Ministry of Transport
Maritime and Port Division
THE KINGDOM OF TONGA

BASIC DESIGN STUDY REPORT

ON

THE PROJECT FOR CONSTRUCTION OF

INTER-ISLAND VESSEL

IN

THE KINGDOM OF TONGA

December 2007

JAPAN INTERNATIONAL COOPERATION AGENCY

FISHERIES ENGINEERING CO., Ltd.

PREFACE

In response to a request from the Government of the Kingdom of Tonga , the Government of Japan decided to conduct a basic design study on the Project for Construction of Inter-island Vessel and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Tonga a study team from February 24 to March 22, 2007.

The team held discussions with the officials concerned of the Government of Tonga, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Tonga in order to discuss a draft basic design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Kingdom of Tonga for their close cooperation extended to the teams.

December 2007

Masafumi Kuroki
Vice-President
Japan International Cooperation
Agency

December 2007

LETTER OF TRANSMITTAL

We are pleased to submit to you the basic design study report on the Project for Construction of Inter-island Vessel in the Kingdom of Tonga.

This study was conducted by Fisheries Engineering Co., Ltd., under a contract to JICA, during the period from February, 2007 to November, 2007 . In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Tonga and formulated the most appropriate basic design for the project under Japan's Grant Aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

Toyonori Watanabe
Project manager,
Basic design study team on
the Project for Construction of
Inter-island Vessel in the Kingdom of
Tonga
Fisheries Engineering Co., Led.

SUMMARY

(1) Outline of Country

The Kingdom of Tonga is an archipelagic country located at the center of the South Pacific Ocean and consisting of 4 groups of islands (from the south, Tongatapu Group, Ha'apai Group, Vava'u Group and Niuas Group) totaling 170 islands from lat. 15° to 23°30' S and from long. 173° to 177° W. The population is approximately 100,000 people. The islands have a total area of 748km^2 (10% larger than Lake Biwa) and distributed in the wide range of 600km from north to south and 200km from east to west. The population structure by group of islands is 75% in the Tongatapu Group which has the metropolitan city of Nuku'alofa, 15% in the Vava'u Group in which tourist development has been making progress, 8% in the Ha'apai Group and 1.5% in the Niaus Group in the northernmost remote area. Some islands are overpopulated and some are underpopulated.

The gross national income (GNI) per capita is US$2,190 (the World Bank data in 2005) and the main industrial fields are services and agriculture. The service industry accounts for over 50% of the gross domestic product (GDP) and more than half relies on the Government. Agriculture accounts for about 40% of the GDP, about 75% of exports and about 50% of employment. As the domestic market is small and the location is not suitable for foreign trade, economic growth is not stabilized and the main export products are limited to agricultural and marine products such as pumpkins, fishes, vanilla and kava. The financial conditions are dependent on constant assistance from overseas countries and remittances from migrant workers overseas to a large extent. In fact, about 70,000 emigrants to the West Coast of the US and 40,000 emigrants each to New Zealand and Australia have sought employment outside of Tonga.

(2) Background, Circumstances and Outline of Requested Project

Traffic and transportation of people between outlying islands, and supply of goods as the lifeline in their daily life and necessary for local development is a social infrastructure indispensable for Tonga.

Regular airplane and shipping lines operate between Nuku'alofa and remote islands. Shipping services account for about 47% of the passenger transportation and nearly 100% of the cargo transportation. The shipping service at low fares is an important means of transport for the people in Tonga. The Government of Tonga has contracted with the Shipping Corporation of Polynesia Limited (SCP) under 100% investment by the Government to lease the government-owned ship MV Olovaha (955 gross tons, built in West Germany in 1981) and to provide regular services of inter-island vessels to the islands including the northernmost Niuas Group on SCP's responsibility. However, MV Olovaha is 26 years old, aging and often out of order, and repair costs are increasing. Therefore, the ship is in a critical condition in which its safe and stable operation is difficult. Notwithstanding its aged conditions, in addition, MV Olovaha is forced to carry an overload exceeding the load line in order to meet the high demand for transportation.

A private ship MV Pulupaki (675 gross tons, built in Japan in 1986 and sold as a used vessel

to Tonga) is operated in parallel in the shipping line to the remote islands in the Vava'u Group in the central area. The private ship has the passenger transport capacity 1.7 times as high as MV Olovaha, but its cargo transport capacity is half that of MV Olovaha. Therefore, MV Pulupaki has no capacity to meet the demand for marine transportation in Tonga.

To resolve the critical situation of its marine transportation as the lifeline of the nation and the local development infrastructure, the Government of Tonga considered renewing its own ship MV Olovaha in the Strategic Development Plan 8 (7/2006 – 9/2008) and made a request for grant aid cooperation in new shipbuilding and related cargo-handling equipment (including forklifts and containers) to the Government of Japan.

(3) Outline of the Study and Details of the Project

In response to this request, the Government of Japan decided to implement the Basic Design Study and Japan International Cooperation Agency (JICA) dispatched a study team for this Basic Design Study to the Tonga for the period from February 24 to March 22, 2007.

Based on the results of this Study, JICA carried out a basic design study in Japan including examination of ship size and specifications, the shipbuilding schedule and a rough estimation of the project cost, and dispatched the Study Team for outline explanation of the Basic Design to Tonga for the period from October 1 to October 12, 2007 to discuss, confirm and agree with the counterparts of Tonga on the basic design items and the responsibilities on the Tonga side.

For the cargo and passenger transport capacities of the Plan Vessel, the transport performance of existing inter-island vessels was confirmed, and the complement and cargo carrying volume to ensure safe navigation without exceeding the load line were determined allowing the current transport performance. The main engine output was determined considering its economic navigating speed, and engines with high fuel efficiency were selected. As the safety standard, the safety rules for passenger ships in Japan were applied accordingly and the safety standards considered for the safety of general passengers unfamiliar with safe behavior on board were adopted. The existing cargo-handling equipment including use conditions of containers in Tonga were studied, and the results were reflected on the cargo-handling equipment to be included in the Project.

As a result, the outline of the plan finally proposed is as follows:

Number of ships	1 vessel
Length overall	53.00 m
Breadth, molded	13.50 m
Depth, molded	4.30 m
Designed draft	3.00 m
Gross tonnage (international)	1,500 ton
Deadweight	520 t
Cargo weight	400 t
Fuel oil tank	120 m^3

Fresh water tank	40 m^3
Passenger capacity	400 persons
Crew	22 persons
Service speed under 85% engine load	11.5 knot
Crane	6.0 t×2
Main engine	735 kW (1,000 ps)×2
Propeller	4-bladed, solid×2
Main generator	250 kVA×2
Harbor generator	40 kVA×1
Navigation equipment	Magnetic compass, gyro compass, radar (2), GPS (2), Echo depth sounder, etc.
Radio apparatus	VHF radiotelephone, MF/HF radio telephone, EPIRB, etc.
Cargo-handling equipment	Dry container (2.4m×1.8m×2.0m)×54 Reefer container (2.4m×1.8m×2.0m)×8 Forklift (6 t, with load scale)×2

(4) Work Schedule

The entire work schedule of this Project will require about 20 months including the tender process (detailed design: 4 months; shipbuilding/navigation and procurement of equipment and machinery: about 16 months).

(5) Project Implementation and Operation/Maintenance System

The competent agency and implementing agency of this Project is the Ministry of Transport and the operation and maintenance of the ship is undertaken by the Shipping Corporation of Polynesia Limited (SCP) in which the Government of Tonga has invested 100% of the capital.

The items for which Tonga should be responsible in this Project are the reconditioning of each port of call (including widening of the landing section for boarding ramp, apron pavement, reconditioning of fenders and installation of power supply for reefer containers).

A preventive maintenance system to maintain the vessel hull, machinery and equipment periodically in pre-determined interval will be introduced, so that the natural increase of the costs of maintenance and repair can be minimized. This maintenance will be carried out by the SCP workshop, whose technical staffs (including welders and mechanics) and workshop equipment are deemed sufficient to carry out the said maintenance.

(6) Verification of Appropriateness of the Project

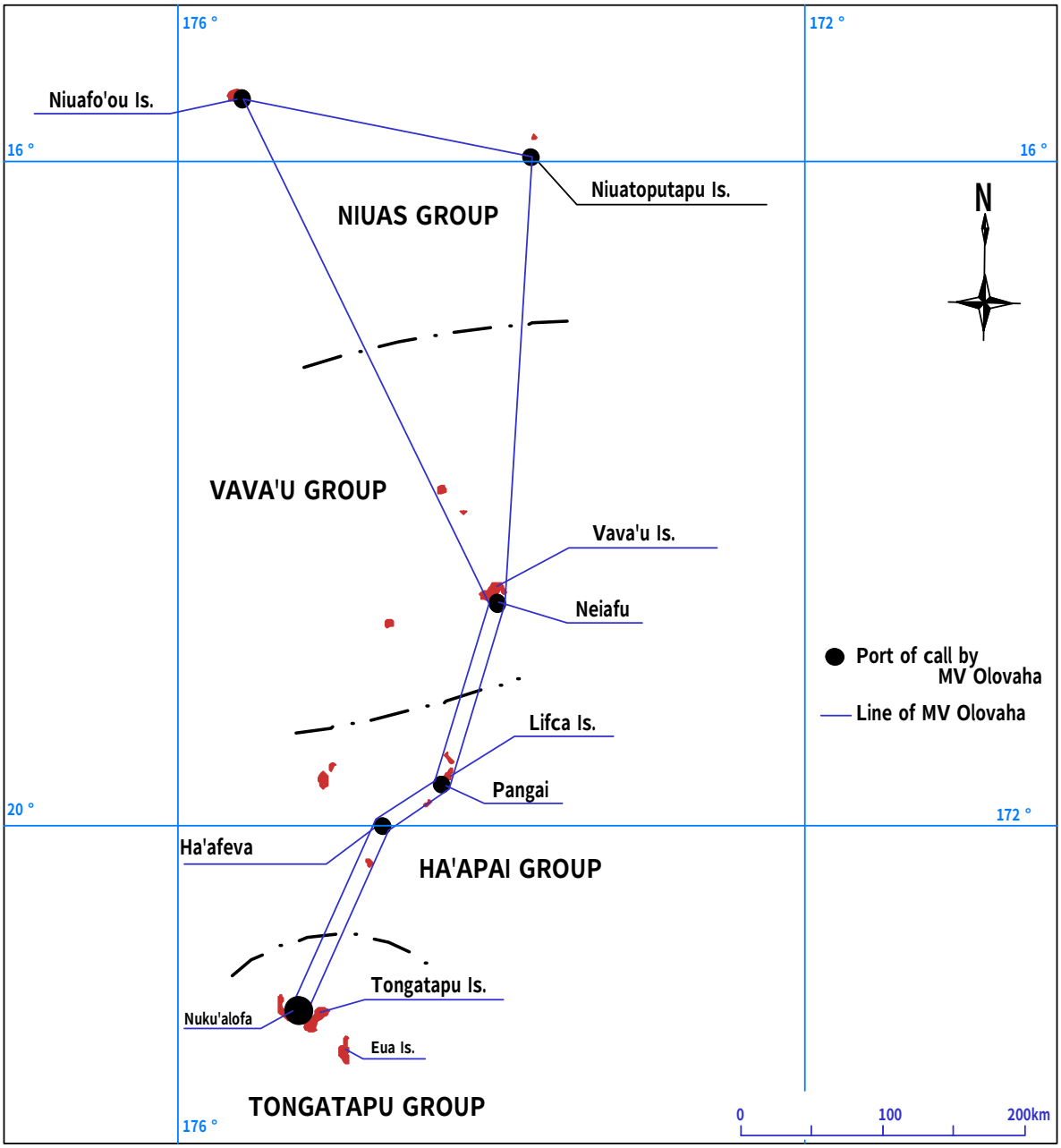
It is expected from the implementation of this Project that the direct and indirect effects as mentioned below are anticipated. The beneficiary range is deemed about 100,000 people in Tonga.

1) Direct effects
   (1) Constant overload cargos will be eliminated.
   (2) Voyages with the number of passengers exceeding the licensed capacity will be eliminated.
   (3) The allowable capacity of safe cargo transportation will be increased from 200 tons at present to 400 tons.
2) Indirect effects
   (1) The transportation of island products to urban areas will be promoted to increase the cash income of the remote islands.
   (2) The inflow of commodities to the remote islands will be increased to promote tourism development and improvement of living conditions.

This Project will resolve the problem of unsafe voyages due to overload which has been the normal state on the trunk lines of marine transportation in Tonga, and serve to secure safe and smooth means of marine transportation for people and the distribution of goods between islands which all the people in Tonga depend upon. Therefore, it has been verified that it will have high significance to implement this Project under the grant aid cooperation by Japan.

CONTENTS

Location Map



Map of Tonga and sailing routes of MV Olovaha

Perspective

LIST OF FIGURES & TABLES

ABBREVIATIONS

CPP	Controllable Pitch Propeller
EU	European Union
FPP	Fixed Pitch Propeller
GDP	Gross Domestic Products
GEOSAT	Geodynamics Experimental Ocean Satellite
GMDSS	Global Maritime Distress and Safety System
GPS	Global Positioning System
HF	High Frequency
IMF	International Monetary Fund
IMO	International Maritime Organization
JICA	Japan International Cooperation Agency
KT	Knot (v = 1,853m/sec)
kW	1 kW = 1.359 PS
LCD	Liquid Crystal Display
LoLo	Lift on Lift off
MARPOL	International Convention for the Prevention of Pollution from Ships
MF	Medium Frequency
MPa	1kgf/cm2 = 0.098 Mpa
NK	Nihon Kaiji Kyokai
NOx	Nitrogen Oxides
Nz$	New Zealand Dollar
PMP	Preventive Maintenance Policy
RoRo	Roll on Roll off
SART	Search and Rescue Radar Transponder
SCP	Shipping Corporation of Polynesia Limited
SOLAS	International Convention for the Safety of Life at Sea
SSB	Single Sided Band
SUS	Stainless Steel
T$	Tonga Dollar
TOPEX /POSEIDON	Seasat for Geodynamics Experimental Ocean Satellite
VHF	Very High Frequency
F.O.	Fuel Oil
GL	Germanischer Lloyd
HK	The Ship Equipment Inspection Society of Japan
ISO	International Organization for Standardization
L.O.	Lubrication Oil
MOT	Ministry of Transport
MV	Motor Vessel
NAVTEX	Navigational Text Messages
UV	Ultra Violet

Chapter 1 Background of the Project

1-1 Background of the request

The islands of the Kingdom of Tonga extend for 600 kilometers north to south and 200 kilometers east to west. Transportation of daily commodities and traffic of people from the capital, Nuku'alofa, to the center of the islands are supported by an inter-island ferry that serves as a lifeline and transports indispensable materials for regional development.

The government, having recognized the critical condition of the MV Olovaha in the Strategy 16 of the Strategic Development Plan 8, 2006/7 - 2008/9, set a goal of procuring a new ferry to replace MV Olovaha.

MV Olovaha, currently operated by the Shipping Corporation of Polynesia Limited (SCP), was built in West Germany in 1981 and is already 25 years old and noticeably superannuated. In 2001, the ferry failed to pass the safety inspection performed by Germanischer Lloyd (GL) of Germany and its class registration was deleted. The ferry is often delayed or cancelled, and repair expenses increase year by year, putting pressure on management of the ferry service.

MV Pulupaki, a ferry owned by UATA, a private shipping company, that serves the Neiafu route in parallel with MV Olovaha, cannot complement MV Olovaha because as well as not having sufficient cargo transportation capacity (about half that of MV Olovaha) to serve as the material transportation lifeline, it may not be able to sustain the service due to poor maintenance, as with MV Olovaha.

With the lifeline from Nuku'alofa to the remote islands in such a critical condition, it is imperative that SCP, as a public corporation, should introduce a new vessel to ensure a safe and stable regular ferry service.

The project items requested by the Tongan Government are as follows:

One inter-island vessel, one weigh-bridge (installed in Nuku'alofa), two forklifts, containers (20 dry containers and 20 reefer containers), etc.

Table 1-1 Inter-island vessel request items

Vessel type	Passenger ferry
Hull shape	Catamaran or single hull
Class	NK classification, etc.
Length overall	55m (Max.)
Breadth, molded	12m (Max.)
Draft, molded	3.5m (Max.)
Depth, molded to main deck	4.5m (Min.)
Service speed	15 knot（max. 18knot）
Passenger capacity	300/400 (5/10 rooms)
Cargo weight	200/300 ton
Fuel oil tank	For sailing 1,500 sea miles as minimum
Fuel to be used	IFO 180
Position of ramp	Preferably at the stern
Radar / radio	Must be equipped with latest one
Cargo gear	5mt

Accommodation area	Mast be air conditioned
Gross tonnage	Approx. 1,430 ton

1-2 Natural conditions of the project site

Having found no statistical data on wave height in the seas around Tonga because the Tongan government does not carry out wave height measurement around the country, the required wave height statistics were obtained from the database provided by the National Maritime Research Institute of Japan. The wave height was measured by the GEOSAT and TOPEX/POSEIDON satellites, which supply wave height statistics for each of the sea areas around the world. Today, wave height measurement through stationary buoy observation has been replaced by satellite observation.

The most probable significant wave height in the Tonga sea area is 2.16 meters. In contrast, the most probable significant wave height in the seas close to Japan is 2.21 meters. Therefore, it was assumed that the ferry in this project may be designed for the same navigational conditions as the ferries navigating around Japan (limited greater coastal area).

Area No.	Spring	Summer	Autumn	Winter	Year
↑ Wave Height ↓	Appearance rate				
Sum	Number of Sample				
	The most probable significant wave height				

No.80 Sea area around Tonga

A80	Spring	Summer	Autumn	Winter	Annual
19.75-	0.0000	0.0000	0.0000	0.0000	0.0000
18.75-	0.0000	0.0000	0.0000	0.0000	0.0000
17.75-	0.0000	0.0000	0.0000	0.0000	0.0000
16.75-	0.0000	0.0000	0.0000	0.0000	0.0000
15.75-	0.0000	0.0000	0.0000	0.0000	0.0000
14.75-	0.0000	0.0000	0.0000	0.0000	0.0000
13.75-	0.0000	0.0000	0.0000	0.0001	0.0000
12.75-	0.0000	0.0001	0.0000	0.0002	0.0001
11.75-	0.0001	0.0004	0.0003	0.0004	0.0003
10.75-	0.0004	0.0004	0.0003	0.0005	0.0004
9.75-	0.0005	0.0006	0.0005	0.0006	0.0006
8.75-	0.0004	0.0005	0.0006	0.0005	0.0005
7.75-	0.0002	0.0004	0.0004	0.0004	0.0003
6.75-	0.0002	0.0007	0.0006	0.0010	0.0006
5.75-	0.0020	0.0035	0.0023	0.0020	0.0024
4.75-	0.0051	0.0052	0.0022	0.0029	0.0040
3.75-	0.0227	0.0358	0.0074	0.0169	0.0210
2.75-	0.1614	0.2112	0.0837	0.0796	0.1346
1.75-	0.5886	0.5579	0.4723	0.5255	0.5429
0.75-	0.2162	0.1811	0.4189	0.3657	0.2882
0-	0.0021	0.0022	0.0104	0.0036	0.0041
TOTAL	93280	59901	53433	79352	285966
	2.2551	2.3846	1.9534	2.0367	2.1653

No.29 Seas close to Japan

A29	Spring	Summer	Autumn	Winter	Annual
19.75-	0.0000	0.0000	0.0000	0.0000	0.0000
18.75-	0.0000	0.0000	0.0000	0.0000	0.0000
17.75-	0.0000	0.0000	0.0000	0.0000	0.0000
16.75-	0.0000	0.0000	0.0000	0.0000	0.0000
15.75-	0.0000	0.0000	0.0000	0.0000	0.0000
14.75-	0.0000	0.0000	0.0000	0.0000	0.0000
13.75-	0.0000	0.0000	0.0001	0.0000	0.0000
12.75-	0.0000	0.0000	0.0000	0.0000	0.0000
11.75-	0.0001	0.0000	0.0004	0.0001	0.0001
10.75-	0.0001	0.0002	0.0008	0.0004	0.0003
9.75-	0.0002	0.0004	0.0009	0.0001	0.0003
8.75-	0.0002	0.0011	0.0004	0.0004	0.0004
7.75-	0.0001	0.0008	0.0014	0.0014	0.0009
6.75-	0.0002	0.0005	0.0012	0.0031	0.0013
5.75-	0.0000	0.0012	0.0031	0.0052	0.0024
4.75-	0.0052	0.0027	0.0083	0.0233	0.0110
3.75-	0.0283	0.0072	0.0497	0.0886	0.0479
2.75-	0.1297	0.0559	0.1383	0.2441	0.1552
1.75-	0.5226	0.2503	0.3589	0.4870	0.4362
0.75-	0.3043	0.6026	0.4195	0.1442	0.3246
0-	0.0092	0.0772	0.0172	0.0023	0.0192
TOTAL	18204	8475	10985	16792	54456
	2.1409	1.6072	2.1127	2.6416	2.2066

Fig. 1-1 Wave height statistics

1-3 Environmental and social conditions

Tonga ratified the International Convention for the Prevention of Pollution from Ships

(MARPOL) and therefore the following preventive measures are required for the ferry in this project.

Measures against oil pollution	:	installation of a deoiler to prevent draining of oil
Measures against sewage pollution	:	installation of a tank to store sewage water from toilets in sea areas where draining is prohibited (within 12 nautical miles from shore)
Measures against air pollution	:	selection of a diesel engine with reduced NOx emissions

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

The land of the Kingdom of Tonga (hereinafter referred to as Tonga) comprises 4 island groups, which further comprises 172 islands. 45 islands among them are inhabited. Islands spread over 600 km south-to-north and 200 km west-to-east. Population of Tonga living in Tongan islands are about 100,000, among which about 70% are concentrated in Tongatapu Island where Nuku'alofa, the capital of Tonga, is placed.

In Tonga there are no major industries except for the capital islands Tongatapu and resort islands Vava'u, and Tongan people are mainly working at agriculture and fishery, some of whose products are carried to Nuku'alofa on board inter-islands vessels. The position of the inter-islands vessels is the lifeline for outer islands people to transport daily life goods, building materials, fuels oil, etc. and transporting island people.

Air transport and sea transport serve as lifelines in cargo and passenger transport among islands, but the sea transport outstanding in the large quantity and economical transport is the fundamental function. Transports between major ports are served by large inter-islands vessels and further to small islands are served by smaller vessels.

As the important means of lifeline and further promotion of islands development for Tongan nationals, Tongan Government entrusts responsible operation of MV Olovaha (955 tons gross, built 1981 in Germany) to Shipping Corporation of Polynesia Limited (SCP, public enterprise, 100% owned by the Government). However, operations of MV Olovaha, aged already 25 years old and deteriorated, are unstable, unsafe and uneconomical due to frequent breakdown and costly repairs.

In the sailing route to Vava'u, a vessel belonging to private shipping is also serving. Capacity of the private shipping vessel compared with MV Olovaha is about 1.7 times more in passenger carrying capacity but about half in cargo carrying capacity, which is found insufficient to undertake Tonga's sea transport demands.

Recognizing such critical situation on the lifeline and needs to promote industrial development in Tongan islands, the Government of Tonga has taken up a national plan of replacing MV Olovaha with a new vessel considering Japan's grant aid in the Strategic Development Plan 8 (2006/7 – 2008/9).

Responding to the national plan, this Project intends to procure a new vessel in place of MV Olovaha, suitable for establishing stable and safe inter-island sea transport infrastructure as the lifeline and industrial development for Tongan islands.

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy

2-2-1-1 Fundamental Functions of the Plan Vessel

As the vessel bearing the lifeline for Tongan islands, design and construction must satisfy: appropriate cargo and passenger carrying capacity; safe navigation; environmental friendliness; economical operation, appropriate accommodation; efficient cargo operation, durable hull and machinery; and maintenance friendliness.

2-2-1-2 Cargo and Passenger Carrying Capacity

Studying detailed cargo and passenger statistics of MV Olovaha (SCP vessel) and MV Pulpaki [1](private shipping vessel), appropriate capacity of the Plan Vessel is found cargo weight 400 tons and number of passengers 400 persons.

Adding weight of fuel oil, lubricating oil, fresh water, forklift, etc. to the cargo weight 400 t and passenger 400 persons, total deadweight capacity is decided 520 t.

Refer further to "2-2-2-1(1) Capacity of the Plan Vessel".

2-2-1-3 Safety

Vessels must be designed and built applying safety regulations of the flag administration, or other appropriate safety regulations as recognized by the flag administration. It was decided by the Tongan administration that Japanese maritime regulations should apply to the Plan Vessel as the class II non-international passenger vessel operating in the greater offshore area.

Subdivision regulations, stability regulations, fire protection regulations, fire fighting regulation, lifesaving regulations, etc., special for passenger vessels, intends to ensure survival of passengers who are innocent in the safety on board ships.

2-2-1-4 Environmental Friendliness

MARPOL regulations (International Convention for the Prevention of Pollution from Ships, 1973) ratified by Tongan Government should apply.

Oily water separator to clean oily bilge water, sewage tank to collect soil water from toilets and NOx emission controlled diesel engines should be installed on board the Plan Vessel.

2-2-1-5 Operation Economy

Excessively high speed easily produces wave from shipside, resulting in big engine horsepower and big fuel oil consumption. The design speed of the Plan Vessel was carefully

[1] MV Pulpaki: Built 1989 in Japan as MV Ororon, 450 gross tons, served coastal ferry in Hokkaido of Japan, sold to Tonga 2002, renamed MV Pulpaki and engaging on inter-island ferry service.

determined at a Froude's number before getting into high wave making resistance. The main engines having suitable horsepower corresponding to the abovementioned speed should be selected considering economic fuel oil consumption.

2-2-1-6 Accommodation

Japanese regulations should be referred to for the passenger accommodation. Allowable number of passengers, number of sanitary facilities, etc. should be decided accordingly. Considering long voyage, involving 1 to 3 nights, most of the passenger accommodation should be large sitting room.

