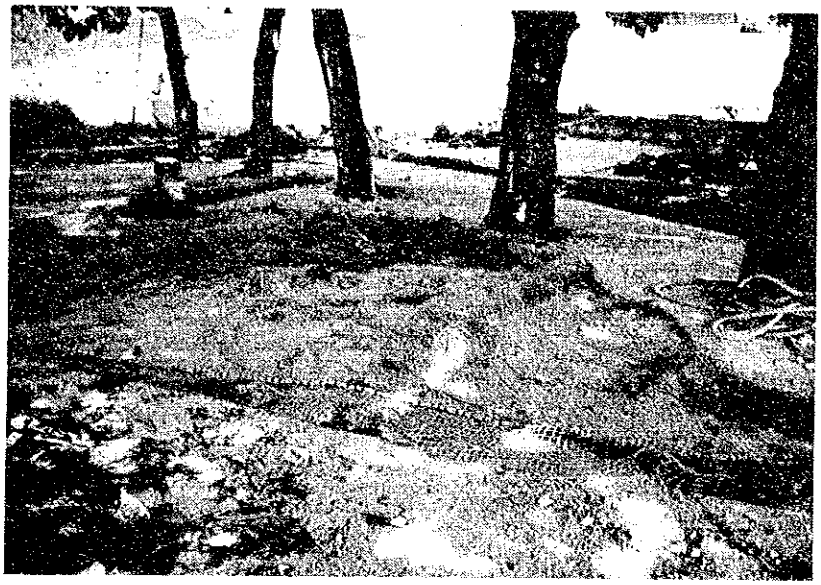
Beach seine fishing

(Bagamoyo)

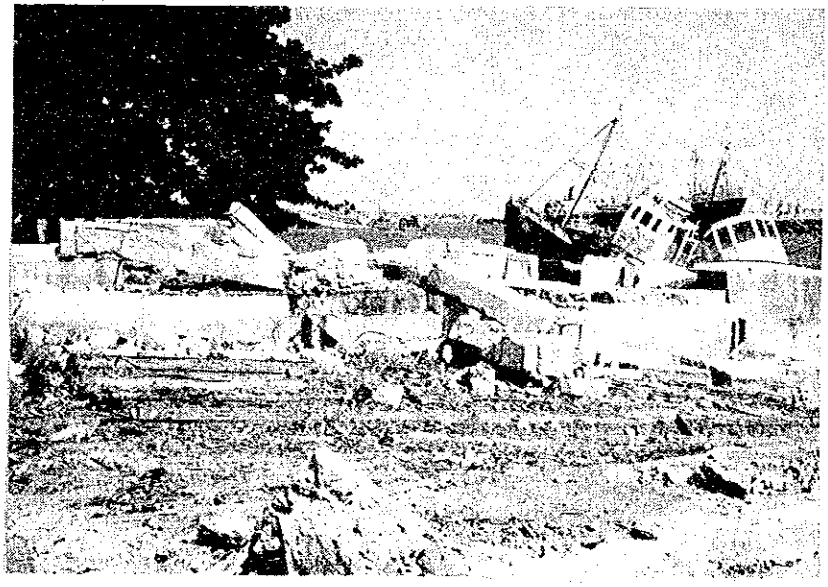


A scene of gill net fishing

(Kisiji)



Planned site for the shore base (Ras Makabe)



Planned site under demolishing work

SUMMARY

1. In line with its Third Five-Year Plan, the United Republic of Tanzania has been promoting its industrial strategies intended for improving the nation's productivity with priority given to investment in the production sector.

In its fishing industry, emphasis is placed on fishing operations rather than on research and study.

In Tanzania, the catches amounted to 192,000 tons in 1978, of which 31,193 tons, or 16.2% was accounted for by marine fishery.

The population of marine fishermen is a little short of 10,000, and the number of fishing boats is about 4,500 of which about 9% are motorized.

Tanzania has a large expanse of fisheries zone along its coastline measuring more than 800 km. Nevertheless, the marine resources remain almost untapped.

For the purpose of promoting the fishing industry and the marketing of marine products, TAFICO was established in 1974. Since then, TAFICO has been endeavoring to introduce large modern fishing boats for the purpose of increasing the catches.

As a part of the Fishery Development Project, TAFICO has conceived a Prawn Fishing Project in order to develop prawn fishing grounds at Bagayomo, the estuary of the Rufiji, and so on, and to export the prawns to earn foreign currency.

2. To help TAFICO implement the Prawn Fishing Project, the Japanese Government donated small trawlers, ice-making facilities, and fishing equipment in FY1979.

As it happened, the catches hauled by these trawlers during the period from December 1980 to May 1981 fell short of the volume originally expected by TAFICO.

One of the major factors attributable to this miscalculation is that the good fishing grounds are located far off Dar es Salaam, and that fishing boats without cold stores are forced to waste away fuel and time shuttling between the home ports and fishing grounds.

Concerned about the situation, TAFICO is planning to improve the efficiency of fishing operations by deploying motherships with freezing and cold storage facilities and constructing a shore base at Dar es Salaam.

3. For the purpose of promoting this plan, the Tanzanian Government requested the Japanese Government's aid.

In response to this request, the Japanese Government, acting through the Japan International Cooperation Agency (JICA), dispatched a basic design survey team to Tanzania.

The survey team took stock of the donated small trawlers, ice-making plant, and fishery equipment, investigated the fishing grounds, including Pangani and the estuary of the Rufiji, and exchanged views with the Tanzanian officials.

4. After due consideration of the findings of the field survey and discussions with the Tanzanian officials, the survey team feel that it would be appropriate to extend a grant, is summerized below.

1. Mothership cum trawler 1

Length	:	Approx. 30m
Width	:	Approx. 7 m
Depth	:	Approx. 3 m
Gross tonnage	:	Approx. 150 tons
Main engine	:	Approx. 500 ps
Contact freezer	:	1 ton/24 hrs. x 2 units
Prawn grading machine		

2.	Skiff		2
	Length	: Approx. 7 m	
	Width	: Approx. 2 m	
	Depth	: Approx. 0.7 m	
	Main engine	: Approx. 30 ps	
3.	Fisheries relevant equipment		1 set
	Insulated container	: 80 units	
	Fish carrying box	: 240 units	
4.	Ice-making facilities		1
	Floor space	: Approx. 340 m^2	
	Structure	: Steel-frame prefabricated one-story building	
	Capacity	: 10 tons/24 hrs.	
	Shape of ice	: Block	
	Ice storage	: Approx. 110 m^3 effective	
	Ice crusher	: 1	
	Hoist crane	: 1	
	Tanks		
	Ice carrying vehicle	: 2 units	

5. While TAFICO is able to manage these ships and facilities, we recommend training of fishery experts by making use of the technical training systems of developed country or inviting fishery experts from abroad, and at the same time to make every effort to improve its management so that the grants can be used efficiently.

The survey team studied the operating costs and analysed the program financially.

It can be said with all emphasis that so far as TAFICO endeavors to abide by the planned number of operating days and to achieve the target output, the project will pay its way, and at the same time will go a long way toward the improvement of the Tanzanian national economy.

The survey team concluded that the extension of grants by the Government of Japan will be immensely significant and effective in moving this Program forward.

Chapter 1 GENERAL

The United Republic of Tanzania stretches from latitude 1°S to about 12°S along the east coast of the African Continent, fringing on the Indian Ocean.

Its coastline measures more than 800 km. However, its marine fishery is still in the inchoate stage, and the greater part of its abundant marine resources is left untapped. The ratio of the fishing industry, including both inland and marine fisheries, to the GDP is as small as 1.7% (1975), although marine products have served as an important source of animal protein for the Tanzanians.

Marine products are also expected to bring foreign currency into Tanzania.

At present, the Tanzanian Government has been promoting coastal fisheries under the jurisdiction of TAFICO in line with the Third Five-Year Plan For Economic and Social Development.

It attaches importance to prawn fishery in view of the marked achievements so far gained by the Japan-Tanzanian joint ventures.

At the request of the Tanzanian Government for cooperation in fishery development, the Japanese Government dispatched a corps of Japan Overseas Cooperation Volunteers to Tanzania.

In FY1979, the Japanese Government also donated six FRP fishing boats, ice-making facilities, and fishery equipment to Tanzania.

At present, TAFICO has been promoting fishery development activities mainly with the fishing boats donated by the Japanese Government.

Since the fishing grounds are far off Dar es Salaam and no boats have cold storage, the fishing boats are busy plying between the fishing grounds and their home port thus wasting their time and fuel.

For this reason, TAFICO is going to make fishing operations more efficient by constructing a shore base in Dar es Salaam and deploying motherships equipped with freezers and cold storage.

The Tanzanian Government requested the Japanese Government's aid in the implementation of the project. In response to this request, the basic design survey team* was dispatched to Tanzania by the Japan International Cooperation Agency (JICA). The survey team, headed by Mr. Eiji Saito, Fishing Boat Inspector, Fishing Boat Division of Oceanic Fisheryies Department, Fisheries Agency, conducted a field survey for nineteen days from June 21 to July 9, 1981.

The composition of the survey team, the itinerary, and the names of the Tanzanian officials who participated in the discussions are shown at the end of the text.

The mission of the survey team was to discuss the Fishery Development Project with the Tanzanian authorities concerned, conduct a field survey and develop a basic design for the mothership and shore base facilities for implementation under the grant appropriated by the Government of Japan.

* As consultants, the Fisheries Engineering Co., Ltd. jointed the survey team.

Chapter 2 BASIC PLAN

2—1 BASIC CONCEPT

2-1-1 Keynotes for Planning

The following were taken as the keynotes in developing the basic design of the mothership and ice-making facilities.

1) To plan the program in a manner to promote the fisheries in Tanzania and at the same time to be economical feasible.

   In the past, the donated fishing boats served for a while for the promotion of the fisheries development in Tanzania. Because of the lack of maintenance facilities and spare parts, however, the fishing boats often are left anchored. Unless the fishing boats earn their maintenance costs, they will naturally be laid aside and become inoperable.

   It is therefore important to plan the program so that the mothership herself, the trawl fleet, and the overall Prawn Fisheries Project including the shore base can be operated profitably.

2) To develop the basic design we have taken account not only of the local laws, regulations and standards, oceanology and meteorology, but also of labor habits and the technical level of the local crew and engineers.

   According to the Tanzanian laws, the qualifications for the ship's crew differ between ships of up to 150 tons and those of 150 tons and over. No seamen on the staff of TAFICO have license, for ships of 150 tons and over, and therefore the mothership should be less than 150 tons.

3) To furnish spare parts that will be necessary for the period (about 3 years) during which TAFICO's engineers will become fully acquainted with the donated ship and facilities.

2-1-2 Basic Performance

The mothership, which serves as the hub of the Prawn Fishing Project, is a depot to supply fuel, fresh water and ice to the five small trawlboats granted by Japan. It also collects the catches from the small trawlboats and carries them to the shore base.

Prawns deterionate shortly after capture because of bacteria and endoenzymes. For this reason, the prawns collected from the small trawlboats must be quick-frozen to maintain their commercial value. The small fish which are caught together with prawns, shall not be collected by the mothership, but shall be carried by the small trawlboats to the shore base. The reason is as follows:

(1) The fish do not degrade as fast as prawns. Their freshness can be maintained satisfactorily for about one week if kept in iced water.

(2) Tanzanians prefer fresh fish to frozen fish. Thus, it is better not to freeze the fish for domestic consumption.

(3) If it is to freeze and keep in cold storage all the prawns and fish caught by a fleet, a large system of freezer and cold storage will be required, which cannot be installed in a ship of up to 150 gross tons.

The mothership also trawls for the purpose of earning her own operation costs. Since there are many coral reefs in the fishing grounds and prawns seasonally migrate toward shallow water, the mothership cum trawler should be given high maneuverability. Consequently, the mothership should be provided with sufficiently large fuel oil tank, fresh water tank, and fish holds to cater for the small trawlboats, and at the same time should be designed to have a high maneuverability. Because of the long time she will spend out of port, fish caught by the mothership should be kept in cold storage.

The fishing villages near the fishing grounds are not furnished with good roads for distribution of fish and prawns. (Road conditions especially detriorate in the rainy season.) The lack of transportation is one of the major hindrances that has checked the development of coastal fisheries in Tanzania.

It is therefore necessary to deploy skiffs to carry prawns from local villages to the mothership. It is also necessary to furnish insulated containers and fish carrying boxes for transportation of the prawns.

The ice-making facilities to be built at the shore base are to produce ice for preservation of catches in the skiffs and trawlboats. The ice is to be transported by the mothership and transshipped to small trawlboats, and will be of the block type for long life and ease of handling.

2-1-3 Projection of Catches and Collected Volume

From December 1960 to May 1981, the small trawlboats donated by Japan have produced the catches listed below:

Fish

(Unit: kg)

Month	Monthly catches	Catches per boat	Catches per trip per boat	Catches per boat per day	Catches per boat per hour of trawling	Remarks
Dec.	14,493	2,415	805	268	26.8	
Jan.	7,193	1,199	399	138	13.8	Min.
Feb.	17,240	2,873	957	319	31.9	
Mar.	18,274	3,046	1,015	338	33.8	
Apr.	23,126	3,854	1,285	428	42.8	Max.
May	17,239	2,873	958	319	31.9	
Avg.	16,261	2,710	903	302	30.2	

Prawns

(Unit: kg)

Monty	Monthly catches	Catches per boat	Catches per trip per boat	Catches per boat per day	Catches per boat per hour of trawling	Remarks
Dec.	2,202	367	122	40.7	4.1	Max.
Jan.	512	85	28	9.3	0.93	
Feb.	39	6.5	2.2	0.7	0.07	
Mar.	467	78	26	8.7	0.87	
Apr.	20	3.3	1.1	0.4	0.04	Min.
May	1,315	219	73	24.3	2.43	
Avg.	759	126.5	42.1	14.02	1.4	

A fishing operation at the estuary of the Pangani the survey team obserbed showed a total catch of some 50 kg per hour of trawling, including 15 kg of prawns, suggesting that TAFICO will be able to make a large haul of prawns depending on its efforts. The catch per trawlboat per hour of trawling may be set at twice as large as the value of December in the above table, or to some 9 kg.

The ratio of prawns to fish assumed one to four for the small trawlboats.

There are other statistics on the prawns catches. According to the achievements of the New Mwananchi Ocean Products (FAO/IOP Workshop Report) Japanese-Tanzania joint venture, the catch per hour of trawling off Bagamoyo and the Rufiji during the 1969-71 period by 83.6GT trawlers was 22.3 to 31.8 kg. In the case of the mothership, the prawns catch per hour of trawling may be set at the maximum of the NMOP's achievements during the 1969-71 period, or about 31 kg.

It is estimated that 1.2 times more small fish than prawns can be caught.

Assuming that the mothership operates for 24 days a month and the small trawlboats for 15 days a month, and the volume collected by skiffs is 200 kg per day, the estimated catches and collected amount in a month will be as follows:

Target catches

Daily catches (Unit: kg)

Fishing boat / Species	Small trawlboat		Mothership catches per day	Daily collected amount
	Catches per boat per day	Catches by five boats per day		
Prawns	72	360	250	200
Fish	(280)	(1,400)	300	-

Total catches (Unit: kg)

Fishing boat / Species	Small trawlboat (5 boats x 15 days)	Mothership (1 ship x 24 days)	Collection (24 days)	Total
Prawns	5,400	6,000	4,800	16,200
Fish	(21,000)	7,200	-	28,200
Total	26,800	13,200	4,800	44,400

*1 Both small trawlboats and the mothership are assumed to operate eight hours a fishing day.

