KWAJALEIN ATOLL JOINT UTILITY RESOURCES
THE REPUBLIC OF MARSHALL ISLANDS

FINAL REPORT ON THE PREPARATORY SURVEY FOR THE PROJECT FOR INSTALLATION OF SOLAR ELECTRICITY GENERATION SYSTEM IN EBEYE ISLAND

OCTOBER 2017

JAPAN INTERNATIONAL COOPERATION AGENCY

ORIENTAL CONSULTANTS GLOBAL CO., LTD.
KYUSHU ELECTRIC POWER CO., INC.

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Summary

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Country Overview

The Republic of Marshall Islands (herein referred as “RMI”) has 34 atolls of 1,156 islands having a land area of about 181.3 square kilometers. The RMI has an estimated population of 53,134 inhabitants. About 27,797 of the islanders live on Majuro, where the country’s capital city is located. The population density is of 295 per km^2.

The RMI has a high dependency on fossil fuels for energy generation, and almost all of the electricity supply (99%) depends on diesel generation using imported fuel (Office of Insular Affairs (2013). This situation represents a thread for the energy security of the RMI as well as a burden for the country’s trade balance. In order to improve this situation, in September of 2009, the RMI established “The National Energy Policy and Energy Action Plan (herein after referred to as NEPEAP)”, aiming to cover 20% of power supply with renewable energy sources by 2020.

At the moment, the introduction of PV systems is advancing in the capital city, Majuro, but in order to achieve the above mentioned energy goal, it is necessary to introduce renewable energies into other areas of the country. This project promotes the introduction of a Solar Electricity Generation System (hereinafter referred to as "PV system") in Ebeye Island, which accounts for 21% of the population of the country and has not yet adopted renewable energy. At the same time, in Ebeye Island more than 80% of the water supply depends on seawater desalination equipment managed by the Kwajalein Atoll Joint Utilities Resources (hereinafter referred to as "KAJUR"). Stable supply of electricity is important for the equipment used for water desalination. Because of this situation, the introduction of another electric power supply other than diesel power generation will help to provide energy and water security to all the citizens of the Island.

The RMI has a tropical climate and is hot and humid through the year. The annual average temperature of Kwajalein, located near to Ebeye Island, is of 28 ℃, which is almost constant around the year.

The domestic market is small and geographically far from the international market. The main industries are fishery, agriculture, traditional crafts and tourism. Nearly all major industries and services are operated by public enterprises.

The Gross National Income (GNI) of the RMI is of 230 million US Dollars with a GNI per capita of 4,390 US Dollars. The inflation rate in 2014 was of 0.9%. With an economic growth rate of 1%, the main contributors to the GDP are the following industries: agriculture 19.9%, industry 11.3% and services 68.7% (World Bank: World Development Indicator 2014).

Project background and general overview

The RMI has a high dependency on fossil fuels for energy generation, and almost all of the electricity supply depends on diesel generation using imported fuel. This situation represents a

thread for the energy security of the RMI.

In this context, the development program research (Technical cooperation) "Project on the Formulation of Self-Sufficient Energy Supply System (2013-2015)" conducted by JICA suggested that the installation of the photovoltaic power generation system in Ebeye Island is an effective way to promote and increase the rate of renewable energy and get a stable energy supply. Following this recommendation, the government of the RMI positioned the "Ebeye Island Solar Power Generation System Development Plan" (herein referred as "this project") as promoting the NEPEAP and requested grant aid assistance to the Japanese Government in May 2016 for the construction of a PV system of 600kW.

Outline of the survey and contents of the project

After the request from the RMI, the Government of Japan decided to conduct a preparatory survey in charge of the Japanese International Cooperation Agency (JICA) from July 7th to 22nd of 2016 (First site survey). For this stage, the study team conducted the site survey with the cooperation of the Ministry of Resources and Development (MRD), The Ministry of Public Works (MPW), The Marshall Energy Company (MEC), The Environmental Protection Agency (EPA), and the Kwajalein Atoll Joint Utility Resources (KAJUR).

Based on the information gathered by the first site survey, the condition of the interconnection lines and the possibility to introduce a new power generation were confirmation.

A month later, from August 29th to September 11th, the second site survey was carried out. The study team examined the site to find out the capacity and scale for this project in consultation with the Marshall's side. After this, the study team carried out the schematic design and compiled the results in the preparatory survey report.

From July 9th to July 23rd of 2017, the study team carried out the outline design onsite, together with the project design and confirmation of the executing agency.

The outline of the project is as follows;

Outline of the Project

Equipment procurement for PV system		
Equipment	Use of power generated	Importance
PV system	To interconnect and supply the power generated by sunlight.	Energy security in the RMI is very weak and the country has an aggressive target to achieve a 20% share of renewable energy by 2020.
Technical assistance for the PV system (Soft Component)		
Technical assistance	Training on basic technical knowledge of PV systems and on the operation and maintenance, including inspection and troubleshooting.	KAJUR has no experience with PV systems. In order to address the technical transfer for the operation and management of the proposed system, the implementation of technical assistance will provide the basic standards and rules for its correct operation.

Project evaluation

1. Consistency with Marshall Island's National Policy

The RMI established the National Energy Policy and Energy Action Plan (NEPEAP) in September 2009, aiming to cover 20% of power supply with renewable energy sources by 2020. The installation of the PV system introduced in this project is aligned with NEPEAP objectives and will contribute to the achievement of its energy targets.

2. Consistency with JICA's Cooperation Policy

The Japanese Development Cooperation Policy for the RMI (December 2012) has established "Overcoming Vulnerabilities" and "Environment and Climate Change" as priority areas for its assistance.

Infrastructure development to strengthen the economic growth is part of the "Overcoming Vulnerabilities" and climate change countermeasures are part of the "Environment and Climate Change" priority.

This project is also consistent with JICA's Country Analysis Paper (December 2012) for the Pacific region, where it was mentioned the importance of projects related to the maintenance of the lifeline facilities of energy for the RMI.

3. Reduction of CO_2 due to power generation with renewable sources (Quantitative results)

As a result of the introduction of renewable power sources, it is possible to increase the amount of power generated and to reduce CO_2 emissions at the same time.

Expected Power Generation and CO_2 reductions

Item	Base value (2017)	Goal value (2022) (3 years after project completion)
System Capacity (kW)	0	600
Annual energy generation (Net generation) (MWh/year)	0	707.3
Diesel reduction (kL/year)	0	170
Expected reduction of CO_2 (tCO_2/year)	0	441

4. Renewable energy expansion (Qualitative results)

It will be the first time for Ebeye area to install a grid connected PV system. This project is considered as an example for the spreading of renewable energies across the country.

Additionally, the soft component of this project will contribute to the development of a group of professional technicians in charge of performing maintenance management and troubleshooting technology transfer related to grid interconnected photovoltaic power generation system.

5. Environmental awareness (Qualitative results)

Technology transfer related to the improvement of the environmental awareness will be provided as part of the soft component. Additionally, the design of this project will allow visitors, such as tourists, children and students to visit the PV system, so it is expected to raise the environmental awareness of all society members.

Based on the reasons stated above, the validity of this project is high and its implementation is expected to succeed.

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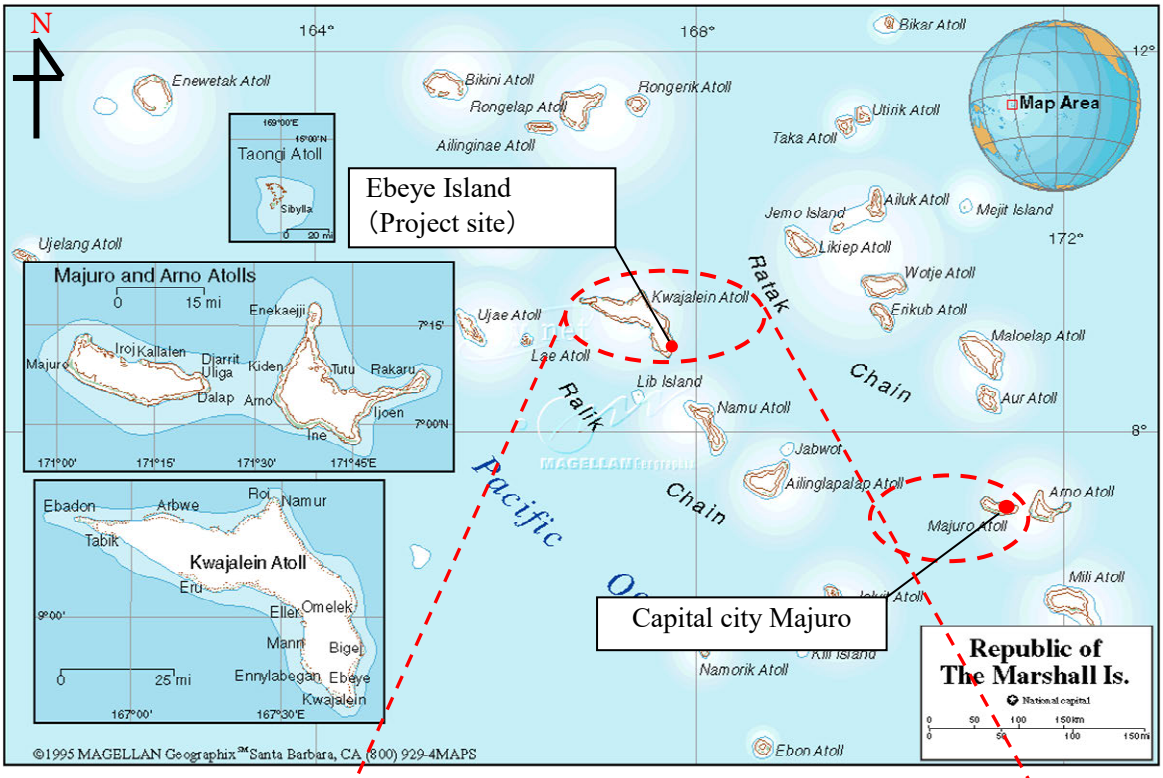
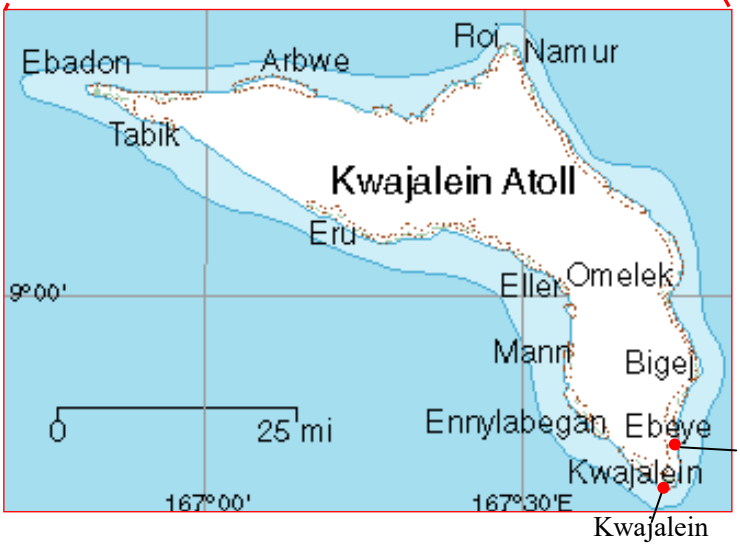
Annexes





