CHAPTER III CONTENTS OF THE PROJECT

3-1 Objectives and Contents of the Project

Development of the fishery, which aims at securing foreign currency and providing the nation with a constant supply of inexpensive fish protein has the following objectives.

(1) To improve the quality of frozen shrimp for exports, to enhance their reputation in overseas markets and to secure foreign currency.

(2) To increase both production and employment by establishing a fish trawler fleet.

(3) To improve the base by increasing the capacity of ice making and freezing and transportation efficiency.

(4) To improve transportation to reinforce the distribution and sales system in line with potential demand for fish in Guyana.

To improve the quality of frozen shrimp and to increase efficiency in the processing factory GFL intends to install;

(1) An automatic shrimp grading machine capable of grading 8,000 pounds a day,

(2) A water treatment and purification system to improve the quality of processing water used for the ice packing of shrimps for export.

In addition, as mentioned before, in order to realize their basic national policies of self-sufficiency in food they plan to install;

(3) 20-ton class fishing trawler used exclusively for fish,

(4) 2 ice making machines with each capacity of 15 tons per day,

(5) Air blast freezer with a capacity of 15 tons per day and also plan to provide the following equipments to enhance quality control, and to increase treatment capacity and sales.

(6) Refrigerator trucks,

(7) Forklifts,

(8) Fish boxes

(9) Standby generators.

3-2 Policy of the Project

This project, which can be considered to be a consistent, integrated project that will provide facilities and equipments required for production treatment and sales following the previous three steps of the Demerara Fishing Port plan in Guyana, aims at implementing the policy of promoting self-sufficiency in food with rice and fish by increasing fish catches of trawlers. It is the first attempt by Guyana to industrialize fishing trawlers through the GFL. It is necessary to examine that scale of the fleet of trawlers on the basis of study of present supply and demand, future scope in Guyana as well as availablity of

labour, technical and management personnel at the GFL. As to the shore equipments, the capacity of shrimp grading machine can be increased at a later stage, the ice making machine, blast freezer, etc., however, must be of sufficient capacity, partly because of the installation site and related construction requirements and partly because they have to cope with the expansion of the fish and shrimp fleets in future.

3-2-1 Fishing Trawlers

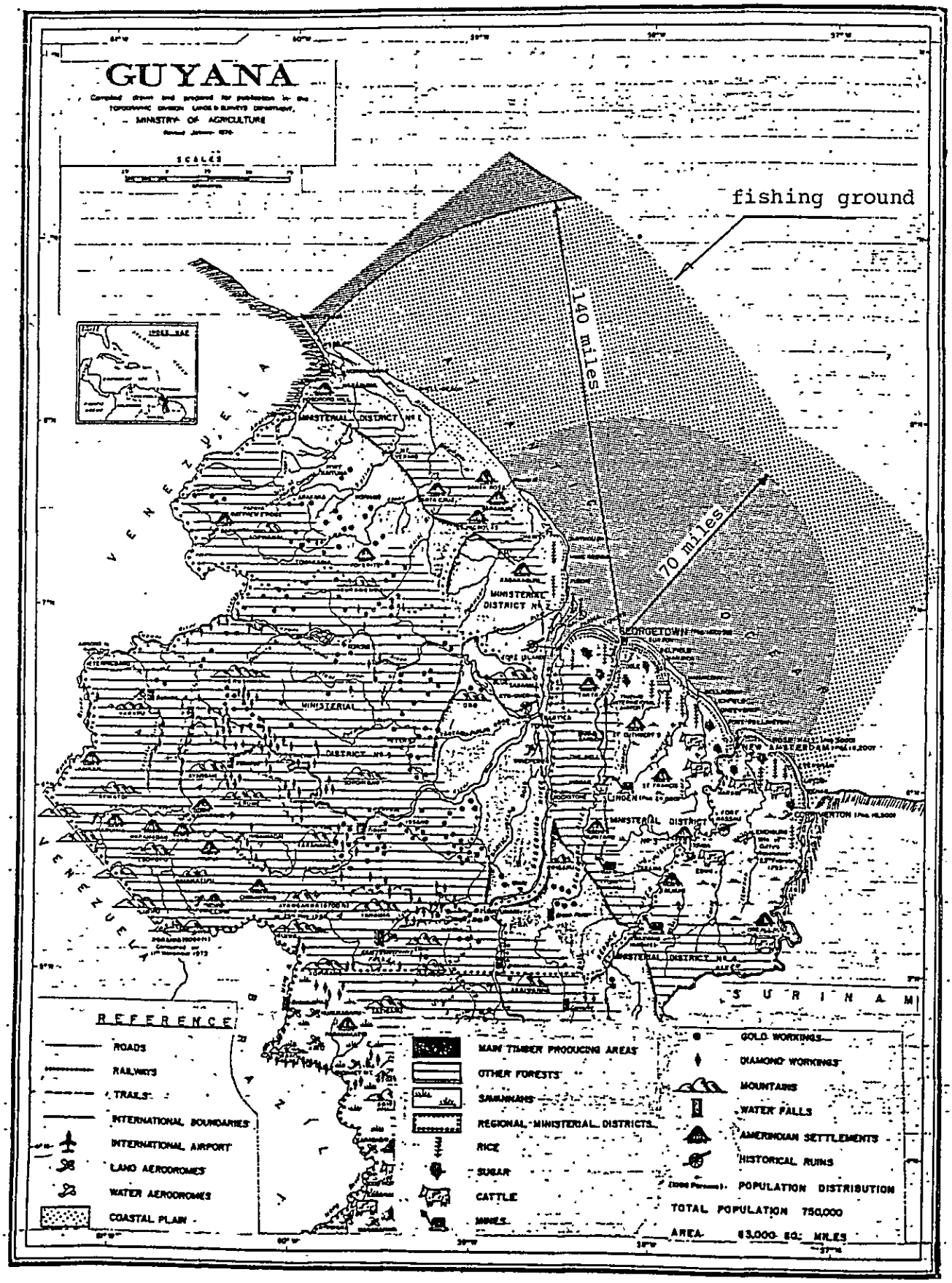
The idea of introducing fishing trawlers to be used exclusively for fish derives from a recognition of Guyanese bottom fish resources in both quantitative and qualitative aspects, and was considered a practical way of securing a constant supply of inexpensive protein resources for the Guyanese.

In Guayana edible fish is supplied through both the coastal fishery by small scale fishermen and the mixed catch of the shrimp trawlers.

The basic management concepts for the introduction of trawlers in this plan are given below.

- To avoid specifications that require heavy expenditure for management, maintenance and control and a high level of technologies.
- To adopt fishing methods that can be used with the techniques Guyanese fishermen have already learned or can adapt to easily with a little training.
- To make practical plan which allows for change in

Fishing ground for Trawl fishery



the future.

- To reduce time in harbour to improve the rate of operation.
- To make a plan that ensures the fishing trawlers a profit.

(1) Appropriate size of the Fishing Trawler

Before reaching a concrete decision as to the size of fishing trawlers, a number of factors would have to be taken into consideration, i.e., the condition of conventional shrimp trawlers used at Demerara base, available fishing grounds, fishing equipment and method and construction of boats.

The largest factors in determining the size of a trawler are efficient labour and investment productivity. This applies to the procurement of plant in other industries.

In case of fishing boats, the sea, as the working environment adds special conditions. The following points need to be investigated.

1) Safety of fishing boats,
2) Resources available,
3) Distance between the base and fishing ground,
4) Unit prices of fish,
5) Capacity of the fish hold,
6) Products costs.

Summing up the above plainly, the target is to guarantee the safety of the boat, to catch the most expensive fish in the largest quantities and lowest cost with the smallest crew at the nearest fishing ground and to sell the fish in a stable market. Applying these to the management of the fishing trawlers based at Demerara fishing port the following table was prepared.

Comparison of 20-ton Trawler and 10-ton Trawler

I t e m	20-ton Trawler	10-ton Trawler
Safety	Superior	Inferior
Load	7 to 8 tons	3 to 4 tons
Crew	4 mariners	4 mariners
Range of Fishing Ground	All areas of Guyanese trawling ground	About 40 nautical miles around Demerara
Main Engine	About 240 HP	About 160 HP
Fishing Gear	Large	Small
Efficiency of Fish Catching	Large	Small
Earnings	Large	Small
Production Costs per 1 kg of Fish	Small	Large
Remarks:	Guyana's request amended after consultation with the Study Team	Guyana's initial request.

This basic argument can be developed taking account of the special features of trawling off the coast of Guyana.

- The fishing ground off Guyana is rich in resources, where a boat equipped with a powerful engine can trawl deep coral sea bottom for catches including high price sea bream to increase the earnings per unit.

- The crew needed for a 20-ton trawler is the same as that for a 10-ton trawler, namely 4, since fishing method and equipments are the same.

- When the number of the crew is the same, the boat with larger hold capacity being capable of staying at sea longer is more attractive. The annual operating rate of a 20-ton trawler is therefore higher than that of 10-ton trawler.

- As bottom fish take 4 to 5 years to reproduce, while shrimp reproduce annually, daily continual trawling by short-range 10-ton trawlers within a narrow fishing ground of 30 to 40 nautical miles around Demurara fishing port will accelerate the devastation of the resources. Further, even when catch slows down the small boats would not be able to go to more long distant fishing grounds.

As is also obvious from the following table the 20-ton trawler can operate in all the trawling rounds off Guyana is more advantageous.

(2) Number of Fishing Trawler

For a proper decision as to exact number of vessels in the trawler fleet, comprehensive decision on factual understanding of the demand and supply situation on fish in Guyana, and Technical capabilities and business management on operation of fishing trawlers, are necessary.

The Guyanese people largely depend on fish for their animal protein and their consumption is twice as large as that of the world average.

There are two sources of supply. Most of the fish comes from the enterprise of small local fishermen who operate in the local coastal waters and the balance is supplied by the mixed catch of GFL shrimp trawlers. Accordingly, for establishment of number of fishing trawlers, it will be indispensable to grasp the fish consumption and production in Guyana, but in the absence of those informations, following basic study as described in (A) and (B) was reviewed:-

Firstly, as for (A), fish demand forecast of the people for the next three years based on actual fish consumption between 1981 and 1983 which obtained through the field survey was examined, and it is estimated that the tonnage of fish required, which is the potential rise in consumption is the difference between above

Comparison of Annual Expenses for
20-ton and 10-ton Trawler

		20-ton Trawler		10-ton Trawler	
		One Trip	Annual	One Trip	Annual
Details of operation (days)	Navigation	days 0.5	days 16	days 0.25	days 11
	Fishing	9.0	288	6.5	286
	Discharge	0.5	16	0.25	11
	Preparing	0.5	16	0.5	22
	Repairing	0.5	16	0.5	22
	Others	-	13	-	13
	Total	11.0	365	8.0	365
Catch per towing		450 lbs		300 lbs	
Landing		7.3 tons	233tons	3.5 tons	154 tons
*Fixed Unit Price of Fish		1.9G$/ lbs		1.9G$/ lbs	
- Ditto - yen/kg		274 yen		274 yen	
REVENUE (thousand yen)					
Proceeds		2,000	64,000	960	42,000
EXPENDITURE					
Fuel			12,250		7,979
Lubricating Oil			640		423
Fishing Gear			7,500		5,020
Food & Water			790		772
Repairing Costs			2,000		1,340
Comsumables			1,500		1,000
Berth Fee			333		458
Ice			5,054		3,336
Insurance			3,294		2,184
Commission			5,054		3,336
General Management Charge			3,841		2,595
Total Expenditure			42,256		28,433
GROSS PROFIT			21,744		13,467

*As projected after the implementation of the plan.

demand forecast and present capacity for production. By the above estimates, number of fishing trawlers to be required was calculated.

The data supplied by the Dept. of Fishery Ministry of Agriculture, Government of Guyana in August 1984, have been relied upon in preparation of above-mentioned estimates.

·Demand

Actual Figures and Projection of Fish Demand

	Year	Population	National Consumption in Tonnage	Consumption per Capita	Comparative Increase
Actual Figures	1981	889,320	18,830	21.2 kg	
	1982	880,000	20,565	23.4	11%
	1983	869,000	23,679	27.2	16
Projection	1984	870,000	27,014	31.1	14%
	1985	870,000	30,811	35.4	14
	1986	870,000	35,118	40.4	14

·Supply

1. Local Fishermen

	Year	Catch in Tonnage	Comparative Increase
Actual Figures	1981	16,265	
	1982	19,056	17%
	1983	21,000	10
Projection	1984	23,100	10%
	1985	25,410	10
	1986	27,951	10

2. Mixed GFL Catch

	Year	Mixed GFL Catch	Comparative Increase	Shrimp Vessels
Actual Figures	1981	2,176		
	1982	1,133		
	1983	2,580		
Projection	1984	3,008	17%	118
	1985	3,416	14	134
	1986	3,824	11	*150

* Shrimp Trawler shall be 150 by 1986.

·Expected quality of catches by fish trawlers for absorption of demand increase.

Analysis of Demand and Supply for Three years based on 1983.

(Unit: M/T)

Year	Demand	Supply		Potential Demand in Tonnage	Required Number of Trawlers
	Assuming 0 Status in 1983 Anticipated Growth	Assuming 0 Status in 1983 Anticipated Growth			
		Local Fishermen	Shrimp Vessels		
1983	o	0	0	0	0
1984	3,335	2,100	428	807	3.4
1985	7,132	4,410	836	1,886	8.1
1986	11,430	6,951	1,244	3,244	13.9

As the above tables show, over the past few years, there has been a steady rise in the consumption of fish in Guyana. Even if we can safely expect a 10% (ten percent) increase in the annual productivity as a result of modernization of fishery in local coastal waters by the aid from EC and Canada, it is clear that the potential demand will be higher than supply.

To meet this it is deemed necessary to provide for approximately 10 trawlers.

Secondly as for (B) in 1972, the Government of Guyana placed a total ban on the import of fish. When per capita fish consumption prior to 1972 is compared with the actual fish consumption in 1983, with due allowance for the increase in population in the 11 year period, it is evident that total tonnage fish consumed would have been far larger, has there been no government ban on its import.

Logically, therefore, a safe projection can be made corresponding to the need of potential fish consumption in the future.

.Fish Consumption in Guyana

Fish Consumption per capita (kg) in the last.

Year	Population	Consumption per Capita	Remarks
1968	695,000	31.05 kg	Pre-ban period
1969	702,000	32.04 "	"
1970	716,000	33.48 "	"
1971	732,000	26.01 "	"
1972	749,000	21.51 "	Past-ban period
1973	763,000	23.40 "	"
1974	775,000	27.68 "	"
1975	787,000	26.42 "	"
1976	800,000	25.52 "	"

(Ministry of Agriculture, Govt. of Guyana)

Actual Amount of Fish Consumed in the Past three years.

Year	Population	Actual Amount of Fish Consumed per Capita
1981	889,320	21.2 kg
1982	880,000	23.4 "
1983	869,000	27.2 "

·Potential of Fish Demand in 1983 in Guyana

Average consumption of fish per capita during 1968 - 1971 was:

(31.05 + 32.04 + 33.48 + 26.01) ÷ 4 years

= 30.65 kg

The total population in 1983 = 869,000. Therefore, the demand for fish could have been

30.65 kg x 869,000 = 26.635 M/T

Actual fish consumption in 1983 = 23,637 M/T

Thus, 26,635 - 23,637 = 2,998 M/T represents deficiency in supply.

The consumer's purchasing power is calculated on the basis of GNP per capita and consumer price index according to UN statistics for 1968 to 1980, and our estimates and projections are adjusted accordingly:

$$\frac{\text{GNP per capita in 1980 = US\$690.00}}{\text{GNP per capita in 1968 = US\$324.00}} = 2.1$$

$$\frac{\text{Consumer's price index in 1980}}{\text{Consumer's price index in 1968}} = \frac{264}{95} = 2.8$$ (1970 base being 100)

Therefore, potential of fish demand in 1983 would have been

$$2{,}998 \text{ M/T} \times \frac{2.1}{2.8} = 2{,}249 \text{ M/T}$$

Provided that the capacity of the trawlers is 20 tons each (30 tons in international tonnage), and further provided that the annual produce is maintained in accordance with the fishing schedule, i.e., approximately 233 M/T per boat, it is determined that the actual number of vessels required in the fleet shall be

$2{,}249 \text{ M/T} \div 233 \text{ M/T} = 9.6 \fallingdotseq 10$ trawlers

In conclusion, therefore, the request of the Government of Guyana for approximately 10 trawlers is deemed entirely reasonable.