Passenger and crew accommodation should be air-conditioned. As the vessel hull and superstructures must maintain watertightness closing all doors and windows at sea, air conditioning is indispensable for vessels sailing in tropic climate.

Uncomfortable rolling motion cannot be avoided for vessels and many passengers are suffered from seasickness. To reduce rolling motion for passenger discomfort, roll-dumping equipment using steering rudder force should be installed.

2-2-1-7 Cargo Transport

For efficient cargo transport and renewal of aged cargo handling equipment, the Project should procure cargo containers, forklifts and cargo weighing equipment. MV Olovaha has been using simple containers to carry break bulk cargoes. In the new vessel, containerization should be further developed by introducing new and substantial containers including reefer containers. Existing forklifts, indispensable means of container handling in all ports, are so deteriorated, and must be replaced with new ones, which have a capacity to handle weight of the new container. Understanding that the weighing equipment serves for better cargo management, the weighing function should be added to the new forklifts.

2-2-1-8 Durability and Maintenance

Durability of vessels depends on material itself and/or on maintenance.

Rusting of seawater pipes represents the former case. In the Plan Vessel, all seawater cooling pipes (steel) should be plastic coated at inside surface, allowing vessel engineer free from trouble on rusting of seawater pipes.

Diesel engine represents the latter case. In the Plan Vessel, Preventive Maintenance Policy (PMP) should be established. PMP carries out overhauling and maintenance regularly not waiting for breakdown or malfunction, expecting decrease of machinery breakdown and long life. Machinery parts necessary for PMP should be procured by the Project .

2-2-2 Basic Plan

2-2-2-1 Basic Plan of the Plan Vessel

(1) Capacity of the Plan Vessel

1) Passenger Capacity of the Plan Vessel

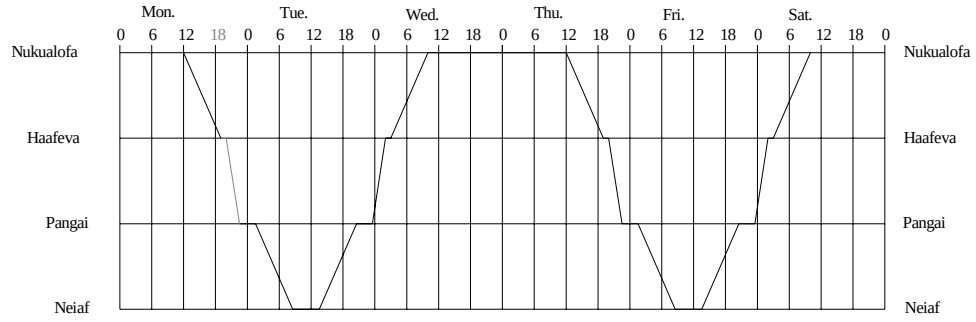
1. **Number of voyages in a week**

In summer holidays of schools and Christmas holidays, many passengers travel in a short time and inter-island vessels become full. In these specific busy times, inter-island vessel will have to complete passenger transport by extra voyages.

Currently MV Olovaha can undertake only one voyage in a week. Fig. 2-1 below shows the Plan Vessel's voyage possibilities of Nuku'alofa – Neiaf (Vava'u island group) service: two voyages in a week and further three voyages in a week.

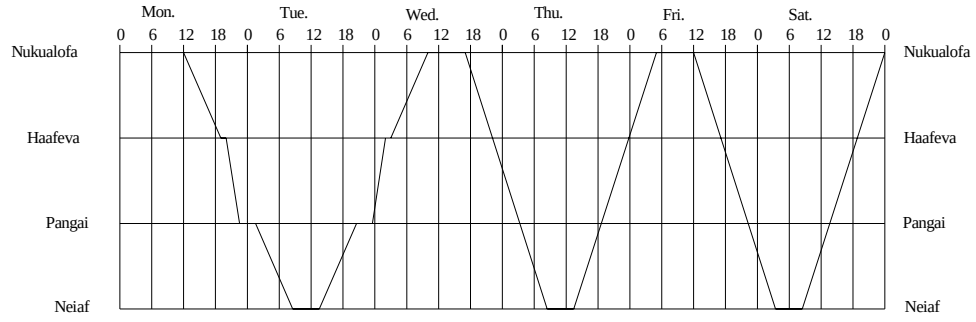
As shown in the diagram, two voyages in a week will be undertaken without problem, and three voyages in a week will be possible subject to the Government approval for the operation on Sunday. The appropriate capacity of the Plan Vessel will be studied hereinafter having in mind of such possibility of number of voyages in a week.

Case-1: 2 voyages in a week (Round voyage to Neiaf x 2).



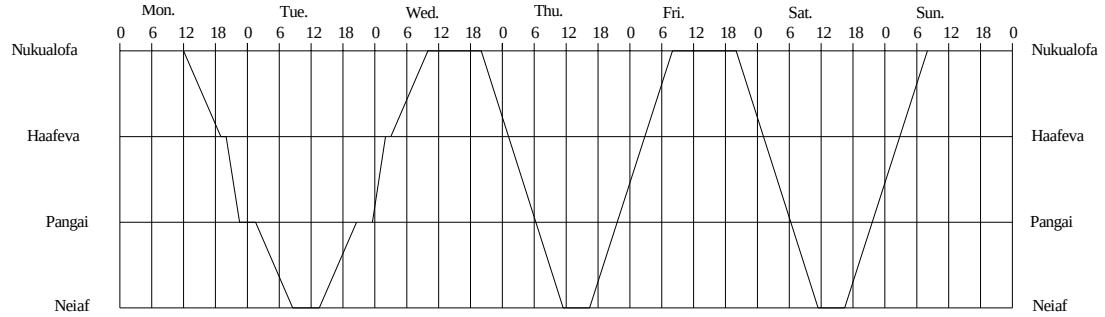
The Plan Vessel can serve two voyages without problem.

Case-2: 3 voyages in a week excluding Sunday. (1 voyage stops all ports and 2 voyages go direct to Neiaf)



3 voyages from Monday to Saturday will be difficult because of short wharf time in Nuku'alofa and arrival at midnight of Saturday.

Case-3: 3 voyages in a week including Sunday. (1 voyage stops all ports and 2 voyages go direct to Neiaf)



Three voyages can be completed in a week. Approval of the Government will be necessary to work on Sunday.[2]

Fig. 2-1 Weekly operation diagram for the Neiaf route

2) Passenger capacity of the Plan Vessel

1. **Passenger transport statistics**

Statistics of passenger transport, by MV Olovaha, MV Pulpaki and other vessels, in the sea routes between Nuku'alofa and outer islands, for the years 2003 to 2006 are as follows. Figures are sum of outward and homeward voyages.

Table 2-1 Passenger statistics, annual summary

Year	Sailing route	Nos. pax			Total
		Olovaha	Pulpaki	Other	
2003	Nuku'alofa – Ha'apai – Neiaf,	4,034	15,130	1,149	20,313
	Nuku'alofa – Ha'apai – Neiaf - Niuas	406	-	-	406
	Total	4,440	15,130	1,149	20,719
2004	Nuku'alofa – Ha'apai – Neiaf,	6,868	28,160	3,310	38,338
	Nuku'alofa – Ha'apai – Neiaf - Niuas	929	-	-	929
	Total	7,797	28,160	3,310	39,267
2005	Nuku'alofa – Ha'apai – Neiaf,	7,810	25,800	2,770	36,380
	Nuku'alofa – Ha'apai – Neiaf - Niuas	973	-	-	973
	Total	8,783	25,800	2,770	37,353
2006	Nuku'alofa – Ha'apai – Neiaf,	10,522	17,200	3,640	31,362
	Nuku'alofa – Ha'apai – Neiaf - Niuas	836	-	70	906
	Total	11,358	11,720	3,710	32,268

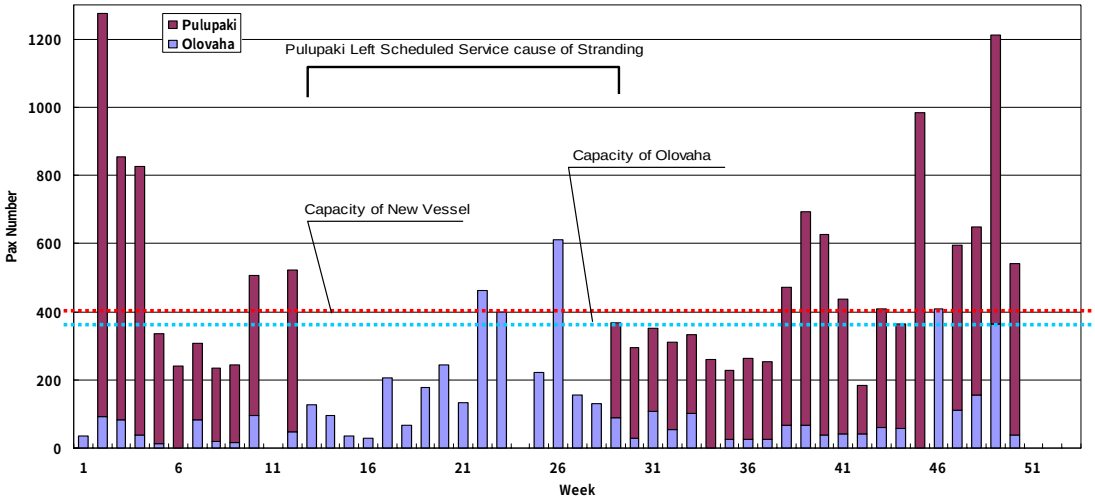
* Statistics up to 33rd week of 2006

Total passengers sailed in the route Nuku'alofa – Ha'apai – Neiaf is 20,000 – 38,000 in recent years. MV Olovaha has carried about 20 - 30%, MV Pulpaki about 55 - 75% and others about 10% in the total.

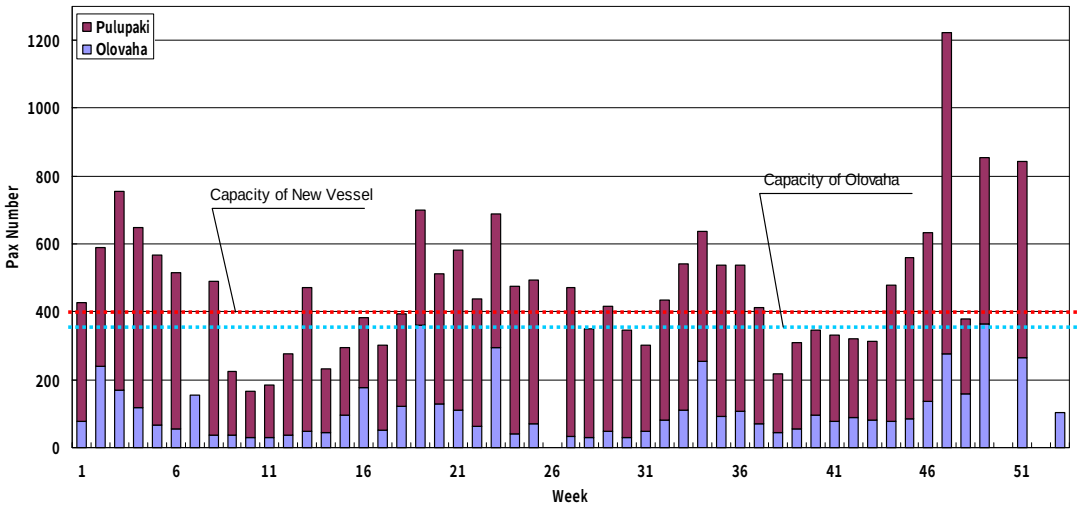
Fig.2-2 below shows detailed passenger statistics by MV Olovaha and MV Pulpaki in the years 2004 to 2006.

[2] In Tonga, Sunday must be a holiday and working on Sunday is in general not allowed. However, as allowed in certain taxis and ferries of public service, permission by the Government for inter-island service will be necessary.

Year 2004



Year 2005



Year 2006

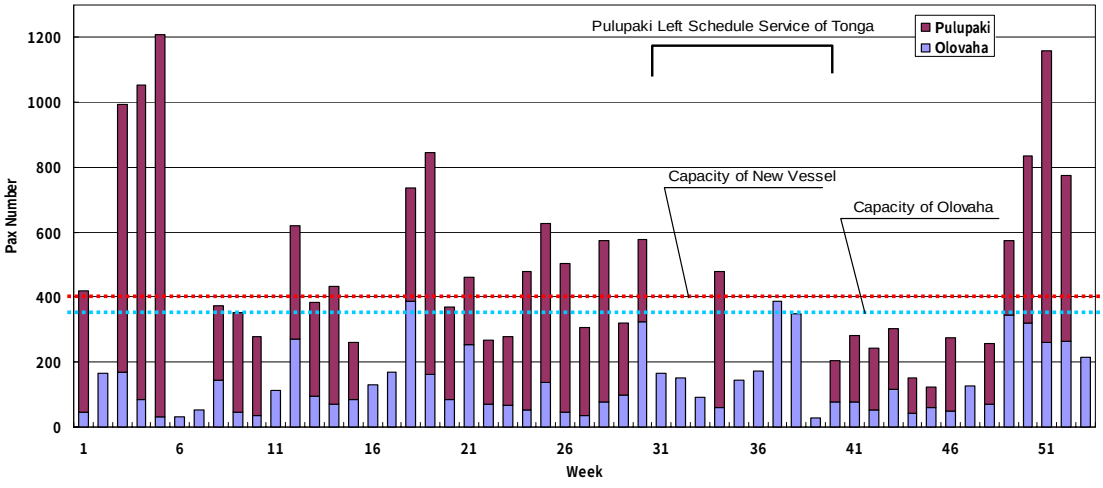


Fig. 2-2 Max. number of passengers in one voyage on board MV Olovaha and MV Pulpaki

Many people from outer islands are living in the capital Tongatapu for working or for going school, and they travel to their home islands on summer holidays and on Christmas holidays. Accordingly, MV Olovaha and MV Pulpaki are busy in June and December, carrying passengers more than the licensed capacity. Vessels become busy also when big Christian conference is held in the outer island and many people travel to participate.

2. Study on the adequate passenger capacity for the Plan Vessel

There may be such case that all passengers have to be carried only by the Plan Vessel, due to the situation of MV Pulpaki, e.g. moving out from service in Tonga (as in August 2006) or retirement, thereby the passenger capacity of the Plan Vessel should be adequate for such extra demand.

Total number of passengers carried by MV Olovaha and MV Pulpaki in a week, as maximum in a year, is about 1,200 persons. Therefore, the least capacity of the Plan Vessel must allow transport of 1,200 passengers in 3 voyages in a week, i.e. 1,200 / 3 = 400 persons.

Table 2-2 Maximum and average number of passengers in a week, 2004 - 2006

	2004			2005			2006		
	Olovaha	Pulpaki	Total	Olovaha	Pulpaki	Total	Olovaha	Pulpaki	Total
Maximum	612	1,185	1,276	364	945	1,222	389	1,178	1,208
Average	112	425	382	109	363	457	135	371	394

Figures 2-3 to 2-5 below show voyage simulations for cases of passenger capacity 400, 350 and 300 persons, based on the actual number of passengers carried by MV Olovaha and MV Pulpaki on every week. When the number of passengers in a week exceeds the vessel capacity, such excess passengers are carried by 2nd and 3rd extra voyages. Red circle shows the case when 3 voyages cannot cover total number of passengers in that week.

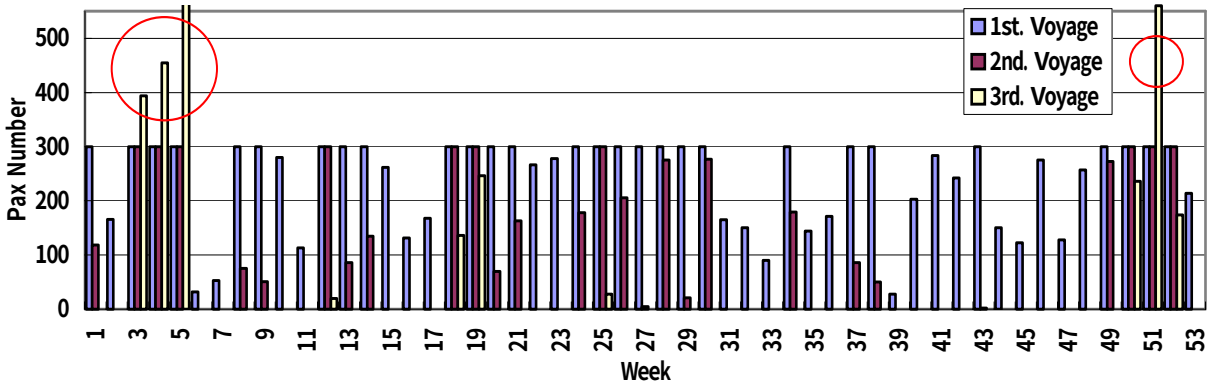


Fig. 2-3 Extra voyage simulation for the vessel capacity of 300 pax (based on 2006 record)

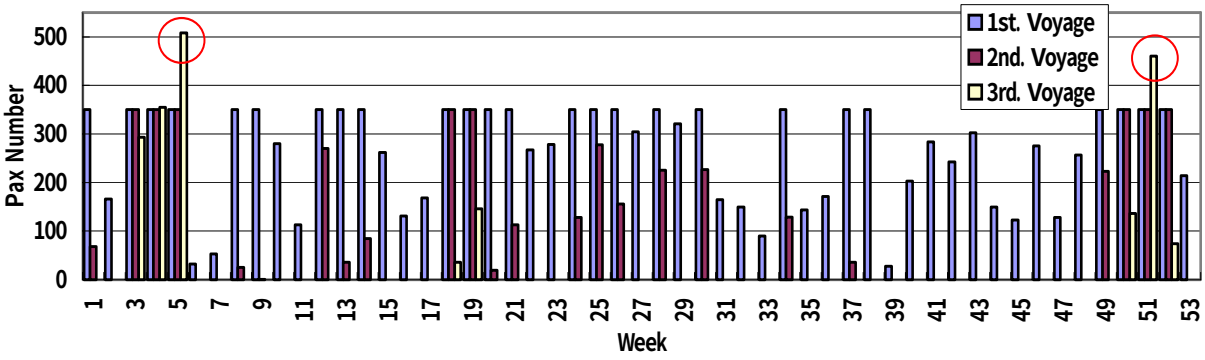


Fig. 2-4 Extra voyage simulation for the vessel capacity of 350 pax (based on 2006 record)

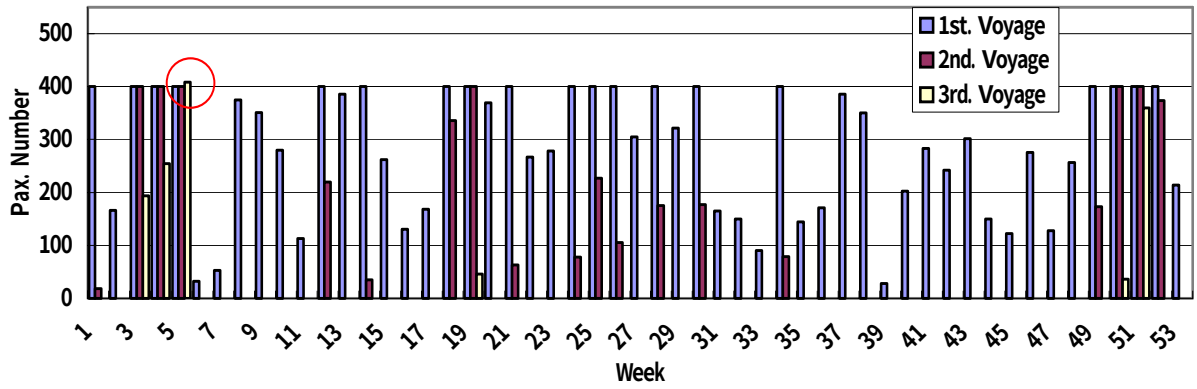


Fig. 2-5 Extra voyage simulation for the vessel capacity of 400 pax (based on 2006 record)

In the case of vessel capacity 400 pax, number of 3rd voyages is 6 times and excess passengers are only 8 in the 5th week, but in the case of vessel capacity 300 and 350 pax, there are much more excess passengers even conducting many 3rd voyages as follows.

Vessel capacity	400 pax	350 pax	300 pax
Number of 3rd voyages	6 times	6 times	10 times
Max. excess pax in a week	8 nos.	158 nos.	308 nos.

When excess passengers are few, those passengers may travel by air service or by extra ferry service or by next week service, but such big excess passengers as 100 persons cannot be compensated by alternative means available in Tonga.

According to above discussion, it is concluded that the passenger capacity of the Plan Vessel should be 400 persons.

3) Cargo Capacity of the Plan Vessel

1. **Cargo transport statistics**

Statistics of cargo transport, by MV Olovaha, MV Pulpaki and other vessels, in the sea routes between Nuku'alofa and outer islands, for the years 2003 to 2006 are as follows. Figures are sum of outward and homeward voyages.

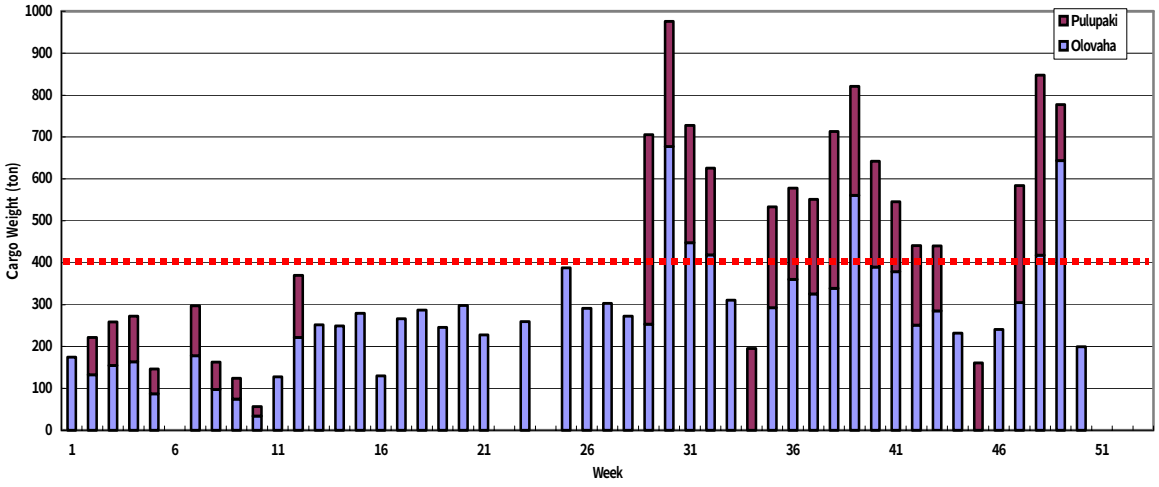
Table 2-3 Cargo transport statistics (metric tons), annual summary

Year	Sailing route	Nos. pax			Total
		Olovaha	Pulpaki	Other	
2003	Nuku'alofa – Ha'apai – Neiaf,	5,300	3,300	600	9,200
	Nuku'alofa – Ha'apai – Neiaf - Niuas	700	-	-	700
	Total	6,000	3,300	600	9,900
2004	Nuku'alofa – Ha'apai – Neiaf,	8,300	3,500	600	12,400
	Nuku'alofa – Ha'apai – Neiaf - Niuas	2,000	-	-	2,000
	Total	10,300	3,500	600	14,400
2005	Nuku'alofa – Ha'apai – Neiaf,	10,600	5,700	700	17,000
	Nuku'alofa – Ha'apai – Neiaf - Niuas	1,900	-	-	1,900
	Total	12,500	5,700	700	18,900
2006	Nuku'alofa – Ha'apai – Neiaf,	12,200	9,900	1,300	23,400
	Nuku'alofa – Ha'apai – Neiaf - Niuas	1,700	-	20	1,720
	Total	13,900	9,900	1,320	25,120

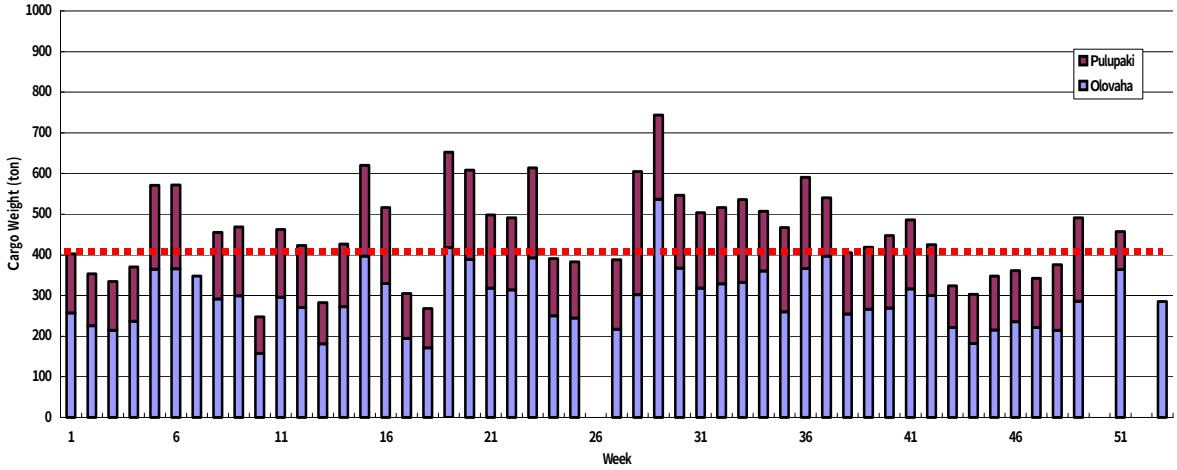
Cargo transport in the Nuku'alofa – Neiaf route is year by year increasing. About 60% has been carried by MV Olovaha, about 35% by MV Pulpaki and about 5% by other vessels.