Source : MEC website

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Abbreviations

	Abbreviation	Original Word
A	ASTM	American Society for Testing and Materials
B	BS	British Standard
C	CMI	College of the Marshall Island
E	EMS	Energy Management System
	E/N	Exchange of Notes
	EPA	Environmental Protection Agency
	EU	European Union
G	G/A	Grant Agreement
	GNI	Gross National Income
H	HMI	Human Machine Interface
I	IEC	International Electrotechnical Commission
	IRENA	International Renewable Energy Agency
J	JICA	Japan International Cooperation Agency
	JASS	Japanese Architectural Standard Specifications
	JIS	Japanese Industrial Standards
	JEM	Japan Electrical Manufacturers' Association
	JEC	Japanese Electrotechnical Committee
	JCS	Japanese Cable Makers' Association Standard
	JEA	Japan Electric Association
K	KAJUR	Kwajalein Atoll Joint Utility Resources
L	LAN	Local Area Network
M	MEC	Marshall Energy Company
	MPW	Ministry of Public Works
	MRD	Ministry of Resources and Development
	MWSC	Marshall Water and Sewage Company
N	NEPEAP	National Energy Policy and Energy Action Plan
	NOAA	National Oceanic and Atmospheric Administration
P	PV	Photovoltaic
	PCS	Power Conditioning System
S	SOC	State of Charge
V	VAT	Value-added tax

Chapter 1 Background of the Project

Chapter 1 Background of the Project

1-1 Background and outline of the Japanese Grant Aid

1-1-1 Background of the request

The Republic of Marshall Islands (herein referred as “RMI”) has a high dependency on fossil fuels for energy generation, and almost all of the electricity supply depends on diesel generation using imported fuel. This situation represents a thread for the energy security of the RMI. In order to improve this situation, the RMI established “The National Energy Policy and Energy Action Plan (herein after referred to as NEPEAP)” in September 2009, aiming to cover 20% of power supply with renewable energy sources by 2020.

In this context, the development program research (Technical cooperation) “Project on the Formulation of Self-Sufficient Energy Supply System (2013-2015)” conducted by JICA suggested that the installation of the PV system in Ebeye Island is an effective way to promote and increase the rate of renewable energy and get a stable energy supply. Following this recommendation, the government of the RMI positioned the "Ebeye Island Solar Power Generation System Development Plan" (herein referred as “this project”) as promoting the NEPEAP and requested grant aid assistance to the Japanese Government.

1-1-2 Outline of the request

The requested components (May 2016) from the RMI to Japanese Government are as follows;

1)- PV system (generation capacity 600 kW), control system, storage battery etc.	1 set
2)- Consulting services	1 set
3)- Soft component	1set

1-2 Natural Conditions

Located near the equator in the Pacific Ocean, the RMI has a marine tropical climate with high-temperature and humidity levels throughout the year. The temperature in Kwajalein Island, near where Ebeye Island is situated, and the rainfall levels are shown in the tables below. Annual rainfall amount is about 3,338mm, and is higher than the average annual rainfall amount in Japan (1,718mm).

Table 1-1 Climate in Kwajalein Island in 2015

Month/Item Category	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
Average daily maximum temperature (℃)	30.2	30.3	30.1	30.6	30.5	31.1	30.8	30.4	30.5	30.3	30.8	N/A	30.5
Average daily minimum temperature (℃)	26.0	25.8	25.3	25.3	25.7	26.4	25.8	26.0	26.2	25.3	26.0	N/A	25.8
Average temperature (℃)	28.1	28.1	27.7	28.0	28.1	28.8	28.3	28.2	28.4	27.8	28.5	N/A	28.2

Source: National Oceanic and Atmospheric Administration

Table 1-2 Average Rainfall in Ebeye Islands from 2000 through 2012

Month	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	Average
Mean rainfall (mm)	219.4	184.1	185.1	270.4	279.3	270.8	285.6	307.7	318.1	362.2	357.1	298.8	278.2

Source: World Weather Online

According to NOAA records, during the last 30 years the strongest wind registered was of 36.6m/s. In general, the wind blows from the east.

Table 1-3 Wind Force (Data of the Last 30 Years)

Month	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
Mean wind speed(m/s)	7.9	7.7	7.5	7.1	6.7	6.3	5.2	4.4	4.0	4.3	5.7	7.5
Maximum instantaneous wind velocity (m/s)	29.5	21.5	19.6	21.0	22.8	30.8	20.5	29.9	21.4	23.7	36.6	28.6
Wind direction	East	East	East	East	East	North-east	South-east	East	East	North-east	North-east	East
Year	1988	1997	1999	2002	2003	2002	1988	2000	1995	1985	1991	2000

Source: National Oceanic and Atmospheric Administration

1-3 Social and Environmental Consideration

Based on JICA's Environmental and Social Consideration Guideline (April 2010), the PV system to be installed by this project, whose generation capacity is of 600kW, is not thought to produce large impacts on the environment. As a result, this project is categorized as "Category C" with which environmental reviews can be skipped after the screening.

1-3-1 Environmental and social considerations of the recipient country

The Environmental Protection Agency (EPA) is the regulatory agency of the project in terms of environment and social considerations. The environmental laws and regulations considered relevant to this project are shown in Table 1-4.

Table 1-4 Environmental Laws and Regulation

Related area	Regulation name	Year
Environmental Impact Assessment	Environmental Impact Assessment Regulations	1994
Civil engineering related regulations	Earthmoving Regulations	1989
Waste related regulations	Solid Waste Regulations	1989

According to the Environmental Impact Assessment Regulations, the business operator shall submit the earthmoving application to the EPA. The EPA will charge the project with the following application cost: 1% of the construction cost or 5,000 US Dollars if the 1% exceeds that number.

This procedure will be carried out by KAJUR. The figure below shows the EPA's flow for the environment examination.

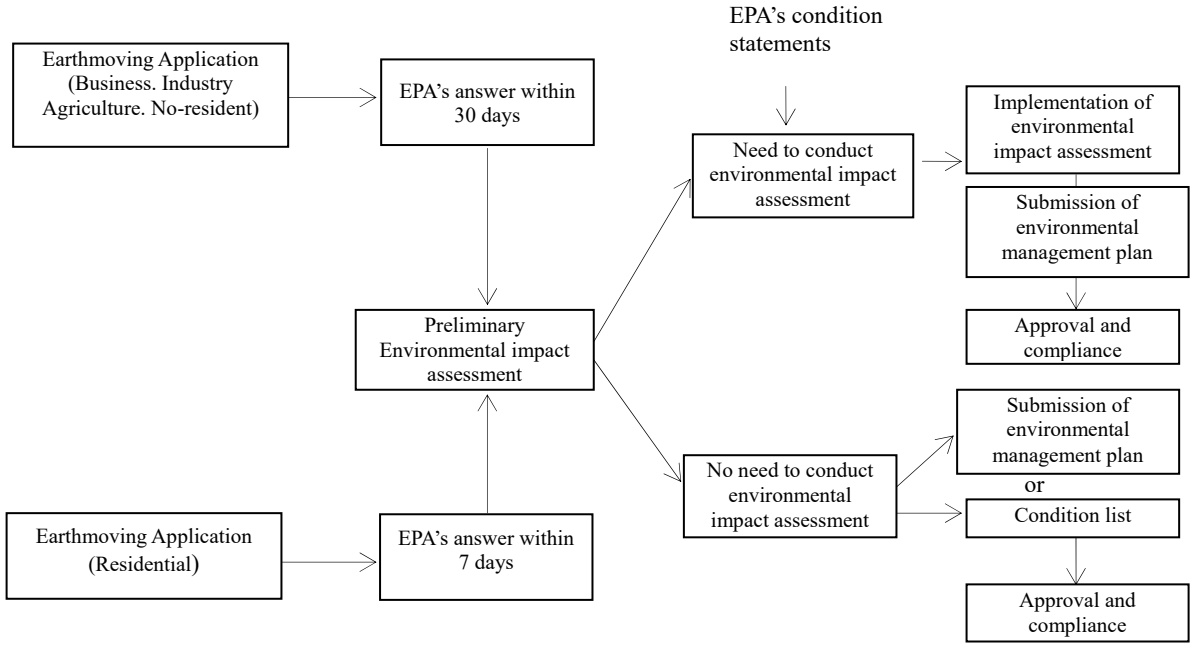


Figure 1-1 Environment examination flow

1-3-2 Comparative study of alternatives (including zero option)