(3) Operating Plan

1) Basic Operating Policies

While the basic concepts for fish trawling in Guyana are as follows.

1- Operation are to be performed over the entire Guyana continental shelf including the shrimp trawling ground.

2- The target of the fish catch includes expensive fishes such as snapper and sea bass, as well as bangamary and croker, which were easily caught by the shrimp trawlers.

3- Catches are to be stored on ice since as they will be consumed domestically.

4- A stern draw net is to be adopted for its efficiency because the net mouth can open

wide at the stern by otterboard to simplify the work.

5- Demerara fishing port is to be used fleet base.

6- Boats should be capable of operating anywhere in the trawing grounds off Guyana.

7- The trawler should be profitable when operated exclusively for fish.

8- Maintenance of the fishing boat should be as easy as possible with respect to both economy and technology.

2) Fishing Schedule and Annual Operation

Since the fish trawling grounds off Guyana have not been developed, boats take only 2 hours from the Demerara river-mouth to reach the nearest fishing ground and not more than 12 hours to the farthest. According to the results of the field survey and GFL's data, the fish caught by shrimp trawler is between 400 lbs and 1,800 lbs per towing. The record of mixed fish catches off Guyana in the past is given in the following tables. (Data of British Fishery Agency)

o Composition of Mix Fish Catch from Shrimp Trawling

Species	Commercial Value	Content %
Sea Trout	Yes	7.4
Butter Fish	"	1.0
Croaker	"	8.1
Bangamary	"	19.1
Others		0.5
Total		36.9
Nonvalue Fish		56.8
Shrimp	Yes	6.3
Grand Total		100.0

o Composition of Fish of Commercial Value

Species	Content %
Sea Trout	20.0
Butter Fish	3.0
Croaker	22.0
Bangamary	1.0
Total	100.0

Thus the mixed fish catch per towing is

(Max. 1,800 lbs + Min. 400 lbs) ÷ 2 = 1,100 lbs average

Applying the content percentage in the above table, fish with commercial value can be calculated as 1,100 lbs x 0.369 = 405 lbs. The trawler to be used exclusively for fish can be expected to achieve a 450 lbs fish catch even if it is estimated to be 10% more than the above, from which we can derive the fishing and operating schedule below.

1- Operating Time : To operate only in the daytime and drift at night.

2- Trawl operation : 4 times a day, 2 hours each

3- Average Catch per towing: 405 lbs x 110% ≒ 450 lbs.

4- Average Navigation Time to Fishing Ground : About 6 hours

5- Operation Schedule of Fishing Trawler : As per the table comparing 20-ton and

10-ton trawlers, 11 days are required for one trip and there are 32 trips per year. The breakdown of annual operation is

- 16 navigation days,
- 288 operating days
- 61 days at anchor and other days, making a total of 365 days.

3) Estimated Catch and Sales

1- Catch per trawler

One trip: 450 lbs x 4 times x 9 days = 16,200 lbs (7.3 tons)

Annually: 16,200 lbs x 32 trips = 518,400 lbs (233 tons)

2- Estimated Proceeds per Trawler

One trip: 16,200 lbs x 1.9 G$ = 30,780 G$ (2 million yen)

Annually: 518,000 lbs x 1.9 G$ = 984,960 G$ (64.022 million yen)

(4) Functions

1) Design and Material of Boat

Following points were taken into account to determine the boat design.

1- Operation to be performed in very calm equatorial sea, given both sea conditions and climate.

2- To increase the hull width to provide a good working area for trawling in view of the tendency of the boats constructed of light FRP material to roll.

3- To increase the hull depth and the propeller diameter to increase net towing power for trawling.

4- For greater efficiency, to adopt stern towing method, handling fish and the net on a stern deck, in order to make working easy for snall crew members.

5- In this connection the wheel house, engine room and crew space are arranged in the bow.

Thus adopted a design with a forecastle and stern trawling, similar to that of the shrimp trawler operating off Guyana at present.

The material of the boat should be selected giving consideration to the sea climate, the mooring, the pier and maintenance expenses.

FRP seems to be the best for the following reasons.

1- The FRP boat is more corrosion resistant and lighter than the steel boat, and more energy saving and economical.

2- On the other hand it is inferior to the steel boat with respect to load bearing, shock and wear resistance. But it should be noted that the pier of Demerara fishing port is made of wood and there are few accidents causing damage hulls from reefs or rocks in the fishing grounds.

3- When considering the trawling efficiency, the FRP boat is more difficult to repair than the steel boat, but this is not serious as the boat is small.

4- Since the hull is lighter than that at a steel boat securing the freeboard is easier.

5- There are no special dockyards for FRP boats, but there are two FRP machining firms in Georgetown, so with the exception of large repair maintenance raises no problem.

2) Fishing Gears, Equipments and Techniques

The fishing method with which the Guyanese are most familiar is shrimp trawling with a double rigger as the Florida type shrimp boats are operating now. In principle the simplest trawling method is adopted in order to catch the bottom fish on a sand and mud sea bed on the off-shore continental shelf.

The dounle net, which is used for shrimp fishing, is not necessary as it is designed for fish. The trawling net should have as wide a mouth as possible and with the net height at least 2.6 m high as opposed to the 1 m of the shrimp net. Moreover, since the fish catch from one trawl is expected to be fairly large, special attention must be paid to the heeling of an out-rigger boat. In this regard the stern trawling method which is the method of extending the net in the stern direction is better for the safety of the boat.

The fish trawling method in this plan differs from the conventional double rigger shrimp trawling method in the following points:

1- Perfect stern trawling instead of the irregular trawling of an out rigger.

2- One set of a large net with a wide mouth is used instead of a pair of small port and starboard trawling nets.

3- Bobbins are used for the ground rope instead of chains.

4- Top and bottom nets are used which form a box with 4 sheets and open widely in both vertical and horizontal directions.

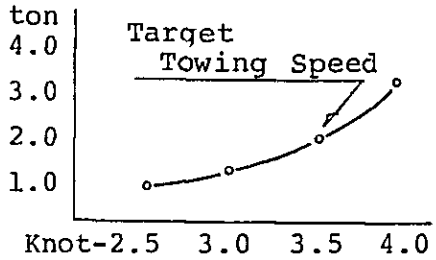
5- Net resistance is reduced to increase the net drawing speed (about 3.5 knots) so that the water flow in the net is smooth draw in the catch efficiently.

The design values for the fish trawling net in this plan will be discussed later. The resistance of the net and the towing speed is estimated as follows.

O Resistance of Fish Trawling Net

Towing Speed, Knot	Resistance ton
2.5	1.4
3.0	1.8
3.5	2.3
4.0	2.9

o Relationship between Net Resistance and Towing Speed



This net is designed to allow the towing speed to rise up to about 4 knots so that a wide range of adjustments are provided to increase fish catching efficiency depending on the species of fish, the depth of the fishing ground and sea bottom conditions. The trawling winch in this plan is designed to be capable of winding up the net by 4 crew member. One crew member can operate the equipment depending on warp conditions. The shifters shall be provided.

Performance of Trawling Winch

	Warp Drum	Net Drum
Winding Capacity	ton unit 1.25 x 100m/mx2	2 ton x 80m/m
Wire Winding-in Capacity	ø14m/m x 1000m	No problem for this kind of net
Braking Power	Designed point: 2,500 kg with ø600m/m	

Comparison of Fish Trawling
and Shrimp Trawling Gear

	Fish Trawling	Shrimp Trawling	Ratio
Height of Net	2.6 m	1.0 m	2.6
Swath	13 m	11 m	1.2
Distance of Otter Board	35 m	14 m	2.5
Towing Speed	4.5 knot	3.0 knot	1.3
Effective Volume of Fish Catch	m^3/hour 8,763,644	m^3/hour 855,624	10.2
Water Flow in net	Fast and smooth. Fish drawing in good	Short net length prevents smooth water flow.	
Fish Collecting Property	Otter distance is large. Pendent and hand rope fitted to net allows large catch fish	Fish do not enter because Bridle Rope threatens them.	
Countermeasure to Rough Bottom	Bobbins to Ground rope	Chain to Ground rope	

Note: Effective Volume of Fish Catch = Area of net mouth x Drawing distance per hour.

(5) Investigation of Respective Capacities

Based on the operating plan of the fish trawler, we calculated the capacities of tanks.

1) Fish Hold

The fishes caught during one trip include mainly small bottom fishes with relatively soft bodies such as the croaker, bangamary, flatfish, shark and snapper. As the estimated catch is 16,200 lbs ≒ 7.3 tons, boxes are not carried to the fishing ground due to lack of space, the fish hold is separated by shifting boards, where the fish are stored on ice. A ratio of loading about 0.3 to 0.4 is considered to be appropriate for this kind of small boat with one hold division being 3 to 4 m^3 in view of quality control, therefore necessary capacity of fish hold is

approximately 20 m^3

(7.3 tons ÷ 20.85 m^3)

2) Fuel Tank

Based upon the sea and weather conditions in Guyana and the operating time of the main engine for trawling, fuel consumption and the necessary capacity of the fuel tank is calculated as follows:

. Main Engine:	240 HP
. Auxiliary engine for generator:	10 HP
. Total	250 HP

. Operating time: Trawling for 12 hors per day and mooring or shifting at night, navigation: 0.5 days

. Fuel Consumption: ..... 4,360.5 kg

250 HP x 85% (load) x 180 g/HP x 12 hours x 9.5 days (operating + navigation)

. Fuel Tank Capacity ..... 5.51 m^3

4,360.5 kg (fuel consumption) ÷ 0.86 (specific gravity) ÷ 0.92 (loading efficiency)

Thus the capacity of the fuel tank, including 10% of the fuel for returning to port is 5.51 m^3 x 110% = 6.06 m^3 ÷ 6.0 m^3

3) Fresh Water Tank

Daily consumption of fresh water per crew member is estimated as 20 lit. 20 lit./person, day x 4 persons x 9.5 days = 76 0 lit.

Water used for other purposes is estimated at 40 lit/day, person and is restricted to the volume for 6 days because of the space available in the boat.

4 lit./person, day x 4 persons x 6 days = 960 lit.

Fresh Water = 760 lit.+960 lit.= 1,720 lit. x 110% = 1,936 lit.

. Capacity of Fresh Water Tank

1,936 lit. (fresh water) ÷ 0.92 (loading efficient) ÷ 2.0 m^3

Note: The basis for setting main engine power is explained later.

(6) Treatment Method for Fish

Catches comprise Bangamary, Croaker, Sea trout, Butter fish, etc. Before considering treatment, it is necessary to understand later processing, process flow and the condition in which they are delivered to consumers; in other words, consumers' needs and the distribution system. The Guyanese make soup or stew and fry or broil fish with butter. Some fish are salted and dried or smoked in local districts.

All catches are landed on the wharf of GFL's McDoom processing factory and are either processed or sold as raw fish according to the sales plan. The unloading method and equipment are affected by how catches are loaded into the boat, which is also an important factor for on-board treatment. Taking account of the above factors, related to the treatment method the following was decided:

1) To prepare plastic baskets for shrimps caught during fish trawling. The shrimps are separated in the fish hold.

2) Expensive fishes such as snapper and sea bass should be distinguished from such inexpensive fishes as croaker, bangamary and shark.

3) All the fishes are loaded in bulk and stored with plate ice.

4) Since the boat is small and space is not available, fish boxes are not used.

(7) Setting of Main Engine Horsepower

From the fishing ground environment, species of fish caught and operating policy concentrating upon them, it is estimated that a maximum towing speed of at least 3.5 knots is required.

The main engine horsepower required was calculated as follows:

. Set Value Delivered horsepower - DHP - 200 PS
Propeller diameter - D = 1.30 M
Propeller revolutions - N = 420 RPM

. Calculated Value corresponding to Set Value (calculated from bollard pull standard)

o Reference torque of Propeller shaft: Q_0

$$Q_0 = \frac{716.2 \times DHP}{N} = \frac{716.2 \times 200}{420} = 341 \text{ kg}$$

o Constant of Propelling force: KQ

$$K_Q = \frac{Q_0}{\rho n^2 D^5} \quad \frac{341}{104.5 \times (7.0)^2 \times (1.30)^5} \fallingdotseq 0.0179$$

o Propeller pitch: P

$$P = P/D \times D = 0.56 \times 1.30 \fallingdotseq 0.73 \text{ M}$$

(The pitch ratio P/D = 0.56 is set based on the propeller curve from data of Ministry of Transportation of Japan)

The characteristic coefficient Ø corresponding to

the above mentioned numerical value is calculated to make a characteristic graph of ø, from which the propelling force J related to a certain drawing speed is calculated as follows.

Advancing Constant $J = v_a/nD$	0	0.1	0.2	0.3	0.4
Propelling Force Constant K_Q	0.0179	0.0160	0.0149	0.0130	0.0116
Torque Constant K_T	0.200	0.1810	0.1576	0.1297	0.0978
Characteristic Coefficient $\phi = \frac{J}{\sqrt{K_Q}} = \frac{v_a \cdot D^{1.5}}{\sqrt{Q_0/P}}$	0	0.7906	1.638	2.631	3.710
$m = \frac{K_T}{K_Q} = \frac{TD}{Q}$	11.11	11.31	10.58	9.98	8.42

With the ø of (A) characteristic graph indicating the calculation results the propelling force for drawing and drawing capacity were calculated as follows.

Item					Remark
Towing Speed V (kt)	0	2.5	3.5	4.5	
Propelling Speed Va (kt)	0	1.85	2.59	3.33	Estimated at W = 0.26
Propelling Speed v_a (ms^{-1})	0	0.9516	1.3323	1.7129	$v_a = 0.5144Va$
Standard Torque Qo (kg·m)	341	341	341	341	
$\frac{D^{1.5}}{\sqrt{Qo/P}} = \frac{1.4822}{1.8064}$	$\frac{1}{1.2187}$	$\frac{1}{1.2187}$	$\frac{1}{1.2187}$	$\frac{1}{1.2187}$	
$\phi = \frac{v_a \cdot D^{1.5}}{\sqrt{Qo/\rho}}$	0	0.7808	1.0932	1.4054	P = 104.5 $D^{1.5}$ = 1.4822
$J = \frac{v_a}{n \cdot D}$	0	0.1025	0.1395	0.173	On Ø Characteristic Diagram
$Kq = \frac{Q}{\rho \cdot n^2 \cdot D^5}$	* 0.0179	0.01635	0.01575	0.01515	
$KT = \frac{T}{\rho \cdot n^2 \cdot D^5}$	* 0.200	0.181	0.173	0.165	
Propeller Revolution N (min^{-1})	* 420	428.4	440.8	457.0	$N = 60 \cdot \frac{Va}{JD}$
Propeller Thrust T (kg)	* 2,925.8	2,893,7	2,881.2	2,856.8	$T = \frac{K_T}{K_Q} \cdot \frac{Qo}{D}$
Speed of the Vessel at Free Conditions To (kg)	0	48	98.1	217.5	Thrust Decreasing Ratio t = 0.15
Towing Thrust T-To (kg)	* 2,925.8	2,855.7	2,783.1	2,639.3	

* Calculated based on bollard-pull.

* T_0 was calculated on the basis of R_0 of EHP of the vessel.

The propelling force of towing, $(T - T_0)$ = Propelling force of the propeller (T) - Propelling force for the boat alone (T_0), is calculated and is shown as a graph of drawing capacity (B).

When the resistance curve (R) of this fish trawling net is drawn on the bases of the towing speed and resistance curve, the intersecting point (x), about 3.9 knots (maximum within standard torque), is obtained.