*2 The value in parentheses denotes the catches to be iced in the fish holds of the small trawlboats.

On the other hand, TAFICO estimates the shrimp catches as follows:

	Small trawlboat	Mothership
Prawns	80 kg/boat/day	300 kg/boat/day

Even though the target catches are smaller than TAFICO's goals, they are not so easy to achieve. Or rather they may be unrealistic in view of TAFICO's past achievements. In order to achieve the target catches, TAFICO should make every effort to improve the management of the fishing boats, stabilize the fuel supply, and boost the morale of the crews.

2—2 BASIC DESIGN — MOTHERSHIP

2-2-1 Operations Plan

Five small trawlboats and a mothership form a fleet. The operating cycle of the mothership is 30 days, of which 24 days are assigned for fishing operations, 2 days for sailing, and 4 days for unloading, supply of fuel, water and provisions, and rest at the shore base.

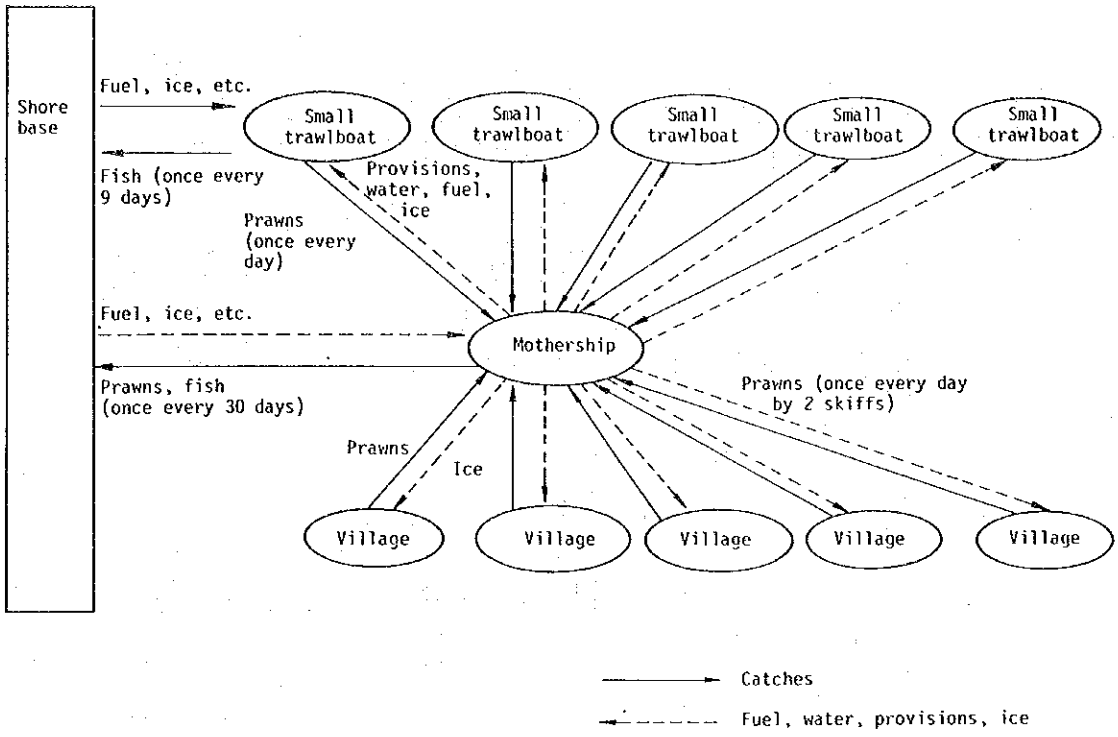
For small trawlboats, the operating cycle should be made as long as possible, but it is difficult to engage the crew in fishing operations more than seven straight days because of poor accomodation aboard. Thus, the operating cycle should be 9 days - 2 days for sailing between the fishing ground and shore base, 5 days for fishing, and 2 days for landing, supply, and rest.

The small trawlboats operate in the waters around the mothership, and transship prawns every day to the mothership, and keep fish in iced water in their own fish holds to be hauled back to the shore base after 5 days of operations.

The small trawlboats should stow as much fuel, fresh water, ice, provisions and other necessaries as possible on sailing out in order to minimize the number of resupplies from the mothership.

The mothership collects prawns from the villages along the coast by making use of skiffs and insulated containers. The number of fishing villages covered is assumed to be 10, and the collection from them will be carried out once every day.

The following is a graphic representation of the operations plan above.



Small trawlboat operating cycle		Mothership operating cycle	
Sailing to and back from the fishing grounds:	2 days	Sailing to and back from the fishing grounds:	2 days
Fishing operations:	5 days	Fishing operations:	24 days
Landing, supply, and rest:	2 days	Landing, supply, and rest:	4 days
Total:	9 days	Total:	30 days

2-2-2 Basic Type of Ship

A double-rigger, long-forecastle, single-deck trawler is selected as the mothership.

This is not only because the said trawler has been refined over many years as a prawn trawler, but also for the following reasons.

1) The trawling can be undertaken by a minimum number of hands, and the other crew members can be assigned to the processing of prawns.

2) This trawler is a kind of cracker-on, and can operate successfully even under rough seas at Beaufort force 5.

   In the coastal waters of Tanzania, the Southeast Trade Wind blows during the May-August period. Its wind force is 4 to 7 on the Beaufort scale. In other months, the Northeast Monsoon of about Beaufort force 3 blows.

   All in all, a Beaufort force 5 is rarely exceeded. Thus, the design wind velocity is set at 5 on the Beaufort scale.

3) The area where the shrimp fishing is carried out is shallow waters near the coastal reefs or at the estuaries of major rivers.

   Double ringer trawling is better than stern trawling, because the former catches more than the latter even when the nets are broken by snags.

4) Other things being equal, trawling one large net is not efficient compared with trawling two nets of half the size, because the latter can cover a wider sweeping area than the former.

2-2-3 Discussion of Principal Particulars

1) Fuel consumption and mothership's fuel tank capacity

The fleet's fuel consumption is estimated as follows:

a) Small trawlboat (x 5)	28,770 kg (33,847 lit.)
Main engine output: 120 ps Operating time: 108 hrs. (Sailing: 2 days x 14 hrs.*/day; fishing: 5 days x 12 hrs./day; shifting: 5 days x 4 hrs./day) Load factor: 80% Specific fuel consumption: 185 g/hr./ps	120 ps x 108 hrs. x 0.8 x 0.185 kg/hr./ps = 1,918 kg/boat/trip 1,918 kg/boat/trip x 5 boats x 3 trip = 28,770 kg (= 33,847 lit.)
b) Mothership (1 bottom)	39,546 kg (46,525 lit.)
(Main engine) Main engine output: 500 ps Operating time: 340 hrs. (Sailing: 2 days x 14 hrs./day; fishing: 24 days x 12 hrs./day; collection: 1 hr. x 24 days) Load factor: 80% Specific fuel consumption: 185 g/hr./ps	500 ps x 340 hrs. x 0.8 x 0.185 kg/hr./ps = 25,160 kg (= 29,600 lit.)
(Auxiliary engine) Auxiliary engine output: 120 ps Operating time: 720 hrs. (30 days x 24 hrs.) Load factor: 90% Specific fuel consumption: 185 g/hr./ps	120 ps x 720 hrs. x 0.9 x 0.185 kg/hr./ps = 14,386 kg (= 16,925 lit.)

c) Skiff boat (2 bottoms) (Main engine) Main engine output: 30 ps Operating time: 192 hrs. (4 hrs./day x 2 bottoms x 24 days) Load factor: 80% Specific fuel consumption: 185 g/hr./ps	853 kg (1,004 lit.) 30 ps x 192 hrs. x 0.8 x 0.185 kg/hr./ps = 853 kg (= 1,004 lit.)

d) Total consumption (= a) + b) + c))	69,169 kg (= 81,375 lit.)

* The sailing time (14 hrs.) is the average time required for the boat to go to the fishing grounds.

Fuel oil tank capacity of mothership

Assume that all the small trawlboats are topped up with fuel oil on sailing out, the total volume of fuel oil to be carried by the small trawlboats is calculated as follows:

1,200 lit. (tank capacity)/bottom x 5 bottoms
x 3 trips x 0.9 (stowage factor)
= 16,200 lit. (16,200 lit. x 0.85 = 13,770 kg)

Namely, the small trawlboats are to be refueled by 55,399 kg (= 69,169 kg - 13,770 kg) from the mothership every month.

Assuming that the stowage factor is 0.96, the specific gravity of fuel oil 0.85 kg/lit., and the allowance 10%, the fuel oil tank capacity of the mothership is calculated as follows:

55,399 kg ÷ 0.96 (stowage factor)
+ 0.85 kg/lit. (specific gravity)
x 1.1 (allowance) = 74,680 lit.

The mothership must be equipped with a fuel oil tank of about 75 m^3.

2) Distilling plant

The distillation efficiency is 100% when the seawater temperature is 28°C. With increase in the seawater temperature, the distillation efficiency declines. Though seawater surface temperature on site is in the range of about 25°C to about 28°C, the fishing operations are carried out in shallow waters, and the seawater surface temperature is expected to rise higher than the above range. Thus, the distillation efficiency is assumed to be about 80%.

The relationship between the distillation rate W_R (tons/24 hrs.) and the distilling plant capacity W_O (tons/24 hrs.) is as follows:

Distillation rate, W_R (tons/day)
= Main engine operating duty (12 hrs./24 hrs.)
x Main engine load factor (0.8)
x Distillation efficiency (0.8)
x Distilling plant capacity, W_O (tons/day)

If the distilling plant capacity is 2.0 tons/24 hrs., the daily distillation rate, W_R, is calculated as follows:

W_R = 0.64 ton/day

In her early days at sea, the mothership has a full tank of fresh water, and need not operate the distilling plant.

Assuming that the distilling plant is to be operated for only 25 days during journey, the distillation amount per roundtrip (W) is calculated as follows:

W_R = 0.64 ton/day x 25 days = 16 tons (= 16,000 lit.)

3) Fresh water tank capacity

Consumption by the fleet

a) Small trawlboat (x 5 bottoms)	8,400 lit.
(Drinking water)	
20 lit./man/day x 4 men x 7 days x 3 cycles = 1,680 lit.	8,400 lit.
1,680 lit./bottom x 5 bottoms = 8,400 lit.	

b) Mothership (x 1 bottom)	44,100 lit.
(Drinking water)	
20 lit./man/day x 30 days x 20 men x 1 trip = 12,000 lit.	12,000 lit.
(General use water)	
40 lits./man/day x 30 days x 20 men x 1 trip = 24,000 lit.	24,000 lit.
(Glazing water)	
(It is assumed that the volume of glazing water required is half the volume of the daily prawns catches.)	8,100 lit.
16,200 x 1/2 = 8,100 lit.	
Total	52,500 lit.

Fresh water initially carried by small trawlboats

Capacity of fresh water tanks	
200 lit. x 5 bottoms x 0.9 x 3 trips = 2,700 lit.	2,700 lit.
Fresh water reserve tank	
20 lit. x 5 pcsx 5 bottoms x 0.9 x 3 trips = 13,500 lit.	1,350 lit.
Total	4,050 lit.

Replenishment by mothership

Fleet consumption (52,500 lit.) -
Initial volume of fresh water carried (4,050 lit.) =
Replenishment (48,450 lit.)

The water distilled by the distilling plant per voyage is 16,000 lit.

Thus, the fresh water tank capacity is calculated by subtracting the amount of distilled water from the replenishment as follows:
(48,450 lit. - 16,000 lit.) ÷ 0.9 (stowage factor) = 36 m^3

The fresh water tank capacity shall be about 36 m^3. The tap water available in Dar es Salaam becomes turbid during the rainy season. Thus, the fresh water tank will be designed to be fitted with a sludge drain plug. When the ship is in dock, the sludge will be withdrawn from this plug.

4) Capacity of lubricating oil tank

Small trawlboat x 5 bottoms 3 trips x 5 bottoms x 120 ps x 108 hrs. x 2.5 g/ps/hr. ÷ 0.85 ÷ 1,000	572 lit.
Mothership main engine 1 trip x 500 ps x 340 hrs. x 30 g/ps/hr. ÷ 0.85 ÷ 1,000	600 lit.
Mothership auxiliary engine 1 trip x 120 ps x 24 hrs./day x 3.0 g/ps/hr. ÷ 0.85 ÷ 1,000	305 lit.
Skiff 30 ps x 8 hrs./day x 24 days x 2.5 g/ps/hr. ÷ 0.85 ÷ 1,000	17 lit.
Total	1,494 lit.

Assuming that the allowance is 10% and the stowage factor 0.9, the tank capacity is calculated as follows:

1,494 lit. x 1.1 ÷ 0.9 = 1,826 lit.

The capacity of the lubricating oil tank shall be about 2 m^3.

5) Capqcity of Fish hold

From the target catches, the fish hold capacity of the mothership for a trip is calculated as follows:

	Transship-ments from small trawlers	Catches by mothership	Collection from village	Total
Prawns	5,400	6,000	4,800	16,200
Fish	-	7,200	-	7,200
Total	5,400	13,200	4,800	23,400

(Unit: kg)

Of the fish, those caught by the small trawlboats are not transshipped to the mothership, but are stored in the fish holds of the small trawlboats themselves. Those caught by the mothership are frozen and stored.

If 15% of the total of the catches is of no commercial value, and if the bulk density is 0.4 and stowage factor 0.7, the fish hold capacity is calculated as follows:

(23,400 kg x 0.85) ÷ 0.4 ÷ 0.7 = 71 m^3

Accordingly, the fish hold shall be about 71 m^3 or larger.

6) Quick freezing unit

From the daily target value of catches, the daily quick freezing capacity is as calculated below:

	Transshipments from small trawlers	Catches by mothership	Collection from villages	Total
Prawns	360	250	200	810
Fish	-	300	-	300
Total	360	550	200	1,110

(unit: kg)

Of the fish caught by the small trawlboats, those of high commercial value will be frozen and stored. If the fish of high commercial value account for 15% of the total of fish catches, the total freezing rate will be about 1,300 kg/day.

Accordingly, two contact freezer units each having a capacity of 1 ton/24 hrs. will be installed.

7) Prawn grading machine

In order to quick-freeze the prawns to preserve their freshness, it is necessary to grade them in as short a time as possible.

Since the daily catches are voluminous, the prawn grading machine should have a large capacity, but the deck space available is limited, the shrimp grader capacity will be 350 kg/hr. for large shrimps, and the shrimps will be classified into 9 grades.

2-2-4 Output Power Requirements of Main and Auxiliary Engines

1) Main engine

From the admiralty coefficient of kindred ships, the power requirement (ps) of the main engine is calculated as follows. Usually, the shrimp trawlers have an admiralty coefficient of 72 to 75. Here, the admiralty coefficient is set at 74.
The formula used is as follows:

$Cadm = \Delta^{2/3} \times V^3/BHP$

Where, Δ: Load displacement (tons) (290 to 295 tons)

V: Service speed (8.5 knots)

Cadm: Admiralty coefficient (72 to 75)

BHP: Transmission horsepower (ps)

Accordingly, $BHP = \Delta^{2/3} \times V^3/Cadm = 378$ to 363

The maximum service rating output, BHP/0.85 = 440 to 458

Thus, the main engine output is to be more than 440 ps. Since the fuel consumption increases with increase in the main engine output, the maximum main engine output is set at 500 ps.