This project proposed the construction of a PV system in the past KAJUR's rainwater reservoir site in Ebeye Island. In Ebeye Island, the storage of rainwater is unnecessary, the water supply is guaranteed by seawater desalination. Because of this situation, together with KAJUR, we hope to introduce a PV system into the site of the former rain water reservoir, to ensure stable supply of electricity plus a reduction of fuel consumption. There is no other place available inside Ebeye Island for the PV system project with 600 kW.

If the "zero option" is selected, it is expected that KAJUR will continue to use the diesel generators, which will affect the stable supply of electricity. For this reason, the selection of the "zero option" is not recommended.

1-3-3 Scoping

Scoping was conducted based on standards for environmental and social evaluation. The following table shows the reasons for evaluation of each item and a preliminary impact evaluation. The impact evaluation results are separated between positive (beneficial) and negative (adverse) with 4 ranking grades of A, B, C and D.

Table 1-5 Results of the Scoping for the PV system in Ebeye Island

Classification	Environment and Social items	Impact Evaluation		Reasons for Evaluation
		Construction Stage	Operation and Maintenance Stage	
Environment quality and pollution control	Air quality	B-	D	Construction Stage: It is assumed that dust and gas emissions will be generated as a result of the construction and transportation during this stage. Operation and Maintenance Stage: The air pollution during this stage is insignificant.
	Water quality	B-	D	Construction Stage: Seawater pollution is expected. Operation and Maintenance Stage: The water pollution during this stage is insignificant
	Waste	B-	B-	Construction Stage: Waste generation from the construction and from the vehicles used for transportation (e.g. tires) is expected. Operation and Maintenance Stage: Inappropriate disposal of battery system after lifespan represents a problem. Dumping without previous recycling of the materials of the batteries and wasted cables may cause health hazards to residents and adverse effects on the surrounding ecosystems.

Classification	Environment and Social items	Impact Evaluation		Reasons for Evaluation
		Construction Stage	Operation and Maintenance Stage	
Environment quality and pollution control	Soil contamination	D	B-	Construction Stage: The soil contamination levels of this project are insignificant Operation and Maintenance Stage: Inappropriate disposal of battery system after lifespan represents a problem. Dumping without previous recycling of the materials of the batteries and wasted cables may cause health hazards to residents and adverse effects on the surrounding ecosystems.
	Noise and vibration	B-	D	Construction Stage: Noise and vibration levels are expected to increase, especially due transportation and construction. Operation and Maintenance Stage: The noise and vibration levels of this stage are insignificant
	Ground subsidence	D	D	The ground subsidence level of this project is insignificant.
	Smell pollution	D	D	The smell pollution level of this project is insignificant.
Natural Environment	Protected areas	D	D	This project does not represent a thread to protected areas
	Ecosystem	D	B-	Construction stage: This project has no influence on the ecosystem balance. Operation and maintenance: Inappropriate disposal of battery system after lifespan represents a problem. Dumping without previous recycling of the materials of the batteries and wasted cables may cause health hazards to residents and adverse effects on the surrounding ecosystems.
	Hydrology	D	D	This project has no influence on the hydrology.
	Topography and Geology	D	D	This project has no influence on the Topography and Geology.
Social Environment	Resettlement	D	D	No requirement for resettlement of the population.
	Livelihood	D	D	Changes in the livelihood are not expected.
	Cultural Heritage	D	D	There are no cultural heritage sites in or around the vicinity of project area.
	Landscape	D	D	As the proposed system will be near the rainwater reservoir site, no deterioration of the landscape is expected.
	Ethnic minorities, indigenous peoples	D	D	There are no indigenous people in or around the vicinity of project area.

Classification	Environment and Social items	Impact Evaluation		Reasons for Evaluation
		Construction Stage	Operation and Maintenance Stage	
Social Environment	Working environment	B-	B-	Construction Stage: Working environment is very important in order to ensure workers safety. Operation and Maintenance Stage: Working environment is very important in order to ensure workers safety.
Other factors	Accidents	B-	B-	Construction Stage: During this stage it is very important to prevent accidents. Operation and Maintenance Stage: Accident prevention is very important in order to ensure workers safety.
	Transboundary impact and climate change	B-	D	Construction Stage: The emissions of CO_2 expected in this project will come from the diesel consumption due to operation and use of heavy construction equipment. Operation and Maintenance Stage: For solar power generation there are no CO_2 emissions.

Legend:

A+/- : Significant positive/ negative impact is expected.

B+/- : Positive/ negative impact is expected to some extent.

C+/- : Extent of positive/ negative impact is unknown. (further examination is needed, and the impact could be clarified as the study progresses)

D : No impact is expected.

As a result of the above scoping results, the most adverse effects are consequence of the implementation of the PV system in the short-term, basically confined to the construction/installation stage of the project, and could be managed with the adoption of good construction/installation practices. For the reason of the absence of population resettlement requirements there are no highly significant social issues involved.

1-3-4 Environmental and Social Survey Results

The table below shows the results of a comparative evaluation based on the inspection and interviews during the field study.

Table 1-6 Comparative Evaluation on Results of Scoping

Item		Impact by Scoping		Impact based on Study Results		Reason for Evaluation
		Construction Stage	O/M	Construction Stage	O/M	
Environmental Quality and Pollution Control						
1	Air Pollution	B-	D	D	D	Construction Stage: Study results show that air pollution will be smaller than expected. In this case, the impact of the project will be insignificant, that is why the impact assessment changed to D.
2	Water Pollution	B-	D	B-	D	Construction Stage: A small batch plant for concrete was necessary for the civil engineering work, so it was necessary to take measures necessary for water pollution, and the impact assessment was maintained.
3	Waste	B-	B-	D	B-	Construction Stage: Study results show that contamination is smaller than initially assumed, and it seems that it is hardly a problem, therefore the impact assessment changed to D. Operation and Maintenance: Appropriate measures are required to mitigate the environmental and social risks of the battery system of the project
4	Soil	D	D	D	D	
5	Noise and vibration	B-	D	D	D	Construction Stage: Study results show that noise and vibration will be smaller than expected. In this case, the impact of the project will be insignificant, that is why the impact assessment changed to D.
6	Ground subsidence	D	D	D	D	
7	Smell Pollution	D	D	D	D	
Natural Environment						
8	Protected areas	D	D	D	D	
9	Ecosystem	D	D	D	D	
10	Hydrology	D	D	D	D	

Item		Impact by Scoping		Impact based on Study Results		Reason for Evaluation
		Construction Stage	O/M	Construction Stage	O/M	
11	Topography and Geology	D	D	D	D	
Social Environment						
12	Resettlement	D	D	D	D	
13	Livelihood	D	D	D	D	
14	Cultural heritage	D	D	D	D	
15	Landscape	D	D	D	D	
16	Ethnic minorities, indigenous peoples	D	D	D	D	
Others						
17	Working environment	B-	B-	B-	B-	Working environment is very important. The impact assessment was maintained because it is needed to take necessary measures to secure working environment and occupational safety.
18	Accident	B-	B-	B-	B-	The impact assessment was maintained because it is needed to take necessary measures to prevent accidents
19	Transboundary impact and climate change	C-	D	D	D	Construction Stage: Study results show that diesel consumption of the project is lower than expected as well as potential gas emissions that is why the value of the impact assessment was maintained.

Legend:

A+/- : Significant positive/ negative impact is expected.

B+/- : Positive/ negative impact is expected to some extent.

C+/- : Extent of positive/ negative impact is unknown.(A further examination is needed, and the impact could be clarified as the study progresses)

D : No impact is expected.

Regarding the disposal of lead–acid battery

The Government of Marshall Islands, together with some international environmental organizations like the Secretariat of the Pacific Regional Environment Programme (SPREP) with assistance of the EU, is carrying out studies in order to ensure the collection of lead acid batteries. The Recovery of lead acid batteries is done at 35 cents per kg by a municipal waste collection company called Majuro Atoll West Company (MAWC). MAWC is under jurisdiction of the Ministry of Public Works (MPW), an organization based on the local government of Majuro Atoll. The lead acid batteries are collected by MAWC and the Majuro Electric Company (MEC) responsible of the final disposal and exports of materials.

According to the General Manager of MEC, Mr. Jack Chong Gum, the recovery of lithium-ion batteries is not done by this company. However, as the market is growing fast, recovery will be necessary very soon. MEC thinks that the recovery of these batteries will be under its responsibility.