Therefore, brake horsepower BHP at planned towing speed V of 3.5 km is

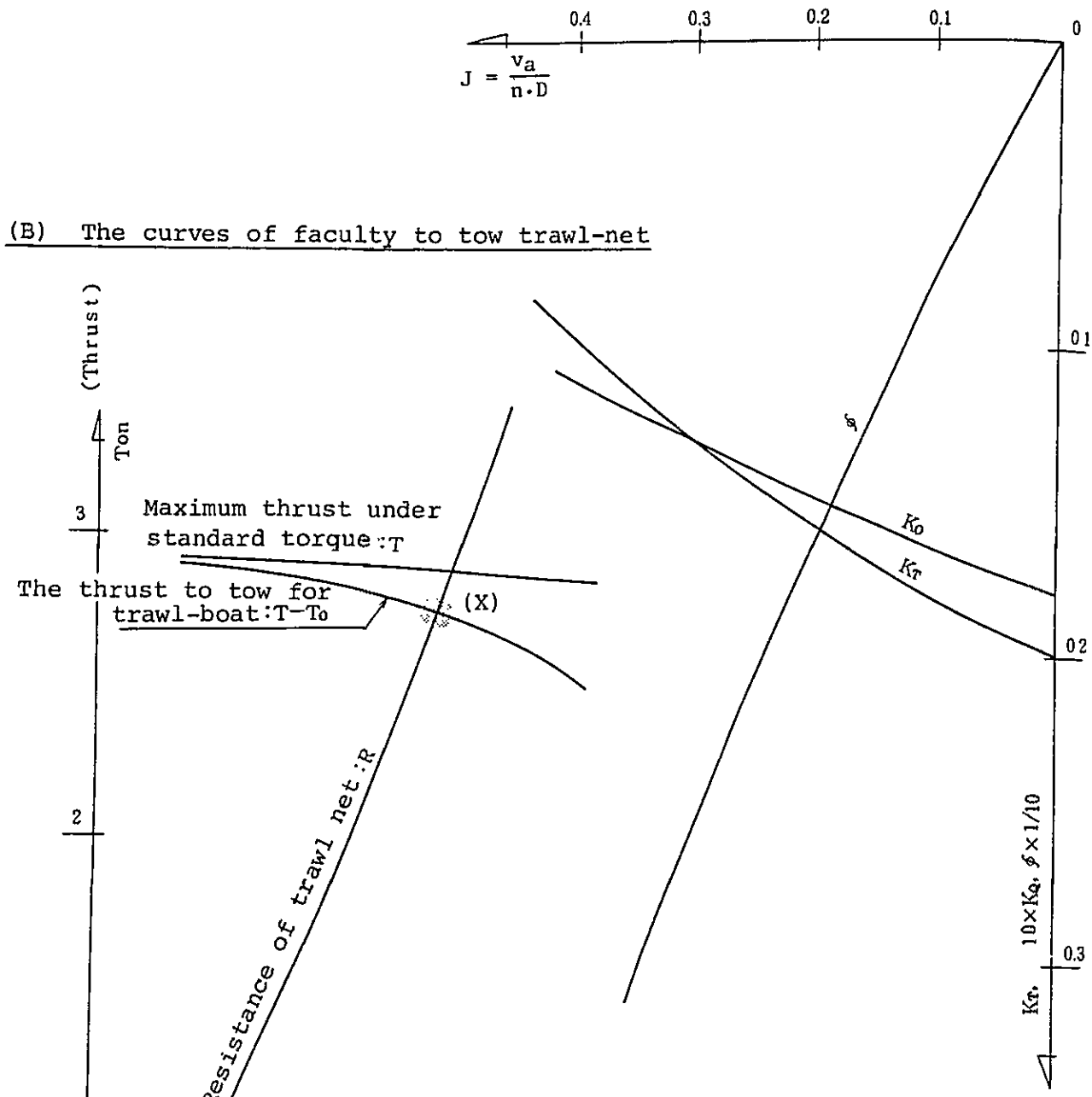
$$BHP = \frac{Q_0 \times N}{716.2 \times g} = \frac{341 \times 440.8}{716.2 \times 0.96} = 218.6 \text{ PS}$$

Required BHP is higher than bollard-pull standard value corresponding an increase of revolution per minute by 20 rpm. By setting efficient load factor of high-speed marine engine at 90%, planned horsepower of this vessel is

$$BHP = 218.6 \text{ PS} \div 0.90 = 242.8 \text{ PS}$$

It is considered that necessary horsepower is about 240 PS.

(A) Characteristic carves for the thrust of trawler



(B) The curves of faculty to tow trawl-net

(8) Nautical Communications and Life-saving Equipment

1) Nautical Instruments

Since the fishing ground of the double rigger shrimp trawler is limiled within 100 mile off on the Guyana's continental sheeff at present, the minimum required nautical instruments, in general, include ① 1 fish detector, ② 1 simple auto pilot, ③ 1 magnetic compass. One or two of the shrimp trawler are equipped with radar, NNSS (artificial satellite navigation), etc., which have not been used for a long time due to a lack of spare parts. Even if they are supplied in the future, the instruments would require overhaul. Consequently, nautical instruments are to be simple with the exception of indispensable aids.

2) Radio communications Set

The shrimp trawler is each equipped with a SSB wireless telephone of 100 - 150 watt, and a VHF wireless telephone, for contacting the shore fishing base 2 times a day. In princile it is appropriate for fishing trawlers also to have the communications equipments of the same standard and capacity as that of the shrimp trawler.

3) Life-saving Equipments and Inspection

Since there is no agent for life-saving equipments such as life rats, flares and signals which are required to be inspected under the Ships

Safety Act, maintenance and preparation does not seem to be satisfactorily carried out. Consequently even if a boat is equipped with these equipments, they often do not meet application or inspection standards. On the other hand, in Guyana rules for the inspection of fishing boats have not been formulated with the exception of the inspection performed by Lloyd's of London when taking out or renewing an insurance policy.

Such being the case, the fishing trawlers in this plan are to be designed and constructed to comply with JG (Japanese Ministry of Transport) rules and to be able to obtain a surveying report from NK (Nihon Keiji Kyokai) with respect to the inspection of life-saving devices and other inspections.

3-2-2 Shore Facilities

In the shore equipments, it is necessary to plan the arrangement of shore facilities giving consideration to the efficient utilization of limited space and the working environment. In this plan the essential point is how to install equipments within the space of MC Doom processing factory in order to replace existing and worn-out equipments, while avoiding, for example, waste and duplication in the future. The basic concept for the execution of this plan is as follows.

The freezing, ice making and processing equipment,

·Maintenance should be reasonable with respect to both technical and scale aspects on the basis of present preceding plans, avoiding excessive maintenance and expenditure.

·An efficient management organization is required to increase the productivity.

The distribution and sales facilities,

·A flexible plan should be prepared on the assumption that factors impeding the expansion of the distribution system (for example, roads conditions) will be improved in future.

·Quality control should always be borne in mind and distribution channels to consumers.

Having regard to the estimated increase in the number of shrimp trawlers, the anticipated increase in the productivity of the mixed fish catch of GFL's fishing fleet, the objective of the Project is to achieve a balance in the overall production so as to meet the estimated demand for the consumption of fish in 1986.

(1) McDoom Shore Facilities

The capacity of ice making machines and icehouse should be sufficiently large to accommodate future increase in catch as a result of the activities of shrimp trawlers and small boats operating in the local waters since the existing

facilities are inadequate for meeting these needs. The next item which warrants top priority in the whole project is replacement of shrimp grading machine. It has a great influence on the export of shrimp which is a key industry of GFL. From the point of view of maintenance, the materials used in the construction of machinery, the simplicity of its operation, the ease of its handling, and human safety aspects must be borne in mind.

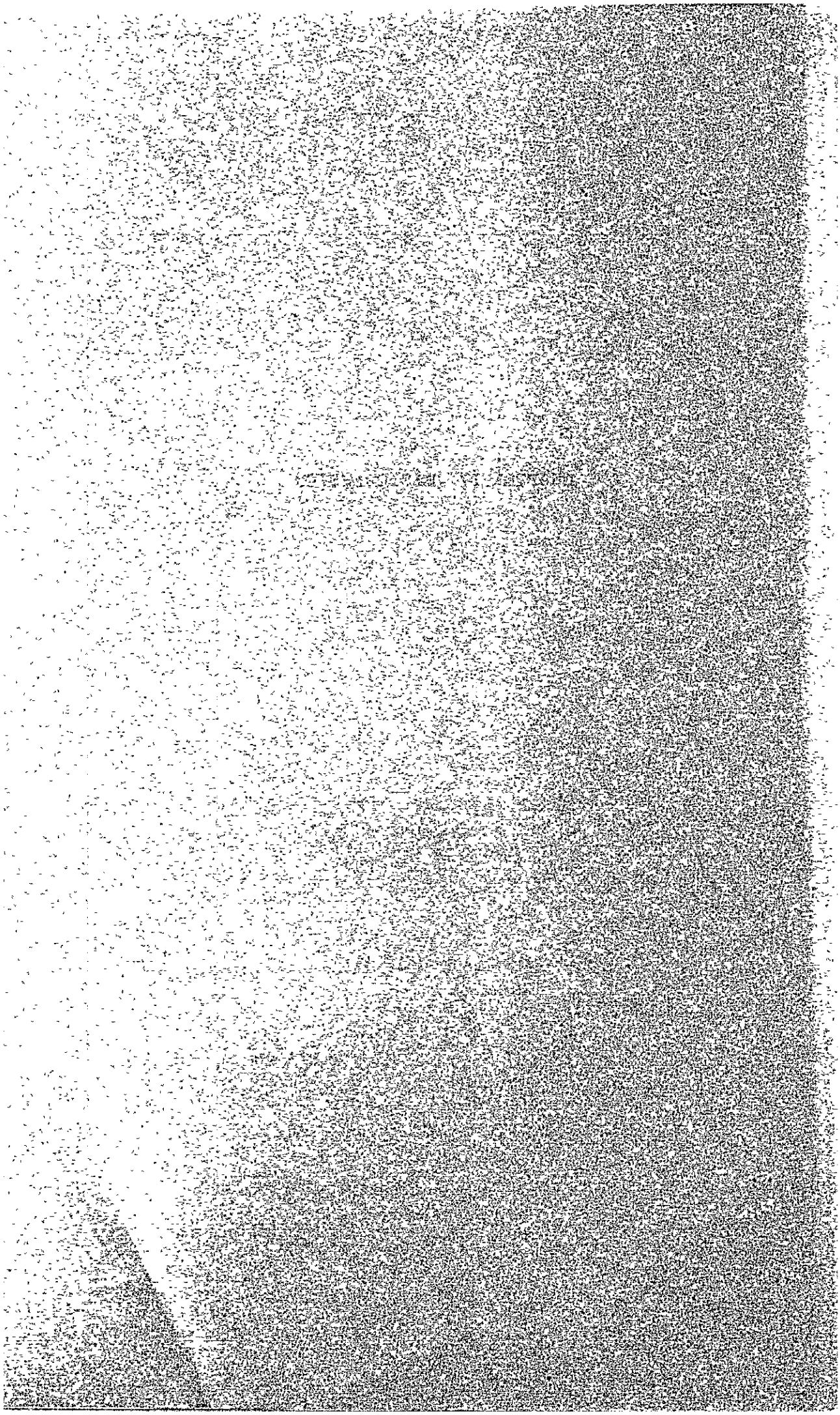
Air Blast freezing is being used at present for freezing shrimp. As for the freezing of fish what is being used is a slow-freezing method. The fish is contained in one thousand ton-cold store. This method aggravates the problem which already exists with respect to lack of freezing capacity. Therefore, the installation of equipment for air blast freezing is deemed mandatory particularly in view of anticipated improvement in production and expansion in marketing under the GFL Project.

The quality of water at present being used in the shrimp processing factories is sub-standard. Having regard to the fact that shrimp is internationally marketable commodity, it is essential that a better quality of equipment be installed for the purification of the water used in cleaning & processing of the shrimp.

(2) Distribution, Sale & Transportation

In view of future increase in fish products, greater demand and corresponding rise in consumption, it is crucial that measures be adopted for providing safe and expanded facilities for the storage of fish and its distribution. To this end, local warehouses for the storage of fish products will have to be established at strategic locations. Also, single unit truck equipped with refrigeration chambers are deemed unavoidable as the Guyanese ferries do not have the capacity for carrying trucks coupled with detachable trailer units.

CHAPTER IV BASIC DESIGN



CHAPTER IV BASIC DESIGN

4-1 Fishing Trawler

(1) Design Policy

The fishing trawler is constructed under the following design policies which aim at catching bottom fish living over the continental shelf in the fishing waters off Guyana by means of the simplest fishing method.

1) Work is to be concentrated at the stern in consideration of working efficiency to operate fishing gear and to handle fish so that a few crew can draw the net at the stern.

2) A bow bridge style is to be adopted, as the fishing waters off Guyana are calm having no hurricanes.

3) A single layer deck type stern trawler design is to be adopted.

4) Part of the forecastle deck is to be raised like a low forecastle in order to secure the height for the crew room (4 persons).

5) The boat is to be arranged, from the bow in order, the bow store, crew room, engine room, fish hold tanks (6 divisions), steering gear room and fuel tank under the main deck.

6) The steering house, galley and engine casing on the deck, are to be arranged at the stern

where fishing equipments such as the trawling winch etc. are installed.

The arrangement was determined taking account simplicity and ease of maintenance.

(2) Main Items of Plan

1) Type: Stern Trawler made of FRP

2) Classification: NK's survey report should be obtained.

3) Main Dimensions of Hull

Total Length	Approx.	15M 85
Registered Length	"	13M 80
Width	"	4M 30
Depth	"	1M 80
Gross Tonnage (Japanese Municipal Law)	"	20.0 ton (International Ton approx. 30 ton)
Design Speed (Offical trial maximum)	"	9.0 knots
Fish Hold Tank Capacity (also serving as ice tank)	"	20.0 M^3
Fuel Tank Capacity	"	6.0 "
Fresh Water Tank Capacity	"	2.0 "

4) Main Items of Engine

Main Engine	One 4 cycle Diesel Engine of about 240 HP (with remote control unit)
Auxiliary Engine and Generator Unit (for emergency)	D.C. Generator, small size Diesel (manual operation)
Driving Unit in front of Main Engine	For deck machinery

Propeller	Three Blades fixed pitch Propeller

5) Main Items of Electric Division

Power Supply in Boat	D.C. 24
Electrical Instruments	Bilge Pump, Electric Fan

6) Wireless and navigation Instrument

SSB Wireless Telephone	1 set
VHF radio Telephone	1 set
Fish Detector	1 set
Auto Pilot (MCP)	1 set

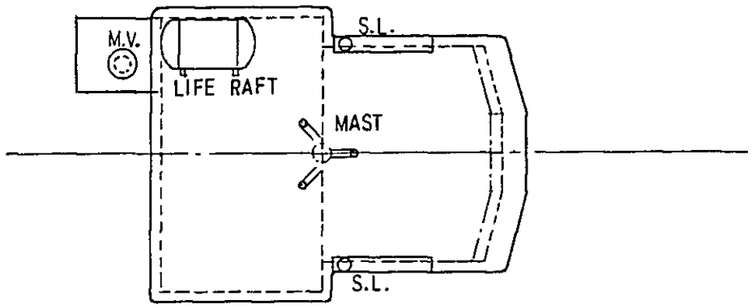
7) Machinery on Deck

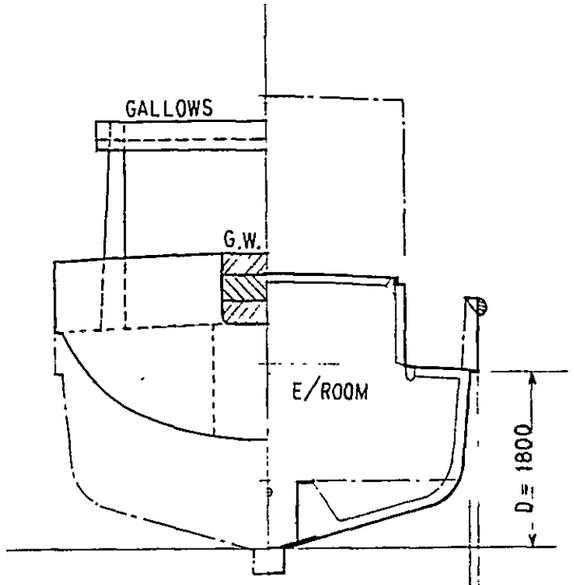
Steering Gear with Hydraulic (linked to MCP)

