Ministry of Land Survey and Natural Resources
Kingdom of Tonga

PREPARATORY SURVEY REPORT

ON

THE PROJECT FOR

INTRODUCTION OF CLEAN ENERGY

BY SOLAR HOME SYSTEM

IN

THE KINGDOM OF TONGA

MARCH 2010

JAPAN INTERNATIONAL COOPERATION AGENCY

YACHIYO ENGINEERING CO., LTD.

ICONS INTERNATIONAL COOPERATION INC.

SHIKOKU ELECTRIC POWER CO., INC.

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PREFACE

Japan International Cooperation Agency (JICA) conducted the preparatory survey on the Project for Introduction of Clean Energy by Solar Home System in the Kingdom of Tonga.

JICA sent to Tonga a survey team from 24th August to 19th September, 2009.

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 outline 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.

March 2010

Kazuhiro YONEDA
Director General
Industrial Development Department
Japan International Cooperation Agency

March 2010

LETTER OF TRANSMITTAL

We are pleased to submit to you the preparatory survey report on the Project for Introduction of Clean Energy by Solar Home System in the Kingdom of Tonga.

This survey was conducted by the Consortium of Yachiyo Engineering Co., Ltd., ICONS International Cooperation Inc., and Shikoku Electric Power Co., Inc., under a contract to JICA, during the period from June, 2009 to March, 2010. In conducting the survey, we have examined the feasibility and rationale of the project with due consideration to the present situation of the Kingdom of Tonga and formulated the most appropriate outline 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,

Tadayuki Ogawa
Project manager,
Preparatory Survey team on
The Project for Introduction of Clean Energy by
Solar Electricity Generation System

The Consortium of Yachiyo Engineering Co., Ltd.,
ICONS International Cooperation Inc., and
Shikoku Electric Power Co., Inc.

SUMMARY

SUMMARY

① Outline of the Recipient Country

Kingdom of Tonga (hereinafter referred to as Tonga) is an island nation belonging of Polynesia and situated between latitude 15~23.30° S. and longitude 173~177° E. in the mid-south west part of the Pacific Ocean. The national land consists of main four islands group such as Tongatapu, Ha'apai, Vava'u and Niuas and their group islands studded in approximately 1,000 kilometers in south to north, approximately 500 kilometers in east to west in of expansive waters centered. The combined land area is 750km2. The national population is approximately 101,991 (results of 2006 census survey), of which 70% or approximately 72,045 live on Tongatapu islands where the capital Nuku'alofa is located. Almost all citizens are Christian. The official languages are Tongan and English. The climate is tropical and marine. Daily fluctuation of temperature shows bigger tendency than daily fluctuation of temperature. The period of low cool weather is generally between June and October by seasonal wind from south-east. Average temperature in July is 21.3℃ in Nuku'alofa

Tonga has a GDP (gross domestic product) of approximately US$247 million (2006-2007, per capita GNP is US$2,422).

Tonga has a burgeoning trade deficit; according to data from 2007, the value of exports was approximately US$8,074 thousand whereas the value of imports was US$143,888 thousand. For this reason, the Government of Tonga is actively working to introduce foreign capital and, under the Law on Preferential Measures for Industrial Development, it has exempted tariffs on goods imported for the purposes of processing, manufacturing and assembly and reduced port taxes by 50% on imports of capital goods. In spite of these efforts, the anticipated effects are not being realized due to the recent recession in the worldwide economy.

Government finances are greatly dependent on donors such as Australia, New Zealand and Japan. According to data from 1998-1999, out of the development planning budget of US$147.6 million, 15.3% was raised internally while 84.7% was derived from grants and loans from overseas donors.

As in other island nations, the main industrial sectors in Tonga are agriculture, forestry and fisheries centered on small-scale exporting and also tourism. In particular, pumpkins have been cultivated for more than 10 years making a contribution to private sector industrial promotion as one of the country's few international commodity crops. These are extremely suited to the unique natural conditions of Tonga, i.e. torus coral shelves, which set it apart from other island nations. In recent years, the main fisheries activity has been coastal fishing by small vessels. Although it isn't capable of targeting international markets like tuna fishing and so on, seaweed is regarded as a potential export item, while in the agriculture sector watermelons are viewed in the same way. The following figure depicts the industrial structure of Tonga.

However, the fact still remains that the Tongan economy is propped up by overseas remittances from emigrants in Australia, New Zealand and the United States, etc. and the aforementioned economic aid of overseas donors such as Australia and New Zealand, etc. According to the data of the World Bank, the overseas remittances hold 39% of the GDP in 2006. As a result, the Tongan economy is far from

self sufficient, and its heavy dependence on imported foods gives rise to the current trade deficit, which is offset by the abovementioned overseas remittances and economic aid. The government has particularly emphasized development of the private sector (tourist resorts) and enhancement of infrastructure areas such as education and public health through the introduction of overseas capital. As a result, the infrastructure of Tonga has reached a certain degree of development. However, since 1996, due to declining prices of pumpkins and other agricultural products, government finances have displayed a perennial deficit.

② Background, Concept of the Project

Concerning energy policy in the Kingdom of Tonga (hereinafter referred to as Tonga), Ministry of Land Survey and Natural Resources (MLSNR) and plural ministries act as responsible ministries. Concerning renewable energy policy in Tonga, the Renewable Energy Committee established under the Office of the Prime Minister has been working out for the policy with support by World Bank and coordinate for implementing related projects. Meanwhile, the Energy Planning Unit (EPU) under MLSNR is responsible for formulating national energy plans and energy policies, as well as diesel generation and off-grid generation on remote islands and implementing and supervising including solar home system projects on remote islands under assistance from donors.

In addition, the Tonga Power Limited (TPL) is in charge of city electricity supply and manages operations from generation through to distribution via the grid facilities installed mainly in the capital Nuku'alofa and the main islands of Vava'u and Ha'apai, however, it doesn't conduct any operations in the field of renewable energy. Concerning LGP, Tonga Home Gas, which is 50% owned by the Government of Tonga, conducts supply based on imported gas.

Tonga has traditionally relied on imported petroleum and biomass (timber, coconuts, etc.) to provide its energy resources. However, in reflection of reduced forest area due to conversion to farmland and shift towards a high energy consuming economy in recent years, the share of biomass has declined while that of petroleum products has increased. In 1992, whereas the shares of biomass and petroleum products were 56% and 44% respectively, these had changed to 43% and 54% respectively by 2001. According to TPL, which is in charge of power supply in key areas, the future rate of increase in electricity demand is projected as around 7% per year, and there are plans to newly supply 2.8MW from thermal power or photovoltaic power by August 2010.

However, because the present energy supply setup greatly dependent on imported petroleum is highly vulnerable to changes in the external environment such as the price inflation of petroleum products in recent times, the Government of Tonga is aiming to build a setup which will guarantee the stable supply of energy irrespective of petroleum price fluctuations. The government is aiming to derive 50% of all grid electricity from renewable energy sources by 2012, and it has been working full-time on the development of renewable energies since 2008.

In order to achieve the purpose photovoltaic power is regarded as one of the important means for achieving this target. Tonga has promoted the installation of solar home systems (SHS) under support from Australia and the EU, etc. on remote islands of the Vava'u islands, Ha'apai islands and Niuas, etc. since the 1990s.

In tandem with support for a sustainable energy supply setup on remote islands, there is also need to utilize the know-how accumulated in these projects with a view to developing a mechanism for realizing clean energy utilization appropriate for supporting measures to address climate change.

Against such a background, Japan International Cooperation Agency dispatched Project Formulation Study Team for collection of related information and project formulation on February 2009, and based on the survey installation of SHS in non-electrification area at present was requested to the Government of Japan for the purpose to establish sustainable energy supply system in remote islands.

③ Outline of the Study Results and Project Contents

In response to the said request, the Government of Japan decided to implement the necessary study and consigned JICA to dispatch the following Study Teams to carry out the Project Formulation Study and Preparatory Study.

Preparatory Study:	24th August to 20th September, 2009
Discussion of Draft Outline Design:	19th February to 28th February, 2010

Based on the findings of the Project Formation Study, the Preparatory Study Team conducted site surveys and proceeded to implement domestic analysis. In doing so, it surveyed and examined the background and contents of the Project, natural conditions, environmental and social consideration, the maintenance setup and the building situation, etc. in Tonga. It then planned the appropriate scale and contents of the Project as a grant aid undertaking, explained the study findings and contents of the Basic Design to the related agencies on the Tonga's side and reached a basic agreement following discussion,

As a result of the study, the appropriate scope of Japan's cooperation in the Project was judged to be the installation of SHS to general households and public institutes such as church, community house and school in 2 islands in Tongatapu Group and 11 ialsnds in Vava'u Groups where are non-electrification area, and the basic design shown in Table 1 below was carried out (right hand column of the table).

Outline of the Basic Plan

	Procurement and installation of the following PV equipment	Quantity
Equipment procurement and installation Plan	PV modules	1 set
	Steel pole for PV module	1 set
	Storage battery	1 set
	Charge Controller	1 set
	Cable and initial lighting fixtures	1 set
Equipment procurement plan	PV system exchange parts, maintenance tools and test apparatus	1 set

④ Project Work Schedule and Cost Estimation

In the event where the Project is implemented under the scheme of Environment and Climate Change Program Grant Aid of the Government of Japan, the rough Project cost will be approximately 584.2 million yen (approximately 583.5 million yen borne by Japan and 0.7 million yen by the Tonga). The main cost item borne by Tongan side will be the expense for personnel regarding equipment future maintenance and management and procurement of necessary consumables, spare parts and so on. The Project works schedule will be around 26 months including the preparation of tender documents.

⑤ Verification of Project Validity

Implementation of the Project will make it possible to supply electric power generated from photovoltaic energy utilizing SHS to approximately 307 citizens in two islands of Tongatapu Group and 1,044 citizens in eleven ialsnds of Vava'u Group, total 1,351 citizens (as of 2006 population census). In doing so, it will be possible to meet basic needs by residents such as night lighting and charging radio and mobile phone to non-electrification area. Accordingly, validity of Project implementation under the Environment and Climate Change Program Grant Aid scheme is deemed to be extremely valid.

Equipment will be possessed by MLSNR after handover. Outer Islands Solar Electricity Society, which will be established in Tongatapu Islands and Vava'u Islands, will do financial management in purpose of not only technical operation, maintenance and management including personnel management of technician assigned in each town. Equipment has been procured by other donors in both targeting Project areas in the past. . Accordingly, since the appropriate operation and maintenance technology for the SHS procured and installed under the Project will be transferred through implementation of the soft component, it should be possible to secure the required operation and maintenance capability providing that the appropriate human resources and budget management is conducted by the Solar societies in the future.

In order for the Project effects to be realized and sustained, the main issues that need to be tackled by the Tongan side are as follows.

(1) To ensure the stable operation of the SHS, it will be necessary to manage and to support technically technician assigned in the each town who observe preventive maintenance measures such as implementing daily and periodic site patrols and inspections, and to implement necessary personnel management of these technicians in collaboration with Solar Electricity Committee in each islands.

(2) To promptly appoint the engineers who will take part in the Project soft component and OJT, to facilitate their attendance at the said training, and to ensure that technology is horizontally conveyed to other engineers who could not participate in the training.

(3) Concerning SHS system that will be procured and installed by the Japanese side in the Project, it will be necessary to establish a power tariff scheme that enables future investment costs to be recovered, particularly in anticipation of renewals of the batteries at the end of their expected service life and will be necessary to implement appropriate financial management.

(4) In the view of environmental protection, system to collect and to recycle used battery shall be established.

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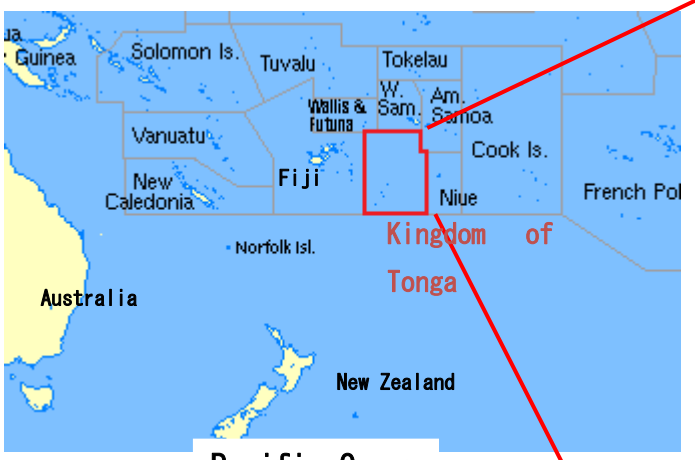
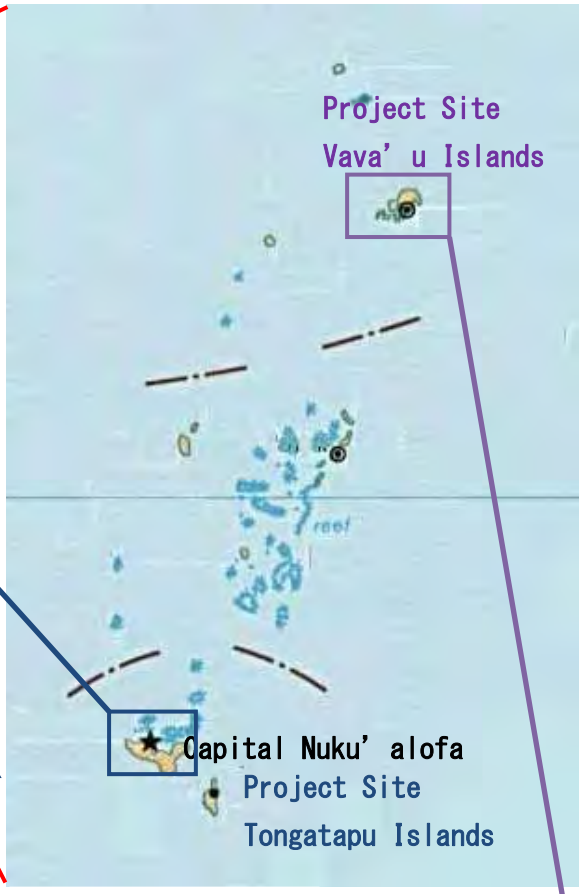
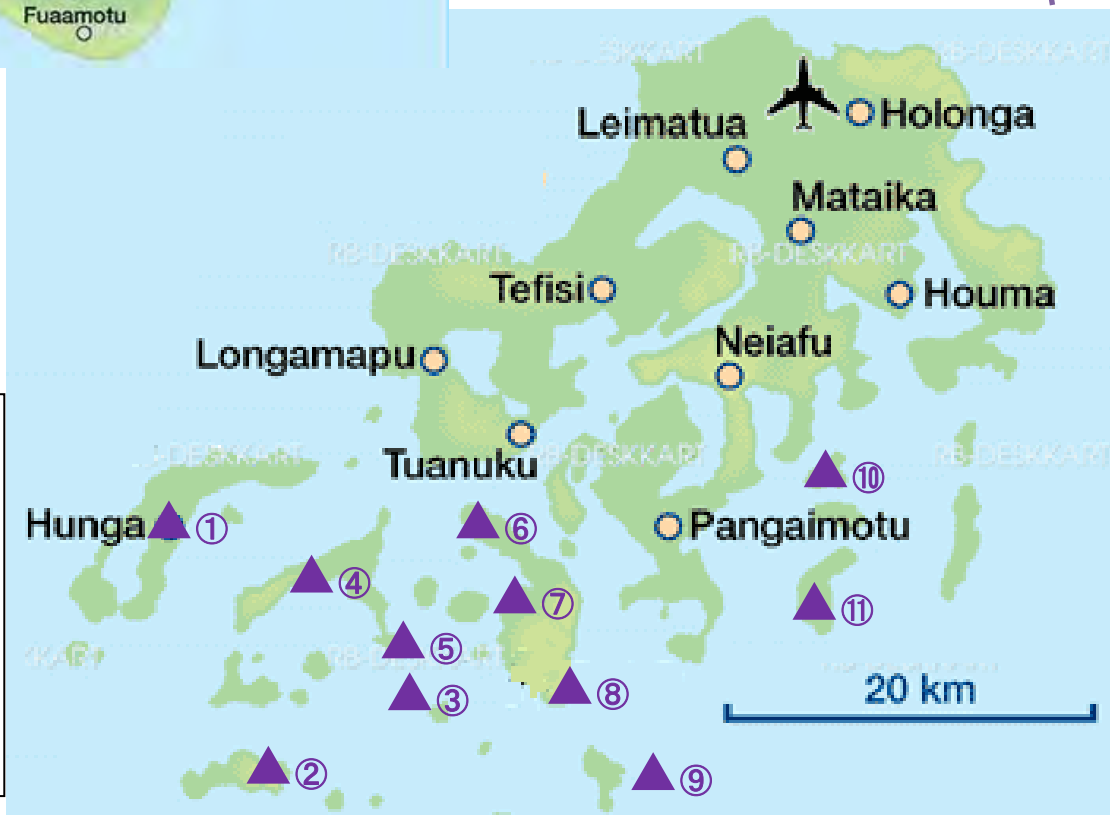


Pacific Ocean



Tongaptapu Islands

① Ata'taa Island
② Eueiki Island



① Hunga Island
② Ovaka Island
③ Lape Island
④ Nuapapu Island
⑤ Matanaka
⑥ 'Otea
⑦ Falevai
⑧ Kapa Island
⑨ Taunga Island
⑩ Olo' ua Island
⑪ Ofu Island

Vava'u Islands

▲ Project Site

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Abbreviation

EPU	Energy Planning Unit
EU	European Union
GDP	Gross Domestic Products
GNP	Gross National Products
HSEC	Ha'apai Solar Electricity Committee
IEC	International Electro technical Commission
IUCN	International Union for Conservation of Nature
JICA	Japan International Cooperation Agency
MLSNR	Ministry of land Survey and Natural resources
MORDI	Mainstreaming of Rural Development Innovation in the Kingdom of Tonga
PALM	Pacific Islands' Leaders Meeting
PIEPSAP	Pacific Islands Energy Policy and Strategic Action Plan
PIGGAREP	Pacific Islands Greenhouse Gas Abatement through Renewable Energy Project
PREFACE	Pacific rural Renewable Energy France and Australia Common Endeavour
SHS	Solar Home System
TCC	Tonga Communications Cooperation
T/O	Town Officer
TPL	Tonga Power Limited
TOISES	Tongatapu Outer Islands Solar Electricity Society
UNESCO	United Nations Educational, Scientific and Cultural Organization
VOISES	Va'vau Outer Islands Solar Electricity Society

CHAPTER 1

BACKGROUND OF THE PROJECT

Chapter 1 Basic Concept of the Project

1-1 Background and Concept of the Project

1-1-1 Background of the Project

Having very limited land area and low altitude on the whole, the Pacific island nations are extremely prone to the effects of climate change and are in urgent need of strategic countermeasures. Support for measures to adapt to climate change in the Pacific island nations and the like started with the announcement of the Cool Earth Partnership by the Japanese former Prime Minister, Fukuda at the Davos summit held in Switzerland in January 2008. Government of Japan established a new financial mechanism, Cool Earth Partnership, on the scale of US$10 billion (1.25 trillion yen) in total. Application of the financial mechanism of support access to adaptation measures and access to clean energy for developing countries based on grant aid and technical assistance, etc. that have undergone policy discussions, the amount up to 250 billion yen over five years, or yen loans for climate change countermeasures based on mitigation measures up to 500 billion yen over five years. In the Pacific region, Palau, Micronesia, the Marshall Islands, Nauru, Kiribati, Papua New Guinea, Vanuatu, Tuvalu, Samoa, Tonga, Niue, and the Cook Islands have already joined the Cool Earth Partnership.

In view of this policy by the Government of Japan, Japan International Cooperation Agency (JICA) has established its basic support policy for climate change countermeasures in developing countries under the heading of “Direction of JICA Operation Addressing Climate Change,” and within this it emphasizes the need to strengthen efforts for cooperation geared to raising the capacity of vulnerable countries and regions, such as small islands, to respond to climate change.

Upon surveying support needs with a view to bolstering Japanese support for climate change countermeasures in the Pacific region, it was found that urgent needs exist for photovoltaic power generation projects in Micronesia, Palau, the Marshall Islands and Tonga. Based on this information, the Project Formation Study for promoting Environment and Climate Change Program Grant Aid Projects (Photovoltaic Power) in the Pacific Region” was implemented from February to March 2009 assuming the scenario of an Environment and Climate Change Program Grant Aid project utilizing PV. As a result, the needs and feasibility of project implementation in each country have been confirmed, and official written requests for projects under the Environment and Climate Change Program Grant Aid scheme were submitted by each country’s government. The Government of Japan reviewed the requests with a view to arriving at decisions on early implementation, and requested JICA to implement the survey.

The survey here has the following objectives: 1) To collect information relating to PV introduction and to reconfirm the detailed need and validity of cooperation, 2) To compile

specific cooperation plans as Environment and Climate Change Program Grant Aid in each country and to perform rough designs, and 3) To estimate the rough project costs and prepare reference materials for tender documents.

1-1-2 Outline of the Grant Aid Request

The Government of Tonga made a request to the Government of Japan to install 444 SHS (solar home systems) in the Vava'u Group and Tongatapu Group and the soft component for maintenance for these equipment. Table 1.1.1-1 shows the specific areas and quantities of equipment that have been requested.

Table 1.1.1-1 Project sites and Requested Quantities

Island Group	Island	Requested Quantity
Tongatapu	Atatta	52
	Eueiki	23
Vava'u	Hunga	51
	Ovaka	19
	Lape	7
	Nuapapu	59
	Matamaka	47
	Otea	35
	Falevai	51
	Kapa	38
	Taunga	12
	Olo'ua	22
	Ofu	29
Total		444

① Main equipment: SHS and spare parts
② Soft component for appropriate maintenance of the SHS

In the Project Formation Study of February 2009, the Study team confirmed that 2 islands in Tongatapu Group and 11 in Vava'u Group were proposed by the Government of Tonga for the following reasons.

1) Remote islands of the Tongatapu Group and Vava'u Group are non-electrified areas and, because their geographical location makes it impossible to connect them to the existing power grid on main islands, they have to depend on SHS for energy supply.
2) The Project sites received SHS supply in the past, however, since this equipment has already become deteriorated or has not been properly maintained, almost all of it is in an unusable state.

3) Moreover, regarding electrification of the Project sites, high local need centering on lighting equipment has been confirmed from the local government officials and according to surveys conducted in each island.

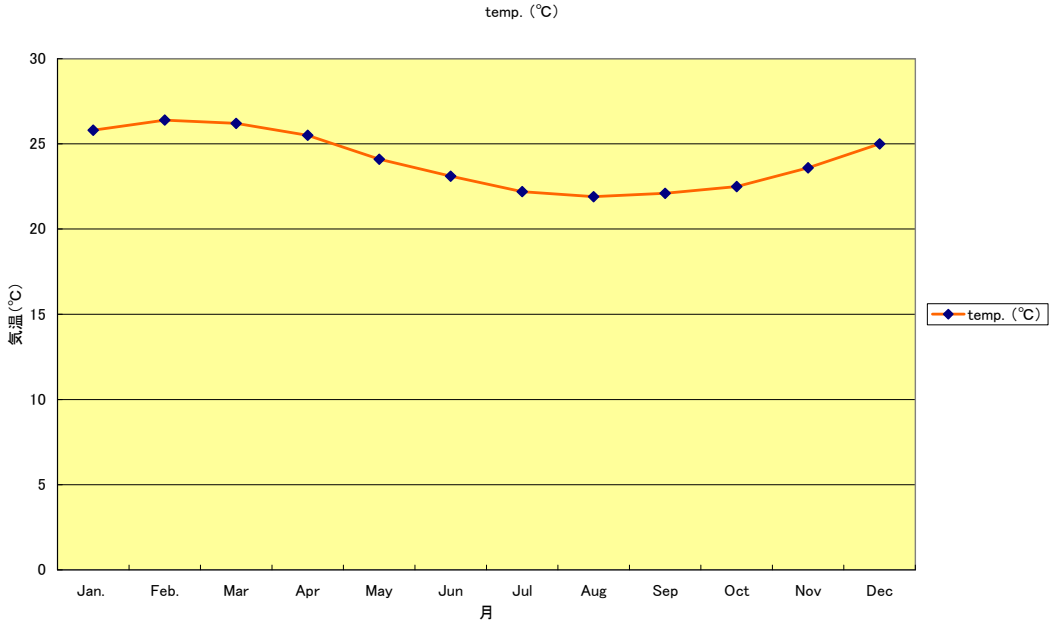
4) Residents of the Project sites have once accessed to renewable energy through utilization of SHS and experienced the positive impacts in the culture and customs, economy and the local environment as well.

1-2 Natural Conditions

The following paragraphs describe the natural conditions for the whole of Tonga and the Project sites of the Tongatapu Group and the Vava'u Group. Since government statistical data from 2006 are the latest data available, these data shall be used.

Tonga is composed of the four main islands of Tongatapu, Ha'apai, Vava'u and Niuas and their island groups scattered around a vast expanse of ocean measuring approximately 1,000km north to south and 500km east to west. The capital city is located on Tongatapu Island. The Ha'apai Group, which is located 100km north of Tongatapu, consists of 36 islands, of which Rifka is the main one, and it is known as the former home of the royal family of Tonga. The island of Kao has Tonga's highest active volcano which spews smoke over distances of 1,000km. Vava'u Island is situated another 100km north of Rifka Island.

The climate of Tonga is marine subtropical. The daily variation in temperature tends to be larger than annual fluctuations. From June to October, seasonal winds from the southeast create a cool climate. The mean temperature in Nuku'alofa in July is 21.3℃.



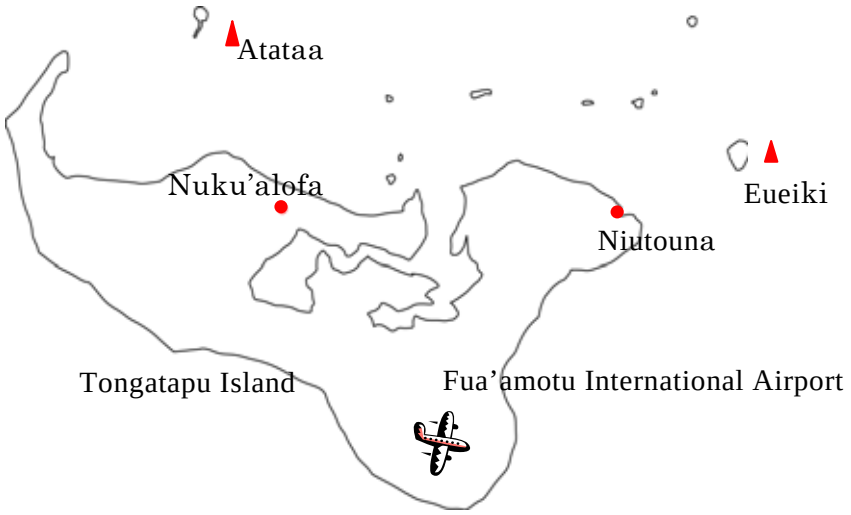
(Source: Prepared by the Survey Team)

Figure 1.2-1Mean Temperature in Nuku' alofa

(1) Project sites information・Geographical location

The Project sites to install SHS are 11 islands in Va'vau Group (Olo'ua, Ofu, Otea, Falevai, Kapa, Taunga, Matamaka, Nuapapu, Lape, Hunga, Ovaka), and 2 islands in Tongatapu Group（Atataa, Eueiki) requested by the government of Tonga.

Islands on Tongatapu Group



(Source：Document provided by MORDI)

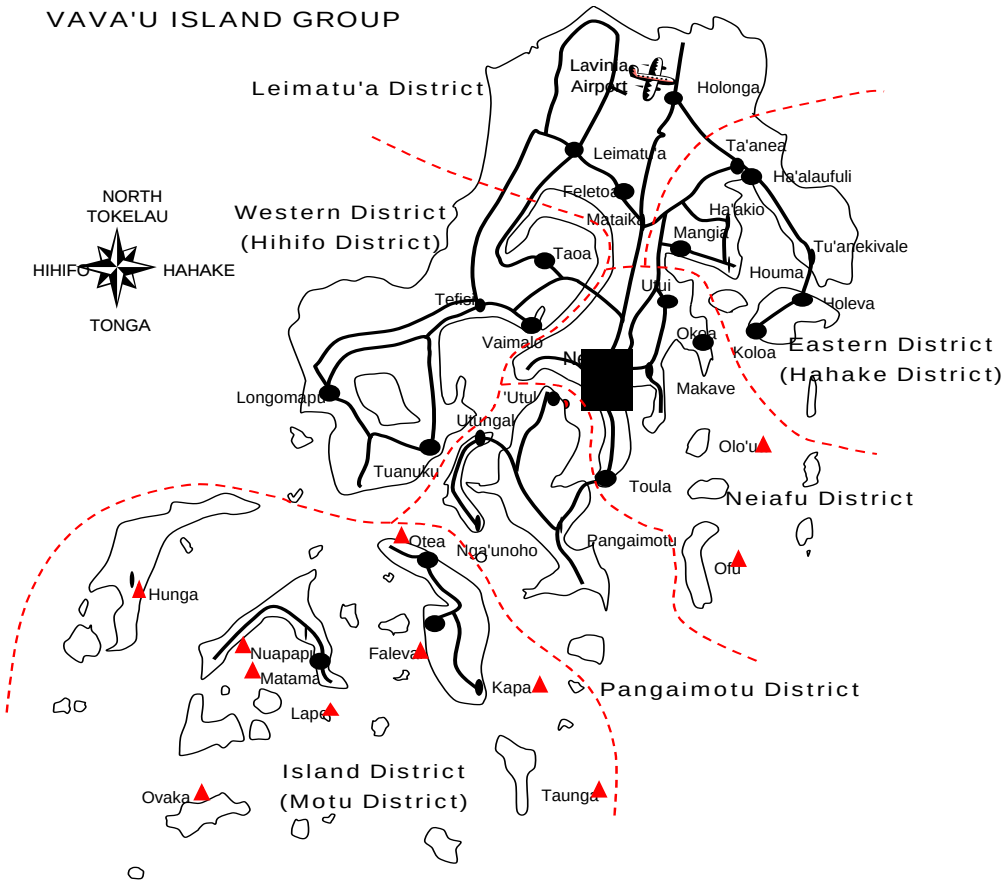
Figure 1.2-2 Islands Targeted for SHS Installation in the Tongatapu Group (marked with ▲)

Atataa which is one of the targeting area is a small island situated approximately 6.2km to the north of Tongatapu Island; it is approximately 13.5km or 40 minutes by boat from the port of the capital Nuku'alofa (21° 08'S / 175° 13'W). Atataa has one guesthouse and jetty.

Eueiki, which is another targeting area is a small island situated to the east of Tongatapu Island; it is located 6.3km as the crow flies from Niutoua on the east coast of Tongatapu and approximately 23km by boat from Nuku'alofa. In terms of distance, this island is roughly half the distance from the southwest of Tongatapu to Atataa, however, the sea waters to this island are hazardous and need to pay fully attenstion to sea condition for shall ship navigating among outer islands. Moreover, since the island has no jetty, cargoes have to be transferred to small boats.

Island in Vava'u Group

Figure 1.2-3-1shows targeting island to install SHS.



(Source：Document provided by MORDI)

Figure 1.2-3 Islands Targeted for SHS Installation in the Vava' u Group (marked with ▲)

The islands in the Project sites are scattered around an area ranging 4~16km south of the Vava'u Group capital of Neiafu (18° 39'S / 173° 59'W). The furthest island from Neiafu is Hunga, which can be reached by leisure boat in just over an hour. All the islands except for Ofu Island have a simple landing jetty. Kapa is usually reached by taking a tractor for roughly 2km from Falevai over mountains.

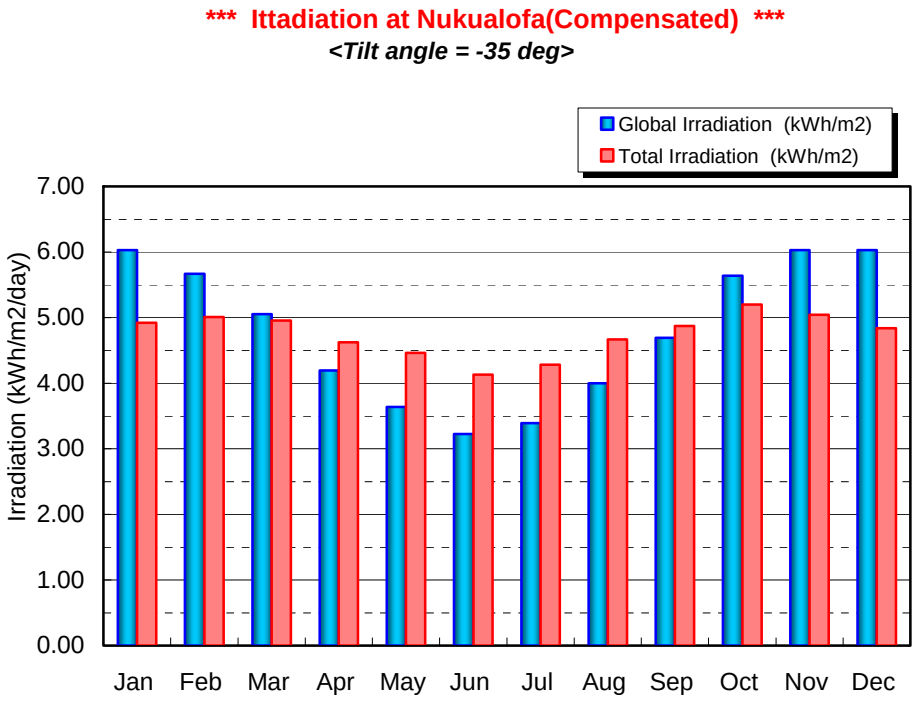
(2) Solar Irradiation Conditions

When planning and designing a photovoltaic system, it is essential to have data on solar irradiation, which is the source of energy. When collecting meteorological data and especially solar irradiation data, it is necessary to obtain mean values based on observations over an extended term, however, Tonga unfortunately doesn't possess any directly observed data.

As the next best option the solar irradiation data in the database of NASA of the United States, which is collected by satellites Since experience shows that data directly observed on the ground show a slight disparity with the NASA data, the data shall be utilized upon multiplying by a correction factor of 0.9. to adjust the NASA data for land use.

Solar Irradiation in Tongatapu:

Nuku'alofa, the capital of Tonga, is located approximately 300km southwest of Vava'u at Lat. 2.5° S. Meteorological conditions are similar to Vava'u Group and solar irradiation is more or less the same at 4.87kWh/m^2. However, in June when the solar irradiation conditions are unfavorable, global irradiation is around 8% lower than on Vava'u Group. Therefore, the total irradiation in the case where PV panels are installed at the ideal angle will also be approximately 8% less at 4.13kWh/m^2.



Global Irradiation (kWh/m2)	Total Irradiation (kWh/m2)
6.03	4.92
5.67	5.01
5.06	4.96
4.19	4.62
3.64	4.47
3.22	4.13
3.39	4.28
4.00	4.67
4.69	4.87
5.64	5.20
6.03	5.05
6.03	4.84
4.80	4.75
3.22	4.13
6.03	5.20

Source: Prepared by the Survey Team

Figure 1.2-4 Global Irradiation (Blue) and Total Irradiation in Nuku'alofa

Solar Irradiation in the Vava'u (capital Neiafu):

Since Tonga is located, solar irradiation is lowest in June. The annual average global irradiation of 4.87 kWh/m^2 in Vava'u is 40% larger than the corresponding value in Tokyo (3.44 kWh/m^2) indicating that conditions are favorable for photovoltaic power generation.