2) Auxiliary engine

The power consumption of the mothership is 73 kW (92 kVA) max. Thus, the generator output will be 100 kVA.
Auxiliary engine output (ps) = generator output (kVA) x 1.2

Hence, the auxiliary engine output shall be 120 ps. The auxiliary system will be dualized.

The voltage, frequency shall be standardized to those for the shore base.

2-2-5 General Arrangement and Principal Particulars

The mothership will be a double rigger, long forecastle, single deck trawler.

The forepeak store, chain locker, fuel oil tank, fish hold, engine room, fresh water tank, and steering gear room and provided below the upper deck from the stem aftward. Part of the engine room is double bottomed to serve as a fuel oil tank and a lubricating oil tank.

The long forecastle on the upper deck is provided, from the stem aftward, with a bos'n store, crew's space, galley, freezing room, and toilet.

Above the forecastle are the wheelhouse and officer's room.
A try-net winch is installed on the aftward starboard side of the wheelhouse, and a radar mast right on the wheelhouse.

Aft of the long forecastle on the upper deck are a king post, prawn grading machine and two trawl winches.

The king post is provided with a side boom each on the port side and starboard side, a center boom aftward and two sets of cargo booms afore.

The cargo boom is provided with a 0.5-ton motor hoist, and is used for cargo handling in the Burtoning method.

The mothership is to be operated in tropical water, and its accommodation space is to be equipped with an air conditioner of sufficient capacity.

For the fish hold, a hairpin coil cooling system is applied. The fish hold is to be held at a temperature of -25°C or lower. The fish hold will be provided with partitions.

One block of the fish hold will be used for storing ice.

The contact freezer is used mainly for the purpose of freezing the prawns, and its surface temperature will be kept below -35°C. The principal particulars are given below. It is to be understood that the values given are approximate ones, and that they do not describe the actual design of the ship.

Principal particulars

° Type of ship	:	Double rigger trawler
° Rules and regulation	:	NK
° Length overall	:	Approx. 30.0 m
° Length registered	:	Approx. 25.5 m
° Length P.P.	:	Approx. 25.0 m
° Breadth molded	:	Approx. 6.8 m

° Depth molded	:	Approx. 2.9 m
° Draft design	:	Approx. 2.55 m
° Gross tonnage	:	Up to 150 tons
° Fuel oil tank capacity	:	Approx. 75 m^3
° Fresh water tank capacity	:	Approx. 36 m^3
° Lubricating oil tank capacity	:	Approx. 2 m^3
° Fish hold capacity	:	Approx. 71 m^3 or more
° Main engine output	:	Approx. 500 ps
° Service speed	:	Approx. 8.5 kt
° Complement	:	20

Engine

° Main engine	:	Approx. 500 ps x 1 set
° Auxiliary engine	:	Approx. 120 ps x 2 sets
° Distilling plant	:	1 set
° Other auxiliaries	:	1 set

Electrical equipment and radio equipment

° Generator	:	3 ø, AC 220 V, 50 Hz, Approx. 100 kVA x 2 sets
° Electrical equipment	:	1 set
° Radio transmitter-receiver	:	SSB, 1 set

Deck machinery

° Trawl winch	:	3 tons x 40 m/min. x 2 x 1 set
° Try-net winch	:	0.5 ton x 40 m/min. x 1 set
° Windlass	:	1 set
° Cargo hoist	:	0.5 ton x 40 m/min. x 2 units
° Prawn grading machine	:	1 set

Navigation instruments

° Steering unit	:	1 set
° Magnetic compass	:	1 set
° Radar, 40 miles, 7"	:	1 set
° Fish finder	:	1 set
° Seawater thermometer	:	1 set
° SOS transmitting buoy	:	1 set

Freezer and air conditioner

° Refrigerant	:	R-22
° Compressor	:	2 sets
° Contact freezer, 1 ton/24 hrs.	:	2 sets
° Cooling unit for fish hold	:	1 set
° Cooling unit for provision store	:	1 set
° Air conditioner for accommodations	:	1 set
° Other accessories	:	1 set
° Mechanical fan (for engine room, galley, etc.)	:	1 set

2-2-6 Skiffs, Containers, Fishing Gear

Most of the villages from which prawns are to be collected are reef-locked or lie within estuaries, defying the access of large boats but can be reached by shallow-draft boats. Also, the procurement of fuel oil is hard at these villages. For these reasons, shallow-draft, lightweight skiffs are selected for the transportation of prawns from these villages to the mothership.

Fuel oil is to be furnished by the mothership to the skiffs, and the skiffs are to be equipped with an inboard diesel engine.

The villages are not provided with piers or quays, and the supplies are to be landed directly ashore, therefore, the propellers of the skiffs shall be of the tilt-up type. The number of skiffs will be two.

The principal particulars of the skiffs are as follows:

° Hull material	:	FRP
° Length overall	:	Approx. 7 m
° Breadth overall	:	Approx. 2 m
° Depth overall	:	Approx. 0.7 m
° Deadweight capacity	:	800 kg or more
° Engine	:	4-cycle diesel engine
° Continuous rated output	:	Approx. 30 ps

The skiffs are used mainly for the collection of prawns and ice, and insulated containers are indispensable for maintaining the freshness of the prawns. The containers are also required for the small trawlboats to transship prawns and fish to the mothership.

Insulated container

An insulated container weights 10 kg, and is capable of accommodating 18 kg of prawns together with 7 kg of ice. As it is designed to collect 100 kg of prawns per service, the number of insulated containers required is six. If each of the ten fishing villages to be covered is provided with six insulated containers and two spares as a set, at least eighty insulated containers will be necessary.

Fish carrying box

The fish carrying boxes are used for unloading fish from the small trawlboats to the shore base. Each small trawlboat is planned to have a total 1,400 kg catches of fish for five days of operation.

Assuming that each box has a capacity of 13 kg of fish, the total number of boxes required will be 1,084. If the boxes are turned over three times, the number of boxes required is 180 (= 36 ps x 5 bottoms). If the boxes are superannuated at a rate of 10% a year, some sixty pieces of spare box will be required for three years. Namely, the total number of fish carrying boxes to be prepared will be more than 240.

Fishing gear and others

The mothership will be furnished with sufficient complete trawl nets, otter boards, spares, and miscellaneous tools necessary for shrimp trawling.

In addition, scales, baskets, freezing pans, arctic boots and clothes, and other materials necessary for processing the shrimps aboard will be furnished.

2-3 BASIC DESIGN - ICE-MAKING FACILITIES

2-3-1 Ice-making Capacity

1) Ice to be carried by small trawlboats

Assuming that the fish hold is 3.5 m^3 and the stowage factor 0.7, the quantity of ice to be carried per bottom per trip is calculated as follows:

$W = 3.5\ m^3 \times 0.7 \times 920\ kg/m^3 = 2,254$ kg/bottom/trip

The monthly ice requirement is calculated as follows:

2,254 kg x 5 bottoms x 3 trips = 33,810 kg

= 34 tons/month ..... (1)

2) Ice to be supplied from the mothership to small trawlboats

The thawing rate of ice due to heat from outside the fish hold of the small trawlboat is calculated as follows:

Thawing rate, W_1 = 21 m^2 x 24 hrs. x 40°C x 0.6 kcal/m^2.°C.hr.
x 1.3 x 6 days ÷ 80 kcal/kg
= 1,182 kg/bottom/trip

The thawing rate of ice due to cooling of fish is calculated as follows, provided that the catches per bottom per day amount to 325 kg.

Thawing rate, W_2 = 352 kg/day x 0.84 kcal/kg.°C x 30°C
x 5 days ÷ 80 kcal/kg
= 555 kg/bottom/trip

Accordingly, the ice remaining in the fish hold after a six day trip is calculated as follows:

Quantity of ice remaining, $W_0 = W - W_1 - W_2 = 517$ kg

The fish hold in a small trawlboat will carry 1,680 kg of fish toward the end of the trip. Of the fish carried, 15% is of high commercial value, and will be transshipped to the mothership. Thus, the fish to be accommodated actually in the fish hold is 1,428 kg.

If the fish are to be stored with the iced water method, and if the weight ratio of fish to ice is 5:3, the ice requirement is calculated as follows:

1,428 kg x 3/5 = 857 kg/bottom/trip

Accordingly, the quantity of ice to be supplied from the mothership to the small trawlboat is calculated as follows:

Ice required, 875 kg - Ice remaining, 517 kg
= 340 kg/bottom/trip

If the small trawlboats go out trawling three times a month, the ice quantity to be supplied from the mothership to the small trawlboats is calculated as follows:

340 kg/bottom/trip x 5 bottoms x 3 trip = 5,100 kg

Since the transshipment from the small trawlboats to the mothership is carried out at sea, an allowance of 1.4 is made. Thus,

5,100 kg x 1.4 = 7,140 kg = 7 tons/month ..... (2)

3) Ice necessary for the collection of prawns by skiffs from the villages

The prawns are collected from the villages once a day, and the weight of the prawns collected per service of skiff is 100 kg.

If the weight ratio of prawns to ice is 5:3, the ice required is calculated as follows:

2 bottoms x 100 kg x 3/5 = 120 kg/day
24 days/trip x 120 kg/day = 2,880 kg

The transshipment of ice to the skiffs is also carried out at sea, and an allowance of 1.4 is made. Thus, the ice requirement is calculated as follows:

2,880 kg x 1.4 = 4,032 kg = 4 tons/month ..... (3)

4) Ice to be carried by other trawlers

TAFICO has nine trawlers in addition to the five small trawlboats donated by Japan. These trawlers are not provided with a mother-ship.

Assume that these trawlers are operated in a cycle consisting of 1 day for sailing to and back from the fishing grounds, four days for fishing operation, and two days for supply and rest, and that the quantity of ice per bottom per trip is 25 tons, the amount of ice required is calculated as follows:

2.5 tons x 9 bottoms x 4 trips/month = 90 tons/month .... (4)

5) Ice necessary for distribution of fish from the shore base

Assuming that the daily catches of fish by each of the nine trawlers are the same as those per small trawlboat donated by Japan, the total of the catches by the nine trawlers is calculated as follows:

280 kg/day/bottom x 9 bottoms x 4 days/trip x 4 trips/month
= 40,320 kg/month

Accordingly, the quantity of fish collected at the shore base is calculated as follows:

40,320 kg + 21,000 kg = 61,320 kg/month

If the weight ratio of ice to fish to be delivered is 0.6, the ice requirement is as follows:

61,320 kg x 0.6 = 36,792 kg = 37 tons/month ..... (5)

6) Ice-making plant capacity

From the calculations above, the monthly ice requirement is as follows:

(1) + (2) + (3) + (4) + (5) = 34 + 7 + 4 + 90 + 37
= 172 tons/month

Assuming that the ice-making plant is to be operated 20 days a month, the capacity of the ice-making plant is calculated as follows:

172 tons/month ÷ 20 days/month = 8.6 tons/month

To make an allowance, the ice-making plant capacity will be 10 tons a day.

2-3-2 Ice-making Facilities

Since the ice is to be used for keeping the catches in fish holds for a long time and for handling in offshore transshipment, block ice will be used as it lasts long and is easy to handle.

The block ice shall weigh 25 kg apiece for ease of handling by one man. The ice-making facilities will be composed of two units of ice-making machines, each having a capacity of 5 tons per 24 hrs.

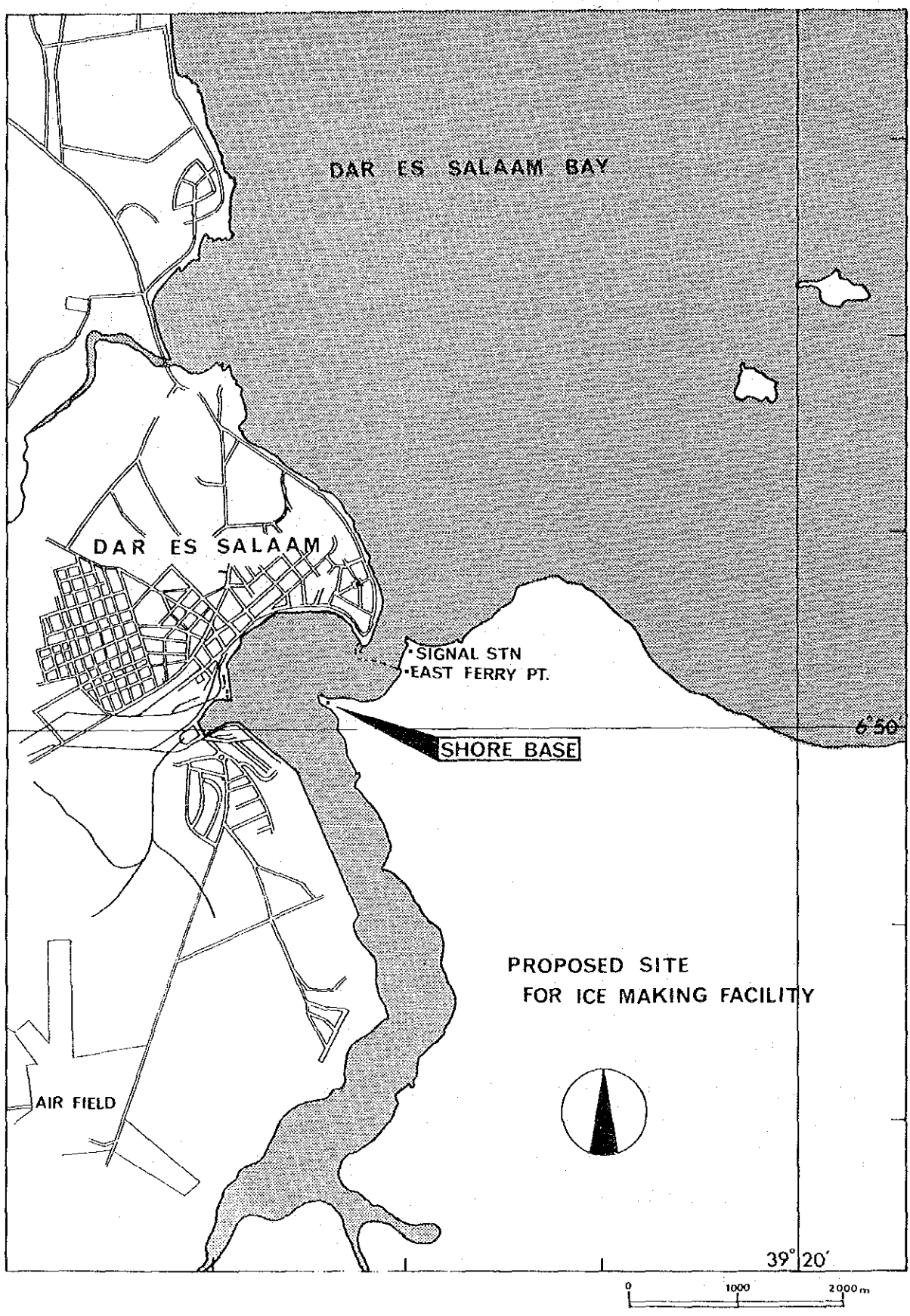
These facilities will be constructed at the shore base at the Las Macabe south of Dar es Salaam. The shore base will comprise a T-shaped jetty, slipway, blacksmith, machine shop, engine shop, store, and net repairing shop.

Communication between the shore base and Dar es Salaam is by ferry because the deep bay of Dar es Salaam has no bridge across the bay and because the land route available is poor and circuitous. The transportation from the ferry to the shore base can be accomplished by car.