E-waste Workshop

Collection and storage of Batteries

1-3-5 Impact evaluation

The environment and social impacts resulting from the construction and operation of this project corresponds to a category where the potential negative effects can be prevented by environmental management such as mitigation measures and monitoring methods.

Chapter 2 Contents of the Project

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

The RMI has a high dependency on fossil fuels and more than 99% of the electricity supply depends on diesel generation using imported fuel (Office of Insular Affairs 2013). This situation represents a threat to the economy and energy security of the country as fuel prices are unstable and transportation costs are very high. In order to improve this situation, The RMI established "The National Energy Policy and Energy Action Plan (herein after referred to as NEPEAP)" in September 2009, aiming to cover 20% of power supply with renewable energy sources by 2020.

Presently, the installation of PV systems is gradually making progress especially in Majuro. However, Ebeye Island has still not improved its renewable energy situation. This project is aligned with NEPEAP objectives and will contribute to the achievement of its energy targets.

This project aims to contribute to the continuous economic growth and counterplan against climate change in Marshall Islands. To achieve this target, Ebeye Island will install a PV system through a grant aid provided by Japan. The use of renewable energy in Ebeye Island will help to stabilize the power supply and reduce the consumption of fossil fuels.

In order to achieve the project objective mentioned above, equipment and materials for the PV system will be procured and technical assistance for the operation and maintenance will be provided.

Table 2-1 Outline of the project

Equipment procurement for PV system		
Equipment	Use of power generated	Importance
PV system	To interconnect and supply the power generated by sunlight.	Energy security in the RMI is very weak and the country has an aggressive target to achieve a 20% share of renewable energy by 2020.
Technical assistance for the PV system (Soft Component)		
Technical assistance	Training on basic technical knowledge of PV systems and on the operation and maintenance, including inspection and troubleshooting.	KAJUR has no experience with PV systems. In order to address the technical transfer for the operation and management of the proposed system, the implementation of technical assistance will provide the basic standards and rules for its correct operation.

2-2 Outline Design of the Project

2-2-1 Design Policy

2-2-1-1 Basic Policy

1) Implementation of the system

The components of the outline designs of the PV system were discussed with KAJUR, concluding that a system that does not affect the operation of the existing diesel power plant shall be constructed. This system will have a battery system that will prevent the instability of the power generated by solar sources.

The PV system will be connected with the existing grid and the diesel power generation facilities. The components of the project are the following ones: 1) PV panel system 2) Battery system 3) Energy Management System (EMS) 4) Grid connection facilities.

The system to be constructed is shown by the figure below:

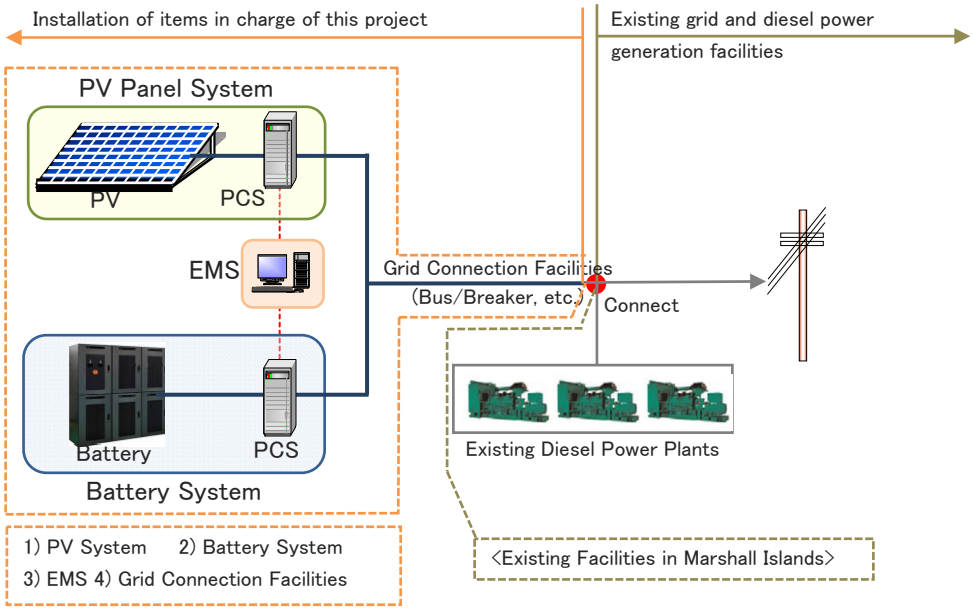


Figure 2-1 Outline of the PV System

2) Installation Site

The PV system will be installed in the past rainwater reservoir site of KAJUR, at the southern tip of Ebeye Island. It was found that it is needed to consider the risk of high tides. According to studies made by The National Oceanic and Atmospheric Administration (herein after referred to NOAA), during the last 30 years, the highest tide registered was of 4.71m (September 1st of 1988). NOAA's predictions suggested that for the next 50 and 100 years, waves of around 5.41m and 6.55m respectively are expected.

Consequently, a frame structure of 5.5m above the sea level (4.6m in ground height) which exceeds the predicted highest tide for the next 50 years will be installed in this project, and the PV panels will be installed over it. Additionally, some parts of the east and southeast surface which are the nearest to the shore will have parapets served as seawalls, they will secure 6.8m (frame structure plus 1.3m) above the sea level that exceeds the predicted tallest sea wave for the next 100 years.

The design of the project will be based on the basic policies stated bellow:

a) Basic components of the PV System

The PV system consists of plural units with two buses for each set, considering security measures in case a defect were to happen, ensuring power supply from the PV system. The PV system to be installed will be connected to the existing diesel generator and to the existing generation line.

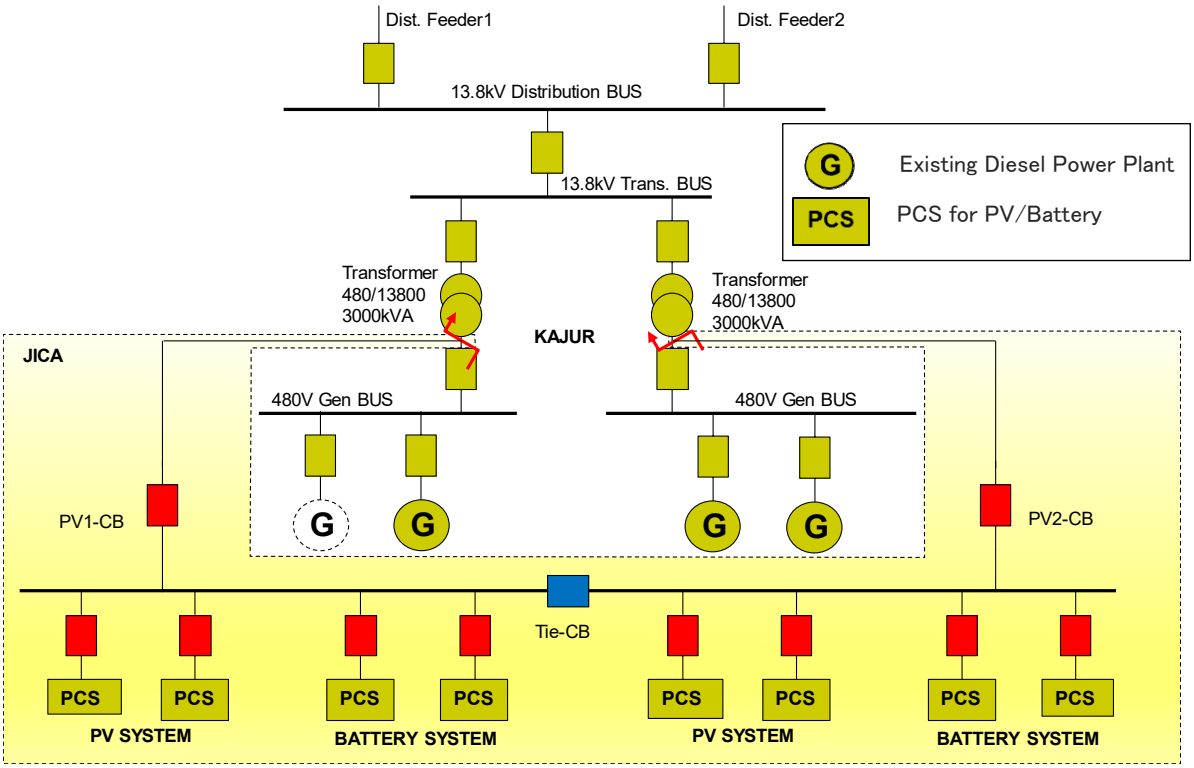


Figure 2-2 Components of the PV System

b) Basic Policy for the frame structure

As mentioned above, the frame structure will installed, and the PV system will be placed over in order to prevent damages produced by high potential sea waves. The basic policies for the installation of the body frame and control room are the following ones:

The PV modules will be installed on the upper part of the body frame. The lower part of the frame shall have free space considering the lighting, and the ventilation.

1. Ensure proper drain.
2. Consider the safety of people, as visitors will be welcome to see the PV system.
3. Consider the existing building design in order to ensure harmony with other facilities of KAJUR.
4. Provide a universal design of the slope used to facilitate the access to the upper part of the body frame.
5. Provide gender separated restrooms.
6. Consider the security and maintenance of the PV system.