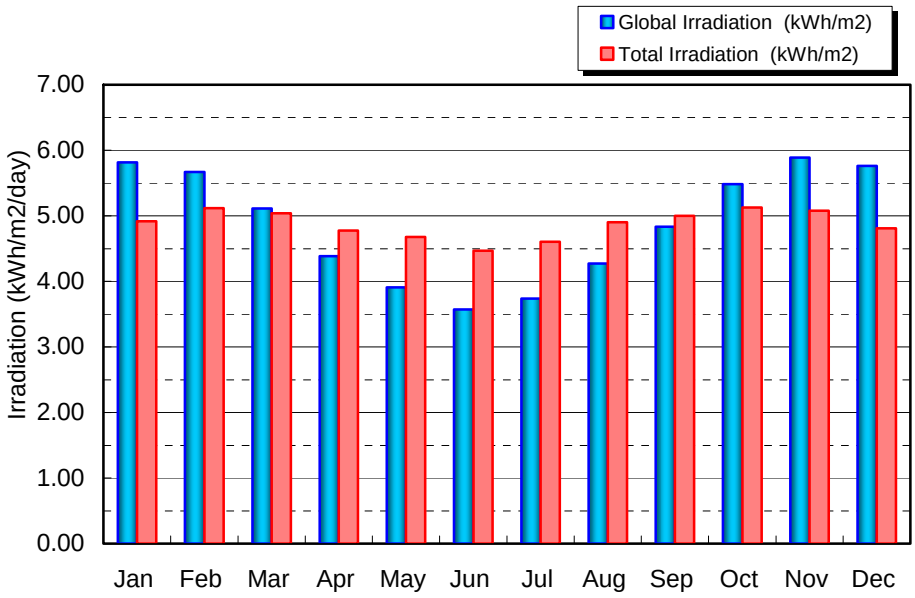
When planning stand-along solar home systems (SHS), it is vital to assume the lowest solar irradiation, i.e. input energy, in the year. In the case of Vava'u Group, this is June, so the PV panels will be installed at the inclination which gives maximum total irradiation at this time.

In Vava'u Group, the optimum angle of inclination is suggested somewhere between 30~35° in June. Naturally, the ideal orientation for panels is due north. In the case where panels are installed with the optimum angle of inclination, the amount of solar irradiation in June is improved by approximately 25% from 3.57kWh/m^2 to 4.47kWh/m^2 as shown in the following figure.

*** Ittadiation at Vavau, Tonga(Compensated) ***

<Tilt angle = -30 deg>

Global Irradiation (kWh/m2)	Total Irradiation (kWh/m2)
5.81	4.92
5.67	5.12
5.11	5.04
4.38	4.78
3.91	4.68
3.57	4.47
3.74	4.61
4.28	4.90
4.83	5.00
5.48	5.13
5.89	5.08
5.76	4.81
4.87	4.88
3.57	4.47
5.89	5.13



Source: Prepared by the Survey Team

Figure 1.2-5 Global Irradiation (Blue) and Total Irradiation in Vava' u

(3) Wind Power and Hurricanes

Gentle northwesterly trade winds blow from May to October in Tonga. The average wind velocity from May to July is 5~7 m/second. However, between April and November, strong winds blow and one or two cyclones hit especially in the north of the country including the Vava'u Group, which is one of the Project sites. 92kt (47.2m/s) wind was observed at Nuku'alofa in the past (cyclone ISSAC 1982, March).

(4) Earthquake

It is recorded of late year that earthquake occurred on February 2010 (magnitude 6.3), on May 2006 (magnitude 7.8) and on March 2009 (magnitude 7.9) and in Tonga

(5) Soil Condition

The soils of Tonga are derived from a mixture of volcanic ash and coral. Tongatapu island soil is a coral base covered with around 3 m of volcanic ash. Outer islands area of Tongatapu is also coral base but covered with volcanic ash and coral sand. The main islands of the Vava'u group originated from raised coral. The soils of the group are volcanic ash, up to 9 m thick, overlaying the coral limestone. And shore area and Outer Islands area beach areas are covered with coral based soils.

1-3 Environmental and Social Consideration

In Tonga, the Environmental Impact Assessment Act was enacted under the jurisdiction of the Ministry of Environment and Climate Change in 2003. Within this, outline contents concerning environmental impact assessment are stipulated in the Environmental Assessment Planning Regulation 2004. The main points are as follows.

On checking the need for implementation of an environmental impact assessment (EIA) in the Project with a responsible official at the Ministry of Environment and Climate Change it is confirmed that MLSNR needs to submit a report of the Project to Ministry of Environment and Climate Change. Ministry of Environment and Climate Change will check the contents of the Project. Moreover in case Ministry of Environment and Climate Change determines that EIA is required for the implementation of the Project, MLSNR will handle the all necessary survey and process for EIA to the Ministry of Environment and Climate Change by the Tender of the Project.

In the case of SHS, a problem arises regarding the treatment of used batteries, although there are no particular rules concerning batteries. Indeed, discarded batteries were actually observed in villages during the field survey.

Concerning the recycling of batteries, a used battery purchasing system has been introduced by a New Zealand private company. This is implemented based on a tie-up contract between a Tongan private company and the New Zealand private company under approval from both countries' governments. Accordingly, this does not infringe on the Basel Convention. The country of final disposal in this case is South Korea.

Moreover, the purchase fees (revenue) and expected costs (expenditure) from transporting batteries to the main island are as indicated below. As is shown in the following table, since it is predicted that a profit will be realized in the purchasing balance, the Tongan Government would not need to budget in particular.

Table 1.3-1 Balance regarding battery recycling

	①Recycling fee(TOP／kg)	②Weight of Battery／pcs(kg)	③No. of batteries procured	Total (Income)(①x②x③)
Recycling fee(Income)	0.5	45	512	11,520
	④Charge of transportation (TOP／kg)	⑤ Measurement of Battery(m^3／pcs)	⑥No. of Battery(only Vava'u)	Total (Expense)(④x⑤x⑥)
Charge of battery transpo	148	0.08	442	5,233
			Balance	**6,287**

*Since the purchasing of batteries is carried out on Tongatapu, only the quantity of batteries supplied to Vava'u Group has been counted in the column for quantity under battery transportation cost (expenditure).

In the Project, since batteries will need to be replaced 7~8 years after installation, it will be necessary for the Solar Societies and MLSNR to collect used batteries. It will be necessary to prohibit the current practice of discarding batteries and to establish sure collection procedure. Solar Electricity Societies, in close corroborations with the EPU, islands and the 2 local battery recyclers, will ensure that the used batteries are collected, transport and handled in an economically and safe manner.

CHAPTER 2

CONTENTS OF THE PROJECT

Chapter 2 Basic Contents of the Project

2-1 Basic Contents of Project Outline

2-1-1 Overall Goal and Project Objectives

Energy production in Tonga is largely dependent on diesel generation, which makes the energy supply setup extremely fragile and vulnerable to the effects of recent inflation in the price of petroleum and so on. In addition it is concerned about global warming caused by CO2 emission and national land loss by sea level rising. In response to this situation, the Renewable Energy Act - the first such legislation in the Pacific region – was enacted in October 2008 under support from the Pacific Islands Energy Policy and Strategic Action Plan (PIEPSAP) and the Pacific Islands Greenhouse Gas Abatement through Renewable Energy Project (PIGGAREP), etc.

Within this, the Government of Tonga is aiming to build a setup which will guarantee the stable supply of energy irrespective of petroleum price fluctuations. The government is aiming to derive 50% of all grid electricity from renewable energy sources by 2012, and it has been working full-time on the development of renewable energies since 2008. In April 2009, a summit of Pacific region energy ministers was held in Tonga and, under the initiative of the Prime Minister of Tonga, a meeting was held with a view to compiling an energy roadmap with participation from the World Bank, ADB, EU and other donors. The draft version of Energy Road Map 2010-2020 is currently being formulated, and following review of the final draft in December 2009, it is scheduled to receive approval from the Government of Tonga in April 2010.

The Project comprises the supply and installation of SHS to the Project Sites and the equipment required in order to maintain those systems. By doing so, the Project intends to achieve for the following overall goal and project objective.

Overall Goal:	The diffusion and promotion of sufficient, socially, technically,and environmentally sustainable renewable energy systems in the energy and power sector in Tonga,
Project Objective:	To supply reliable and affordable source of electricity to non-electrified areas, namely two islands in the Tongatapu Group and 11 islands in the Vava'u Group.

Moreover, based on the findings of the Project Formation Study for Promotion of Program Grant Aid for Environment and Climate Change Projects (PV Generation) in the Pacific Region in Febrary / March 2009, the Survey was conducted for detailed survey and the formulation of a concrete cooperation plan as a project under the Program Grant Aid for Environment and Climate Change scheme in Tonga, and design and cost estimation will be carried out and tender document reference materials was prepared. The necessary support for establishment of operating organizations (Outer Island Solar Electricity Society) responsible for educating of suitable usage and offering technical support and services to residents in the Project sites was also investigated to ensure that the supplied equipment operates stably for a long time.

2-1-2 Outline of the Project

The Project aims to procure and install the equipment of SHS including wiring indoor, to support to establish operation, maintenance and management organization, and assistance on capacity strengthness of the organization required to achieve the above targets, to thereby promote the introduction of renewable energy to the energy sector in Tonga.

The cooperation covers the procurement and installation of the following equipment required for the target PV generating system. Initial instrument will be installed under the project; however, the operation of the indoors load instruments after the installation will be under the responsibility of each user.

- PV module
- Steel pole for PV module
- Storage Battery
- Cable and initial lighting fixtures
- PV system spare parts and maintenance tools

2-2 Basic Design of the Project

2-2-1 Design Policy

2-2-1-1 Basic Concept

Based on the request from the Government of Tonga, the survey team implemented the field survey in 2 islands in the Tongatapu Group and 11 islands in the Vava'u Group, examining site environment and equipment contents suited to an aid undertaking, and decided to select these areas as the Project targets because, 1) the local residents have very high needs for SHS supply, 2) electricity supply in the said areas will continue to depend on SHS in future.

The two islands in the Tongatapu Group are non-electrified areas that have received supply of SHS in the past. The Vava'u Group consists of 25 or more remote islands which, apart from the two islands neighboring Vava'u Main Island (Pangaimotu, Koloa), are also non-electrified. SHS equipment was installed by international donors in the requested areas in the past. For the residents of the Project sites in both Tongatapu Group and Vava'u Group, these SHS represent the sole source of electricity, however, these systems have not been continuously used for a long time because the procured equipment did not comprise the ideal specifications and the maintenance system including necessary budgetary arrangements was not properly established.

In order to ensure that equipment procured under the Japanese Grant Aid is used in stable condition over the long term, it was necessary to carry out proper basic design upon collecting information on past projects, extracting and analyzing problem points, collecting and analyzing information on conditions and identifying good practices in the Ha'apai Islands where similar SHS have been installed by other donors.

Concerning the quantities of SHS to procure, following discussions with the Tongan government, it has been decided to examine general public facilities such as churches, community centers and schools, in addition to ordinary households (households that made lease agreement with Outer Island Solar Electricity Societies).

After that, the Energy Planning Unit (EPU), which is the implementing agency on the Tongan side under the MLSNR, held detailed explanation meetings for residents, added up the number of households that wish to install the equipment, and reported to the Study Team that 512 systems had been requested from households and public facilities in 13 islands in the Project sites. The Tongan request was for 444 units, corresponding to the number of systems provided by other donors in the past (supply by the World Bank in 1995, etc., however, considering with the present number of the household and populations and public facilities, it has been decided to design the Project assuming supply of 512 SHS with a view to attaining the Project objectives.

In the Project, the installation of SHS equipment and fitting of LED bulbs and night lights, etc. in households shall also be included for the following reasons.

- Since the Project aims to reduce CO2 emissions through replacing diesel generated energy with SHS photovoltaic energy in non-electrified areas, the Project effect will be guaranteed through including load equipment (lights, etc.) in the contents. Moreover, exchange of lighting apparatus will be carried out at the expense of users.
- Through supplying LED bulbs and assuming use of such bulbs in the Project, the energy saving effect and load on batteries will be mitigated, thereby enabling stable use over the long term. Moreover, since such bulbs can be used for a longer life than DC fluorescent lights (around 10 years compared to 1 year), another effect will be reduction in the amount of waste from used fluorescent lights.

Furthermore, through including indoor wiring among the support targets of the Project, it will be possible to limit load only to electrical instruments such as lights, thereby contributing to the load reduction of batteries and longer term use.

2-2-1-2 Natural Conditions

The items and important points to consider in the Project equipment installation works are as described below.

(1) Irradiance

Since some houses are surrounded by trees in the Project sites, equipment procured under the Project shall be installed upon checking the existence of obstacle to irradiance. Irradiation condition is explained in 1-2-1 (2) in detail.

(2) Temperature and Humidity

The equipment procured under the Project shall basically comprise specifications suited to tropical coastal conditions which include exposure to high ambient temperature, high humidity and outdoor use.

(3) Salt Damage

Since the all Project sites are located in small outer islands, and these sites are relatively close to the coastline, and high levels of atmospheric salt, anti-corrosive coating shall be applied to the outdoor PV module frame and the junction box, etc. used for making electrical wiring connections.

(4) Wind Resistance

When installing the equipment, structures that satisfy the required wind resistance of 70m/sec in the Tongan building standard shall be adopted.

2-2-1-3 Social and Economic Conditions

The metropolitan area and major islands of Tonga have relatively well developed and convenient infrastructure including roads, public water supply, sewage systems, electricity supply and telecommunications, etc. However as the Project sites are located in outer islands, social infrastructures have not been well-constructed. Jetties have been constructed under assistance from the EU, etc. in most of the islands targeted in the Project, however, concerning inland transportation, there are no means for transporting large cargoes. Accordingly, it will be necessary to borrow tractors and secure other cooperation from the islands. On Eueiki Island, which is one of the Project sites in the Tongatapu Group, since the ocean conditions between here and the main island are extremely hazardous, it will be necessary to carefully plan transportation while targeting only periods when ocean and weather conditions are favorable.

Since English is used even in islands, conditions are convenient for foreign visitors. Also, since most of the citizens of Tonga are Christians, there are no religious customs that have a large impact on the construction schedule such as Ramadan in Islamic countries. Having said that, as work on Sundays is prohibited in principle by law in Tonga, it will be necessary to compile the execution plan taking this point into account.

2-2-1-4 Construction and Procurement Conditions, Special Situations and Commercial Practice

Facilities in Tonga are implemented based on the standards of Australia and New Zealand.

Regarding the construction situation in Tonga, it is sometimes necessary to employ design technicians from neighboring countries like Australia and New Zealand, so it is difficult to secure

engineers of a certain level locally. Therefore, the equipment needs to be designed considering these standards and circumstances.

2-2-1-5 Effective Use of Local Companies (Builders, Consultants)

(1) Utilization of Local Contractors

Tonga has experienced SHS installation works by international agencies and donors in the past, and on such occasions local general contractors implemented the installation works. As of December 2009, three local contractors which have had experiences are existed. For this reason, it should be relatively easy to secure workers for installing the SHS equipment in the Project.

After the completion of the Project, there may be cases where equipment is going to be removed due to non-payment of charges by users, or cases where additional equipment needs to be installed in response to the binding of new SHS contracts. Accordingly, it will be necessary to transfer technology sufficiently to the local contractors for appropriate removal of equipment, installation and their supervison. Since it is difficult to find such technicians or engineers in Tongan private company, it will be necessary to dispatch engineers from Japan or third countries well versed with Japanese products in order to conduct quality control, offer technical guidance, to manage the works schedule because the main equipment procured in the Project are made in Japan and to train local contractors taking the circumstances after the completion of the Project into consideration.

(2) Utilization of Local Equipment and Materials

As for the main equipment in the PV system, since local products should not be used in the interests of securing high reliability and easy maintenance. Equipment shall be procured from Japan or a third country.

The aggregate, cement and reinforcing bars, etc. used in foundation works which are imported from neibouring countries such as New Zealand can be procured in Tonga. On the other hands, there are no facilities capable of implementing heavy corrosion prevention treatment such as galvanizing for steel frame. Accordingly, all steel members for installation in the Project will be carried onto site after undergoing corrosion proofing in advance.

2-2-1-6 Operation and Maintenance

On implementing the Project, EPU affiliated with MLSNR plans to establish Outer Islands Solar Electricity Society in each Group of Tongatapu and Vava'u as a management organization of SHS procured under the Project, and the Outer Islands Solar Electricity Society plans to operate and maintain the equipment under the management by MLSNR. The Outer Islands Solar Electricity Society will be a party authorized by the government based on Incorporated Society Act same as HSEC.

It is with a plan that MLSNR implement operation and maintenance of the equipment. The following shows each role, and responsibility. Detail of the division of duties is shown in the table 2.2.1-2.

MLSNR :	Responsible ministry of the Project. Owner of the equipment, Supervision of management of the Outer Islands Solar Electricity Societies. - Provision of technical support - Supervision on financial accountability of the Outer Islands Solar Electricity Societies
Outer Islands Solar Electricity Society in each islands Group:	Operation and maintenance of the equipment Financial management (the fund administration collected from the residents) Management of technicians in each Project sites Supply including the lighting equipment, inventory control, the sale to the residents The monthly payment collection from residents
Technician (Employed by Solar Electricity Society) who are posted in each island:	Daily maintenance Advice for SHS use to the residence Make maintenance record Spare parts stock and management
Each user:	Maintenance lighting fixture indoor, all internal wiring and inhouse accessories.

In addition, each user assumes obligations to pay initial installation cost (TOP200), monthly payment (TOP15 in Tongatapu Group and TOP13 in Vava'u Group).

*Initial Installation cost:

The installation of SHS is included in the Project, and initial installation cost collected from the residents is not expensed for the equipment installation. The expense is utilized as down payment spent for operation and maintenance including replacing battery in future. By collecting the expense, effects such as the use of the interest rate by saving the fund and the fiscal stabilization are expected.

Similar SHS haven been installed in the Project sites through support from the EU and Australia in the past. Therefore, residents in the Project sites know and understand how to use the equipment on empirical bases. However, in order that the SHS is utilized appropriately, it is necessary to train technicians and the like to properly teach and give information to residents about routine SHS usage and battery disposal methods,.

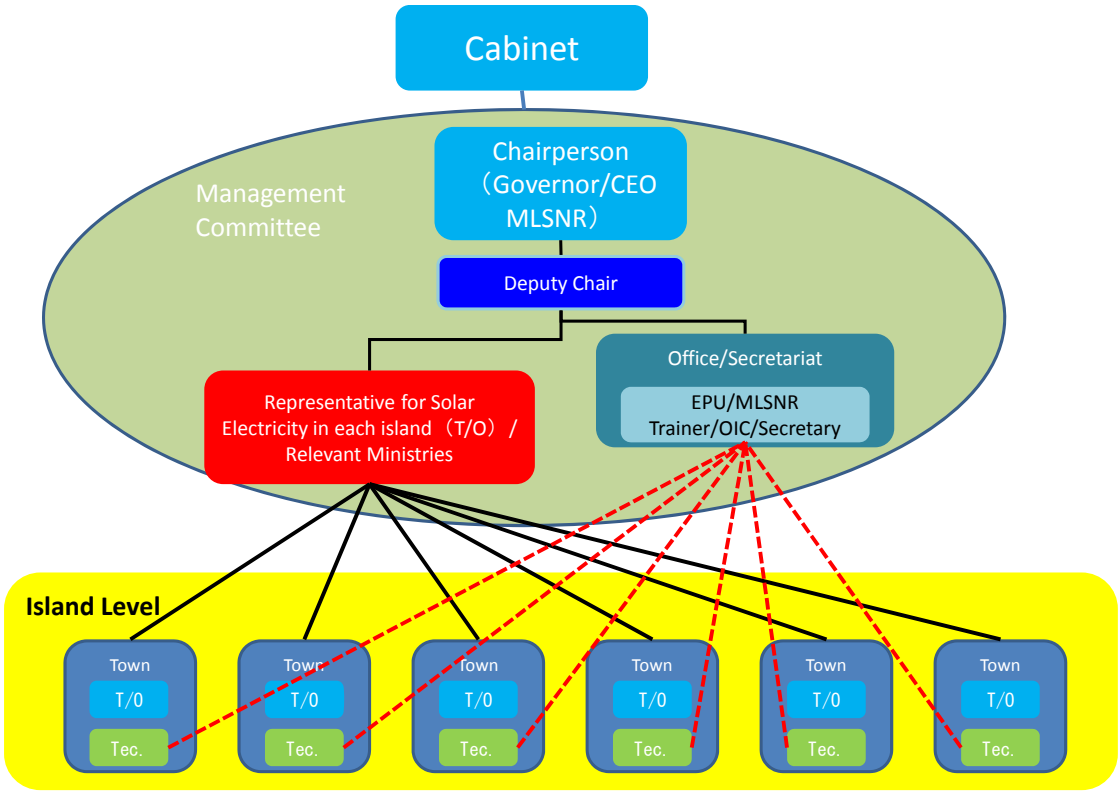
In cases where it becomes necessary to procure spare parts and expendable items, it will be necessary to procure at each user's burden, however, due to the poor state of distribution channels on remote islands, and correspondence by that trader is not able to be expected well because order bulk is small, it is difficult to procure expendable parts, etc. for individual users and islands. In view of this economic structure, it will be necessary to build systems for supporting procurement and appropriately stocking the necessary funds as well as to strengthen the fund management setup. In the Tongan side, it is promised to establish and build the said organization before the Project equipment

actually installed. Tongan side has prepared to establish the Outer Island Societies in Tongatapu and Vava'u.

(1) Organizational Shape of Outer Islands Solar Electricity Society

In implementing the project, the EPU has prepared to establish Outer Islands Solar Electricity Societies on Tongatapu and Vava'u to operate and maintain the SHS to be supplied in the project. The Solar Electricity Societies will be a party authorized by the government based on Incorporated Society Act same as HSEC (Ha'apai Solar Electricity Commitee) which is Solar Electricity Society in Ha'apai Islands. Concerning the organizational design, it is planned to construct a similar organization to the HSEC in the Ha'apai Islands, and the Survey Team has proposed an organizational design along the lines of the Tongatapu Outer Islands Solar Electricity Society (TOISES, provisional name) and Vava'u Outer Islands Solar Electricity Society (VOISES provisional name) as shown in Figure 2.2.1-1 and the organizational design was confirmed by MLSNR. The MLSNR through the EPU will act as the Society's Secretariat for the coming 4-5 years and all office expenses will be covered by MLSNR.

The organizational shape proposed by the Survey Team is shown below. It is planned to establish the Solar Electricity Society before the Project is implemented.



OIC: Office in charge
T/O: Town Officer
Tec.: Technician

※ VOISES will have jurisdiction over 11 islands, and TOISES will have jurisdiction over two islands.
※ Concerning TOISES, since this is a very small organization targeting just two islands and it will have EPU involvement rather than being based in the Tongatapu provincial government, it will be necessary to discuss the form of organization with the MLSNR and related officials when the soft component is implemented.
※ It is planned that EPU trainers / Society's Office OIC/CommitteeSecretary is posted from MLSNR officials. They will conduct guidance patrols and training for technicians in other islands as the need arises. The personnel will be permanently stationed in the Societies' Office.

Source: Prepared by the Survey Team

Figure 2.2.1-1 Outer Islands Solar Electricity Society Organization

The division of duties of VOISES and TOISES members has been proposed as shown below.

Table 2.2.1-1 TOISES, VOISES Employment Structure

Position	Number of people	Remarks and division of duties
MLSNR	-	・ Dispatch a staff of MLSNR to each Outer Islands Solar Electricity Society ・ Technical support to the Societies ・ Supervision on finance of the Societies
Solar Society	At least 1 officials from MLSNR 1 person per island	・ Collect the Society's revenue and spend in accordance with directives provided by the Solar Electricity Society ・ Preparation and the safe keeping of all the Solar Electricity Society's financial and technical records ・ Prepare and submit the Society's annual budget of income and expenditures ・ Deliver to EPU a; (a) brief half-yearly, (b) Annual Report of the operations of the Solar Electricity Society and the consolidated financial statements for the financial year consisting of the statements of financial position, financial performance, changes in financial position, and any other necessary statements within two months of the end of each stated periods. ・ Provide to the EPU an annual audit report on the financial statements within six months of the end of the financial year ・ Stock and sell solar equipment ・ Repair and maintain the solar components that are owned by the Solar Electricity Society ・ Seek donor assistance for the Solar Electricity Society ・ Fulfil reporting obligations directed under Incorporated Society Act.
Technicians	1 or 2 person(s) per island	・ Check and test PV panels, batteries and charge controllers ・ Check and refill battery water ・ Encouragement appropriate use of SHS for user: - Advice on appropriate use of electricity - Advice on electricity use when the time continued long periods of low sunshine days. ・ Spare parts stock and manage ・ Collection of electricity charges from residents and transfer to VOISES and TOISES (joint work with town officer) ・ Record maintenance logbook and create suitable of forms, such as invoice particulars, etc. (joint work with town officer)

Source: Prepared by the Survey Team

(3) Financial Affairs

When executing the Project, not only suitable equipment operation but also that financial affairs be done appropriately are important for following points.

- To secure the cost for storage batteries' replacement (even in case the batteries are un-stably, these batteries expect to be replaced seven to eight years after commencement of use.)
- To secure appropriate management and maintenance budget by the Societies
- To secure wage for technicians in each island.

Referred to the budget classification in HSEC at present, following budget account list made by the survey team and suggested to the Tonga side. In addition the survey team suggested pesrsons who bear each items of expense and MLSNR agreed to the suggestion. For the details, it will be adjusted and advised in the soft component.

Table 2.2.1-2 VOISES and TOISES Budget

VOISES, TOISES budget items		VOISES		TOISES	
		2011-2015	2016 and beyond	2011-2015	2016 and beyond
1	Internal travel expenses and fares	Borne by the Government of Tonga	Budget for	Borne by the Government of Tonga	Budget for
2	Telephone and net charges	Borne by the Government of Tonga	Budget for	Borne by the Government of Tonga	Budget for
3	Electricity tariffs	Borne by the Government of Tonga	Budget for	Borne by the government of Tonga (continued)	Borne by the government of Tonga
4	Office supplies	Borne by the Government of Tonga	Budget for	Borne by the Government of Tonga	Budget for
5	Office repairs and maintenance	Borne by the Government of Tonga	Budget for	Borne by the Government of Tonga (continued)	Borne by the Government of Tonga
6	Technicians' wages	Budget for	Budget for	Budget for	Budget for
7	Meeting expenses	Borne by the Government of Tonga	Budget for	Borne by the Government of Tonga (continued)	Borne by the Government of Tonga
8	Revolving fund	Do not consider	Budget for	Do not consider	
9	Clerical staff salaries [Office Manager - OIC]	Covered by the Government of Tonga	Budget for	Covered by the Government of Tonga (continued)	Covered by the Government of Tonga
10	Rent	Borne by the Government of Tonga	Budget for	Borne by the Government of Tonga (continued)	Borne by the Government of Tonga
11	Engineering expenses and fixtures	Budget for	Budget for	Budget for	Budget for
12	System monitoring	Borne by the Government of Tonga	Budget for	Borne by the Government of Tonga	Borne by the Government of Tonga
13	General assembly and meeting expenses	Borne by the Government of Tonga	Borne by the Government of Tonga	Borne by the Government of Tonga	Borne by the Government of Tonga

(Detail of proposed item)

※ The Tonga Government will cover the salary for secretariat staff for the first five years

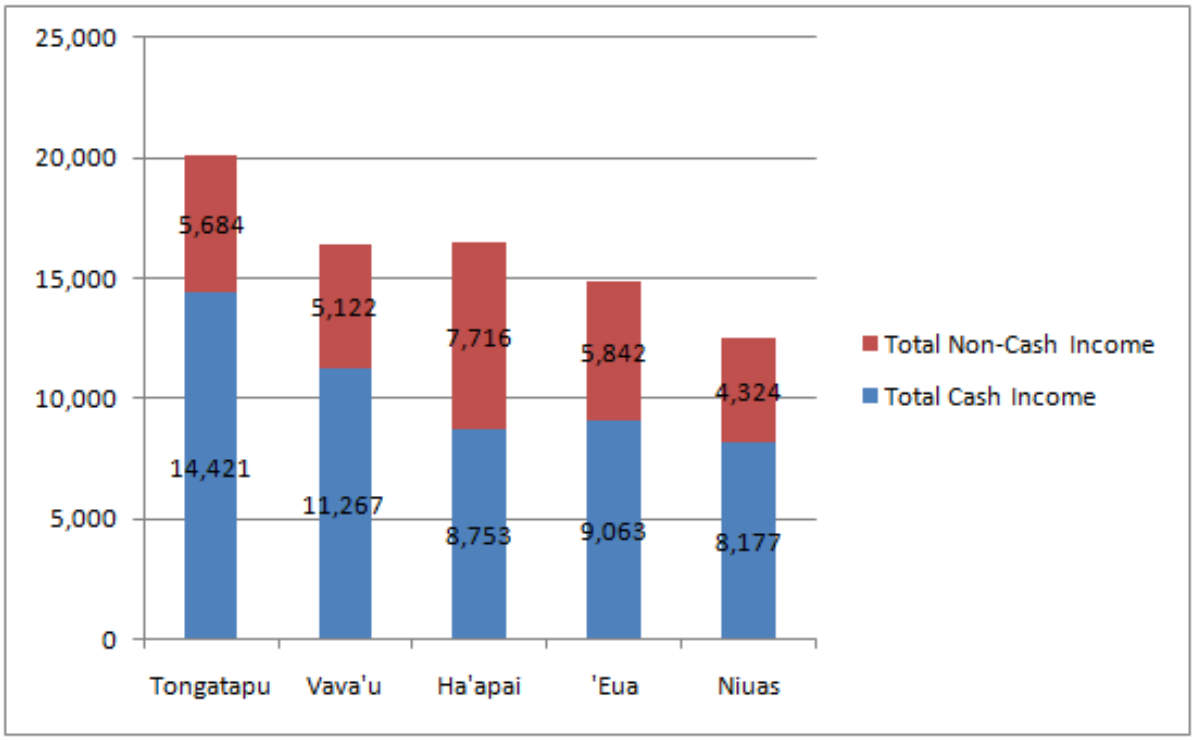
※ The Tonga Government will cover the secretariat expenses (Internal travel expenses and fares, Telephone and net charges) for VOISES and TOISES after the installation from 2011 for the first five years

※ Since TOISES has small number of SHS and if budget management system is same as VOISES one, it will be difficult to secure necessary expense, therefore TOISES will continue to receive support for salary for trainer and so on by the Government of Tonga.

(4) Examination concerning the Ability to Pay of Residents in Project sites

At present, Solar Society of each Group group (Ha'apai, Niuas) in Tonga collect TOP200 as initial installation cost and TOP13 as monthly payment from residents to secure the budget for maintenance.In order to implement the unified management, Tonga side set up the tariff rate in Solar Electricity Societies of the Project sites to assume same amout of money mentioned above as the lower limit. On the other hand, since appropriate tariff rate setting leads to security of the collection rate from residents, the Survey team examined whether the tariff setting was proper in the Prpject sites.

This time, for the examination, the team used the results of Household Income and Expenditure survey conducted in 2000/2001. As a result, taking a point that operation and maintenance of SHS have implemented with the tariff rate even in areas where the income is lower than Vava'u Group into consideration, it is judged that collection rate is secured if they get good service.



(Source : Prepared by the Survey team based on Report on the Household Income and Expenditure Survey 2000/01)

Figure2.2.1-2 Result on the Household Income and Expenditure Survey 2000/01 in Tonga

The Survey Team did trial calculation for the income and expenditure balance of each Solar Electricity Society based on rate setting in which is TOP 200 as Initial installation cost and TOP15 (TOISES) and TOP13 (VOISES) as a monthly payment. Tongatapu Outer Islands Solar Electricity Society is small scale and their money collection will be small amount, moreover Tongatapu Group are comparatively the areas where there is cash income, therefore monthly payment is set in TOP15 for sustainable management. The main expenses involved when calculating the income and expenditure balance are as follows: The following condition is based on the Expense of Solar Electricity Society.

① Technicians' wages TOP 60/month, raised by 5% every 3 years

② Clerical staff salaries TOP 300/ month, raised by 5% every 3 years

③ Bank interest 7.2%

The results of calculation based on the above conditions are as shown below. This shows that there is absolutely no change in the financial support of the government or the electricity tariff setup. Moreover, in the case where the same tariffs as charged by HSEC are levied, both TOISES and VOISES will have enough cash in case they need to carry out all their own SHS battery replacements 7~8 years.

Table 2.2.1-3 Case Study (Estimation of TOISES Budget)

			Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Budget	Household	Initial Cost	TOP200	11,800									
	(59)	Monthly Payment	TOP15/Month	10,620	10,620	10,620	10,620	10,620	10,620	10,620	10,620	10,620	10,620
		Sub-total①		22,420	10,620	10,620	10,620	10,620	10,620	10,620	10,620	10,620	10,620
	Public Institute	Initial Cost	TOP200	2,200									
	(11)	Monthly Payment	TOP15/Month	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980
		Sub-total②		4,180	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980	1,980
	Interest③	7.20%			1,614	2,337	3,039	3,692	4,433	5,147	5,105	3,667	2,113
	Budget Expense(①+②+③)			26,600	14,214	14,937	15,639	16,292	17,033	17,747	17,705	16,267	14,713
Expense	Budget												
	Domestic travel & transport						200	210	221	232	243	255	268
	Telephone & Internet						150	150	150	200	200	200	200
	Electricity												
	Office Equipment & Printing			100	100	100	500	100	100	600	100	100	100
	Office Repair & Maintenance												
	Wages	4persons	60/Month	2,880	2,880	2,880	3,024	3,024	3,024	3,175	3,175	3,175	3,175
	Meeting & Training			200	200	200	500	200	200	500	200	200	200
	Revolving funds												
	Salary	2staff					0	0	0	0	0	0	0
	House Rental						50	50	50	50	50	50	50
	Technical Equipment(Battery+BOS)			0	0	1,000	1,100	1,210	1,331	11,464	31,611	31,772	1,949
	(Battery)			0	0	0	0	0	0	10,000	30,000	30,000	0
	(BOS)			0	0	1,000	1,100	1,210	1,331	1,464	1,611	1,772	1,949
	System Monitoring			0	0	0	0	0	1,000	1,000	1,000	1,000	1,000
	Meeting once a year			1,000	1,000	1,000	1,050	1,050	1,050	1,103	1,103	1,103	1,103
	Total Expense			4,180	4,180	5,180	6,574	5,994	7,126	18,323	37,681	37,855	8,044
	Balance (Budget-Expense)			22,420	32,454	42,211	51,276	61,574	71,482	70,905	50,929	29,341	36,010

Source: Prepared by the Survey Team

Table 2.2.1-4 Case Study (Estimation of VOISES Budget)

			Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Budget	Household	Initial Cost	TOP200	74,400									
	(372)	Monthly Payment	TOP13/Month	58,032	58,032	58,032	58,032	58,032	58,032	58,032	58,032	58,032	58,032
		Sub-total①		132,432	58,032	58,032	58,032	58,032	58,032	58,032	58,032	58,032	58,032
	Public Institute	Initial Cost	TOP200	14,000									
	(70)	Monthly Payment	TOP13/Month	10,920	10,920	10,920	10,920	10,920	10,920	10,920	10,920	10,920	10,920
		Sub-total②		24,920	10,920	10,920	10,920	10,920	10,920	10,920	10,920	10,920	10,920
	Interest③	7.20%			9,908	14,161	18,652	22,712	27,091	31,394	29,252	20,947	12,037
	Budget Expense (①+②+③)			157,352	78,860	83,113	87,604	91,664	96,043	100,346	98,204	89,899	80,989
Expense	Budget												
	Domestic travel & transport						500	525	551	579	608	638	670
	Telephone & Internet						250	250	300	300	300	300	300
	Electricity						100	100	100	100	100	100	100
	Office Equipment & Printing			100	100	100	500	100	100	600	100	100	100
	Office Repair & Maintenance				50		100		50		100		50
	Wages	22persons	60/Month	15,840	15,840	15,840	16,632	16,632	16,632	17,464	17,464	17,464	17,464
	Meeting & Training			200	200	200	1,000	1,000	1,000	1,000	1500	1500	1500
	Revolving funds												
	Salary	2staff	300/Month				7,200	7,200	7,200	7,560	7,560	7,560	7,938
	House Rental						50	50	50	50	50	50	50
	Technical Equipment(Battery+BOS)			0	0	1,000	1,100	1,210	1,331	93,464	176,611	176,772	1,949
	(Battery)			0	0	0	0	0	0	92,000	175,000	175,000	0
	(BOS)			0	0	1,000	1,100	1,210	1,331	1,464	1,611	1,772	1,949
	System Monitoring			0	0	0	0	0	5,000	5,000	5,000	5,000	5,000
	Meeting once a year			3,600	3,600	3,600	3,780	3,780	3,969	3,969	4,167	4,167	4,375
	Total Expense			19,740	19,790	20,740	31,212	30,847	36,283	130,086	213,559	213,650	39,496
	Balance (Budget-Expense)			137,612	196,682	259,055	315,447	376,264	436,024	406,284	290,930	167,178	208,671

Source: Prepared by the Survey Team

A questionnaire survey was implemented to investigate the desired monthly tariff in the event of SHS introduction of residents in the Project sites, in order to provide reference data for setting the monthly tariffs, which will be the primary source of income for the Solar Electricity Societies. The survey targeted 156 people and 120 responses were obtained. According to the results of this survey, on Tongatapu, most respondents (78.6%) indicated a desire for TOP9-12. Meanwhile, in the Vava'u Group, most residents indicated a desire for TOP5-8. This difference is thought to arise from cash income differentials in the two areas, however, the monthly tariff of TOP13 which is charged by the Societies in other areas is likely to be considered too expensive in these two areas, and it will be necessary to carry out appropriate tariff collection.