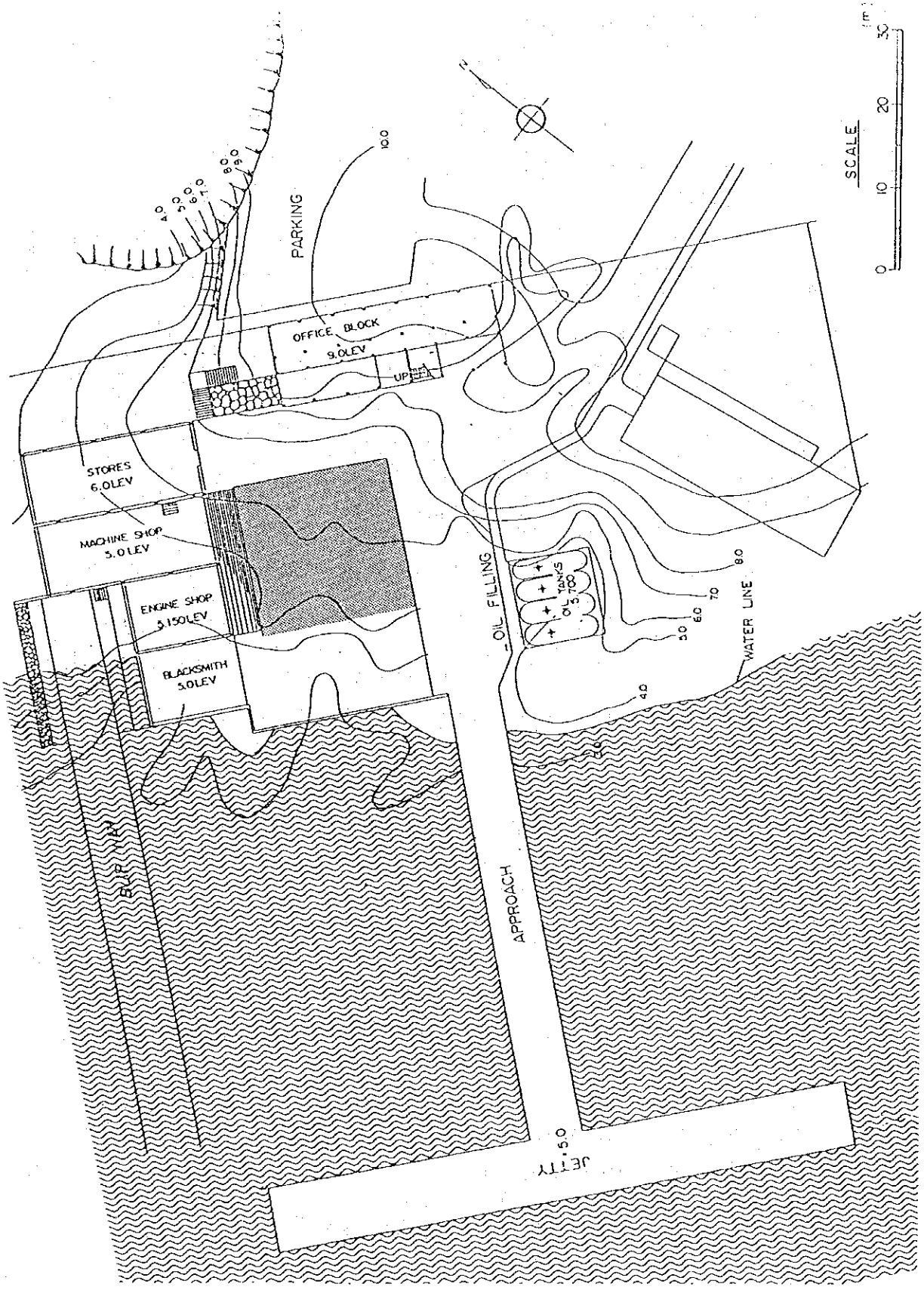
The site proposed for the ice-making facilities is about 18 m wide by about 19 m long (approx. 342 m^2), and adjoins the approach road to the jetty and the road to the stores.

Its northwest side is on the road leading to the engine shop and machine shop, and its southwest side borders on the net repairing shop.

The following shows the location of the shore base and the proposed site for the ice-making facilities.



SHORE BASE FOR TAFICO FLEET



PROPOSED SITE FOR ICE-MAKING FACILITIES

All the water for the shore base will be supplied from a 100-ton water storage tank to be installed within its premises. The water quality will be the same as available for the ice-making plant at Kurasini. The characteristics of water for the ice-making plant at Kurasini were sampled during the field survey. The test results are as follows:

Characteristics	Sample	City water in Tokyo	Requirements for drinking water in Japan
pH	7.8	6.9 to 7.2	5.8 to 8.6
SS	10 mg/lit.	Up to 1 mg/lit.	—
Chloride ion	25 mg/lit.	25 to 30 mg/lit.	Up to 200 mg/lit.
Minerals	74 mg/lit.	65 to 90 mg/lit.	Up to 300 mg/lit.

Compared with the drinking water in Tokyo, the suspended solids (SS) are considerably higher.

The above data was obtained during the dry season. In the rainy season, the water will become more turbid, or perhaps muddy. For this reason, the ice-making facilities will necessitate a water-receiving facility equipped with a settling tank and a filtration tank. In the rainy season, it will be necessary to collect rain water from the roof for use for ice-making for the purpose of minimizing filter troubles.

The fish to be distributed from the shore base will require crushed ice, and the ice-making facilities will be equipped with an ice crusher. The ice-making facilities will also be equipped with a hoist crane for ease of ice handling.

The shore base is located near the shore, and its facilities will unavoidably be affected by high temperature and the humid and briny atomosphere. For this reason, the shore base buildings, facilities and equipment will be made, wherever possible, of salt-resistant materials.

2-3-3 Ice Storage

The monthly ice consumption will peak when a fleet of five small trawlboats and the other nine trawlers come home concurrently for supply.

Namely, the maximum demand is calculated as follows:

2.25 tons x 5 bottoms + 2.5 tons x 9 bottoms = 33.75 tons

The capacity of the ice store for keeping 33.75 tons of ice is calculated as follows:

33.75 tons ÷ 0.92 ton/m^3 ÷ 0.5 = 73.4 m^3

Assuming that the stacking height of ice is 1.5 m, the floor space of the ice store is calculated as follows:

73.4 m^3 ÷ 1.5 = 48.9 m^2

Namely, the ice storage will have to have a floor space of more than 48.9 m^2.

Since the ice storage is to be made up of prefabricated panels, its floor space will be about 50 m^2.

The insulated panels will be as thick as 100 mm in order to minimize the power consumption by the cooling units.

The cooling unit will be of the ceiling type in order to maximize the effective space of the ice storage.

2-3-4 Tanks

The water-receiving facility will be composed of a settling tank, filtration tank, rain water tank, ice-making raw water tank, and pumps.

Settling tank

This is used mainly for removing suspended solids from the city water during the rainy season.

The settling tank will be made of concrete. Its size will be made as large as possible for the purpose of making the flow velocity low enough to precipitate the suspended solids.

Filtration tank

On sailing out from the shore base the mothership will be loaded with a large quantity of filtered water by way of the ice-making raw water tank.

Thus, the filtration tank will be designed based on the quantity of water to be loaded aboard the mothership.

Assuming that the filtration is to be carried out at 60% of the ordinary velocity (5 m/hr.), and that 35 tons of water will be loaded aboard the mothership in 3 hrs., the filtration rate, Q (m^3/hr.), is calculated as follows:

Q (m^3/hr.) = A (m^2) x V (m/hr.)

Where, A: Filtration area (m^2)

V: Filtration velocity (m/hr.)

The filtration area, A (m^2), is given by the following formula:

Filtration area, A (m^2) = Q (m^3/hr.)/V (m/hr.)

= (35 tons/hr.)/5 (m/hr.) x 0.6

= 4 m^2

The height of the filtration tank will be about 3 m.

Rain water tank

During the rainy season, it is expected that the suspended solids in the city water will increase demanding frequent of the filtration tank. The rain water tank is intended for storing cleaner water.

The rain water may contain dust, but may be used after being passed through a simple filter.

The capacity of the rain water tank will be more than 2 tons or 2 days' worth of ice-making.

Ice-making raw water tank

It will be enough if this tank has a capacity of about 5 tons. By making an allowance, however, the tank capacity will be set at 10 tons.

2-3-5 Construction and Layout

Most of the construction materials for the ice-making plant are available in Tanzania. But, it will be better to assemble the blocks prefabricated in Japan so that the site work can be minimized, because the local supply situation is precarious and the construction schedule seems to be tight.

The building for the ice-making facilities will be of steel-frame prefabricated one story construction. The ice-making facilities are composed of an ice-making room, machine room, ice storage,water tanks, compressor, and a working platform.

The platform, for the delivery and crushing of ice, will be located facing the southeast road for ease of loading.

The access to the ice storage will also be located southeastward. The refrigerating compressor and raw water tank should preferably be located at a well-ventilated place.

Thus, they will be installed facing the northeast road. The ice-making room and ice storage will be interconnected with a chuter for the purpose of minimizing the loss of chilled air and facilitating the handling of ice.

At the southwest corner, a store to keep calcium chloride, service parts, will be installed. The following shows approximate specifications of the ice-making facilities.

Approximate specifications

(1) Building

° Floor space	:	Approx. 342 m^2
° Ice-making room	:	Approx. 112.5 m^2
° Machine room	:	Approx. 321 m^2
° Pump room	:	Approx. 2.5 m^2
° Condenser room	:	Approx. 24.8 m^2
° Water tanks	:	Approx. 70.0 m^2
° Ice storage	:	Approx. 60.0 m^2
° Platform	:	Approx. 24.5 m^2
° Main structure	:	Steel-frame prefabricated one story
° Roof	:	Insulated, Polyvinyl chloride coated metal sheet roofing
° Siding	:	Insulated, Polyvinyl chloride coated metal sheet
° Wall	:	Block masonry, mortar-coated, paint finish
° Inside floor	:	Mortar finish

(2) Ice-making facility

° Ice-making tank	:	5 tons/24 hrs. x 2 sets
° Thawing tank	:	25-kg can x 7 to 10 cans, 1 unit
° Can dumper	:	25-kg can x 7 to 10 cans, 1 unit
° Brine cooler	:	2 sets
° Automatic water filling tank	:	25-kg can x 7 to 10 cans, 1 unit
° Condenser	:	1 unit

° Ice storage (-5°C) : 2 sets

Prefabricated type
Floor space, approx. 109 m^2
w/unit cooler (for -5°C)
and air curtain

° Ice crusher : 7 tons/hr. x 1 set

° Hoist crane : 0.5 ton x 1 unit

° Accessory equipment : 1 set

(3) Water tanks

° Settling tank : 53 tons, concrete, 3.5 m depth, x 1 unit

° Filtration tank : Filtration area, 4 m^2, depth, 3 m x 1 unit

° Raw water tank : 10 tons x 1 unit

° Rain water tank : 20 tons x 1 unit

° Accessory equipment (pump, filter, piping) : 1 set

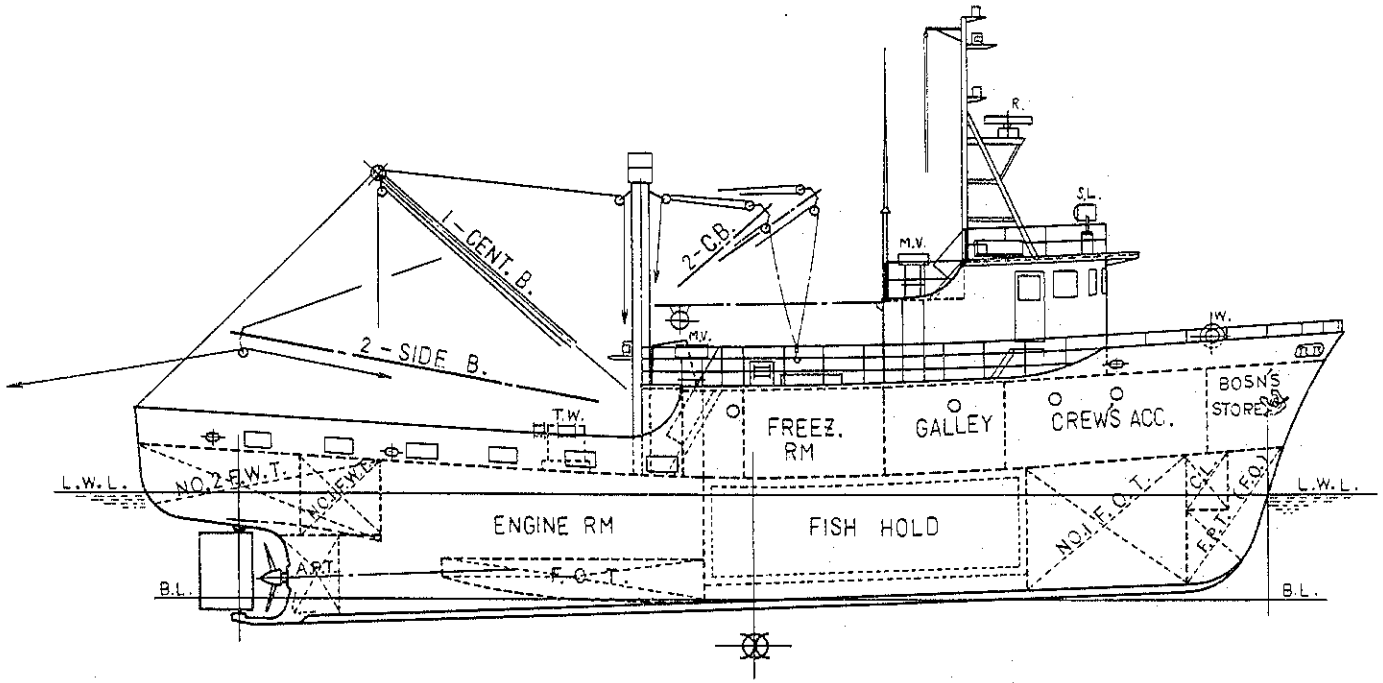
° Drain system : 1 set

(4) Others

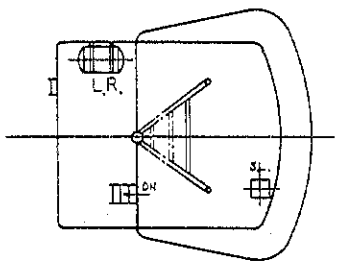
° Calcium chloride, ice-making can, arctic clothes, ice tongs