Figure 2-6 below shows cargo transport statistics by MV Olovaha and MV Pulpaki in the years 2004 to 2006. Shown cargo weight is the heaver cargo weight either on outward voyage or on homeward voyage.

Year 2004



Year 2005



Year 2006

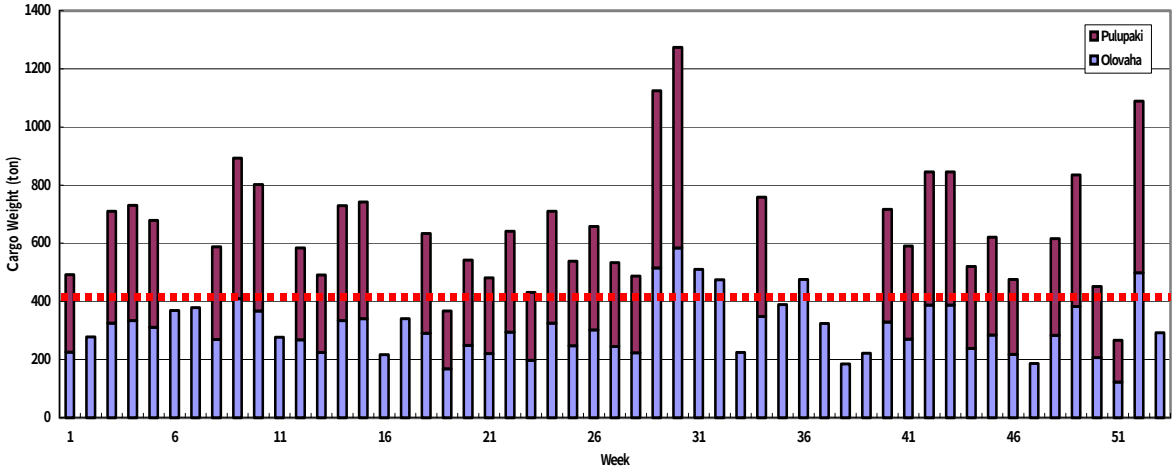


Fig. 2-6 Max cargo weight in every voyage of MV Olovaha and MV Pulpaki

2. **Study on the adequate cargo capacity for the Plan Vessel from the past statistics**

Using cargo statistics of 2004 to 2006, study to find out adequate cargo capacity of the Plan Vessel was made from a view of weekly simulation taking weekly fluctuation into account and also from a view of annual average full rate.

a) Study of weekly simulation taking weekly fluctuation into account

Table 2-4 shows the simulation to carry total cargoes of MV Olovaha on board vessel cases of 300 tons, 350 tons and 400 tons capacity, and on weekly fluctuation cases of 2004, 2005 and 2006 patterns. Among these cases, details of 2006 fluctuation pattern cases are shown on figure 2-7 to 2-9. Fluctuation pattern of weekly cargo amount is not very closely related to season as the case in passenger fluctuations, but has to do with individual constructions schedules in islands. In 2004 cargoes were concentrating in latter half of the year and in 2005 fluctuations were little.

According to this study, it is found that in cases of vessel capacity of 300 tons and 350

tons, 3rd voyages have to be very frequent (12 – 24 times annually occupying more than 30% of total voyage weeks), and excess cargoes unable to be carried in a week are large amount (maximum 275 tons exceeding capacity of one week considerably). Vessel cases of 300 tons and 350 tons capacity can cause large excess cargoes unable to be settled by next week voyages.

Table 2-4 Cargo operation by 300, 350 and 400 tons vessel cases

		Vesse lcargo capacity		
		300 t	350 t	400 t
2004 fluctuation pattern	Nos. 3rd voyages	18 (36%)	16 (32%)	14 (28%)
	Max. excess cargo	725 t	575 t	425 t
2005 fluctuation pattern	Nos. 3rd voyages	24 (45%)	12 (23%)	5 (9%)
	Max. excess cargo	81 t	0	0
2006 fluctuation pattern	Nos. 3rd voyages	21 (40%)	15 (28%)	8 (15%)
	Max. excess cargo	373 t	223 t	73 t

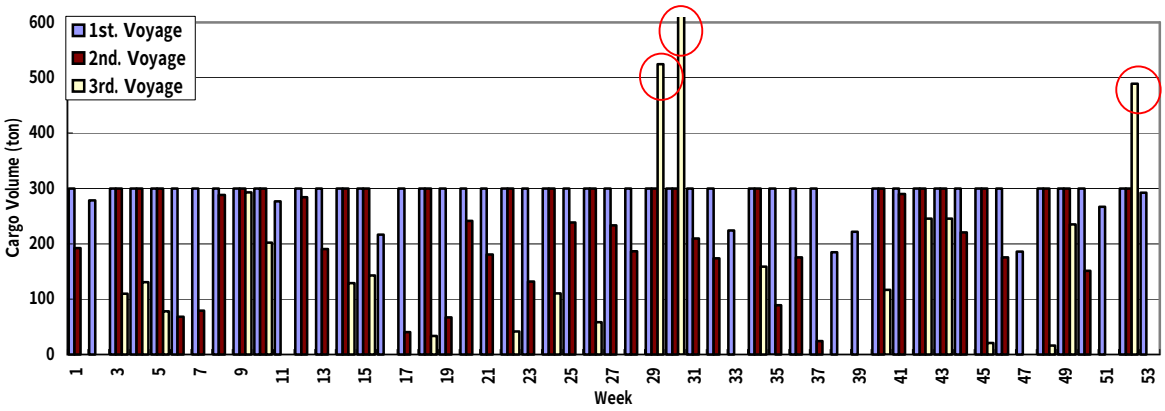


Fig. 2-7 Cargo operation with vessel capacity 300 tons under weekly fluctuation of 2006

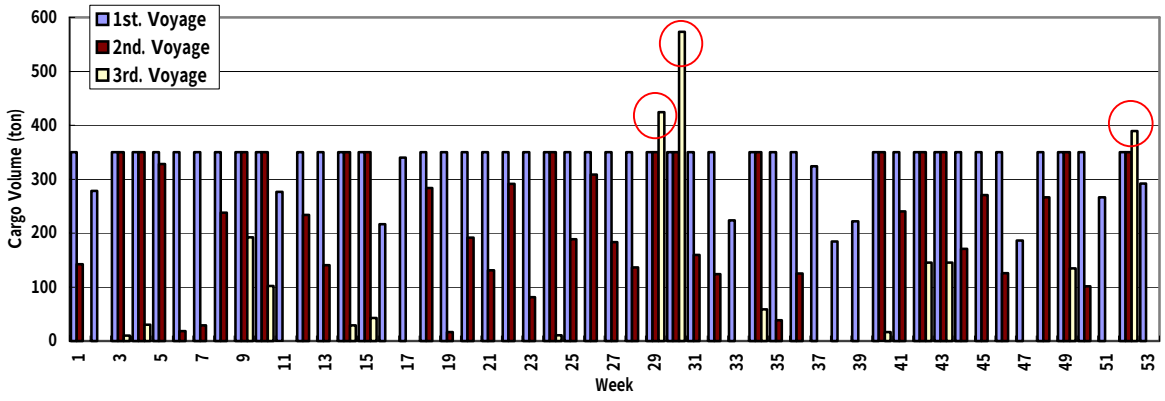


Fig. 2-8 Cargo operation with vessel capacity 350 tons under weekly fluctuation of 2006

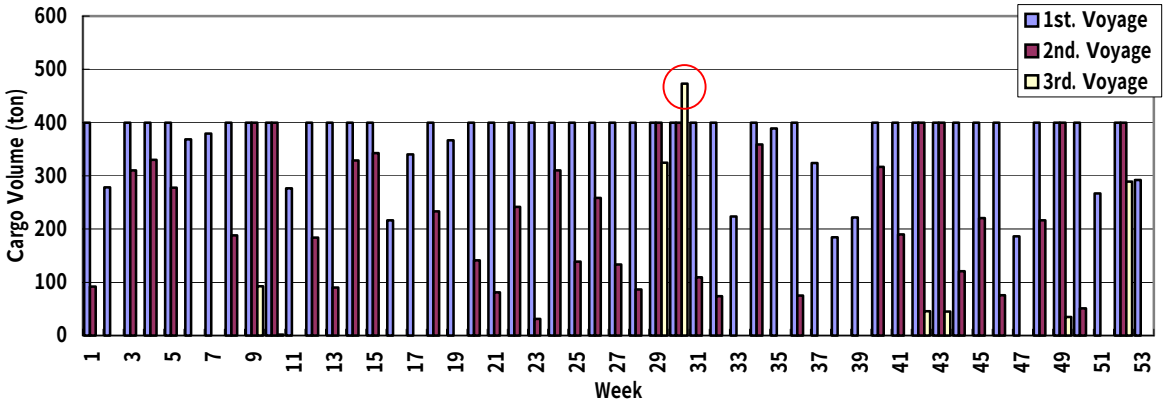


Fig. 2-9 Cargo operation with vessel capacity 400 tons under weekly fluctuation of 2006

In the 400 tons vessel capacity case, excess cargo is 73 tons appearing only in one week, which will be reasonably carried over to the next week. In the 300 tons and 350 tons capacity cases, amount of excess cargo is sometimes too large to be carried-over to the next week.

b) Study of annual average full rate

Annual average full rate (AAFR) carrying total cargo of the year 2006 (29.633tons = total of figure 2-7 to 2-9 in two voyages compared with the annual cargo capacity of the vessel (= vessel capacity x 53 week x 2 voyages) throughout in the year is as following.

Table 2-5 Vessel capacity and annual average full rate

Vessel capacity	Max. annual cargo capacity	2006 annual cargo	AAFR
300 t	31,800 t	29,633 t	93 %
350 t	37,100 t	29,633 t	80 %
400 t	42,400 t	29,633 t	70 %

High AAFR makes opportunity of frequent excess over the vessel capacity (refer to the Fig. 2-7 and 2-9), and further cannot suitably cope with future increase. It should be noted that sea cargoes tend to increase in Tonga.

3. **Study on the adequate cargo capacity for the Plan Vessel from future cargo demand**

Following is the study of cargo carrying simulation from 2007 to 2020 based on increased cargo demands. Amount of cargo used in this study is estimated from the statistic of MV Olovaha, i.e. the Plan Vessel and MV Pulpaki work together taking same share to carry cargoes as before.

Figure 2-10 below shows tendency of increase of cargo carried by MV Olovaha.

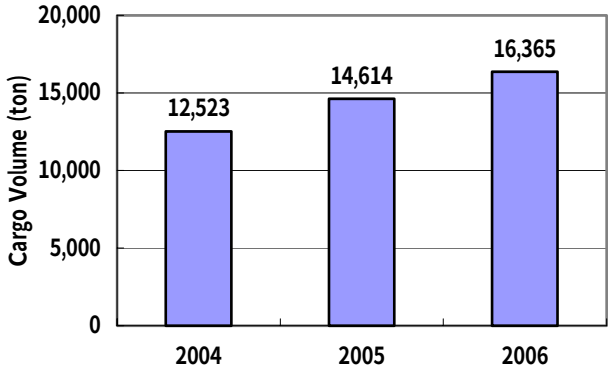


Fig. 2-10 Increase of cargo carried by MV Olovaha

Cargoes carried by MV Olovaha have been increasing steadily. As the Strategic Development Plan 8 (2006/7 – 2008/9) of the Government of Tonga urges development of resorts in Vava'u and other islands, increase of transporting construction materials for resorts is probable. When resort is completed and tourists increase, the transport of material to run the resort will be steadily added.

Assuming that cargoes increase linearly as before, the Plan Vessel has a cargo capacity of 400 tons, and cargo fluctuation pattern is same as that of 2006, then the services of the Plan Vessel on and after 2007 are estimated as follows.

Table 2-6 Plan Vessel services on and after 2007

Year	Annual cargo (t)	Number of 3rd voyages in a week for the year	Cargo in excess of vessel capacity (t)	Number of weeks of excess cargo	Annual average full rate (%)		
					1 voyage in a week (53 voy.)	2 voyages in a week (106 voy.)	3 voyages in a week (159 voy.)
2007	18,444	0	0	0	87	43	29
2008	20,352	0	0	0	96	48	32
2009	22,260	0	0	0	105	52	35
2010	24,168	1	0	0	114	57	38
2011	26,076	3	0	0	123	61	41
2012	27,984	6	0	0	132	66	44
2013	29,892	6	0	0	141	70	47
2014	31,800	6	0	0	150	75	50
2015	33,708	8	2	1	159	80	53
2016	35,616	13	71	1	168	84	56
2017	37,524	14	139	1	177	89	59
2018	39,432	19	208	3	186	93	62
2019	41,340	19	284	4	195	98	65
2020	43,248	24	892	6	204	102	68

In the table 2-6 above, annual average full rate (AAFR: percentage of cargo amount in the maximum annual cargo carrying capacity (= 400 tons x 53 weeks x 1-3 voyages) is shown. In the busy seasons, arrangement to deal with excess cargoes over the vessel capacity, i.e. to carry before and after that week, will be necessary, but there will be no room to make such arrangement when AAFR has become high.

When only one voyage in a week is continued, AAFR becomes high at 87% in 2007, and becomes over 100% in 2009, unable to complete cargo demand even if all voyages have full cargoes. Even when the Plan Vessel undertakes two voyages throughout the year, AAFR becomes high at 80% in 2015. Three voyages in a week as a regular timetable may be difficult in Tonga (Sunday involved), but 3rd voyage should be flexibly conducted when large amount of cargo has to be carried.

Figure 2-11 and 2-12 below shows detail of years 2012 and 2020 in the table 2-6. Total amount in every week is equal to (week amount in 2006) x (2012 or 2020 annual amount) / (2006 annual amount).

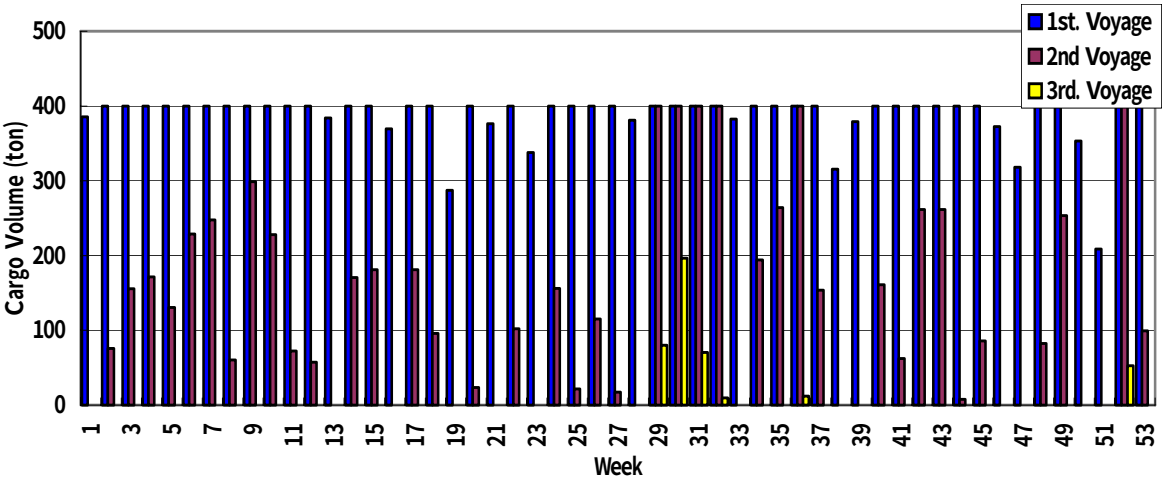


Fig. 2-11 Simulated cargo operation in 2012

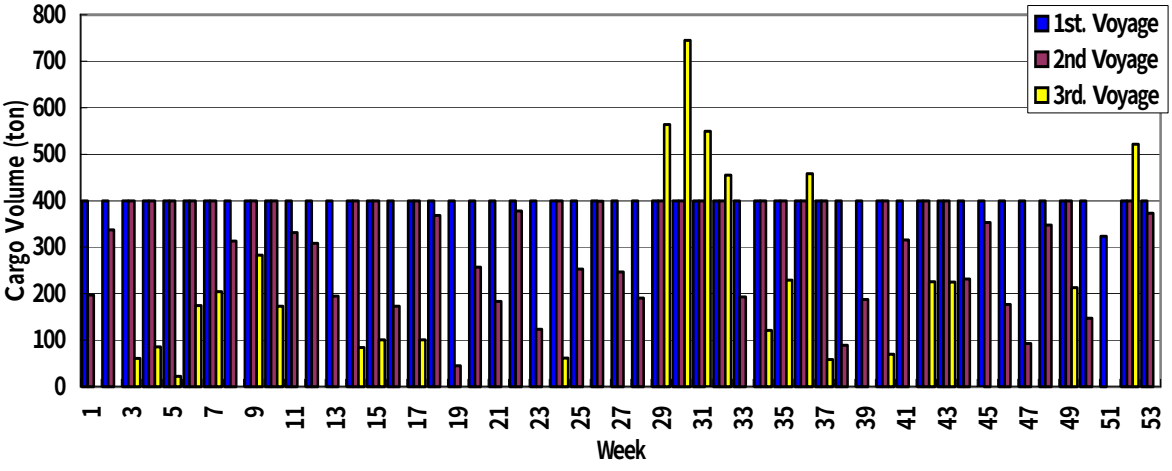


Fig. 2-12 Simulated cargo operation in 2012

Above figures show that 3rd voyages are necessary 6 times in 2012 and about half of entire weeks in 2020.

From above study considering cargo increase in future demands, it is concluded that cargo-carrying capacity of the Plan Vessel should be 400 tons.

4) Deadweight

Cargo carrying capacity 400 tons on board the Plan Vessel was decided from the cargo statistics of MV Olovaha. MV Olovaha's deadweight capacity is, however, only 250 tons. MV Olovaha has been obliged to carry excessive cargoes on over-draft regularly. 400 tons as the actual cargo demand, on over-draft though, must be considered on the Plan Vessel capacity, but the over-draft must be avoided in the Plan Vessel design.

The deadweight capacity of the Plan Vessel should be 520 tons, which comprise 400 tons cargo weight plus weight of passengers, fuel oil, fresh water, etc. The Plan Vessel must have such sufficient buoyancy as to support weight of the hull plus 520 tons deadweight on a draft not exceeding approved draft mark.

5) Deciding size of the hull from deadweight capacity

The Plan Vessel must have a deadweight capacity of 520 tons as stated above. Procedure to decide size of the hull is the iteration of following.

Deadweight = Displacement at max. draft – Light ship weight

Displacement at max. draft = Length x Breadth x Draft x 1.025 (seawater density) x Block coefficient (Cb)

Light ship weight = function of [Length; Breadth; Depth; Outfitting; Other weight data]

Draft = function of [Depth; Layout of watertight bulkhead; Stability in damaged condition]

Speed = function of [Displacement at max. draft; Length; Cb; Engine horsepower; water resistance, Propeller efficiency]

Large block coefficient (Cb) makes water resistance higher and thereby speed performance worse, where small Cb makes hull bigger to obtain required deadweight capacity.

Size of the hull was decided setting economical speed at 11.5 knots as follows.

Table 2-7 Comparison of the Plan Vessel, MV Olovaha and original request

Designs / Item	Existing vessel MV Olovaha	Original request	The Plan Vessel
Length overall	48.91 m	≤ 55 m	53.00 m
Length bp	43.50 m		48.00 m
Breadth, molded	11.00 m	≤ 12 m	13.50 m
Depth, molded to main deck	3.60 m	≤ 4.5 m	4.30 m
Draft, molded	2.40 m	≤ 3.5 m	3.00 m
Deadweight	250 t		520 t
Gross tonnage	955	1,430	1,500
Passenger capacity	340 p	300/400 p	400 p

Item \ Designs	Existing vessel MV Olovaha	Original request	The Plan Vessel
Cargo weight	200 t[3]	200/300 t	400 t
Service speed	9 knot	15 knot	11.5 knot
Crew	28 p		22 人
Main engine	701kW(950 ps)x 2		735kW(1,000 ps)x 2

6) Restriction on the main dimensions

1. **Gross tonnage**

Threshold of gross tonnage 1,000 makes difference on the scale of deck officer license.

Gross tonnage	Captain	First Mate	Second Mate
< 1,000	Class 4 Captain	Class 4 Mate	—
≥ 1,000	Class 3 Captain	Class 3 Mate	Class 4 Mate

If Class 3 Captain is not easily available, then hull has to be so designed as to avoid gross tonnage above 1,000.

However, there are 21 Class 3 Captains registered in Tonga, thereby employment of Class 3 Captain is not difficult. Accordingly restriction on the gross tonnage need not be considered on the design of the Plan Vessel.

2. **Restriction on the vessel length**

Length overall 60m is, in crewing and certificate, dealt with same as 1,000 gross tons.

Under-water length of a vessel is sometimes restricted in some narrow basin. It is found, however, no such narrow basin in the ports of call for the Plan Vessel, and thereby no limitation on the length of the vessel need be considered in fact.

3. **Restriction on the vessel breadth**

Width of the wharf ramp, on which vessel ramp lands, is limited in Nuku'alofa wharf and Neiafu wharf of Vava'u island, thereby width of the Plan Vessel can be restricted.

However, Tongan Government confirms that the wharf ramp be widened under the responsibility of the Tongan Government before the Plan Vessel enters into service, thereby the Plan Vessel can be designed with no restriction on the vessel breadth and the vessel ramp.

4. **Restriction on the vessel draft**

Water depth of Ha'afeva wharf is close to the maximum draft of the Plan Vessel.

However, Tongan Government confirms that the waterway be dredged to about 4 m under the responsibility of the Tongan Government before the Plan Vessel enters into service, thereby the design draft of the Plan Vessel should be maintained.

[3] Estimated from the total deadweight capacity of 250 t. MV Olovaha has been usually carrying cargo weight over the permissible draft.

5. **Restriction on the vessel air draft (height above waterline)**

No restrictions.

6. **Restriction on the vessel main engine horse power**

Threshold of certain engine horsepower makes difference on the scale of engineer officer license.

	Chief Engineer	Second Engineer	Duty Engineer
750kW≤Horsepower<3,000kW	Class 2	Class 3	Class 4
450kW≤Horsepower<750kW	Class 3	Class 4	—

In the Plan Vessel, main engine horsepower is about 1,500 kW (total of two engines), thereby the required scale of engine officer can be same as those on board MV Olovaha, and further there are 15 Class 2 Chief engineers registered in Tonga. Accordingly, it is concluded that restriction on the engine horsepower need not be considered.

(2) Rules to Apply and Classification Society

1) Rule to apply

For vessels engaging on international voyage, various international convention rules including SOLAS Convention are imposed. For vessels of domestic service, no such international convention rules are imposed (except for certain rule, e.g. COLREG and MARPOL), but safety regulations laid down by the individual national administration apply instead. Finding that Safety regulation system for domestic vessels was not sufficiently developed in Tonga, discussion with Tongan Administration concluded that the Japanese maritime regulations for the domestic passenger vessels should apply in general. NK Classification is appointed to inspect and issue certificate on behalf of the Tongan Government in this Project case. At the sea trial of the Plan Vessel, Tongan Administration officer inspect the Plan Vessel and issue Provisional Certificate of Nationality, which is compulsory for vessels to sail from Japan to Tonga.

Tongan Government has become a member country of IMO in 2000, and ratified a number of international regulations, among which, those regulations applicable to the Plan Vessel will be applied as far as possible.

Consequently, following rules and regulations should apply to the Plan Vessel.

a. Tongan maritime Regulations
b. Japanese Maritime Regulations
c. Rules of the Classification Society

d. International Convention on Tonnage Measurement of Ships, 1969
e. International Convention for Load Lines, 1966
f. International Conference for Preventing Collision at Sea, 1972
g. International Convention for Preventing Pollution from Ships, 1973
(Oil pollution, sewage pollution and air pollution)

2) Classification

Tongan Government entrusts inspection of the Plan Vessel during construction on behalf of the Tongan Government to NK Classification Society as a third party authority. When the Plan Vessel has completed, classification certificate needs be obtained from the NK Classification. Tongan Government will confirm the classification certificate, accept registry into Tonga and issue Certificate of Nationality.

Even after completion of newbuilding inspection, NK Classification should be maintained through periodical inspection, to maintain and ensure safety level of the vessel.

Classification certificate is important also for insuring the vessel. Existing vessel MV Olovaha has been maintaining Germanischer Lloyd (GL) Classification since newbuilding in 1981 in West Germany, but could not pass GL inspection in 2001 and has been removed from the GL Classification since then. MV Olovaha is now working under unsafe condition and obliged to pay high insurance premium.

Maintenance of the Classification is the outcome of the daily maintenance. Support from SCP workshop working on the Preventive Maintenance Policy will be important.

(3) Sub-division and stability

The Plan Vessel, as a passenger vessel, is required to be stable without any part of the bulkhead deck (vehicle deck) edge being immersed, after flooding in any watertight compartment by running aground or by collision. Design of a passenger vessel has following special features in general.

a. To limit amount of flooding water, watertight compartment under the bulkhead deck must be sub-divided into small compartments.
b. Accordingly, engine room has to be sub-divided into main engine room and generator room, and accommodation areas cannot be large compartments.
c. Vertical distance from the load waterline to the bulkhead deck (freeboard) must be deep enough as a reserve buoyancy to cope with capsizing due to flooding.
d. Therefore, the load water line cannot be made deeper. Hull is large but displacement is relatively small and thereby deadweight capacity is relatively small.
e. To be sufficiently stable even after hull damage and flooding, high stability (large GM) is

required in the intact conditions.

f. Accordingly, in the normal sailing condition, stability characteristic is rather at excessive GM side. Rolling period is short and rolling amplitude tends to be large. Onboard people may feel fast acceleration due to fast rolling.