2-2-1-2 Policy for Natural Conditions

1) Temperature/Rainfall

The RMI has a marine tropical climate with high-temperature and humidity levels through the year. The temperature in Kwajalein Island, near the place where Ebeye Island is located, and the rainfall levels are shown in the tables below. Annual rainfall amount is about 3,338mm, and is higher than the average annual rainfall amount in Japan (1,718mm). With these high rainfall levels, self-cleaning against the dust and the salt damage of solar panels is expected.

Table 2-2 Climate in Kwajalein Island in 2015

Month/Item Category	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
Average daily maximum temperature (℃)	30.2	30.3	30.1	30.6	30.5	31.1	30.8	30.4	30.5	30.3	30.8	N/A	30.5
Average daily minimum temperature (℃)	26.0	25.8	25.3	25.3	25.7	26.4	25.8	26.0	26.2	25.3	26.0	N/A	25.8
Average temperature(℃)	28.1	28.1	27.7	28.0	28.1	28.8	28.3	28.2	28.4	27.8	28.5	N/A	28.2

Source: National Oceanic and Atmospheric Administration

Table 2-3 Average Rainfall in Ebeye Island from 2000 through 2012

Month	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	Average
Mean rainfall (mm)	219.4	184.1	185.1	270.4	279.3	270.8	285.6	307.7	318.1	362.2	357.1	298.8	278.2

Source: World Weather Online

2) Ocean Waves

According to research made by NOAA, during the last 30 years, the tallest sea wave registered was of 4.71m (September 1988). NOAA's predictions suggested that for the next 50 and 100 years waves of around 5.41m and 6.55m respectively are expected. The regular height of the sea waves are about 1m high, and 1.8m high waves occur once or twice a year.

3) Wind Conditions

According to NOAA records, during the last 30 years the strongest wind registered was of 36.6m/s. In general, the wind blows from the east.

Table 2-4 Wind force (Data of the Last 30 Years)

Month	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
Mean wind speed(m/s)	7.9	7.7	7.5	7.1	6.7	6.3	5.2	4.4	4.0	4.3	5.7	7.5
Maximum instantaneous wind velocity (m/s)	29.5	21.5	19.6	21.0	22.8	30.8	20.5	29.9	21.4	23.7	36.6	28.6
Wind direction	East	East	East	East	East	North-east	South-east	East	East	North-east	North-east	East
Year	1988	1997	1999	2002	2003	2002	1988	2000	1995	1985	1991	2000

Source: National Oceanic and Atmospheric Administration

4) Solar Radiation

In comparison with the average daily solar radiation in Japan (3.84kWh/m^2), the solar radiation in The RMI is much higher; this fact ensures the stability of the solar radiation through the year.

Table 2-5 Solar Radiation (Monthly averages from 1983 until 2005)

Month	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	Average
Daily mean of solar radiation kWh/m^2)	5.45	6.10	6.39	6.26	6.02	5.70	5.68	5.72	5.62	5.25	4.92	5.01	5.68

Source: NASA Surface meteorology and solar energy

5) Lightning

NOAA says that the possibility of lightning events in Ebeye Island is unlikely to happen. However, the installation of a lightning rod is included in the plan.

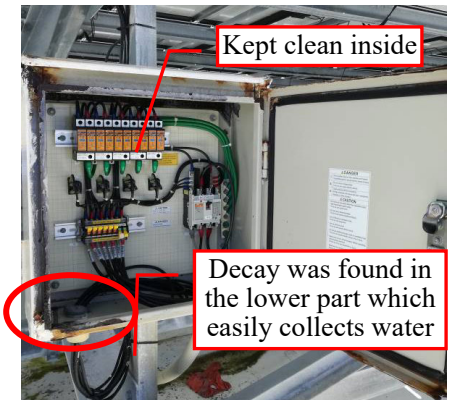
6) Salt Damage

The project site is located along the sea coast, and it is important to protect it from salt damage. The salt damage on the existing facilities was studied in consideration of a prevention plan. The results are described as follows;

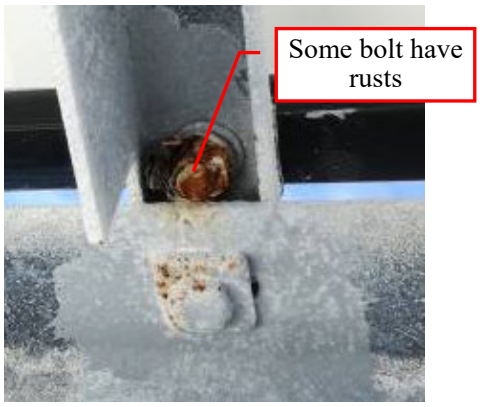
a) Roof of Majuro Hospital

In 2012, 209 kW solar panels were installed on the roof of Majuro Hospital through the project "The Project for Introduction of Clean Energy by Solar Electricity Generation System" conducted by JICA. Rusts were hardly found on the frames with protection against salt such as covered bolts and coated by zincification. However, some parts of the junction box had some decays. This can be attributed because it has been about 5 years since the installation.

JICA has carried out several maintenance works to improve the condition of the equipment, like the use of rust proof paint.



Junction Box



Part of Bolt in the Frame

Covers on the Bolts in the Frame

Coating of Rust Proof Paint

b) Ebeye Islands- The Antenna Tower (relocation is expected)

The cell phone's antenna tower in Ebeye Islands, which is expected to be relocated, has 12 years. The tower has several damages produced by salt water; this situation shows how important is the protection from salt water in the area.

Decay of the antenna tower

Decay of the basement of the antenna tower

c) The PV facilities in Majuro Airport (Galvanic corrosion)

The 600kW grid connected PV system facilities were installed near the site of the rainfall tank near Majuro Airport by an UAE fund in May of 2016. Decay on the door handle of the junction box and the box itself were found a few months after the installation. This damage was possibly caused by galvanic corrosion from salt breeze.

The PV Facilities near the sides of the water tank

UAE Fund

Field Explanation by the Engineer

Galvanic Corrosion

2-2-1-3 Policy Related to Socio-Economic Situation

The RMI does not have its own energy resources; consequently most of the energy supply depends on imported fuels. NEPEAP has the objective to reach 20% of the whole energy supply with renewable energy by 2020.

The development program research (Technical cooperation) "Project on the Formulation of Self-Sufficient Energy Supply System (2013-2015)" conducted by JICA suggested that the installation of the photovoltaic power generation system in Ebeye Island is an effective way to promote and increase the rate of renewable energy and get a stable energy supply.

Therefore, this project considers the reduction of power generation cost and stabilization of the grid by the proper operation of the PV system with the existing diesel power generators. These items will be considered in the project plan and design.

2-2-1-4 Technical Policies, Criteria, and Standards for the Procurement Apparatus and Materials

The design and operation of this project is based on the laws and standards stated below. As still there is no regulation regarding grid connection in Marshall Islands, the project will follow the following Japanese standards. "Grid Connection Guideline for Electricity Quality Assurance (October 1st of 2004)"

Electric Utility Industry Law

a. Industrial Safety and Health Law
b. Technical Basis of Electric Equipment
c. Building Standards Law
d. Japanese Industrial Standard (JIS)
e. Standard of Japan Electrical Manufacturer's Association (JEM)
f. Standard of Japanese Electrical Committee (JEC)
g. Japanese Cable Maker's Association Standard (JCS)
h. System Interconnection Requirement JEAG9701-2016
i. Other International Standards related to the photovoltaic power generation equipment

IEC61215: Crystalline silicon terrestrial photovoltaic (PV) modules-Design qualification and type approval

IEC61646: Thin film PV modules-Design qualification and type approval

IEC61730-1: PV module safety qualification and type approval Part 1: Requirements for construction

IEC61730-2: PV module safety qualification Part 2: Requirements for testing

2-2-1-5 Policy for the Local Engineer

Since the RMI has small experience with the installation of PV systems, it is required that the prime contractor of the Japanese company arranges the whole installation work, and the training for the local engineers are conducted by the experienced engineer. Therefore, the installation of the PV system is conducted by the local engineer under the control of the experienced Japanese engineer. The common works for installation and construction are conducted by the local engineers as much as possible.

2-2-1-6 Policy for Operation and Maintenance

1) Operating Conditions

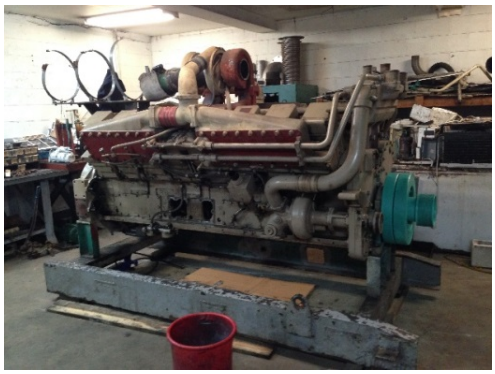
KAJUR is the owner of 3 diesel power generators. Each one has 1,200kW rated power. However, the generators work at 1,050kW/unit, due to the substantial limit generated because the temperature levels of the cooling water for the engine. Generally, if the demand does not exceed the 2,100 kW just only 2 of 3 generators will operate.

However, when the 3rd generator is needed, it will be necessary to start the operation manually. Once the last generator has started it will operate until the lower limit of load. The operation, the monitoring of the output capacity, the generated amount per hour, the voltage and frequently are also done manually. This situation represents an efficiency problem.