2–4 DRAWINGS

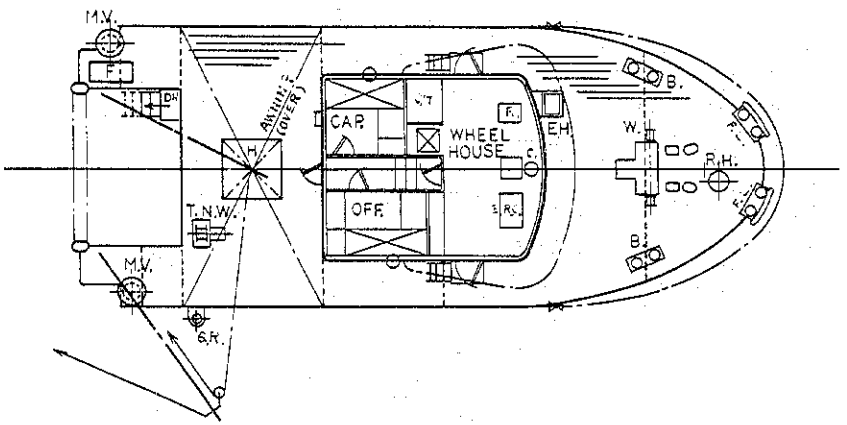
GENERAL ARRANGEMENT

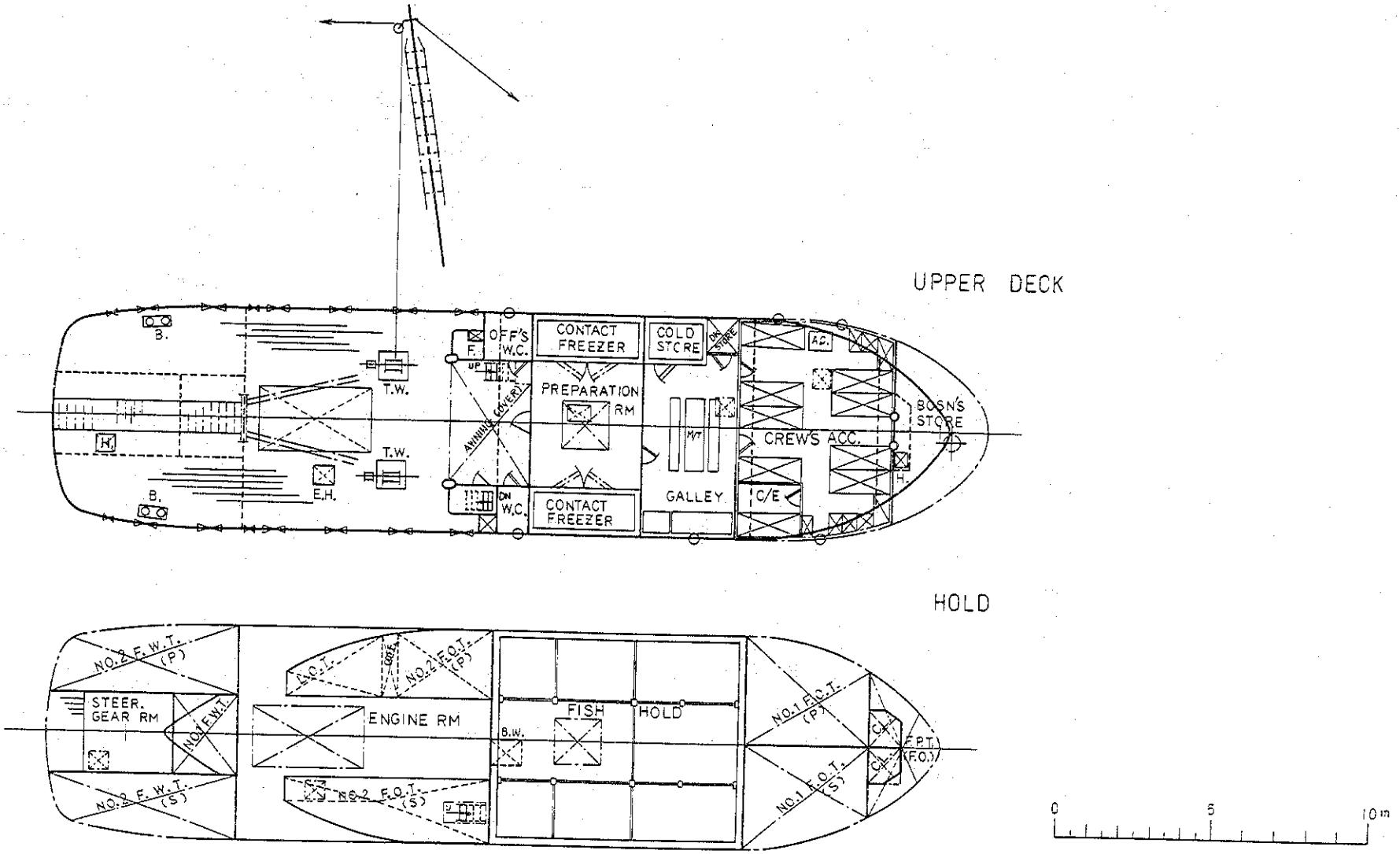


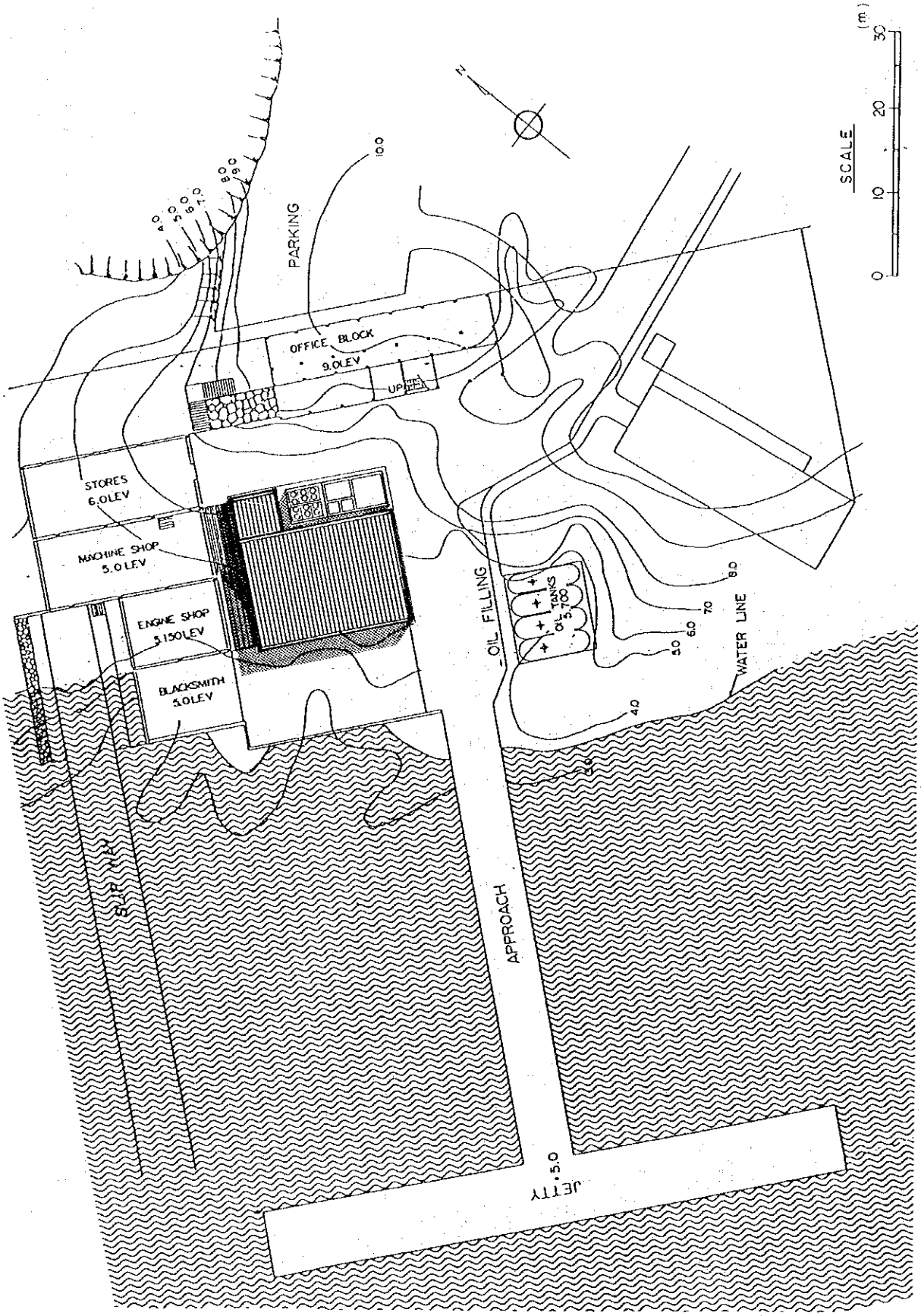
WHEEL HOUSE TOP

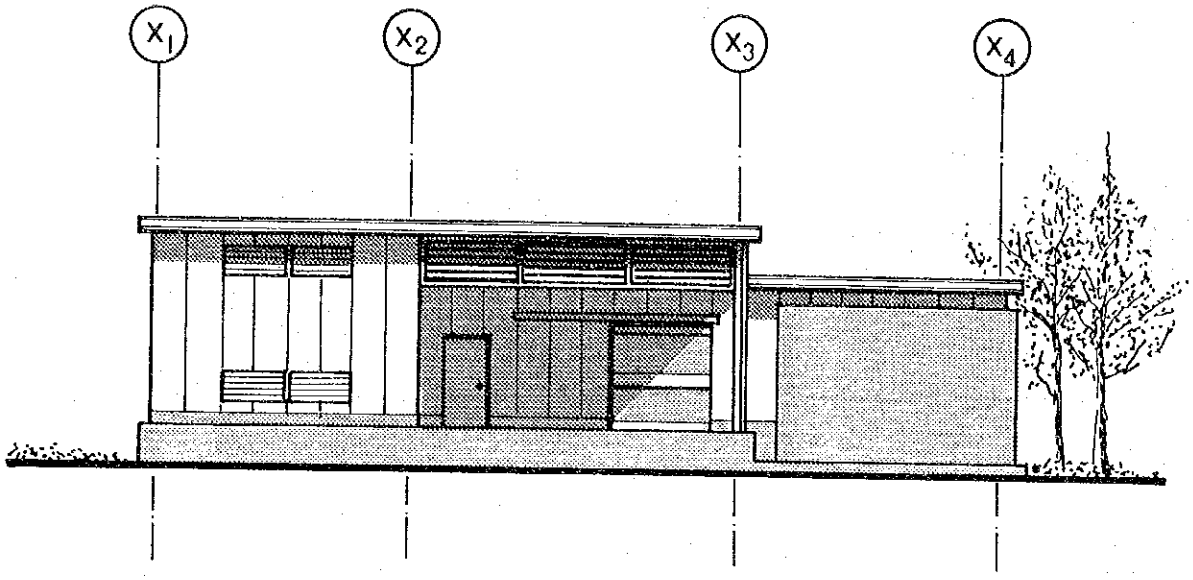


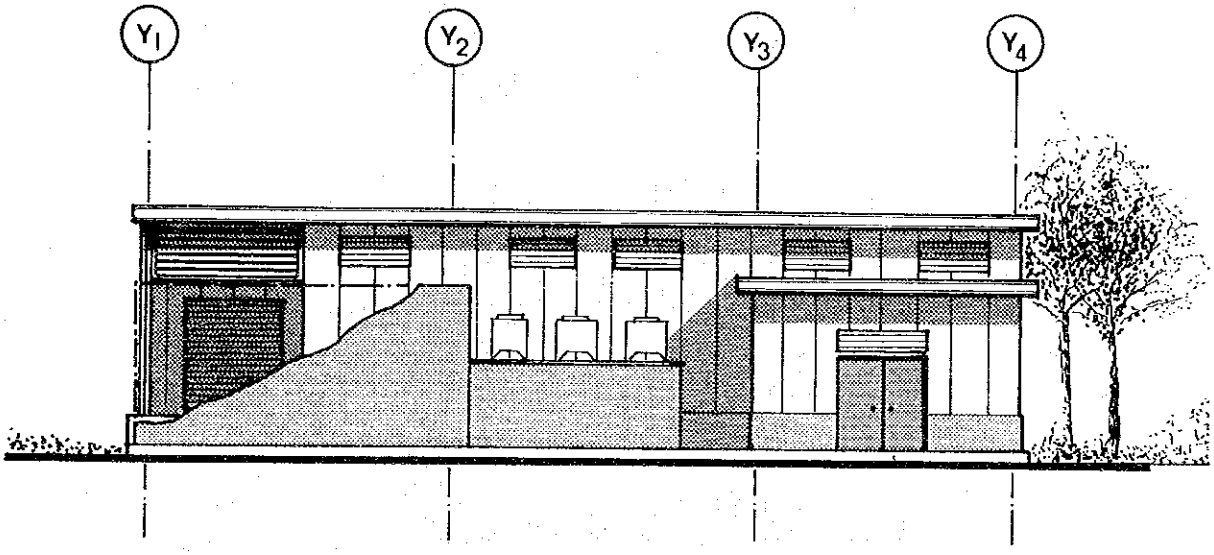
F'CLE DECK



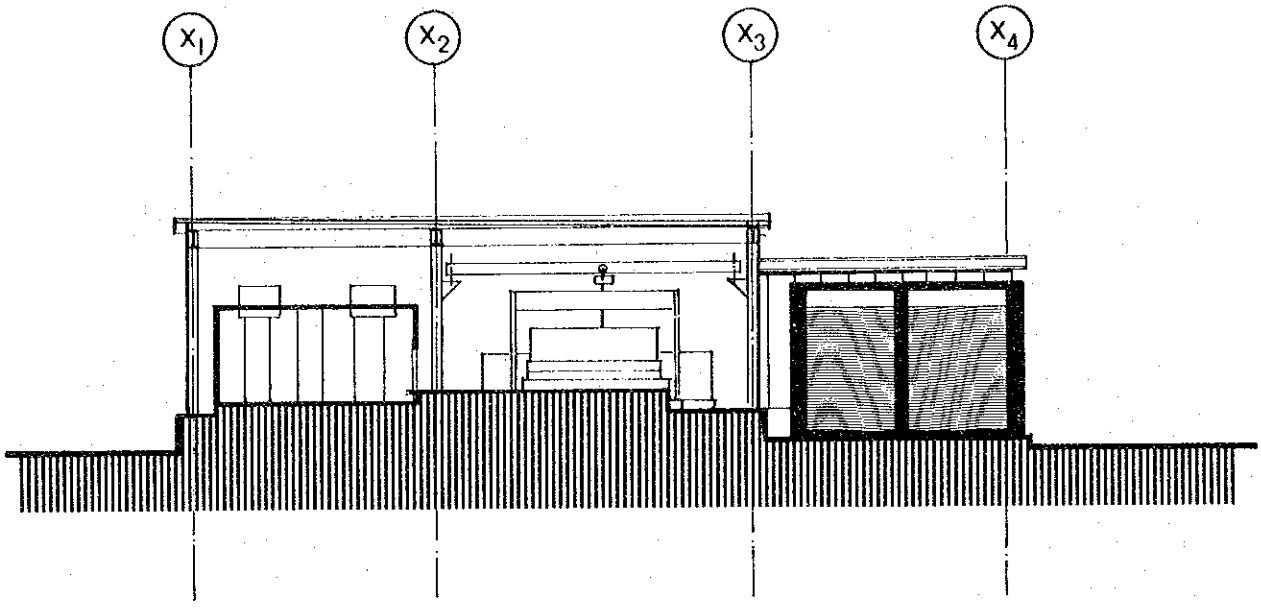

UPPER DECK
B.
T.W.
T.W.
E.H.
B.
OFF'S W.C.
F.
UP
AWNING COVER
CONTACT FREEZER
COLD STORE
ON TOP
PREPARATION RM
A.C.
CREW'S ACC.
BOSN'S STORE
H.
ON W.C.
CONTACT FREEZER
GALLEY
C/E
HOLD
NO.2 F.W.T. (P)
STEER. GEAR RM
NO.1 F.W.T.
NO.2 F.W.T. (S)
A.O.T.
SEA
NO.2 F.O.T. (P)
ENGINE RM
NO.2 F.O.T. (S)
FISH HOLD
B.W.
NO.1 F.O.T. (P)
C.L.
F.P.T. (F.O.)
NO.1 F.O.T. (S)
0
5
10m