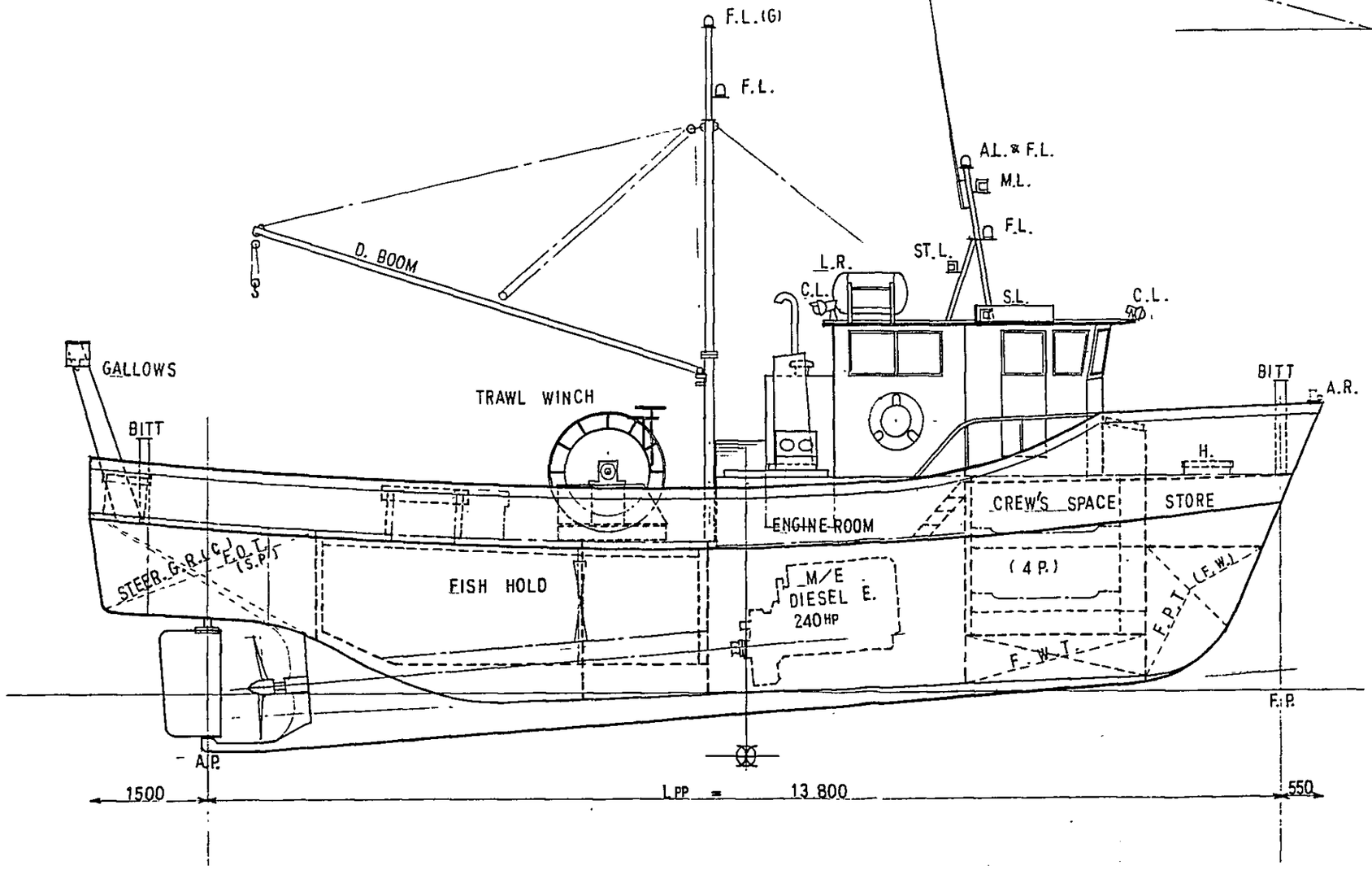
Trawl Winch with Warp Drum, Net Drum Portal Gallows

8) Crew 4 persons

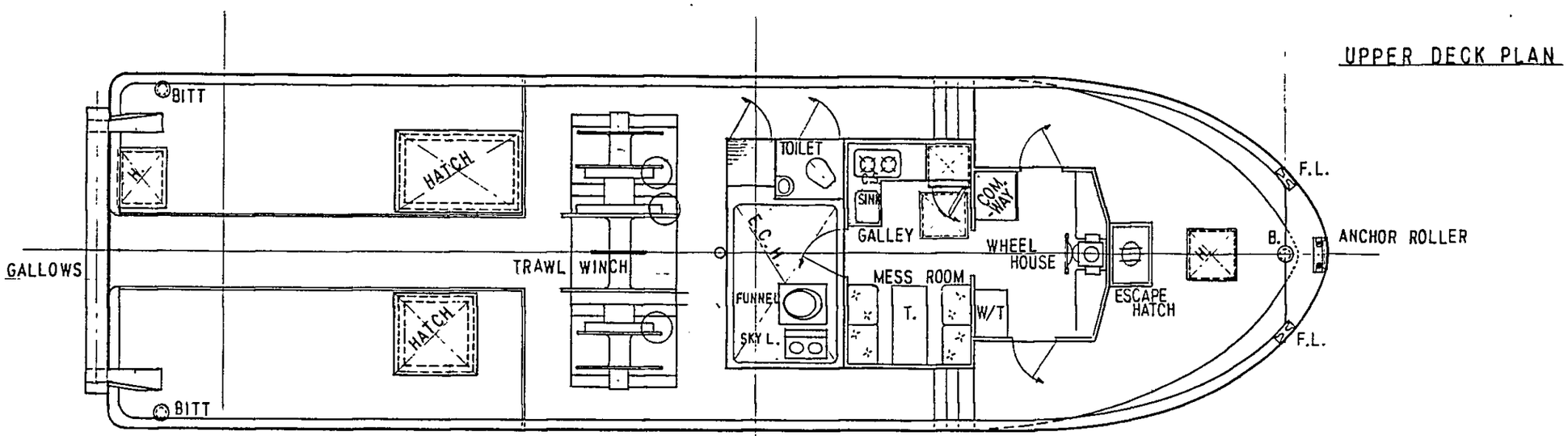
(3) General Arrangement Plan



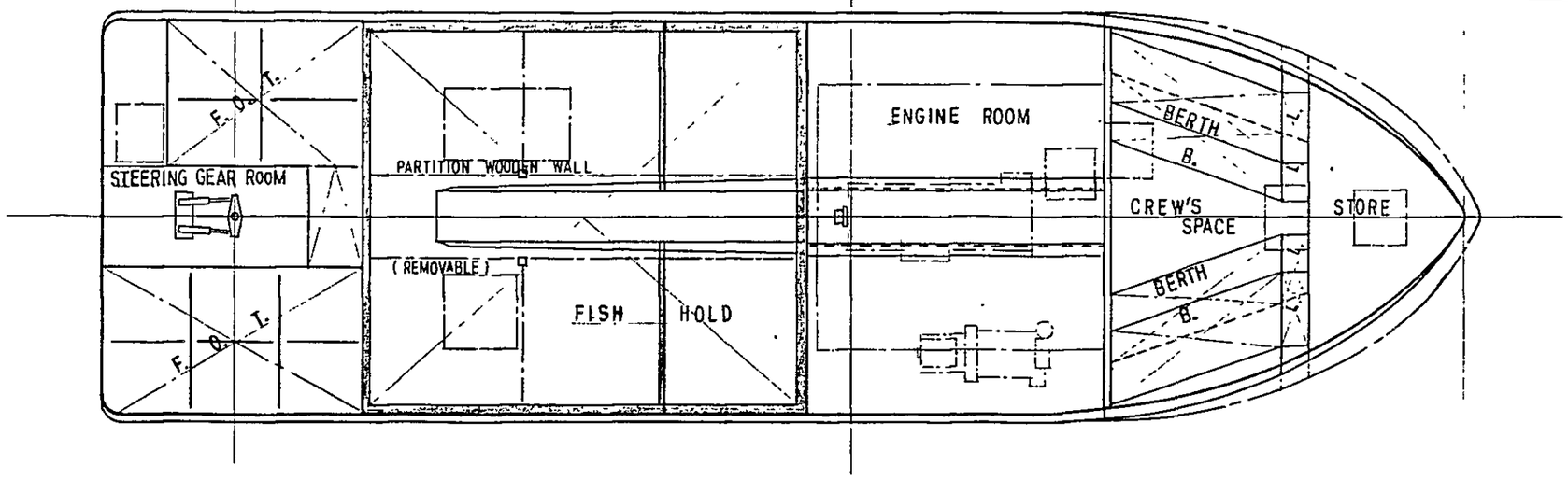




UPPER DECK PLAN



HOLD PLAN



0 1 2 3M

(4) Specifications and Composition of Fishing Gear for Fishing Trawler

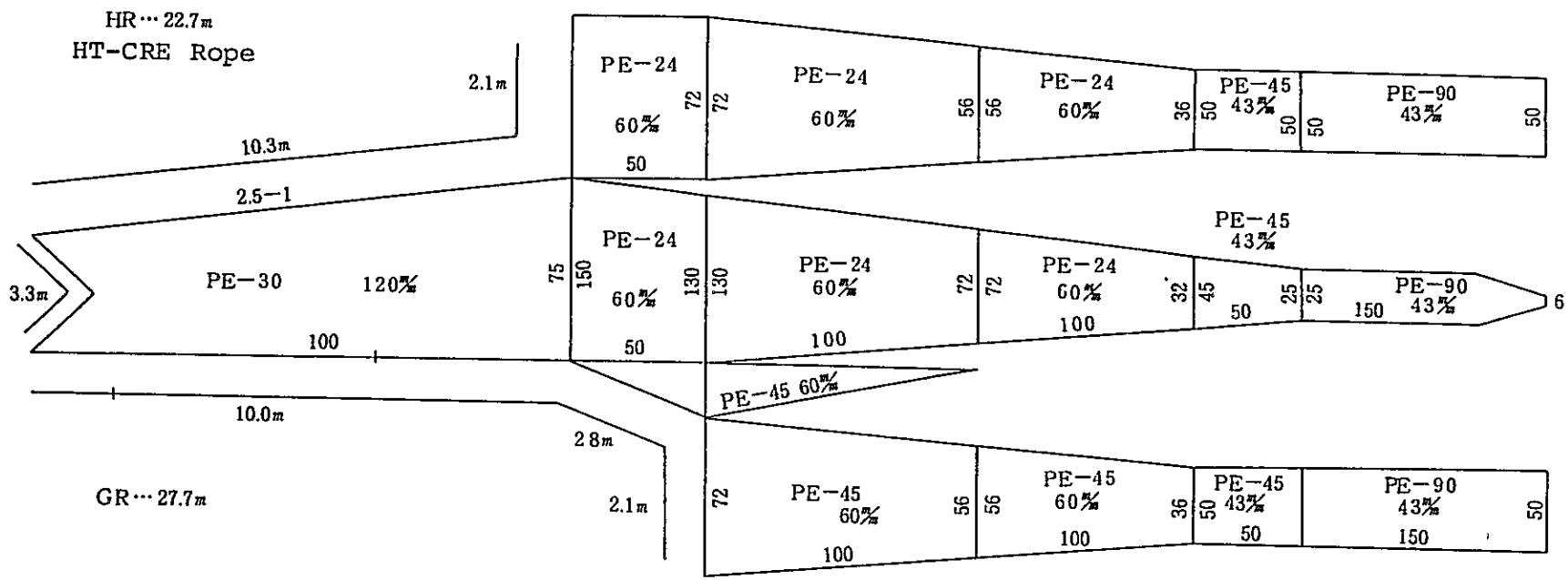
Specifications of Fish Trawling Net

Part	Material	No. of Threads	Size of Mesh	No. of Mesh			No. of Sheets
				Front	Rear	Length	
	Polyethylene	D/ Threads	m/m	Mesh	Mesh	Mesh	Sheets
Wing Net	PE	400/30	120	35	75	100	2
Inner wing	"	" /24	60	150	130	50	2
Inner Triangle	"	" /45	60	2	22	50	2
Front Ceiling	"	" /24	60	72	72	50	1
Body Top 1	"	" /24	60	72	56	100	1
" Top 2	"	" /24	60	56	36	100	1
" Side 1	"	" /24	60	130	72	100	2
" Side 2	"	" /24	60	72	32	100	2
" Bottom 1	"	" /45	60	72	56	100	1
" Bottom 2	"	" /45	60	56	36	100	1
Quad. Head Top	"	" /45	43	50	50	50	1
" Side	"	" /45	43	45	25	50	2
" Bottom	"	" /45	43	50	50	50	1
Quad. Top	"	" /90	43	50	50	150	1
" Side	"	" /90	43	25	6	150	2
" Bottom	"	" /90	43	50	50	150	1

Head Rope	P-V & P-E	Dia.	16øm/m	Length	22.7m
Ground Rope	Chain	"	9.5øm/m	"	27.7m
Lacing Line	P-V & P-E		16øm/m	"	24.5m×4
Float	ABS Resin Dia. 200øm/m × Hole 23øm/m	Buoyancy 3.92 kg/pce for 300m deep 15 pcs			

(The construction net)

20 G/T 240PS Trawl-net



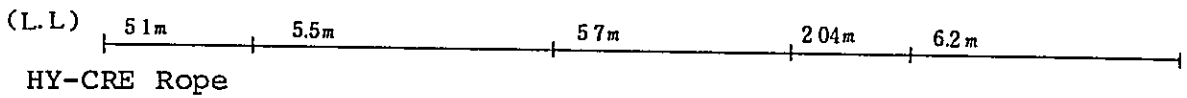
HR : Head Rope

PE - Poly-ethylene

GR = Ground Rope

HY = Hyzex

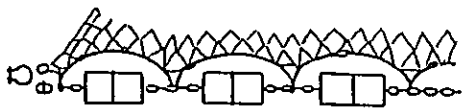
CRE = Cremona



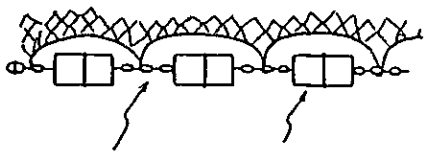
HY-CRE Rope

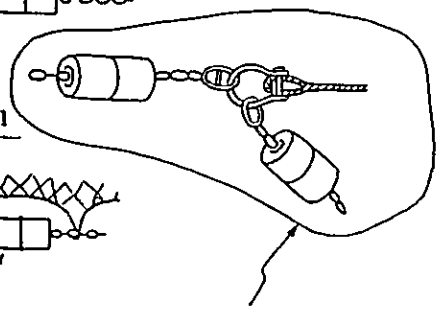
Ground-rope

Top-wing net 100m×2



Inner-Wing net 7.7m×1

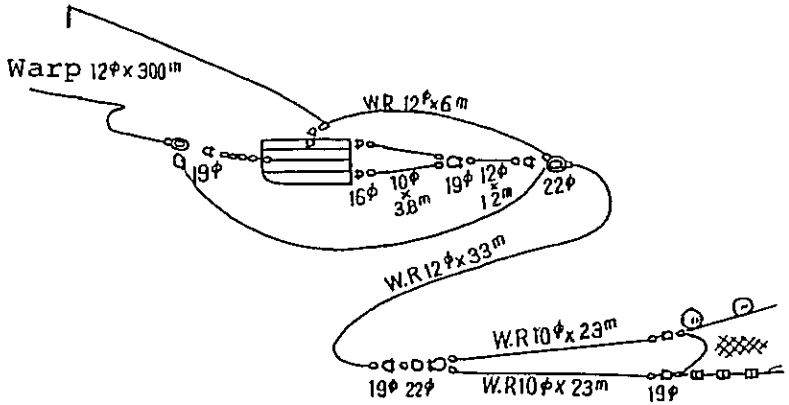




D.C Chain 9.5φ Rubber-bobin 80φ×80 m/m

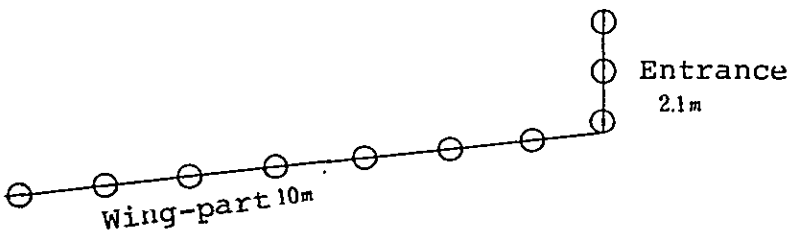
The position of Top-wing, Inner-wing and Lacing line.