KAJUR Diesel Power Plant

2) Maintenance Conditions

Based on the manufacturer recommendation, the consumables (lube oil and air filters) are replaced every 250 hours, and KAJUR conducts the overhaul of the whole diesel power generators at the workshop in the power plant every 10,000 hours. Before the overhaul, the engine should be stopped. In order to make this process as efficient as possible the spare parts coming from US, Australia, Singapore, etc. should be prepared in advance as well as the local reused or spare parts.



The Maintenance Conditions of the Consumables

3) Policy for the Project

To install the PV system, KAJUR will arrange an operation and maintenance team consisting of 15 members.

KAJUR has never installed any PV system and does not have the knowledge required. In order to gain the required techniques and skills to operate and maintain the PV system, guidance and training must be provided. The guidance will consist of the instruction for the initial operation by the manufacturer and the soft component.

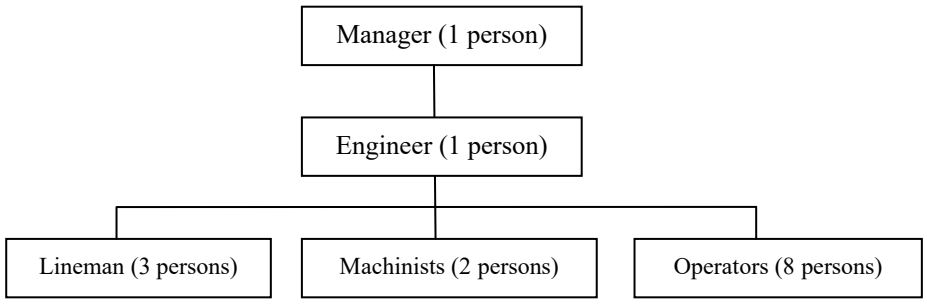


Figure 2-3 Operation and Maintenance Structure by KAJUR for the PV System (Plan)

2-2-1-7 Policy for Installation/Procurement Method

Regarding the frame structure, the concrete foundation and column-beam skeleton will be placed in the site. The structure of the body frame is based on the common structures of the local place: reinforced concrete structure.

Since the equipment for the PV system is not produced in Marshall Islands, it has to be imported from overseas; all necessary equipment has to be provided from Japan.

2-2-2 Basic Plan (Construction Plan/ Equipment Plan)

2-2-2-1 Formulation of Basic Plan

The PV system in the project will be connected with the existing grid and the diesel power generation facilities. It will consist of (1) PV panel system, (2) Battery system, (3) EMS, and (4) Grid interconnection facilities.

1) PV System

a) Photovoltaic Module

The whole capacity of the PV modules is higher than 600kW, and the whole installation area is smaller than 6,000m^2. The power generation efficiency is higher than 150W/m^2 (temperature: 25 ℃, solar irradiance: 1,000W/m^2). In addition, the output warranty provided by the manufacturer has to be of 10 years (more than 90% of the lowest rating output) and 20 years (more than 80% of the lowest rating output). The environmental conditions of the warranty are: temperature ranges 0℃~+50℃ and10 ~ 90% of humidity RH.

The annual expected generation capacity of the 600kW PV system in Ebeye Island is of 707MWh. Currently, the peak demand for electricity during day in Ebeye Island is about 2.3 MW, therefore the introduction of the proposed PV system will not interference with the operation of the existing diesel generators. If the amount of electricity generated by the PV system were to replace the power generated by diesel, it is expected to reduce the carbon dioxide emissions annually by around 441 t CO_2. (The calculation formula is shown in the table below)

Table 2-6 Expected reduction of CO_2 by PV system

Item	Value	Unit	Comments
System Capacity	600	kW	KAJUR reservoir
Annual solar radiance	5.53	kWh/m^2/ day	IRENA "The Republic of Marshall Islands Renewables Readiness Assessment (2015)"
Annual energy generation (Gross generation)	884.1	MWh/year	(system capacity) × (solar radiation) × (system efficiency 0.73) × 365 day
Annual energy generation (Net generation)	707.3	MWh/year	Gross Generation less 20% of expected transmission loss (provisional value of loss due to power conditioner, etc.)
Fuel consumption of KAJUR's diesel generator	4.14	kWh/L	Information from KAJUR
Diesel CO_2 emissions	2.58	kg-CO_2/L	Japanese standards
Expected reduction of CO_2	441	t-CO_2	(Annual energy generation (Net generation)) × fuel consumption for power generation) × (diesel emission factor)

Source: JICA's Study Team

According to KAJUR, the annual electricity generation has increased 1.6% in 3 years from 2013 (15,336 MWh) to 2015 (15,588 MWh). However, because of the limited area of Ebeye Island and population characteristics a substantial increase of power demand is not expected.

b) Frame Structure

The PV modules will be set on the frame structure; this will secure the power generation efficiency. Moreover, the frame has 8 degrees of inclination angle in order to remove the pollution by rainfall. The material shall be galvanized or made of concrete to avoid rusting off.

c) Power Conditioner

The power conditioner performs automatically the following operations:

i. Monitor the performance of the PV module, and start automatically when it reaches the required value.

ii. Monitor the performance of the PV module, and stop automatically when it becomes smaller than the required value.

iii. The PV system provides electricity generated to the electricity grid and charge the storage battery in the day time only. If due to the lack of sunlight the supply becomes impossible, the operation will be automatically stopped.

iv. Safety recovery of the PV module after the immediate disconnection of the loads due to a quick demand response. Thanks to this characteristic, it will be possible to prevent problems due an overloading of the electricity grid as blackouts.

v. When an accident occurs in the AC system, or when the power conditioner breaks down, the system will turn off.

vi. In case of a system accident, the system will automatically reset and resume operation after the confirmation of the system restoration.

d) Junction Box

It collects the DC power generated by PV modules, and connects with the power collection box. The material shall be stainless and antirust painted.

e) Power Collection Box

It consolidates the DC power collected by the box mentioned above, and connects with the power conditioner. The material shall be the same as the junction box; stainless and antirust painted.

f) Distribution Cables

It consolidates the DC power collected by each junction box, and it connects with the power conditioner.

2) Battery System

The battery system will be installed to cope with the short cycle of the PV system. The maximum power generation capacity of the system is 600kW. The battery is supposed to ensure the stability of the production even though the power generation changes suddenly to zero.

In addition, to secure the duration to switch the power supply from the PV system to the diesel power generation system (30 minutes from the standby to be ready to operate the diesel power generator), the battery system shall have enough capacity. It consists of plural units for each series of 2 to secure the redundancy.

3) EMS

EMS consists of a calculator, HMI (Human Machine Interface), network device, output device, software, distribution cables, and external communication equipment, and has the following functions.

i. Control system for the storage battery: EMS is responsible for the charge/discharge of the battery power.

ii. Information input and monitoring the following items: the diesel generator, the storage battery, power demand, diesel generator output. PV system, charge and discharge capacity of the storage battery, storage battery state of charge (SOC), system frequency, system voltage, and grids.

iii. Display function: It shows information of each one of the functions mentioned above to the display screen or the printer in different formats (table, list, graph, graphics, etc.).

iv. Recording function: It stores important data.

4) Grid Interconnected Facilities

Grid interconnected facilities are connected to the PV system and the storage battery system. They connect the grid with the existing transformer. They are composed of the system interconnection bus facility, the system interconnection breaker facility, a disconnecting switch, measurement devices, protective relay and distribution cables.

The system interconnection bus facility which connects the PV system and the battery system is divided, and connects the facilities that have the same capacity. The breaker is installed so that each facility becomes able to be detached. The divided buses connect to the existing bus of the power generators, and have breakers and disconnecting switches for each one. The breaker is installed to enable the divided buses to connect each other.

2-2-2-2 Equipment plan

The procured equipment for the PV system is as follows;

Table 2-7 Equipment specifications

Material		Quantity	Remarks
1. PV system			
1-1	PV module	1 set	More than 600 kW
1-2	Frame for the PV module	1 set	Molten galvanized is permissible
1-3	Power conditioner for the PV	1 set	More than 600 kW and 4 partitions
1-4	Junction box	1 set	-
1-5	Power collection box	1 set	-
1-6	Distribution cables for the PV	1 set	-
1-7	Data measuring and recording equipment for PV	1 set	-
2.	Meteorological equipment (pyranometer)	1 unit	-
3.	Meteorological equipment (thermometer)	1 unit	-
4.	Meteorological equipment (aerometer)	1 unit	-
5.	Meteorological equipment (ombrometer)	1 unit	-
6.	Meteorological equipment (hygrometer)	1 unit	-
7. Battery system			
7-1	Battery	2 sets	600kW - more than 30 minutes × 2 units
7-2	Battery control panel	1 set	
7-3	Power conditioner for the battery	1 set	2 pairs × 2 units
7-4	Incoming panel	1 set	-
7-5	Distribution cables for the battery	1 set	-
7-6	Data measuring and recording equipment for the battery	1 set	-
7-7	Battery board	1 set	-
7-8	DC power collection board	1set	-
8. EMS			
8-1	Calculator	1 set	-
8-2	HMI	1 set	-
8-3	Network device	1 set	-
8-4	Output device	1 set	-
8-5	EMS software	1 set	-
8-6	Distribution cables for EMS	1 set	-
8-7	External communication equipment	1 set	-
9. Grid interconnection facilities			
9-1	System interconnection bus facility	1 set	-
9-2	System interconnection breaker	1 set	-
9-3	System interconnection breaker facility	1 set	-
9-4	Disconnecting switch	1 set	-
9-5	Measurement device	1 set	-
9-6	Protective relay	1 set	-
9-7	Protective relay board	1 set	-
9-8	Distribution cables for grid interconnection facilities	1 set	-

Material		Quantity	Remarks
10. Equipment for maintenance			
10-1	Thermographic camera	1 unit	-
10-2	Total tester for the photovoltaic power generation system	1 unit	-
10-3	Insulation resistance measuring device	1 unit	-
10-4	Digital tester	1 unit	-
10-5	Digital cramp meter	1 unit	-
10-6	Cramp sensor	1 unit	-
10-7	Low voltage test device	1 unit	-
10-8	Tools	1 unit	-

The spare parts that are difficult to obtain in the local site should be provided in the project. The consumables are not counted.