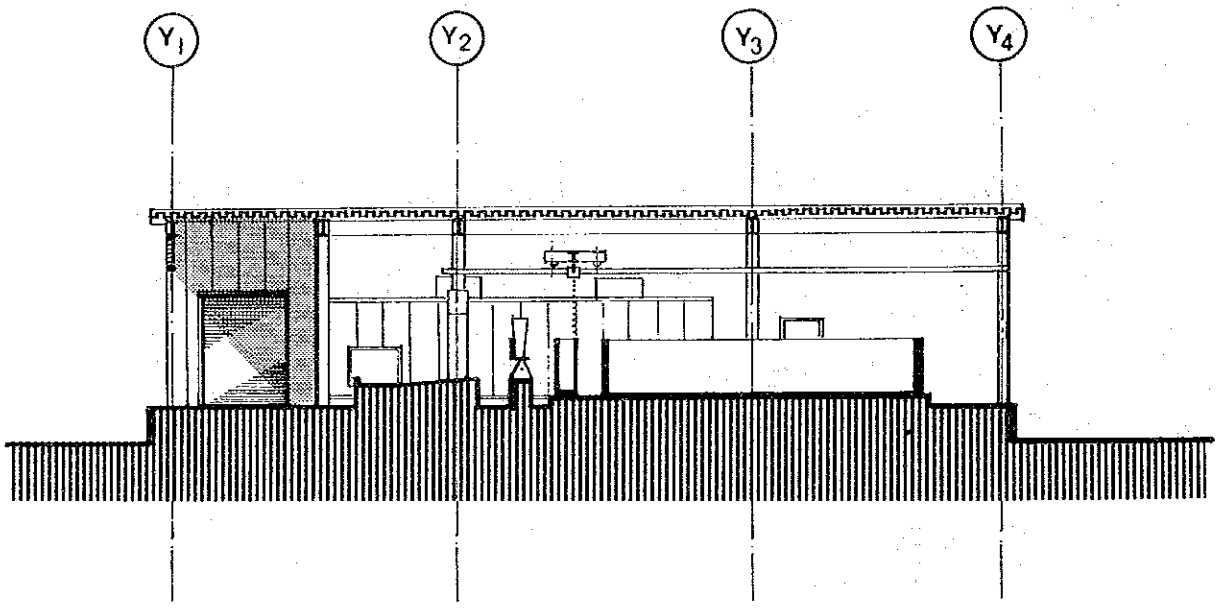

SCALE
(m)
0
10
20
30
PARKING
OFFICE BLOCK
9.0LEV
STORES
6.0LEV
MACHINE SHOP
5.0LEV
ENGINE SHOP
5.150LEV
BLACKSMITH
5.0LEV
OIL FILLING
TANKS
5,700
WATER LINE
APPROACH
JETTY
10.0
9.0
8.0
7.0
6.0
5.0
4.0



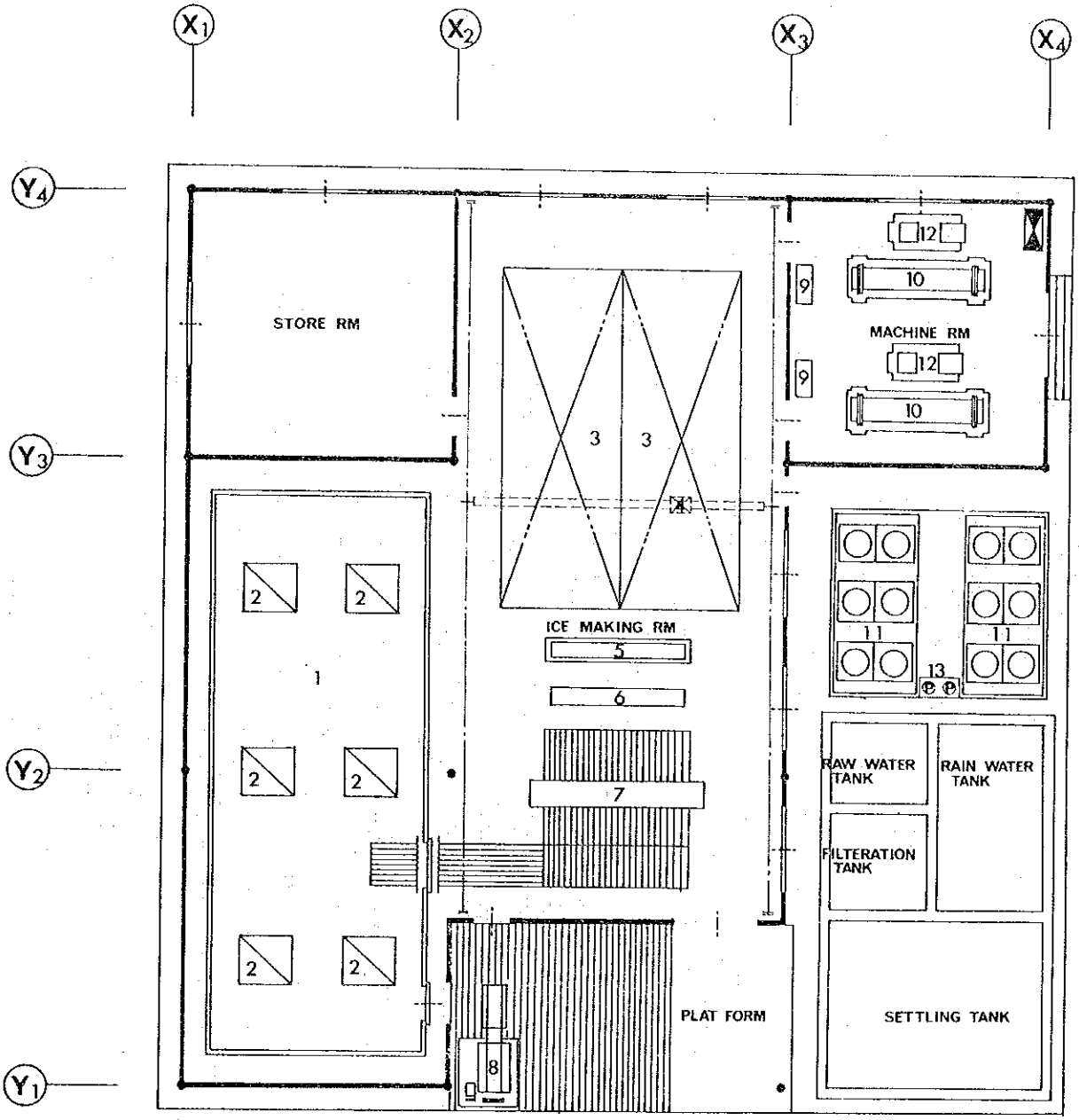


ELEVATION S = 1 : 150





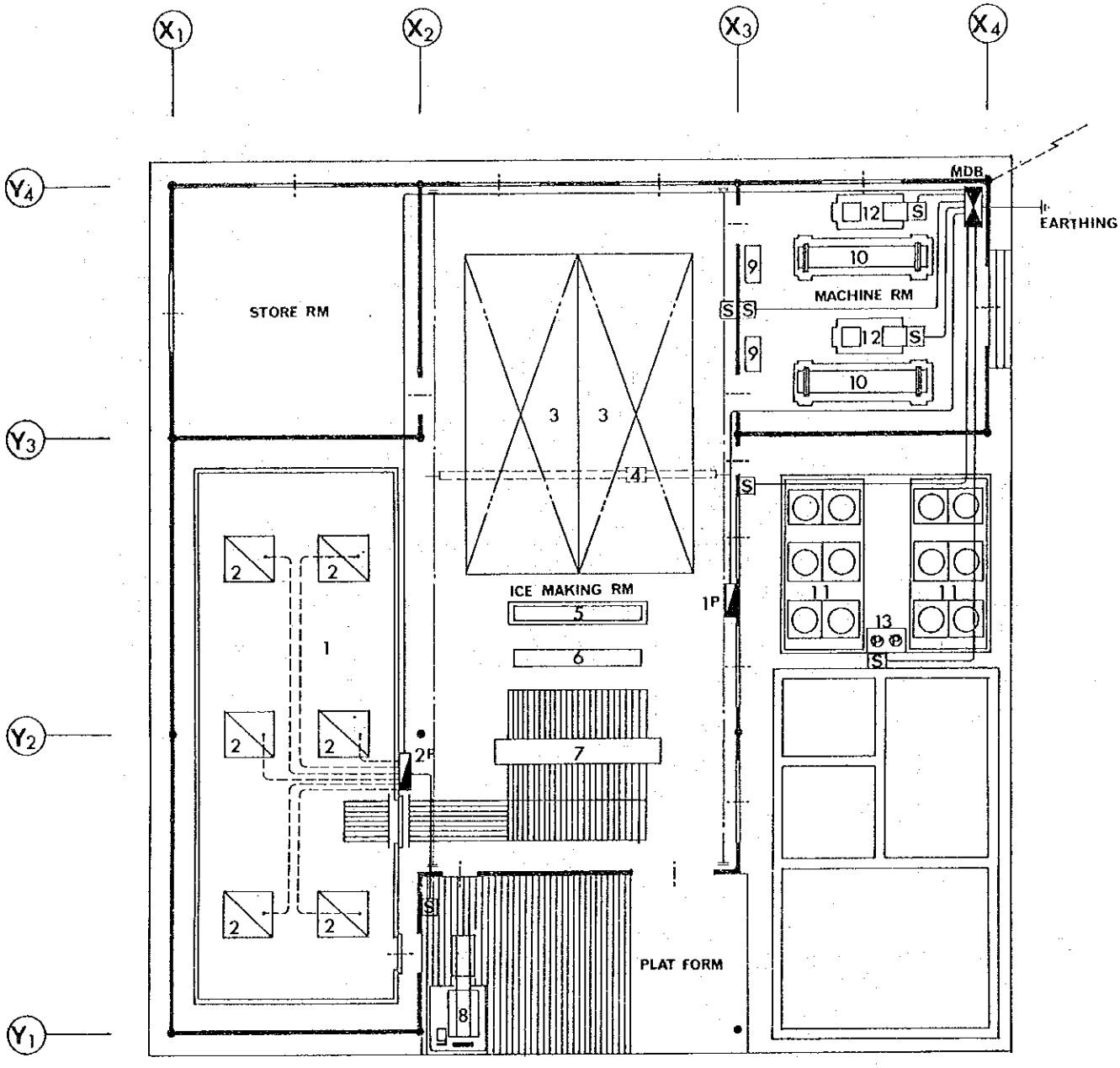
SECTION s =1:150



1 ICE STORAGE BIN
2 REFRIGERATOR
3 ICE MAKING TANK
4 HOIST CRANE
5 THAWING TANK
6 CAN DUMPER
7 RAW WATER FILLING TANK
8 ICE CRUSHER
9 BRINE PUMP
10 BRINE COOLER
11 AIR-COOLED CONDENSER
12 COMPRESSOR UNIT
13 RAW WATER PUMP