The connection of wire-ropes

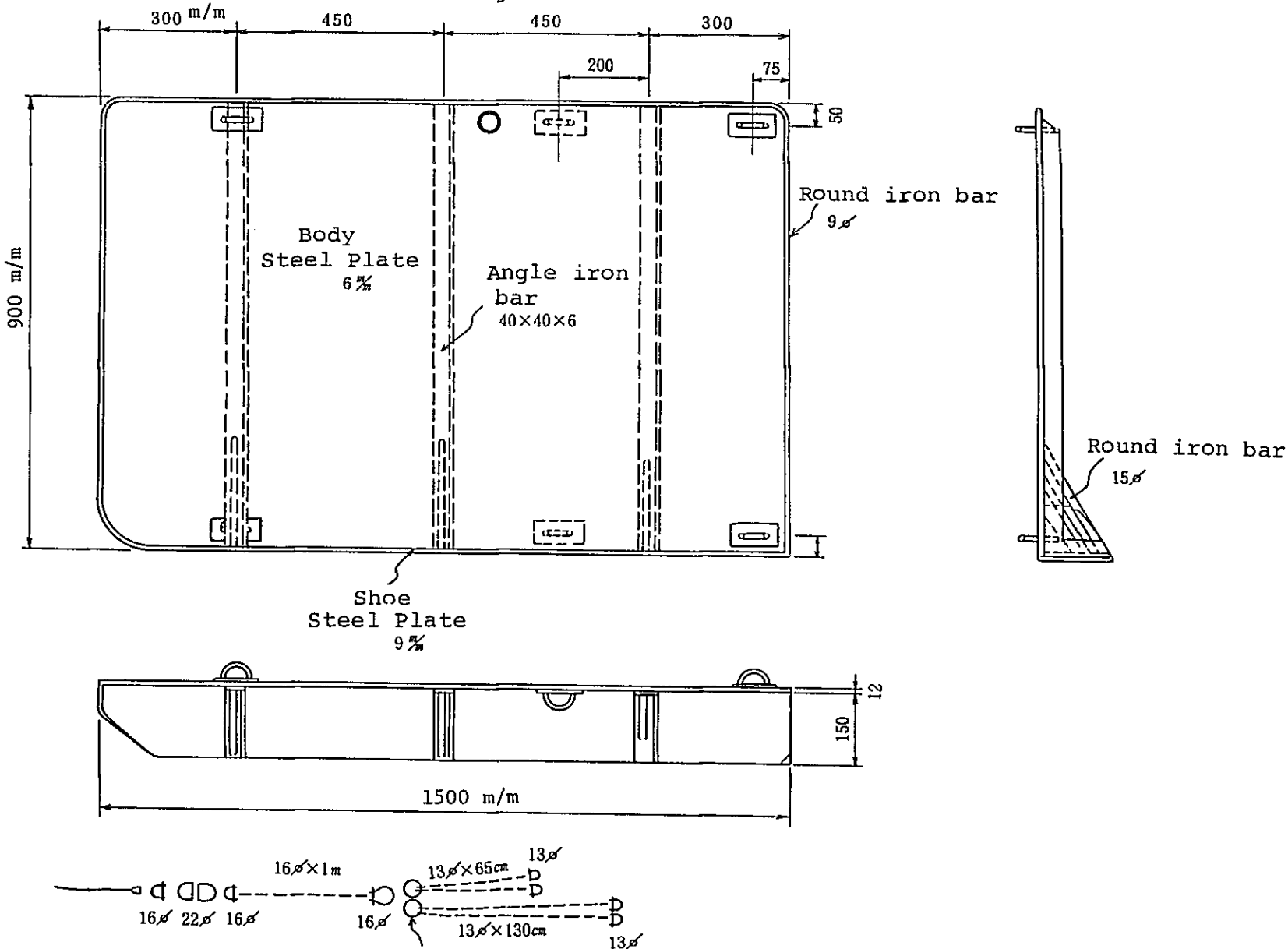


Float-arrangement

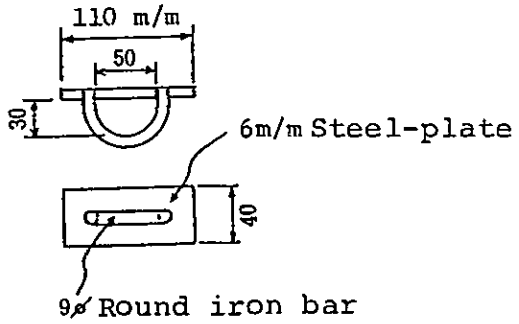
Float-7B-3 (Buc 3.92kg)×15pcs

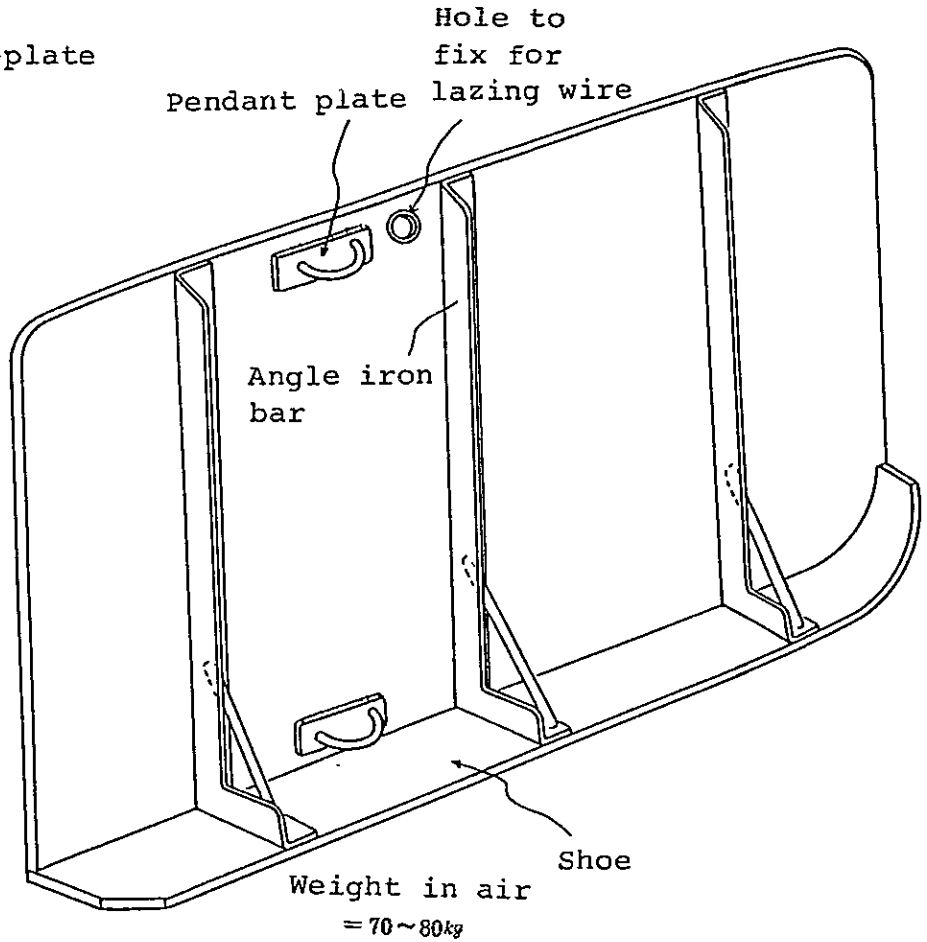


The drawing of Otter-board



Pendant and bridle plate 6pcs/plate





4-2 Ice Making & Storage Facilities

(1) Design Policy

- Taking account of the Guyanese equatorial climate, the equipment should be constructed at a proper place near the processing factory so that ice can be loaded on the boats without thawing.
- Ice making, storing and transporting should be capable of being carried out easily with little trouble and low maintenance costs.

(2) Ice Making Capacity

On the basis of the estimation of the demand and supply of fish in 1986 the ice making capacity, which can satisfy the demand for (1) 10 fish trawlers, (2) small coastal fishingboats, (3) shrimp processing and (4) sales of fish, is as follows.

1) Estimated Demand for Ice for Fishing Boat

1 20-ton Fish Trawler

· Number of boats	10
· Fisn catch of 1 boat per trip	16,200 lbs (7.29 tons)
· Number of trips per year	32
· Loading ratio of fish to ice	1:1
· Annual demand	Q_1 = 10x7.29x32x1/1 ≒ 2,332.0 tons/year

2 Small Coastal Small Fishing Boat

With GFL's purchase of fish being 940,000 lbs (423 tons/year) in 1983 and

on the assumption of the annual increase of the coastal fishermen's catches is 10% (performance in 1983) GFL's purchases of fish, and thus the demand for ice for fishing boats Q_2 can be estimated as follows:

$Q_2 = 423 \text{ tons} \times 1.1^3 = 563 \text{ tons/year}$

2) Estimated Demand for Ice for Fish and Shrimp Processing and Distribution

With the performance of the existing ice making machine at 5 tons/day and according to GFL's plan to expand the number of their own shrimp boats to 50 and contract shrimp boats to 20 by 1986 the amount of ice required in 1986 can be calculated as 70 boats/43 boats ≒ 1.63 times, which gives the demand per day Q_3 as follows.

$Q_3 = 5 \text{ tons} \times 1.63 = 8.15 \text{ tons/day}$

3) Appropriate Ice Making Capacity

From the results of the calculations in items 1) and 2)the required ice making capacity can be estimated as follows, i.e. assuming 300 annual operating days,

$$Q = \frac{Q_1 + Q_2}{300} = Q_3 = \frac{2,332.8 + 563}{300} + 8.15$$

≒ 17.8 tons per day

The above calculation indicates that the

required capacity of the ice making machine is 17.8 tons per day. Assuming 16 daily operating hours, the capacity is calculated as 17.8 x 24/16 = 26.7 tons/24 hours per day. Thus, as mentioned before, since long term operation of the existing ice making machine cannot be expected because of machine failures, the above mentioned capacity 26.7 tons/24 hours is considered reasonable compared with requested 15 tons/ 24 hours x 2 sets = 30 tons/24 hours.

(3) Ice Making Equipment

1) Plan of Arrangement

The ice making equipment is to be installed on the pier located near the fishing boats and processing factory. Part of the pier by the McDoom processing factory is therefore to be extended and machinery is to be arranged is such a way as not to interfere with the transportation of trucks, forklifts, etc. and landing work.

2) Model of Ice Making Machine and Type of Ice

Two sets of fully automatic plate type ice making machine with a capacity of 15 tons/ day are to be installed, by which indeterminate forms of rubber ice, 10 to 18m/m thick and 20 to 25m/m square, are to be produced.

3) Related Equipments

The water for ice making and cooling is to be supplied through existing piping by a feed pump installed exclusively for ice making equipment in the pump room at the processing factory. The new piping should be connected with a bypass to the existing feed piping at the processing factory to avoid any problems resulting from water pump failure.

(4) Ice Storage and Transporting System

1) Ice Storage

The amount of ice to be stored as supply increases can be estimated as follows.

When a large amount of ice is to be loaded on congested fish trawlers and small coastal boats set sail on the same day, the amount of ice required is calculated as follows, for example in the case of 5 fish trawlers,

W = (for trawlers 7.29 tons x 5 boats) +
(for shore processing factory 8.15 tons)
= 44.6 tons

Thus, about 50 tons of stored ice will satisfy the demand. On the assumption that the bulky gravity of ice is 0.5, the required capacity of storage V is calculated

as 50 tons ÷ 0.5 = 100m^3, while assuming that the average loading height of ice is 2.5m, the floor space of storage A is calculated as 100m^3 ÷ 2.5m = 40m^2, which is the irreducible minimum space required, The storage is to be built with insulating panels 100m/m thick by the prefabricated panel method.

2) Cooling System

The cooling system consists of the condensing unit, cooler unit having from the ceiling, cooling tower and cooling water pump.

The temperature is kept at -5°C to prevent ice from melting by a freezer operated automatically (with a thermostat).

3) Ice Transporting System

To load ice onto fishing boats coming alongside the pier, a method to wash it down by a chute from the platform of the ice storage is to be adopted as the simplest method. On the other hand, if it is possible in view of the structure, the flatcar of the truck could be inserted under the floor of the storage where the ice is washed down by hopper.

(5) Plan of Structure and Arrangement

As to the machinery for the ice making equipment,

since building materials cannot easily be obtained locally, prefabricating structures made in Japan will be assembled.

The extension of the pier (7.4m x 5.1m) will be undertaken by a local subcontractor up to the piles of green heart timber (65 feet long, 14 inches dia.), where the building for the ice making machine is to be constructed on foundations on sufficient strength.
The building is to have three floors, on which the machines listed below are to be installed.

Arrangement of Machines
for
Ice Making Equipment

	Machines to be Installed
Second Floor	Ice Making Machine, Condensing Unit
First Floor	Ice Storage, Platform for Loading of Ice, Chute or hopper
Ground Floor	Cooling Water Pump, Cooling Tower

The platform and chute or hopper for ice loading on the first floor is to be arranged at both the boat side and processing factory side for easy loading.

(6) Outline of Specifications

1) Building

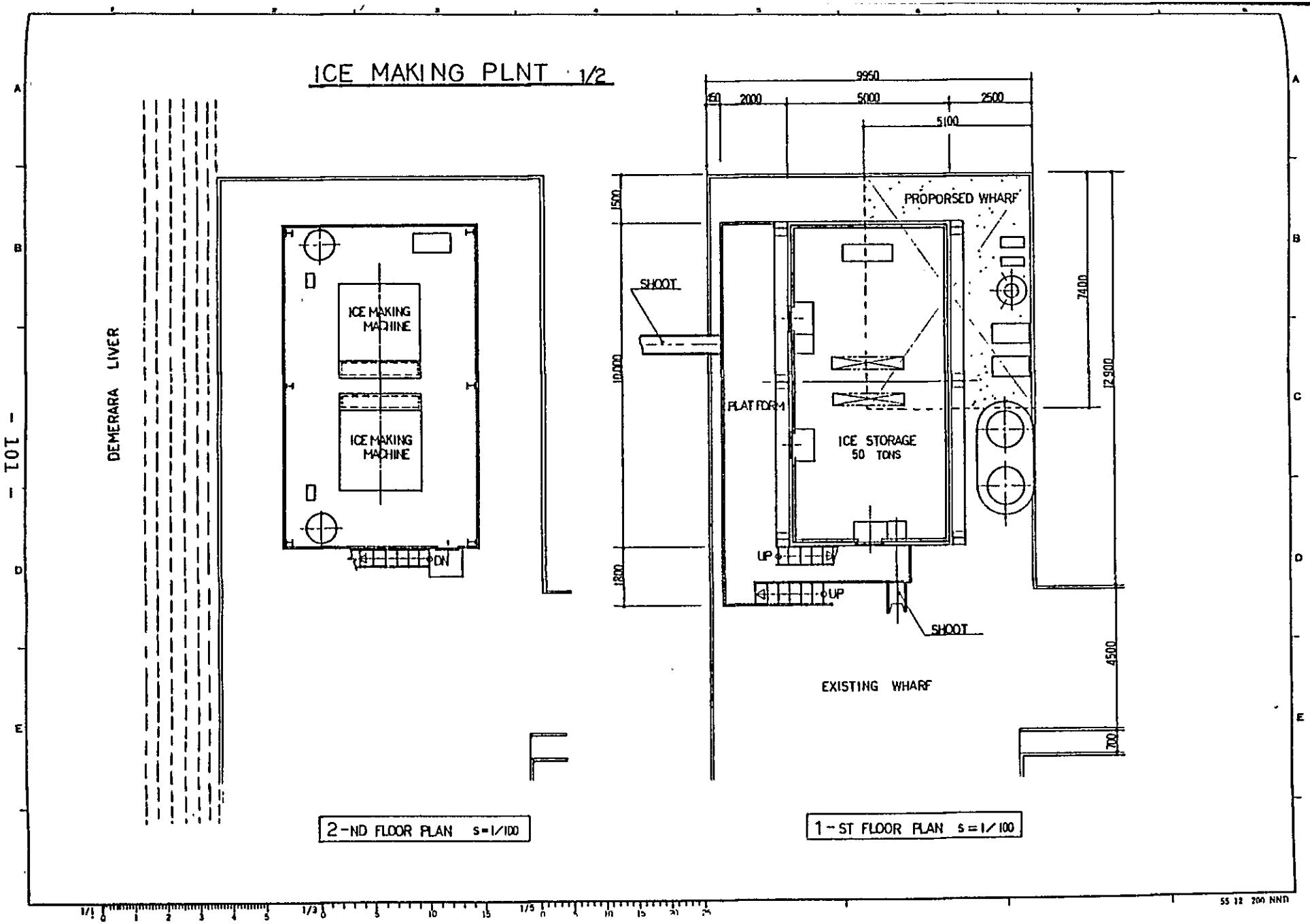
Construction Method Steel-frame, prefabricated and with three stories