Table 2-8 Spare parts

Material		Quantity	Remarks
1	PV modules	25 sheets	1% of the installed modules
2	The power conditioner for the PV, and its attachment, etc.	1 set	-

2-2-2-3 Utilities plan

As mentioned above, the PV system is installed on the upperpart of the frame structure to protect the panels from potential high waves. The PV system will also have a monitoring building that will be installed the power conditioner, the battery, the data measuring and other related equipment. In addition, the control room should contemplate the visit of interested people such as school students.

1) Electric Facilities

The facility to connect the power generated by the PV system and the grid is installed inside the electric room, and supply the low voltage power used in the building. The electric facilities are as follow:

a. Trunk facility
b. Power facility
c. Lightning protection/ground earth equipment
d. Lamp/outlet equipment
e. Light electrical equipment

LAN conduit, LAN outlet, LAN outlet box for LAN, and LAN wiring are conducted with the installation of the materials.

2) Plumbing system

Restrooms are installed for visitors and for KAJUR staff. Therefore, water is supplied in the facility after the water from the existing water supply pipe has been collected in the elevated tank. The elevated tank is installed on the roof of the building/control room. Sewage and drain are discharged to the public main sewage pipe located in the public road in the northern part of the site.

To drain the rainfall, roof drains and gutters will be installed on the upper part of the body frame. The project site used to be the catchment retention facilities of the rainfall, and the soil of the site is lower around 1m than the one of the surroundings areas. Due to this situation, the rainfall gathers at the lower part of the frame body when it rains. The drain ditch should be installed in the lower part of the frame body to cope with this problem. The drain ditch will lead to the rainfall reservoir pit in an efficiently and sanitary way, and then the water will be drained to the eastern sea area of the site by the pump and the sewage pipe.

3) Air conditioning facility

To keep the operating environment of the materials in the power conditioner room, the battery room, the electric room, and the control room, split typed air conditioner shall be installed. Also, the mechanical typed ventilation equipment shall be installed in the restrooms and store rooms.

4) Description of the PV system

The description of the PV system is shown below.

Table 2-9 Description of the PV system

	Details
Total extended floor area	7,057.64 m^2
Structure Overview	2 floors above the ground, Concrete RC structure, independent foundation structure, rainwater storage pit
Installation area	6,483m^2
Monitoring Building	574.77m^2 Pump room, control room, electric room, battery room, power conditioner room, corridor etc.

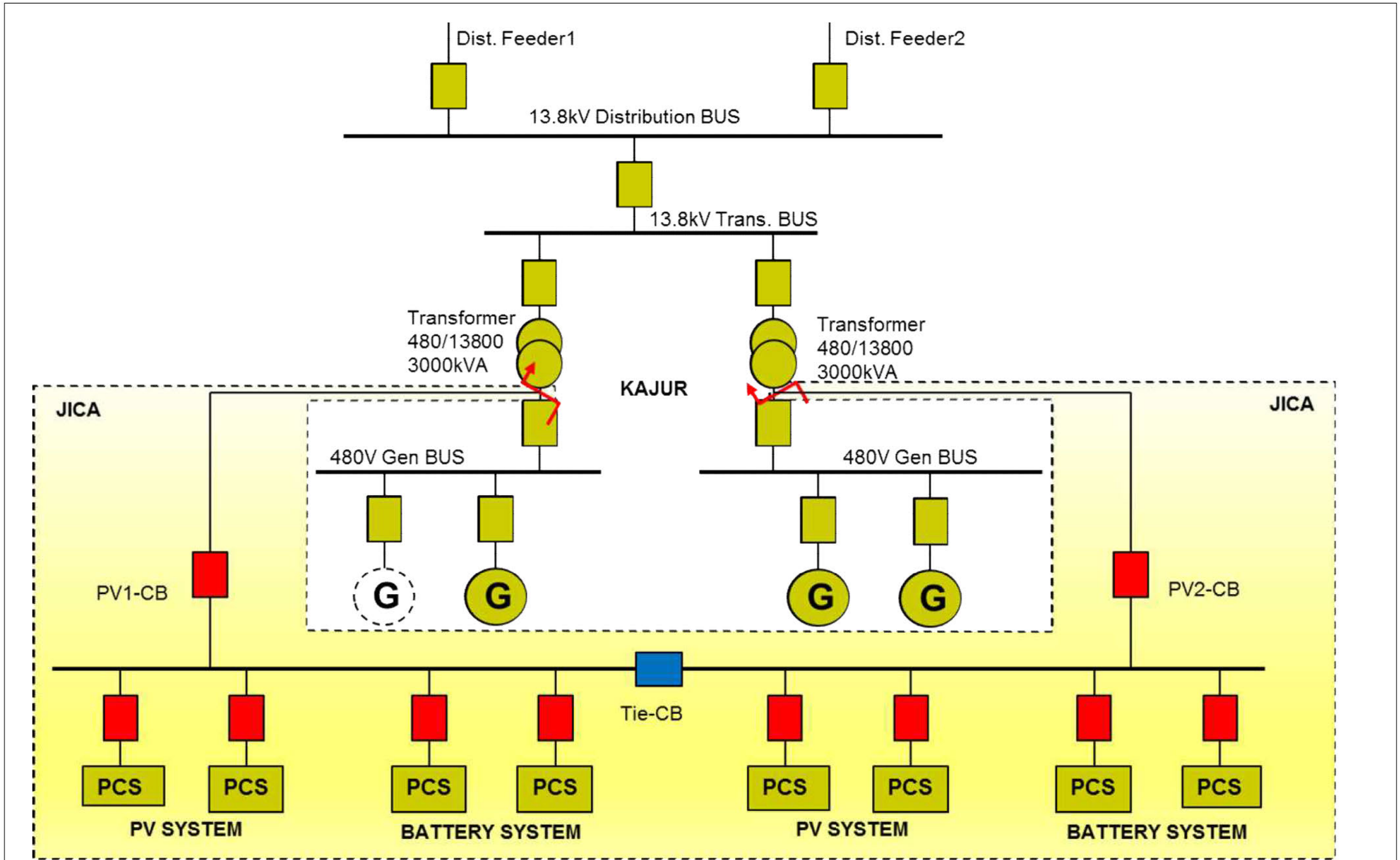
Figure 2-4 Overall view of the PV system (from southwest)

2-2-3 Outline Design Drawing

The system diagram of the PV system is based on “2-2-2 Basic Plan” and the schematic drawing of basic design such as the drawing of the layout for the equipment and the body frame are as follow.

PV-01	Schematic drawing of the photovoltaic power generation system
PV-02	Layout drawing of the PV panels
PV-03	Layout drawing of the materials
PV-04	System diagram of the photovoltaic power generation system
A-001	Plan (1) (2)
A-002	Section and Elevation

PV-01 Schematic drawing of the photovoltaic power generation system



PROJECT TITLE THE PROJECT FOR PV POWER GENERATION SYSTEM IN EBEYE ISLAND		SCALE: NONE DWG TITLE: CONCEPTUAL KEY LINES FOR CONNECTING OF PV SYSTEM DWG NO: PV-01 DESIGNED BY / DRAWN BY / CHECKED BY ORIENTAL CONSULTANTS GLOBAL CO., LTD.