5 10 METER

MECHANICAL PLAN



LEGEND

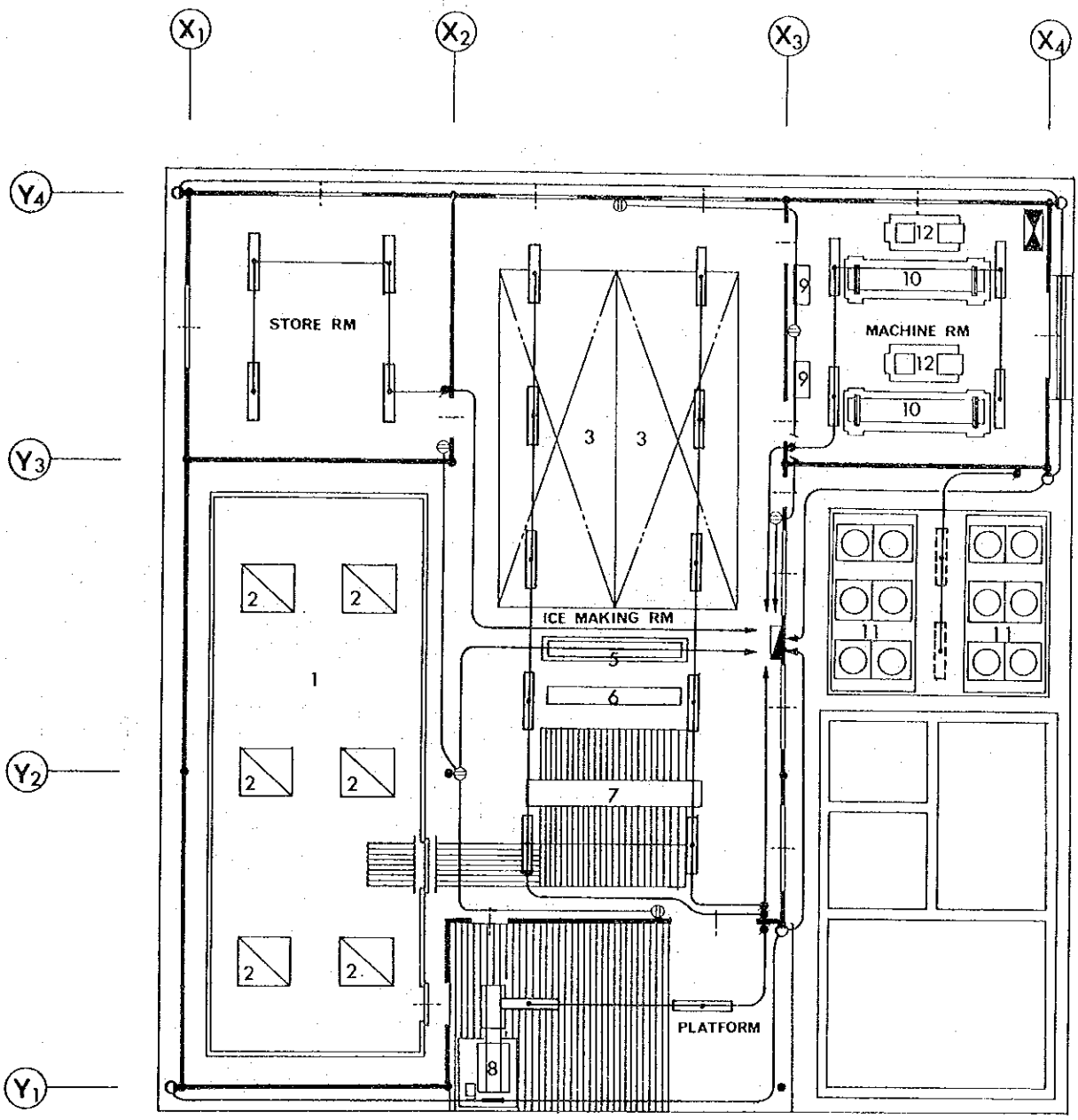
MDB : MAIN DISTRIBUTION BOARD

1P : DISTRIBUTION BOARD FOR LIGHT

2P : DISTRIBUTION BOARD FOR ICE STORAGE BIN

S : SAFETY SWITCH

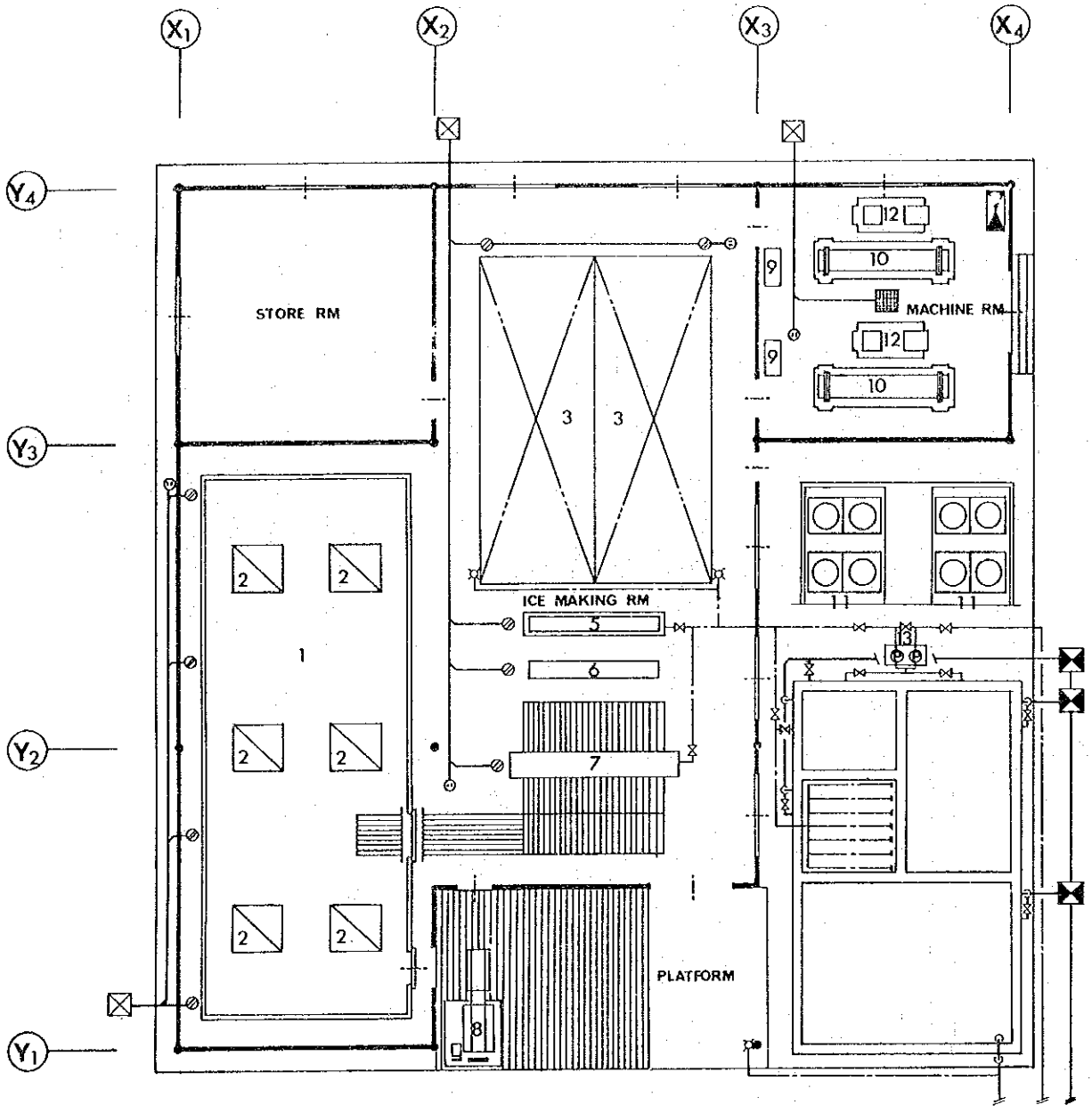
ELECTRICAL PLAN(POWER)



LEGEND

- DISTRIBUTION BOARD
- FLUORESCENT LIGHT
- INCANDESCENT LIGHT
- OUTLET
- SWITCH

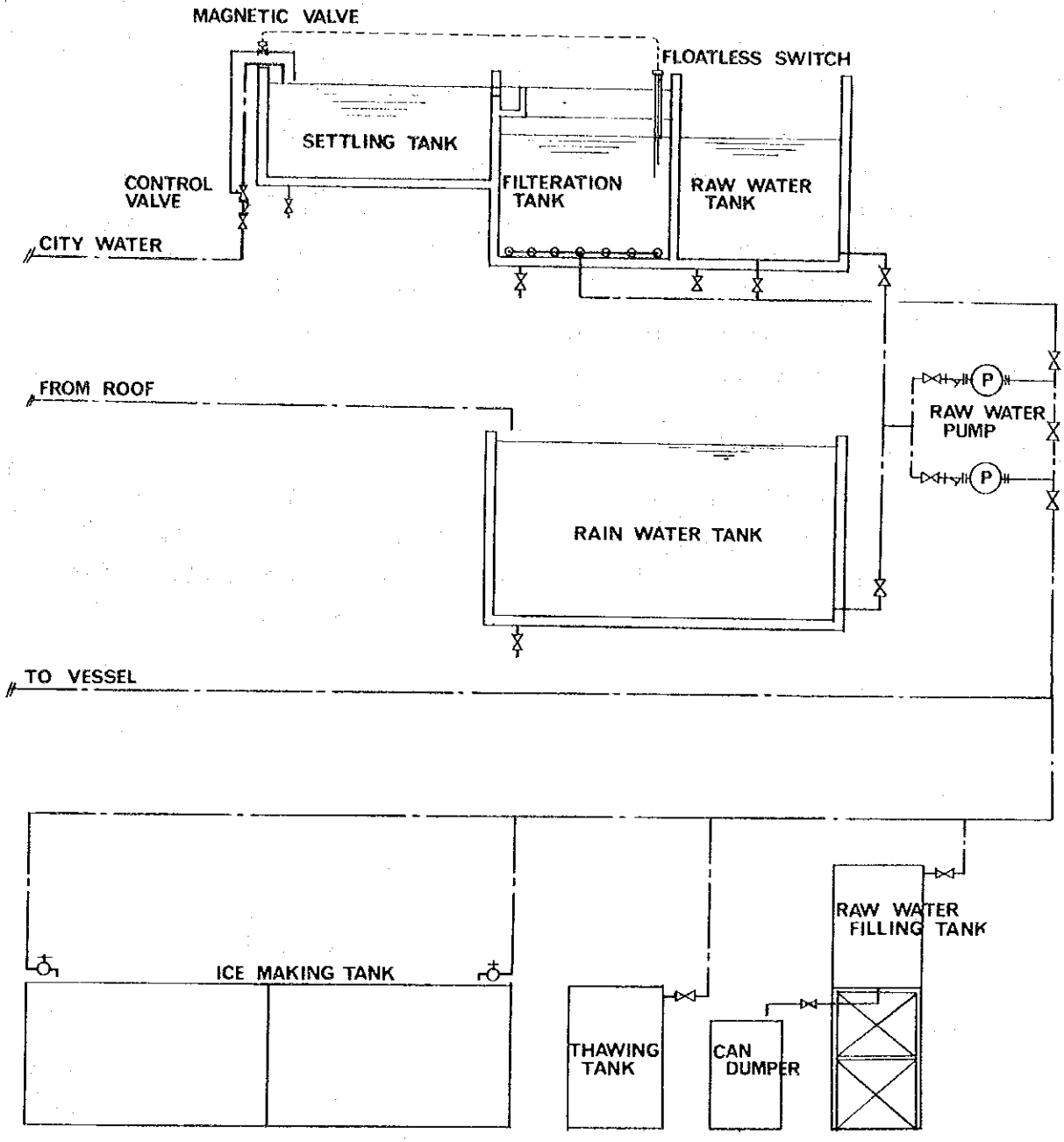
ELECTRICAL PLAN(LIGHT)



LEGEND

- ⊠ : SOAK-AWAY
- ▦ : CATCH BASIN
- ⌀ : FLOOR DRAIN
- ⌑ : FAUCET
- ⋈ : VALVE
- P : RAW WATER PUMP
- ⊙ : CLEAN OUT
- ⧓ : CATCH BASIN

PLUMBING PLAN



WATER SUPPLY DIAGRAM

Chapter 3 MANAGEMENT PLAN

3-1 MANAGEMENT

The prawns have the following biological characteristics.

1) As they are a yearly animal, their production varies widely from year to year.
2) The catches vary over a wide range seasonally because the prawns change their habitats according to their growth stages.
3) The productivity is extremely low.
4) The sizes vary largely depending on the species.

The low prawn productivity is a disadvantage for prawn fishing, which is a highly capital intensive industry. There are many cases of prawn fishing companies going bankrupt because of overinvestment in ships and equipment.

A survey report prepared by T.M. Jones shows that the labor productivity in the shrimp fishing industry in South Calorina, U.S.A., fell 12.7% every year during the period from 1971 to 1975. (Refer to Appendix V.)

According to the survey, it is found that the skipper's experience and fuel consumption (that is, operating hours) have a greater bearing on the catches than the main engine output. It is obvious that the catches can be increased by effective fishing operations led by experienced skippers and by endeavors to find fishing grounds and trawling nets rather than by increasing the ship size and engine output.

TAFICO will be able to operate the mothership to be donated without any problem because it has authorized captains and engineers.

TAFICO has been operating the donated ice-making plant by itself, and will be able to operate the larger one to be granted.

It should be noted however that to manage the mothership, prawn trawling fleet, ice-making facilities and shore base as an integral system in a profitable way is different from when these are operated independently.

The successful management of the mothership, fleet, and the prawn fishing project as a whole is founded upon stable supply of fuel, fresh water, and provisions, observation of scheduled the fishing time schedule, heightening of the morale of crew, preservation of the quality of products, and sale of marine products in a lucrative way.

TAFICO has yet to cultivate its experience in all of these and will have to face the challenges of many problems incidental to present-day Tanzania.

Though the target catches for the mothership and small trawlboats are a little too much for the past achievements of TAFICO, as already mentioned. The target catches will not be beyond the capacity of TAFICO considering the fishing record of the joint ventures. They can be achieved if TAFICO will make every effort to learn and apply modern fishery management.

3-2 PERSONNEL

The crew that will be necessary for the operation of the prawn fishing fleet will be as follows:

Fleet

Mothership	
Master fisherman	1
Captain	1
Chief engineer	1
Crew	17
Total	20

Small trawlboat	
Skipper serving also as master fisherman	1 (per bottom)
Chief engineer	1 (per bottom)
Crew	3 (per bottom)
Total	5 (per bottom)

The seamen now in TAFICO's employ will be assigned to these ships after they are given proper training and refresher courses.

The personnel required for the operation of the ice-making facilities will be as follows:

Manager	1
Refrigeration engineer	1
Electrician	1
Operator, 2 persons x 2 shifts	4
Hand, 3 persons x 2 shifts	6
Total	13

Some of the staff in the Kurasini ice-making plant may be transferred to the ice-making facilities, and the members may be trained in Kurasini.

As regards the refrigerator engineers and electrician, the Japan International Cooperation Agency has a training system, and there are similar systems in other countries. TAFICO should make use of these systems for upgrading its techniques and developing a trained and efficient staff.

3-3 OPERATING COSTS

3-3-1 Mothership

(1) Materials costs

1) Fuel cost

We have discussed the fuel consumption in Sections 2-2-4, "Discussions of Principal Particulars." The fuel consumption is calculated as follows:

Main Engine	29,600 lit./month x 11 months = 325,600 lit./year
Auxiliary Engine	16,905 lit./month x 12 months = 203,100 lit./year
Total	528,900 lit./year

TAFICO is in a favorable position to purchase fuel oil at a tax-free price of 3.26 shillings per liter (as of July 1981).

Thus, the fuel cost is calculated as follows:

528,700 lit. x 3.26 shillings = 1,723,562 shillings
= 1,723 thousand shillings

2) Lubricating oil

Assuming that the lubricating oil consumption are for main engine is 600 lit./month, for auxiliary engine is 305 lit./month, total 905 lit./month and that the price is 16 shillings per liter, the cost for lubricating oil is calculated as follows:

Main engine	600 lit./month x 11 months = 6,600 lit.
Auxiliary engine	305 lit./month x 12 months = 3,660 lit.

10,260 lit. x 16 shillings = 164,160 shillings
= 164 thousand shillings

3) Cost of fishing gear

For consumables like trawl nets, it will be necessary to appropriate 150 thousand shillings a year.

4) Packing cost

The shrimps are to be packaged aboard for the purpose of marketing.

The package materials, including inner carton and master carton, will cost 2,000 shillings per ton of shrimps. Thus, the annual packing cost is calculated as follows:

66 tons (annual total of catches) x 2,000 shillings
= 132 thousand shillings

5) Water charges

The annual cost for water is calculated as follows, provided that the water costs 2.5 shillings per ton:

32 tons x 2.5 shillings x 12 months = 960 shillings
= 1 thousand shillings

6) Supplies, and cost for other consumables

Assumed to be 38,000 shillings/year

(2) Labor cost

1) Captain, chief engineer, master fisherman

The monthly average income, including salary and crews share, will be 2,500 shillings.

2,500 shillings x 3 persons x 12 months
= 90 thousand shillings

2) Crew

The monthly average income, including salary and crews share, will be 1,000 shillings.

1,000 shillings x 17 persons x 12 months
= 204 thousand shillings

3) Provisions

30 shillings/persons/day

30 shillings x 20 persons x 365 days
= 219 thousand shillings

(3) Ship costs

1) Depreciation cost

As the mothership is to be granted by the Japanese Government, there is no need for accounting the depreciation cost. For reference, however, the depreciation cost is calculated according to the straight-line depreciation on condition that the depreciable life in years is set at nine years pursuant to the Japanese Income Tax Law.

2) Cost for repairs and maintenance

The cost for repairs and maintenance is calculated by multiplying the ship price by the following factor which is a function of the years passed after construction.

Years passed	1	2	3	4	5	6	7	8
Factor (%)	2	3.3	3.96	4.6	5.26	5.9	6.56	7.2

3) Insurance premium

1.5% of ship price

(4) Expenses

1) Warehousing charges

The products unloaded from the mothership are to be kept in a cold storage until they are exported. The storage will cost 200 shillings per ton per month.

Thus, the warehousing cost is calculated as follows:

6 tons x 200 shillings x 11 months = 13,200 shillings

= 13.2 thousand shillings

2) Overhead

12% of the total of costs and expenses above, excluding depreciation.