However, for the sustainable management, it is necessary to follow the above rate setting, to prepare and to secure fund for replacement of battery 7 or 8 years later, and to perform the proper rate collection from user of SHS and financial management adequately.

Table 2.2.1-5 Monthly use charge demanded by resident in the Project Sites

	No. of Sample	**Less than TOP4**	**TOP5-8**	**TOP9-12**	**More than TOP13**	**Average**
Eueiki	3	0	0	3	0	10.00
Atataa	11	0	2	8	1	9.73
①Sub-total of Tongatapu	**14**	**0**	**2**	**11**	**1**	**9.79**
①Rate(%)		**0.0%**	**14.3%**	**78.6%**	**7.1%**	**69.9%**
Hunga	25	17	6	2	0	4.04
Ovaka	10	4	5	1	0	5.10
Lape	3	0	3	0	0	5.67
Nuapapu	13	5	8	0	0	4.23
Matamaka	9	4	5	0	0	4.67
Otea	10	2	6	1	1	3.80
Falevai	9	3	4	2	0	5.78
Kapa	6	2	3	0	1	6.83

	No. of Sample	Less than TOP4	TOP5-8	TOP9-12	More than TOP13	Average
Taunga	7	3	3	1	0	5.29
Olo'ua	5	0	4	1	0	7.00
Ofu	9	1	7	1	0	6.00
②Sub-total of Vava' u	**106**	**41**	**54**	**9**	**2**	**4.93**
②Rate(%)		**38.7%**	**50.9%**	**8.5%**	**1.9%**	**4.7%**
Total	**120**	**41**	**56**	**20**	**3**	**5.50**
Total Rate		**34.2%**	**46.7%**	**16.7%**	**2.5%**	**4.6%**

（Source：Prepared by the Survey Team based on Socio-Economic Status Survey 2009）

2-2-1-7 Grade Setting for Equipment

Considering the above conditions, the scope, scale and technical level of equipment procurement and installation shall be compiled according to the following principles.

(1) Concept regarding the scope of equipment, etc.

To ensure design that is both technically and economically appropriate, standard products corresponding to IEC and other international standards shall be procured as far as possible. The Equipment shall be composed with minimum structure, specification and the quantities.

(2) Concept regarding technical level

Specifications of the component equipment in the PV system shall be that do not need maintenance as possible in conformance with the technical level of the technicians who will be responsible for operation and maintenance following the completion of the Project.

2-2-1-8 Procurement and construction Period

Transportation from Japan and third countries to Tonga mainly rely on the sea. The main port in Tonga is Nukualofa, however, majority of the Project target sites are in the Vava'u Group, and international services from New Zealand, etc. also operate out of Neiaf (the main island in Vava'u Group). Accordingly, equipment intended for the Tongatapu Group will be transported to Nukualofa Port, while that intended for Vava'u Group will be transported to Neiaf Port.

The 13 islands in the Project sites are located in the remote islands. Equipment will be transported from the main islands to these remote islands by boat. Since there are no regular services from trading ports, charter services will be used. From trading ports, the number of boats possessing sufficient transportation capacity is limited, and there will be cases where marine transportation does not go to schedule due to the weather conditions. It will be necessary to compile an appropriate schedule upon giving proper consideration to these points.

At the early stage of installation work, in handling the PV systems, schedule coordination and adjustments, it will be necessary to dispatch technicians of high understanding for Japanse products.

2-2-2 Basic Plan (Equipment Plan)

2-2-2-1 Prerequisite of the plan

(1) Supply Power and Load Planning

a. Design panel surface solar irradiation

Following correction of the NASA database global irradiation in Vava'u using the correction factor of 0.9 (empirical value), the inclination angle of 18~21˚facing true north, which ensures the maximum solar irradiation in winter, generates design solar irradiation as follows:

The latitude of the Project site: 18°～21° South

The longitude of the Project site: 173°～175° west.

- Design panel face irradiation = **4.4 kWh/m^2**

b. Planned electrical appliances and consumed power

The amount of electric power that can be used per day shall be assumed to be 400Wh. This amount permits the following load.

SHS is a system for supplying the minimum required electricity. Considering that such system has small electricity supply capacity and cannot even supply the designed power under certain solar irradiation conditions, it is necessary for users to closely adhere to the rules of use.

From the requirements on the demand side, thinking in usage of SHS shall differ from that in general power supply systems for determining the scale of the generator unit. Excessive use of electricity must be strictly refrained from because it will drastically shorten the service life of batteries.

The following shows the types of electrical appliances and their period of time in uses that are compatible with load in the SHS:

Indoor LED lights: 1.1W type 4 lights, 6 hr each (26.4Wh)

Outdoor LED lights 1.1W type 1 light, 10hr each (11Wh)

Radio (including voltage converter): 30W, 12 hr (360Wh)

Total designed equipment load: 35.5W

(2) Necessary Laws and Regulations for SHS Introduction

Tonga has compiled and currently applies the National Building Code of the Kingdom of Tonga 2007 based on the Australian and New Zealand codes.

Within this particular attention should be given to the structural criteria regarding cyclones and earthquakes. Regarding cyclones, structures are required to possess wind resistance of 70 m/s, while Zone factor 0.4 (same as San Francisco) in the California Building Code is required with respect to earthquakes.

SHS installation shall be designed according to the following standards:

Wind resistance: 70m/sec

Seismic zone factor: 0.4（California Building Code）

Concerning electrical equipment works, since no particular standards are established, design shall be conducted based on IEC (International Electorotechnical Committee) and JEC (Japan Electrotechnical Commitee).

2-2-2-2 Overall Plan

(1) Determination of SHS System Capacity

PV module:

PA = EL×GS / HA / KB [W] ---------①

PA: Solar cell capacity [W]

EL: Daily power supply capacity [Wh]

GS: Solar irradiance when solar cells are in the standard state =1.0 [kW/m^2]

HA: Solar panel face irradiation [kWh/m2/day]

KB: System output coefficient = 0.45~0.55 (case of SHS with DC output)

Considering natural condition in the Project sites that solar irradiation is strong and the ambient tempature is high, PV module shall be Crystal Silicon types which are less affected by the ambient tempature than the other types of PV module.

* KB shall be set 0.45~0.55 considering module tempature, battery loss by discharge and charge, survival capacity of storage battery, wiring loss, charge controller loss, PV cut-loss and other factors.

Battery capacity:

BE = EL×ND / UB [Wh] ---------②

BE: Battery capacity [Wh]

ND: Consecutive days without sun [days]

UB: Battery output contribution rate [0.5～0.7]

*Battery output voltage is dropped sharpely and its sustainability is lost in case survival capacity is less than approximately 20%. Therefore the standard of Battery output contribution rate shall be 0.5-0.7 for the selection of battery commonly.

PV module capacity calculation:

In ①:

EL = 400Wh

GS = 1.0

HA = 4.4 kWh/m^2

KB = 0.55

In this case:

PA = 400×1 / 4.4 / 0.55 = 165.3 [W]

Accordingly, PV module with capacity of around 170Wp is selected. For example, 2x36-cell 85W type PV modules, which can be used with 12V circuits, can be connected in parallel.

Note) It should be noted that only 36-cell composition PV modules can be used with 12V SHS systems.

Battery capacity calculation:

In ②:

EL = 400Wh

ND = 4

UB = 0.7

In this case, the required battery capacity BE will be as follows:

BE = 400×4 / 0.7 = 2285.7 [Wh]

Expressed in ampere hours in a 12V circuit, this becomes as follows:

BE = 2285.7 / 12 = 190.5 Ah

Therefore, battery capacity of around 12V, 180Ah～200Ah is appropriate.

Charge controller required specifications:

The charge controller is determined by the types of storage battery and PV module that are used.

Assuming an 85W PV module, the peak power operation current of the PV module will be 5.0A and the shorting current Isc will be around 5.34A. Accordingly, since two parallel series of 85W modules are used, the maximum current in the PV circuit is kept to no more than 10.68A (5.34A x 2).

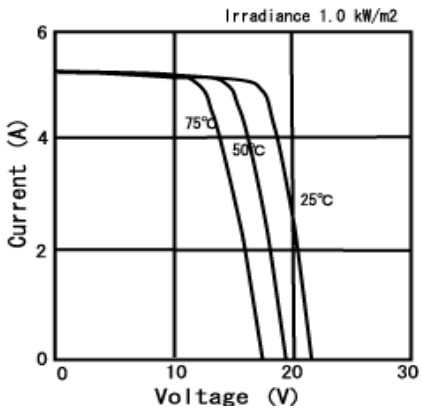


Figure 2.2.2-1 PV Module Characteristics Example

Meanwhile, the peak discharge current and load current of the storage battery are around 2.95A (35.6W / 12V). Therefore, considering some allowance, the required current of the controller have to have at least 15A.

As conclusion, a controller with a 20A rating shall be used. The control voltage shall be the ideal value for a 12V open lead sulfate battery. In the Project 12V open lead sulfate battery shall be adopted. For the reason the point is given that the open lead sulfate battery is basically same type with car battery (open type) and trainings for technicians are assumpted to be easy.

2-2-2-3 Outline of the Basic Plan

Table 2.2.2-1 shows the basic plan of the Project based on the basic design concept described above (see 2-2-1). The project consists of equipment concerned SHS installed outdoor, and wiring and lighting equipment installed indoor.

Table 2.2.2-1 Outline of the Basic Plan

	Procurement and installation of the following PV equipment	Quantity
Equipment procurement and installation Plan	PV modules	1 set
	Steel pole for PV module	1 set
	Storage battery	1 set
	Charge Controller	1 set
	Cable and initial lighting fixtures	1 set
Equipment procurement plan	PV system exchange parts, maintenance tools and test apparatus	1 set

(2) Equipment Procurement Quantities

The quantities of the main equipment to be procured in the Project are as shown in Table 2.2.2-2 The following is a number that EPU confirmed in the Project sites from November to December 2009. The Project equipment will be procured and installed after lease agreement was made between the Solar Electricity Society and each user.

Table 2.2.2-2 Number of SHS planned to be procured under the Project

Name of islands	Island	No.of SHS	No. of household which will install SHS	No. of Institutional Buildings which will install SHS
Vava'u Group				
	HUNGA	**95**	79	16
	OVAKA	**38**	32	6
	LAPE	**10**	8	2
	NOAPAPU	**52**	43	9
	MATAMAKA	**49**	39	10
	OTEA	**36**	31	5
	FALEVAI	**38**	32	6
	KAPA	**20**	16	4
	TAUNGA	**20**	18	2
	OLO'UA	**33**	28	5
	OFU	**51**	46	5
Sub-total (Vava' u Group)		**442**	**372**	**70**
Tongatapu Group				
	'EUEIKI	**22**	16	6
	ATA'TAA	**48**	43	5
Sub-total (Tongatapu Group)		**70**	**59**	**11**
Total		**512**	**431**	**81**
Notes		Institutional Buildings : Church Buildings, Church & Community Halls, Schools and Clinics.		

(Source:Survey Result conducted by EPU)

2-2-3 Basic Design Drawings

(1) Basic SHS Composition and Division of Management Responsibility

a. SHS basic component elements

- PV module: 170 W (85W x 2)
- Storage battery: Deep discharge, Lead sulfate (include tubular plate-type), battery、,
  180~200Ah /12 V (Deep discharge type,
  Expected life = 4,000 at DOD = 20%)
- Charge controller: 12 V / 20 A (lead battery setting)
- Electric appliances: Lighting fixtures (with LED lights) and radio power supply voltage converter for radio.

b. SHS system composition

Apart from the PV panels, the instruments that comprise SHS are usually installed indoors. In Tonga, in order to clarify the division of management responsibility for equipment, it is desirable to divide the SHS into the solar power utility and the load part and to install the entire solar power utility outdoors apart from the load instruments indoors. SHS equipment, wiring indoor and lighting fixture shall be maintained by the Outer Islands Solar Electricity Society, however regarding bulb, in case replacement is needed, replacement cost shall be borne by the SHS users.

Figure 2.2.3-1 shows the composition of a solar home system (SHS) that satisfies this requirement. Figure 2.2.3-2 shows the circuitry schematic diagram.

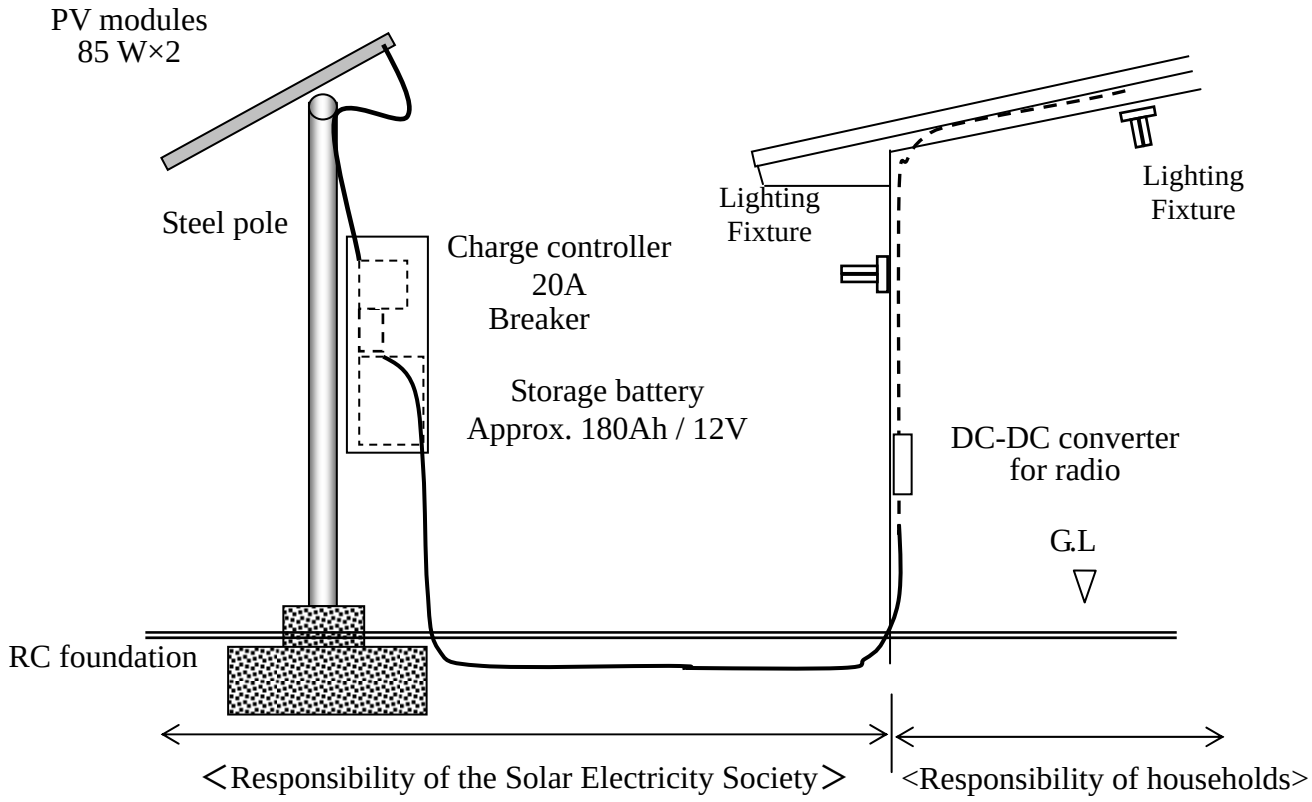
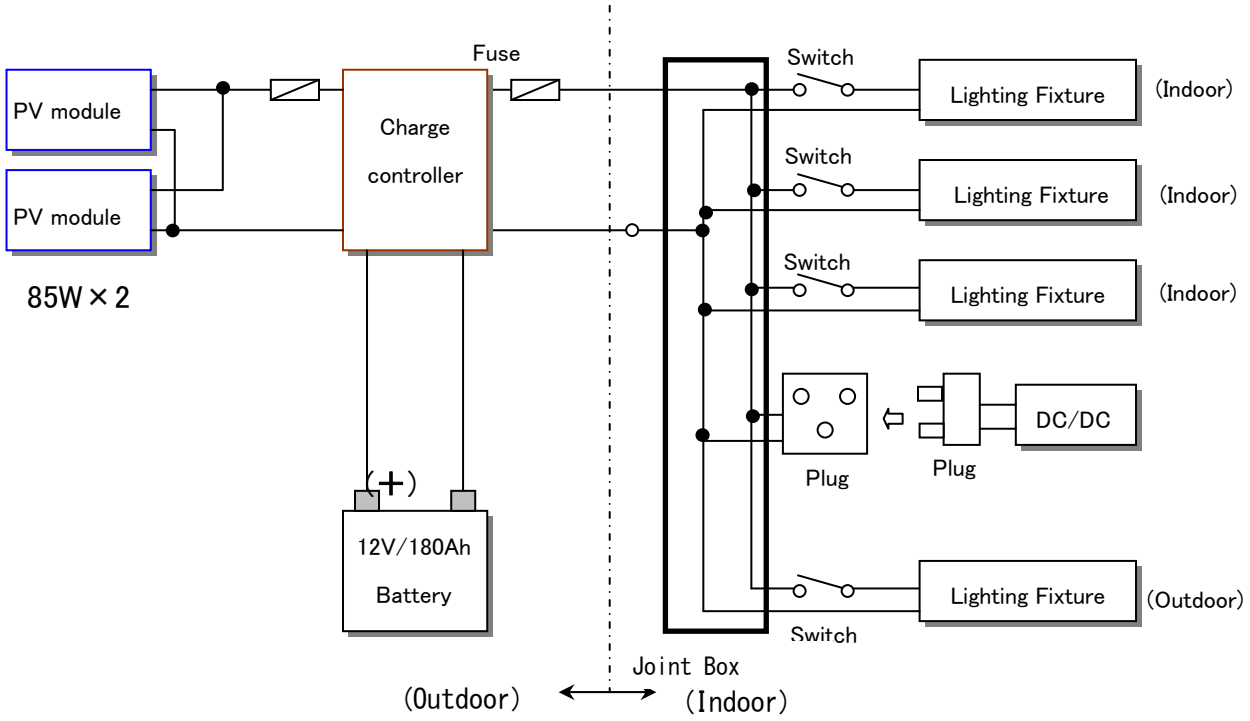


Figure 2.2.3-1 SHS Basic Composition and Division of Responsibility



(Source: Developed by the Survey Team)

Figure 2.2.3-2 SHS Circuitry Schematic

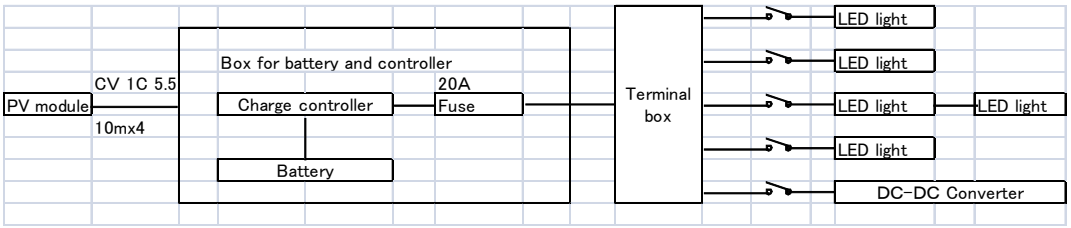
c. Important points to consider in SHS installation

- PV module frame: Attach to an outdoor pole. To adopt a frame structure which enables the angle of inclination to be easily changed and the orientation to be altered by loosening.
- Standard setting of the PV module frame: Orient the frame due north at an angle of latitude°
- Battery storage box: To adopt a well ventilated structure over the entire box to ensure adequate discharge of hydrogen gas and heat. Also, secure ample space to minimize the impact of radiant heat on the stored battery. Moreover it should enough storong to hold desined battery.
- Charge controller: When using a controller not fitted with a protective fuse for shorting, install a 20A protective fuse for safety on the controller input/output side.
- Use electric cable of sufficient size to ensure that voltage drop does not become too excessive between the solar power utility and indoor wiring connections.
- Indoor wiring distances are shorter than outdoor wiring, and it is possible to use a wire size of 2mm^2 or more since current is dispersed to instruments (lights).
- When installing a radio power supply voltage converter in the indoor equipment, *the voltage converter continues to consume power* even when the radio is not in use. To prevent this, always connect the voltage converter through a switch or plug so that it can be disconnected when the radio is not in use.

(2) Equipment Rough Specifications (Draft)

Table 2.2.3-1 shows the rough specifications (draft) of the equipment.

Table 2.2.3-1 Rough Equipment Specifications (Draft) and Procure Quantities

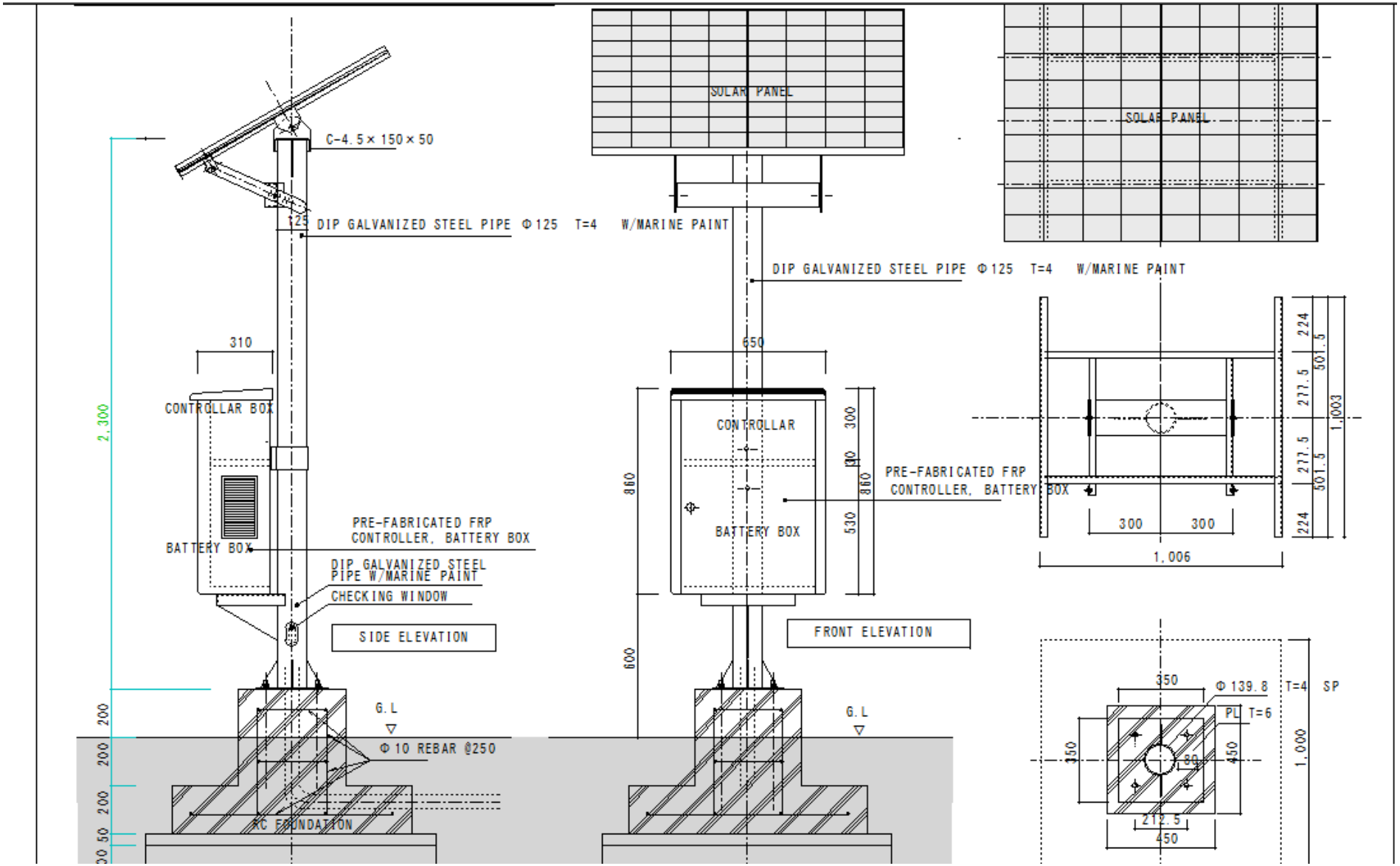
Item / Description		Specifications	
Solar power system			
Quantity		512 Set	
Country of Origin		Japan	
Manufacturer			
Maximum daily load		287Wh (per day)	
System autonomy duration without sunshine		Minimum 4 days	
System configuration		Following configuration is a standard system	
			
Components		Each system consists of the following items (1)-(11).	
(1)	Solar module/panel	Quantity:	2pcs
		Country of Origin:	Japan
		Type:	mono or polycrystalline silicon. 36 cells connected in series
		Maximum rated peak power at 1000 W/m2 and 25° C of 85 Wp +/- 5%.	
		Maximum power current :	5.02 A
		Maximum power voltage :	17.4 V
		Required parameters of PV module at standard test condition AM1.5 (Solar insolation 1000W/㎡,25℃)	
		A statement of warranties in effect: provided.	
		The photovoltaic modules rated output :within ±15% for a minimum of ten years.	
(2)	Panel mounting structure	Quantity:	1 pc
		Country of Origin:	Japan
		Type:	Pole mounting
		Material:	Pole mounting : a steel collar. Pole mounting collars, clamps and hardware include bolts and nuts and washers shall be stainless steel or hot dipped galvanized steel.
		Length	2.3m
		Tilt angle:	Adjustable to 15degree – 25degree

(3)	Charge Controller	Quantity:	1 set
		Country of Origin:	Japan
		System Voltage:	DC22V, 20A
		Output:	DC11.4V-15.0V (fluctuation range)
		Protection:	The charge regulator must be protected against reverse polarity in both generator and battery lines. Diode-fuse or other arrangements can be used
			Full charge protection, Over discharge protection
		Indicator:	LED charging status indicators Warning facilities may be included
		Other functions:	Battery voltage selector
		A statement of warranties in effect : provided.	
(4)	Battery	Quantity:	1 set
		Country of Origin:	Japan, or third country
		Voltage:	12V
		Minimum capacity:	180Ah/20 h or more
		Type:	Deep cycle, suitable for photovoltaic system Multi bank will be accepted only in case tubler type battery
(5)	Box for battery and controller	Quantity:	1pc
		Country of Origin:	Japan
		Type:	Outdoor use
		Material:	FRP
		Other:	Equipment storage installed wiring, storage Partition between charger and battery
		The battery box: lockable.	
(6)	Terminal Box	Quantity:	1pc
		Country of Origin:	Japan
		Material:	FRP or ABS,or stainless steel
		Input:	More than $14mm^2$ 2cable x 1
		Output:	More than $2mm^2$ 2cable x 5
(7)	Lighting Fixture (indoor)	Quantity:	4pcs
		Type	LED type
		Input:	rating DC10V - 15V 1.1W or more
		Brightness:	LED type 300LX (0.3m) per bulb
		Socket:	E26 type
(8)	Lighting Fixture (outdoor)	Quantity:	1pc
		Input:	rating DC10V - 15V

		Type:	LED
		Casing	Water proofing type with E26 Socket
(9)	DC/DC converter	Quantity:	1pc
		Country of Origin:	Japan
		Input:	DC8V - 18V
		Output:	Sect one from 3.3V, 5V, 6V, 12V, 15V, 24V
		Capacity:	50W and/or more
		Type:	Indoor
(10)	Wiring/interconnects	Quantity:	1 set
		PV module - Box for battery and controller : (outdoor) single-coil cable 5.5mm^2 and/or more, 10m x 4 (including wiring material)	
		Box for battery and controller - battery : (in the box) single-coil cable 8mm^2 and/or more, 1m x 2 (including wiring material)	
		Box for battery and controller - Joint box : (outdoor) double- cable 14mm^2 and/or more, 20m x 2 (including wiring material)	
		Joint box - Load: (indoor) double cable 2mm^2 and/or more, 10m x 4 (80m) (including wiring material)	
		Switch for DC/DC converter and lights DC 2P, 5pcs	
(11) Other requirements		Installation drawing and maintenance manual in English	
Cooperation Marking		Displayed on enclosure and shipping carton	

(3) basic Design Drawing (Draft)

Basic Design Drawing (Draft) is as follows.


SOLAR PANEL
C-4.5×150×50
DIP GALVANIZED STEEL PIPE Φ125 T=4 W/MARINE PAINT
125
310
CONTROLLAR BOX
2,300
BATTERY BOX
PRE-FABRICATED FRP CONTROLLER, BATTERY BOX
DIP GALVANIZED STEEL PIPE W/MARINE PAINT
CHECKING WINDOW
SIDE ELEVATION
G.L
Φ10 REBAR @250
200
200
200
50
RC FOUNDATION
650
CONTROLLAR
BATTERY BOX
860
300
30
530
600
FRONT ELEVATION
SOLAR PANEL
DIP GALVANIZED STEEL PIPE Φ125 T=4 W/MARINE PAINT
PRE-FABRICATED FRP CONTROLLER, BATTERY BOX
224
277.5
501.5
1,003
300
300
1,006
350
Φ139.8
T=4
SP
PL T=6
350
80
450
1,000
212.5
450

The warranty of equipment after completion of installation work shall remain valid for one year from the date of the provisional commissioning certificate which will be signed by the Consultant, Contractor, EPU and User. If the warranty period of each components will more than one year by the manufacturer, each equipment will cover by manufacturer warranty.

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

The Project will be implemented based on the Government of Japan's Program Grant Aid for Environment and Climate Change. According to this, the Project will receive approval by the Government of Japan and the two countries' governments will sign the Exchange of Notes (E/N) before the Project progresses to the implementation stage. The Procurement Management Agent (herein after "the Agent") will be recommended to Tongan side by the Government of Japan and the Agent will assist the Tongan side to ensure that the contract (tender and equipment procurement) is appropriately and smoothly executed. The Agency will also execute project fund administration on behalf of the Government of the Kingdom of Tonga.

(1) Implementation Setup

Following the conclusion of the Exchange of Notes (E/N) and Grant Agreement (G/A) concerning the Project, the Government of Tonga will entrust selection and contracting of the works consultant and suppliers to the Agent. Also, the works supervision consultant and suppliers will implement their respective duties upon binding contracts with the Agent.

(2) Responsible Government Agency

The responsible government agency will be the Ministry of Land Survey and Natural Resources (MLSNR) or/and the other responsibility Ministry of the Government of Tonga.

(3) Implementing Agency

The implementing agency for the Project is MLSNR or other Government bodies of the Kingdom of Tonga. The Project will be implemented as a Program Grant Aid for Environment and Climate Change undertaking based on the Agent Agreement that is concluded between the responsible government body on the Tonga side – and the Japanese Agent.

Other related agencies on the Tongan side are as indicated below, the Renewable Energy Subcommittee has been established under the Office of the Prime Minister and it will be necessary to fully share information and coordinate with each agency from Renewable Energy Subcommittee in the implementation stage. When coordinating with each agency, it has been confirmed that the MLSNR will act as the primary contact.

-CEO of MLSNR (Chair)

- Representative(s) of Energy Planning Unit (Secretary)

-CEO of Ministry of Finance and National Planning

- Representative(s) of JICA Tonga Office

So far Japan has implemented numerous general grant aid projects in the medical and transportation sectors, etc. in Tonga, however, since Tonga has no experience of tender and contract operations based on the procurement agency approach, it will be necessary to share information with the responsible government agency of Tongan side and Energy Task Force agencies to ensure smooth implementation. Also, the main agencies on the Tongan side and the Japan side will establish an intergovernmental conference composed of representatives from each to discuss the items that require confirmation for the Project. Furthermore, a working group will be established by the Implementation body of the Government of Tonga, JICA Tonga Islands Office and the Agent, and this will confirm progress and discuss technical confirmation points and so on.

The Project implementation setup is indicated below.