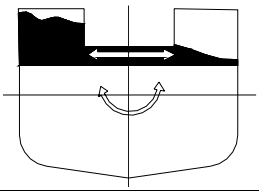
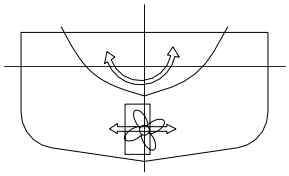
(4) Rolling Motion

The Plan Vessel navigates in the open sea, where annual average wave height is 2.16 m [4], equivalent to the average 2.20 m in the Pacific Ocean near Japan. As large passenger ferries sailing in the offshore seas around Japan are easily suffered from severe rolling, almost all ferries are fitted with positive means of roll reduction. Rolling motion of MV Olovaha is severe in the open and heavy seas, but no positive means of roll reduction is installed and passengers are suffered from seasickness.

Rolling motion of the Plan Vessel can easily be up to 30 degree (to either side) in the amplitude, and accordingly rolling acceleration is high, which had become severer due to high GM (metacentric height). Considering wave statistics and high GM of the Plan Vessel, it is concluded that a positive means of roll reduction should be installed on board the Plan Vessel.

There are several means of roll reduction.

Table 2-8 Positive means of roll reduction

System	Anti rolling tank	Fin stabilizer	Rudder roll stabilizer
			
Working principle	Movement of free water is so tuned as to reduce rolling.	Angle of wing, fitted at bilge corners, is so controlled as to reduce rolling.	Rudders are so controlled as to reduce rolling.
Roll reduction	About 30% less	About 50% less	About 40% less
Price	About USD 80,000	About USD 800,000	About USD 65,000
Advantage	Effective when vessel stops	Most effective	Small place to install Reasonable effect
Disadvantage	Large place to install Heavy weight Narrow in effective range	Large place to install Not effective when vessel stops	Not effective when vessel stops
Decision	Not suitable	Not suitable	Suitable

[4] Wave height statistic measured by microwave height sensor on Satellite GEOSAT and TOPEX/POSEIDON

It is concluded that the rudder roll stabilizer is suitable for the Plan Vessel from view of system size, cost and effectiveness.

(5) Maneuverability

The Plan Vessel is a ferryboat type, with large windage area and small underwater area, which is easy to drift laterally by the wind from shipside. Good maneuvering characteristics in the vessel itself and careful operation are important for this kind of vessels, especially navigating in a narrow water channel and maneuvering for wharfing.

The graph below shows accumulated wind probability statistic. Probability of 20 knots (10.3 m/s) and over, which requires tug assistance, is low at 2.2 %. Probability of 17 knots (8.7 m/s) and over, which requires careful operation, is rather high at 12.7 %.

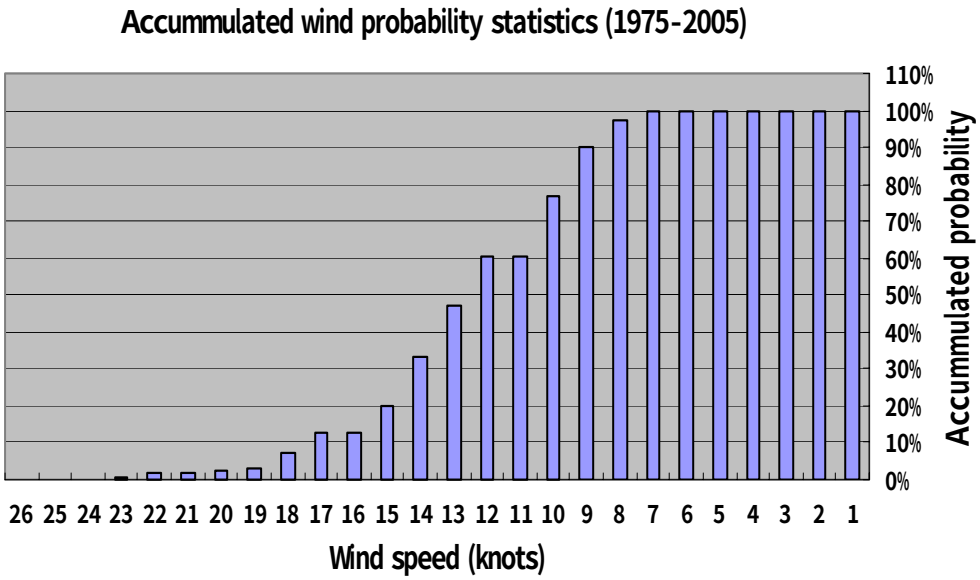
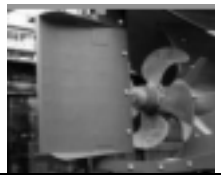


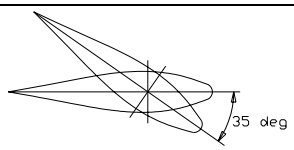
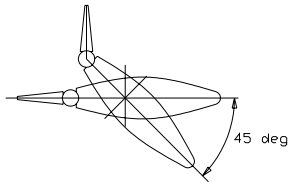
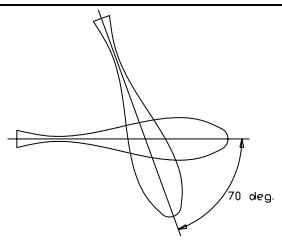
Fig. 2-13 Accumulated wind probability statistic

In the wharf of homeport Nuku'alofa, there are usually many vessels moored next to the SCP wharf. Control of stern part by efficient high lift rudders and control of bow part by a bow thruster efficiently are necessary for Captain's operation in approaching the wharf.

There are two kinds of high lift rudders, i.e. flap rudder (Becker type) and fish tail (Schilling type). Fish tail type, which has no moving underwater mechanism, will be better for the Plan Vessel.

Table 2-9 Rudder types

Type of rudders	Ordinary type	High lift rudder with flap	High lift rudder of fish tail section
			

Working principle	 Rudder blade fitted to the rudder shaft, steerable to 35 degrees to either side.	 Fitted with flap at tail end of the rudder. The flap moves to larger angle than main rudder section by the mechanism fitted at top of rudder.	 Having special fishtail section, and moves 75 degrees to either side. Fish tail section does not stall until large angle.
Price	About USD 60,000	About USD 80,000	About USD 80,000
Advantage	Low price No underwater mechanism	High lift	High lift No underwater mechanism
Disadvantage	Low steering force	Underwater mechanism	Steering gear to steer large angle
Conclusion	Not suitable	Not suitable	Suitable

Bow thruster is used mainly in the berthing operation. The Capacity of the bow thruster should be so determined that the vessel can be laterally moved at about 0.15 m/s against wind of about 9 m/s.[5]

According to these operation criteria, the Plan Vessel needs a bow thruster of about 15kN lateral thrust. Electric motor to run the bow thruster will be about 100 kW, which can be fed from the two main generators of 250 kVA running in parallel.

Fig. 2-14 Bow thruster

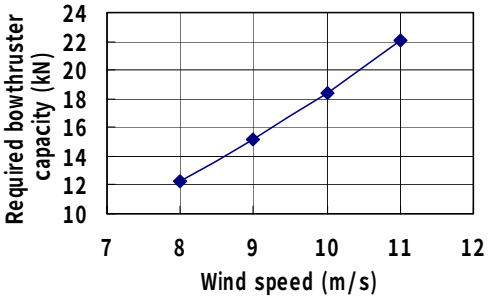


Fig. 2-15 Required capacity of bow thruster

(6) Speed

MV Olovaha can only run at about 9knots due to aged engine and hull, and passengers comment “slow”.

Whereas original request refers to high speed, i.e. maximum speed of 19 knots and cruising speed of 15 knots, it is found that the service speed of the Plan Vessel should be 11.5 knots,

[5] General criteria of bow thruster for ordinary vessel for maneuvering in ports: Against wind force of 9 m/s which is the maximum for not asking tug assistance, hull must be moved laterally at a speed about 0.15 m/s, equivalent to mooring rope speed.
For offshore working vessel, e.g. anchor handling supply vessel, severer criteria are applied.

which corresponds to the Froude's number 0.27 before wave making resistance has become predominant, and that the main engine power need be two sets of 735 kW (1,000 ps).

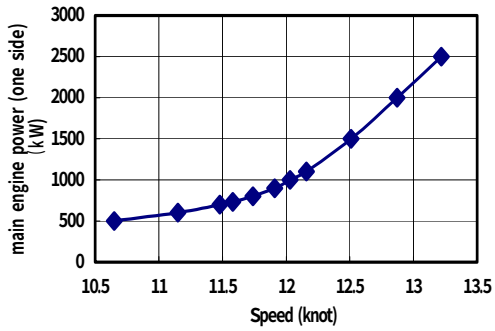


Fig. 2-16 Service speed vs. Main engine power

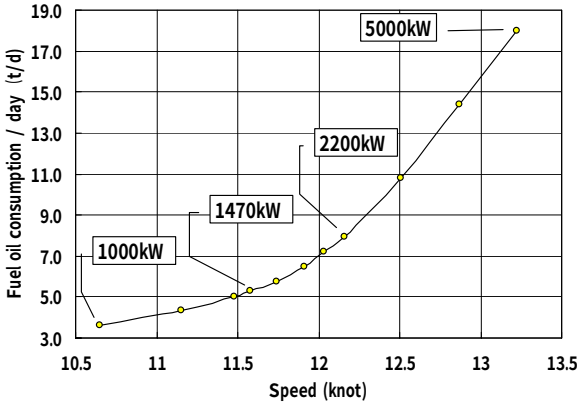


Fig. 2-17 Service speed vs. fuel oil consumption

(7) Main Engine

Table 2-10 shows comparison of one-engine one-shaft and two-engine two-shaft propulsion systems. Emergency single engine get-home possibility and superior in maneuverability are important advantage in the operation of the Plan Vessel.

Table 2-10 Propulsion system

	Item	One-engine one-shaft	Two-engine two-shaft
1	Speed	Base for comparison	A little better
2	Fuel oil consumption	Base for comparison	A little better
3	Maneuverability	Base for comparison	Better
4	Redundancy (in emergency)	Stop by engine failure	Continue running by single engine
5	Maintenance cost	Base for comparison	A little higher (many parts)
6	Familiarity of crew	Unfamiliar	Familiar
7	Building cost	Base for comparison	Higher

Original request from the Tongan Government refers to IFO180 as the fuel oil for the main engine. IFO180 is, however, heavy fuel oil, which is like grease in the normal temperature requiring heating to fluidize. To heat fuel oil, boiler and associated fuel oil treatment system are necessary, but normal engineers are not familiar with such heavy fuel oil handling system. It is concluded, therefore, ordinary diesel fuel oil is suitable for the Plan Vessel.

Propellers should be of solid fixed pitch, which is same as MV Olovaha's and SCP crews are familiar with, whereas controllable pitch propeller is better in maneuverability, but costly in maintenance.

Type of the main engines should not be high speed multi-cylinder type like MV Olovaha's but should be of a reliable and maintenance friendly type running at 1,000 rpm or less and 6 cylinders, and besides should be of a type with good fuel economy.

(8) Accommodation

1) Passenger accommodation

Styles of the passenger accommodation (bed, sitting floor, chair) were studied as follows.

[Opinion of passengers on board MV Olovaha]	[Actual condition of MV Olovaha]	[Accommodation regulation, Japan]
Like to sleep lying on bed or on floor.	Long benches are arranged. Passengers lay down on benches and on passages at night.	Travel hours ≥ 24 h: Bed or floor Travel hours < 24 h: Bed, floor or chair

In the sailing route [Nuku'alofa – Ha'afeva – Pangai – Neiaf – Niuafo'ou – Niuatoputapu], between Nuku'alofa and Neiaf takes about 24 hours (1 night two days), and between Nuku'alofa and Niuafo'ou takes about 70 hours (3 nights 4 days). Passengers between Nuku'alofa and Ha'afeva/Pangai need not stay overnight, but most of passengers must stay overnight.

[Policy of the Plan Vessel]

1. For overnight passengers, sitting floor room is suitable → To arrange sitting floor room of about 300 pax capacity
2. For short voyage without overnight, chair is suitable → To arrange chair room of about 100 pax capacity
3. For sick people and VIP, small bed cabins are necessary → To arrange 2 rooms each with 2 beds.

To determine passenger capacity of sitting rooms, standard of Japanese regulation: 1.0 m^2 for one person should apply.

Space under the main deck, forward of the engine room, should be used for passenger space, but such passenger spaces under main deck are minimized considering that some Tongans may not prefer staying on tank top.

Considering length of voyage, food supply facility should be provided on board the Plan Vessel. However, as many passengers take their own food with themselves, the food supply facility should be just kiosk selling dry snacks, instant noodles, drinks, and the like.

Funeral is the very important custom in Tonga. There can be several funeral parties with

casket on board the Plan Vessel at once. For funeral party to sit around the casket, passenger space should be fitted with curtains to separate from other passengers. Curtains should be arranged for maximum three parties. Onboard crane will lift casket, and door to pass the casket should be wide enough.

Toilets and showers should be provided at a standard according to the Japanese regulation.

2) Crew accommodation

The Plan Vessel will be manned by 22 crew members taking into consideration of improved cargo handling efficiency in the Plan Vessel, whereas MV Olovaha is currently manned by 28 crew members.

Table 2-11 Crew on board the Plan Vessel (same as MV Olovaha)

Deck part	Machinery part	Catering part
Captain	Chief Engineer	Purser
Chief Mate	2nd Engineer	Chief Steward
2nd Mate	3rd Engineer	Canteen Manager
Boatswain	Motorman (3)	Cook
Ordinary Seaman (5)	Oiler	Assistant Cook (2)
Total 9p	Total 7p	Total 6p
Grand total 22 p		

Single cabin for the captain and chief engineer, four cabins each with two bunks for officers, and a large room with bunks for others will be provided.

Galley, mess room, toilets and showers will be provided for crew.

(9) Cargo Operation System

1) Shore facility

Cargo hold, deck cargo space, RoRo (roll-on-roll-off) gears, LoLo (lift-on-lift-off) gears of the Plan Vessel should adapt to the wharf facilities.

Wharf facilities of each port are as follows.

Port	Nuku'alofa	Ha'afeva	Pangai	Neiafu	Niuafo'ou	Niuatoputapu
Quay Facilities	RoRo+LoLo	RoRo	RoRo+LoLo	RoRo+LoLo	No wharf Lighter operation	RoRo

The Plan Vessel should be fitted with a stern ramp for RoRo operation and two cranes for LoLo operation.

To allow discharging of deck cargoes even in the wharf without LoLo berth (Ha'afeva and Niuatoputapu), cargo crane should be so arranged as to land deck cargoes on the RoRo ramp.

2) Carriage of various cargoes

Kind of packing for various cargoes will be as follows.

Table 2-12 Kind of cargoes and their style

Kind of cargoes	Packing
Break bulk cargoes	Stowed in container
Bagged cement, flour, sugar, etc.	Stowed in container
Bulky cargoes, long cargoes	Bundled, stowed on deck
Dangerous goods (oil drum and gas bottle)	Stowed in existing open container, stowed on exposed deck[6]
Vehicles: car, truck, bus	Drive-on into cargo hold
Heavy industrial vehicle	Drive-on into cargo hold with necessary dunnage under
Reefer cargoes	Stowed in reefer container
Livestock	Stowed in existing open container with nets around

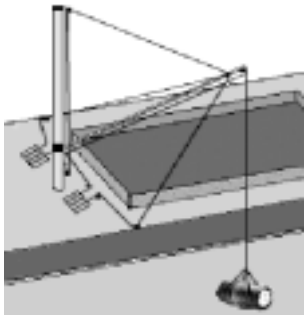
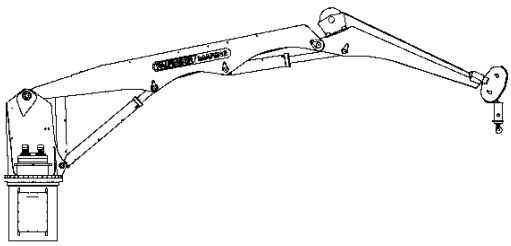
3) Crane

Crane should be installed for cargo handling and cargo hatchcover open/close. The crane should be two sets for efficient operation and to cope with the case one set being out of order. The crane should be of safe working load 6 tons to handle max. weight of container 6 tons.

ISO 10' container (10 tons max.) may have to be carried on board the Plan Vessel. Such 10' containers will be handled by two cranes working together using common beam.

It is concluded that the knuckle boom crane is suitable for the Plan Vessel according to the following.

Table 2-13 Cargo gears

Kind of gears	Derrick boom	Knuckle boom crane
Example		
Skill to operate	Require skill for setting derrick booms at a position.	Easy to operate

[6] To carry oils in drum and gas cylinders, fire extinguishers and fire fighters' outfit should be complete according to international regulations to carry dangerous goods on board vessels.

Kind of gears	Derrick boom	Knuckle boom crane
Efficiency in operation	Working radius cannot be easily changed. Cargoes scattered in wide area are difficult to handle.	Working radius can be easily changed so that cargoes scattered in wide area can be reached and lifted easily.
Mechanism	Simple system.	Complex mechanism (There are many truck cranes of similar type. Maintenance is possible in Tonga.)
Stability of lifted cargo	Cargo hook is stable (in the union purchase operation)	By lowering jib end, cargo hook becomes stable.

4) Stern ramp

Stern ramp of following specification should be installed to allow vehicle access into the cargo hold.

Table 2-14 Specification for stern ramp design

Item	Specification
Permissible load	Forklift lifting 6 tons container
Width of ramp	5.5 m as the width of the stern entrance opening. Structural width of the ramp will be about 5.8 m. 5.5 m width allows passage of two forklifts (one with container: 2.44m width, and the other without container: about 2 m width) with 0.35 m clearance between forklifts and between forklift and gate side.
Length	7.0 m including flap of about 1 m, adapting various wharf ramps.
Mechanism	Open/close by steel wire operation or direct oil hydraulic cylinder operation. Watertight wedge operation by oil hydraulic cylinder operation.

5) Cargo hatch

Cargo hatch should be sized 6.0 m length x 2.8 m width to allow passage of container (plan dimension of 2.44m x 1.83m) and medium size truck (plan dimension of about 5m x 1.9m).

Hatchcovers will be steel pontoon with two layers of tarpaulin on top for weathertightness.

Crane handles hatchcovers.

6) Lighter operation

Niuafo'ou Island has no berthing facility. Lighter boat works between the inter-island vessel and the island beach carrying cargoes and passengers. Niuafo'ou island beach is very sensitive with swells. Even by 1.5 m high swell, the lighter is difficult to approach the beach. It is found not practical to look for solution in the design of lighter, but some fundamental

countermeasures are necessary at the island's side. The existing lighter itself is found good condition, possible to continue to use. Lighter operation should be continued as it has been so far.

(10) Fuel Oil Tank

Mileage of the farthest inter islands service, to the Niuas islands route, is about 855 sea miles, for which net steaming days by the Plan Vessel will be about 3.2 days consuming fuel oil about 20 k.liters. The Plan Vessel, however, must run about 4,550 sea miles taking about 17.5 days consuming about 117 k.liters for maiden voyage from Japan to Tonga.

From the safety requirement, the Plan Vessel must have double bottom, which has ample tankage capacity for necessary oil and water for the Plan Vessel, i.e. fuel oil necessary for the voyage from Japan to Tonga can be covered.

Fuel oil consumption of the Plan Vessel will be as follows.

Main engine FOC/day = M/E power^{kW} x Load rate x Specific FOC rate $^{kg/kW/h}$ x 24^{h} x 10^{-3}/FO density$^{kg/lit}$ =

1470 x 0.70 x 0.190 x 24 x 0.001/0.86 = 5.46 k.lit/day

Genset FOC/day＝Genset power^{kW} x Load rate x Specific FOC rate $^{kg/kW/h}$ x 24^{h} x 10^{-3}/FO density$^{kg/lit}$ =

220 x 0.55 x 0.200 x 24 x 0.001/0.86 = 0.68 klit/day

Total fuel oil consumption/day = 6.14 k.lit/day

Fuel oil consumption for one Niuas round trip = 6.14 k.lit/day x 3.5 days = 20 k.liters

Fuel oil consumption from Japan to Tonga = 6.14 k.lit x 19 days = 117 k.liters

The Plan vessel should have fuel oil tank of about 120 klit, which covers Japan / Tonga voyage and some allowance.

(11) Fresh Water Tank and Water Maker

Facility of water supply to the Plan Vessel in the homeport Nuku'alofa is sufficient. Deadweight capacity of the Plan Vessel is, however, so limited that full quantity of fresh water cannot be carried. To compensate necessary fresh water consumption, mainly for shower consumption, water maker should be installed on board the Plan Vessel.

Standard fresh water consumption is about 4.5 lit/day for drinking: about 40 lit/day for shower and washing. Table 2-15 is the estimate of the fresh water consumption and necessary water maker capacity in the Vava'u route of 2 days steaming and Niuas route of 5 days steaming.

Table 2-15 Fresh water consumption and necessary water maker capacity

Route	Nuku'alofa – Vava'u	
Nos. persons on board	422	
Duration (days)	2	
Consumption by drinking (t)	3.8	
Consumption by shower (t)	22.5	2/3 of onboard people use shower
Total consumption (t)	26.3	
Water filling in Nuku'alofa (t)	10	
Water produced by water maker (t)	16.3	
Capacity of water maker (t/day)	8.2	

From above, it is concluded that the water maker should have a capacity of 8 tons/ day.

There are two types in the water maker: vacuum evaporation type and reverse osmosis type. The former utilizes waste heat of diesel engines but only 1 ~ 2 tons is available. The latter, reverse osmosis can produce water required by the Plan Vessel not depending on waste heat. The Plan Vessel should use reverse osmosis type water maker.

(12) Navigation Equipment

Common navigation equipment, including those required by the regulations, e.g. magnet standard compass, gyro compass (or GPS compass), radars (2 sets), GPS, plotter with GPS, echo sounder, Doppler speed log, etc. should be installed on board the Plan Vessel.

(13) Radio Apparatus

Vessels are fitted with safety radio apparatus working on VHF, MF or HF, and they are used for daily business communication. GMDSS (Global Maritime Distress and Safety System) regulation specifies details of the radio apparatus on board vessels for different sea areas and shore stations. Shore station of Tonga is, however, still conventional system not on GMDSS. It was confirmed that the sea area of the Plan Vessel be A1 + A2 and installation of NAVTEX, whose broadcasting is not available in Tonga, be exempted.

(14) Electric Generator

Electric generator should be of common configuration, i.e. two main diesel generators and one harbor use diesel generator. Capacity of the main generators should be 250 kVA taking into consideration of all electric consumers during navigation, cargo handling, etc. Electric

frequency should be 50 Hz, same as Tongan power supply ashore.

(15) Anti-Pollution Measures

Tongan Government ratifies MARPOL Convention (International Convention for Preventing Pollution from Ships, 1973), thereby the Plan Vessel should install followings.

Against oil pollution:	Oily water separator to stop discharging oily water
Against sewage pollution:	Sewage collecting tank to stop discharging sewage in the harbor
Against air pollution:	NOx emission controlled diesel engines

(16) Material

Important ground to repair and maintain vessel's hull is the electrolysis action to rust steel material in contact with seawater. Especially, rusting inside seawater pipes grow quickly and accounts for great part of the repair cost even in the young vessels.

In the Plan Vessel, all seawater cooling pipes of steel should be plastic-coated at inside surface, allowing vessel engineer free from trouble on rusting of seawater pipes. Plastic pipes should be used for fresh water pipes in the areas outside engine room.

2-2-2-2 Basic plan of the Equipment

(1) Weighing Equipment

Nuku'alofa and other wharves have no means to measure weight of cargoes, thereby cargo management relies on weight from estimate except for bagged cargoes indicating weight on bag.

Understanding importance to manage cargoes on reliable weight basis, equipment to measure weight should be introduced. Original request was referring to a weighbridge fixed on the apron of the Nuku'alofa wharf, but it was found through discussions with the Tongan side that the weighing functions should be added to the new forklifts, so that the forklifts fitted with weighing equipment can measure cargo weight not only in Nuku'alofa but also in other wharves.

(2) Forklift

SCP now possesses three forklifts as follows. Two of them are bad condition and cannot be used long. Original request was referring to two forklifts to be included in the Project.

Table 2-16 Existing SCP Forklifts

No.	Maker	Capacity	Purpose	Current problem
1	Hyster	6.5 tons	For cargo operation Carried on board MV Olovaha	Power dropped: cannot lift 5 tons now. Frequent trouble requiring high repair cost. Life of few years.
2	Mitsubishi	4.5 tons	For cargo operation Carried on board MV Olovaha	No problems
3	Toyota	3.8 tons	Cargo operation and workshop use	Easy to over-heat not allowing operation over 15 minute. High repair cost. Life of few years.

The new forklifts to be procured by the Project should have rated load of 6.0 tons (net load after reducing the loss due to adding weighing equipment) to allow handling 6 tons new containers (tare weight plus cargo weight) to be procured by this Project. Number of forklifts to be procured by the Project should be two, which are to work in Nuku'alofa wharf, carried on board the Plan Vessel, and then work in other wharves.

Existing Mitsubishi forklift should continue to work for wharf operation and workshop use.

Regarding the handling of the ISO 10' containers, it is concluded that the ISO 10' containers should be stowed on deck and handled by two cranes working together, and that forklift should not be so large as to handle 10 tons but should be 6 tons capacity suitable for ordinary use.

(3) Containerization

SCP has been already using simple containers as pictures below.

In Nuku'alofa wharf, SCP Freight department accepts cargo from client and stow it in container, then carry it into the cargo hold. After all cargoes have been stowed on board, two forklifts are also stowed in the cargo hold and the inter-island vessel leaves Nuku'alofa wharf. At the ports of call, containers are off-loaded by forklifts, containers filled with cargoes are loaded, empty containers are collected, and then the vessel returns back to Nuku'alofa.

Empty containers

Containers stowed in MV Olovaha

Fig. 2-18 Existing SCP containers

There are problems in using existing open containers, e.g. cargoes waiting at the open apron become wet by rain and risk of robbery, thereby enclosed containers have been requested. As there are different cargoes: existing open containers are suitable or enclosed containers are suitable, open and enclosed containers will have to be used together on board the Plan Vessel.