The following shows the annual estimated operating costs of the mothership:

(Unit: Thousand shillings)

Item \ Year	1st	2nd	3rd	4th	5th	6th	7th	8th	9th
Materials costs									
1) Fuel oil	1,724	1,724	1,724	1,724	1,724	1,724	1,724	1,724	1,724
2) Lubricating oil	164	164	164	164	164	164	164	164	164
3) Fishing gears	150	150	150	150	150	150	150	150	150
4) Packing	132	132	132	132	132	132	132	132	132
5) Water	1	1	1	1	1	1	1	1	1
6) Supplies	38	38	38	38	38	38	38	38	38
Subtotal	2,209	2,209	2,209	2,209	2,209	2,209	2,209	2,209	2,209
Personnel charges									
1) Officers	90	90	90	90	90	90	90	90	90
2) Crews	204	204	204	204	204	204	204	204	204
3) Provisions	219	219	219	219	219	219	219	219	219
Subtotal	513	513	513	513	513	513	513	513	513
Ship's cost (excl. depreciation)									
1) Repairs and maintenance	0	174	287	345	400	457	513	570	626
2) Insurance premium	130	130	130	130	130	130	130	130	130
Subtotal	130	304	417	475	530	587	643	700	756
Expenses									
1) Warehousing charge	13	13	13	13	13	13	13	13	13
2) Overhead	344	365	378	385	392	399	405	412	419
Subtotal	357	378	391	396	405	412	418	425	432
Total	3,209	3,404	3,530	3,593	3,657	3,721	3,783	3,847	3,910
Depreciation	965	965	965	965	965	965	965	965	965
Grand total	4,174	4,369	4,495	4,558	4,622	4,686	4,748	4,812	4,875

3-3-2 Ice-making Facilities

(1) Electric charges

60 kW x 0.75 x 24 hrs. = 1,080 kWh/day
1,080 kWh x 240 days = 259,200 kWh

Assuming that electricity costs 0.8 shilling per kWh, the electric charges are calculated as follows:

259,200 kWh x 0.8 shilling = 207,360 shillings
= 207 thousand shillings/year

(2) Water charges

The water quantity required for making 10 tons of ice a day is 15 tons a day. Thus, the water charges are calculated as follows:

15 tons x 240 days x 2.5 shillings/ton = 9,000 shillings

(3) Personnel charges

Manager x 1	2,000 shillings/month	2,000 shillings
Refrigerator engineer x 1	1,500 shillings/month	1,500 shillings
Electrician x 1	1,500 shillings/month	1,500 shillings
Operator x 4	1,000 shillings/month	4,000 shillings
Hand x 6	800 shillings/month	4,800 shillings
	Total	13,800 shillings

13,800 shillings x 12 months = 465,600 shillings
= 466 thousand shillings

(4) Overhead

10% of the total of the above costs

(5) Depreciation

For reference the depreciation cost is calculated. The depreciable life in years is 22 years for the building and 13 years for the equipment.

The depreciation cost is calculated according to the straight-line method.

Annual operating costs for the ice-making facilities

		(in thousand shillings)
° Electric charges	:	207
° Water charges	:	9
° Wages and salaries	:	466
° Overhead	:	68
Subtotal	:	750
Depreciation		
° Buildings	:	114
° Equipment	:	177
Subtotal	:	291
Total	:	1,041

3-3-3 Small Trawlboats

The small trawlboats already granted are not the subject of the basic design here. But, for the purpose of evaluating the profitability of the fleet, their operating costs are calculated below.

(1) Materials costs

1) Fuel

33,847 lit./month x 11 months = 372,317 lit./year

372,317 lit. x 3.26 shillings = 1,176,522 shillings
= 1,177 thousand shillings/year

2) Lubricating oil

572 lit. x 11 months x 16 shillings = 100,672 shillings
= 101 thousand shillings/year

3) Fishing gears

87 thousand shillings for the replacement of consumable fishing gears for 5 fishing boats

4) Packing

The packing material costs for the prawns transshipped to the mothership are calculated as follows:

54 tons x 11 months x 2,000 shillings
= 118,800 shillings = 119 thousand shillings

5) Water

8.4 tons x 11 months x 2.5 shillings = 231 shillings

This small amount may be neglected.

6) Ice

The annual ice consumption by all the fishing boats is calculated as follows:

172 tons x 11 months = 1,892 tons

On the other hand, the annual operating cost for the ice-making facilities is 1,041 thousand shillings.

Hence, the unit price of ice is calculated as follows:

1,041 thousand shillings ÷ 1,892 tons
= 0.55 thousand shillings/ton

Thus, the annual ice cost for the five small trawlboats is calculated as follows:

41 tons x 11 months x 0.55 thousand shillings
= 248 thousand shillings

7) Supplies

12 thousand shillings/year

(2) Personnel charges

1) Skipper and chief engineer

The monthly average wages, including salary and crews share, are set at 2,000 shillings.

2,000 shillings x 2 persons x 12 months
= 48 thousand shillings

48 thousand shillings x 5 small trawlboats
= 240 thousand shillings

2) Crew

The monthly average wages, including salary and crew share, are set at 1,000 shillings.

1,000 shillings x 3 persons x 12 months
= 36 thousand shillings

36 thousand shillings x 5 small trawlboats
= 180 thousand shillings

3) Provisions

30 shillings x 5 persons x 365 days = 54,750 shillings

54,750 shillings x 5 small trawlboats
= 273,750 shillings = 274 thousand shillings

(3) Ship's cost

1) Depreciation

The small trawlboats are made of FRP, and their depreciable life is 7 years according to the Japanese Income Tax Law. Their depreciation cost is calculated according to the straight-line method.

2) Cost for repairs and maintenance

The cost for repairs and maintenance can be calculated by multiplying the ship price by the following factor which is a function of the years passed after construction.

(%)

Years passed	1	2	3	4	5	6
Factor, %	2	3.3	3.96	4.6	5.25	5.9

3) Insurance premium

2.5% of ship price

(4) Expenses

1) Warehousing charges

5.4 tons x 11 months x 200 shillings
= 11,880 shillings = 12 thousand shillings

3-3-4 Skiffs

The annual operating costs for the skiffs are calculated below.

It is assumed that the skiff will be operated by one operator, and that the prawns will be purchased from the fishing villages at 15 shillings per kg. The overhead cost, costs for provisions, and insurance premium are omitted.

(Unit: Thousand shillings)

Item \ Year	1st	2nd	3rd	4th	5th	6th	7th
Materials costs							
Fuel oil	39	39	39	39	39	39	39
Lubricating oil	3	3	3	3	3	3	3
Packing	115	115	115	115	115	115	115
Ice	24	24	24	24	24	24	24
Subtotal	181	181	181	181	181	181	181
Prawns	864	864	864	864	864	864	864
Salaries and wages							
Operator	24	24	24	24	24	24	24
Ship cost							
Repairs and maintenance	0	2	3	3	4	4	5
Expenses							
Warehousing charges	12	12	12	12	12	12	12
Overhead	53	54	54	54	54	54	54
Subtotal	65	66	66	66	66	66	66
Total	953	956	957	957	958	958	959
Depreciation	111	111	111	111	111	111	111
Grand total	1,064	1,067	1,068	1,068	1,069	1,069	1,069

2) Overhead

12% of the total of the costs above (not including depreciation)

The annual operating costs for the five small trawlboats are as listed below.

(Unit: Thousand shillings)

Item \ Year	1st	2nd	3rd	4th	5th	6th	7th
Materials costs							
Fuel oil	1,177	1,177	1,177	1,177	1,177	1,177	1,177
Lubricating oil	101	101	101	101	101	101	101
Fishing gears	87	87	87	87	87	87	87
Packing	119	119	119	119	119	119	119
Ice	248	248	248	248	248	248	248
Supplies	12	12	12	12	12	12	12
Subtotal	1,744	1,744	1,744	1,744	1,744	1,744	1,744
Personnel charges							
Officers	240	240	240	240	240	240	240
Crew	180	180	180	180	180	180	180
Provisions	274	274	274	274	274	274	274
Subtotal	694	694	694	694	694	694	694
Ship's cost (excl. depreciation)							
Repairs and maintenance	0	22	36	44	51	58	65
Insurance premium	28	28	28	28	28	28	28
Subtotal	28	50	64	72	79	86	93
Expenses							
Warehousing charges	12	12	12	12	12	12	12
Overhead	297	300	301	302	303	304	305
Subtotal	309	312	313	314	315	316	317
Total	2,775	2,813	2,828	2,837	2,845	2,853	2,861
Depreciation	156	156	156	156	156	156	156
Grand total	2,931	2,969	2,984	2,993	3,001	3,009	3,017

Chapter 4 CONSTRUCTION PROGRAM

4—1 CONSTRUCTION SCHEDULE

4-1-1 Plan

On account of the project, the mothership will be built in Japan and towed to Dar es Salaam.

The fishing gear will also be procured in Japan, and will be shipped to Tanzania.

As regards the ice-making facilities, however, site work is required. The Tanzanian Government is requested to complete the following prior to the site work.

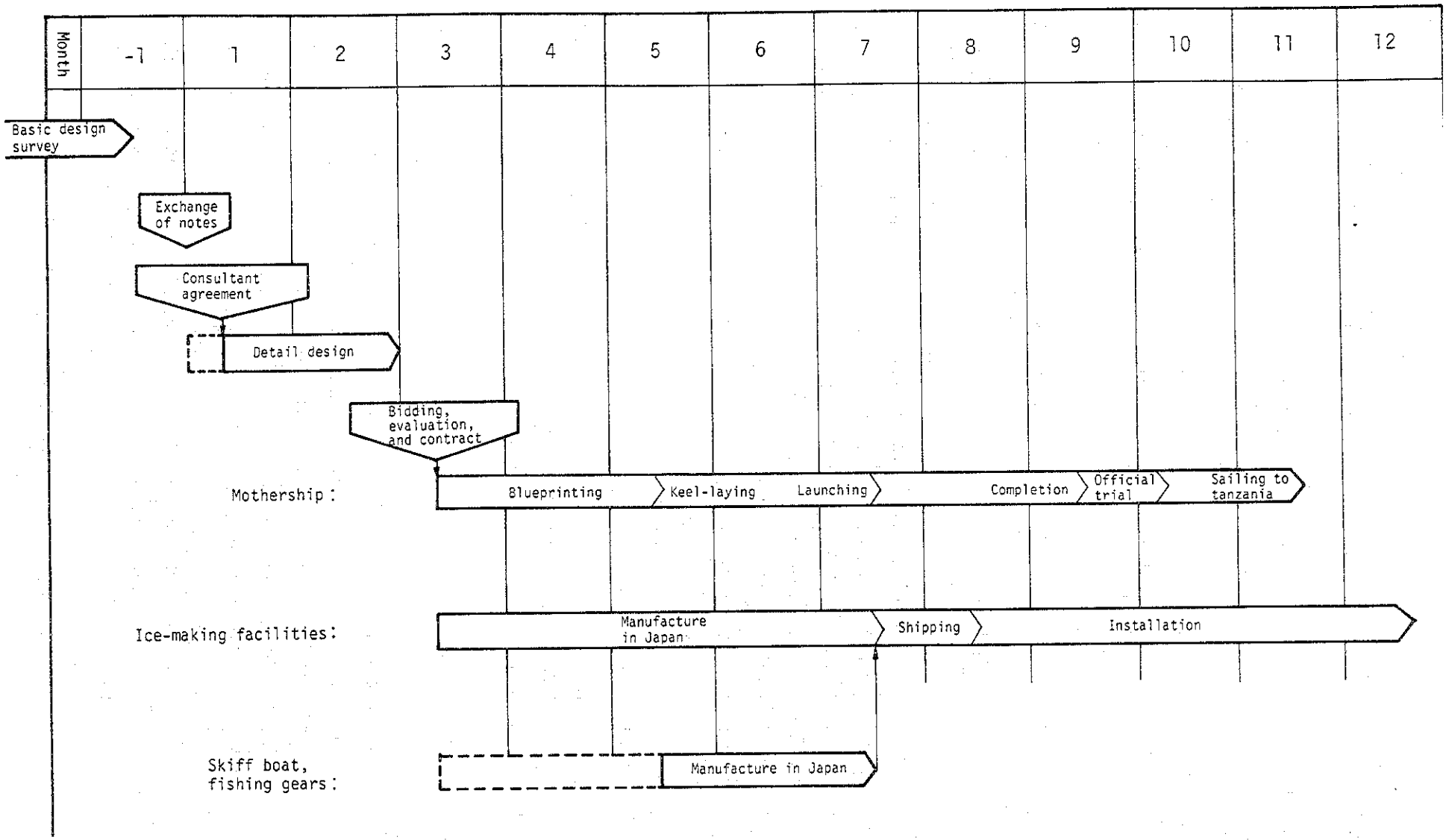
(1) Final identification of the site for ice-making facilities, and coordination between the government authorities concerned.
(2) Leveling of site, and filling where required.
(3) Supply of electricity and water of required capacity to site to make the construction work ready immediately after arrival of the construction materials at the site.
(4) Formalities for permits concerning site work.
(5) All necessary arrangements for smooth customs clearance of building materials, equipment, etc., safe custody of materials and supplies for protection from weather, damage and theft.

4-1-2 Schedule

After a excharge of notes between the two governments, a consultant agreement will be made at the earliest convenience, and the detail design will be carried out. The bidding will be carried out according to the tender specifications, drawings, and instructions prepared by the consultant.

Within about nine months after the construction contracts, the mothership, ice-making facilities and fishing gear will be delivered to TAFICO.

The following shows an approximate schedule.


Month
-1
1
2
3
4
5
6
7
8
9
10
11
12
Basic design survey
Exchange of notes
Consultant agreement
Detail design
Bidding, evaluation, and contract
Mothership :
Blueprinting
Keel-laying
Launching
Completion
Official trial
Sailing to tanzania
Ice-making facilities:
Manufacture in Japan
Shipping
Installation
Skiff boat, fishing gears :
Manufacture in Japan

Chapter 5 PROJECT EVALUATION

This analysis attempts to evaluate the appropriateness of the proposed aid for Fisheries Development Project in Tanzania, in terms of financial effects on financial status of TAFICO and economic effects on Tanzanian national economy, under conditions where the analytical techniques themselves are not yet fully developed and bench mark data from the target country are inadequate.

Nevertheless, such an exercise will give a basis for reassessing the benefits and costs entailed in the project operation.

5—1 FINANCIAL ANALYSIS

As stated in Section 2-1-1, the discussions here center on the economic feasability of the mothership to be donated and that the trawl fleet, and it should be borne in mind that:
First, the financial analysis here is intended not for analysis of the profitability of the project, but to study whether the grants can be operated without encumbering TAFICO: and second, this financial analysis is based on the number of operating days of the mothership and trawlboats, target catches, and collections from the villages studied in Chapter 2.

5-1-1 Mothership

(1) Sales

The prawnts are typical international marine products. As they are a type of merchandise, their price follows the rule of demand and supply. The exchange rate is also one of the major factors determining their price. In fact, the price of prawns on the international market are governed by various factors, and elude projection.

The price is set at 56,000 shillings per ton as standard, however. This is the international average price normal for international standard qualities in view of freshness and size.

The fish are consumed domestically, and their price differs according to the species. Here, however, it is set at 10,000 shillings per ton.

According to the catches given in Chapter 4, the annual sales of the catches achieved by the mothership herself are calculated as follows:

° Prawns
6 tons/month x 11 months x 54 thousand shillings (avg. price)
= 3,696 thousand shillings

° Fish
7.2 tons/month x 11 months x 10 thousand shillings (avg. price)
= 792 thousand shillings

Total: 4,488 thousand shillings

(2) Cash flow

The cash flow concerning the mothership is as follows. Although the purchase of the mothership actually cost TAFICO nothing, it is counted as an initial investment. It is assumed that the mothership will be sold at a salvage value (10% of ship price) after its depreciable life has elapsed.

(Unit: Thousand shillings)

Year	0th	1st	2nd	3rd	4th	5th	6th	7th	8th	9th
Sales	0	4,488	4,488	4,488	4,488	4,488	4,488	4,488	4,488	4,488
Sale of assets	0	0	0	0	0	0	0	0	0	870
Cash inflow, total	0	4,488	4,488	4,488	4,488	4,488	4,488	4,488	4,488	5,358
Operating expenses	0	3,209	3,404	3,530	3,593	3,657	3,721	3,783	3,847	3,910
Purchase of capital	8,700	0	0	0	0	0	0	0	0	0
Cash outflow, total	8,700	3,209	3,404	3,530	3,593	3,657	3,721	3,783	3,847	4,780
Net cash inflow	-8,700	1,279	1,084	958	895	831	767	705	641	1,448
Cumulative total	-8,700	-7,421	-6,337	-5,379	-4,484	-3,653	-2,886	-2,181	-1,540	-92