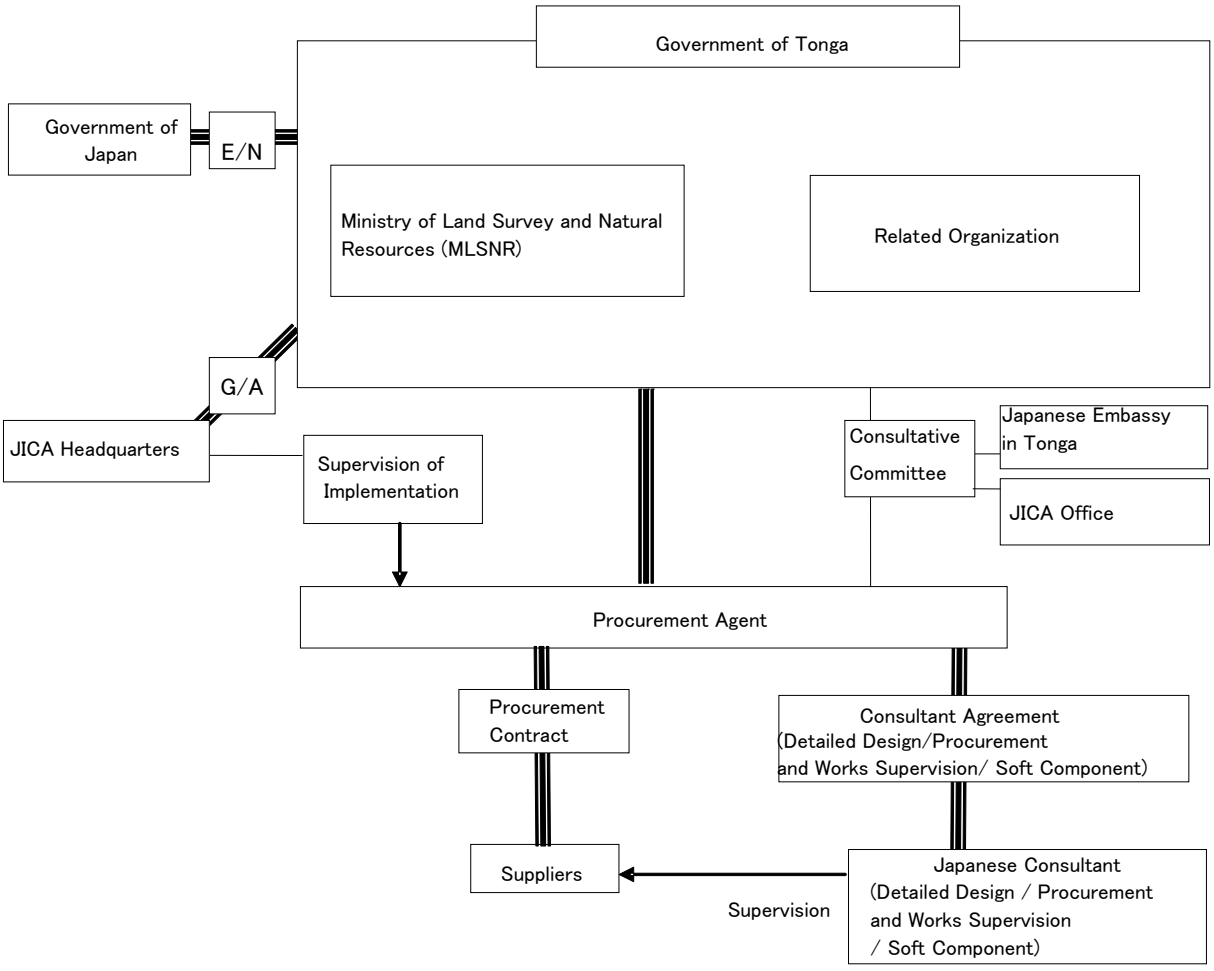


Figure 2.2.4-1 Implementation Setup

(4) Procurement Management Agent

1) Implementation Contents

The Procurement Management Agent in close collaboration with the Implementing Agency of Tonga side will prepare the tender documents for equipment procurement, thereby initiating the tender management proceedings and procurement operations for the Project. The Agent, which will be recommended to the Tonga side by the Government of Japan, will implement and execute general supervision to ensure that the Project components are appropriately and smoothly implemented in its capacity as the mandatory of the implementing agency.

Concerning tender work supervision, the Agent will prepare documents concerning the Agent Agreement, bank arrangements and contracts pertaining to tender, and it will distribute the tender documents and conduct duties pertaining to the tender, evaluation and contracting of suppliers.

In the area of works management, the supervisor dispatched by the Japanese Agent will conduct fund management including payments, expenditure planning in the event where excess funds arise, confirmation of implemented contents and reporting of progress to both governments, as well as maintain constant discussions, coordinate with and report to Tonga side.

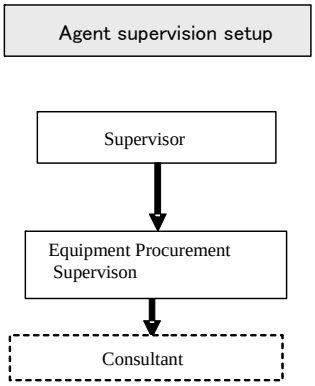
2) Implementation Setup

- Tender work management period

The Agent and the Implementing Agency of Tonga side will compile the tender documents, confirm equipment specifications and evaluate the tendering firms, however, since the competitive tender for equipment procurement is likely to be complicated, the Agent will procure local auxiliary personnel. Moreover, since it will be necessary to receive and answer technical questions on the tender contents and appropriately evaluate the technical proposals of tenderers, the Japanese consultant will assist in the technical affairs.

- Works supervision period

The Agent based on commission from Implementing Agency of Tonga side will conduct general management during the work execution period, however, this will only comprise checking of key points and will be conducted under the work supervision of the Japanese consultant.



(5) Equipment Installation Supervision and Procurement Supervision Consultant

The technical consultant that is appointed by the Agent in close corroboration with the Implementing Agency of Tonga side will supervise the procurement and equipment installation works in their capacity as the equipment installation supervision and procurement supervision consultant. The Consultant and Implementing Agency of Tonga side will supervise the quality of work, schedule and safety, etc. of, equipment installation confirm quality, functions, performance and quantities in the equipment procurement, and check for exterior damage, etc. during the transportation of equipment. If there are any problems in confirmation matters, it will immediately prepare a report and discuss countermeasures with related officials. Moreover, the Consultant in charge of equipment installation supervision and the Implementing Agency of Tonga side will assess the performance of installation works. An Inspection Checklist and Commissioning Form shall be countersigned by the Consultant, Contractor, EPU and User which stated that they're agreeing to the installation works.

(6) Equipment Installation Contractor and Equipment Suppliers

The suppliers that are selected by the Agent by tender must fully understand and certainly and without delay execute the contents of the contracts they bind with the Agent.

2-2-4-2 Implementation Conditions

(1) Construction Conditions and Technology Transfer in Tonga

General construction contractors and electricity works contractors owned by native can be found in Tonga, that it is possible to procure local transportation and construction equipment, materials for installation work and wiring works. However, since the Project is being implemented as Program Grant Aid for Environment and Climate Change, which requires high quality execution in a short time, in addition considering the quality of works realized in existing SHS system installed by local equipment installation contractors, it is judged to be essential to dispatch Japanese engineers to ensure schedule control, quality control and safety control.

SHS installation works had implemented on remote islands in the 1990s in Tonga. However, following the SHS installation works, the equipment suffered breakdowns due to a lack of aftercare. Since geographical constraints make it almost impossible for the main islands of island groups to supply electricity to remote islands, the Tongan side will need to depend on SHS in order to supply power on remote islands for the immediate future. Amidst such high needs for SHS, and since Tonga is so remote from neighboring advanced countries, the Tongan side hopes that local operators will become sufficiently technically proficient to build a largely autonomous technical response setup. Considering such situations, when implementing the installation work, it is desirable that the Japanese supplier procures local laborers and works equipment and dispatches engineers who understand and experienced Japanese PV installation. Moreover, the supplier will conduct

technology transfer in the shape of OJT to improve more their technical skills for Tongan Contractors at the early stage of the installation period.

(2) Utilization of Local Equipment and Materials

The aggregate, cement and reinforcing bars, etc. required for building the foundations of the frame for the PV modules can be procured in Tonga, although it will be necessary to implement management and supervision of quality and deadlines. Accordingly, when compiling the execution plan, locally procurable equipment shall be utilized as far as possible.

(3) Safety Measures

The Project target site has relatively few problems in terms of law and order, however, it will be necessary to display ample care for preventing theft of equipment and securing the safety of works personnel. Accordingly, not only is it essential that Tongan side take safety measures, but also the Japanese supplier will need to take steps such as assigning guards and so on.

(4) Tax Exemptions

In order to receive exemptions of customs charges and tariffs on the Project equipment, the contractor will need to give advance notification to the Ministry of Finance and national Planning through the Implementing Agency in Tonga. It is possible to receive exemptions of all taxes for the project, however, it has been confirmed that this is not an advance rebate system but rather a total exemption scheme whereby the Implementing Agency in Tonga

(5) Transportation

1) Marine transportation from Japan

Regarding equipment transportation in the Project transportation routes for Project equipment needed to be set separately according to the Tongatapu Group and the Vava'u Group.

The reasons for this are as follows: ① Due to the sinking of a domestic ferry in 2009, domestic shipping capacity in Tonga has declined and priority is given to the transportation of food regarding freight between Tongatapu and Vava'u; and ② Existing domestic ships do not have the capability to reload international standard containers (20 feet containers). Accordingly, examination was carried out on the direct transportation of containers to Tongatapu and Vava'u.

Table 2.2.4-1Transportation channel from Japan to Tonga

Tongatapu（for Nuku' alofa） Estimated transportation	Period : 1.5month	One shipment a month
Vava' u (for Neiaf) Estimated transportation	Period : 2.0 month	One shipment a month

2) Domestic Transportation

Concerning domestic transportation to remote islands in the Project sites, since the installation sites do not possess quays which can moor ships of 10 tons or more, the equipment will need to be transported in small vessels.

2-2-4-3 Scope of Works

According to the Program Grant Aid Scheme for Environment and Climate Change, Table 2.2.4-2 shows the detailed scope of works on the Japanese and Tongan sides.

Table 2.2.4-2 Scope of Works on the Japanese and Tongan Sides

No.	Item	Japan	Tonga	Remarks
1	Securing of the equipment installation site		●	
2	Ground leveling and removal of obstructions on the equipment installation site		●	
3	Installation of fences and gates		●	
4	Parking area works		●	
5	Road works			
	(1) Outside the site (access road)		●	
6	Equipment installation	●		Including temporary installation works in line with the facilities construction
7	Electrical, water supply and sanitary works			
	(1) Electrical works			
	a) Indoor wiring works (lighting, sockets, etc.)	●		
8	Commission for opening of bank account based on the B/A		●	
9	Handling of transport and customs clearance procedures and taxes			
	(1) Responsibility for ocean transport (air transport) of products related to procured equipment to the recipient country (Tonga)	●		
	(2) Tax burden and customs clearance procedures at the port of unloading in Palau		●	
	(3) Transportation of procured equipment, etc. from the port of unloading to the inland site in Tonga	●		
	(4) Exemption or bearing of domestic value added tax on procured construction materials and equipment in Tonga		●	
10	OJT concerning operation and maintenance of facilities and procured equipment	●	●	The Tongan side will select the personnel who will receive OJT
11	Operation and maintenance of facilities and procured equipment		●	
12	Other costs not covered by the grant aid		●	

Note: B/A: Banking Arrangement

●: Indicates the scope of responsibility regarding each item.

2-2-4-4 Consultant Supervision

Based on the scheme of the Government of Japan's Program Grant Aid for Environment and Climate Change, the Consultant will organize a consistent Project Team to smoothly conduct the preparation of tender documents and equipment installation supervision work according to the contract documents and drawings. The Consultant will assign at least one engineer to Tonga during the equipment installation supervision stage in order to supervise schedule control, quality control, performance control and safety control by the contracted supplier. Furthermore, an expert in Japan will attend plant inspections and pre-shipping inspections of equipment and materials manufactured and procured in Japan with a view to ensuring that no troubles occur following delivery of materials and equipment to Tonga.

(1) Basic Concept of equipment installation Supervision

The basic concept of equipment installation supervision by the Consultant will be as follows: to supervise the work progress to ensure they finish within the designated period, and to supervise and instruct the supplier to ensure that the quality, performance and delivery times specified in the contract are secured and that the site works are executed safely.

The important points to consider in equipment installation supervision are described below.

(2) Schedule Supervision

The contractor will compare progress with the implementation schedule decided in the contract every month or every week in order to adhere to the delivery deadline given in the contract. In cases where delays are predicted, the contractor will warn the subcontractors, present and instruct a plan of countermeasures and offer guidance to ensure that the works and equipment delivery are completed within the contract period. The comparison of the planned schedule and actual progress will be carried out according to the following items.

① Confirmation of works performance (manufacture of equipment and materials in plant and performance of civil engineering works on site)

② Confirmation of equipment and materials delivery (switching equipment, distribution equipment and materials, and civil engineering works equipment and materials)

④ Confirmation of yield and actual numbers of engineers, skilled workers and laborers, etc.

(3) Quality and Performance Supervision

Supervision will be carried out pre-shipping inspections based on the following items to determine whether the manufactured, delivered and installed equipment and materials and constructed facilities satisfy the required quality and performance stated in the contract documents. In cases where doubts arise over quality and performance, the Consultant will immediately demand that the contractor make amendments, revisions or corrections.

(4) Safety Supervision

Discussions will be held and cooperation sought with responsible officers of the supplier to ensure they will exercise orioier safety control during the implementation period in order to prevent industrial accidents and accidents affecting third parties. Important points to consider in safety control on the site of the supplier are as follows:

① Establishment of safety control rules and appointment of manager
② Encouragement of laborers to utilize welfare measures and vacations

(5) Installation work supervisor

The supplier will implement the PV module's foundation works, the procurement and installation of PV equipment and materials. In order to implement these works, the supplier will employ a subcontractor in Tonga. Therefore, since the Consltant(s) will dispatch supervisor to the site assited by EPU, to ensure that the installation works following the contract regarding schedule, quality, performance and safety measures prescribed in the contract and the Consltant(s) with EPU will provide guidance and advice to the supplier.

2-2-4-5 Quality Control Plan

The supplier will ensure and the Consultant's supervisor will carry out supervision and checking the following items to ensure that the supplier secures the quality of Project equipment and materials and the execution and installation performance stipulated in the contract documents (technical specifications and implementation design drawings, etc.). In cases where doubts arise over quality and performance, the construction supervisor will immediately demand that the contractor make amendments, revisions or corrections. An Inspection and Commissioning Form shall be produced for the Contractor, EPU and a consultant to sign / agreed before a system is commissioned.

① Checking of shop drawings and specifications of equipment and materials
② Attendance of plant inspections of equipment and materials and checking of plant inspection results
③ Checking of packing, transportation and on-site temporary storage methods
④ Checking of shop drawings and installation guidelines of equipment and materials
⑤ Checking of trial operation, adjustment, test and inspection guidelines of equipment and materials
⑥ Supervision of site installation works of equipment and materials and attendance of trial operations, adjustments, tests and inspections assisted by EPU
⑦ Checking of facilities shop drawings against work performance on site assisted by EPU
⑧ Checking of completion drawings assisted by EPU

2-2-4-6 Equipment Procurement Plan

The PV modules, poles and batteries to be procured and installed in the Project are not manufactured in Tonga. Numerous SHS projects have been implemented under foreign assistance in

Tonga since the 1990s and modules made by BP and Siemens, etc. have been introduced, however, since these makers do not possess local branches or agents, the after-sales service setup for responding to accidents, making repairs and procuring spare parts, etc. is not in place. When the EU supplied SHS equipment in 1995, a local agent of the maker existed for three years after procurement, however, this was subsequently closed down making it impossible to secure after-sales services. Furthermore, because the SHS systems supplied in the said EU project ceased functioning after five years, criticism was raised that the supplied equipment did not comprise adequate specifications. Because of this experience, the Tongan side is requesting that high quality equipment be procured in future. Accordingly, when selecting the supplier of PV equipment in the Project, it will be necessary to take local conditions, ease of operation and maintenance by local engineers, and existence of the post-installation setup for procuring spare parts, etc. into account.

Moreover, the implementation agency of Tonga, which possess the PV equipment after completion of the Project, has recognized that Japanese photovoltaic power generation manufacturers are more dominant than the other countries at a point of product quality and the reliability Furthermore, it is hoped that Japanese PV equipment be procured in this Japanese grant aid project.

In consideration of the above points, the suppliers of equipment and materials in the Project will be as follows.

(1) Locally procured equipment and materials

Works equipment and materials including cement, sand, concrete aggregate, reinforcing bars.

(2) Equipment and materials procured in Japan

PV modules, charge controller

(3) Equipment and materials procured in Japan or the third countries

Battery, materials for wiring cable, etc

(4) Procurement Method

In past SHS installation and procurement projects implemented by other donors in Tonga, the Outer Islands Solar Electricity Societies have bound contracts including payment conditions with prospective SHS users before the final quantities were decided. In implementing the Project, the Tongan side presented the initial SHS installation cost and monthly payment to residents in the Project site in November 2009 and canvassed the prospective users before requesting the corresponding number (512) of SHS units to the Japanese side. In the Project it is planned to procure the equipment on the assumption of the figure.

In order to ensure that the appropriate number of SHS units are procured and installed in the Project without any excess, MLSNR shall implement recruitment of applicants of SHS lease and contract with them without delay and needs to report the progress to Japanse side.

2-2-4-7 Operation Guidance Plan

Before the works are finished, guidance will be carried out on the initial equipment controls and operation and maintenance methods. Such guidance will basically be carried out by the instructors from the manufacturer or supplier by site OJT according to the operation and maintenance manual.

In order to advance the plan of guidance smoothly, the implementing agency, Tongatapu Outer Islands Solar Electricity Society and Vava'u Outer Islands Solar Electricity Society will need to hold close communications and discussions with the Japanese Consultant and contractor..

2-2-4-8 Soft Component Plan

(1) Current situation and Objective

In Tonga, programs for the widespread introduction of SHS to communities on remote islands were vigorously implemented under assistance from Australia, New Zealand and the EU from the 1990s as a means of supplying electricity to non-electrified areas where do not served by city electricity supply. Under such programs, 813 SHSs were installed prior to this project. In the Project target areas too, SHS were supplied to the Vava'u Group under EU assistance in 1995, and to the Tongatapu Group under Grassroots grant aid by the government of Japan, UNESCO and AusAid support from 1997. However, 10 years following installation, almost all of these systems currently lie unused. In the implementation of the Project here, information was collected and problems were identified on these past SHS projects and programs implemented in other areas. As a result, identified problems are as follows.

- Physical problems
  - Equipment possessing specifications capable of withstanding long-term use was not procured.
- Financial problems
  - Fund management was not properly conducted by the Solar Electricity Society
  - Consumable replacement could not be renewed intentionally.
- Organization and human problems
  - Appropriate technical guidance was not implemented.
  - Daily maintenance is not carried out.
  - Guidance on proper methods of use for residents was not conducted.
  - Solar Electricity Society does not properly conduct personnel management of technicians.
- Information problems
  - The equipment makers had no agents in Tonga, which meant that the setup for responding to troubles was inadequate

Concerning the physical problems and information problems, countermeasures can and should be taken in the Project by introducing equipment that possesses the proper specifications and by requiring that contractors have agents in Tonga as a condition for participation in the tender process. On the other hands since in current condition, it is judged that operation and maintenance system and their method, etc by the resident and the implementation agency as for the human and financial

problems, in order to ensure the smooth start and sustainable operation and maintenance, it will be hoped to implement technology transfer through soft component. Expected outputs by implementing soft component are shown full detail in the Soft component PDM.

(2) Objectives of the Soft component

It is intended to establish the Project operation and maintenance setup centering on the Solar Electricity Societies through preparing the Solar Electricity Society operating manual and SHS maintenance manual and supporting activities utilizing those manuals. The superior objective shall be to realize the long-term utilization of the procured SHS following installation.

(3) PDM of the Soft component (Draft)

PDM of Soft component is shown as follows.

Table 2.2.4-3 PDM of the Soft component (Draft)

Project title :Project for Introduction of Clean Energy by Solar home system
Duration (Soft component)：March 2011～march 2012 Ver. 0
Target area : Tongatapu Group, Vava'u Group
Target : Officials in charge of EPU head office, Officials of EPU in charge of each islands Group Office, Outer Island Solar Societies and technicians Date : March 2010

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption
Overall Goal Procured SHS will be utilized for a long period after installation.	Usage of SHS (tentatively 10 years after installation of equipment)	Records of repair and maintenance Solar Electricity Society's records	
Project (Soft component) purpose Operation and maintenance system of the Project will be developed around a core of Solar Electricity Society through development of the management manual of SHS operation, maintenance manual and support on the activities using the manuals.	1. Situation of management manual development 2. Situation of SHS operation and maintenance manual development 3. Usage of manual by Society's members.	1. Solar Electricity Society's reports 2. Solar Electricity Society's records 3. Test regarding Manuals contents and questionnaire to the Society's members.	
Outputs 1. Financial management is implemented appropriately by Solar Electricity Society	1-1 Development of financial management manual 1-2 Number of training sessions and degree of understanding regarding financial management 1-3 Situation of financial management	1-1 Financial management manual and situation of the revision 1-2 Record of patrol, results of the supervision 1-3 Balance at the bank and accounting report	
2. Personnel management for officials of the Society and technicians is implemented appropriately by a manager of Solar Electricity Society	2-1 Development of personnel management 2-2 Number of training sessions and degree of understanding regarding personnel management 2-3 Situation of personnel management	2-1 Solar Electricity Society's records 2-2 Record of patrol guidance (including monitoring of understanding degree) 2-3 Working record sheet and periodical report	
3. Annual activity plan is drawn up.	3-1 Number of training sessions for project management and the participants, and degree of understanding 3-2 Situation of drawing up annual activity plan	3-1 Solar Electricity Society's records, interview with training participants 3-2 Solar Electricity Society's annual reports	
4. SHS operation and maintenance manual necessary for technicians is developed.	4-1 Development of operation and maintenance manual 4-2 Number of training sessions for operation and maintenance technology and the participants, and degree of understanding	4-1 Operation and maintenance manual and situation of the revision 4-2 Records of maintenance service and situation of maintenance for existed equipment	

5. Manual for trouble shooting is developed. 6. SHS proper use manual for residents is developed.	5-1 Development of manual regarding trouble shooting 5-2 Number of training sessions for trouble shooting 6-1 Development of manual to enlighten residents 6-2 Achievement to conduct activity for residents enlightening	5-1 Trouble shooting manual and situation of the revision 5-2 Interview with participants of training, records of maintenance service 6-1 Records of workshop 6-2 Solar Electricity Society's annual reports	
Activity	Input		
1-1 Implement support on development and revision for Solar Electricity Society financial management manual. 1-2 Conduct guidance for financial management. 1-3 Implement financial management based on the manual and conduct the OJT for periodical monitoring. 2-1 Implement support on development and revision for Solar Electricity Society personnel management manual. 2-2 Implement personnel management based on the manual and conduct the OJT for periodical monitoring 2-3 Implement assistance for support system for technicians around a core of EPU trainer. 2-4 Conduct training for trainers and technicians. 3-1 Conduct OJT regarding Solar Electricity Society activity plan. 4-1 Implement support on development and revision for SHS operation and maintenance manual 4-2 Conduct training regarding SHS for technicians and trainers based on the manual. 5-1 Implement support on development of manuals for trouble shooting. 5-2 Conduct training regarding trouble shooting for technicians and trainers based on the manual. 6-1 Implement support on development of manuals of activity for residents enlightening. 6-2 Support on implementing activity for residents enlightening.	【Tonga side】 ・ Counterparts ・ Office rooms ・ Expense for soft component activities	【Japan side】 ・ Consultants (Project manager, Organization management, SHS technology)	Disasters which bring to immense damage to SHS will not occur. Pre-condition Tonga side will recognize the importance of long term usage of SHS.

Each manual shall include the following contents.

- Solar Electricity Society management manual
  - Fund management/Financial management (balance sheet and document format creation methods, etc.)
  - Labor control/Personnel management (reward system, evaluation system, leadership theory, etc.)
  - Project control (equipment (bulbs, etc.) procurement, stock control, execution plan formulation, etc.)

- SHS Maintenance Manual
  - Basic know-how on photovoltaic power generation and SHS
  - SHS routine inspection methods
  - SHS maintenance methods
  - Methods for teaching SHS use to residents
  - Troubleshooting
  - Monitoring methods

(4) Contents of Activities

1) Establishment of the soft component implementation setup

To ensure the smooth implementation of the activities, orientation shall be conducted to inform the soft component to the related agencies and 13 target islands on the Tongan side, and the setup for acceptance shall be established and coordinated.

Moreover, in order to promote the smooth implementation of the soft component and sustainable operation following completion of the soft component, a Soft Component Committee composed of members of the EPU, Solar Electricity Societies and consultant shall be established in order to gauge progress of the soft component, exchange opinions and discuss issues.

2) Support for preparation of manuals

① Organizational strengthening of Solar Electricity Societies

Support will be given for preparation of the Solar Electricity Society operating manual by the Solar Electricity Societies. The contents will be as indicated in the soft component draft PDM (section 3).

② Enhancement of SHS knowledge and technology

Support will be given for preparation of the SHS maintenance manual by the Solar Electricity Societies. The contents will be as indicated in the soft component draft PDM (section 3).

3) Support for on-site implementation guidance using manuals

① Organizational strengthening of Solar Electricity Societies

Training on committee running and organizational strengthening will be implemented for the Solar Electricity Societies in each island group based on the Solar Electricity Society operating manual.

② Enhancement of SHS knowledge and technology

Training for enhancement of knowledge and technical capability targeting the EPU trainers and technicians will be implemented for the Solar Electricity Societies in each island group based on the SHS maintenance manual.

Moreover, the islands where the technicians live are all located in remote islands and it will not be possible to conduct training in each island. Therefore the training shall be implemented over two stages to ensure greater efficiency and effectiveness, i.e. initial training targeting all technicians conducted in Vava'u main island and training of trainers dispatched by the EPU. First, two technicians to take part in the initial training will be selected from each island, and training comprising basic lectures on SHS maintenance and simple implementation guidance using equipment will be implemented. After that, training for the EPU trainers will be implemented using actual SHS equipment.

4) Follow-up of on-site implementation guidance

① Organizational strengthening of Solar Electricity Societies

The operating condition of the Solar Electricity Societies in each island group will be confirmed from the perspectives of fund management, labor management and project control, and in addition to offering guidance and advice to the committees, technical follow-up centering on monitoring techniques will be conducted for the EPU officers to ensure that technology can be passed on following completion of the soft component. Also, support will be offered for revision of the Solar Electricity Society operating manual as required.

② Enhancement of SHS knowledge and technology

Conditions of training by EPU trainers for technicians in each island will be confirmed, and in addition to offering guidance and advice to the trainers, technical follow-up centering on monitoring techniques will be conducted for the Solar Electricity Societies to ensure that technology can be passed on following completion of the soft component. Also, support will be offered for revision of the SHS maintenance manual as required.

5) Report on the activities output

The Consultant will confirm the activities outputs, summarize the outputs and future problems and report them to the agents concerned.

(5) Implementation schedule for the Soft Component

The soft component will be implemented as the following schedules.

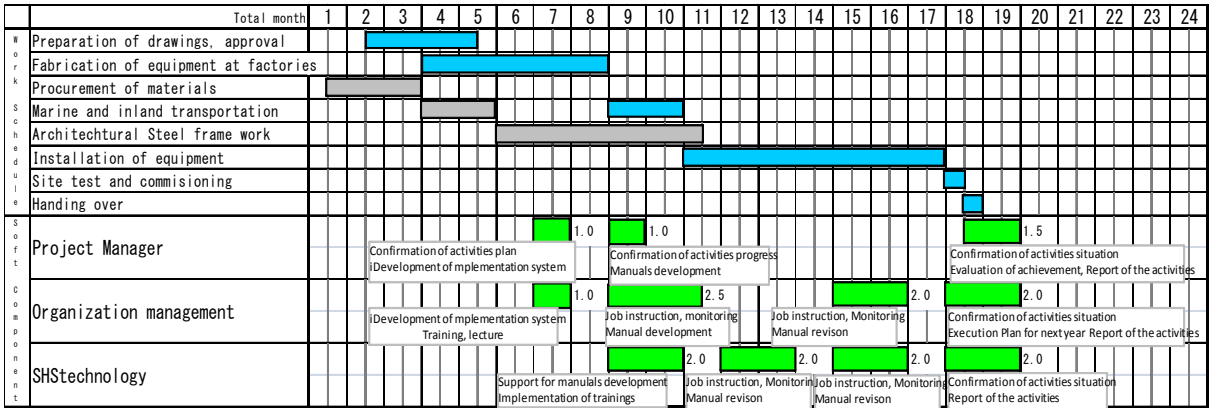


Figure 2.2.4-2 Proposed schedule for the implementation of Soft Component

(6) Outputs of the Soft Component

The following outputs will be obtained from implementation of the soft component:

1) Records of the orientation
2) Records of opening of the soft component committee's meetings
3) Progress reports (submitted in each progress)
4) Operation and Maintenance manual of Solar Society (English and local language)
5) Financial management report
6) Work management report (including the report for the work implementation conditions of technicians)
7) An understanding degree confirmation reports (test results)
8) Result of interview survey to actual maintenance manager and actual work evaluation

(7) Responsibilities of the Counterpart Agency

1) EPU will establish the Soft Component Committee to cooperate for the smooth implementation promotion of the soft component in collaboration with the Solar Electricity Society in each island group.
2) EPU will prepare work rooms, etc. necessary for implementing the soft component upon coordinating with the Solar Electricity Societies in each island group.
3) EPU and the Solar Electricity Societies in each island group will provide the manpower necessary.
4) EPU and the Solar Electricity Societies in each island group will revise operation and maintenance manual voluntarily discussed with the consultant.
5) Solar Electricity Societies in each island group implements the fund management collected from residents for SHS use to introduce under management of EPU based on the proposal of the consultant adequately.

6) Solar Electricity Societies in each island group implements the work management of the technician adequately.

7) The technicians in each community maintain of SHS based on the operation and maintenance manual adequately.

8) EPU and Solar Electricity Societies in each island group submit reports of financial management work management to a Japanese consultant periodically in the fixed period of time.

2-2-4-9 Implementation Schedule

The Team designed the Implementation Schedule of the Project as follows based on scheme of Japanese Environment Program grant aid.

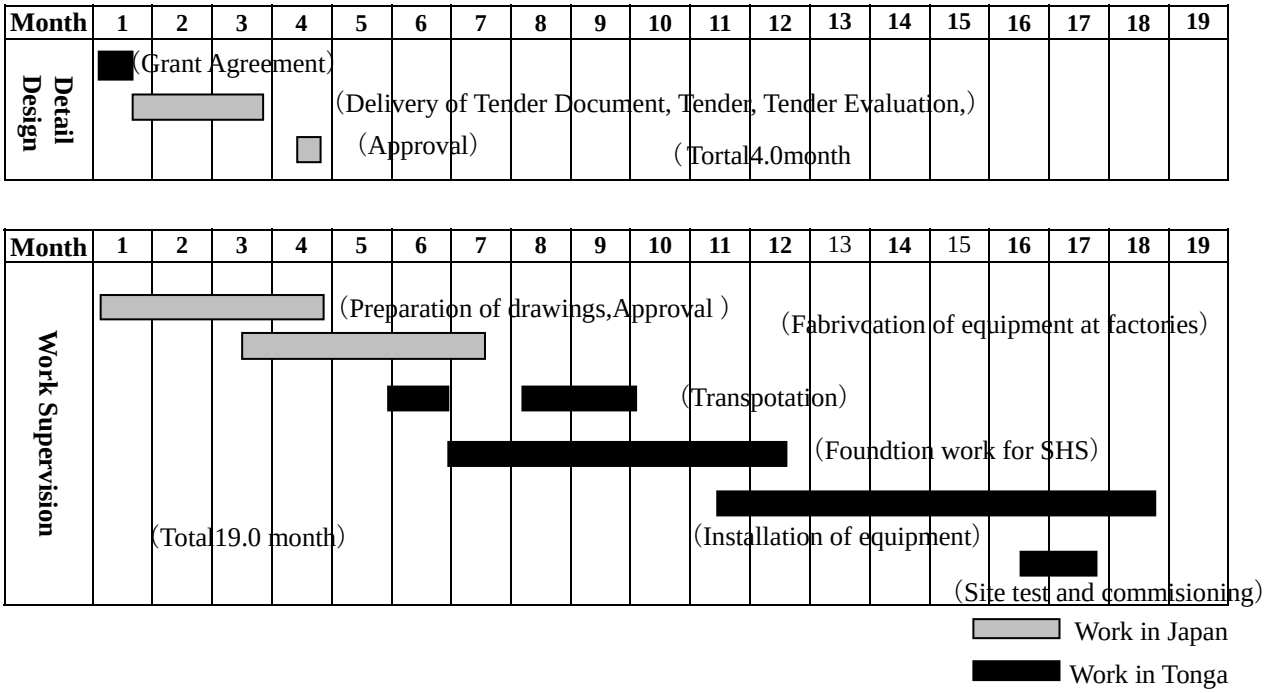


Figure 2.2.4-3 Schedule for Implementation of the Project

2-3 Obligation of recipient Country

When it comes to implementing the Project, in addition to the scope of works on Tongan side indicated in 2.4.1-1 Scope of Works, Procurement and Installation, items to be implemented or borne by Tongan side are as follows.

(1) To provide information and materials necessary for the Project

(2) To secure tax exemption and customs clearance and the speedy unloading of products for the Project at the port of unloading in Tonga.

(3) To grant permission for Japanese nationals to enter and stay in Tonga in relation to the products and services provided based on the authorized contract

(4) To exempt Japanese nationals from taxes and tariffs, etc. that is ordinarily levied in the Tonga

on products and services supplied based on authorized contracts.

(5) To pay commission fees to the Japanese bank in relation to opening of the bank account for the Project

(6) To bear all items not covered under Japan's Program Grant Aid for Environment and Climate Change when implementing the Project

(7) To assit Consultants during equipment and materials inspections on site and to appoint an engineer and skilled workers from EPU as counterparts for the transfer of operation and maintenance technology

(8) To properly and effectively use and maintain the equipment and materials procured under Japan's grant aid

(9) To secure a disposal site for excavated earth, and recovered equipment and materials during the works period

(10) To provide temporally stock yards for the equipment

2-4 Project Operation Plan

2-4-1 Routine Inspection and Periodic Inspection Items

Technicians assigned in each island and trained will checks contents and frequency such as follows and shall maintain.

Table 2.4.1-1 Routine Inspection and Periodic Inspection Items

	Inspection Item	Frequency	Remarks
1	Battery liquid level check and cleaning	Every 2 weeks	Visual inspection. Record on check sheet. If the level is low, replenish with pure water. Wipe dirt from the battery surface with a dry cloth.
2	Battery liquid specific gravity measurement	Every 4 weeks	Record the specific gravity and liquid temperature. If there is a problem with specific gravity, investigate the cause (over-current, low liquid level, cell trouble, etc.)
3	Battery voltage and current measurement	Every 4 weeks Same times as #2	Measure and record the battery voltage and current
4	PV panel inspection	Every 2 weeks	Visual inspection and recording of discoloration, dirt and breakage, etc.
5	Outdoor equipment installation	Appropriately	Visual inspection of deformation, looseness and rust, etc.
6	Power line connections	Appropriately	Visual inspection loose terminals, rust on battery terminals, etc.
7	Indoor equipment	Appropriately	Inspect when requested or required. Visual inspection or use clamp meter, etc.

2-4-2 Spare Parts Purchase Plan

(1) Spare Parts Categories

The spare parts targeted in the Project are classified into the following uses.

① Replacement parts : Repair parts needed to replace parts that are damaged, etc.

② Emergency spare parts : Instruments that need to be urgently replaced, otherwise the power distribution system could be compromised due to equipment failure, etc.

(2) Selection Criteria for Each Category

1) Replacement parts

These parts suppose to be with a high possibility of damage, adopt 100% of the amount projected to be necessary per year.

2) Emergency spare parts

Emergency spare parts are not procured under the Project.

(3) Test Apparatus and Maintenance Tools

The minimum required test apparatus and maintenance tools for conducting appropriate maintenance of the Project PV system will be procured.

Table 2.4.2-1 Spare Parts, Test apparatus and Maintenance Tools Procured in the Project

Equipment	Unit	Q'ty	Remarks
1. Replacement Parts			
1.1 Charge Controller	Set	15	Tongatapu： 2 sets Vava'u： 13 sets
1.2 DC/DC Converter	Set	15	Tongatapu： 2 sets Vava'u： 13 sets
1.3 PV Module	Pcs	30	13 islands and Solar Electricity Society head office in Tongatapu and Vava'u each 2 sets
2. Test apparatus			
2.1 Battery hydrometer	Set	30	13 islands and Solar Electricity Society head office in Tongatapu and Vava'u each 2 sets
2.2 Clamp tester	Set	2	Head office in Tongatapu and Vava'u each 1 set
2.3 Pocket tester	Set	15	13 islands and Solar Electricity Society head office in Tongatapu and Vava'u each 2 sets
3. Maintenance tools			
3.1 Driver set (+)	Set	15	Ditto

3.2	Driver set (-)	Set	15	Ditto
3.3	Socket wrench 9-14, 17,19,21	Set	15	Ditto
3.4	Tool box	Set	15	Ditto
3.5	Crimping Pliers	Set	15	Ditto
3.6	Nipper	Set	15	Ditto
3.7	Pliers	Set	15	Ditto
3.8	Cutter	Set	15	Ditto
3.9	Wire Puller	Set	15	Ditto
3.10	Hammer	Set	15	Ditto
3.11	Round crimping terminal R type 14mm^2 100pcs	Set	15	Ditto
3.12	Round crimping terminal R type 8mm^2 100pcs	Set	15	Ditto
3. 13	Round crimping terminal R type 5.5mm^{2}用 100pcs	Set	15	Ditto
3.14	Round crimping terminal R type 2.2mm^{2}pcs	Set	30	13 islands and Solar Electricity Society head office in Tongatapu and Vava'u each 2 sets

2-5 Project Cost Estimation

2-5-1 Estimated Cost of the Requested Japanese Assistance

The total project cost in the event where the Project is implemented under the grant aid scheme of the Government of Japan will be approximately 584.2million yen, and the breakdown of costs on both sides based on the abovementioned scope of works is estimated as follows according to the following estimation criteria. However, the project cost estimate given here is a provisional value and does not represent the supply limit stated in the exchanged notes. The actual cost will be subjected to more detailed review when the Project implementation contents are examined.