To allow stacking of these different containers, size of footprint of the new enclosed containers should be same as that of the existing ones. Height should be, however, 1.5 times to allow working inside and to make two stack high of the new containers same as three stack high of the existing containers.

Procurement of reefer containers is requested as well as ordinary enclosed dry containers.

MV Olovaha has no facility to stow frozen stuffs. Frozen meats are stowed in the ordinary open containers, leaving them free to thaw-out. When MV Olovaha has arrived island, frozen stuffs start spoiling, but yet demand for frozen stuff is as high as 10% in the total cargo amount. For preservation of the foods for islands peoples, procurement of reefer containers is important.

Fig. 2-19 Frozen meat stowed in a open container

Considering above, specification of the new containers should be as follows.

Table 2-17 Specification of the new cargo containers

Outside dimensions	2.438 m (8') width x 1.829 m (6') depth x 2.000 m high
Tare weight of dry container	1.00 t
Cargo weight of dray container	5.00 t
Gross weight of container	6.00 t (dry container and reefer container)
Temperature of reefer container	+5ºC ~ -25ºC (to be adjustable)
Electric consumption	About 4 kW

20 dry containers and 20 reefer containers were the original request.

The Plan Vessel design allows 66 containers (based on new container size). It is assumed that 40 containers in 66 (60%) are the new containers, and the rest, 39 containers ((66-40) x 1.5 = 39), are existing containers.

In the new 40 boxes, 4 boxes (equal to about 10%) should be reefer containers according to the statistics of carrying frozen stuff.

Dry containers staying ashore in every island, other than the containers carried on board, should be about 50% of working number. Number of reefer containers staying shore should be 100%. Thereby, the total number of containers should be as follows.

Dry containers 36 (working) + 18 (ashore) = 54

Reefer containers 4 (working) + 4 (ashore) = 8

4 reefer containers ashore will be 2 in Nuku'alofa, 1 in Ha'apai and 1 in Vava'u.

According to above, it is concluded that 54 dry containers and 8 reefer containers should be procured by the Project.

2-2-2-3 Basic plan of the Spare Parts

(1) Preventive Maintenance Policy

Tonga is remote from industrial countries and it takes long time to get spare parts and engineer servicing, thereby vessels are obliged to stop working once important machinery has become out of order.

For the stable operation of the Plan Vessel, honest implementation of the periodical maintenance is important.

It is vital that the PMP (Preventive Maintenance Policy) be introduced in the Plan Vessel. According to the PMP, overhauling and maintenance must be carried out regardless of the condition of the machinery (i.e. whether it is in order or out of order) at the time planned in advance according to the PMP. Working parts will be removed from the machinery and

replaced with spare parts. The removed parts will be cleaned, reconditioned and stowed in the workshop shelf. In the next maintenance for the same part, reconditioned and stowed parts will be used and same work will be repeated. This procedure requires initial investment to procure a set of spare parts, but reduces breakdown due to e.g. wearing and elongates life of parts.

Fig 2-20 below shows the periodical working procedure to change all cylinder heads. Entire cylinder heads of the main engine at one side are changed at every 12 months, cylinder heads of all main engines are maintained at every two years. Similar parts exchange will be done for piston, attached pump, bearing, etc. along the PMP manual.

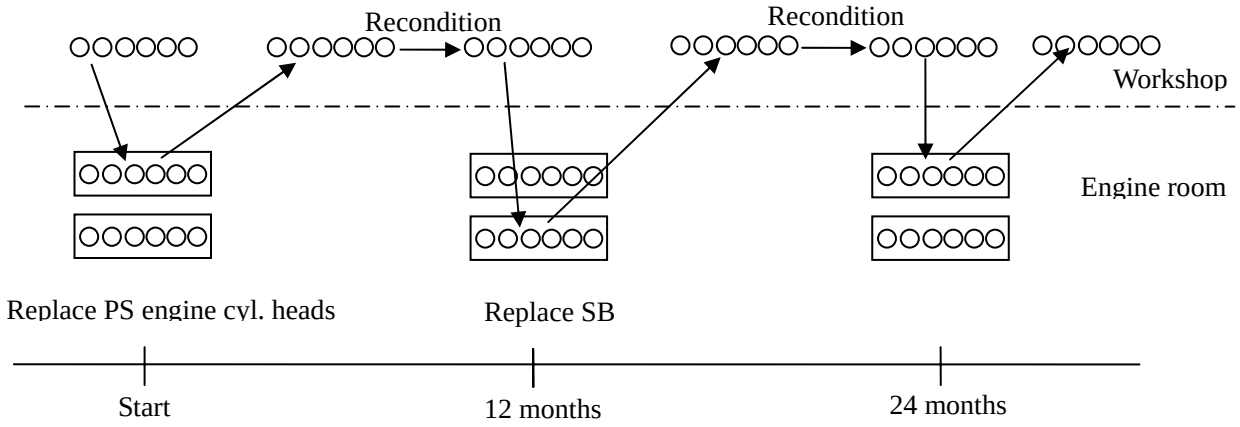


Fig. 2-20 Exchange of cylinder heads according to PMP procedure

PMP system should be established in the Plan Vessel operation involving SCP management, vessel crew and SCP workshop.

(2) Machinery parts to exchange

Spare parts as a part of the PMP in the preceding paragraph should be procured by the Project.

Outline of the spare parts for PMP as well as spare parts for contingency is as follows. (Refer to 2-2-4 Particulars of the Plan Vessel, Equipment and spare parts about detail.)

PMP parts

Main engine and main generator diesel engine

Cylinder head assembly	1 engine set
Piston ring	2 engine set
Bearing	2 engine set
Fuel oil injection pump	1 engine set
Fuel oil injection valve	2 engine set

Suction and exhaust valve	1 engine set
Governor	1 engine set
Turbocharger	1 engine set
Pumps attached to the engine	1 engine set
Others	
Contingency spare parts	
Thermometer, pressure gauge, tachometer	2 engine set
Propeller	2 (port and starboard) damage risk in shallow water
Propeller shaft	2 (port and starboard) damage risk in shallow water
Shaft bearing	2 set (port and starboard) damage together with shaft
Reverse osmosis desalinate membrane	1 set
Lighting bulb	1 set
Others	

2-2-2-4 Particulars of the Plan Vessel, Equipment and Spare Parts

Item	No.	Spec.
1. **Main particulars**		
Kind of vessel		Cargo passenger vessel
Nationality		Tongan
Navigation area		Tongan water including Niuas islands To engage in the service same as MV Olovaha, i.e. round tour calling Nuku'alofa, Ha'afeva, Pangai, Neiafu, Niuafo'ou and Niuatoputapu.
Length overall		53.00 m
Length between perpendiculars		48.00 m
Breadth, molded		13.50 m
Depth, molded (to 02 deck)		4.30 m
Depth, molded (to 03 deck)		6.70 m
Full load draft, molded		3.00 m
Gross tonnage, international		1,500 t
Deadweight		520 t
Cargo payload		400 t
Cargo hold dimensions		Length 31.40 m x Width 8.00 m x Free height 4.55 m Floor area 251 m^2 Hold volume 1,140 m^3
Fuel oil tank		120 m^3
Fresh water tank		40 m^3
Ballast water tank		150 m^3
Passenger capacity		400 p
Crew		22 p
Service speed		11.5 knot, 85% MCR, 15% sea margin
Main engine		735 kW (1,000 ps) x 2
Propeller		Solid fixed pitch propeller x 2
Diesel generators		Main genset 250 kVA x 225 V x 50 Hz x 2 Harbor genset 40 kVA x 225 V x 50 Hz x 1
Classification		ClassNK: NS* MNS* "Passenger Ship"
Rules to apply		Tongan maritime Regulations Japanese Maritime Regulations Rules of the Classification Society International Convention on Tonnage Measurement of Ships International Convention for Load Lines International Conference for Preventing Collision at Sea International Convention for Preventing Pollution from Ships International Radio Regulation
2. **Safety equipment**		
Rescue boat	1	FRP hull (not of composite type), Length abt. 4.5 m 15ps outboard, Complement 6 p
Rescue boat davit	1	Single slewing arm or gravity hinge
Life raft	450p	25 p type x 18 (ordinary type)
Life jacket with light	432	For adults: total complement 422 + bridge 5 + engine room 5
	40	For kids: pax capacity x 10%
Life line throwing apparatus	1	
Life buoy	4	2 with 30 m buoyant line
Self igniting light	2	

Item	No.	Spec.
Self igniting smoke signal	2	
Parachute signal	8	
Thunder light	4	
Fixed CO2 fire extinguisher	1 set	Main engine room and generator room CO2 cylinders @55kg x 5
Fixed pressure water-spraying system	1 set	For cargo hold, exclusive drenching pump and spraying nozzles, 33 nozzles
Water fog applicator	9	Cargo hold x 3, Main engine room x 2, generator room x 2, fireman's outfit room x 2
Portable foam applicator 20 lit With 100% spare charge	4	Cargo hold x 2, main engine room x 1, generator room x 1
Portable fire extinguisher 6kg powder With 100% spare charge	37	Cargo hold x 6, main engine room x 2, generator room x 2, bow thruster room x 1, sewage tank room x 1, shaft space x 1, steering gear room x 1, A/C room x 2, bridge x 1, accommodation alleyway x 8, mess room x 1, large pax room x 7, galley x 1, luggage room x 2, canteen x 1
Portable fire extinguisher 9 lit foam With 100% spare charge	1	Bridge x 1
Fixed fire extinguisher 6.8kg CO2	1	Galley exhaust over cooking range x 1
Automatic dispersing fire extinguisher 1.5kg powder	1	Paint locker x 1
Portable foam fire extinguisher 45 lit	2	Main engine room x 1, generator room x 1
Fire hydrant, fire hose, nozzle and spanner	16	Main engine room x 2, generator room x 2, deck part x 12 Hydrant 40A, hose 40A, nozzle 12mm, each with spanner
Pressure tank for fie main	1 set	About 100 lit. Fire pump starts automatically by low pressure in the tank. Non-return valve between the tank and pump
Automatic fire detector and manual call points	1 set	Ionized smoke detector Cargo hold (intrinsically safe type) x 12, main engine room x6, generator room x 6, accommodation alleyway and stair casing x 12, manual call point x 12
Emergency fire pump	1	11 kW diesel engine driven, 25 m3/h Installed in the bow thruster room.
Emergency escape breathing device (EEBD)	10	Engine room x 2, accommodation x 4, spare x 2
Fireman's outfit	4	Including self-contained breathing apparatus
Personal equipment	2	
Equipment for carrying dangerous goods on deck		
Full protective clothing resistant to chemical attack	4	For on-deck dangerous goods
Self contained breathing apparatus	2	For on-deck dangerous goods
Personal equipment	2	For on-deck dangerous goods
Portable fire extinguisher 6kg powder	2	For on-deck dangerous goods

Item	No.	Spec.
3. **Deck machinery**		
Bower anchor	2	Each 1,440 kg
Bower anchor chain	1	34 mmD grade U2 x 412.5 m (15 shackle @ 27.5m)
Tow line	1	180 m x 25 mm 6 x 24 SWR
Mooring rope	4	140 m x 34 mm polypropylene monofilament
Windlass	1	2 x chain wheel + 2 x warping head Chain wheel duty 64 kN x 9 m/min Warping head duty 20 kN 20 kW electric motor driven
Mooring capstan	2	30kN x 13 m/min, 7.5 kW e.motor driven
Stern ramp / weathertight door	1	Hydraulic cylinder direct pull, or Steel wire rope pull Ramp dim. 5.80 mW x 7.0 mL (incl. flap length abt. 1.0m) Gate clear dim. 5.50 mW x 4.55 mH Ramp weight abt. 11.5 t Hydraulic wedge operation Hydraulic upper end securing Stanchions and safety rope at sides Herring bone 13mm□ non-slip on ramp tread
Hydraulic oil pump for stern ramp	1	Exclusive use for the stern ramp operation
Cargo hatch	1	600mL x 3.00mB　Steel pontoons and weathertight tarpaulin
Cargo crane	2	Knuckle boom crane (Palfinger PKM520 or equivalent) SWL 5.0t/6.0t x 12.5m/10m radius, Min. radius 1.5m 6.5t×20m/min hydraulic hoisting winch Max inclination 5˚ 37kW e. motor driven hydraulic power pack in the crane post
Mechanical ventilators		
Cargo hold	2	1.5 kW, 100 m^3/min, 10/hrair change, explosion free
Main engine room	2	3.7 kW×1,500 rpm, 230 m^3/min×30 mmAq reversible
Generator room	1	2.2 kW×1,500 rpm, 140 m^3/min×30 mmAq reversible
Shaft space	1	0.2 kW, 40 m^3/min
Steering gear room	1	0.2 kW, 40 m^3/min
Bow thruster room	1	0.4 kW, 50 m^3/min
Sewage tank room	1	0.4 kW, 50 m^3/min
Galley	1	0.4 kW, 50 m^3/min
Bath room (02 deck)	1	0.4 kW, 40 m^3/min
Bath room (03 deck)	1	0.4 kW, 40 m^3/min
Bath room (05 deck)	1	Pipe fan
Stair casing	4	0.2 kW, 40 m^3/min
Rudder	2	Hanging rudder, high lift, flap or Schilling, rudder area about 3.0m^2 each
Steering gear	1	Electro hydraulic, 3.0kW hydraulic pump unit (100%) x 2 Abt. 35kN.m　28”/75˚
Bow thruster	1	100 kW e.motor driven, variable pitch

Item	No.	Spec.
Air conditioning unit No.1 unit No.2 unit No.3 unit	 1 1 1	 For No.1 and 2decks 32ºC/80%RH → 27ºC/50%RH, 70% recirculation For No.3, 4 and 5 decks 32ºC/80%RH → 27ºC/50%RH, 70% recirculation Engine monitor room
Roll dumping device	1	Rudder roll stabilizer, working with auto pilot
Watertight sluice door	1	On WT bulkhead separating main engine room and generator room 0.75kW e.motor driven hydraulic pump With hand pump and pressure accumulator tank Local control and remote control from deck above
4. **Accommodation**		
Accommodation carpenter work-	1 set	
Bulkhead, lining and ceiling material		Steel cassette non-combustible system
Pax room floor		Wide vinyl flooring
Funeral party		To be separated by curtain max. for 3 groups
Galley equipment	1	Electric cooking range with hot plate x 4, total 20 kW
	1	Water boiler, 10 lit., 1 kW
	1	Fridge, 400 lit., domestic type
	1	Microwave, 900 W domestic type
	1	Toaster industrial type
	1 set	Sink, cooking table, shelves, cupboard, etc.
Canteen	1	Fridge, 400 lit., domestic type
	1	Chest freezer, 300 lit domestic type
	1	Water boiler, 10 lit., 1 kW
	1	Microwave, 900 W domestic type
	1 set	Sink, shelves, cupboard, etc.
Refrigerated provision chamber	1 set	Freezer room abt. 3.5m^3 –25˚C Vegetable roomabt. 4.5m^3 +5˚C Ref. machine comprises two compressor unit
Bridge windows	11	750mmH x 900mmW x 10 750mmH x 1300mmW x 1
Square windows	42	500H x 350mmW
Round scuttles	16	250mmD
5. **Bath room**		
Pax (gents)	2 place	Each 2 WC x 2, 2p urinal x 1, shower x 3, wash basin x 2
Pax (ladies)	2 place	Each 2 WC x 4, shower x 3, wash basin x 2
Crew	2 room	Each 1 WC, 1 shower and 1 wash basin
Officer / VIP	2 room	Each 1 WC, 1 shower and 1 wash basin
Laundry	1 room	With abt. 6 kg washing machine
Sewage collecting tank	1	26 m^3, high level alarm, auto discharge at high level, two –way valve to collect in the tank or discharge direct overboard
Sewage discharge pump	1	Electric centrifugal pump 15 m^3/h x 0.196 MPa x 2.2 kW x 1,500 rpm SUS impeller

Item	No.	Spec.
6. **Engine room machinery**		
Main engine	2	735 kW (1,000 ps) Rev≤1,000 rpm 6 cylinder in line burning MDO
Reduction gear	2	Output rev. = 300rpm with astern clutch
Propeller shaft	2	Abt. 5.5 m SF
Intermediate shaft	2	Abt. 2.1m SF
Propeller	2	FPP 2.10 mD keyless NiAlBz
Stern tube bearing	2	Seawater lubricated cutless rubber bearing
Outer bearing	2	Seawater lubricated cutless rubber bearing
Intermediate bearing	2	
Sterntube seal	2	Mechanical
Bulkhead seal	2	Rubber seal
Shaft stopper	2	Claw type
Propeller shaft grounding	2	
Main generator	2	250 kVA x 225V x 50Hz x 1,500rpm
Harbor generator	1	40kVA x 225V x 50Hz x 1,500rpm water cooled
Main air compressor	2	Vertical 2 stage air-cooled abt. 12.5 m^3/h (FA) x 2.94 MPa 3.7 kW x 1,500 rpm e.motor driven
Emergency air compressor	1	Horizontal abt. 6.3 m^3/h (FA) x 2.94 MPa 4 ps diesel driven
Main air reservoir	2	Vertical cylinder 100 lit. x 2.94 MPa
Pumps		
Main cooling SW pump	2	Centr. 35 m^3/h x 0.18 MPa x 3.7 kW
Fire/bilge/GS pump	2	Centr. 55/25 m^3/h x 0.2/0.6 MPa x 11kW
Pressure tank for hydrant	1 set	About 100 lit. Fire pump starts automatically by low pressure in the tank. Non-return valve between the tank and pump
FW pump (hydrophore)	2	Centr. 4.0 m^3/h x 0.44 MPa x 3.7 kW
Sanitary pump (hydrophore)	2	Centr. 4.0 m^3/h x 0.44 MPa x 3.7 kW
A/C cooling SW pump	2	Centr. 70 m^3/h x 0.2 MPa x 11kW
FO transfer pump	1	Gear 4.0 m^3/h x 0.2 MPa x 2.2 kW
FO service pump	1	Gear 4.0 m^3/h x 0.2 MPa x 2.2 kW
Engine room bilge pump	1	Piston 1.0 m^3/h x 0.2 MPa x 1.5kW
Sludge transfer pump	1	Screw 1.0 m^3/h x 0.4 MPa x 1.5kW
ME LO priming pump	2	Gear 5.0 m^3/h x 0.2 MPa x 1.5 kW
ME standby LO pump	1	Gear 18.2 m^3/h x 0.8 MPa (kept as spare)
Gearbox standby LO pump	1	Gear 4 m^3/h x 0.8 MPa (kept as spare)
LO service pump	1	Gear 3.0 m^3/h x 0.2 MPa x 1.5 kW
SW supply pump for water maker	1	Centr. 3.0 m^3/h x 0.2 MPa x 0.75 kW
Fixed pressure water-spraying pump	1	Centr. 131 m^3/h x 0.55 MPa x 33 kW
ME cooling FW pump	2	Centr.27 m^3/h x 0.255 MPa (ME driven)
Main generator engine cool FW P	2	Centr. 22.5 m^3/h x 0.076 MPa (ME driven)
Main generator engine cool SW P	2	Centr. 12.5 m^3/h x 0.065 MPa (ME driven)
Hot water circulation pump	1	Centr. 3 m^3/h x 0.2 MPa x 0.75 kW
Flow meter		
For main engine	2	Digital local reading and remote indication, for 20A bore
For generator engine	1	Digital local reading and remote indication, for 15A bore

Item	No.	Spec.
Fuel oil purifier	1	Centrifuge 700 lit./h automatic, 3 kW heater
Lube oil purifier	2	Centrifuge 700 lit./h automatic, 5 kW heater
Water maker	1	Reverse osmosis, nylon spiral module 8 tons / day (at 30˚C SW temp) With pre filter but no sand filter required
FW sterilizer	1	UV type for drinking water line
Machine tool		
Drill	1	13 mmD 0.4 kW
Grinder	1	200 mmD x two heads 0.4 kW
E.arc welder	1	AC220V x 250A 50 m e.cable x 2
Gas welder set	1	50 kg Ox x 1 50 kg Ac x 1
Chain block	2	Manual 0.9 t for main engine overhaul
Anti-pollution measures		
Oily water separator	1	0.5 m^3/hr x 15 ppm
Sewage collecting tank	1	26 m^3 x 1
NOx controlled diesel engine	1 set	
Engine room tank		
FO service tank	1	3,500 lit.
FO settling tank	1	3,500 lit.
ME LO sump tank	2	1,700 lit.
LO storage tank	1	2,000 lit.
Wash oil tank	1	100 lit.
LO daily tank	1	100 lit.
Sludge tank for LO purifier	1	100 lit.
Sludge tank for FO purifier	1	100 lit.
Sludge tank	1	1,300 lit.
FO drain tank	1	70 lit.
LO drain tank	1	70 lit.
FW expansion tank	2	300 lit.
FW hydrophore tank	1	500 lit.
SW hydrophore tank	1	500 lit.
ME FO sedimentation tank	2	30 lit.
Hot water tank	1	400 lit 70˚C 22 kW e.heater
Engine monitor console	1	In engine monitor room LCD monitor x 2 Exhaust temp, LO press, cooling water temp, etc.
7. **Electric supply**		
Main switchboard and local board	1 set	3-gen panel, 1-synchro panel, 1-group starter Auto synchro and auto load sharing
E.supply		220V 1/3φ AC 50Hz, 24V DC
Battery	1 set	Radio and general use
Charging and discharging board	1 set	
Shore connection	1	440V AC 3φ 50Hz 40kVA
Transformer	1	445/225 V 3φ 40kVA for shore supply
Switch and consent		
Switch, water proof	40	
Switch, non-water proof	80	
Receptacle, water proof	20	
Receptacle, non-water proof	40	
Switch receptacle	20	
Junction box, water proof	80	
Junction box, non-water proof	50	

Item	No.	Spec.
Receptacle for reefer container	6	Fitted in the cargo hold 4 containers to be carried on board
8. **Lighting**		
Navigation light	1 set	Masthead light (60Wx2) x 2, side light (60Wx2) x 2, Stern light (40Wx2) x 1, anchor light (40Wx2) x 1, NUC light (60Wx2) x 2
Onboard light		
Fluorescent ceiling light	102	2 x 20W
Do. with emergency light	30	2 x 20W +5W DC
Fluorescent open light	20	2 x 20W
Do. with emergency light	5	2 x 20W + 5W DC
Fluorescent light with guard	18	2 x 20W
Do. with emergency light	7	2 x 20W +5W DC
Fluorescent hold light with guard intrinsically safe	22	2 x 20W
So. With emergency light	4	2 x 20W +5W DC
Incandescent engine room light	20	60W
Incandescent wall light	24	60W
Incandescent wall emergency light	2	10W
Fluorescent bed light	32	10W
Fluorescent desk light	2	20W
Chart table light	1	20W
Hand light	2	60W
Search light	2	500W incandescent
Projector	12	500WHalogen
Life raft embarkation light	2	40W DC
Daylight signal light	1	
9. **Navigation equipment**		
Magnetic compass	1	Reflector type
Gyro compass	1	Repeaters: 4 (steering stand, wings (2), steering gear room) With azimuth circle and mirror
Steering control	1	Gyro compass auto pilot
Radar	2	9 GHz, abt. 10 kW, abt.15" display (LCD preferable) ATA (automatic tracking aid)
GPS	1	LCD, simple position display
	1	Abt. 10" display, course plotter, with ROM card for Tongan sea chart
Navigation echo sounder	1	Abt. 6.5" LCD display
Air horn	1	Automatic horn control
Public addressor	1	Intercom (bridge, bow, stern, ramp gate, muster station, life raft embarkation stations)
Helm indicator	3	Bridge and wings
Propeller shaft rev. indicator	6	Bridge and wings
Wind meter	1	
Telephone	1 set	Bridge – Engine room, steering gear room, mess room
Engine order telegraph	1:1 x 2	(main engine room – Bridge) x 2 engines
Bridge remote controls	1	Main engine control, bow thruster control, telegraph, PA, telephone
Wing controls	2	Main engine control, steering control, bow thruster control, PA

Item	No.	Spec.
Window wiper	2	Bridge front windows
PC	2	Clerical work and loading calculation
AIS (Automatic Identification System)	1	
Speed log	1	Doppler
10. **Radio apparatus**		GMDSS A1 + A2
VHF radio telephone	1	
VHF DSC alert	1	Ch.70
VHF DSC watch keeping	1	Ch.70
MF/HF radio telephone	1	About 250W
MF/HF DSC alert	1	2,187.5kHz, etc.
MF/HF DSC watch keeping	1	2,187.5kHz, etc.
Distress alarm panel	1	To send alert by one button and to receive all alert
EPIRB	1	Via satellite
Two-way portable VHF radio	3	With battery charger
SART	2	
Walkie talkie	4	With battery charger
11. **Material**		
Hull		Steel
Piping material		
Seawater pipe		Steel
Cooling seawater pipe		Polyethylene lining inside, from sea chest to inlet to pump
Fresh water pipe		Stainless steel or plastic
Hot water pipe		Stainless steel or copper
Hydraulic oil pipe		Stainless steel (exposed) and steel (inside)
Paint		
Bottom hull		Epoxy anti-corrosive + tin-free self polishing anti-fouling at 2.5 years standard
Hull topside		Epoxy
Cargo hold		Epoxy
Superstructure		Modified epoxy
Exposed deck		Modified epoxy non slip
Engine room bottom		Epoxy
Accommodation inside		Oleoresinous
Fresh water tank		Epoxy for drinking water tank
Ballast water tank		Epoxy
Sacrifice anode		2.5years aluminum anode