Floor Area about $140m^2$

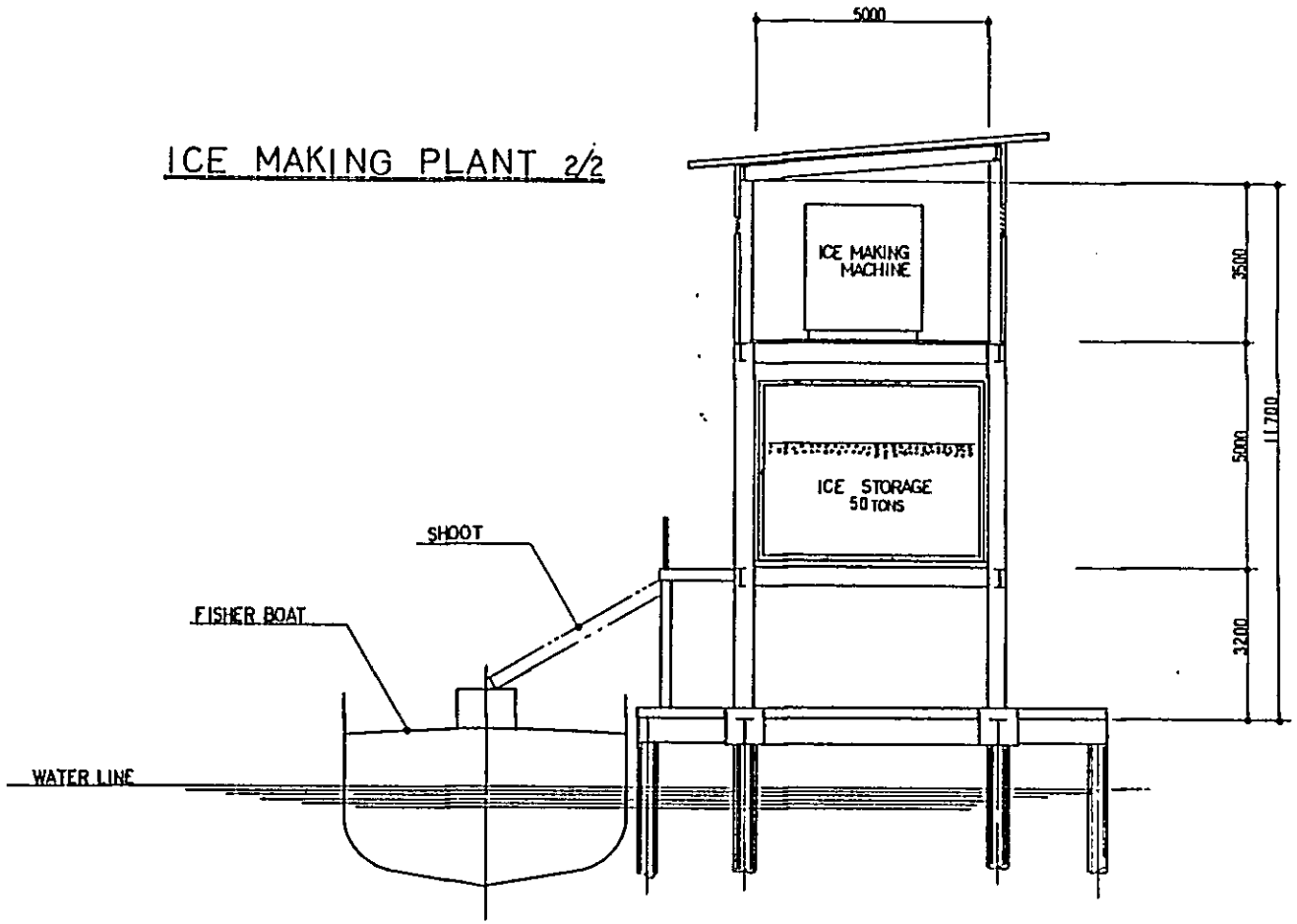
2) Ice Making & Storing System

1	Ice Making System	15 tons/day x 2 = 30 tons/day 1 set
	·Ice Making Machine	Plate type fully automatic ice making machine 15 tons/day 2 units
	·Water Tank Unit	2 units
	·Water pump	1 unit
	·Shoot for Ice Loading	2 units
	·Cooling Tower	1 unit
	·Cooling Water Pump	2 units
2	Ice Storing System	Retained Temperature -5°C x 50 tons 1 set
	·Condensing Unit	1 unit
	·Unit Cooler hanged on Ceiling	1 unit
	·Cooling Tower	1 unit
	·Cooling Water Pump	2 units
3	Incidental Equipment	Air Curtain, Conveyor, Shoot 1 set
4	Chemicals	Refrigerant, Oil 1 set

ICE MAKING PLNT 1/2



ICE MAKING PLANT 2/2



SECTION S = 1 / 100

4-3 Shrimp Grading Machine

(1) Design Policy

To design a shrimp grading machine;

- Of about the same size on the existing one to be withdrawn from service, as the new one is installed at the same location.
- Made of a highly durable corrosion resistant material.
- Not more complex to operate than the existing machine
- With a conveyor motor water-proofed to the extent required for normal shrimp grading.
- With safety guards etc. to protect operators.

(2) Grading Capacity

As mentioned before the capacity should be designed to have some margin. The capacity is based on GFL's data of monthly shrimp landings listed below.

GFL's Shrimp Landings in 1983

Month	Landed & Processed Amount (lbs)	Coefficient of Fluctuation of Average Process Amount
Jan.	27,665.8	0.319
Feb.	50,148.6	0.578
Mar.	61,168.6	0.705
Apr.	91,399.6	1.054
May.	111,117.6	1.280
Jun.	125,925.6	1.452
Jul.	68,861.8	0.794
Aug.	100,939.6	1.164
Sep.	112,191.4	1.294

Month	Landed & Processed Amount (lbs)	Coefficient of Fluctuation of Average Process Amount
Oct.	104,098.8	1.200
Nov.	80,653.0	0.930
Dec.	106,259.8	1.225
Total	1,040,450.0 lbs/year	

Monthly Average of Landed & Processed Shrimp
86,704.2 lbs/month

The above amounts of landed & processed shrimp have been achieved by the present system of 43 shrimp boats consisting of 23 GFL boats and 20 contract boats. The required capacity of the shrimp grading machine can be calculated according to the monthly average landings as follows.

- Average operating days of grading machine per month — 25 days
- Coefficiency of fluctuation of average processed amount per month — 30% (taking September as the basis)

Thus the required daily capacity of the grading machine H_0 is calculated as,

$$H_0 = \frac{\text{(Monthly average processed amount of shrimp) } 86{,}704 \text{ lbs.}}{\text{(Monthly average operating days) } 25 \text{ days}} \times \text{(Coefficiency of fluctuation) } 1.3 \doteqdot 4{,}509 \text{ lbs./day}$$

The above processing capacity is the irreducible minimum under the present system. With the GFL's plan to enlarge the system up to total 70 boats

of shrimp trawlers by 1986, with 50 their own boats and 20 contract boats, the capacity of the shrimp grading machine required for 70 GFL boats is calculated as follows.

$$H = 4{,}509 \text{ lbs} \times \frac{70}{43} \text{ boats} \div 7{,}340 \text{ lbs/day}$$

On the basis of this calculation the shrimp grading capacity of 8,000 lbs/day requested this time can be evaluated to be reasonable.

(3) Grading Equipment

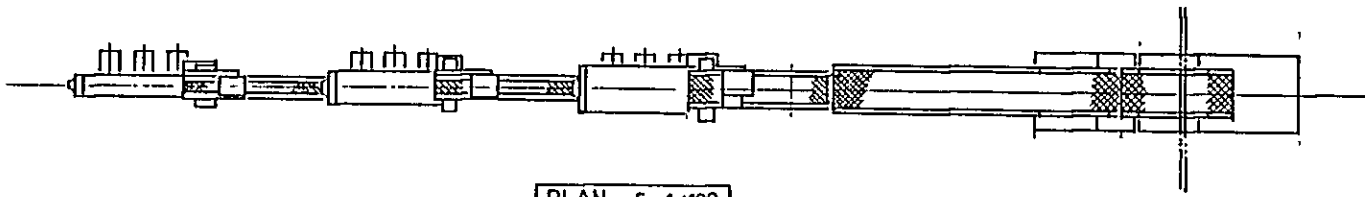
The size of the new grading machine should not exceed that of the existing machine as the new one is to be installed at the same location.

The grading method, in principle, should be as similar to the present method.

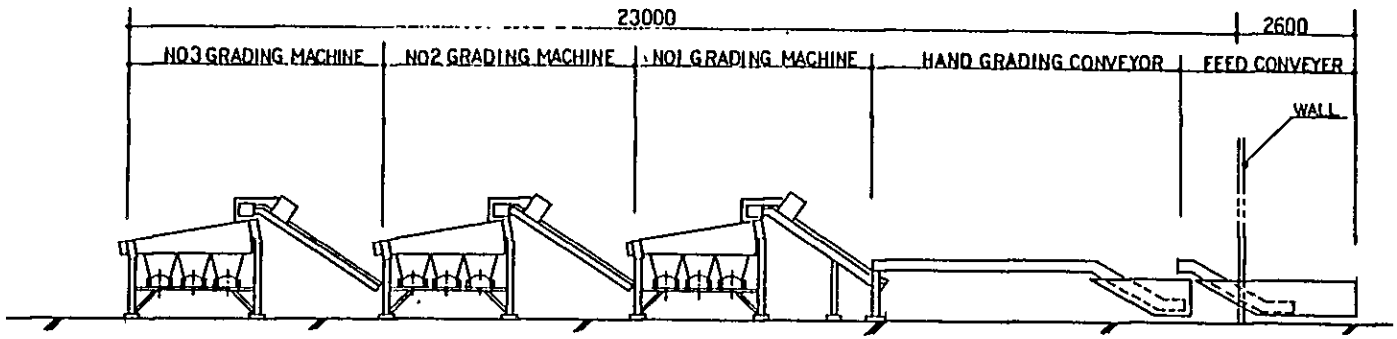
(4) Outline of Specifications

1)	Grading Capacity	8,000 lbs/ day
2)	Grading Steps	
	· Grading by Size	11 steps
3)	Material of Grading Machine (Main part)	SUS 304
4)	Unit	
	· Hopper to receive shrimp	1 unit
	· Conveyor to transfer shrimp	1 unit
	· Grading conveyor (for classification)	1 unit
	· Shrimp grading machine	3 units
	· Outgoing conveyor	1 set

SHRIMP GRADING MACHINE



PLAN S=1/100



ELEVETION S=1/100

4-4 Air Blast Freezing Facilities

(1) Design Policy

·To locate the equipment near the processing line of shrimps and fish and between both cold stores for the convenience of both work flow and carrying them into the cold store after freezing.

·To allow both pan freezing and round freezing of shrimps and fish to be done smoothly.

·To allow starting and stopping of freezing fan to be done smoothly with fewer malfunctions and lower maintenance expenses.

(2) Freezing Capacity

As mentioned in the section, Orientation of the Plan in the preceding chapter, although the Guyanese have a custom to eat salted and dried fish and smoked fish, the majority of the population near the coast consume the fish cooked from a raw condition. Since frozen fish have an advantage in that on being thawed they can be cooked in any way, and considering present consumption trends in Georgetown (minority of GFL's fish are fresh), the freezing capacity of the blast freezer is to be studied assuming that all the fish catches are to be frozen and on the basis of the estimated fish catch in 1986.

1) Capacity Required for Freezing Fish (per year)

1 Fishing trawler

·Number of boats	10 boats
·Fish catch tonnage of 1 boat per trip	7.29 tons
·Number of trips per year	32 strip
·Estimated fish catch per year	Q_1 tons/year
Q_1 = 7.29 x 10 boats x 32 trips	2,332.8 tons

2 Fish purchased from coastal fishermen

With the purchases by GFL in 1983 from coastal fishermen being about 940,000 lbs (about 423 tons) and the estimated annual increase of their fish catch set as 10% GFL's purchasing amount Q_2, is estimated to increase by 10% annually as well, and can be calculated as

$$Q_2 = 423 \text{ tons} \times 1.1^3 = 563 \text{ tons/year}$$

3 Mixed fish catch by shrimp trawler

As in item 2 the estimated landing tonnage of mixed fish in 1986 Q_3 is calculated as follows, on the basis of the amount of catch of GFL in 1983. The number of shrimp trawlers are expected to increase to 150 boats.

$$2{,}580 \text{ tons} \times \frac{150 \text{ boats}}{118 \text{ boats}} = 3{,}279 \text{ tons}$$

Accordingly the freezing capacity required for fish QF is calculated as

$$QF = Q_1 + Q_2 + Q_3 = 2,322.8 + 563 + 3,279 = 6,175 \text{ tons/year}$$

2) Capacity Required for Shrimp Freezing (per day)

The capacity of the shrimp grading machine is 8,000 lbs/day, which is the maximum that can be frozen. Thus the maximum amount of shrimps that can be frozen per day is:

Q_S = 8,000 lbs/day (3.60 tons/day)

From the results of the above calculations and on the assumption that GFL's air blast freezer will operate 300 days per year in 1986, the total required freezing tonnage per day can be estimated as follows.

$$Q = \frac{QF}{300} + Q_S = \frac{6,175}{300} + 3.6 = 24.2 \text{ tons/day}$$

Consequently the total freezing capacity of 30 tons/day consisting of the existing 15 tons and 15 tons provided in the plan would cover GFL's freezing demand, the freezing capacity of 15 tons/day can be evaluated to be appropriate.

(3) Freezing Equipment

1) Location of Equipment

The equipment is to be installed, in view of the work flow of freezing, between the shrimp and fish processing division and the cold store, where it will not interfere with the forklift and handcarts.

The site opposite the air blast freezing room in the McDoom processing factory satisfies the conditions.

2) Freezing Method

The freezing method to be adopted is the same as that of the existing equipments.

The reasons are:

1 The objects of freezing, i.e. shrimps and fish, and the sales system, consumer packs, etc. are almost the same as now.

2 To enable both the pan freezing put in by the handcart and the round freezing in the freezing room.

3 The cooling and cargo-handling methods adopted in the existing freezing equipment are quite simple and have fewer problems.

4 The Guyanese workers are skilled in this method of freezing work.

The 15 tons/day capacity of the freezing system is to be made up of 3 freezers of

5 tons each. The cooling method and 4 freezing units are to be installed, one of which will be a spare unit. Taking in and out of the freezing room is to be by handcarts are is currently the practice.

The defrosting method should be a sprinkler system operated manually which is to be branched from the existing feed pipe or defrost pipe and the returning water is to be discarded.

The freezing room is to have a prehabricated panel construction with heat insulating panels 150m/m thick.

(4) Plan of Structure and Arrangement

The freezing equipment is to be of a prefabricating construction with the components made in Japan as far as possible the basic idea of which is the same as that for constructing the ice making equipment.

The three freezing rooms are to be installed opposite the existing air blast freezing equipment. Since the insulated floor of the freezing room is 250 to 300m/m higher than that of the processing factory floor, it is necessary to provide a platform about 2m wide with a proper slope from the factory

floor in front of the doorway of thefreezing room so that the handcart can travel smoothly in and out. The four freezing units are to be installed on frames built.