(1) Cost on the Japanese side

Rough total project cost approximately 583.5 million yen

Item		Rough project Cost (million yen)
Equipment	SHS	468.9
Implementation design and procurement supervision cost		48.2
Soft component cost		49.7
Procurement agent costs		16.7

(2) Cost on Tongan side 6,800 US$ (approximately 0.7 million yen)

The contents and cost of work on Tongan side are as follows:

① Payment of commission to Japanese bank for opening bank account: 6,800 US$ (approximately 0.7 million yen)

(3) Estimation criteria

① Estimation point:: September 2009
② Exchange rate : 1 US$＝97.57 yen (TTS mean value from March to September 2009)
③ Works and procurement period: The detailed design and equipment procurement and installation period is as shown in the implementation schedule.
④ Other points : The Project will be implemented according to the Grant Aid Scheme of the Government of Japan.

2-5-2 Operation and Maintenance Cost

The equipment to be procured in the Project is basically maintenance-free except for water level check of storage battery and water supply, however, it will be necessary to always keep replacement parts on hand in case of breakdowns as was mentioned earlier (see 2-4-2). Moreover, it will be necessary to secure personnel expenses for technicians assigned in each island in order to be prepared for daily maintenance, accident and trouble. Therefore, the Tonga side will need to budget for the following operation and maintenance expenses (annual) to ensure that no problems arise in the operation and maintenance of equipment.

[Tongatapu Group]

① Personnel expenses Approximately TOP 2,200
(approximately 0.1 million yen)
② Expendable and replacement parts costs Approximately TOP3,300
(approximately 0.16 million yen)
③ Total Approximately TOP5,500 (approximately 0.26 million yen)

[Vava'u Group]

① Personnel expenses Approximately TOP 15,000
(approximately 0.7 million yen)
② Expendable and replacement parts costs Approximately TOP12,000
(approximately 0.6 million yen)
③ Total Approximately TOP27,000 (approximately 1.30 million yen)

Furthermore, the above amount is the annual forecast cost expected to arise in the first seven years when there will be no need for battery replacements. The above cost corresponds to roughly 10% of the forecast annual income. If appropriate fund management is carried out, it should be possible to comfortably secure the funds required to conduct each year's maintenance and battery replacements.

2-6 Other Relevant Issues

Important points to consider that will have a direct impact on the Project implementation are thought to be as follows.

(1) Before the SHS are procured and installed by the Japanese side in the Project, it will be necessary for the MLSNR and administrative agencies in the Project sites to jointly establish Outer Islands Solar Electricity Societies, to draw up regulations, and to select and assign the necessary personnel (office staff and island technicians).

(2) Since some of the target islands include areas which don't have adequate roads and other infrastructure, it will be essential to obtain the cooperation of local residents to ensure the smooth execution of works. In order to obtain such cooperation, it will be necessary for the MLSNR and Outer Islands Solar Electricity Societies to secure the understanding and cooperation of residents regarding the works before they start.

(3) Implementation of the Project will enable power supply setups for the lighting equipment and mobile telephones of local residents, however, the Tongan Government will compile a distribution plan with the main islands upon giving consideration to expansion of the power demand area taking into account future possibilities for industrial development in the Project sites.

(4) It will be desirable to survey the socioeconomic indicators for the Project site collected in this study after implementation of the Project in order to quantitatively assess the effect that the Project and similar electrification projects impart on socioeconomic conditions in non-electrified areas.

(5) When implementing the Project, the works and operation and maintenance activities shall be implemented in cooperation with the responsible organization and implementing agency while paying attention to the environmental impact mitigation measures compiled by the Survey Team and the recommendations described in approved documents from the responsible government agency in the Tonga.

(6) Unfunctional SHSs and wirings installed by the other donors exsited in the Project sites shall be removed, disposed and stored properly before the implementation of the Project by Tonga side with taking necessary permission from the previous project donors and getting the consent from householders, and the process shall be supervised by MLSNR.

CHAPTER 3

PROJECT EVALUATION AND RECOMMENDATIONS

Chapter 3 Verification of Project Validity

3-1 Project Effects

The anticipated effects of Project implementation are as follows.

(1) Direct Effects

Current Conditions and Problems	Project Countermeasures (target works)	Degree of Project Effects and Improvement
The Government of Tonga regards breaking away from a supply setup dependent on diesel fuel in the energy and electric power sector to be an urgent issue, and it is also concerned over climate change, unstable crude oil prices and transportation costs. Accordingly, it regards development of renewable clean energies, primarily photovoltaic power, geared to promoting electrification of non-electrified towns on remote islands as a priority policy. However, the SHS that have been installed in such towns have not been used stably over the long term, and the SHS equipment does not perform sufficient functions.	Procure and install SHS at the Project target sites, namely two islands in the Tongatapu Group and 11 islands in the Vava'u Group. Moreover, by the soft component, improve operation and maintenance capability through cooperating with technical guidance on SHS and guidance on organizational management including financial and human resource management to the Solar Electricity Committees which will implement the operation and maintenance work.	(1) Electricity supply utilizing renewable energy in non-electrified communities By introduction of SHS equipment in the Project sites, it will be possible to provide electricity utilizing renewable energy to non-electrified communities. (2) Improvement of SHS equipment operation and maintenance capacity Taking battery replacement into consideration, operation and maintenance capability for safely and stably operating the Project equipment over the long term (including not only SHS technology but also organization management) will be improved.

(2) Indirect Effects

Current Conditions and Problems	Project Countermeasures (target works)	Degree of Project Effects and Improvement
In Tonga, SHS equipment was supplied to non-electrified remote island areas under assistance from Australia and other donors from the 1990s. In some outer islands such as four islands in Ha'apai Group, diesel generation has been introduced, however because of geological constraints, acquisition of the fuel oil is difficult and CO2 is emitted by diesel generation	Procure and install SHS in the Project sites, namely two communities in the Tongatapu Group and 11 communities in the Vava'u Group.	In the Project Sites, photovoltaic generation is main energy, and following effect is expected compared with the case of introduction of diesel generation (1) Reduction of diesel and kerosene fuel consumption In the case where power generated by the SHS equipment procured and installed in the project is generated with diesel equipment, approximately 28 kl of fuel will be required per year. Through implementing the Project, however, this fuel can be saved. (2) Reduction of approximately 6.4tonne CO_2 equivalent emissions per month In line with reduction in the operating capacity of diesel generating equipment due to power generation by the SHS procured in the Project, CO_2 emissions will be cut by approximately 76 tons per year.

3-2 Recommendations

3-2-1 Issue and recommendations to be wrestled by Recipient Country

In order for the Project effects to be realized and sustained, the main issues that need to be tackled by the Tongan side are as follows.

(1) To ensure the stable operation of the SHS, it will be necessary to manage and to support technically technician assigned in the each town who implement preventive maintenance measures such as implementing daily and periodic site patrols and inspections, and to implement necessary personnel management of these technicians in collaboration with Solar Electricity Committee in each islands.

(2) To promptly appoint the engineers who will take part in the Project soft component and OJT, to facilitate their attendance at the said training, and to ensure that technology is horizontally conveyed to other engineers who could not participate in the training.

(3) Concerning SHS system that will be procured and installed by the Japanese side in the Project, it will be necessary to establish a power tariff scheme that enables future investment costs to be recovered, particularly in anticipation of renewals of the batteries at the end of their

expected service life and will be necessary to implement appropriate financial management.

(4) In the view of environmental protection, system to collect and to recycle used battery shall be established.

3-2-2 Technical Cooperation and Coordination with Other Donors

There is not technical cooperation becoming the precondition for implementation of the Project, and Tonga side needs to inform the donors who procured SHS in the Project sites that Tonga side remove, dispose and store unfunctioning equipment in the implementation of the Project.

APPENDICES

1. MEMBER LIST OF THE STUDY TEAM

1. Member List of the Study Team

1-1 Preparatory Study

Name	Title	Organization
Ryuji MATSUNAGA	Leader	Japan International Cooperation Agency (JICA)
Masahiro ITO	Planning Management	Japan International Cooperation Agency (JICA)
Hiromichi MIYASHITA	Procurement Management	Japan International Cooperation System (JICS)
Kaname MOTOKI	Vice Chief Consultant / PV System /Environmental and Social Considerations	ICONS International Cooperation Co., Ltd.
Masahiro KAIMOTO	SHS PV System / Operation and Management 1	ICONS International Cooperation Co., Ltd..
Katsuo URANO	SHS PV System / Operation and Management 2	Yachiyo Engineering Co., Ltd.
Takayuki KURITA	Equipment / Installation Planning	ICONS International Cooperation Co., Ltd.
Masakazu ISHII	Procurement Planning / Cost Estimation	ICONS International Cooperation Co., Ltd.

1-2 Discussion of Draft Outline Design

Name	Title	Organization
Nobuaki MATSUI	Leader	Japan International Cooperation Agency (JICA)
Hidemasa FUKUDA	Equipment / Installation Planning	Japan International Cooperation Agency (JICA)
Yoshie MURAMATSU	Procurement Planning / Cost Estimation	Japan International Cooperation System (JICS)
Kaname MOTOKI	Vice Chief Consultant / PV System /Environmental and Social Considerations	ICONS International Cooperation Co., Ltd.
Takayuki KURITA	Equipment / Installation Planning	ICONS International Cooperation Co., Ltd.
Masakazu ISHII	Procurement Planning / Cost Estimation	ICONS International Cooperation Co., Ltd.

2. STUDY SCHEDULE

2. Survey Schedule

2.1 Preparatory Study Schedule

No.	Date	Day of the week	Survey Contents			Stay at
			Official	Consultant Members		
			Mr. Ryuji MATSUNAGA Mr. Masahiro ITO Mr. Hiromichi MIYASHITA	Team A Mr. Kaname MOTOKI Mr. Takayuki KURITA Mr. Masakazu ISHII	Team B Mr. Masahiro KAIMOTO Mr. Katsuo URANO	
1	Aug.24	Mon		• Trip [Narita →]		
2	Aug.25	Tue		• Trip [Arrive in Auckland] • Trip [Auckland → Nuku Alofa]		Nuku Alofa
3	Aug.26	Wed		• Meeting with JICA Tonga Office • Courtesy call to EOJ • Courtesy call to Foreign Affairs Office • Courtesy call to Ministry of Lands, Survey, Natural Resources & Environment (MLSNR) • Site Survey on Power Station • Meeting with Energy Planning Unit		Nuku Alofa
4	Aug.27	Thu		• Explanation and Discussion of Inception Report, Questionnaire and so on with MLSNR. • Meeting with AUS AID • Meeting with Ministry of Finance and National Planning		Nuku Alofa
5	Aug.28	Fri	• Trip [Narita →] NZ0090 (1900 -)	• Meeting with MLSNR.		Nuku Alofa
6	Aug.29	Sat	• Trip[Arrive in Auckland] (- 0900) • Trip[Auckland → Nuku Alofa] NZ066 (1530-1920)	• Data and information collection		Nuku Alofa
7	Aug.30	Sun	• Site Survey	• Site Survey		Nuku Alofa
8	Aug.31	Mon	• Meeting with JICA Tonga Office • Courtesy call to EOJ • Courtesy call to Foreign Affairs Office • Courtesy call to Ministry of Lands, Survey, Natural Resources & Environment (MLSNR), explanation and Discussion on Minutes of Discussion (M/D)	• Market Survey • Visit ministries and agencies concerned	• Trip [Nuku Alofa → Vava'u]	Nuku Alofa Vava'u
9	Sep.1	Tue	• Preparation of drafted (M/D) • Explanation and Discussion on (M/D)	• Preparation of drafted Minutes of Discussion (M/D) • Explanation and Discussion on (M/D)	• Site Survey	Nuku Alofa Vava'u
10	Sep.2	Wed	• Explanation and Discussion on (M/D)		• Site Survey	Nuku Alofa Vava'u
11	Sep.3	Thu	• Trip [Nuku Alofa → Vava'u] • Site Survey • Trip [Vava'u → Nuku Alofa]		• Site Survey	Nuku Alofa Vava'u
12	Sep.4	Fri	• Signing of M/D • Report to EOJ • Report to JICA Tonga Office on the result of first field survey		• Site Survey	Nuku Alofa Vava'u
13	Sep.5	Sat	• Trip[Nuku Alofa → Auckland] NZ0065 (2040 - 2240)	• Equipment procurement / cost estimation planner leave Tonga [Nuku Alofa → Auckland] NZ0065 (2040 - 2240)	• Data and information collection	Nuku Alofa Vava'u (Auckland)
14	Sep.6	Sun	• Trip[Auckland→ Narita] NZ099(0830 – 1640)	• Team meeting • Equipment procurement / cost estimation planner [Auckland → Narita] NZ0099 (0830 - 1640)	• Ditto	Nuku Alofa Vava'u (Narita)
15	Sep.7	Mon		• Meeting with MLSNR	• Site Survey	Nuku Alofa Vava'u
16	Sep.8	Tue		• Trip[Nuku Alofa → Lifuka]	• TripVava'u → Lifuka]	Ha'apai
17	Sep.9	Wed		• Site Survey		Ha'apai

No.	Date	Day of the week	Survey Contents			Stay at
			Official	Consultant Members		
			Mr. Ryuji MATSUNAGA Mr. Masahiro ITO Mr. Hiromichi MIYASHITA	Team A	Team B	
				Mr. Kaname MOTOKI Mr. Takayuki KURITA Mr. Masakazu ISHII	Mr. Masahiro KAIMOTO Mr. Katsuo URANO	
18	Sep.10	Thu		• Site Survey • Trip[Lifuka → Nuku Alofa]		Ha'apai
19	Sep.11	Fri		• Meeting with MLSNR		Nuku Alofa
20	Sep.12	Sat		• Team meeting		Nuku Alofa
21	Sep.13	Sun		• Ditto		Nuku Alofa
22	Sep.14	Mon		• Site Survey in Atataa Islands		Nuku Alofa
23	Sep.15	Tue		• Meeting with MLSNR	• Ditto	Nuku Alofa
24	Sep.16	Wed		• Meeting with MLSNR • Meeting with Vava'u Development Committee		Nuku Alofa
25	Sep.17	Thu		• Data analysis		Nuku Alofa
26	Sep.18	Fri		• Report to JICA Tonga Office • Report to EOJ on the result of first field survey		Nuku Alofa
27	Sep.19	Sat		• Trip[Nuku Alofa → Auckland]		Auckland
28	Sep.20	Sun		• Trip[Auckland → Narita]		

2.2 Discussion of Draft Outline Design schedule

No.	Date	Day of the week	Survey Contents				Stay at
			Official			Consultant Members	
			Mr. Nobuaki MASUI	Mr. Hidemasa Fukuda	Ms Yosie Matsunaga	Mr. Kaname MOTOKI Mr. Takayuki KURITA Mr. Masakazu ISHII	
1	Feb 19	Fri				• Trip [Narita →]	
2	Feb 20	Sat		• Trip [Haneda→ Kansai] • Trip[Kansai→ Auckland]		• Trip[→Auckland] • Trip[Auckland → Nuku Alofa]	
3	Feb 21	Sun	• Team meeting	• Trip [Auckland → Nuku Alofa]	• Trip[Narita→ [Auckland]	• Team meeting	Nuku Alofa
4	Feb 22	Mon	• Courtesy call to Ministry of Lands, Survey, Natural Resources & Environment (MLSNR) • Meeting with Energy Planning Unit (EPU)		• Trip [Auckland→ Nuku Alofa]	• Courtesy call to Ministry of Lands, Survey, Natural Resources & Environment (MLSNR) • Meeting with EPU	Nuku Alofa
5	Feb 23	Tue	• Trip [Nuku Alofa →Vava'u] • Visit Hunga Vilage • Meeting with Outer Islands SolarElectricity Society		• Preparation of Minutes of Discussion (M/D)	• Explanation and Discussion of Inception Report, Questionnaire and so on with MLSNR. • Meeting with AUS AID • Meeting with Ministry of Finance and National Planning	Nuku Alofa
6	Feb 24	Wed	• Trip [Vava'u→ Nuku Alofa]	• Meeting with EPU	• Preparation of (M/D)	• Meeting with EPU	Nuku Alofa /Vava'u
7	Feb 25	Thr	• Discussion of (M/D)	• Trip [Vava'u → Nuku Alofa]	• Discussion of (M/D)	• Trip [Vava'u → • Nuku Alofa]	Nuku Alofa /Vava'u
8	Feb 26	Fri	• Explanation and Discussion of (M/D) with MLSNR and Renewable Energy Committee				
9	Feb 27	Sat		• Trip [Nuku Alofa → Auckland] • Trip[Auckland → Narita]		• Trip [Nuku Alofa → Auckland]	
10	Feb 28	Sun				• Trip[Auckland → Kansai] • Trip [Kansai → Haneda]	

3. LIST OF PARTIES CONCERNED

IN THE RECIPIENT COUNTRY

3. LIST OF PARTIES CONCERNED IN THE RECIPIENT COUNTRY

Organization and Name	Job Title
3.1 Preparatory Study	
Prime Minister's Office	
Dr. Feleti Sevele	Prime Minister
Mr. `Akau'ola	Renewable Energy Coordinator
Ministry of Land Survey and Natural Resource	
Hon. TUITA	Minister
Mr. Sione Halatuituia	CEO
Mr. Kelepei S. Mafi	Acting Deputy Secretary, Natural Resource
Mr. Ofa Sefana	Energy Planner
Ms. Winnie Veikoso	Energy Planner
Ministry of Foreign Affairs	
Mr Vayin Tone	Secretary for Foreign Affairs
Mr. Tatafu Moenlin	Deputy Secretary
Ministry of Finance and National Planning	
Mr. 'Aisake V Eke	Secretary for Finance and National Planning
Ms. Natalia Palu Latu	Principal Economist, Aid & Project Management Division
Mr. Teruhisa MIYATA	JOCV Senior Volunteer
European Union（EU）	
Mr. Isileli Aholelei	EU Technical Advisor
AusAid	
Mr. Ms. Mele'ofa Mafi	Senior Program Manager/Development Cooperation
The Main Streaming of Rural Development Innovations （NPO 団体）	
Mr. Soane Patolo	Program Coordinator
Ms. Ana Aka	Personal Assistant

Embassy of Japan in the Kingdom of Tonga

Mr. Yasuo TAKASE	Ambassador
Mr. Akira OUCHI	Counsellor
Mr. Yasuhide SAKAMOTO	Adviser(Economic and Technical Cooperation)
Mr. Kenichi SHIBUYA	Grant Aid reseacher

JICA Tonga Office

Mr. Nobuaki MATSUI	Resident Representative
Mr. Hiroyuki UEDA	Volunteer Coordinator
Mr. Masafumi INOUE	Volunteer Coordinator
Mr. Alfred VAKA	Programme Officer

JICA Fiji Office

Mr. Fumiaki SASO	Project Formulation Advisor

3.2 Discussion of Draft Outline Design schedule

Ministry of Land Survey and Natural Resource

Mr. Fetuu Vea	Acting CEO
Mr. Ofa Sefana	Energy Planner
Ms. Winnie Veikoso	Energy Planner

Embassy of Japan in the Kingdom of Tonga

Mr. Yasuo TAKASE	Ambassador
Mr. Akira OUCHI	Counsellor
Mr. Yoshimitu KAWADA	Counsellor
Mr. Yasuhide SAKAMOTO	Adviser(Economic and Technical Cooperation)

JICA Tonga Office

Mr. Nobuaki MATSUI	Resident Representative
Mr. Alfred VAKA	Programme Officer

4. MINUTES OF DISCUSSIONS

Minutes of Discussions
on the Preparatory Survey
on the Project for introduction of Clean Energy by solar home system

The Government of Japan (hereinafter referred to as "GoJ") has established Cool Earth Partnership as a new financial mechanism. Through this, GoJ is cooperating actively with developing countries' efforts to reduce greenhouse gasses emissions, such as efforts to promote clean energy. A new scheme of grant aid, "Program Grant Aid for Environment and Climate Change ", was also created by GoJ as a component of this financial mechanism. According to the initiative of Cool Earth Partnership, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), in consultation with GoJ, decided to conduct a Preparatory Survey (hereinafter referred to as "the Survey") on the Project for introduction of Clean Energy by solar home system in the Kingdom of Tonga (hereinafter referred to as "the Project").

JICA sent to the Kingdom of Tonga (hereinafter referred to as "Tonga") the Preparatory Survey Team (hereinafter referred to as "the Team"), headed by Mr. Ryuji MATSUNAGA, Deputy Director General, Office for Climate Change, JICA , and is scheduled to stay in the country from August 24 to September 19 as the Preparatory Survey for Detailed Design.

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

In the course of discussions and field survey, both sides confirmed the main items described in the attached sheets.

Nuku'alofa, September 4, 2009

Mr. Ryuji MATSUNAGA
Leader
Preparatory Survey Team
Japan International Cooperation Agency
JAPAN

Dr. Sione Nailasikau Halatuituia
Chief Executive Officer (CEO)
Lands, Survey, and Natural Resources
(MLSNR)

Mr. Aisake Eke
CEO/Secretary for Finance and National
Planning
Ministry of Finance and National Planning

ATTACHMENT

1. Current Situation

Based on the result of the previous project formulation study and the official request from the Government of Tonga, Detailed Design and Draft Tender Documents shall be created under the Survey.

2. Objective of the Project

The objective of the Project is to promote rural electrification using clean energy.

3. Responsible Organization and Implementing Agency

The responsible and implementing organization is the Ministry of Lands, Survey, and Natural Resources (MLSNR). (The organization chart of the responsible and implementing organization is shown in Annex-1.)

4. Project Component

4-1. After discussions with the Team, the procurement and the installation of the stand-alone Solar Home System (SHS) including soft component (technical assistance) was requested by the Tonga side. (The basic design is shown in Annex-2)

4-2. Project site is Tongapatapu islands and Vava'u islands as shown in Annex-3

4-3. The Tonga side explained that there is no duplication between the contents of the Project and any other plans implemented by the other donors or the Tonga side. Having experiences of SHS installation with financial supports by other donors in the Project sites, MLSNR recognizes the sites to be unelectrified areas for the reason almost all system have not worked.

4-4. The Team will assess the appropriateness of the request and will report the findings to JICA Headquarters and the GoJ. The Tonga side has understood that the final components and the design of the Project shall be decided (confirmed) after further survey.

5. Japan's Program Grant Aid for Environment and Climate Change

The Tonga side understood the Japan's Program Grant Aid for Environment and Climate Change scheme explained by the Team as described in Annex-4, 5 and 6.

6. Schedule of the Study

(1) The Team will proceed to further survey in Tonga until September 19, 2009.

(2) JICA will prepare the draft report and reference document in English and dispatch a mission to Tonga in order to explain their contents in December, 2009.

(3) When the contents of the report are accepted in principle by the Government of Tonga, JICA will complete the final report and reference document, and submit them to the Government of Tonga and to the Procurement Agent by the end of January, 2010.

7. Other Relevant Issues

7-1 Major Undertakings to be taken by Each Government

The Tonga side confirmed that major undertakings as shown in Annex-7 should be taken by Tonga side at its own budget. In addition, the Tonga side should be responsible for following issues;

(1) Securing necessary land
- for PV Modules

(2) Temporary Stockyard during installation of the equipment and materials

(3) Vehicles for Operation and Maintenance

(4) Tables and PCs, if necessary

7-2 Explanation to recipient householders

The Tonga side shall hold meetings with all recipient communities to explain the project outline including their obligations, and confirm their participation by the end of January 2010.

7-3 Procurement of Equipment and Materials

The Team explained that, in accordance with the policy of GoJ, products of Japan shall be procured for major equipment in the Project. The Tonga side agreed with the policy of GoJ.

7-4 Coordination with Related Organizations

The Implementing Agency of the Project (MLSNR) shall be the focal point for the Team, and responsible for the coordination with related organizations.

7-5 Establishment of implementation body

Making reference to Ha'apai model, both sides understood that establishment of implementation body including Solar Incorporated Society is indispensable for their sustainable operation. The Tonga side agreed that all institutional, financial and technical arrangement shall be established and be explained to the communities and the Societies under their responsibility by the end of January 2010, and report the results to the Japanese side immediately.

7-6 Clearance of existent modules

Regarding existent modules installed by other donors, the Tonga side shall remove and properly manage them at its own budget with permissions by the donors and the householders before the commencement of installation.

7-7 Property of Equipment and Materials

The Implementing Agency of the Project (MLSNR) shall own the equipment and materials provided under the Project during and after implementation of the Project.

7-8 Environmental and Social Considerations

The Team explained the outline of JICA Environmental and Social Considerations Guideline (hereinafter referred to as "the JICA Guideline") to the Tonga side. The Tonga side took the JICA

Guideline into consideration, and shall complete the necessary procedures.

7-9 Operation and Maintenance

The Tonga side agreed to secure the necessary budget and personnel for the Operation and Maintenance of SHS procured and installed under the Project.

7-10 Customs and Tax exemption

The Tonga side agreed that the Tonga side shall be responsible for the exemption and/or reimbursement (payment/assumption) of all customs, tax, levies and duties incurred in Tonga for implementation of the Project.

7-11 The Tonga side shall ensure the security of all concerned Japanese nationals working for the Project, if deemed necessary.

7-12 The Tonga side shall provide necessary numbers of counterpart personnel to the Team during the period of their studies in Tonga.

7-13 The Tonga side shall submit all the answers to the Questionnaire, which the Team handed to the Tonga side, by September 19, 2009.

<List of Annex>

Annex-1 Organization Chart of the Ministry of Lands, Survey, and Natural Resources & Environment

Annex-2 Basic design of stand-alone SHS

Annex-3 Project site / Candidate site of the Project

Annex-4 Japan's Environment Program Grant Aid Scheme

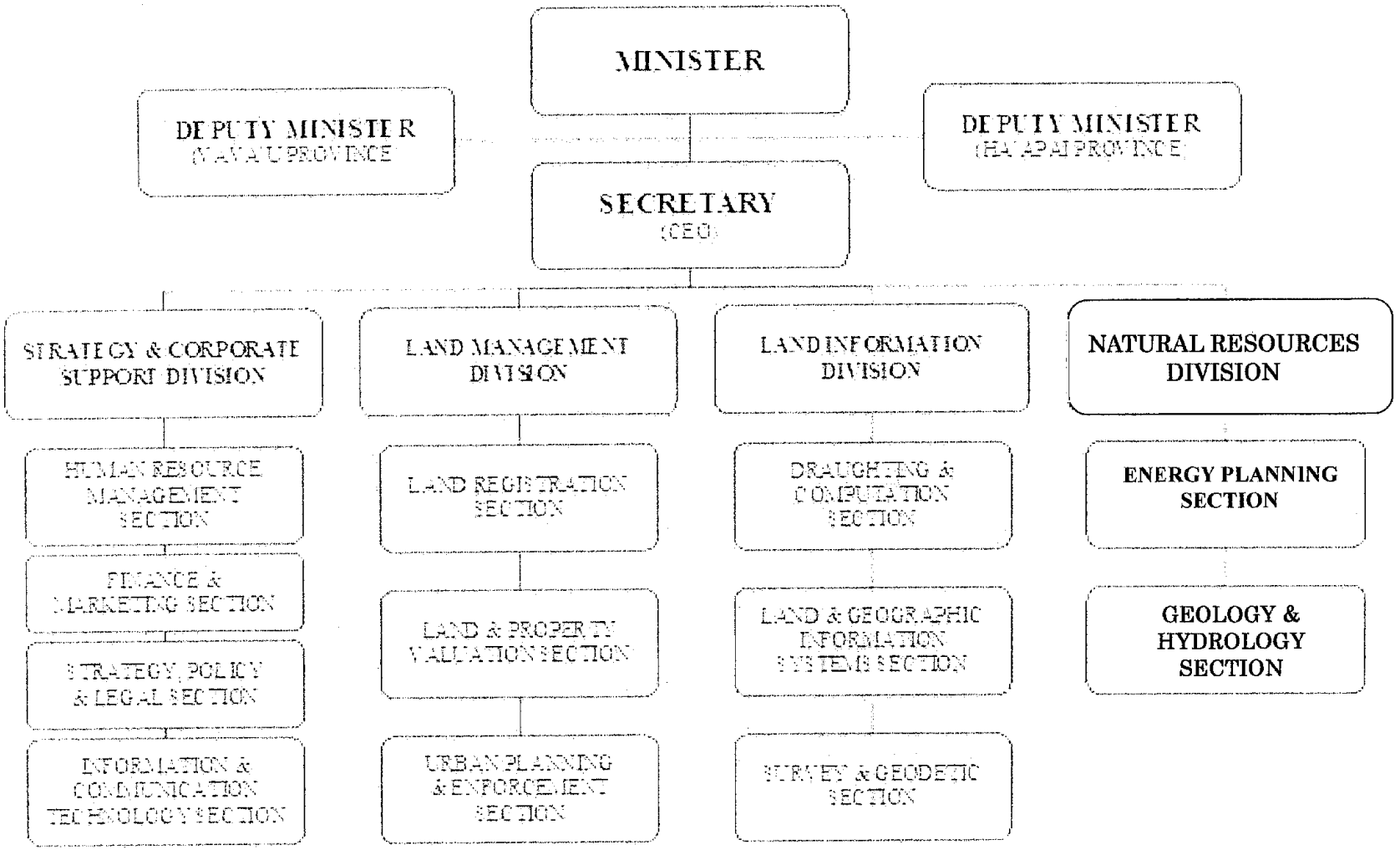
Annex-5 Flow of Funds for Project Implementation

Annex-6 Project Implementation System

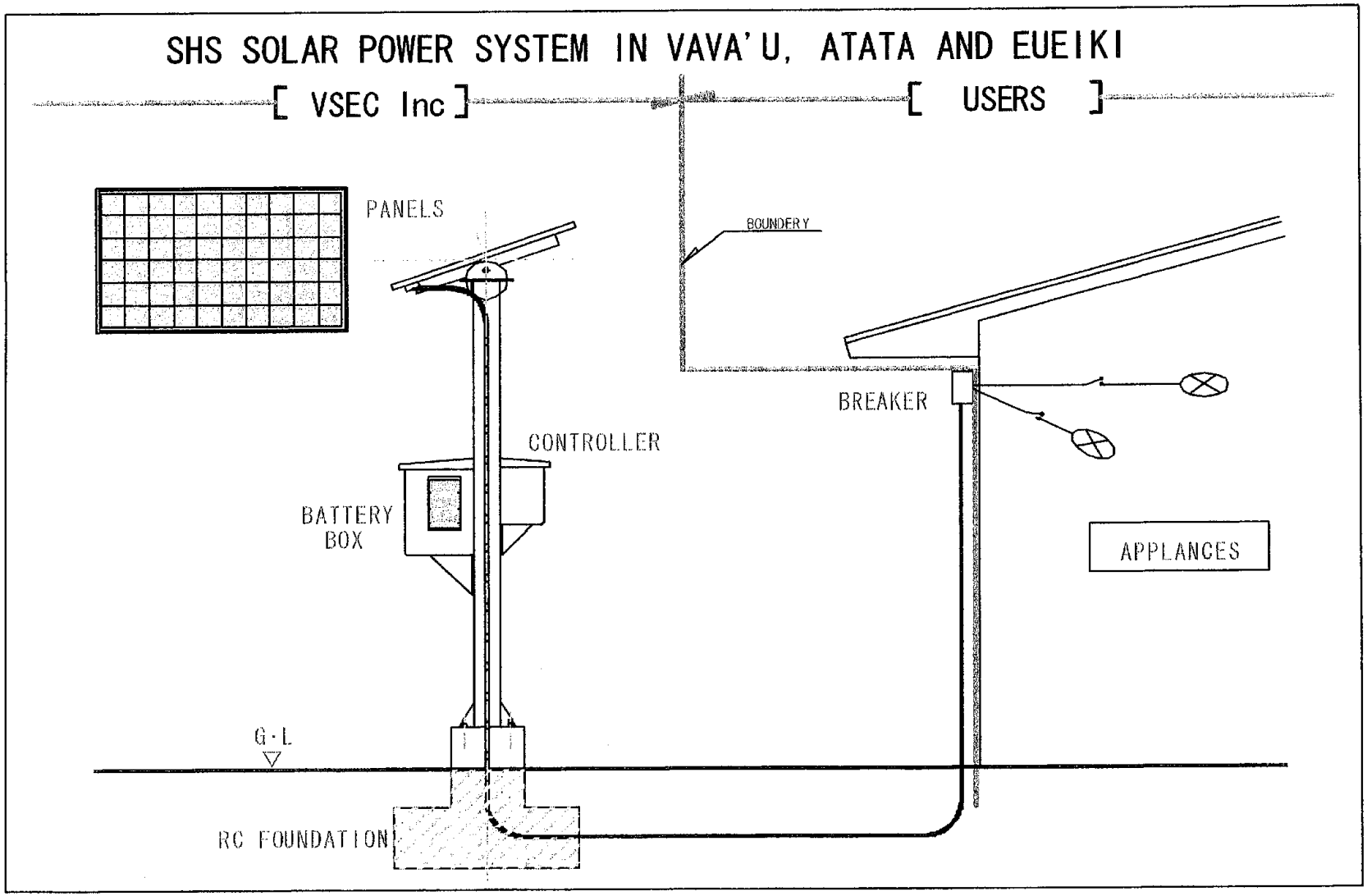
Annex-7 Major Undertakings to be taken by Each Government

Annex-8 Terms of Reference of the Consultative Committee (Provisional)