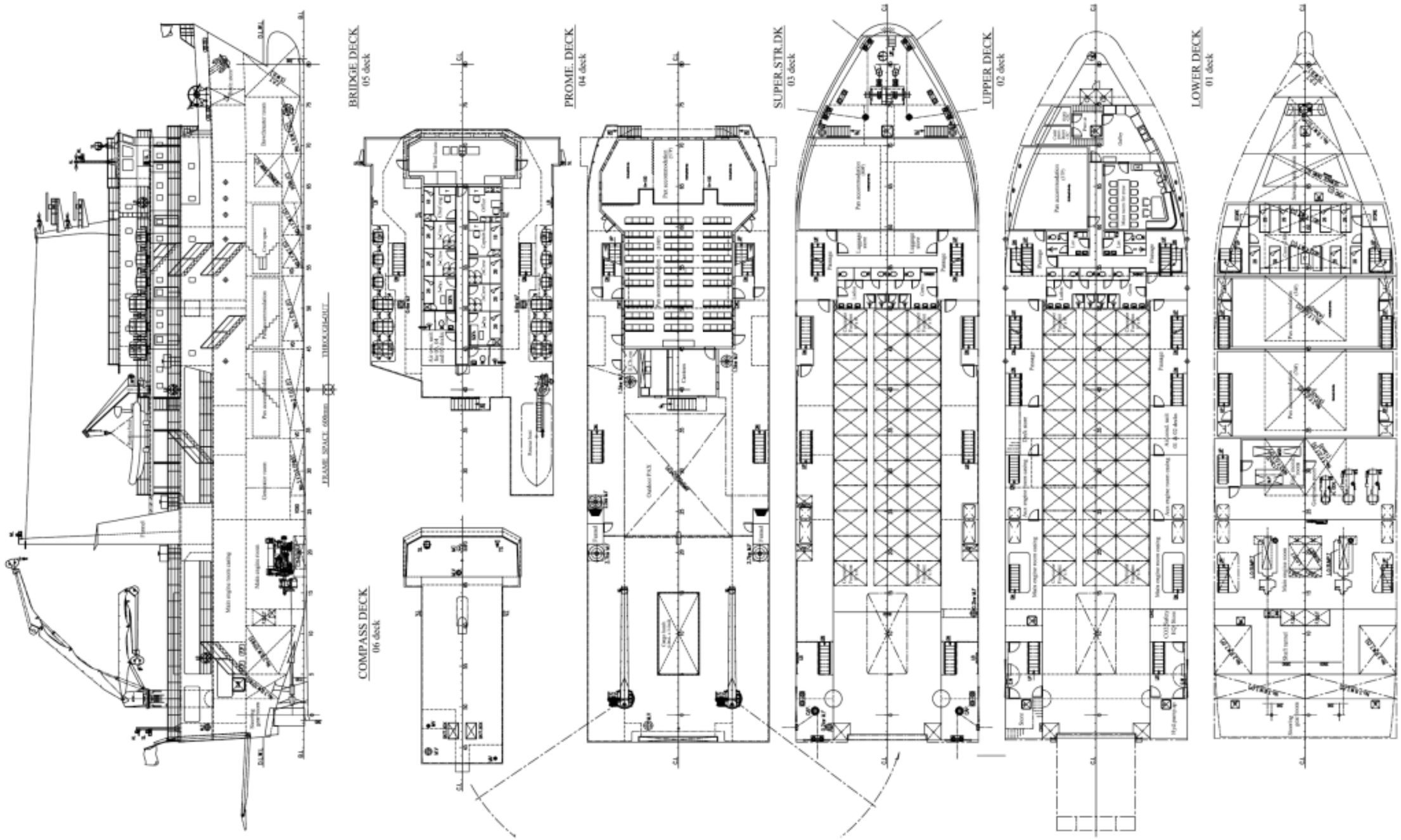
12. **Equipment**		
(1) Cargo container		Outside dim. 2,438mmW x 1.829mmL x 2,000mmH 2 high in cargo hold
Dry container	54	Working x 36 box + standby 18 box Tare 1.0 t cargo 5.0 t gross 6.0t
Reefer container	8	Working 4 box + standby 4 box Temperature +5˚C ~ -25˚C (adjustable) E.power 4 kW Gross weight 6.0 t
(2) Forklift	2	Rated load 6 tons with load meter Diesel engine driven

13. **Spare parts**	Quantity
For main engine	
Cylinder head assembly	6
Piston and connecting rod assembly (with crank pin metal)	2
Piston ring	12 cylinder
Cylinder liner assembly (with seal, ring, etc.)	2
Main bearing (base and center) and thrust bearing metal	2 engine
Crank pin metal	12 cylinder
Connecting rod bolt	24
Fuel injection pump complete	6
Fuel injection valve	12
Nozzle assembly	12
Fuel oil injection pipe	6
Suction valve, valve seat and valve guide	Each 12
Exhaust valve, valve seat and valve guide	Each 12
Governor	1
Turbocharger	1
Gasket for turbocharger	1 set
Engine driven pumps (FW, SW, FO, LO)	1 set
Cooling fresh water thermostat and seal	Each 1
Engine attached cooling seawater pipes (steel and rubber)	1 set
O ring and seal packing for special survey overhaul	2 ship
LO and FO filter element (in case of paper filter)	12 engine
Pressure gauge	1 ship
Thermometer	1 ship
Pressure switch and temp switch	1 ship
Tachometer	1 ship
Cooling fresh water chemical and test kit	1
Cylinder head overhauling turntable	1
Tool for piston ring insert	1
Cylinder liner withdrawing tool	1
Gearbdox	
LO pump	1
LO cooler side cover	1
Pressure gauge	2 engine
O ring, seal packing for special survey overhaul	2 ship
Shafting	
Propeller (port and starboard, no cap required)	1 ship
Propeller shaft (port and starboard, no nut required))	1 ship
Propeller shaft bearing	1 ship
Mechanical seal ring and associated parts	1 ship
O ring for propeller	1 ship
Main generator	
Cylinder head assembly	6
Piston ring	12 cylinder
Main bearing (base and center)	2 engine
Crank pin metal	12 cylinder
Fuel injection pump complete	6
Fuel injection valve	12
Nozzle assembly	12
Governor	1
Turbocharger	1

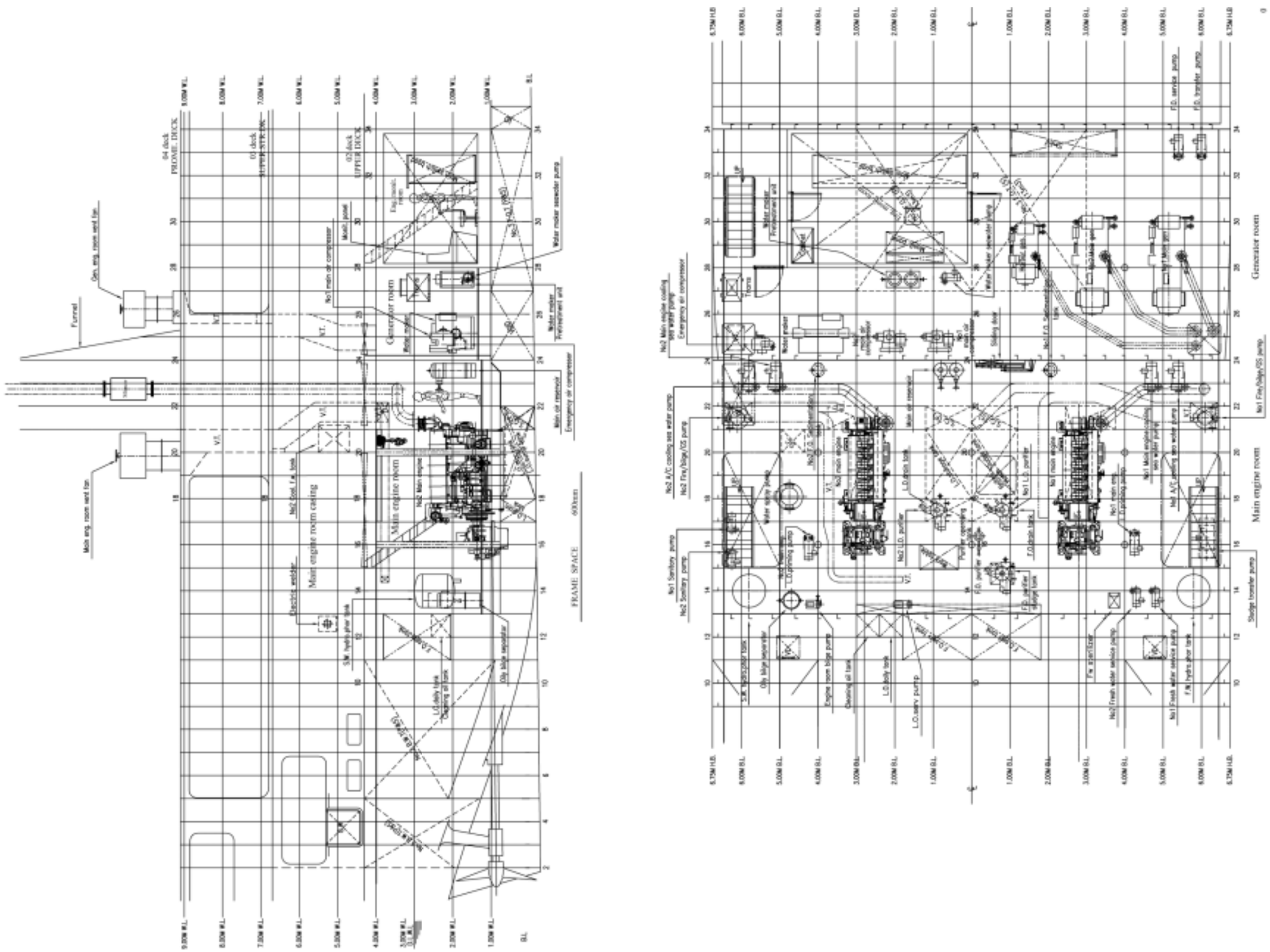
13. **Spare parts**	Quantity
Gasket for turbocharger	1 set
Engine driven pumps (FW, SW, FO, LO)	1 set
Cooling fresh water thermostat and seal	Each 1
Engine attached cooling seawater pipes (steel and rubber)	1 set
O ring and seal packing for special survey overhaul	2 ship
LO and FO filter element (in case of paper filter)	12 engine
Pressure gauge	1 ship
Thermometer	1 ship
Pressure switch and temp switch	1 ship
Tachometer	1 ship
Harbor generator	
LO and FO filter element (in case of paper filter)	6 engine
Shell and tube cooler	
O ring and seal packing	2 ship
Anodes	
Aluminum anodes for bottom hull	1 ship
Anode plate and bar for engine room cooling seawater system	4 ship
Engine attached anode plate and bar for cooling seawater	4 ship
Packing for above	2 ship
Zinc anodes for propeller shaft	2 ship
Sacrifice pipe piece	1 ship
Reverse osmosis water maker	
Reverse osmosis module	1 set
Hot water tank	
Heater element	1
Crane	
High pressure rubber hose	1 crane
Oil filter element	2 crane
Generator	
Ball bearing	1 ship
Lighting	
Navigation light	200%
Incandescent lamp	100%
Fluorescent lamp	100%
Projector bulb	100%
Search light bulb	100%
Glass glove	Each size 2
Fuse element	Each size 5
Receptacle and plug (waterproof))	1 set
Receptacle and plug (non-waterproof))	1 set
Switch (waterproof)	1
Switch (non-waterproof)	1

2-3 Basic Design Drawing

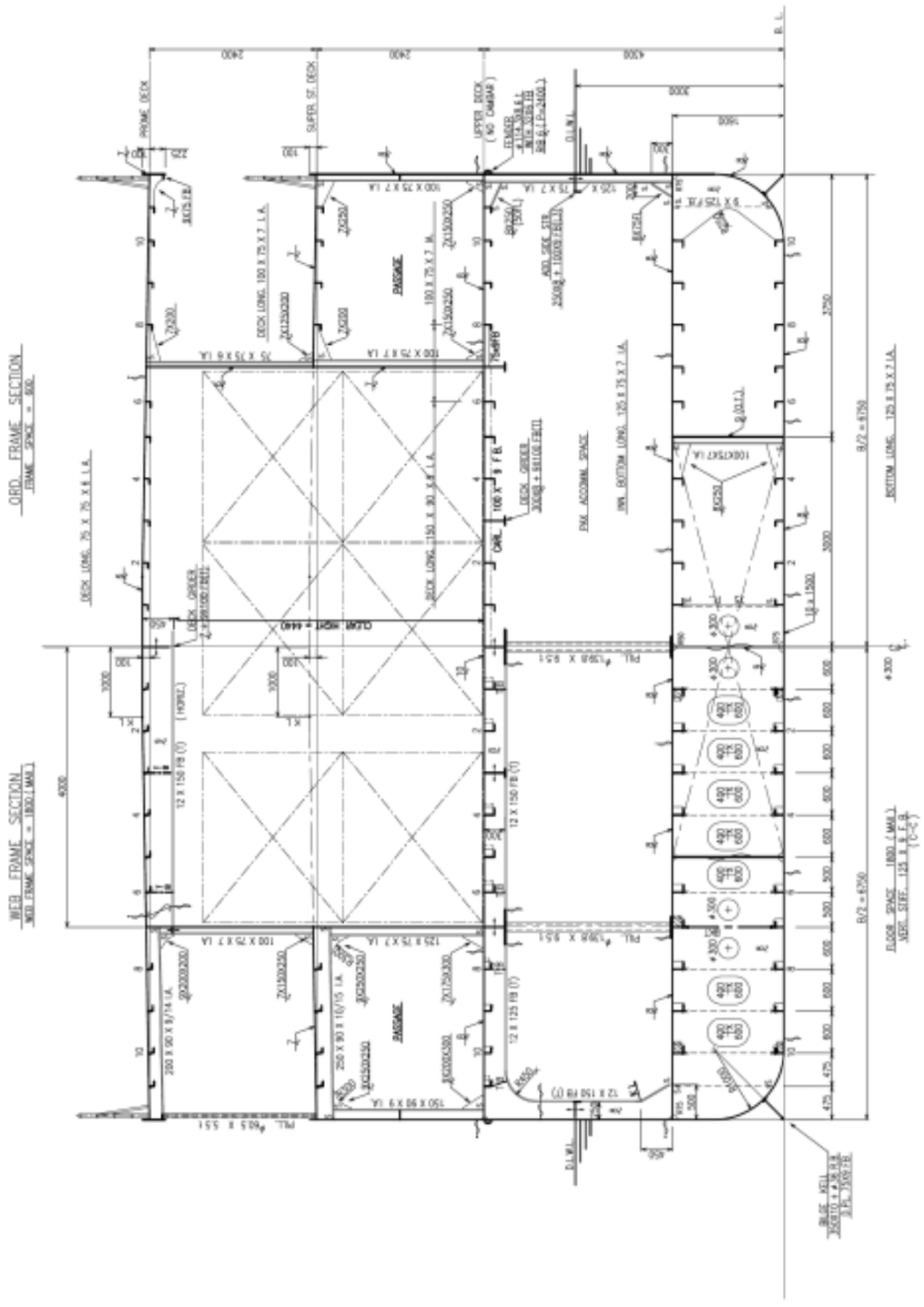
(1) General arrangement



(2) Engine room arrangement



(3) Midship section structure plan



2-3-2 Implementation Plan

2-3-2-1 Implementation Policy

(1) Procedure

The Plan Vessel will be planned, documented and constructed along following procedure under the Grant-Aid program of the Government of Japan.

a) Exchange of Notes between the Government of Japan and the Government of Tonga, for the implementation of the Project.
b) Conclusion of a Consultant Agreement between a Consultant recommended by the Government of Japan and the Project Implementing Body established by the Government of Tonga, for the Consultant's work to implement the Project.
c) Verification of the Consultant Agreement by the Government of Japan.
d) The Consultant prepares detail designs and draft tender documents, and obtains approval from the Government of Tonga. These include methods of pre-qualification, technical specifications, general arrangement plan, project cost estimates, and construction contract drafts.
e) Based on the approved Tender Qualification methods, the Consultant conducts Tender qualification examination, obtain the approval of the Government of Tonga, and select the applicants.
f) The Applicant must be a Japanese corporate body of shipbuilder including joint venture established by two or more Japanese shipbuilding corporate bodies.
g) The Consultant carries out the Tender process, in the presence of the Government of Tonga, and examines the Tender documents submitted by the applicants. Based on the results of the applicant evaluations, the Consultant recommends the intended contractor to the Government of Tonga.
h) The Consultant assists in contract negotiations with the Government of Tonga and witness the Contract.
i) The signed contract takes effect upon verification by the Government of Japan.
j) Based on the construction contract, the Contractor builds and conducts sea trials of the Plan Vessel, t and hands-over the Plan Vessel together with the Equipment. The Consultant, in accordance with the Consultant Contract, provides construction supervision, conducts sea trial, and witnesses the hand-over of the vessel.
k) The Plan Vessel with Equipment on board departs Japan for Tonga.

(2) Basic provisions related to the Project procedures

Basic items related to the Project procedures under the Grant-Aid program are as follows.

1) Project implementation body

The agency responsible for the Project is the Ministry of Transport (MOT), Government of Tonga, and the implementing agency is Shipping Corporation of Polynesia Limited (SCP), a government owned shipping company. With respect to the project implementation, MOT will generally deal with all documents and give approval, but SCP will deal with technical documents and drawings by the authority of MOT.

2) Consultant

Following the Exchange of Notes, a Consultant contracts will be concluded between the Government of Tonga and the Consultant (a Japanese firm recommended by the Government of Japan). As the proxy for the Government of Tonga, the Consultant will prepare tender documents, including technical specifications, and give assistance as necessary in the tender bidding and contractual phases, and further provide continuous supervision of the Plan Vessel construction. For purposes of carrying out this supervisory function, the Consultant will dispatch responsible engineers and outfitting experts to the shipyard, as necessary during the construction process.

3) The Plan Vessel building and the Equipment procurement contract

For the Plan Vessel building, qualification data submitted by Japanese shipbuilding corporate bodies will be evaluated first, and those who had passed the qualification appraisal are allowed to participate in the tender bidding. The Japanese shipbuilding corporate bodies who are eligible to participate in the tender may be either single corporate body or joint venture established by two or more corporate bodies. The tender is conducted along the procedure established in advance. The successful tenderer signs the contract for building the Plan Vessel. The Contractor builds the Plan Vessel, conducts sea trials, procures the Equipment and transports the Vessel with the Equipment on board to Tonga for turnover.

4) Building plan of the Plan Vessel

To build the Plan Vessel, the Contractor, pursuant to the contract and technical specifications, designs the hull and outfittings for building in the Contractor's yard facilities. Following preparation of the construction design by the Contractor, the Plan Vessel is built along shipbuilding process: steel hull construction, outfitting (deck, machinery and electrical), tests, and then transport to Tonga. The following areas must be given careful consideration when examining the Construction Plan.

a) As this Project is being implemented via a Grant-Aid from the Government of Japan, strict adherence to the construction schedule is the major premise. The building plan

must be prepared so as to fulfill all contract conditions within the term validity stipulated in the Exchange of Notes.

b) With regard to the delivery deadlines for machinery and equipment, careful consideration must also be given to preventing disruption of the construction work flow by maintaining tight control of machinery and equipment procurement and linking the hull construction and outfitting program to delivery schedules of the relevant machinery and equipment.

c) Various tests must be performed, as determined by the Classification Society, maritime regulations in the Tonga, and maritime regulations in Japan. The required sea trial must be performed upon completion of the construction phase to certify vessel performance.

d) In the final stage of construction, two engineers appointed to the Plan Vessel as senior officers are invited to Japan to participate in the final outfitting work and sea trials as well as receiving instructions from various makers, all for familiarization with the vessel systems and performance. These engineers travel aboard the new vessel back to Tonga, for further familiarization.

e) Receiving the Provisional Certificate of Nationality from the Government of Tonga, the Contractor transports the Plan Vessel, at his own responsibility, from the Contractor's quay (wharf) to Nuku'alofa, the Plan Vessel's homeport. After arrival at Nuku'alofa, final inspection will be immediately conducted and thereafter the Vessel will be turned over to the Government of Tonga.

5) Procurement plan of the Equipment

The Contractor procures cargo containers (dry and reefer) and forklifts based on the contract and the technical specification.

6) Dispatch of engineers

After turning-over the vessel, two engineers (deck part and machinery part) will be dispatched by the shipbuilding Contractor to Tonga for 15 days to provide ongoing guidance on operation of machinery, system and maintenance.

2-3-2-2 Special Considerations with regard to Construction and Procurement

(1) Work schedule control

Following should be observed in building the Plan Vessel and reflected in controlling work schedule.

a) Layout of the Plan Vessel being differ from ordinary cargo vessels, procedure of hull assembly and outfitting should be established taking into consideration of the Plan Vessel layout and special features.

b) For those materials, machinery and equipment, whose delivery is not very firm, delivery possibility should be followed up frequently and reflect the change in the work schedule promptly.

c) Quay tests for various machinery and equipment and sea trials should be in detail planned and included in the work schedule.

d) The work schedule should be regularly (at least once in a week) followed up and updated.

(2) Application of passenger safety regulations

The Plan Vessel falls under a passenger vessel category in applying safety regulations. For survival of innocent passengers who are not trained for onboard safety, safety regulations imposes stringent safety measures for passenger vessels in detail.

Design department of the shipbuilder should study every line of passenger safety regulations (stability, sub-division, fire protection, fire fighting, lifesaving, etc.) and reflect them in the production design drawings.

(3) Weight control

Generally in passenger vessels, weight of light ship occupies major part of a displacement at fully loaded draft. Increase in the light ship weight due to loose weight control decreases deadweight capacity considerably in greater percentage. In the production designs and at shipbuilding site, weight control is important.

2-3-2-3 Scope of Works

Scope of works at Japan side and Tongan side is generally as follows.

a) Building of the Plan Vessel, procurement of the Equipment and their transport from Japan to Tonga are all undertaken by the Japan side.

b) Tongan side undertakes repairing, modification and refurbishment of Tongan wharves, water channels and shore facility necessary for the operation of the Plan Vessel. Tongan side must undertake arrangement of licenses necessary to build and transport the Plan Vessel.

As above, the Project implementation after the shipbuilding and equipment procurement contracts does not rely on the work to be shared by the Tongan side, except for the Provisional Certificate of Nationality, which must be issued by the Government of Tonga.

Undertakings at Tongan side are the works necessary for the operation of the Plan Vessel and to be completed before commissioning of the Plan Vessel in Tonga.

Following is the further breakdown of the works at Japan side and Tongan side.

(1) Scope of works at Japan side

Scope of works at Japan side as the Project under the Grant-Aid Program of Japan.

a) Design and construction of the Plan Vessel
b) Procurement of the Equipment
c) Transport of the Plan Vessel and Equipment: The Plan Vessel sails from Japan to Tonga carrying Equipment on Board.
d) Consultant services for designs for implementation, assistance in tender business and supervision during shipbuilding and equipment procurement.

(2) Scope of works at Tongan side

Building of the Plan Vessel and procurement of the Equipment are the work at Japan side, but Tongan side must undertake following works.

(Arrangements during implementation of the Project)

a) Banking arrangement (with an authorized foreign exchange bank in Japan), issuance of an authorization to pay, and bearing necessary commissions to the bank, for the contracts verified by the Government of Japan in relation with this Project.
b) Acquisition of licenses and certificates of the Government of Tonga, necessary for building and transporting the Plan Vessel, e.g. Provisional Certificate of Nationality.

(Arrangements when the Plan Vessel has arrived at Tonga)

c) Exemption of the Plan Vessel and Equipment from customs duties, internal taxes and fiscal levies, and prompt customs clearance.
d) Exemption of Japanese nationals from customs duties, internal taxes and fiscal levies for their services in Tonga.

(Preparation of wharf facility)

e) Homeport Nuku'alofa

Apron of Nuku'alofa wharf, unpaved, becomes entirely muddy, which makes passengers foot and forklift tires all muddy, and further makes vessel inside muddy. Apron of Nuku'alofa wharf should be paved.

Fender along Nuku'alofa wharf is too poor: only with two aged rubber tires. More fenders, solid rubber or used tires, should be added for safer berthing of vessels including the Plan Vessel.

f) Widening wharf ramps

All wharf ramps, on which vessel's stern ramp lands, should be so widened as to adapt landing area of the Plan Vessel's stern ramp.

Wharf ramps of Nuku'alofa, Pangai and Neiafu are too narrow for the Plan Vessel's stern ramp to land on those wharf ramps, and need widening.

g) Water depth in way of wharf and access channel

Water depth of Ha'afeva should be so deepened as to adapt draft of the Plan Vessel. Ports, which need dredging, may be Ha'afeva only, but Tongan side operator must examine and determine the dredging.

h) SCP workshop refurbish

SCP workshop should be refurbished fitting shelves to stow spare parts of the Plan Vessel and workbench for cleaning and reconditioning of parts.

i) Electric receptacles for reefer containers ashore

Electric receptacles should be fitted ashore to supply electric power to the reefer containers procured by the Project.

(Other)

j) Any other items which are not covered under the Project.

2-3-2-4 Consultant supervision

(1) Basic guidelines

The Consultant will verify that the construction and procurement schedule have been designed based on Grant-Aid system. Supervision of both shipbuilding and equipment procurement supervision plans will be prepared on this basis. The Consultant will check whether the quantities, plans, and specifications satisfy contract documents. The supervision programs will be conducted as follows.

1) Approval of drawings and specifications

The Consultant should examine, approve and/or gives instructions to correct the construction plan, work schedule, production design drawings and specifications promptly, and should reply to the questions from the Contractors promptly as well, so as to prevent disruption in the project schedules.

2) Work schedule supervision

The Consultant should always grasp progress of the work schedule, and order whenever necessary to adjust working schedule to ensure on-time completion.

3) Quality inspection

Along with building progress, the supervisor(s) in charge of outfitting and equipment should be dispatched for necessary periods to workshops and the shipyard to inspect construction at site, checking machinery and outfitting work with the contract plans, specifications, and approval documents. The supervisor(s) should conduct inspections of the equipment and outfitting work, based on the approved test procedure and the Contractor's in-house standards.