(5) Outline of Specifications

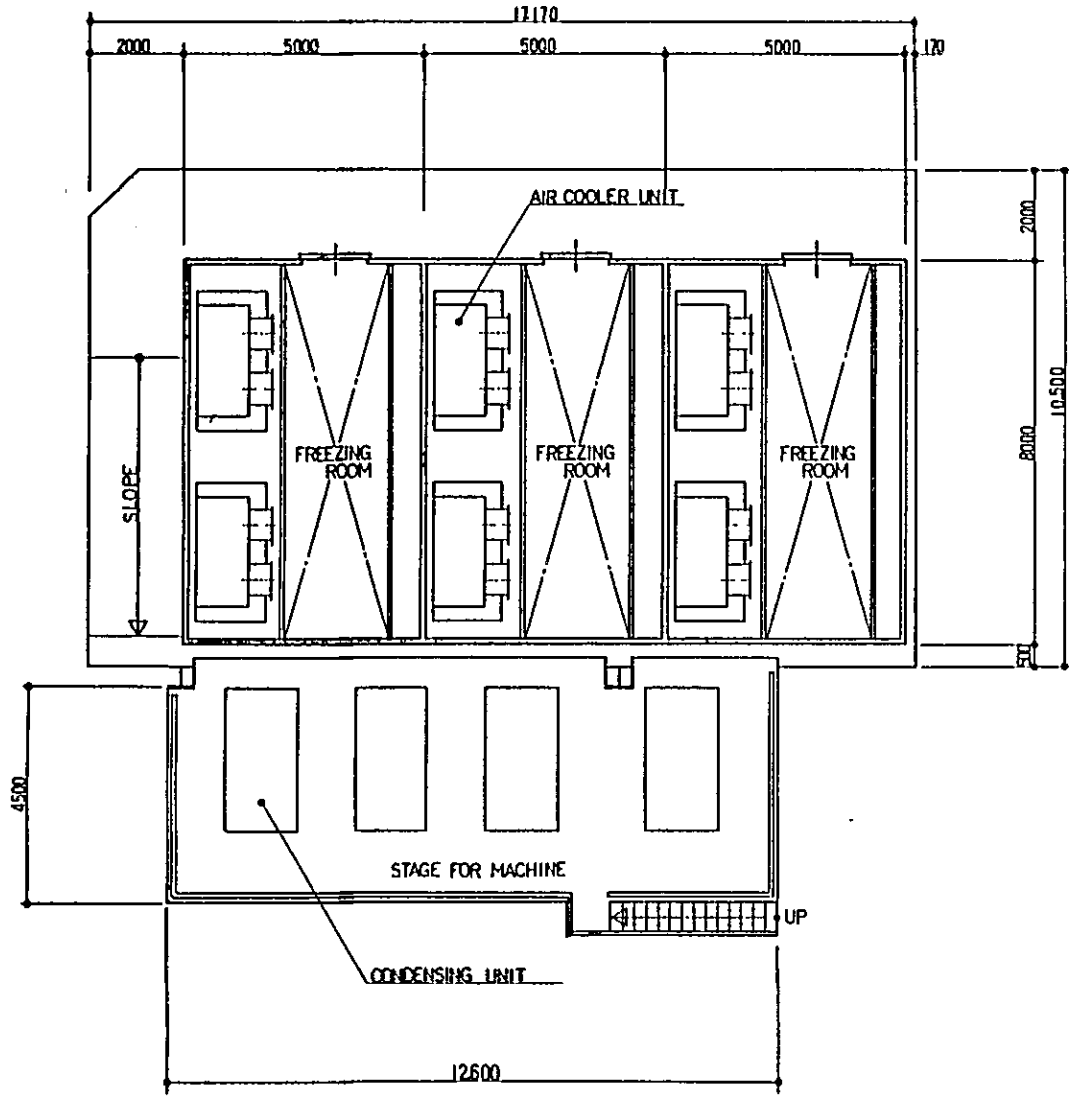
1) Building of freezing Room 1 house

Building Method	Prefabricating method heat insulating panels
Area of Freezing Room	about 120m^2
Frame of Freezing Unit	about 60m^2

2) Air Blast Freezing Equipment

1	Freezing Capacity	15 tons/day (5 tons/day x 3 sets)
2	Cooling Method	R-22 dry expansion method
3	Freezing Load	36 JRT
4	Defrosting Method	Manually operated sprinkler system
5	Unit	1 set
	.Freezing units	4 units
	.Floor type unit coolers	6 units
	.Cooling tower	1 unit
	.Cooling water pumps	2 units
	.Handcarts	36 units
6	Incidental Equipment	Air Curtain 1 set
7	Chemicals	Refrigerant, Oil 1 set

AIR BLAST FREEZING EQUIPMENT



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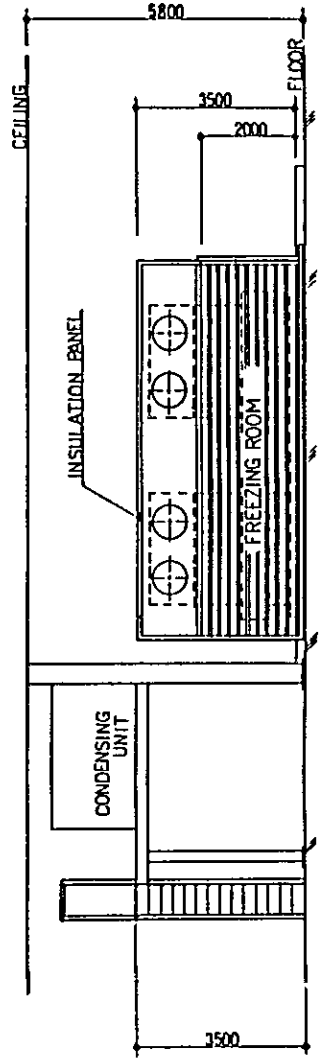

SECTION S = 1/100

4-5 Water Treatment and Purification System

(1) Design Policy

.To install a system which carries out the chemical process (hypochlorous acid soda) to oxidize the iron contained in the well water.

.To eliminate iron by means of sand filters.

.To install a system to eliminate the turbidity and dours by means of an activated charcoal filter tank.

.To adopt PVC piping as the connecting piping to prevent corrosion.

.To install a $50m^3$ tank made of FRP outdoors.

.Taking account of the installation location, the system should be designed to occupy less space, be easy to handle.

(2) Water Treating Capacity

Treated water is supplied for:

.Processing water for shrimps .....for ice packing, thawing, cooling and washing

.Processing water for fish.....for thawing and washing

.Drinking water .....for drinking and sanitation

Based on the estimation of the amount of water used at McDoom fishery processing factory and processing and treating work the capacity of processed water was set as follows:

1) Processing water for shrimps.....8,000 lbs/day = 3.6 tons x 5 lit/kg = 18 tons/day

2) Processing water for fish..... Annual processing Amount of fish / 300 days =

$$\frac{(563+2,333+3,279)\ \text{tons}}{300} \times \text{lit./kg} = 21\ \text{tons/day}$$

3) Drinking water.....Employees at McDoom approx.120 persons x 40 lit. = 5 tons/day

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Estimated amount of water used...44 tons/day

The above calculation is based on the estimated processing amount in 1986. Thus the capacity of the water treatment and purification system is 50 tons/day.

(3) Water Treatment Equipment and Arrangement plan

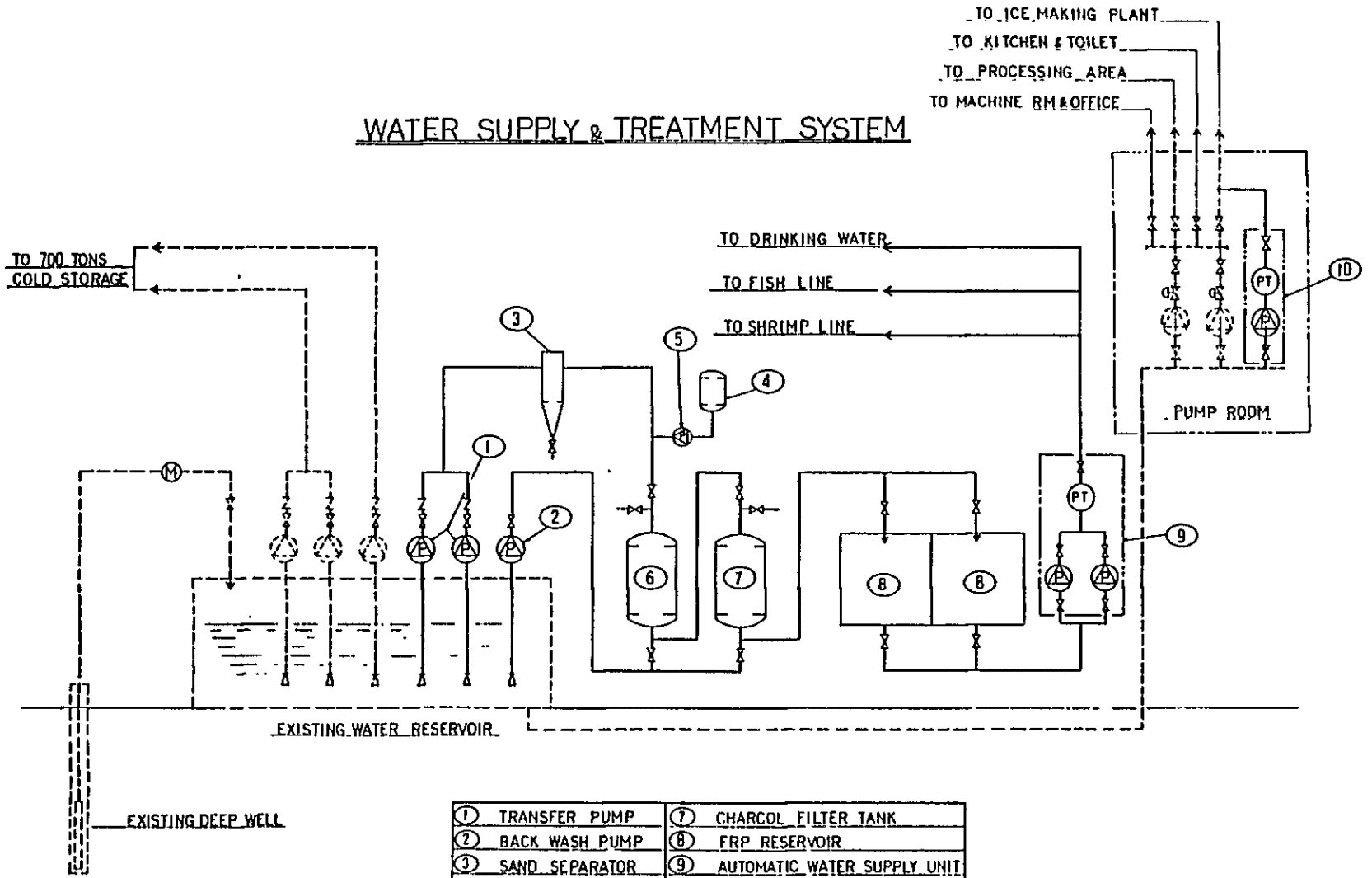
The water treatment equipment is to be installed on a flat area near the 15 ton intake tank to facilitate easy piping.

The water treating system comprises a raw water pump, sand separator, chemicals injector, sand filter tank, activated charcoal filter tank, water storage tank, feed pump for treated water, etc., which are connected by piping. Treated water is supplied by a feed pump to the shrimp treating and processing circuit, and fish processing circuit, and to 7 drinking water circuit (8 taps and 2 cold water units).

(4) Outline of Specifications

Water Purifying System		1 set
1)	Water Treating Capacity	50 tons/day
2)	Treatment Method	Filtration and precipitation method using chemicals
3)	Unit	
	.Raw water pumps	2 units (1 unit for spare)
	.Sand separator	1 unit
	.Sand filter tank	1 unit
	.Chemical injector	1 unit
	.Activatec charcoal filter tank	1 unit
	.Water storage tank	1 unit ($50m^3$)
	.Feed pumps	2 units (1 unit for spare)
	.Feed piping	3 systems

WATER SUPPLY & TREATMENT SYSTEM



①	TRANSFER PUMP	⑦	CHARCOL FILTER TANK
②	BACK WASH PUMP	⑧	FRP RESERVOIR
③	SAND SEPARATOR	⑨	AUTOMATIC WATER SUPPLY UNIT
④	$NaOCl$ TANK	⑩	AUTOMATIC WATER SUPPLY UNIT
⑤	$NaOCl$ FEED PUMP		
⑥	SAND FILTER TANK		

4-6 Standby Generator

(1) Design Policy

.Since the generator is used for emergencies to compensate for the erratic electricity supply in Guyana, the capacity should at least be sufficient to drive the ice making equipment, air blast freezer and water treatment and purification system.

.To allow parallel running of 2 generators.

.To adopt a method by which the standby generator can be started manually even if the power is cut off and stopped manually when the power is restored.

(2) Capacity of Standby Generator

The capacity of the standby generator is calculated, 275 KVA x 2 sets = 550 KVA on the base of Load list of Equipment as follows,

1) Load list of Equipment (Estimated values, Spares excluded.)

Equipment	Unit	Load	Equipment Total
Ice Making Equipment	Ice Making Machine, Freezer	55KW x 2 units = 110KW	136.35KW
	Crusher	2.2KW x 2 units = 4.4KW	
	Circulating pump	0.75KW x 2 units = 1.5KW	
	Cooling tower fan	1.1KW x 2 units = 2.2KW	
	Cooling water pump	7.5KW x 1 unit = 7.5KW	
	Raw water pump	2.2KW x 1 unit = 2.2KW	
	Ice storage freezer	5.5KW x 1 unit = 5.5KW	
	Ice storage cooler fan	0.2KW x 3 units = 0.6KW	
	Ice storage cooling tower	0.2KW x 1 unit = 0.2KW	
	Conveyer cooling water pump etc.	= 2.25KW	
Air Blast Freezer	Freezer	44KW x 3 units = 132KW	168.1KW
	Cooler fan	2.2KW x 4 x 3 units = 26.4KW	
	Cooling tower fan	1.1KW x 2 units = 2.2KW	
	Cooling water pump	7.5KW x 1 unit = 7.5KW	
Water Treating and Purifying System	Raw water feed pump	1.5KW x 1 unit = 1.5KW	3.7KW
	Feed pump	2.2KW x 1 unit = 2.2KW	
Total load of equipment for output			308.15KW

(3) Outline Specifications

. AC Generator unit drived by 2 sets of diesel engines

. AC Generator: Output 275KVA

Voltage x Frequency x Phase: 440V x 60HZ x 3 phase

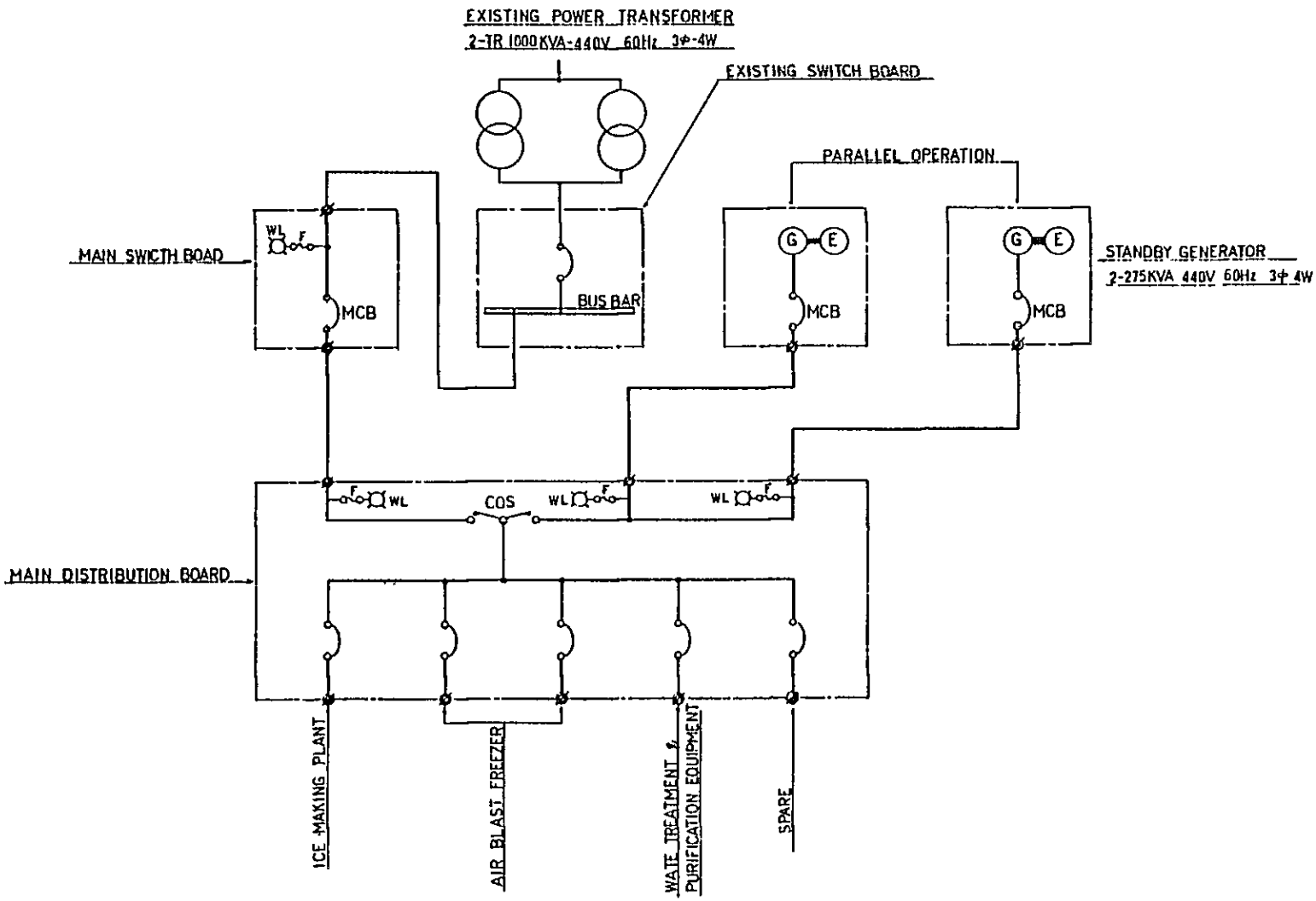
. Diesel engine: Water cooled, manually started

. Accessories: Common bed, Radiator, Fuel tank, Battery, etc.