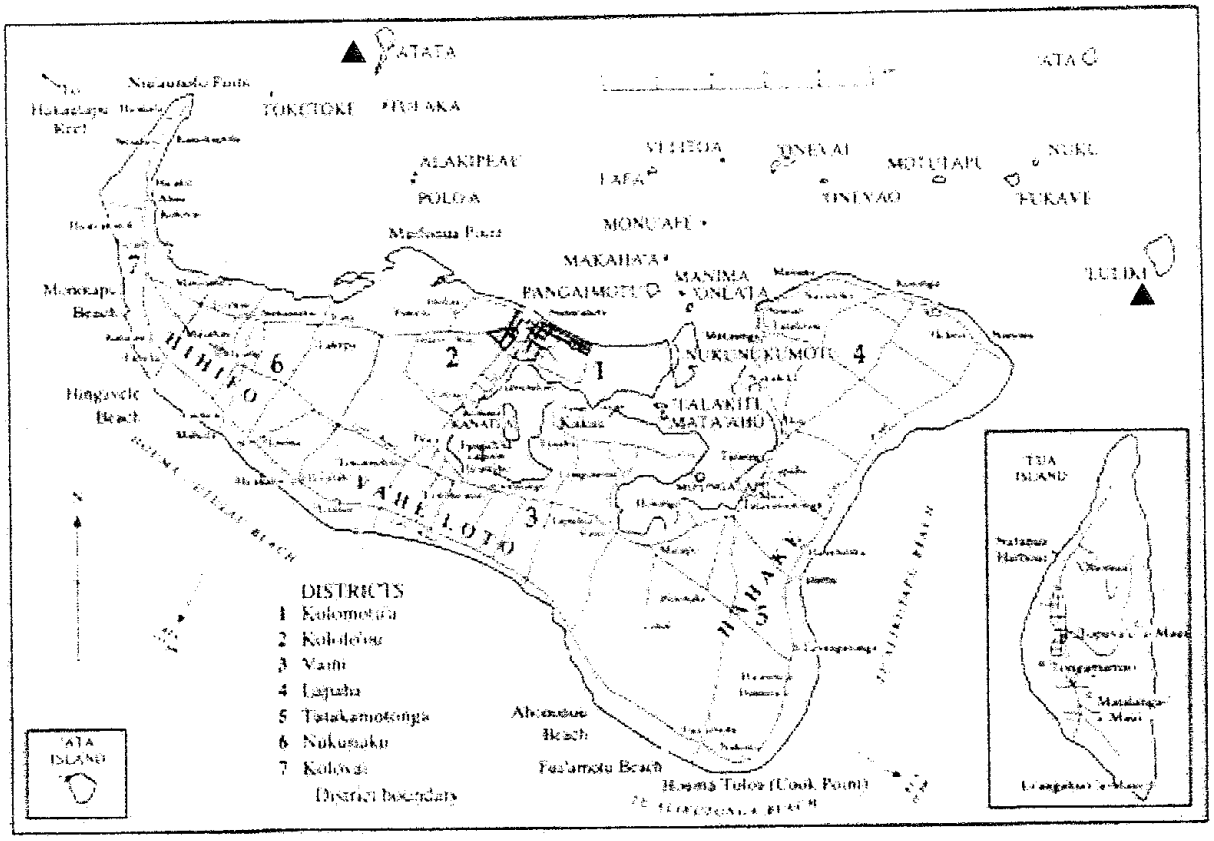
Organization Chart of the Ministry of Lands, Survey, and Natural Resources & Environment

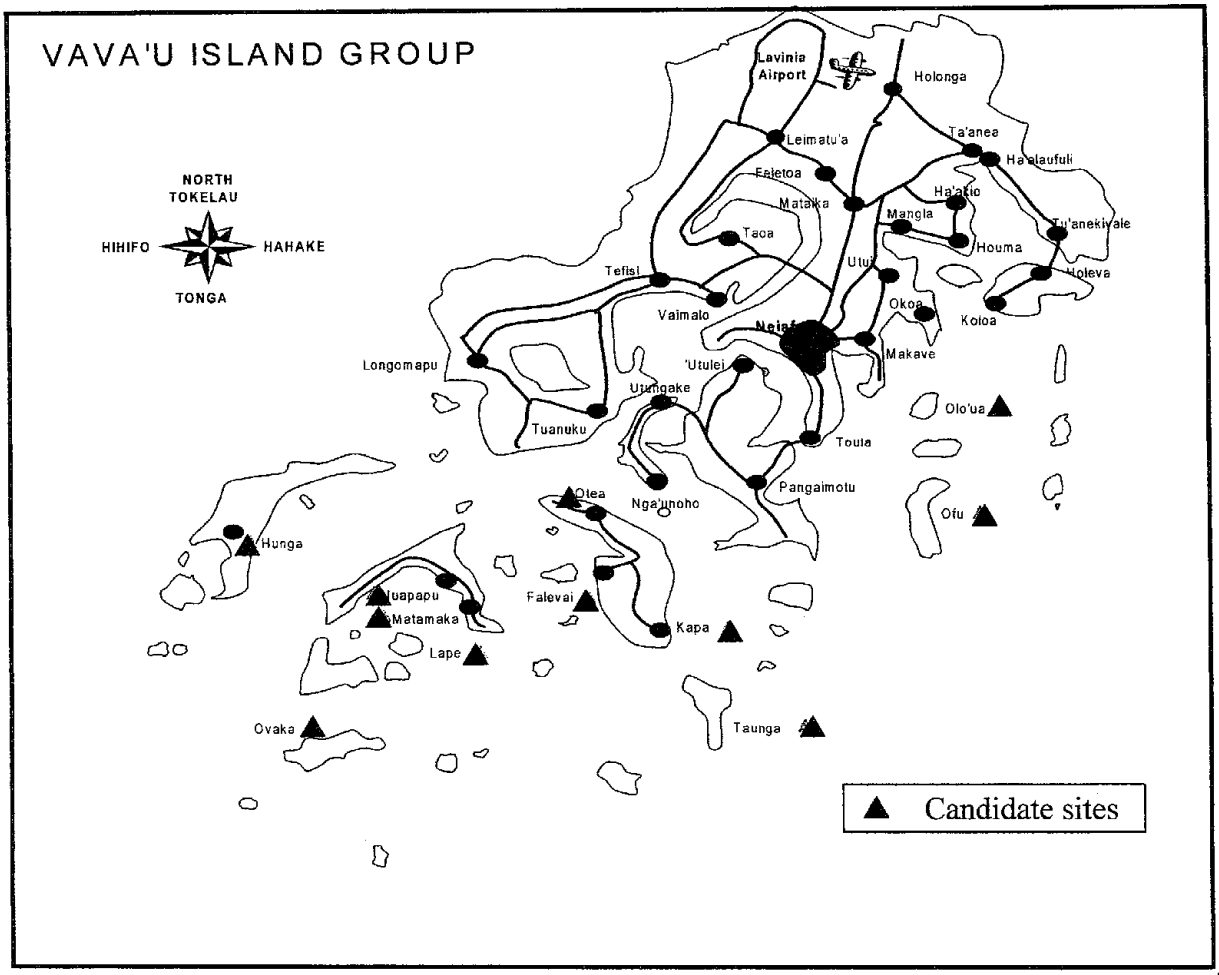


Basic design of stand-alone SHS



Project site / Candidate site of the Project





Program Grant Aid for Environment and Climate Change of the Government of Japan
(Provisional)

The Grant Aid provides a recipient country (hereafter referred to as "the Recipient") 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 relevant laws and regulations of Japan. The Grant Aid is not supplied through the donation of materials as such.

Based on "Cool Earth Partnership" initiative of the Government of Japan, the Program Grant Aid for Environment and Climate Change (hereafter referred to as "GAEC") aims to mitigate effects of global warming by reducing GHGs emission (mitigation; e.g. improvement of energy efficiency) and to take adaptive measures (adaptation; e.g. measures against disasters related to climate change, including disaster prevention such as enhancing disaster risk management).

1. Procedures for GAEC

GAEC is executed through the following procedures.

Preparatory Survey (Phase 1)	Preparatory Survey (Phase 1 for project identification) conducted by Japan International Cooperation Agency (JICA)
Application	Request made by a recipient country
Appraisal & Approval	Appraisal by the Government of Japan and Approval by the Cabinet
Determination of Implementation	The Notes exchanged between the Government of Japan and the Recipient Country
Grant Agreement (hereinafter referred to as the "G/A")	Agreement concluded between JICA and the Recipient
Preparatory Survey (Phase 2)	Preparatory Survey (Phase 2 for detailed design) conducted by JICA
Implementation	Procurement through the Procurement Agency by the Recipient

Firstly, if the candidate project for a GAEC is identified by the Recipient and the Government of Japan, the Government of Japan (the Ministry of Foreign Affairs) examines it whether it is eligible for GAEC. When the request is deemed appropriate, JICA, in consultation with the Government of Japan, conducts the Preparatory Survey (hereafter referred to as "the Survey") on the candidate project as Phase 1 of the Survey with Japanese consulting firms.

Secondly, the Recipient submits the official request to the Government of Japan, while the appropriateness, necessity and the basic components of the project are examined in the course of Phase 1 of the Survey,

Thirdly, the Government of Japan appraises the project to see whether it is suitable for Japan's GAEC, based on the Survey 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 (E/N) signed by the Governments of Japan and the Recipient.

Fifthly, JICA engages Grant Agreement (G/A) with the Recipient and executes the Grant by making payments of the amount agreed in the E/N and strictly monitors that the funds of the Grant are properly and effectively used.

Procurement Management Agent is designated to conduct the procurement services of products and services (including fund management, preparing tenders, contracts) for GAEC on behalf of the Recipient. The Agent is an impartial and specialized organization that will render services according to the Agent Agreement with the Recipient. The Agent is recommended to the Recipient by the Government of Japan and agreed between the two Governments in the Agreed Minutes ("A/M").

2 Preparatory Survey

1) Contents of the Survey

The purpose of the Preparatory Survey (hereafter referred to as "the Survey"), conducted by JICA on a requested project (hereafter referred to as "the Project"), is to provide the basic document necessary for the appraisal of the Project by the Government of Japan. The contents of the Survey are as follows:

- Confirmation of background, objectives, and benefits of the Project and institutional capacity of agencies and communities concerned of the Recipient necessary for project implementation.
- Evaluation of relevance of the Project to be implemented under the Grant Aid Scheme for Environment and Climate Change from a technical, social, and economic point of view.
- Confirmation of items agreed upon by both parties concerning the basic concept of the Project.
- Preparation of the detailed design of the Project and reference document for tender.
- Estimation of cost for the Project.

The contents of the original request will be modified, as found necessary, in the design of the Project according to the guidelines of Japan's Grant Aid scheme.

The Government of Japan requests the Government of the Recipient to take whatever measures necessary to ensure its responsibility in implementing the Project. Such measures must be guaranteed even if they may fall outside the jurisdiction of the implementing organization of the Recipient. This has been confirmed by all relevant organizations of the Recipient through the Minutes of Discussions.

2) Selection of consulting firms

For the smooth implementation of the Survey, JICA will conduct the Survey with registered consulting firms. JICA selects the firms based on proposals submitted by firms with interest in implementing the Survey. The firms selected will carry out the Preparatory Survey and prepare a report, based on the terms of reference set by JICA.

3. Implementation of GAEC after the E/N

1) Exchange of Notes (E/N)

The content of GAEC will be determined in accordance with the Notes exchanged by the two Governments concerned, in which items including, objectives of the project, period of execution, conditions and amount of the Grant Aid are confirmed.

2) Details of Procedures

Details of procedures on procurement and services under GAEC will be agreed between the authorities of the two governments concerned at the time of the signing of the G/A.

Essential points to be agreed are outlined as follows:

a) JICA will supervise the implementation of the Project.
b) Products and services will be procured and provided in accordance with JICA's "Procurement Guidelines for the Program Grant Aid for Environment and Climate Change."
c) The Recipient will conclude a contract with the Agent.
d) The Agent is the representative acting in the name of the Recipient concerning all transfers of funds to the Agent.

3) Focal points of "Procurement Guidelines for the Program Grant Aid for Environment and Climate Change"

a) The Agent

The Agent is the organization, which provides procurement of products and services on behalf of the Recipient according to the Agent Agreement with the Recipient. The Agent is recommended to the Recipient by the Government of Japan and agreed between the two Governments in the A/M.

b) Agent Agreement

The Recipient will conclude the Agent Agreement, in principle, within two months after the signing of the G/A, in accordance with the A/M. The scope of the Agent's services will be clearly specified in the Agent Agreement.

c) Approval of the Agent Agreement

The Agent Agreement is prepared as two identical documents and the copy of the Agent Agreement will be submitted to JICA by the Recipient through the Agent. JICA confirms whether the Agent Agreement is concluded in conformity with the E/N, A/M, and G/A and the Procurement Guidelines for the Program Grant Aid for Environment and Climate Change then approves the Agent Agreement.

The Agent Agreement concluded between the Recipient and the Agent will become effective after the approval by JICA in a written form.

d) Payment Methods

The Agent Agreement will stipulate that "Regarding all transfers of the fund to the Agent, the Recipient will designate the Agent to act on behalf of the Recipient and issue a Blanket Disbursement Authorization ("the BDA")to conduct the transfer of the fund (hereinafter referred to as "the Advances") to the Procurement Account from the Recipient Account.

The Agent Agreement will clearly state that the payment to the Agent will be made in Japanese yen from the Advances and that the final payment to the Agent will be made when the total remaining amount become less than three percent (3%) of the Grant and its accrued interests excluding the Agent's fees.

e) Products and Services Eligible for Procurement

Products and services to be procured will be selected from those defined in the G/A.

f) Selection of firms

In principle, firms of any nationality could be contracted as long as the firms satisfy the conditions specified in the tender documents.

The same applies for any individual consultants who will be involved in the project and provide services necessary for the training and guidance related to the Project. The consultants that will be employed to do detail design and supervise the work for the Project, however will be, in principle Japanese nationals recommended by JICA for the purpose of maintaining technical consistency with the Survey

g) Method of Procurement
When conducting the procurement, sufficient attention will be paid to transparency in selecting the firms and for this purpose, competitive tendering will be employed in principle.

h) Tender Documents
The tender documents should contain all information necessary to enable tenderers to prepare valid offers for the products and services to be procured by GAEC.

The rights and obligations of the Recipient, the Agent and the firms supplying products and services should be stipulated in the tender documents to be prepared by the Agent. Aside from this, the tender documents will be prepared in consultation with the Recipient.

i) Pre-qualification Examination of Tenderers
The Agent may conduct a pre-qualification examination of tenderers in advance of the tender so that the invitation to the tender can be extended only to eligible firms. The pre-qualification examination should be performed only with respect to whether the prospective tenderers have the capability of concluding the contracts.

For this, the following points should be taken into consideration:
(1) Experience and past performance in contracts of similar kind
(2) Financial credibility (including assets such as real estate)
(3) Existence of offices and other items to be specified in the tender documents.
(4) Their potentialities to use necessary personnel and facilities.

j) Tender Evaluation
The tender evaluation should be implemented on the basis of the conditions specified in the tender documents.

Those tenderers which substantially conform to the technical specifications and other stipulations of the tender documents, will be judged in principle on the basis of the submitted price, and the tenderer who offers the lowest price will be designated as the successful tenderer.

The Agent will submit a detailed evaluation report of tenders to JICA for its information, while the notification of the results to the tenderers will not be premised on the confirmation by JICA.

k) Additional procurement
If there is any remaining balance after the competitive and/or selective tendering and/or direct negotiation for a contract, and if the Recipient would like to procure additional items, the Agent is allowed to conduct this additional procurement, following the points mentioned below:
(1) Procurement of same products and services
When the products and services to be additionally procured are identical with the initial tender and a competitive tendering is judged not efficient, additional procurement can be conducted by a negotiated contract with the successful tenderer of the initial tender.
(2) Other procurements

When products and services other than those mentioned above in (1) are to be procured, the procurement should be conducted through competitive tendering. In this case, the products and services for additional procurement will be selected from among those in accordance with the G/A.

l) Conclusion of the Contracts
In order to procure products and services in accordance with the guideline, the Agent will conclude contracts with firms selected by tendering or other methods.

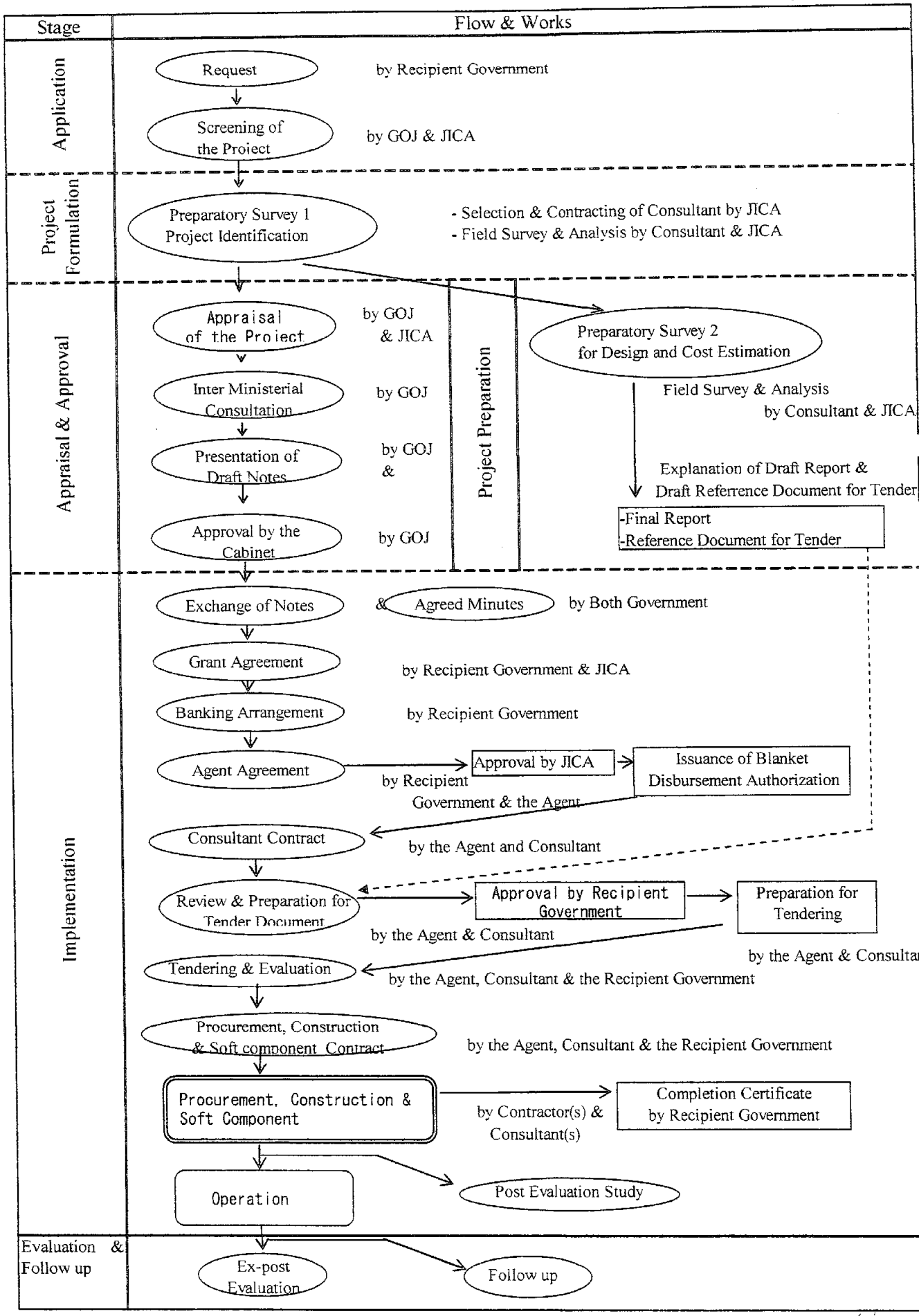
m) Terms of Payment
The contract will clearly state the terms of payment. The Agent will make payment from the "advances," against the submission of the necessary documents from the firm on the basis of the conditions specified in the contract. When the services are the object of procurement, the Agent may pay certain portion of the contract amount in advance to the firms on the conditions that such firms submit the advance payment guarantee worth the amount of the advance payment to the Agent.

4) Undertakings required by the Government of the Recipient Country
In the implementation of the Grant Aid Project, the Recipient is required to undertake necessary measures as the following:

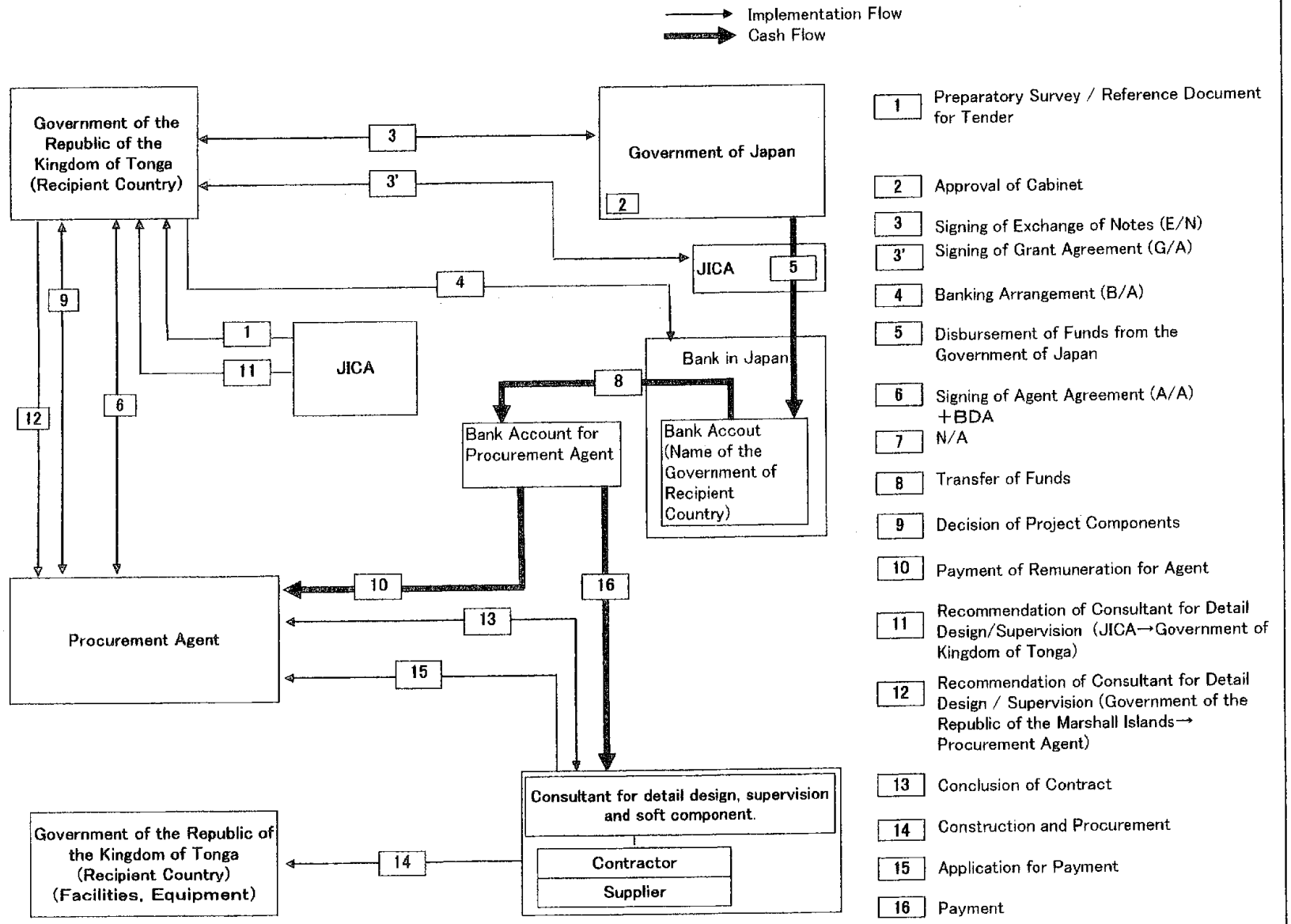
a) To secure land necessary for the sites of the Project and to clear, level and reclaim the land prior to commencement of the Project.
b) To provide facilities for distributing electricity, water supply and drainage and other incidental facilities in and around the sites.
c) To ensure all the expense and prompt execution for unloading, customs clearing at the port of disembarkation and domestic transportation of products purchased under the Grant Aid,
d) To ensure that customs duty, internal taxes and other fiscal levies that may be imposed in the Recipient with respect to the purchase of the Components and the Agent's services will be exempted by the Government of the Recipient.
e) To accord all the concerned parties, whose services may be required in connection with supply of the products and services under the contracts, such facilities as may be necessary for their entry into the Recipient and stay therein for the performance of their work.

5) "Proper use of funds"
The Recipient is required to operate and maintain the facilities constructed and equipment purchased under the Grant Aid properly and effectively and to assign personnel necessary for this operation and maintenance as well as to bear all the expenses other than those covered by the Grant Aid.

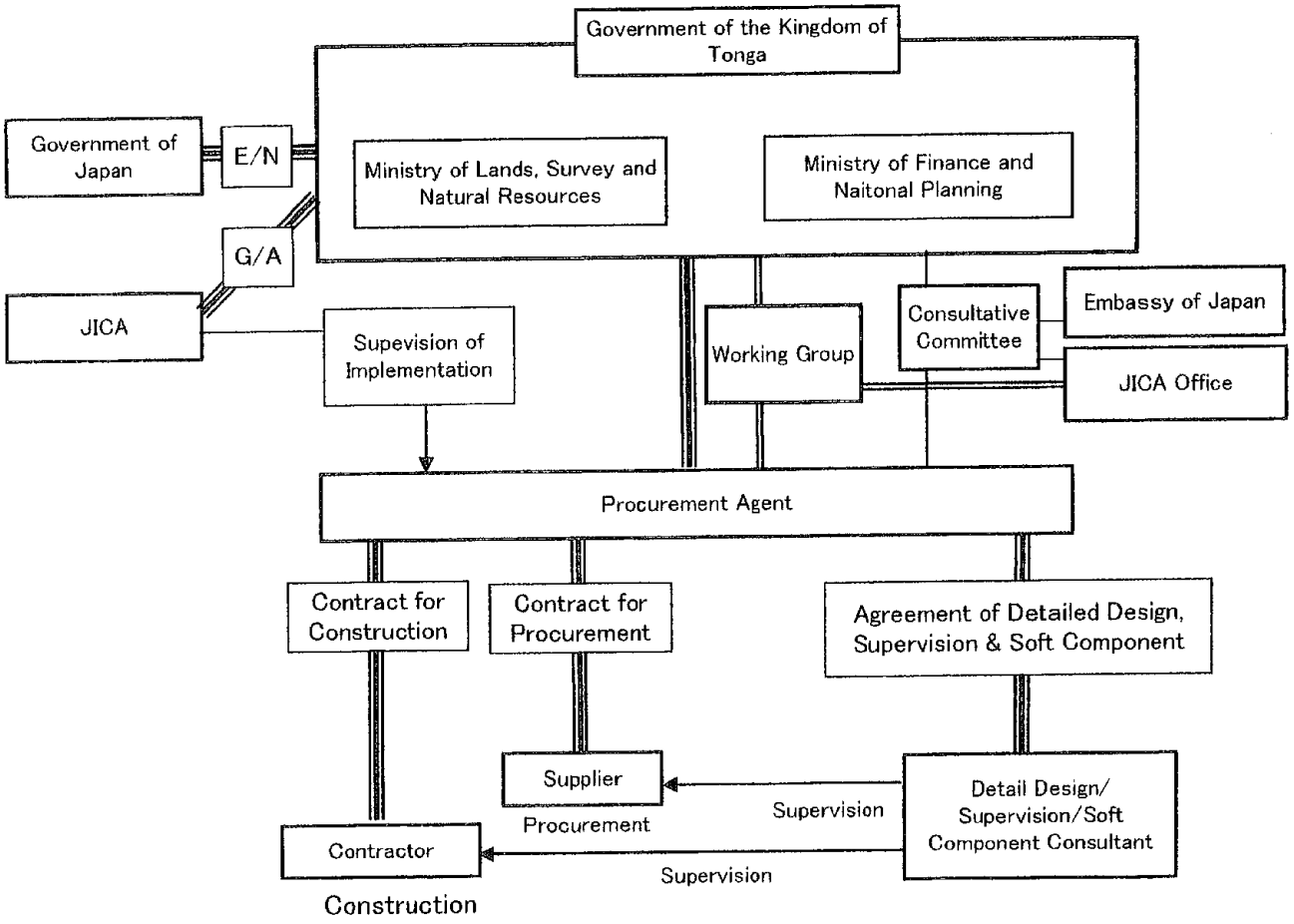
6) "Export and Re-export" of products
The products purchased under the Grant and its accrued interest will not be exported or re-exported from the Recipient.


Stage
Flow & Works
Application
Request
by Recipient Government
Screening of the Project
by GOJ & JICA
Project Formulation
Preparatory Survey 1
Project Identification
- Selection & Contracting of Consultant by JICA
- Field Survey & Analysis by Consultant & JICA
Appraisal & Approval
Appraisal of the Project
by GOJ & JICA
Inter Ministerial Consultation
by GOJ
Presentation of Draft Notes
by GOJ &
Approval by the Cabinet
by GOJ
Project Preparation
Preparatory Survey 2
for Design and Cost Estimation
Field Survey & Analysis
by Consultant & JICA
Explanation of Draft Report &
Draft Referrence Document for Tender
-Final Report
-Reference Document for Tender
Implementation
Exchange of Notes
& Agreed Minutes
by Both Government
Grant Agreement
by Recipient Government & JICA
Banking Arrangement
by Recipient Government
Agent Agreement
by Recipient Government & the Agent
Approval by JICA
Issuance of Blanket Disbursement Authorization
Consultant Contract
by the Agent and Consultant
Review & Preparation for Tender Document
Approval by Recipient Government
Preparation for Tendering
by the Agent & Consultant
Tendering & Evaluation
by the Agent, Consultant & the Recipient Government
by the Agent & Consultan
Procurement, Construction & Soft component Contract
by the Agent, Consultant & the Recipient Government
Procurement, Construction & Soft Component
by Contractor(s) & Consultant(s)
Completion Certificate by Recipient Government
Operation
Post Evaluation Study
Evaluation & Follow up
Ex-post Evaluation
Follow up

Flow of Funds for Project Implementation



Project Implementation System



Major undertakings to be taken by each Government

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	To secure land		●
2	To clear, level and reclaim the site when needed urgently		●
3	To construct gates and fences in and around the site		●
4	To construct a parking lot if necessary		●
5	To construct roads		
	1) Within the site	●	
	2) Outside the site and Access road		●
6	To construct the facility and install the equipment	●	
7	To provide facilities for the distribution of electricity, water supply, drainage and other incidental facilities if necessary:		
	1)Electricity		
	a. The power distribution line to the site		●
	b. The drop wiring and internal wiring within the site	●	
	c. The main circuit breaker and transformer for the site	●	
	2) Water Supply		
	a. The city water distribution main to the site		●
	b. The supply system within the site (receiving and elevated tanks)	●	
	3) Drainage		
	a. The city drainage main (for conveying storm water, sewage, etc. from the site)		●
	b. The drainage system within the site (for sewage, ordinary waste, storm water, etc.)	●	
	4) Gas Supply		
	a. The city gas main to the site		●
	b. The gas supply system within the site	●	
	5) Telephone System		
	a. The telephone trunk line to the main distribution frame/panel (MDF) of the building		●
	b. The MDF and the extension after the frame/panel	●	
	6) Furniture and Equipment		
	a. General furniture		●
	b. Project equipment	●	
8	To bear the following commissions applied by the bank in Japan for banking services based upon the Bank Arrangement (B/A):		
	1) Payment of bank commission		●
9	To ensure all the expense and prompt execution of unloading and customs clearance at the port of disembarkation in the recipient country		
	1) Marine or air transportation of the products from Japan or third countries to the recipient	●	
	2) To ensure all the expense and prompt execution of unloading, tax exemption and customs clearance of the products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site	●	
10	To accord Japanese nationals and / or nationals of third countries, including persons employed by the agent whose services may be required in connection with the Components such facilities as may be necessary for their entry into recipient country and stay therein for the performance of their work.		●
11	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the Components and to the employment of the Agent will be exempted by the Government of recipient country		●
12	To maintain and use properly and effectively the facilities that are constructed and the equipment that is provided under the Grant.		●
13	To bear all the expenses, other than those covered by the Grant and its accrued interest, necessary for the purchase of the Components as well as for the agent's fees.		●
14	To ensure environmental and social consideration for the Programme.		●

Terms of Reference of the Consultative Committee (Provisional)

1. To confirm an implementation schedule of the Programme for the speedy and effective utilization of the Grant and its accrued interest.

2. To discuss the modifications of the Programme, including modification of the design of the facility.

3. To exchange views on allocations of the Grant and its accrued interest as well as on potential end-users.

4. To identify problems which may delay the utilization of the Grant and its accrued interest, and to explore solutions to such problems.

5. To exchange views on publicity related to the utilization of the Grant and its accrued interest.

6. To discuss any other matters that may arise from or in connection with the G/A.

Minutes of Discussions
on
the Preparatory Survey
on
the Project for Introduction of Clean Energy by Solar Home System
in the Kingdom of Tonga

(Explanation on Draft Final Report)

In September 2009, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Preparatory Survey Team on the Project for Introduction of Clean Energy by Solar Home System (hereinafter referred to as "the Project") in the Kingdom of Tonga (hereinafter referred to as "Tonga"), and through discussions, field survey and technical examination of the results of the survey in Japan, JICA prepared a Draft Final Report of the Preparatory Survey.

In order to explain and to consult with the concerned officials of the Government of Tonga on the component of Draft Final Report, JICA sent Tonga the Draft Final Report Explanation Team (hereinafter referred to as "the Team"), which is headed by Mr. Nobuaki MATSUI , Resident Representative of JICA Tonga office from 22nd February, 2010 to 26th February, 2010.

As a result of discussion, both sides confirmed the main items described on the attached sheets.

Nuku'alofa, 5th March, 2010

Mr. Nobuaki MATSUI
Leader
Outline Design Study Team
Japan International Cooperation Agency
JAPAN

Mr. Fetu'u Vea
Acting Chief Executive Officer
Ministry of Land Survey and Natural Resources

Witness

Mr. Aisake Eke
Chief Executive officer
Secretary for Finance and National Planning

ATTACHMENT

1. Components of the Draft Final Report

The Ministry of Land Survey and Natural Resources (hereinafter referred to as "MLSNR") agreed and accepted in principle the components of the Draft Final Report explained by the Team.

2. Program Grant Aid for Environment and Climate Change of the Government of Japan

The Tongan side understood components of the Minutes of Discussion signed by both sides on 4th September, 2009 (hereinafter referred to as "the previous M/D"), and would take the necessary measures confirmed on the previous M/D for smooth implementation of the Project following procedures of the Program Grant Aid for Environment and Climate Change of the Government of Japan as shown in **Annex-1**.

3. Schedule of Study

JICA sent a revised draft final report on 4th March, 2010. The comments from the Tongan side shall be no later than 12th March, 2010.

JICA will complete the final report in accordance with the confirmed items and send it to the MLSNR by 31st March, 2010.

4. Confirmation of Progress Made from the Previous M/D

4-1. Relation with Tongan Energy Roadmap

Both sides confirmed that the Project is in line with the Tongan Energy Roadmap, the final version of which is expected to be issued in late April 2010.

The Japanese side was informed by Renewable Energy Sub-Committee, the Prime Minister's Office, that the Project would be implemented as designed; however, some institutional reform might be taken in place in accordance with the Roadmap.

4-2. Project sites and number of Solar Home System

Both sides confirmed that project sites are Tongatapu islands and Vava'u islands shown in **Annex-2** and the number of stand-alone Solar Home System (SHS) procured under the Project shall not exceed 512 sets.

4-3. The procedure to determine the final number and locations to install SHS

The final number and locations to install SHS to be described in a tender document for the Project will be determined in accordance with the number of the participants contracted paying full initial payment by the end of July 2010 and agreed to comply with the guideline and rules Outer Islands Solar Electricity Societies (hereinafter referred to as "Solar Societies)") in Tongatapu and Va'vau.

In case participant(s) cancel their participation after the commencement of tender process for the procurement, MLSNR and Solar Society shall secure the replacement site(s) to install excess SHS which was cancelled to alternative houses or institutional building(s) with in the same group of project villages.

4-4. Official permission to install SHS on the Project sites

Both sides confirmed that no official permission is necessary from related organization to install SHS in the Project sites. However, MLSNR will obtain the confirmation letter from Electricity Commission.

4-5. Environment Impact Assessment (EIA)

MLSNR confirmed with CEO of the Ministry of Environment Climate Changes (MECC) that the approval of EIA for the Project is necessary in prior to the commencement of implementation.

MLSNR will consult with MECC, and finalize the items and level necessary for the EIA report by the end of March 2010.