4) Turnover business

After transporting the Plan Vessel to Nuku'alofa, the Consultant should be present at all inspections at the wharf and issue the certification documents required for local turnover.

5) Construction report

The Consultant should make monthly reports on construction progress and scheduled work for the succeeding month, appending factory photos. These reports should be submitted to both the Tongan Government and the Government of Japan.

(2) Supervisory arrangement

The Consultant should establish a project team consisting of project manager, naval architect, outfitting staff, machinery staff, electric staff, joiner work staff, and equipment procurement staff, and prepare implementing design and exercise supervision over the construction and procurement activities.

2-3-2-5 Quality Control Plan

Quality control of raw materials and installed machinery / equipment for the Plan Vessel and Equipment should be conducted as follows.

Materials		Quality control
	Structural steel	To use steel materials with certificate of inspection (mill sheet) for every plate and every bar section according to the ClassNK standard.
	Pipes and valves	To use pipes and valves with JIS certificate.
	Timber	Consultant to inspect on arrival of the material.
	Fire protection	Fireproof bulkhead, lining, insulation, fire door, etc. for structural fire protection to be of SOLAS and ClassNK standards, for which prototype tests had been conducted and have type-approval.
Installed machinery and equipment		
	Diesel engine	Designed according to ClassNK standards, prototype tests had been conducted, type-approved, and manufactured in the factory qualified by ClassNK. Completed diesel engines to be load-tested including overload for necessary duration on test bench according to the standard program of ClassNK.
	Auxiliaries	Designed according to ClassNK standards, manufactured in the factory qualified by ClassNK, and have certificate of ClassNK.

Materials		Quality control
	Fire extinguishers	Designed according to SOLAS regulation, and have type-approval No. of HK (The ship Equipment Inspection Society of Japan)
	Inventories	Designed according to SOLAS regulation, and have type-approval No. of HK (The ship Equipment Inspection Society of Japan)
	Deck outfitting	Designed according to JIS, and the Consultant to inspect the equipment.
Equipment		
	Container	Designed according to ISO standard, and inspected by the Consultant during fabrication and completion. Operation test for all reefer containers.
	Forklift	Final inspection including operation. Weighing load test lifting certified weights.

2-3-2-6 Machinery / Equipment Procurement Plan

Machinery and equipment to be on board the Plan Vessel and associated Equipment being not produced in Tonga, they will be in general of Japanese products, which are stable in quality, delivery and price.

Regarding dry containers, workshops in Fiji have facility to supply, but their pricing were several times more expensive than that of Japan, thereby excluded from the short list.

Procuring from third countries is possible for following onboard equipment not binding procurement to Japanese products.

No.	Item	Specification	Procurement possibility
1	Crane	Knuckle boom type SWL5.0t/6.0t x 12.5m/10mR	No Knuckle boom crane is manufactured in Japan. Some European Products are available.
2	Fuel oil purifier and lubricating oil purifier	Centrifuge about 700 lit./h	Only one maker in Japan, whereas purifiers from some European makers are competitive and widely used in Japan.

2-3-2-7 Soft Component Plan

No soft component is included in the Project.

2-3-2-8 Implementation Schedule

(1) Portion of work at Tongan side in building the Plan Vessel and procuring the Equipment

The Project implementation after the shipbuilding and equipment procurement contracts does not rely on the work to be shared by the Tongan side, except for the Provisional Certificate of Nationality, which must be issued by the Government of Tonga. Undertakings at Tongan side are the works necessary for the operation of the Plan Vessel and to be completed before the commissioning of the Plan Vessel in Tonga.

Refer further to section 2-4-3 Scope of Works, regarding detail of sharing of works at Japan side and Tongan side.

(2) Building schedule of the Plan Vessel

In building the Plan Vessel, the shipbuilding Contractor first carries out production designs of steel hull structures and various outfittings based on the contract and associated technical specification, and besides based on the shipbuilder's own facility. With the completed production design drawings, hull construction, deck outfitting, machinery outfitting and electric outfitting follow as below.

a) Hull construction

Hull is the watertight structure with internal volume as buoyancy, and with strength to withstand water pressure, wave pressure, cargo loads in static and dynamic conditions. The work starts from marking on raw steel material, cutting, sub-assembly and block assembly on shipbuilding berth.

b) Deck outfitting

This work is performed after completion of the hull work. It comprises mooring arrangements, steering system, accommodation work, lifesaving apparatus, fire fighting equipment, cargo gears, etc.

c) Machinery outfitting

This work comprises installation, piping and associated work of main engines, diesel generators, pumps, etc.

d) Electric outfitting

This work is for installation of electric apparatus, control panels, etc. and for electric cable installation to supply electric power to all electric equipment on board.

e) Transport

After completion of the construction work at the shipyard and necessary tests, the Plan Vessel will be handed-over to the Government of Tonga. The Equipment (containers and forklifts) are delivered from the Contractor of the Equipment procurement, and loaded on board the Plan Vessel. Transport of the vessel loaded with the Equipment to Tonga is carried out under the responsibility of the shipbuilding Contractor.

Two engineers who had been dispatched from Tonga are to return to Tonga on board the Plan Vessel sailing from Japan to Tonga for the purpose of familiarization with the new vessel.

The projected building schedule of the Plan Vessel is as shown on the following.

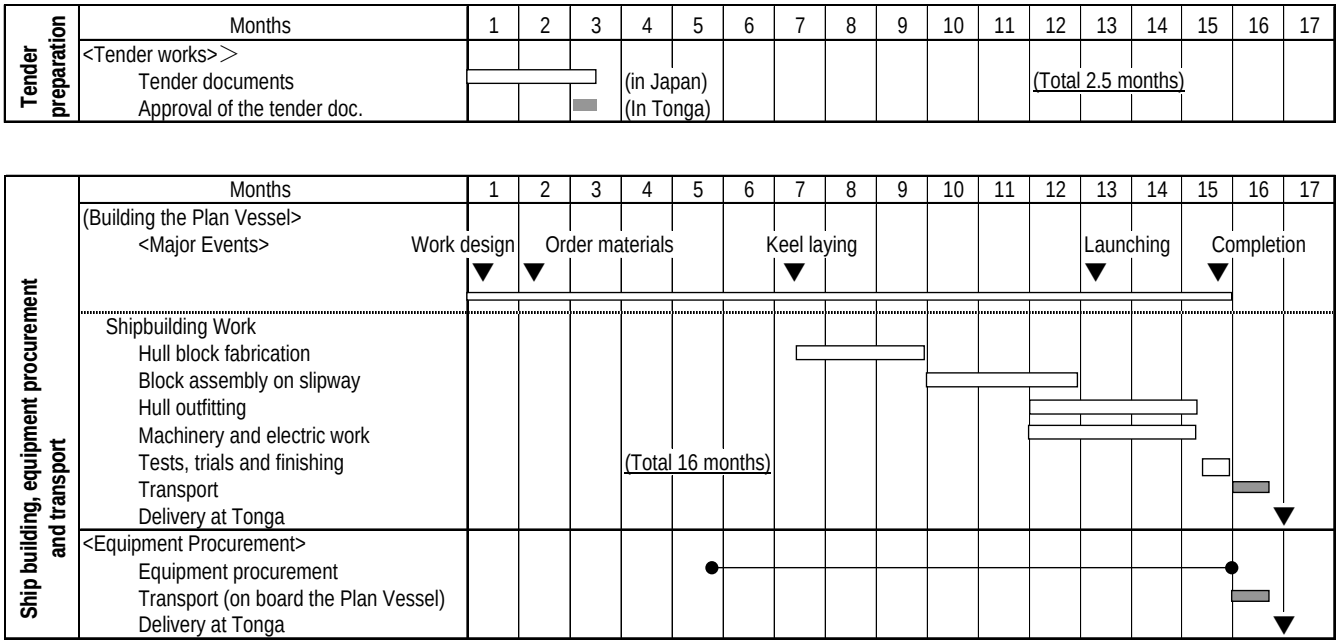


Fig. 2-21 Implementation schedule

Construction of the Plan Vessel is the long schedule taking 15 months from the shipbuilding contract to the completion in Japan, and further 1 month for transport to Tonga and final turning-over to the Government of Tonga. In this building schedule, the Consultant assigns 7 supervisors including the project manage, i.e. project manager / naval architect, hull outfitting – I and II, machinery expert, electric expert, accommodation expert and equipment procurement for supervising production designs and building site of complex passenger vessel.

Detailed work schedule for the production designs, building at site and onboard machinery / equipment procurement, submitted by the shipbuilder will be regularly followed up and countermeasures will be taken whenever necessary to maintain the planned schedule.

2-4 Obligations of the Recipient Country

Building of the Plan Vessel and the procurement of the Equipment are all undertaken by the Japan side, while the Tongan side should undertake following.

(Arrangements during implementation of the Project)

a) Banking arrangement (with an authorized foreign exchange bank in Japan), issuance of an authorization to pay, and bearing necessary commissions to the bank, for the contracts verified by the Government of Japan in relation with this Project.

b) Acquisition of licenses and certificates of the Government of Tonga, necessary for building and transporting the Plan Vessel, e.g. Provisional Certificate of Nationality.

(Arrangements when the Plan Vessel has arrived at Tonga)

c) Exemption of the Plan Vessel and Equipment from customs duties, internal taxes and fiscal levies, and prompt customs clearance.

d) Exemption of Japanese nationals from customs duties, internal taxes and fiscal levies for their services in Tonga.

(Preparation of wharf facility)

e) Homeport Nuku'alofa

Apron of Nuku'alofa wharf, unpaved, becomes entirely muddy, which makes passengers foot and forklift tires all muddy, and further makes vessel inside muddy. Apron of Nuku'alofa wharf should be paved.

Fender along Nuku'alofa wharf is too poor: only with two aged rubber tires. More fenders, solid rubber or used tires, should be added for safer berthing of vessels including the Plan Vessel.

f) Widening wharf ramps

All wharf ramps, on which vessel's stern ramp lands, should be so widened as to adapt landing area of the Plan Vessel's stern ramp.

Wharf ramps of Nuku'alofa, Pangai and Neiafu are too narrow for the Plan Vessel's stern ramp to land on those wharf ramps, and need widening.

g) Water depth in way of wharf and access channel

Water depth of Ha'afeva should be so deepened as to adapt draft of the Plan Vessel. Ports, which need dredging, may be Ha'afeva only, but Tongan side operator must examine and determine the dredging.

h) SCP workshop refurbish

SCP workshop should be refurbished fitting shelves to stow spare parts of the Plan Vessel and workbench for cleaning and reconditioning of parts.

i) Electric receptacles for reefer containers ashore

Electric receptacles should be fitted ashore to supply electric power to the reefer

containers procured by the Project.

(Other)

j) Any other items which are not covered under the Project.

2-5 Project Operation Plan

2-5-1 Vessel Operation Body

The Plan Vessel is to be registered in Tonga with the ownership of Ministry of Transport (MOT), Government of Tonga, to be leased by the public enterprise SCP, and SCP is to operate the Plan Vessel exclusively.

All businesses necessary for the vessel operation, e.g. clerical business, operation planning, crew manning, cargo collection, loading and unloading, supply of fuel, maintenance, and etc. are the business of SCP.

MOT, as the Owner, imposes responsible maintenance of inter-island sea transport on SCP. For the services to the Niuas islands, MOT specially subsidizes for every voyage to ensure the services.

2-5-2 Vessel Maintenance

Maintenance of the Plan Vessel is to be undertaken by the crew of the vessel and SCP workshop.

SCP workshop is in the main building of SCP, with floor area of 382m^2, 20 engineers, and machine tools necessary for ordinary maintenance job.

In this Project, Preventive Maintenance Policy (PMP) is adopted to minimize breakdown of machineries and elongate life of machineries. In the PMP, overhauling and maintenance must be carried out regardless of the condition of the machinery (i.e. whether it is in order or out of order) at the time planned in advance according to the PMP. Working parts

Weekly, monthly quarterly and annually working plan, and spare parts of diesel engines, generator, and auxiliaries necessary for PMP are to be procured by the Project.

Refer also to section 2-2-3 Basic Plan of the Spare Parts.

2-6 Operation and Maintenance Cost

SCP to operate the Plan Vessel is a public enterprise working on self-supporting accounting system.

Result SCP shipping business for three years, from 2004 to 2006, was revenue T$ 6,070,000 to expenditure T$ 6,379,000, i.e. loss of about 5%. Fuel cost occupies the largest part of the total expenditure, and badly influences corporate management. The next largest expenditure

is the maintenance/repair cost: total of three years is added up T$ 1,620,000 to occupy 25% of the total amount of expenditure, which is abnormally high.

Shown below is the past records of MV Olovaha and estimate of the Plan Vessel in operation. In 2004, MV Pulpaki was for long time absent due to aground accident, and in 2006 MV Pulpaki was again absent for 2 months to work outside Tonga. Therefore data of MV Olovaha in 2005 is used here to develop estimate of the Plan Vessel operation.

Result of the estimate (case 1) shows small profit even though cargo and passenger revenues stay same as 2005, contributed by the low maintenance / repair cost fairly compensating high fuel cost.

However, increase in cargo and passenger revenues is probable (case 2 and 3), resulting in more profit.

When the Plan Vessel is young, maintenance / repair cost is low but it gradually increases year by year. It is, therefore, important to implement PMP and to maintain steadily from the time when the vessel is still new looking for low repair cost in future.

It should also be considered to reserve a part of profits for funds of eventual big repairs and future procurement of a new or good secondhand vessel.

Table 2-18 Revenue and expenditure of SCP MV Olovaha and the Plan Vessel

	MV Olvaha records				**The Plan Vessel estimate**			
	Unit in T$ 1,000				Unit in T$ 1,000			
Year / Item	2004	2005年	2006年	2007 Plan	Case 1	Case 2	Case 3	Remark
Cargo amount (t)	10,300	12,500	13,900		12,500	18,750	12,500	
Nos. pax (pers.)	7,800	8,980	11,360		8,980	35,022	35,022	
Total nos. voyage	49	50	53		50	81	81	
Nos. voyage to Niuas	6	6	6	10	12	12	12	
FOC in Vava'u route (kl/voy.)					8.58	8.58	8.58	Calculated
FOC in Niuas route (kl/voy.)					20.82	20.82	20.82	Calculated
Annual FOC (kL)	560	540	560		576	842	842	
FO unit price (T$/kL)	791	1,569	1,884	1,748	1,884	1,884	1,884	Record in 2006
<Revenue>								
Cargo transport	859	1222	1762	1625	1,222	1,833	1,222	Proportional to 2005
Pax transport	390	444	616	468	444	1,732	1,732	Proportional to 2005
Charter	93	10	0	0	0	0	0	No charter
Government subsidy	180	188	179	283	376	376	376	Proportional to 2005
Other	2	117	8	16	10	10	10	
Total of revenue	1524	1981	2565	2392	2,052	3,951	3,340	
<Expenditure>								
Fuel oil	443	847	1055	1033	1,085	1,586	1,586	FOC x unit price
Lube oil	10	13	24	26	24	24	24	As Olovaha
Repair (incl. forklift)	264	357	999	612	131	131	131	Data of Japanese vessels
Crew food	34	42	49	48	47	70	70	Proportional to nos. voyage
Crew wage	101	110	127	138	141	173	173	Prop. to root of sail days of 2006
Technical advisor fee	0	0	33	54	54	54	54	2007 plan
Insurance	94	67	75	92	92	92	92	2007 plan
Dock fee	0	0	0	0	0	0	0	Included in repair
Forklift rental	8	22	29	47	0	0	0	No forklift rental
Wharfage	56	55	59	84	56	90	90	Prop. to voyage nos. 2006
Miscellaneous	73	71	82	53	53	53	53	2007 plan
General charges	200	200	201	200	200	200	200	2007 plan
Loan payments	107	60	60	0	0	0	0	2007 plan
Special expenditure	321	31	0	0	0	0	0	2007 plan
Total of expenditure	1711	1875	2793	2387	1,883	2,473	2,473	
Balance	-187	106	-228	5	169	1,478	867	
Profit rate (balance/revenue)	-12%	5%	-9%	0%	8%	37%	26%	

Case 1: Cargo weight, pax numbers and nos. voyages are kept same as 2005, but voyages to Niuas are increased to 12 as the Government commitment.

Case 2: Cargo and pax carried by MV Pulpaki in 2005 are all carried by the new Plan Vessel (cargo of 1.5 times and pax of 3.9 times). Nos. voyages are increased considerably to cover increase.

Case 3: Pax carried by MV Pulpaki in 2005 is all carried by the new Plan Vessel (cargo remains same but pax of 3.9 times). Increase in nos. voyage makes expenditure higher but profitable cargo revenue stays same.

Fuel cost: Quantity of consumption is based on the calculation of the Plan Vessel, and unit price is assumed same as that in 2006.

Maintenance/repair cost:

Average of 10 years after new building, estimated from the record of Japanese vessels

Chapter 3 Project Evaluation and Recommendations

3-1 Project Effects

Table 3-1 shows the expected effects from implementation of this project.

Table 3-1 Effects of the project

Status quo and problems	The existing inter-island ferry, despite being indispensable for the inhabitants of the islands, is already long overdue for retirement and decommissioning, and because of insufficient load capacity, is perpetually overloaded.
Measures taken in the cooperation project	Building of a new inter-island ferry
Direct effects and degree of improvement	(1) The ferry service can be continued. (2) The enhancement of the load capacity from 200 tons to 400 tons will prevent unsafe overloading. (3) A highly safe and stable ferry service can be ensured.
Indirect effects and degree of improvement	(1) The transportation of island products to urban areas will be promoted to increase the cash income of the remote islands. (2) The inflow of commodities to the remote islands will be increased to promote tourism development and improvement of living conditions.

3-2 Recommendations

3-2-1 Problems to be addressed by Tonga and proposals to Tonga

The proposals for making further use of the target facilities and equipment covered in this project are as follows:

The proposals for making further use of the target facilities and equipment covered in this Project are as follows:

(1) Supply of ferry service according to demand

The ferry to be built in this Project will have a loading capacity of 400 passengers and 400 tons cargoes. Since there is great variation in the demand for transportation of passengers and cargoes between the high and low seasons, the Project assumes that peak demand in the high season should be met by increasing the service frequency from the current once a week. SCP needs to estimate the demand in advance as accurately as possible and draw up a ferry service schedule with increased frequency as required in an effort to minimize freight congestion.

(2) Implementation of a Preventive Maintenance Policy (PMP) system

In the three-year income and expenditure balance of SCP from 2004 to 2006, maintenance and repair expenses accounted for about 25% of total expenditure, putting great pressure on management. Therefore, the current Project assumes the introduction of a Preventive Maintenance Policy (PMP) system. The PMP system refers to replacing parts at regular intervals regardless of the degree of breakdown and exhaustion and keeping the replaced parts serviced and stored, which can be done with the current level of technology in Tonga.

The ferry in this Project, while it is new just after entering service, will need little repair expenses and will bring a significant increase in revenue, but it will gradually need more and more repair expenses as it gets older. However, steady implementation of the PMP maintenance management system will allow SCP to significantly reduce the increase in expenses in the future.

APPENDIX

APPENDIX - 1 MEMBER LIST OF THE SURVEY TEAM

1-1 Member List (Field Survey)

FUNCTION	NAME	ORGANIZATION
Team Leader	Mr. Teiji Takeshita	Resident Representative of JICA Regional Support Office for Oceania
Project Coordinator	Mr. Hidetaka Sakabe	Transportation and Electric Power Team, Project Management Group I, Grant Aid Management Dept., JICA
Chief Consultant / Operation and Transportation Planning / Management and Maintenance Planning	Mr. Toyonori Watanabe	Fisheries Engineering Co., Ltd.
Hull and Engine Planning	Mr. Akio Yamada	Fisheries Engineering Co., Ltd.
Outfit and Electrical Planning	Mr. Satoshi Yamane	Fisheries Engineering Co., Ltd.
Equipment planning / procurement planning / cost estimate	Mr. Noboru Yamamoto	Fisheries Engineering Co., Ltd.

1-2 Member List (Consultation of Draft Report)

FUNCTION	NAME	ORGANIZATION
Team Leader	Mr. Teiji Takeshita	Resident Representative of JICA Regional Support Office for Oceania
Chief Consultant / Operation and Transportation Planning / Management and Maintenance Planning	Mr. Toyonori Watanabe	Fisheries Engineering Co., Ltd.
Hull and Engine Planning	Mr. Akio Yamada	Fisheries Engineering Co., Ltd.

APPENDIX - 2　SURVEY ITINERARY

2-1 Survey Schedule (Field Survey)

Day	Date	Movement	Activities	
1	Feb. 24 (Sat)	Lv. Tokyo(19:00)		
2	25 (Sun)	(Ar. Nadi)		
3	26 (Mon)	(Lv. Nadi) Nuku Alofa ETA11:05	Visit to Ministry of Transport (MOT) and JICA Tonga office Explanation / discussion about contents of Inception Report, Questionnaire and Tentative Schedule, to MOT and Shipping Corporation of Polynesia Limited (SCP)	
			Mr. Takeshita, Mr. Sakabe	Mr. Watanabe, Mr. Yamada Mr. Yamane, Mr. Yamamoto
4	27 (Tue)		Discussion with MOT and SCP	On board MV Olovaha： Nuku Alofa（13:00）→(22:30) Ha'afeva（23:00）→
5	28 (Wed)		Removal to Neiafu by Air plane －Survey of wharlf of Neiafu	→（01:30）Pangai (04:00) →(13:45) Neiafu
			Removal to Nuku Alofa by Air plane	
			Mr. Takeshita, Mr. Sakabe	Mr. Watanabe, Mr. Yamada Mr. Yamane, Mr. Yamamoto
6	Mar. 1 (Thu)		Discussion on the Minutes of Discussion at MOT	Discussion with SCP
7	2 (Fri)		Signing of the Minutes of Discussion	Survey of MV Olovaha Discussion with MOT
8	3 (Sat)		Discussion within the survey team	
9	4 (Sun)		Data analysis	
			Mr. Takeshita, Mr. Sakabe, Mr. Watanabe	Mr. Yamada, Mr. Yamane, Mr. Yamamoto
10	5 (Mon)	Mr. Takeshita to Suva	Visit to Foreign Affairs	Survey of work for loading/off loading on MV Olovaha at Nuku Alofa
			Mr. Sakabe, Mr. Watanabe, Mr. Yamada	Mr. Yamane, Mr. Yamamoto
11	6 (Tue)		Mr. Sakabe, Mr. Watanabe： Visit to Australia Aid office & New Zealand Aid office Mr. Yamada： Survey of SCP's Workshop	By air plane：Nuku Alofa→Neiafu On board MV Olovaha： Neiafu → Niuas Islands
12	7 (Wed)	Mr. Sakabe to Suva	Visit to JICA Tonga office Mr. Watanabe, Mr. Yamada：Discussion with SCP	On board MV Olovaha
			Mr. Watanabe, Mr. Yamada	Mr. Yamane, Mr. Yamamoto
13	8 (Thu)		AM：Discussion with Secretary of MOT PM：Discussion with SCP	On board MV Olovaha
14	9 (Fri)		Discussion with Secretary of MOT and surveyors of Marine & Ports	MV Olovaha arrive at Neiafu By air plane：Neiafu→Nuku Alofa
15	10 (Sat)		Discussion within the survey team. Collection data.	
16	11 (Sun)		Data analysis	

Day	Date	Movement	Activities	
			Mr. Watanabe, Mr. Yamada	Mr. Yamane, Mr. Yamamoto
17	12 (Mon)	Mr. Yamane, Mr. Yamamoto to Suva.	AM : Visit to JICA Tonga office PM : Discussion with SCP	AM : Visit to JICA Tonga office Survey of Equipment in Suva.
18	13 (Tue)		AM : Discussion with MOT PM : Discussion with SCP	
19	14 (Wed)		Discussion with MOT and SCP	
20	15 (Thu)		AM : Discussion with Minister of MOT PM : Survey of Forklift in SCP, collection data	
21	16 (Fri)		AM : Discussion with SCP PM : Discussion with MOT and SCP	
22	17 (Sat)		Discussion within the survey team. Collection data.	
23	18 (Sun)		Data analysis	
24	19 (Mon)	Mr. Watanabe, Mr. Yamada to Suva	Visit to MOT, SCP and JICA Tonga office Report to JICA Fiji office	
25	20 (Tue)		Report to Embassy of Japan	
26	21 (Wed)	Mr. Watanabe, Mr. Yamada to move to Nadi		
27	22 (Thu)	Lv. Nadi(10:50) Tokyo ETA17:00		

2-2 Survey Schedule **(Consultation of Draft Report)**

Day	Date	Movement	Activities
1	Oct. 1 (Mon)	Lv. Tokyo(19:00)	
2	2 (Tue)	(Nadi Ar.) (Nadi Lv.) Suva ETA10:00	Visit to Embassy of Japan and JICA Fiji office Explanation / discussion about contents of the Draft Report and Tentative Schedule
3	3 (Wed)	Lv. Suva(9:15)→ Nuku Alofa ETA11:50	Explanation / discussion about contents of the Draft Report and Tentative Schedule to Minister of MOT, SCP, surveyors of M & P and head of JICA Tonga office
4	4 (Thu)		Discussion with SCP and M & P
5	5 (Fri)		Discussion with Minister of MOT, SCP, surveyors of M & P, head of JICA Tonga office
6	6 (Sat)		Survey of wharf of Nuku Alofa
7	7 (Sun)		Discussion within the survey team
8	8 (Mon)		Discussion on the Minutes of Discussion at SCP : Minister of MOT, SCP, surveyors of M & P, head of JICA Tonga office and the survey team
9	9 (Tue)		Signing of the Minutes of Discussion
10	10 (Wed)	Lv. Nuku Alofa Suva ETA15:45	
11	11 (Thu)	Mr. Watanabe, Mr. Yamada to move to Nadi	Report to Embassy of Japan and JICA Fiji office
12	12 (Fri)	Lv. Nadi(9:55) Via Seoul Tokyo ETA20:55	

APPENDIX - 3 List of Parties Concerned in the Recipient Country

3-1 Field Survey

NAME	FUNCTION
Hon. Paul Karalus	Minister, Ministry of Transport
Mr. Sione 'Akau'iola	Ministry of Transport
Mr. Aisaki Eke	Secretary for , Ministry of Finance & Planning
Mr. Mosese Fatukala	Budget Project division, Ministry of Finance & Planning
Mr. Heney Cocker	Budget Project division, Ministry of Finance & Planning
Capt. William Johnson	Ministry of Marine & Ports
Capt. H.Motu Fakapelea	Ministry of Marine & Ports
Mr. Robert Hight	Shipping Corporation of Polynesia Limited
Capt. Viliami Vi	Shipping Corporation of Polynesia Limited
Mr. Tony Procter	Shipping Corporation of Polynesia Limited
Mr. Nikola Tau	Shipping Corporation of Polynesia Limited
Mele'ofa Mafi	Australian Agency for International Development
Moape Batgai	Fiji Ships & Heavy Industries Ltd.
Hirosi WATANABE	Fiji Embassy of Japan
Tetsuhiro IKE	JICA Fiji & Regional Support Office
Satoshi WAKASUGI	JICA Fiji office
Oka Tu'umoto'oa Hiroko	JICA Tonga office
Masako Takemae	JICA Tonga office

3-2 Consultation of Draft Report

NAME	FUNCTION
Hon. Paul Karalus	Minister, Ministry of Transport
Mr. Aisaki Eke	Secretary for , Ministry of Finance & Planning
Capt. William Johnson	Ministry of Marine & Ports
Capt. H.Motu Fakapelea	Ministry of Marine & Ports
Mr. John Jonesse	Shipping Corporation of Polynesia Limited, CEO
Capt. Viliami Vi	Shipping Corporation of Polynesia Limited
Mr. Tony Procter	Shipping Corporation of Polynesia Limited
Mr. Nikola Tau	Shipping Corporation of Polynesia Limited
Tatsushi Matsuo	Fiji Embassy of Japan
Hirosi Watanabe	Fiji Embassy of Japan
Reiko Konosu	Fiji Embassy of Japan

Nariaki Mikuni	JICA Fiji & Regional Support Office
Satoshi WAKASUGI	JICA Fiji office
Nobuaki Matsui	JICA Tonga office
Noriyuki Nakamura	JICA Tonga office
Oka Tu'umoto'oa Hiroko	JICA Tonga office

APPENDIX - 4 MINUTES OF DISCUSSION

4-1 Field Survey

Minutes of Discussions
on the Basic Design Study
on the Upgrading Project of Inter-island Sea Transportation
in the Kingdom of Tonga

In response to a request from the Government of the Kingdom of Tonga (hereinafter referred to as "the Tonga"), the Government of Japan decided to conduct a Basic Design Study on the Upgrading Project of Inter-island Sea Transportation (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent the Basic Design Study Team (hereinafter referred to as "the Team"), which is headed by Teiji Takeshita, Resident Representative of Regional Support Office for Oceania, JICA, and is scheduled to stay in the country from February 26, 2007 to March 19, 2007.