. Main switch board and main distribution board 1 set

. Housing: 1

ELECTRIC WIRING DIAGRAM



4-7 Refrigerator Trucks and Fish Boxes

Refrigerator Trucks

(1) Design Policy

- To adopt a standard refrigerator truck with a combined tractor and refrigerated container rather than an articulated truck.
- To be able to carry a load of at least 7 tons of frozen fish while keeping the total weight below 15 tons.
- To equip the container with a small freezer also the city electricity can be used.

(2) Outline Specifications

- Total weight: less than 15 tons (fish 7 tons truck 8 tons)
- Main dimensions: L x B x G = about 9.40M x 2.50M x 3.30M
- Container capacity: about $25M^3$
- Equipment
  - Diesel engine, and right handling
  - The freezer should be 220V/60HZ
  - Container body covered with aluminum and insulated with urethane.
  - Retained temperature -18°C (assuming outside temperature to be 35°C)
  - Including spare parts for 3 years
  - Quantity: Complete set 3 trucks

Fish Boxes

Outline Specifications

- Blue or white box made of polyethylene
- With GFL's Logo stamped both on front and back

. Bore drain 4 holes on its bottom

. Adopt a form such as can be stacked when empty to occupy less space

. Adopt strong ready-made boxed

. Size of boxes used for holdy fish will have to be so designed as to be tight fitting inside the refrigerator truck so as to prevent gaps in between boxes

. Dimensions: 563m/m x 360m/m x 202m/m

. Quantity: 5,000

4-8 Forklifts

(1) Design Policy

. Not to emit exhaust gas, heat or odours when running.

. To be able to carry out loading safely up to more than 3.6m from the frozen floor.

. Since the forklift is used under severe conditions such as high and low temperatures and high humidity in the cold store and processing factory, and on the pier damp-proofing and rust-proofing measures should be taken the electrical system insulated on the assumption that the temperature is between -25°C and +35°C.

(2) Outline Specifications

. Overall height (fork at the lowest position): less than 2.4M

. Lift height (height of loading): 3.6m

. Maximum lifting load: 1,500 kg

. Climbing ability: 1/8

. Driving method: Battery

. Battery: DC48V (fixed type with charger)

. Spare Battery: 1 set for one forklift

. Spare parts for 3 years operation: Oil element, Oil seal, Electric bulb, Fuse, Repair hit, etc.

. Quantity: 2 units

4-9 Fishing Gear of Fish Trawlers (for 3 years operation per boat)

Parts and materials for repair are hard to obtain at GFL fishing net factories. Therefore, it is necessary to provide good quality fishing gear in sufficient quantity to serve for 3 years per boat to ensure smooth operation without disruption necessary gear consists of the following items:

1) Set Net

Trawling Net: Complete set etc.

2) Repair Net

PE 30-90 x 120m/m-43m/m x 100 MD x 500 mesh etc.

3) Wire

Warp 14Ø, Wire Rope 12Ø-14Ø etc.

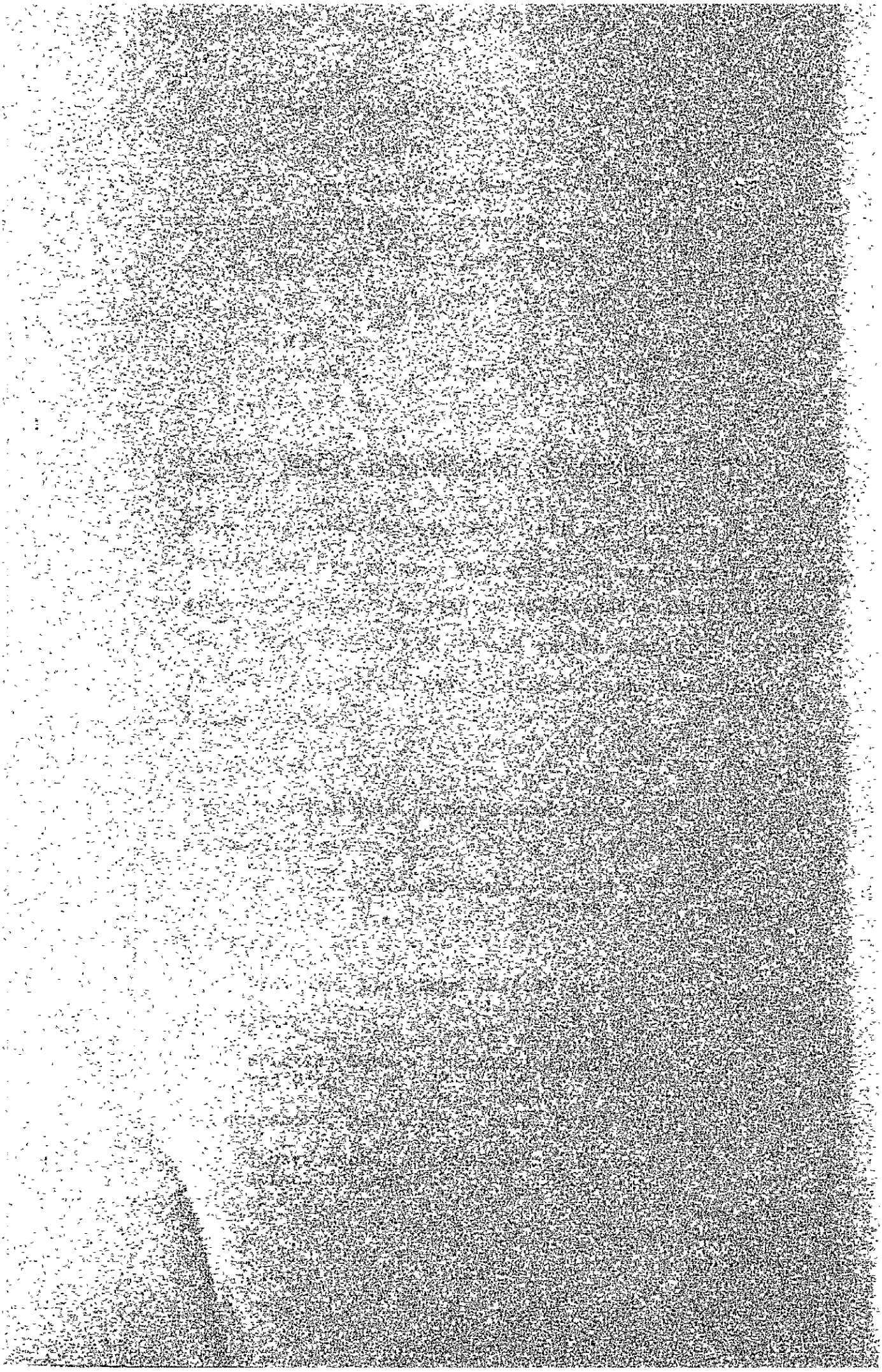
4) Fitting

Shuckle, Square Shackle, swivel, End Ring etc.

5) Accessory, Repairing Thread, Small Tools

Float, Rubber Weight, Twine, Scissors, Spike, Spanner etc.

CHAPTER V IMPLEMENTATION SCHEME



CHAPTER V IMPLEMENTATION SCHEME

5-1 Executive Agency

All responsibilities pertaining to the implementation of the project will be assumed by the GFL; in other words, the GFL will undertake to execute all stages of the planning, construction, and administration of facilities and equipment that are considered to be part of this project.

The GFL has several departments; the Administrative Department, the Vessels Department, and the Shore Plant Department. These latter two departments will be placed directly in charge of the present project; in passing, these departments mainly deal with fishing activities and the processing, distributing, and selling of shrimp and fish, respectively. The Special Project Administrative Department, which is also a part of the GFL, will be responsible for organizing of this project.

5-2 Construction Plan

Among the materials and equipment necessary for the proejct, those available locally are limited to cement, aggregate, gravel, and lumber; for this reason, main materials and equipment will have to be procured in Japan.

Thorough preparation prior to the commencement of the work is necessary for material to be procured locally, as their availability is not always constant.

For the purpose of the project and in view of the nature of the work, it is necessary that facilities and

equipment be roughly divided into those requiring construction or assembly at the site and those requiring no work.

(1) Facilities and equipment requiring construction/assembly at site.

1) Shrimp grading machine.

2) Ice making facilities and extension of pier as part of foundation work.

3) Water treatment system.

4) Air blast freezer.

5) Standby generator

With the exception of the pier, the items above will be brought to the site, and constructed or assembled at the site and handed over to the GFL. Most of the materials and equipment to be used for the pier will be procured locally. As for the ability of the subcontractors working under Japanese firms and who will be directly involved in the construction or assembly of these items, there appears to be no problems judging from the performance during the first through third steps of this project.

(2) Facilities and equipment not requiring construction/assembly at site.

1) 20 ton trawler

2) Forklift

3) Refrigerating truck and fish boxes

4) Fishing gear of fish trawler

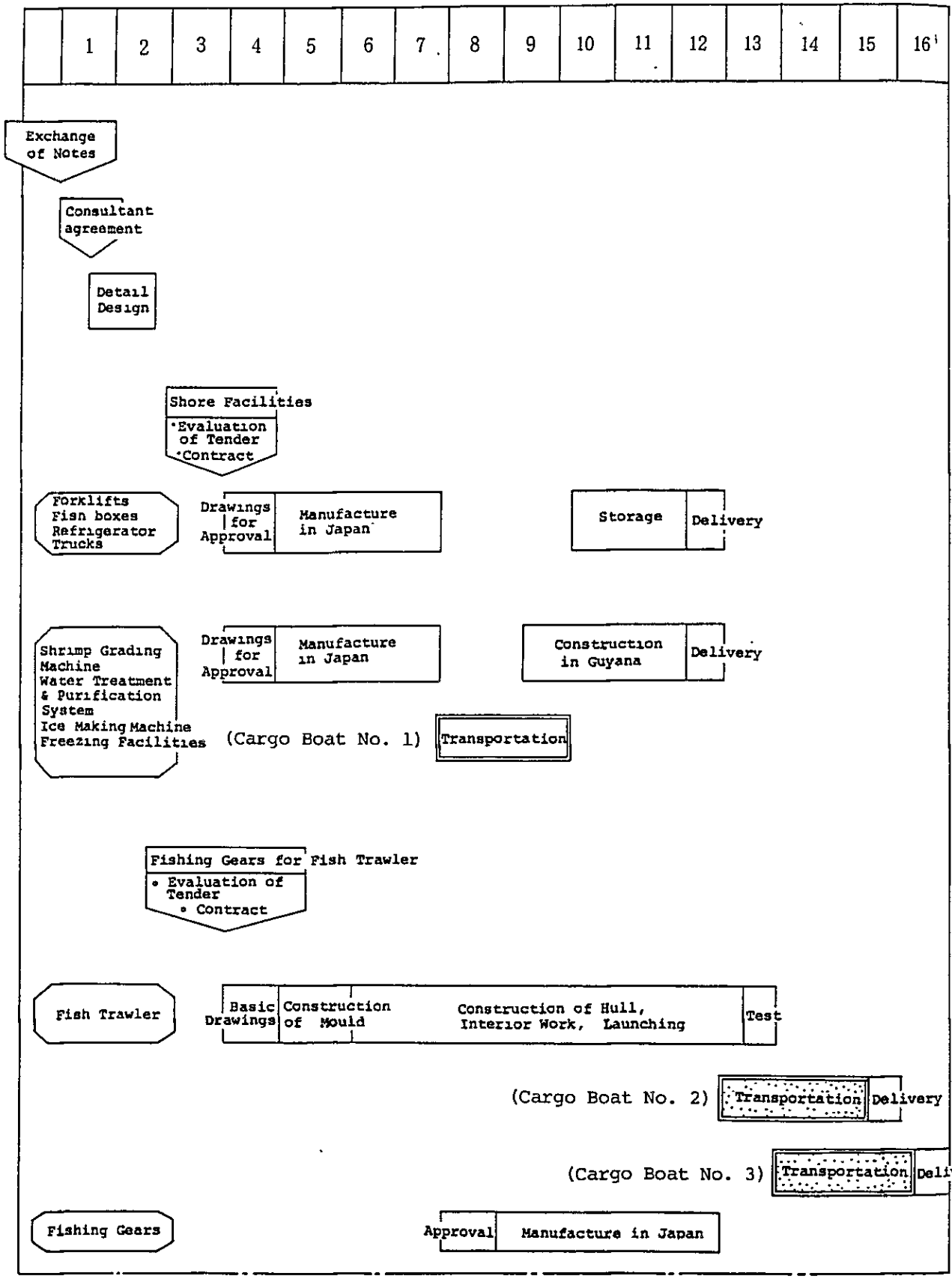
These items will be shipped from Japan and unloaded at Port of Georgetown for land transportation to McDoom; the trawler will proceed from the main wharf to GFL fishing base in Houston. For land transport, a paved road with a width of about 8m is available over a distance of about 2.5km between Port of Georgetown and the site. The government and Guyana Shipping Corporation are in possession of 20 and 30 tons trailers; application, if made in advance, can make them easily available for inland transport.

5-3 Completion Schedule

The project can be thought of as consisting of diverse work items; it is, therefore, very important that such items be executed based on a balanced and economical work plan.

As already mentioned in 5-2 "Construction Plan", facilities and equipment to be used in this project are roughly divided regardless of work at the site; using the ship loading schedule as a guide an outline work plan has been prepared (see table below). The actual work for the shore facilities will require approximately 9 months and 13 months will be needed for the delivery of fishing trawlers after the execution of the contract.

Work Schedule Table



5-4 Scope of Work

5-4-1 Plan

The present project is an aid offered by the Japanese government under which capital necessary for the provision of various materials and equipment will be extended to introduce fishing trawlers and improve the quality of shrimps for export and increase its productivities, the scope of work to be dealt with in the project is as shown below. The project is expected to increase the catch of fish and stimulate distribution.

(1) Construction of fish trawlers and provision of trawling gear for three years.

(2) Installation of blast freezer, standby generator and ice making facilities, including extension of pier.

(3) Installation of shrimp grading machine and water treatment system.

(4) Provision of refrigerator trucks, fish boxes, and forklifts.

5-4-2 Work Assumed by Guyana

Assistance to be made available by the Guyanese government for the project is as set out below:

(1) Clearance of the proposed site free from all debris.

(2) Procurement of temporary store yards for materials and equipment necessary for the construction of facilities and securing service to prevent theft and vandalism.

(3) Exemption from customs duties, taxes and other forms of taxation imposed in Guyana on Japanese engineers and facilities, materials, and equipment brought into the country.

(4) Provision of permission, authorization, and licenses necessary for the execution of work.

(5) Assistance for unloading and the transportation inland of materials and equipment scheduled for delivery to the country.

5-5 Costs to be borne by the Guyanese side

The estimates of expenses to be borne by the Guyanese side are as follows.

1) Removal of the existing shrimp grading mechines at the propesed site
   G$20.00 x 10 persons x 2 days = G$400

2) Removal of the existing contact freezers and their attached equipment
   G$20.00 x 10 persons x 5 days = G$1,000

3) Cleaning of the site on which the water treatment equipment and standby generators shall be installed and removal of scrap and others
   G$20.00 x 10 persons x 3 days = G$600

4) Provision of necessary gurds at the storage yard for materials
   G$25.00 x 30 days x 3 months x 2 persons = G$4,500

Total	G$6,500

CHAPTER VI ADMINISTRATION AND MAINTENANCE PLAN