MLSNR requested JICA to provide assistance to employ a consultant to produce a report for

EIA, if it is required, because MLSNR does not have designated budget. JICA will take it in consideration and inform MLSNR the result.

5. Items of Equipment to be Procured

The Team explained that the items of equipment to be procured as shown in **Annex-3** as well as their specifications based on the result of the Preparatory Survey conducted in September, 2009. MLSNR understood and will give comments on the composition of items and specification of the equipment by 12th March 2010.

6. Soft Component

The Team explained that the following items are included to the soft component of the Project.

Category	Outline of the items
SHS Technology:	• Training for EPU Trainer • Training for Community Technician Basics of electric circuitry, SHS basic knowledge, SHS maintenance. Instruction of preventive maintenance to technicians in the communities.
Organization Strengthening:	• Training for management staff Financial management, organizational management, human resources management, labor affairs management.

MLSNR requested Japanese sides to include printing of Tongan version technical training manual for Community Technician and sticker for beneficiaries.

7. Project Cost

The Tongan side agreed that the Project cost should not exceed the upper limit of amount agreed on in Exchange of Notes (E/N). Both sides also confirmed that the Project cost contains procurement cost of equipment, the cost for transportation up to the Project Sites, installation cost, the Agent fee, and the consultant fee includes cost for soft component for the technical support of operation and maintenance of equipment.

The Tongan side understood that the Project Cost Estimation attached as **Annex-4** is not final and is subject to change by the result of examination through revision of the Preparatory Survey.

8. Project Schedule

Both sides adapted the tentative implementation schedule as shown in the draft final report. The agreed Project Schedule (provisional) is attached as **Annex-5**.

9. Procurement Process of the Project

Both sides reconfirmed that procurement process would be supervised by the Procurement Management Agent (hereinafter referred to as "the Agent") with necessary consultation by the Consultative Committee (hereinafter referred to as "the Committee"). And both sides also reconfirmed roles of the Agent as follows;

(1) The Agent renders the services stipulated in the provisions of the G/A as well as the E/N for the Project;

(2) The Agent will undertake the procurement procedure necessary for the Project according to the provisions of the G/A and E/N and any other concerned guidelines;

(3) The Agent will commence the procurement according to the contents of the Final Report of the Outline Design.

The Team explained that if tender price exceeds the amount agreed on G/A and E/N, quantity or/and items of the equipment would be reduced until the Project cost comes down to

the amount agreed on G/A and E/N.

The Tongan side agreed that if there is a remaining amount of the project cost after tenders, additional items of equipment which is identical with the initial tender would be procured.

The Tongan side also understood that decision on addition or reduction of the equipment to be procured would be made through necessary consultation among members of the Consultative Committee.

10. The Consultative Committee

The Tongan side understood that the MLSNR CEO will chair the Consultative committee in order to facilitate consultation and procurement process. The Terms of Reference of the Consultative Committee was settled in **Annex-6**.

The members of the Committee are as follows:

(1) CEO of Ministry of Land Survey and Natural Resources (Chair)
(2) Representative(s) of Energy Planning Unit (Secretary)
(3) CEO of Ministry of Finance and National Planning
(4) Representative of JICA Tonga Office

The first meeting of the Committee shall be held immediately after the JICA's approval of the Agent Agreement which shall be concluded between MLSNR and the Procurement Agent. The employment of the Agent shall be agreed between the two Governments.

Further meetings shall be held upon request of either the Tongan side or the Japanese side. The Procurement Agent may advise both sides on the necessity to call a meeting of the Committee.

11. Undertakings required by the Recipient Country

The Team requested the Tongan side to abide by the following undertakings by the Tongan side in addition to major undertakings described in the previous M/D. The Tongan side agreed to do so.

(1) Allocation of land/space for installation of PV system

The Tongan side should be responsible for following issues;

1) Securing necessary land for PV Modules

2) Temporary stockyard (at least 250m^2 in Tongatapu main island and 1,400m^2 in Va'vau main island) during installation of equipment and materials

(2) Establishment of implementing organization of the Project

In Ha'apai islands, operation and maintenance of SHS, and budgetary arrangement for its maintenance and management are conducted by Ha'apai Solar Committee in collaboration with MLSNR. Making reference to SHS management and operation system in Ha'apai islands, both sides understood that establishment of Solar Societies as an implementing organization authorized by MLSNR is indispensable for sustainable operation of SHS in Tongatapu islands and Vava'u islands.

Both sides confirmed that MLSNR has commenced institutional and financial arrangement to establish a Solar Society in each island.

Moreover, MLSNR shall draw up their guidelines and rules, organization structures, their roles and report to JICA TONGA Office by 12th March 2010.

Outline of organization structure and role of the Solar Societies are shown in the Draft Final Report

(3) Explanation to recipient household

Both sides confirmed that the Tongan side has already held meetings with all recipient communities to explain the project outline and their obligation in accordance with the guideline and rules of each Solar Society to install and use SHS.

Outline of their obligation submitted is as follows.

- to pay TOP 200 as an initial payment per one SHS by the end of July 2010.
- to pay TOP13 and TOP15 as a monthly payment per one SHS at Vava'u and Tongatapu respectively.

(4) Clearance of Existing PV Module

The Tongan side agreed that the each householder and institutions shall remove and dispose/store existing unfunctioning PV modules installed by other donors in the Project Sites at its own cost before the commencement of installation of SHS. MLSNR shall take the permission by the donors and the consent from householders, and supervise the process.

(5) Ownership of Equipment and Materials

Both sides agreed that the equipment and materials provided by the Project become the asset of MLSNR.

(6) Electric Lights

Japanese side requested Tongan side to bare the cost for the light bulbs to be installed with SHS by the time of completion of SHS installation because they are not usually covered by the Japanese Grant Aid.

MSLNR and Solar Societies explained that procurement of bulb would not be possible by the Tongan side due to Government fiscal and financial constraints and outer islands communities' current socioeconomic incapability.

Both sides confirmed that there would be a great risk that the project fails to bring about the expected outcome without bulbs from the beginning if the Japanese Grant Aid does not cover the bulbs.

Japanese side will take further consideration about this issue.

(7) Operation and Maintenance of the Equipment

The Tongan side agreed that the maintenance service for the external wiring and equipment shall be provided by the Solar Society. The Tongan side agreed to secure the necessary personnel for the operation and maintenance, and make appropriate budgetary arrangement for the personnel and procurement of the necessary equipment such as renew of batteries, maintenance tools and equipment and office supplies from the accumulated initial and monthly payment from the beneficiaries. The quarterly report which includes the financial condition, maintenance record and activities of Solar Society shall be submitted to JICA Tonga Office until the completion of soft components.

Both sides confirmed that each household takes responsibility to maintain the system inside the individual house, i.e., the internal wiring, electric fixture and bulbs, switches, etc. as described in the draft final report and each household will bear the cost to change the bulbs when necessary even if the electric bulbs were initially installed by the donor.

(8) Environmental and Social Considerations

The Tongan side shall determine the plan for collection and disposal of the batteries used for SHS and be responsible for obtaining necessary permission by MECC by the end of July 2010. The Tongan side shall report the plan and result to JICA Tonga Office. This plan is to be included EIA report.

(9) Application of the Related Laws and Regulations

The Tongan side agreed the structural design for the installation of SHS shall comply with the Architectural Regulation in Japan and Tonga. Electrical design for SHS should follow the standards and codes of Japan Electrotechnical Committee (JEC).

The Tongan side agreed that the MLSNR shall be responsible for the application of related laws and regulations for the operation of SHS. The Japanese side shall assist the Tongan side to

introduce necessary procedures through soft component during the implementation of the Project.

Solar Societies shall obtain the status of authorized non-profit society under the Incorporated Societies Act as soon as possible, and MLSNR shall monitor the process.

(10) Customs and Tax Exemption

In respect of all materials and supplies for the project, the Tongan side will, in accordance with Tongan law:

a) exempt at the border all materials and supplies from import duties and other taxes such as consumption tax and excise tax;
b) facilitate movement of such supplies by providing appropriate customs and wharfage facilities including payment of any necessary storage costs at the first port of discharge of the Project Supplies in Tonga;
c) exempt from consumption tax all materials and supplies purchased in Tonga if the supplier is registered for consumption tax;
d) exempt from excise tax any vehicle purchased in Tonga for the project.

(11) Assignment of Counterpart Personnel

1) Overall project management

The Tongan side agreed to assign necessary personnel for overall project management.

The Tongan side shall inform the name of the following number of Counterpart Personnel to JICA Tonga office by the end of March 2010:

- Project contact person as a secretary for Consultative Committee
- Two staff from MLSNR (one each for Tongatapu islands and Vava'u islands) who will be in charge of financial, technical and personnel management and will eventually be the trainers. Roles are also highlighted in the Solar Society's guidelines and rules.

(12) Banking Arrangement

The Tongan side, being convinced that the conclusion of the Banking Arrangement (B/A) and Blanket Disbursement Authorization (BDA) constitutes a very important factor to implement the Program smoothly and without delay, shall take the necessary measures. The flow of funds is shown in the Annex-I.

By signing the BDA, the Tongan side designates the Procurement Agent as the representative authorized to act in the name of the Tongan side concerning all transfers of the Grant plus any interest earned to the Procurement Account.

12. Confidentiality of the Project

Both sides confirmed that all the information related to the Project shall not be released to any outside parties before conclusion of all the contract(s) for the Project because they are confidential document that contains information related to the tender.

These information includes:

a) detailed drawings, specifications, and other technical information of the facilities and equipment;
b) cost estimation
c) the Final Report

<List of Annex>

Annex-1 Program Grant Aid for Environment and Climate Change of the Government of Japan

Annex-2 Project sites

Annex-3 List of Equipments
Annex-4 Project Cost Estimation (Confidential)
Annex-5 Project Schedule (Provisional)
Annex-6 The Terms of Reference of the Consultative Committee

Annex – 1

Program Grant Aid for Environment and Climate Change of the Government of Japan
(Provisional)

The Grant Aid provides a recipient country (hereafter referred to as "the Recipient") 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 relevant laws and regulations of Japan. The Grant Aid is not supplied through the donation of materials as such.

Based on "Cool Earth Partnership" initiative of the Government of Japan, the Program Grant Aid for Environment and Climate Change (hereafter referred to as "GAEC") aims to mitigate effects of global warming by reducing GHGs emission (mitigation; e.g. improvement of energy efficiency) and to take adaptive measures (adaptation; e.g. measures against disasters related to climate change, including disaster prevention such as enhancing disaster risk management).GAEC may contain multiple components that can be combined to effectively meet these needs.

1. Procedures for GAEC

GAEC is executed through the following procedures.

Preparatory Survey 1	Preparatory Survey for project identification conducted by Japan International Cooperation Agency (JICA)
Application	Request made by a recipient country
Appraisal & Approval	Appraisal by the Government of Japan and Approval by the Cabinet
Determination of Implementation	The Notes exchanged between the Government of Japan and the Recipient Country
Grant Agreement (hereinafter referred to as the "G/A")	Agreement concluded between JICA and the Recipient
Preparatory Survey 2	Preparatory Survey for design conducted by JICA
Implementation	Procurement through the Procurement Agency by the Recipient

Firstly, if the candidate project for a GAEC is identified by the Recipient and the Government of Japan, the Government of Japan (the Ministry of Foreign Affairs) examines it whether it is eligible for GAEC. When the request is deemed appropriate, JICA, in consultation with the Government of Japan, conducts the Preparatory Survey (hereafter referred to as "the Survey") on the candidate project as Phase 1 of the Survey with Japanese consulting firms.

Secondly, the Recipient submits the official request to the Government of Japan, while the appropriateness, necessity and the basic components of the project are examined in the course of Phase 1 of the Survey.

Thirdly, the Government of Japan appraises the project to see whether it is suitable for Japan's GAEC, based on the Survey 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 (E/N) signed by the Governments of Japan and the Recipient.

Fifthly, JICA engages Grant Agreement (G/A) with the Recipient and executes the Grant by making payments of the amount agreed in the E/N and strictly monitors that the funds of the Grant are properly and effectively used.

Procurement Management Agent is designated to conduct the procurement services of products and services (including fund management, preparing tenders, contracts) for GAEC on behalf of the Recipient. The Agent is an impartial and specialized organization that will render services according to the Agent Agreement with the Recipient. The Agent is recommended to the Recipient by the Government of Japan and agreed between the two Governments in the Agreed Minutes ("A/M").

2. Preparatory Survey

1) Contents of the Survey

The purpose of the Preparatory Survey (hereafter referred to as "the Survey"), conducted by JICA on a requested project (hereafter referred to as "the Project"), is to provide the basic document necessary for the appraisal of the Project by the Government of Japan. The contents of the Survey are as follows:

- Confirmation of background, objectives, and benefits of the Project and institutional capacity of agencies and communities concerned of the Recipient necessary for project implementation.
- Evaluation of relevance of the Project to be implemented under the Grant Aid Scheme for Environment and Climate Change from a technical, social, and economic point of view.
- Confirmation of items agreed upon by both parties concerning the basic concept of the Project.
- Preparation of the design of the Project and reference document for tender.
- Estimation of cost for the Project.

The contents of the original request will be modified, as found necessary, in the design of the Project according to the guidelines of Japan's Grant Aid scheme.

The Government of Japan requests the Government of the Recipient to take whatever measures necessary to ensure its responsibility in implementing the Project. Such measures must be guaranteed even if they may fall outside the jurisdiction of the implementing organization of the Recipient. This has been confirmed by all relevant organizations of the Recipient through the Minutes of Discussions.

2) Selection of consulting firms

For the smooth implementation of the Survey, JICA will conduct the Survey with registered consulting firms. JICA selects the firms based on proposals submitted by firms with interest in implementing the Survey. The firms selected will carry out the Preparatory Survey and prepare a report, based on the terms of reference set by JICA.

3. Implementation of GAEC after the E/N

1) Exchange of Notes (E/N)
The content of GAEC will be determined in accordance with the Notes exchanged by the two Governments concerned, in which items including, objectives of the project, period of execution, conditions and amount of the Grant Aid are confirmed.

2) Details of Procedures
Details of procedures on procurement and services under GAEC will be agreed between the authorities of the two governments concerned at the time of the signing of the G/A.

Essential points to be agreed are outlined as follows:
a) JICA will supervise the implementation of the Project.
b) Products and services will be procured and provided in accordance with JICA's "Procurement Guidelines for the Program Grant Aid for Environment and Climate Change."
c) The Recipient will conclude a contract with the Agent.
d) The Agent is the representative acting in the name of the Recipient concerning all transfers of funds to the Agent.

3) Focal points of "Procurement Guidelines for the Program Grant Aid for Environment and Climate Change"
a) The Agent
The Agent is the organization, which provides procurement of products and services on behalf of the Recipient according to the Agent Agreement with the Recipient. The Agent is recommended to the Recipient by the Government of Japan and agreed between the two Governments in the A/M.

b) Agent Agreement
The Recipient will conclude the Agent Agreement, in principle, within two months after the signing of the G/A, in accordance with the A/M. The scope of the Agent's services will be clearly specified in the Agent Agreement.

c) Approval of the Agent Agreement
The Agent Agreement is prepared as two identical documents and the copy of the Agent Agreement will be submitted to JICA by the Recipient through the Agent. JICA confirms whether the Agent Agreement is concluded in conformity with the E/N, A/M, and G/A and the Procurement Guidelines for the Program Grant Aid for Environment and Climate Change then approves the Agent Agreement.

The Agent Agreement concluded between the Recipient and the Agent will become effective after the approval by JICA in a written form.

d) Payment Methods
The Agent Agreement will stipulate that "Regarding all transfers of the fund to the Agent, the Recipient will designate the Agent to act on behalf of the Recipient and issue a Blanket Disbursement Authorization ("the BDA")to conduct the transfer of the fund (hereinafter referred to as "the Advances") to the Procurement Account from the Recipient Account.

The Agent Agreement will clearly state that the payment to the Agent will be made in Japanese yen from the Advances and that the final payment to the Agent will be made when the total remaining amount become less than three percent (3%) of the Grant and its

accrued interests excluding the Agent's fees.

e) Products and Services Eligible for Procurement
Products and services to be procured will be selected from those defined in the G/A.

f) Firm and Consultant
The firm and consultant who would contract with the Agent shall be Japanese Nationals.

The consultants that will be employed to do detail design and supervise the work for the Project, however will be in principle, Japanese nationals recommended by JICA for the purpose of maintaining technical consistency with the Study.

g) Method of Procurement
When conducting the procurement, sufficient attention will be paid to transparency in selecting the firms and for this purpose, competitive tendering will be employed in principle.

h) Tender Documents
The tender documents should contain all information necessary to enable tenderers to prepare valid offers for the products and services to be procured by GAEC.

The rights and obligations of the Recipient, the Agent and the firms supplying products and services should be stipulated in the tender documents to be prepared by the Agent. Aside from this, the tender documents will be prepared in consultation with the Recipient.

i) Pre-qualification Examination of Tenderers
The Agent may conduct a pre-qualification examination of tenderers in advance of the tender so that the invitation to the tender can be extended only to eligible firms. The pre-qualification examination should be performed only with respect to whether the prospective tenderers have the capability of concluding the contracts.

For this, the following points should be taken into consideration:
(1) Experience and past performance in contracts of similar kind
(2) Financial credibility (including assets such as real estate)
(3) Existence of offices and other items to be specified in the tender documents.
(4) Their potentialities to use necessary personnel and facilities.

j) Tender Evaluation
The tender evaluation should be implemented on the basis of the conditions specified in the tender documents.

Those tenderers which substantially conform to the technical specifications and other stipulations of the tender documents, will be judged in principle on the basis of the submitted price, and the tenderer who offers the lowest price will be designated as the successful tenderer.

The Agent will submit a detailed evaluation report of tenders to JICA for its information, while the notification of the results to the tenderers will not be premised on the confirmation by JICA.

k) Additional procurement
If there is any remaining balance after the competitive and/or selective tendering and/or direct negotiation for a contract, and if the Recipient would like to procure additional

items, the Agent is allowed to conduct this additional procurement, following the points mentioned below:

(1) Procurement of same products and services
When the products and services to be additionally procured are identical with the initial tender and a competitive tendering is judged not efficient, additional procurement can be conducted by a negotiated contract with the successful tenderer of the initial tender.

(2) Other procurements
When products and services other than those mentioned above in (1) are to be procured, the procurement should be conducted through competitive tendering. In this case, the products and services for additional procurement will be selected from among those in accordance with the G/A.

l) Conclusion of the Contracts
In order to procure products and services in accordance with the guideline, the Agent will conclude contracts with firms selected by tendering or other methods.

m) Terms of Payment
The contract will clearly state the terms of payment. The Agent will make payment from the "advances," against the submission of the necessary documents from the firm on the basis of the conditions specified in the contract. When the services are the object of procurement, the Agent may pay certain portion of the contract amount in advance to the firms on the conditions that such firms submit the advance payment guarantee worth the amount of the advance payment to the Agent.

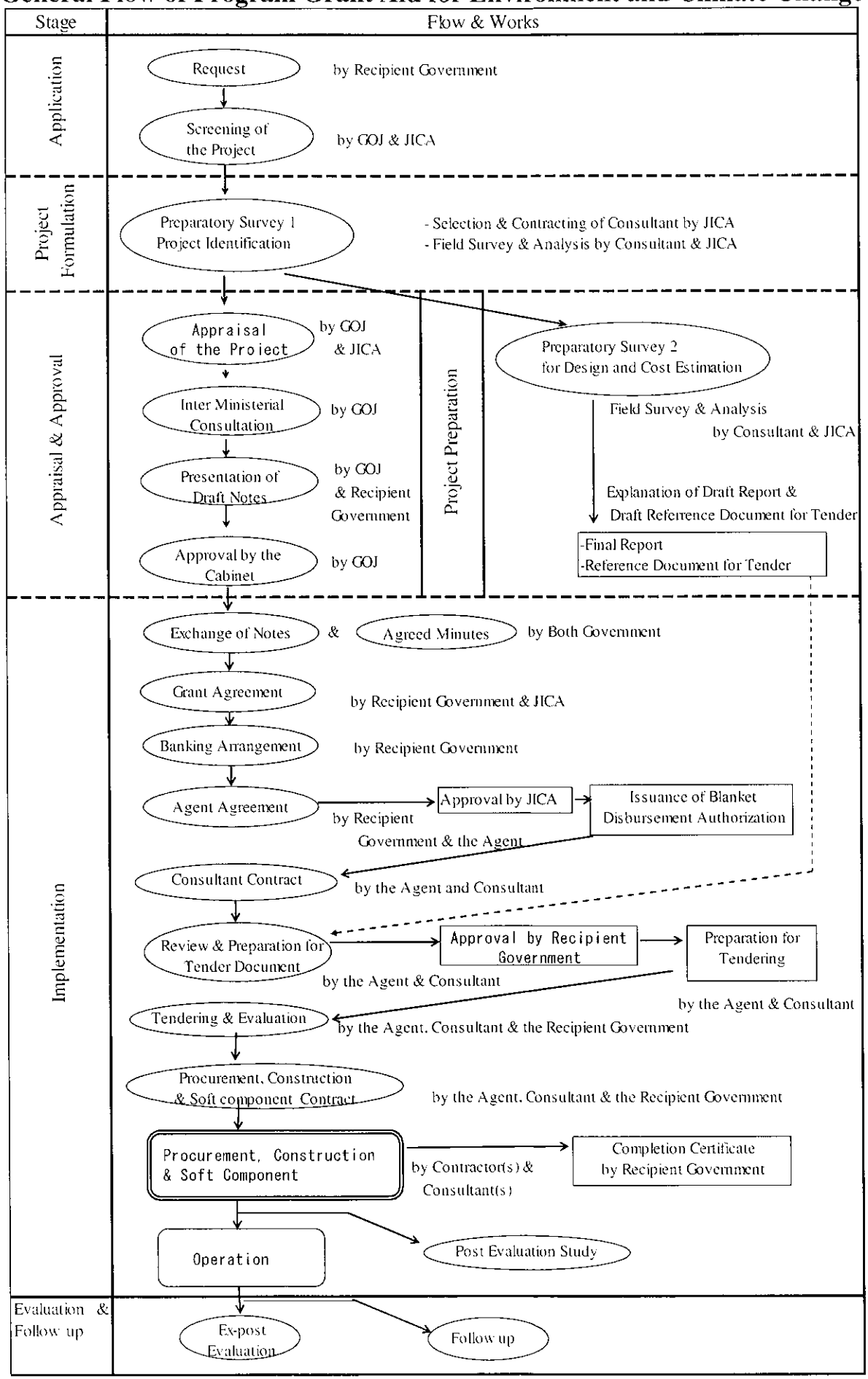
4) Undertakings required by the Government of the Recipient Country
In the implementation of the Grant Aid Project, the Recipient is required to undertake necessary measures as the following:

a) To secure land necessary for the sites of the Project and to clear, level and reclaim the land prior to commencement of the Project.
b) To provide facilities for distributing electricity, water supply and drainage and other incidental facilities in and around the sites.
c) To ensure all the expense and prompt execution for unloading, customs clearing at the port of disembarkation and domestic transportation of products purchased under the Grant Aid,
d) To ensure that customs duty, internal taxes and other fiscal levies that may be imposed in the Recipient with respect to the purchase of the Components and the Agent's services will be exempted by the Government of the Recipient.
e) To accord all the concerned parties, whose services may be required in connection with supply of the products and services under the contracts, such facilities as may be necessary for their entry into the Recipient and stay therein for the performance of their work.

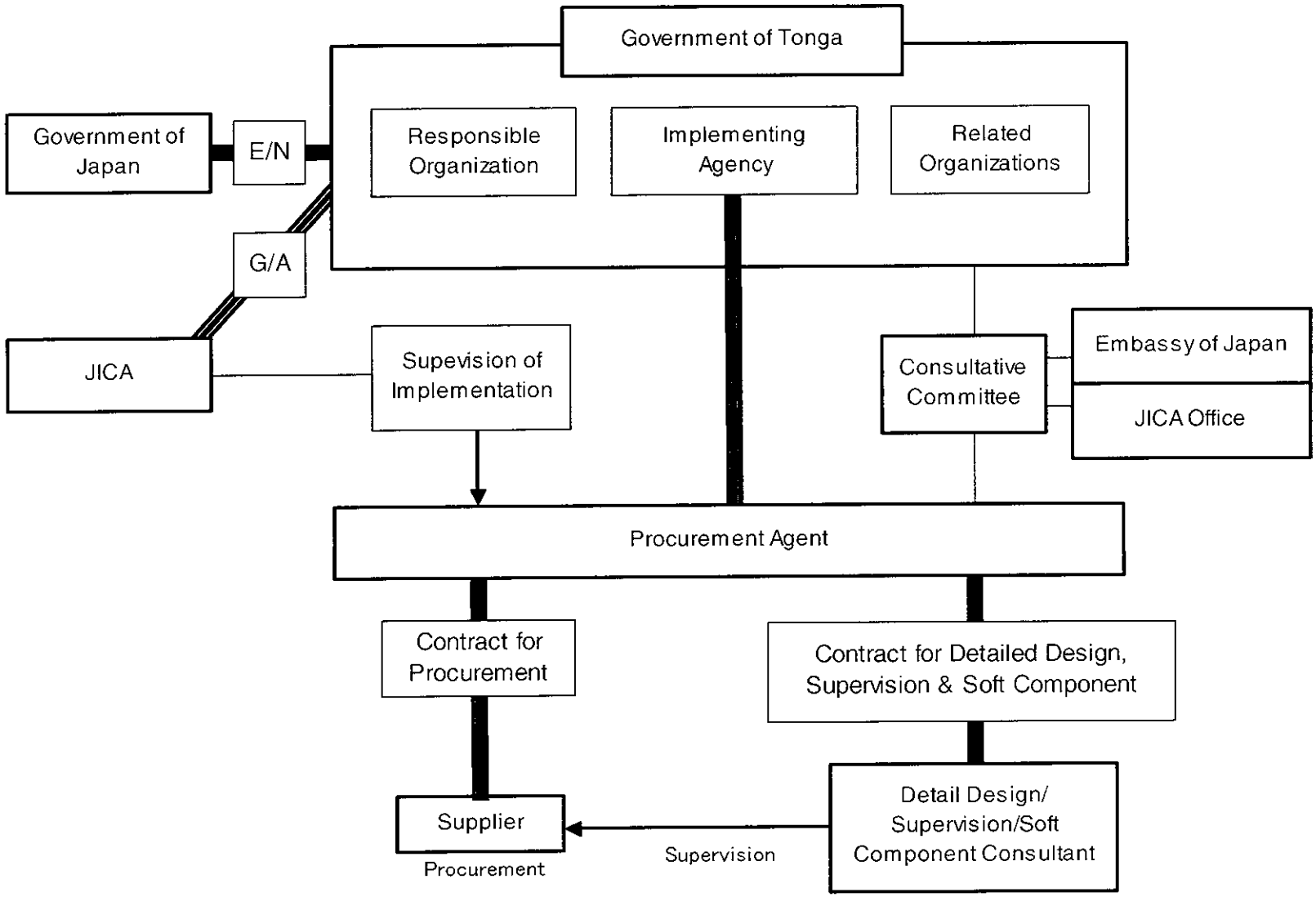
5) "Proper use of funds"
The Recipient is required to operate and maintain the facilities constructed and equipment purchased under the Grant Aid properly and effectively and to assign personnel necessary for this operation and maintenance as well as to bear all the expenses other than those covered by the Grant Aid.

6) "Export and Re-export" of products
The products purchased under the Grant and its accrued interest will not be exported or re-exported from the Recipient.

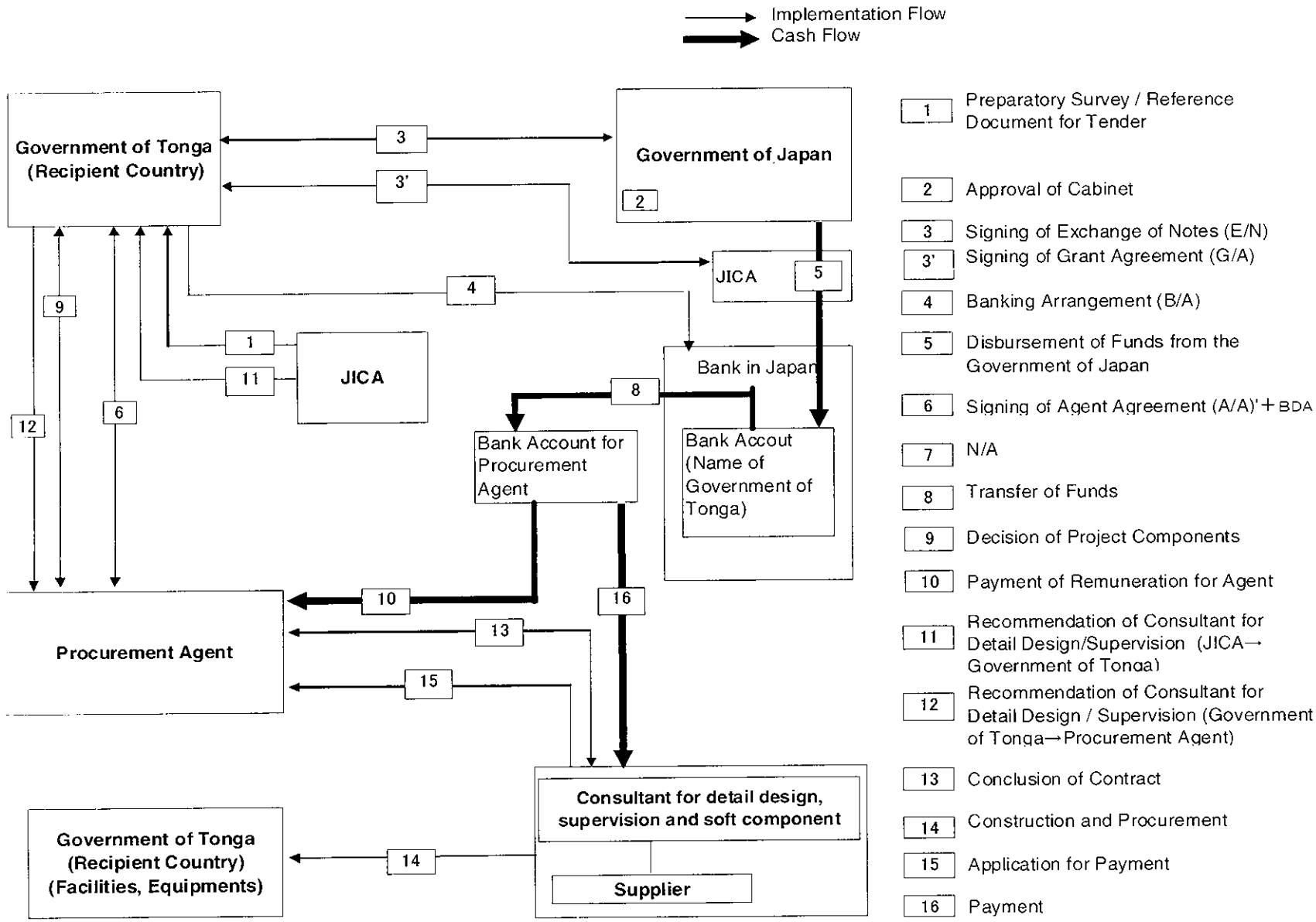
General Flow of Program Grant Aid for Environment and Climate Change



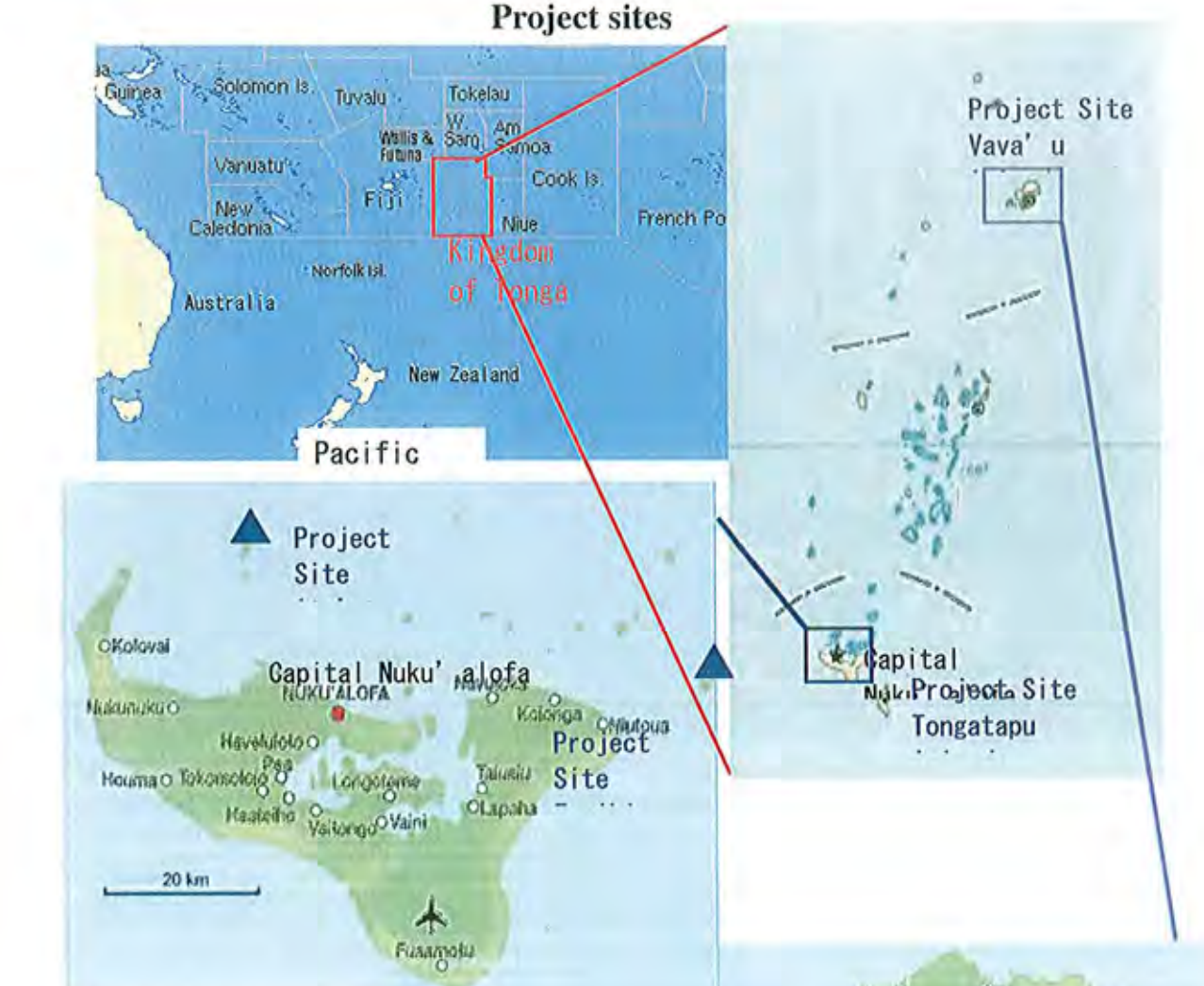
Project Implementation System



Flow of Funds for Project Implementation

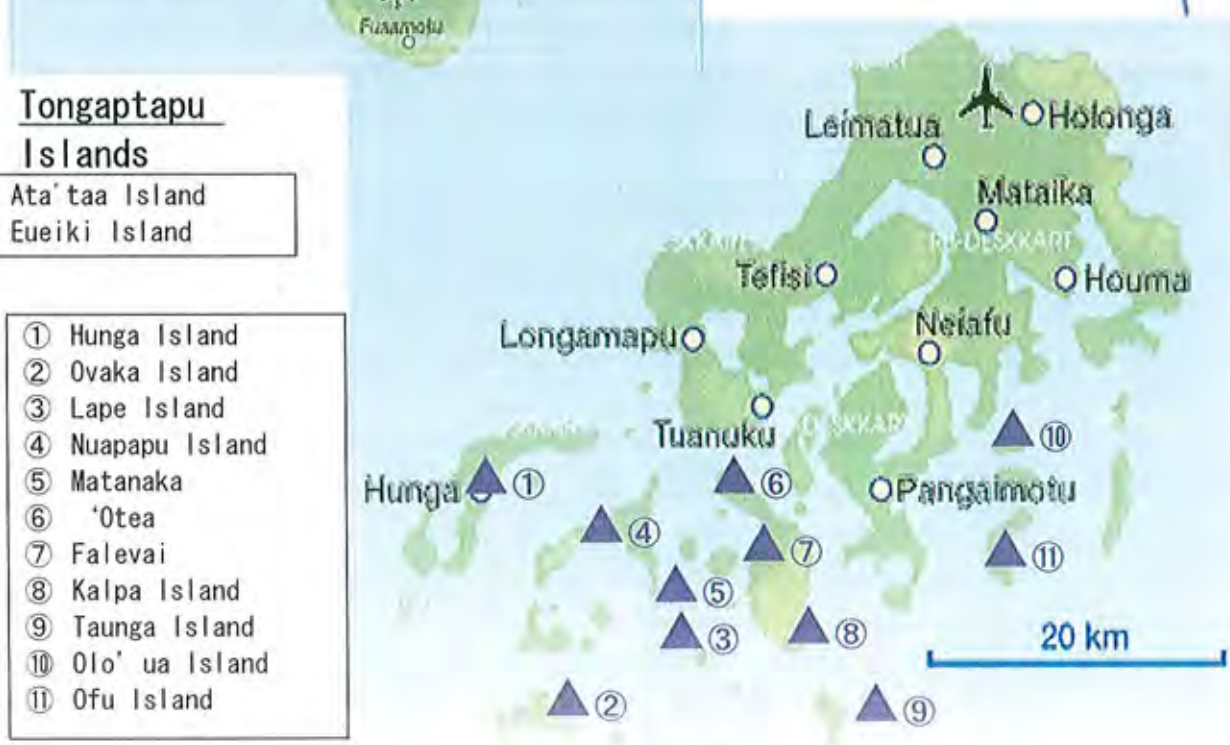


Project sites



Tongaptapu Islands

① Ata'taa Island
② Eueiki Island



① Hunga Island
② Ovaka Island
③ Lape Island
④ Nuapapu Island
⑤ Matanaka
⑥ 'Otea
⑦ Falevai
⑧ Kalpa Island
⑨ Taunga Island
⑩ Olo' ua Island
⑪ Ofu Island

Vava'u Islands

▲ Project Site

List of Equipments

3-1 List of Equipments
The following table shows a list of equipments procured under the Project.