The Team held discussions with the officials concerned of the Government of Tonga and conducted a field survey at the study area.

In the course of discussions and field survey, both parties confirmed the main items described on the attached sheets. The Team will proceed to further works and prepare the Basic Design Study Report.

Nuku'alofa, March 2, 2007

Teiji Takeshita
Leader
Basic Design Study Team
Japan International Cooperation Agency

Hon. Paul Karalus
Minister for Transport
Ministry of Transport
Kingdom of Tonga

'Aisake Eke
Secretary for Finance and Planning
Ministry of Finance and Planning
Kingdom of Tonga

ATTACHMENT

1. Objective of the Project

The objective of the Project is to provide a ferry and related equipment for improvement of safety and reliability of domestic sea transportation.

2. Project sites

The site is shown in Annex-1.

3. Responsible and Implementing Agency

The Responsible and Implementing Organization is "Ministry of Transport". The Organization Chart of the Ministry of Transport is shown in Annex-2.

4. Items requested by the Government of Tonga

4-1. After discussions with the Team, the following items described as follows were finally requested by the Tongan side.

(1) Construction of a Ferry

To construct one ferry for domestic passenger and cargo specified as follows:

- Length Overall: Max 55m;
- Passenger capacity: 300/400 persons;
- Cargo carrying capacity: 200/300 ton.

(2) Procurement of Equipment

1) One weigh-bridge at port Nuku'alofa,
2) Two Forklift Trucks (Capacity 6ton), and
3) Cargo containers for the ferry to be constructed (20 dry containers, 20 reefer containers).

(3) Spare parts

Spare parts for the ferry and the equipment mentioned above necessary for 2 years operation and Maintenance.

4-2. Through the discussions, the Tongan side explained that demand of sea-transportation for new ferry increased from that of the original request, and therefore proposed that the capacity of the ferry to be constructed should be increased considerably from the indication on the original request. The Team answered that its proposal might not be acceptable for the Japanese side, and the capacity of the ferry should be examined through the study based on the result of

demand forecasting, planning of ferry operation etc.

4-3. JICA will assess the appropriateness of the request and will recommend to the Government of Japan for approval.

5. Japan's Grant Aid Scheme

5-1. The Tongan side understands the Japan's Grant Aid Scheme explained by the Team, as described in Annex-3.

5-2. The Tongan side will take the necessary measures, as described in Annex-4, for smooth implementation of the Project, as a condition for the Japanese Grant Aid to be implemented.

6. Schedule of the Study

6-1. The Team will proceed to further studies in Tonga until March 19, 2007.

6-2. JICA will prepare the draft report and draft specification in English and dispatch a mission in order to explain its contents around August, 2007.

6-3. In case that the contents of the report are accepted in principle by the Government of Tonga, JICA will complete the final report in English and send it to the Government of Tonga by November, 2007.

7. Other relevant issues

7-1. The Tongan side explained that there is no duplication between contents of the Project and any other plan and/or project implemented by the other donors or the Tongan own expenses.

7-2. The Tongan side explained that "Shipping Corporation of Polynesia Limited (SCP)" had been established as a public corporation, which were administrated by the Ministry of Transport, and would not be privatized in the foreseeable future.

7-3. The Tongan side will improve and/or rehabilitate the existing wharf necessary for safe and smooth operation of the ferry at its own expense, if necessary.

7-4. The Tongan side understood that the importance of appropriate operation and the periodical maintenance for the new ferry as explained by the Team, and shall allocate the appropriate budget and conduct the undertakings in a timely manner necessary for proper operation, maintenance and substitution of the ferry to be constructed under the Project. Both sides confirmed that the Tongan side would examine the budget allocation plan necessary for operation and maintenance of the ferry after discussion within the government of Tonga, and submit the result to JICA Tonga Office by the end of July, 2007.

7-5. The Tongan side explained that inter-islands sea transportation by public sector in Tonga was fundamental to bolster the livelihood of isolated islands' residents in aspects of the stable supply of commodities, foodstuff, pharmaceutical preparations etc. and promotion of the economic activities in isolated islands, e.g. export of the cash products etc.

7-6. The Tongan side explained that the cargo handling (loading and unloading) for the ferry O'lovaha was managed and conducted by SCP at each port of berth, and it would be continued after the substitution of the ferry by the Project.

7-7. The Tongan side agreed to conduct the safety control and measures necessary for the smooth implementation of the Study during the period of the Team in Tonga.

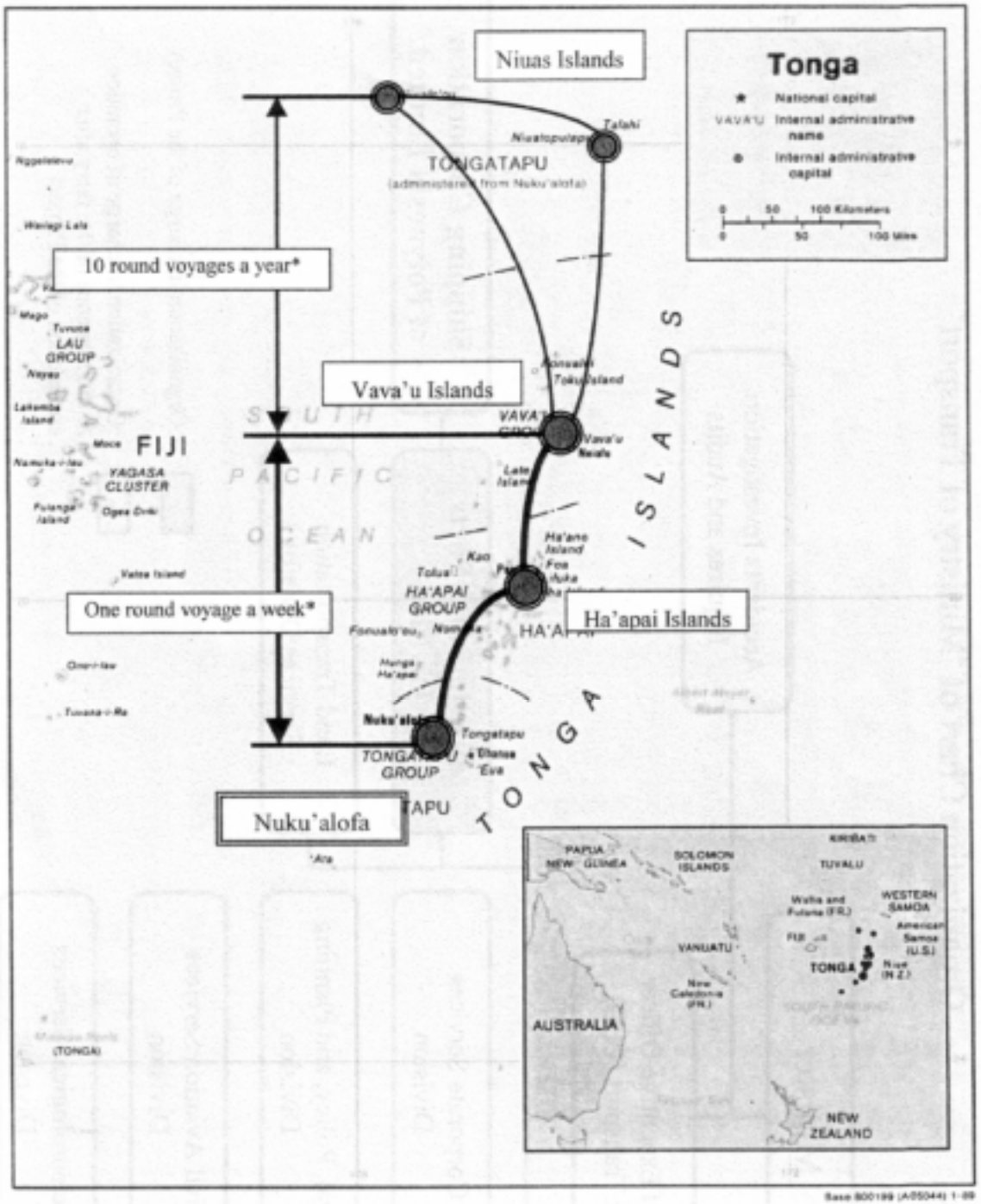
7-8. Tongan side shall arrange and/or issue the permission for the members of the Team to enter the existing ferries and related sites and film necessary for collection of information for Basic Design.

7-9. The Tongan side shall provide necessary number(s) of counterpart personnel to the Team during the period of the Team in Tonga.

7-10. The Tongan side shall submit answers to the Questionnaire to the Team, which the Team handed to the Tongan side, by March 5th, 2007. If more time for response is required, the rest of the answers shall be forwarded to the Team by March 18, 2007.

(Annex-1)

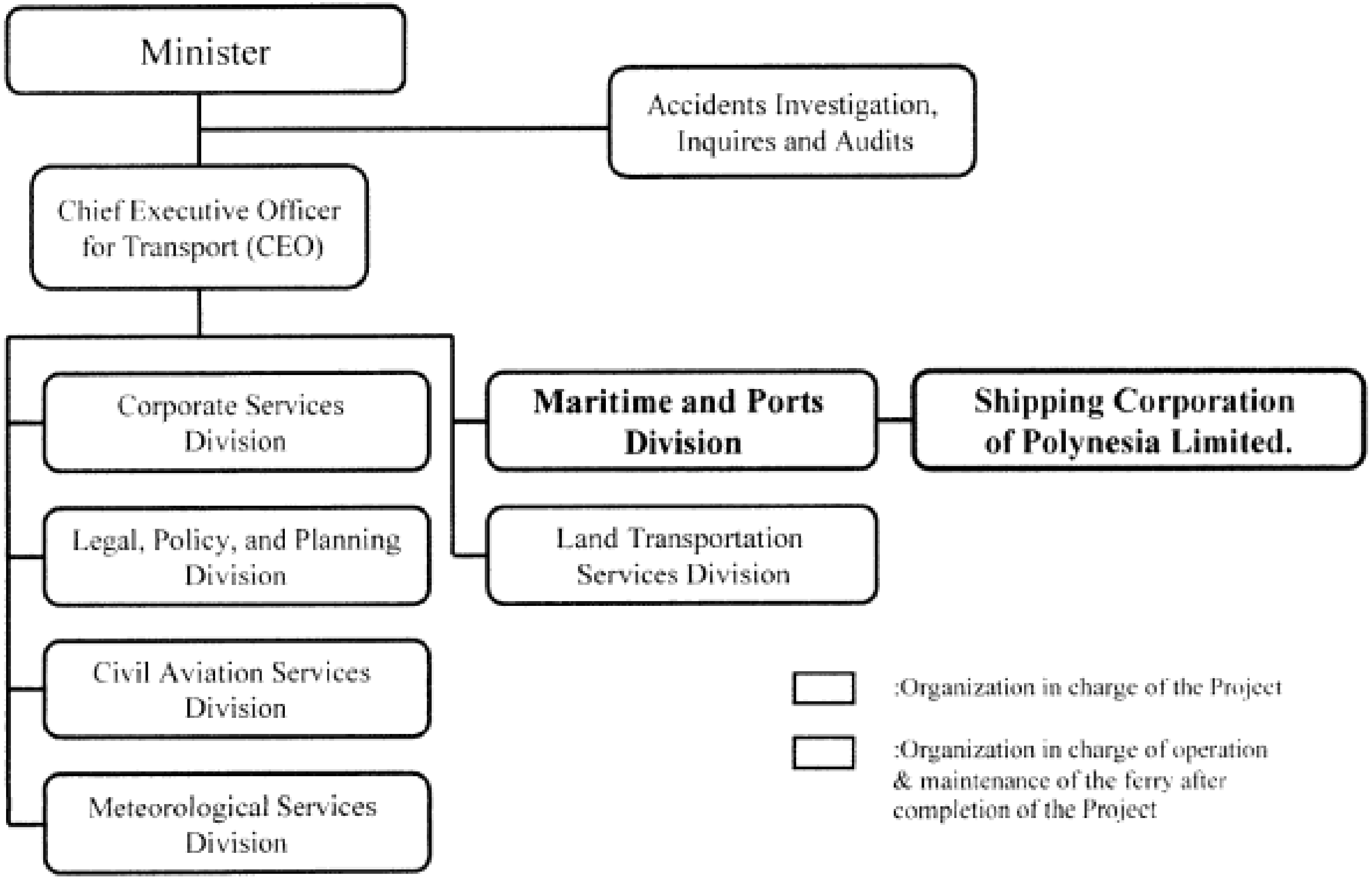
Project Site



*Note: The frequency of the voyage is current condition

(Annex-2)

Organization Chart of "Ministry of Transport"



Japan's Grant Aid Scheme for General Project

The Grant Aid Program provides a recipient country with non-reimbursable funds to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for economic and social development of the country under principles in accordance with the relevant laws and regulations of Japan. Grant Aid is not supplied through the donation of materials as such.

1. Grant Aid Procedure

1) Japan's Grant Aid Program is executed through the following procedures.

Application	(Request made by a recipient country)
Study	(Basic Design Study conducted by JICA)
Appraisal & Approval	(Appraisal by the Government of Japan and Approval by Cabinet)
Determination of Implementation	(The Notes exchanged between the Governments of Japan and the recipient country)

2) Firstly, the application or request for a Grant Aid project submitted by a recipient country is examined by the Government of Japan (the Ministry of Foreign Affairs) to determine whether or not it is eligible for Grant Aid. If the request is deemed appropriate, the Government of Japan assigns JICA to conduct a study on the request. If necessary, JICA send a Preliminary Study Team to the recipient country to confirm the contents of the request.

Secondly, JICA conducts the study (Basic Design Study), using Japanese consulting firms.

Thirdly, the Government of Japan appraises the project to see whether or not it is suitable for Japan's Grant Aid Programme, based on the Basic Design Study report prepared by JICA, and the results are then submitted to the Cabinet for approval.

Fourthly, the project, once approved by the Cabinet, becomes official with the Exchange of Notes signed by the Governments of Japan and the recipient country.

Finally, for the implementation of the project, JICA assists the recipient country in such matters as preparing tenders, contracts and so on.

2. Basic Design Study

1) Contents of the Study

The aim of the Basic Design Study (hereinafter referred to as "the Study"), conducted by JICA on a requested project (hereinafter referred to as "the Project"), is to provide a basic document necessary for the appraisal of the Project by the Government of Japan. The contents of the Study are as follows:

a) confirmation of the background, objectives and benefits of the Project and also institutional capacity of agencies concerned of the recipient country necessary for the Project's implementation;
b) evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from the technical, social and economic points of view;
c) confirmation of items agreed on by both parties concerning the basic concept of the Project;
d) preparation of a basic design of the Project; and
e) estimation of costs of the Project.

The contents of the original request are not necessarily approved in their initial form as the contents of the Grant Aid project. The Basic Design of the Project is confirmed considering the guidelines of Japan's Grant Aid Scheme.

The Government of Japan requests the Government of the recipient country to take whatever measures are necessary to ensure its self-reliance in the implementation of the Project. Such measures must be guaranteed even through they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country through the Minutes of Discussions.

2) Selection of Consultants

For the smooth implementation of the Study, JICA uses a consulting firm selected through its own procedure (competitive proposal). The selected firm participates the Study and prepares a report based upon the terms of reference set by JICA.

At the beginning of implementation after the Exchange of Notes, for the services of the Detailed Design and Construction Supervision of the Project, JICA recommends the same consulting firm which participated in the Study to the recipient country, in order to maintain the technical consistency between the Basic Design and Detailed Design as well as to avoid any undue delay caused by the selection of a new consulting firm.

3. Japan's Grant Aid Scheme

1) Exchange of Notes (E/N)

Japan's Grant Aid is extended in accordance with the Notes exchanged by the two Governments concerned, in which the objectives of the project, period of execution, conditions and amount of the Grant Aid, etc., are confirmed.

2) "The period of the Grant" means the one fiscal year which the Cabinet approves the project for. Within the fiscal year, all procedure such as exchanging of the Notes, concluding contracts with consulting firms and contractors and final payment to them must be completed.
However, in case of delays in delivery, installation or construction due to unforeseen factors such as weather, the period of the Grant Aid can be further extended for a maximum of one fiscal year at most by mutual agreement between the two Governments.

3) Under the Grant, in principle, Japanese products and services including transport or those of the recipient country are to be purchased.

When the two Governments deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country.

However, the prime contractors, namely consulting, contracting and procurement firms, are limited to "Japanese nationals". (The term "Japanese nationals" means persons of Japanese nationality or Japanese corporations controlled by persons of Japanese nationality.)

4) Necessity of "Verification"
The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by the Government of Japan. This "Verification" is deemed necessary to secure accountability of Japanese taxpayers.

5) Undertakings required to the Government of the recipient country
a) to secure a lot of land necessary for the construction of the Project and to clear the site;
b) to provide facilities for distribution of electricity, water supply and drainage and other incidental facilities outside the site;
c) to ensure prompt unloading and customs clearance at ports of disembarkation in the recipient country and internal transportation therein of the products purchased under the Grant Aid;
d) to exempt Japanese nationals from customs duties, internal taxes and fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the verified contracts;
e) to accord Japanese nationals whose services may be required in connection with the supply of the products and services under the verified contracts such as facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work;
f) to ensure that the facilities constructed and products purchased under the Grant Aid be maintained and used properly and effectively for the Project; and
g) to bear all the expenses, other than those covered by the Grant Aid, necessary for the Project.

6) "Proper Use"
The recipient country is required to maintain and use the facilities constructed and equipment purchased under the Grant Aid properly and effectively and to assign the necessary staff for operation and maintenance of them as well as to bear all the expenses other than those covered by the Grant Aid.

7) "Re-export"
The products purchased under the Grant Aid shall not be re-exported from the recipient country.

8) Banking Arrangement (B/A)
a) The Government of the recipient country or its designated authority should open an account in the name of the Government of the recipient country in an authorized foreign exchange bank in Japan (hereinafter referred to as "the Bank"). The Government of Japan will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the verified contracts.
b) The payments will be made when payment requests are presented by the Bank to the

Government of Japan under an Authorization to Pay (A/P) issued by the Government of recipient country or its designated authority.

9) Authorization to Pay (A/P)
The Government of the recipient country should bear an advising commission of an Authorization to Pay and payment commission to the Bank.

(Annex-4)

Major Undertakings to be taken by Each Government

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	Design and Construction of the ferry	●	
2	Procurement of equipment to be covered under the Project	●	
3	Any items which are not covered under the Project, e.g. rehabilitation of existing wharf, etc.		●
4	Allocate the appropriate budget and conduct the undertakings in a timely manner necessary for proper operation and maintenance of the ships to be provided (procurement of fuel and spare parts, and overhaul of the ferry)		●
5	To bear the following commissions to the Japanese bank for banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
6	To ensure unloading and customs clearance at port of disembarkation in recipient country		
	1) Marine (Air) transportation of the products from Japan to the recipient	●	
	2) Tax exemption and custom clearance of the products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site	(●)	(●)
7	To accord Japanese nationals, whose service may be required in connection with the supply of the products and the services under the verified contact, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●
8	To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the verified contracts		●
9	To maintain and use properly and effectively the facilities contracted and equipment provided under the Grant		●
10	To bear all the expenses, other than those to be borne by the Grant, necessary for construction of the facilities as well as for the transportation and installation of the equipment		●

(B/A: Banking Arrangement, A/P: Authorization to pay)

4-2 Consultation of Draft Report

Minutes of Discussions
on Basic Design Study
on the Project for Construction of Inter-Island Vessel
in the Kingdom of Tonga
(Explanation of Draft Report)

In February 2007, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Basic Design Study Team on Upgrading Project of Inter-island Sea Transportation (hereinafter referred to as "the Project") to the Kingdom of Tonga (hereinafter referred to as "Tonga"), and through discussions, field survey and technical examination of the results in Japan, JICA prepared a draft report of the study.

In order to explain and to consult with the concerned officials of the Government of Tonga on the contents of the draft report, JICA sent to Tonga the Basic Design Explanation Team (hereinafter referred to as "the Team"), which is headed by Teiji Takeshita, Resident Representative of Regional Support Office for Oceania, JICA, from October 3 to October 10, 2007.

As a result of discussions, both sides confirmed the main items described in the attached sheets.

Nuku'alofa, October 9, 2007

Teiji TAKESHITA
Leader
Basic Design Explanation Team
Japan International Cooperation Agency

Hon. Paul Karalus
Minister for Transport
Ministry of Transport
Kingdom of Tonga

'Aisake Eke
Secretary for Finance and Planning
Ministry of Finance and Planning
Kingdom of Tonga

ATTACHMENT

1. Components of the Draft Report

The Tongan side agreed and accepted in principle the contents of the draft report of Basic Design Study explained by the Team.

2. Japan's Grant Aid Scheme

The Tongan side reconfirmed the Japan's Grant Aid scheme and the necessary measures to be taken by the Tongan side as explained by the Basic Design Study Team and described in the Annex-3 and 4 of the Minutes of Discussions signed by both sides on March 2, 2007.

3. Schedule of the Study

JICA will complete the Final Report in English, in accordance with the confirmed items and send it to the Tongan side by the end of January 2008.

4. Cost Estimation

Both sides agreed that the Project Cost Estimation as attached in Annex-1 should never be duplicated or released to any third parties before the signing of all the Contract(s) for the Project.

5. Other Relevant Issues

5-1. Both sides confirmed that the following undertakings should be taken by the Tongan side at the Tongan expenses.

(1) To obtain the provisional nationality certificate and necessary document for the transportation of the ferry to be constructed under the Project from Japan to Tonga,
(2) Necessary improvement and/or repair of existing facilities at each port, e.g. pavement of apron, widening of slope at quays, etc. by the end of 2009,
(3) Procurement and installation of reefer receptacles for reefer containers to be procured under the Project,
(4) To dredge the quay side and approach course at each port of call for berthing of the ferry to be constructed under the Project, if necessary,
(5) Necessary arrangement for the tax exemption for the Project,
(6) Budget allocation for commission for Authorization to Pay and Payment,
(7) To purchase and install racks necessary for stock of spare parts.

5-2. The Tongan side shall secure necessary budget and personnel for the operation and maintenance of the facilities to be constructed under the Project, including periodical maintenance works after the completion of the Project.

5-3. The Tongan side shall accumulate sufficient funds necessary for construction of a new vessel for future replacement. Tongan side shall establish a mechanism of accumulating funds and report the same mechanism to the JICA Tonga Office and the Embassy of Japan for Tonga.

5-4. Both sides confirmed that when the operation system for the vessel under the Project will be changed, e.g. code-sharing operation with private companies, etc., the Tongan side should contact to and consult with the JICA Tonga Office and the Embassy of Japan for Tonga about this matter in advance.

5-5. Both sides confirmed that the name of the Project is "the Project for Construction of Inter-Island Vessel".