Item No.	Name of Equipment	Maximum quantity	Final Delivery Point (Site)
1	Solar module/panel 85W	1,024 pcs	See the following Table 3-2
2	Panel mounting structure	512 unit	
3	Box for battery and controller	512unit	
4	Charge Controller	512 unit	
5	Battery	512 unit	
6	DC/DC converter	512 unit	
7	Wiring/interconnects	512set	
8	Emergency Spare parts	1set	
9	Test Apparatus	1set	
10	Maintenance tools and equipment	1set	

3-2 Number of SHS installed

The following table shows Number of SHS installed under the Project by community in the Project sited.

Name of islands	Town	No.of SHS	No. of household which will install SHS	No. of institutional building which will install SHS
Vava'u Islands				
	FALEVAI	**38**	32	6
	HUNGA	**95**	79	16
	KAPA	**20**	16	4
	LAPE	**10**	8	2
	MATAMAKA	**49**	39	10
	NOAPAPU	**52**	43	9
	OFU	**51**	46	5
	OLO'UA	**33**	28	5
	OVAKA	**38**	32	6
	OTEA	**36**	31	5
	TAUNGA	**20**	18	2
Sub-total (Vava'u Islands)		**442**	**372**	**70**
Tongatapu Islands				
	'EUEIKI	**22**	16	6
	'ATATAA	**48**	43	5
Sub-total (Tongatapu Islands)		**70**	**59**	**11**
Total		**512**	**431**	**81**
Notes		Institutional Buildings : Church Buildings. Church & Community Halls. Schools and Clinics.		

Project Cost Estimation (Confidential)

This cost estimate is provisional and would be further examined by the Government of Japan for the approval of the Grant Aid.

1. Cost to be borne by the Japanese side: approximately ¥ million

Item	Amount (Million Japanese Yen)
1. Procurement cost of equipment and materials	
2. Procurement Agent & Consulting Services Fee	
3. Total (1+2)	

2. Cost to be borne by the Tongan side: US$ 6,800 (approximately ¥ 0.655million)

The contents and cost of work on the Tongan side are as follows:

Item	Amount
1. Payment of commission to Japanese bank	6,800 US$ (Approximately ¥0.655 million)
Total	6,800 US$ (Approximately ¥0.655 million)

Operation and Maintenance Cost on the Tongan side are as follows:

The equipment to be procured in the Project is basically maintenance-free except for water level check of storage battery and water supply, however, it will be necessary to always keep replacement parts on hand in case of breakdowns as was mentioned earlier (see 2-4-2). Moreover, it will be necessary to secure personnel expenses for technicians assigned in each islands in order to be prepared for daily maintenance, accident and trouble. Therefore, the Tonga side will need to budget for the following operation and maintenance expenses (annual) to ensure that no problems arise in the operation and maintenance of equipment in accordance with Solar Society's Guideline and Rules.

① Personnel expenses
② Expendable and replacement parts costs (after warrantee period)
③ Total Approximately

Furthermore, the above amount is the annual forecast cost expected to arise in the first seven years when there will be no need for battery replacements. The above cost corresponds to roughly 10% of the forecast annual income. If appropriate fund management is carried out, it should be possible to comfortably secure the funds required to conduct each year's maintenance and battery replacements.

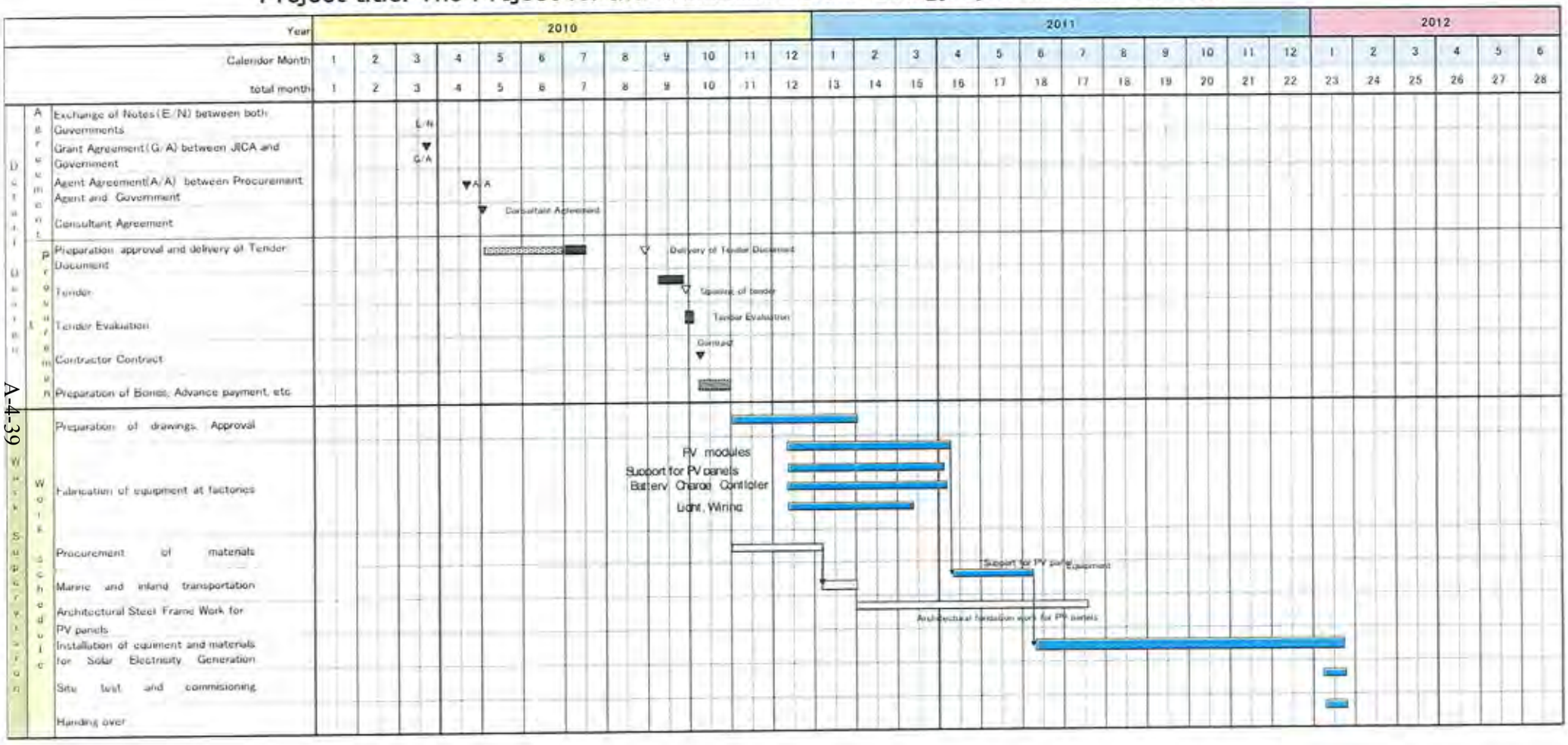
3. Conditions for estimation
(1) Time of estimation: September 2009
(2) Foreign exchange rate: 1 US$ = ¥ 97.57

(3) Others:

The above estimation was carried out in accordance with relevant rules and the guideline of Japan's Grant Aid.

Project Schedule (Provisional)

Project title: The Project for Introduction of Clean Energy by solar home system



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Terms of Reference of the Consultative Committee

1. To confirm an implementation schedule of the Programme for the speedy and effective utilization of the Grant and its accrued interest.

2. To discuss the modifications of the Programme, including modification of the design of the facility.

3. To exchange views on allocations of the Grant and its accrued interest as well as on potential end-users.

4. To identify problems which may delay the utilization of the Grant and its accrued interest, and to explore solutions to such problems.

5. To exchange views on publicity related to the utilization of the Grant and its accrued interest.

6. To discuss any other matters that may arise from or in connection with the G/A.

5. SOFT COMPONENT

(TECHNICAL ASSISTANCE) PLAN

Soft Component Plan (Draft)

1 Background to Implementation of the Soft Component

(1) Surrounding situation and the background

Energy production in Tonga is largely dependent on diesel generation, which makes the energy supply setup extremely fragile and vulnerable to the effects of recent inflation in the price of petroleum and so on. In response to this situation, the Government of Tonga enacted the Renewable Energy Act - the first such legislation in the Pacific region - in October 2008 under support from the Pacific Islands Energy Policy and Strategic Action Plan (PIEPSAP) and the Pacific Islands Greenhouse Gas Abatement through Renewable Energy Project (PIGGAREP), etc. Within this, the Government of Tonga is aiming to build a setup which will guarantee the stable supply of energy irrespective of petroleum price fluctuations. The government is aiming to derive 50% of all grid electricity from renewable energy sources by 2012, and it has been working full-time on the development of renewable energies since 2008. In this plan the government is aiming to derive 50% of all grid electricity from renewable energy sources by 2012, and it has been working full-time on the development of renewable energies since 2008.

In April 2009, a summit of Pacific region energy ministers was held in Tonga and, under the initiative of the Prime Minister of Tonga, a meeting was held with a view to compiling a renewable energy roadmap with participation from the World Bank, ADB, EU and other donors. The draft version of the Road Map is scheduled to receive approval from the Government of Tonga in February 2010.

The environmental program grant aid project “The Project for Introduction of Clean Energy by Solar Home Systems” here targets two islands and 11 islands respectively in the Tongatapu Group and the Vava’u Group, which do not receive city electricity supply, and the Ministry of Land Survey and Natural Resource (MLSNR) will serve as both the government agency with primary responsibility and the implementing agency. Within the MLSNR, the Energy Planning Unit (EPU) is responsible for planning, implementing and administering renewable energy-related projects.

In the Project sets of Solar Home System (SHS) will be procured Moreover, although all the supplied equipment such as PV modules, batteries, wiring indoor and so on will be owned by the MLSNR, the operation and maintenance of the systems plans to be managed by the Outer islands Solar Electricity Societies which will be established in each island group around a core of EPU.

Incidentally, the Solar Electricity Societies, will be composed of EPU officials, provincial governors, the technicians assigned to each island and the town officers, and will be a government approved agencies based on the Incorporated Society Act, and in other islands groups (Ha’apai Group and Niuas Group) where SHS were installed in the past, equipment operation and maintenance has been conducted with the same system.

(2) Current situation and Objective

In Tonga, programs for the widespread introduction of SHS to communities on remote islands were vigorously implemented under assistance from Australia, New Zealand and the EU from the 1990s as a means of supplying electricity to non-electrified areas where do not served by city electricity supply. Under such programs, 813 SHSs were installed prior to this project. In the Project target areas too, SHS were supplied to the Vava’u Group under EU assistance in 1995, and to the Tongatapu Group under Grassroots grant aid by the government of Japan, UNESCO and AusAid support from 1997. However, 10 years following installation, almost all of these systems currently lie unused. In the implementation of the Project here, information was collected and problems were identified on these past SHS projects and programs implemented in other areas. As a result, identified problems are as follows.

- Physical problems
  - Equipment possessing specifications capable of withstanding long-term use was not procured.
- Financial problems
  - Fund management was not properly conducted by the Solar Electricity Society
  - Consumable replacement could not be renewed intentionally.
- Organization and human problems
  - Appropriate technical guidance was not implemented.
  - Daily maintenance is not carried out.
  - Guidance on proper methods of use for residents was not conducted.
  - Solar Electricity Society does not properly conduct personnel management of technicians.
- Information problems
  - The equipment makers had no agents in Tonga, which meant that the setup for responding to troubles was inadequate

Concerning the physical problems and information problems, countermeasures can and should be taken in the Project by introducing equipment that possesses the proper specifications and by requiring that contractors have agents in Tonga as a condition for participation in the tender process. On the other hands since in current condition, it is judged that operation and maintenance system and their method, etc by the resident and the implementation agency as for the human and financial problems, in order to ensure the smooth start and sustainable operation and maintenance, it will be hoped to implement technology transfer through soft component. Expected outputs by implementing soft component are shown full detail in the Soft component PDM.

(3) Operation and Maintenance system and role of persons concerned

Supposed operation and maintenance system in the project is as follows.

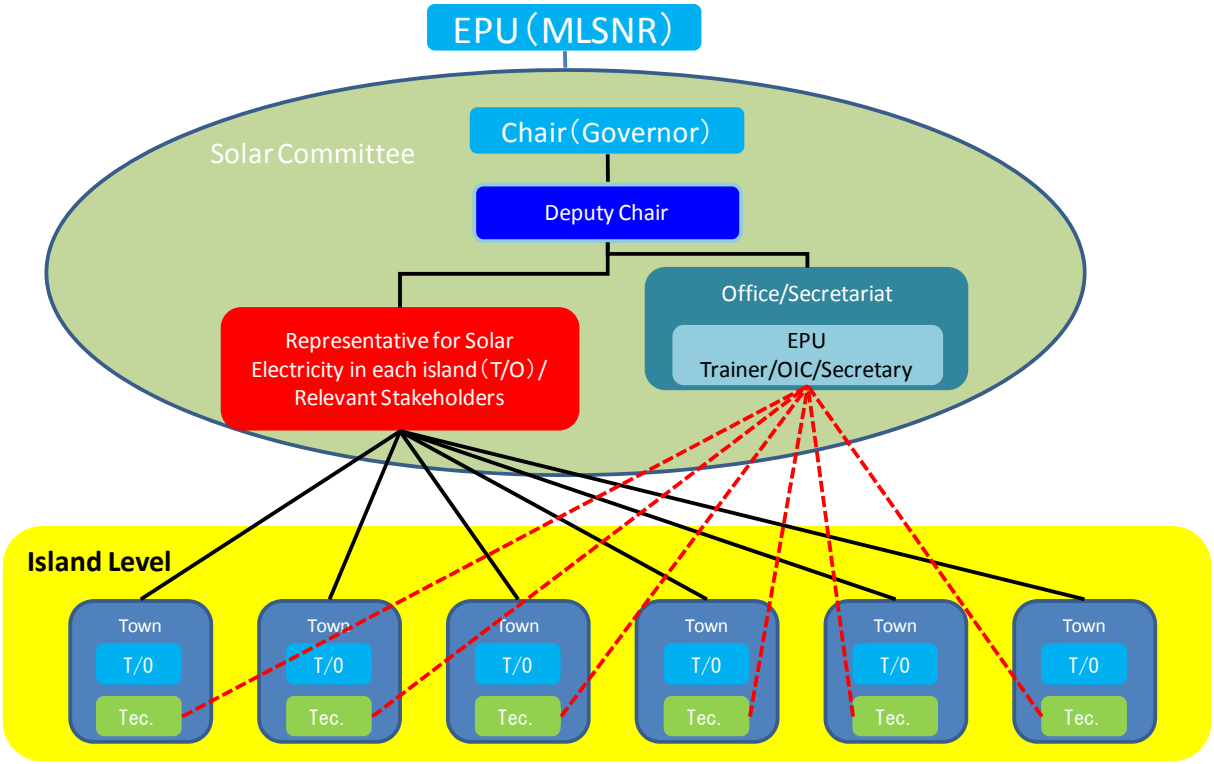


Figure 1 organization Structure of Outer Islands Solar Electricity Society

Tonga side will establish Outer Islands Solar Electricity Society in each islands group. Each Solar Electricity Society will be composed of each governor of islands group, EPU, town officer of each island and 1-2 technicians posted from each islands, and they will plan to implement sharing information, daily maintenance and collection of SHS lease fee. The role of persons concerned is as follows.

- Chairperson (provisional governor): As chairperson of the Solar Electricity Society, he/she shall convene committee meetings and sum up the consensus of the committee.
- EPU Headquarters officer: He/she shall be involved in operation of the Solar Electricity Societies as the Project officer, and shall be responsible for compiling the Solar Electricity Society operating manual and SHS maintenance manual. Moreover, he/she shall periodically grasp the operating condition of the Solar Electricity Societies and offer guidance on improvements when required.
- EPU island group office representative: As operating administrator of the Solar Electricity Society, he/she shall conduct fund and Project management and personnel management regarding the Solar Electricity Society staff and technicians appointed in each island. Also, as trainers, the EPU island group office representatives shall implement training on SHS maintenance for the technicians.
- Town representatives (town officers): They shall grasp the operating condition of SHS and the fund collection situation in each island and report their findings to the operating administrator.
- Technicians: They shall learn SHS maintenance methods via the training implemented by the Solar Electricity Societies, and periodically inspect the SHS operating conditions in each island. Moreover, they shall repair instruments as the need arises.

2. Objectives of the Soft component

It is intended to establish the Project operation and maintenance setup centering on the Solar

Electricity Societies through preparing the Solar Electricity Society operating manual and SHS maintenance manual and supporting activities utilizing those manuals. The superior objective shall be to realize the long-term utilization of the procured SHS following installation.

3 PDM of the Soft component (Draft)

PDM of Soft component is shown as follows.

Table 1 PDM of the Soft component (Draft)

Project title :Project for Introduction of Clean Energy by Solar home system
Duration (Soft component)： March 2011～march 2012 Ver. 0
Target area : Tongatapu Group, Vava'u Group
Target : Officials in charge of EPU head office, Officials of EPU in charge of each islands Group Office, Outer Island Solar Societies and technicians Date : March 2010

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption
Overall Goal Procured SHS will be utilized for a long period after installation.	Usage of SHS (tentatively 10 years after installation of equipment)	Records of repair and maintenance Solar Electricity Society's records	
Project (Soft component) purpose Operation and maintenance system of the Project will be developed around a core of Solar Electricity Society through development of the management manual of SHS operation, maintenance manual and support on the activities using the manuals.	1. Situation of management manual development 2. Situation of SHS operation and maintenance manual development 3. Usage of manual by Society's members.	1. Solar Electricity Society's reports 2. Solar Electricity Society's records 3. Test regarding Manuals contents and questionnaire to the Society's members.	
Outputs 1. Financial management is implemented appropriately by Solar Electricity Society	1-1 Development of financial management manual 1-2 Number of training sessions and degree of understanding regarding financial management 1-3 Situation of financial management	1-1 Financial management manual and situation of the revision 1-2 Record of patrol, results of the supervision 1-3 Balance at the bank and accounting report	
2. Personnel management for officials of the Society and technicians is implemented appropriately by a manager of Solar Electricity Society	2-1 Development of personnel management 2-2 Number of training sessions and degree of understanding regarding personnel management 2-3 Situation of personnel management	2-1 Solar Electricity Society's records 2-2 Record of patrol guidance (including monitoring of understanding degree) 2-3 Working record sheet and periodical report	
3. Annual activity plan is drawn up.	3-1 Number of training sessions for project management and the participants, and degree of understanding 3-2 Situation of drawing up annual activity plan	3-1 Solar Electricity Society's records, interview with training participants 3-2 Solar Electricity Society's annual reports	

4. SHS operation and maintenance manual necessary for technicians is developed.	4-1 Development of operation and maintenance manual 4-2 Number of training sessions for operation and maintenance technology and the participants, and degree of understanding	4-1 Operation and maintenance manual and situation of the revision 4-2 Records of maintenance service and situation of maintenance for existed equipment	
5. Manual for trouble shooting is developed.	5-1 Development of manual regarding trouble shooting 5-2 Number of training sessions for trouble shooting	5-1 Trouble shooting manual and situation of the revision 5-2 Interview with participants of training, records of maintenance service	
6. SHS proper use manual for residents is developed.	6-1 Development of manual to enlighten residents 6-2 Achievement to conduct activity for residents enlightening	6-1 Records of workshop 6-2 Solar Electricity Society's annual reports	
Activity	Input		
1-1 Implement support on development and revision for Solar Electricity Society financial management manual. 1-2 Conduct guidance for financial management. 1-3 Implement financial management based on the manual and conduct the OJT for periodical monitoring. 2-1 Implement support on development and revision for Solar Electricity Society personnel management manual. 2-2 Implement personnel management based on the manual and conduct the OJT for periodical monitoring 2-3 Implement assistance for support system for technicians around a core of EPU trainer. 2-4 Conduct training for trainers and technicians. 3-1 Conduct OJT regarding Solar Electricity Society activity plan. 4-1 Implement support on development and revision for SHS operation and maintenance manual 4-2 Conduct training regarding SHS for technicians and trainers based on the manual.	【Tonga side】 ・ Counterparts ・ Office rooms ・ Expense for soft component activities	【Japan side】 ・ Consultants (Project manager, Organization management, SHS technology)	Disasters which bring to immense damage to SHS will not occur. Pre-condition Tonga side will recognize the importance of long term usage of SHS.

5-1 Implement support on development of manuals for trouble shooting. 5-2 Conduct training regarding trouble shooting for technicians and trainers based on the manual. 6-1 Implement support on development of manuals of activity for residents enlightening. 6-2 Support on implementing activity for residents enlightening.			

Each manual shall include the following contents.

- Solar Electricity Society management manual
  - Fund management/Financial management (balance sheet and document format creation methods, etc.)
  - Labor control/Personnel management (reward system, evaluation system, leadership theory, etc.)
  - Project control (equipment (bulbs, etc.) procurement, stock control, execution plan formulation, etc.)

- SHS Maintenance Manual
  - Basic know-how on photovoltaic power generation and SHS
  - SHS routine inspection methods
  - SHS maintenance methods
  - Methods for teaching SHS use to residents
  - Troubleshooting
  - Monitoring methods

5. Soft Component Activities (Input Plan)

(1) Division of Activities

The soft component activities can broadly be divided as follows: establishment of the soft component implementation setup, support for preparation of manuals, support for on-site implementation guidance using manuals, follow-up of on-site implementation guidance, and reporting on the outputs of activities. The contents of activities for attaining the outputs shown in the soft component draft PDM (section 3) are organized in (5) Contents of Activities.

(2) Inputs on the Tongan Side

① Organizational strengthening of Solar Electricity Societies
Direct targets: EPU headquarters officer, EPU island group office representatives
Indirect targets: Solar Electricity Societies

② Improvement of SHS knowledge and technology
Direct targets: EPU headquarters officer, EPU island group office representatives
Indirect targets: Technicians

(3) Inputs on the Japanese Side

Since many of the SHS instruments to be introduced in the Project are made in Japan, it is scheduled that they will conform to the technical requirements for securing Japanese power

quality. Accordingly, since it is desirable that the parties implementing the soft component in the Project fully understand Japanese guidelines, direct support by a Japanese consultant shall be adopted. Moreover, because the consultant work entailing manual preparation support, implementation guidance support using manuals, and post-implementation monitoring will be implemented intermittently, three consultants, i.e. the general manager and consultants in charge of organizational management and SHS technology respectively, shall be dispatched as required in each stage. The overall M/M of each consultant shall be planned as follows.

- Project manager : 3.5M/M
- Organization management : 6.5M/M
- SHS Technology : 7.5M/M

(4) Roles for persons concerned

Roles for persons concerned in Soft Component are as follows.

Table 2 Division of Roles for persons concerned in Soft Component

Work Area	Japanese Consultant	Tongan Side
Project organization	3 members: Project manager Organization management PV technology	MLSNR: 1~ 2 members Solar Electricity Societies: 1~2 members from each community
Project operating method	Management of the overall progress	Overall work management and actual maintenance
Collected tariffs	Recommendations	Examination and decision
Orientation on the Project contents	Support for staging	Staging
Maintenance manual	Advice	Draft preparation
Maintenance follow-up	Management and guidance	Presentation of results
Fund management and personnel (technicians) management manual, designing of execution plan	Advice	Draft preparation
Fund management and personnel (technicians) management follow-up	Management and guidance	Presentation of results
Report destination	Agencies concerned of Tongan Government	Japanese Consultant

(5) Contents of Activities

1) Establishment of the soft component implementation setup

To ensure the smooth implementation of the activities, orientation shall be conducted to inform the soft component to the related agencies and 13 target islands on the Tongan side, and the setup for acceptance shall be established and coordinated.

Moreover, in order to promote the smooth implementation of the soft component and sustainable operation following completion of the soft component, a Soft Component Committee composed of members of the EPU, Solar Electricity Societies and consultant shall be established in order to gauge progress of the soft component, exchange opinions and discuss issues.

2) Support for preparation of manuals

① Organizational strengthening of Solar Electricity Societies

Support will be given for preparation of the Solar Electricity Society operating manual by the Solar Electricity Societies. The contents will be as indicated in the soft component draft PDM (section 3).

② Enhancement of SHS knowledge and technology

Support will be given for preparation of the SHS maintenance manual by the Solar Electricity Societies. The contents will be as indicated in the soft component draft PDM (section 3).

3) Support for on-site implementation guidance using manuals

① Organizational strengthening of Solar Electricity Societies

Training on committee running and organizational strengthening will be implemented for the Solar Electricity Societies in each island group based on the Solar Electricity Society operating manual.

② Enhancement of SHS knowledge and technology

Training for enhancement of knowledge and technical capability targeting the EPU trainers and technicians will be implemented for the Solar Electricity Societies in each island group based on the SHS maintenance manual.

Moreover, the islands where the technicians live are all located in remote islands and it will not be possible to conduct training in each island. Therefore the training shall be implemented over two stages to ensure greater efficiency and effectiveness, i.e. initial training targeting all technicians conducted in Vava'u main island and training of trainers dispatched by the EPU. First, two technicians to take part in the initial training will be selected from each island, and training comprising basic lectures on SHS maintenance and simple implementation guidance using equipment will be implemented. After that, training for the EPU trainers will be implemented using actual SHS equipment.

4) Follow-up of on-site implementation guidance

① Organizational strengthening of Solar Electricity Societies

The operating condition of the Solar Electricity Societies in each island group will be confirmed from the perspectives of fund management, labor management and project control, and in addition to offering guidance and advice to the Solar Societies, technical follow-up centering on monitoring techniques will be conducted for the EPU officers to ensure that technology can be passed on following completion of the soft component. Also, support will be offered for revision of the Solar Electricity Society operating manual as required.

② Enhancement of SHS knowledge and technology

Conditions of training by EPU trainers for technicians in each island will be confirmed, and in addition to offering guidance and advice to the trainers, technical follow-up centering on monitoring techniques will be conducted for the Solar Electricity Societies to ensure that technology can be passed on following completion of the soft component. Also, support will be offered for revision of the SHS maintenance manual as required.

5) Report on the activities output

The Consultant will confirm the activities outputs, summarize the outputs and future problems and report them to the agents concerned.

6 Soft Component implementation progress

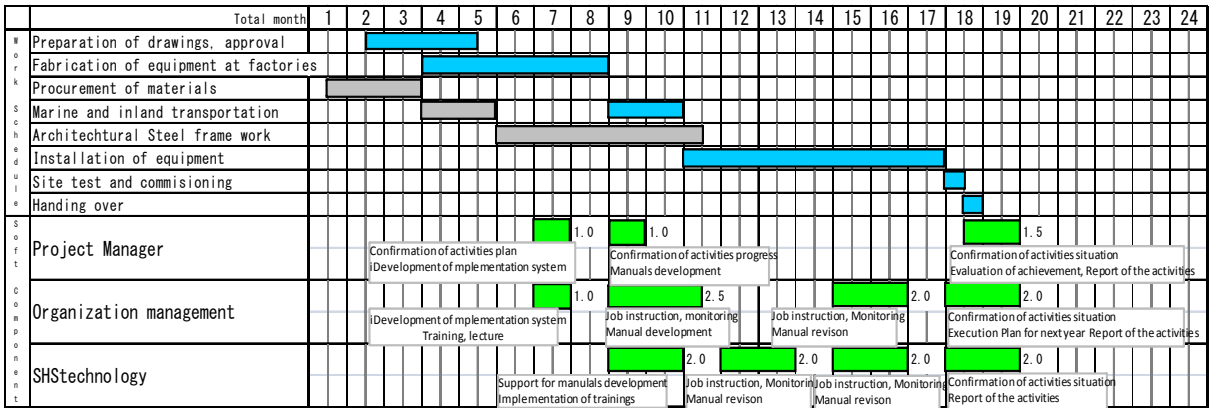
Soft Component will be 2 phases “Organization strengthening of Solar Society” and “knowledge and technical improvement regarding SHS”, and Japanese side will post 2 consultants in charge of “organization management” and “SHS technology” in each phase. Moreover Japanese side will post “Project manager” for management of whole progress, negotiation with agents concerned, support for other consultants, summary of whole activities and their evaluation.

Japanese side sort Whole progress of Soft Component in table 4, and relation between whole progress of the Project and progress of the soft component in table 3.

Table 3 Whole Implementation schedule of Soft Component

	Guidance on Organization	Guidance on SHS Technology
Preparation for implementation of Soft Component	・ Coordinate agents concerned regarding preparation for implementation of the Project ・ Grasp technical level of the necessary personnel ・ Analyze account document in the past	・ Coordinate agents concerned regarding preparation for implementation of the Project ・ Grasp technical level of the necessary personnel ・ Support to develop manuals
Input	Project Manager：0.25MM Organization Management：1.00MM	Project manager：0.75MM
<Development of manuals, and Lectures>	・ Develop operation and management manuals ・ Conduct lectures on financial management (fund ledger management), human resources management, leadership	・ Develop operation and maintenance manual ・ Basics of electric circuitry, SHS basic knowledge, Handling of solar energy, Estimation of generated electric power, Characteristics and specifications of main instruments, SHS maintenance, Properties and handling of storage batteries, Instrumentation and handling of operation data, etc.
Input	Project manager：0.50MM Organization management：2.50MM	Project manager：0.25MM PV technology：1.00MM
<Trainer certification>	・ Trainer certification will not be carried out in particular.	・ Implement an assessment examination for trainees (candidate trainers) who sit the lectures and hands-on training and recognize the successful candidates as trainers.
Input		Project manager：0.50MM PV technology：0.50MM
<Hands-on training or on-the-job training>	・ Conduct practical routing of fund management and human resources management (labor affairs management of local technicians) equipment stock management and monitoring of the execution plan.	・ SHS composition visual checking, Usage of measuring instruments, Acquisition and evaluation of operating data during normal operation, Confirmation of disparities between normal PV

		modules and abnormal PV Modules, PV module installation conditions and output confirmation, Storage battery liquid level confirmation method and conditioning method, Storage battery discharge state confirmation (specific gravity measurement, terminal voltage measurement, etc.), Continuous operation (over days) data acquisition and evaluation method, Operating status confirmation and evaluation method during bad weather (by covering the module, etc.), etc.
Input	Organization management : Total 3.25MM（2 times）	PV technology：Total4.50MM（3 times）
Final Report	・ Check the output. The activity report making to the organizations concerned including the future issues and report	・ Check the output. The activity report making to the organizations concerned including the future issues and report
Input	Project manager：0.75MM Organization management：0.50MM	Project manager：0.75MM PV technology：0.50MM



＊Concerning the progress report, present to the client following completion of each process.

Figure 2 Proposed schedule for the implementation of Soft Component

7 Outputs of the Soft Component

The following outputs will be obtained from implementation of the soft component:

1) Records of the orientation
2) Records of opening of the soft component committee's meetings
3) Progress reports (submitted in each progress)
4) Operation and Maintenance manual of Solar Society (English and local language)
5) Financial management report
6) Work management report (including the report for the work implementation conditions of technicians)
7) An understanding degree confirmation reports (test results)
8) Result of interview survey to actual maintenance manager and actual work evaluation

8 Estimation cost for the soft component

Cost for the soft component is estimated in 49,700,000 yen.

9 Responsibilities of the Counterpart Agency

1) EPU will establish the Soft Component Committee to cooperate for the smooth implementation promotion of the soft component in collaboration with the Solar Electricity Society in each island group.
2) EPU will prepare work rooms, etc. necessary for implementing the soft component upon coordinating with the Solar Electricity Societies in each island group.
3) EPU and the Solar Electricity Societies in each island group will provide the manpower necessary.
4) EPU and the Solar Electricity Societies in each island group will revise operation and maintenance manual voluntarily discussed with the consultant.
5) Solar Electricity Societies in each island group implements the fund management collected from residents for SHS use to introduce under management of EPU based on the proposal of the consultant adequately.
6) Solar Electricity Societies in each island group implements the work management of the technician adequately.
7) The technicians in each community maintain of SHS based on the operation and maintenance manual adequately.
8) EPU and Solar Electricity Societies in each island group submit reports of financial management work management to a Japanese consultant periodically in the fixed period of time.

6. OTHER RELEVANT DA

6. LIST OF ACQUIRED REFERENCE MATERIALS AND DATA

No.	Name	Form Book/Video/Map/ Photograph etc.	Original/Copy	Issue Organization	Issue Year
1	Tonga 2006 Census of Population and housing, Volume 1: Administrative Report and Basic Tables	Book	Copy	Tongan Statistics Department	2008
2	Tonga 2006 Census of Population and housing, Volume 2: Analytical Report	Book	Copy	Tongan Statistics Department	2008
3	Statistical Abstract - 2006	Book	Copy	Tongan Statistics Department	2006
4	Report on the Household Income and Expenditure Survey	Book	Copy	Tongan Statistics Department	2002
5	Community Based Information	Book	Copy	Mainstreaming of Rural Development Innovation in the Kingdom of Tonga	
6	Participatory Learning and Action Report	Book	Copy	Mainstreaming of Rural Development Innovation in the Kingdom of Tonga	2007
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