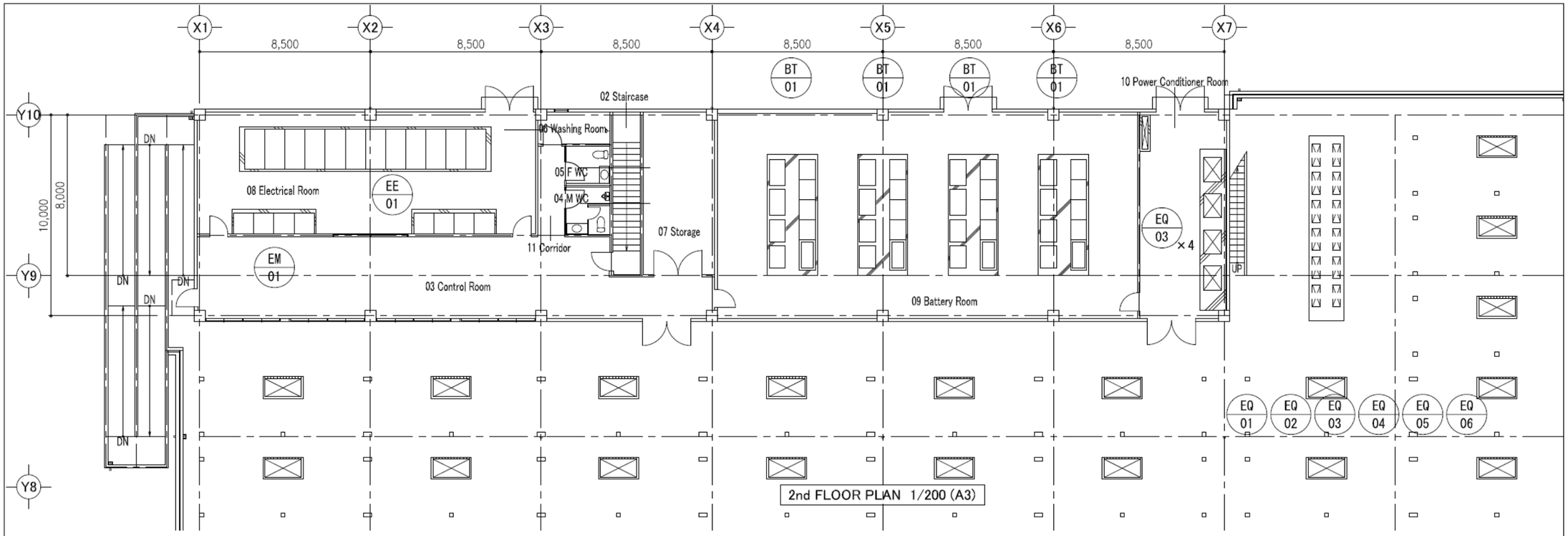
PV-02 Layout drawing of the PV panels

SITE LAYOUT scale = 1/1,000

PROJECT TITLE: THE PROJECT FOR PV POWER GENERATION SYSTEM IN EBEYE ISLAND		SCALE: 1/1,000	DWG TITLE: SITE LAYOUT & PANEL PLAN
		DATE: NOV. 2016	DWG NO: PV-02
		DRAWING BY	DESIGNED BY: ORIENTAL CONSULTANTS GLOBAL CO., LTD.
		CHECKED BY	

REVISIONS: NO | DATE | DESCRIPTIONS | BY | APP'D

PV-03 Layout drawing of the materials



EQUIPMENT SCHEDULE FOR PV POWER GENERATION SYSTEM

NO.	ITEM	SPECIFICATION	QUANTITY	LOCATION
EQ－01	PV MODULES	RATING CAPACITY OF 600KWP OR MORE	1Lot	OUTSIDE
EQ－02	SUPPORTING STRUCTURES FOR PV MODULES	HOT-DIPPED GALVANIZED STEEL FRAMES	1Lot	OUTSIDE
EQ－03	POWER CONDITIONERS FOR PV	RATING CAPACITY OF 600KW OR MORE AND OUTPUT VOLTAGE SHALL BE 480V RATED EFFICIENCY: 95% OR MORE AC OUTPUT POWER FACTOR: 0.95 OR MORE HARMONICS: INTEGRATION 5% OR LESS EACH DIMENSION 3% OR LESS PROTECTION DEVICE S a) OVER VOLTAGE RELAY (OVR) b) UNDER VOLTAGE RELAY (UVR) c) OVER FREQUENCY RELAY (OFR) d) UNDER FREQUENCY RELAY (UFR) e) PROTECTION OF IS LANTING OPERATION PASSIVE AND ACTIVE	1Lot	MONITORING BUILDING 2F 10 POWER CONDITIONERS ROOM (MORE THAN 4 UNITS)
EQ－04	CONNECTION BOX	DEVICES TO BE CONTAINED a) CIRCUIT BREAKERS (MCCB) b) DIODE FOR REVERSE POWER PROTECTION SURGE PROTECTION c) DEVICES d) TERMINAL BLOCK GRADE OF PROTECTION: IP53 OR MORE	1Lot	OUTSIDE
EQ－05	COLLECTION BOX	DEVICES TO BE CONTAINED a) CIRCUIT BREAKERS (MCCB) GRADE OF PROTECTION: IP53 OR MORE	1Lot	OUTSIDE
EQ－06	METEOROLOGICAL OBSERVATION INSTRUMENTS	SOLAR RADIATION METER THERMOMETER HUMIDITY INSTRUMENT RAIN GAUGE ANEMONETER	1Lot	OUTSIDE
BT－01	BATTERY SYSTEM	TYPE:LITIUM BATTERY CAP :300kw-30min OR MORE INCLUDING CONTROL PANEL, POWER CONDITIONER etc.	4Lot	MONITORING BUILDING 2F 09 BATTERY ROOM
EM－01	ENERGY MANAGEMENT SYSTEM	SYSTEM COMPONENTS: ・SREVER ・HMI ・NETWORK EQUIPMENT ・PRINTER ・SOFT WARE etc.	1Lot	MONITORING BUILDING 2F 03 CONTROL ROOM
EE－01	POWER RECEIVING PANEL		1Lot	MONITORING BUILDING 2F 08 ELECTRICAL ROOM

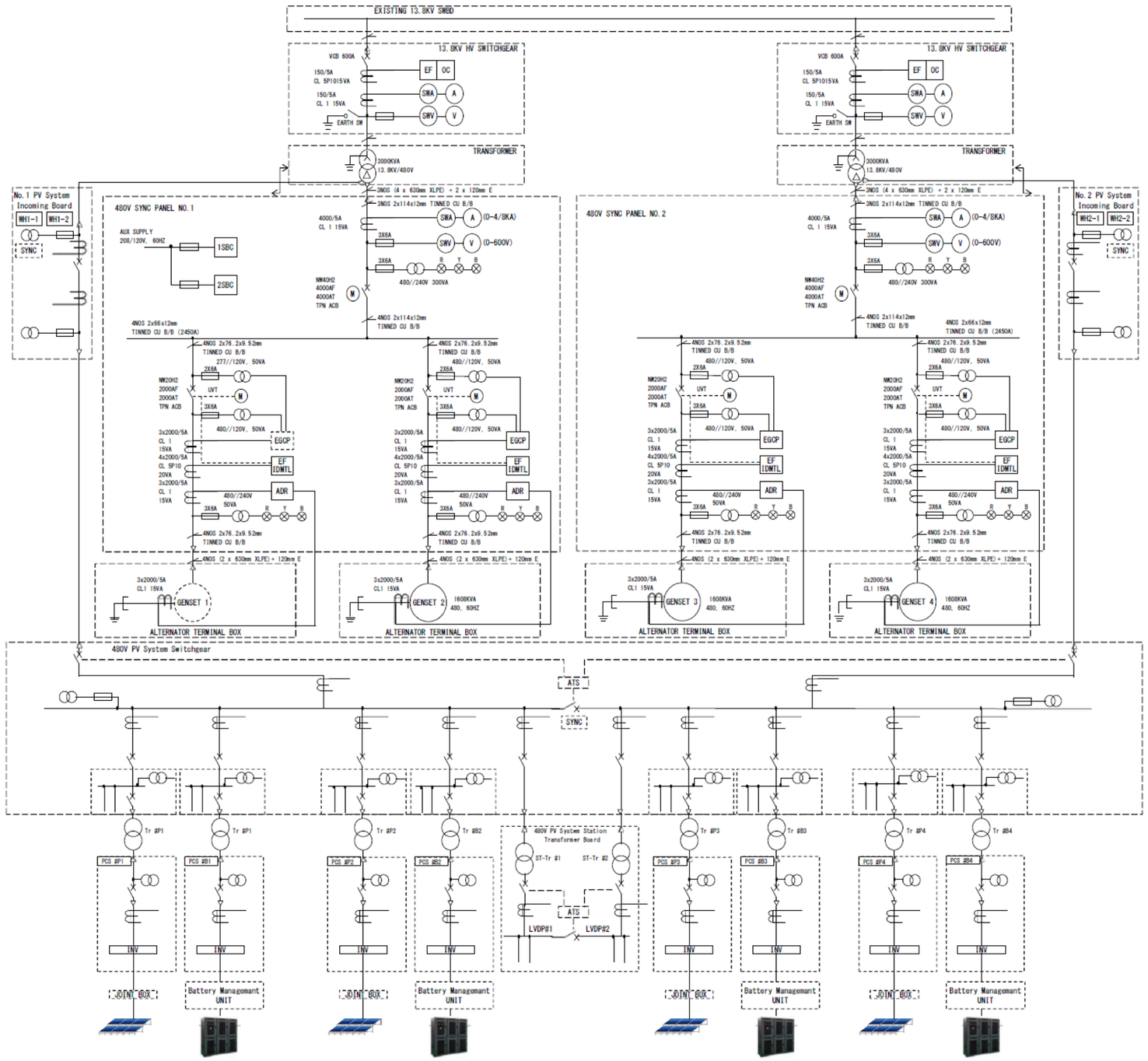
PROJECT TITLE
THE PROJECT FOR
PV POWER GENERATION SYSTEM IN EBEYE ISLAND

NO	DATE	DESCRIPTIONS	BY	APP'D
		REVISIONS		

SCALE 1/200
DATE JUNE, 2017
DRAWING BY
CHECKED BY

DWG TITLE EQUIPMENT SCHEDULE & GENERAL ARRANGEMENT FOR PV POWER GENERATION SYSTEM
DWG NO PV-03
DESIGNED BY ORIENTAL CONSULTANTS GLOBAL CO., LTD.

PV-04 System diagram of the photovoltaic power generation system



Transformer

1	Rated Power(IEC60076)		3000	kVA
2	Phase		3	Nos
3	Rated Frequency		60	Hz
4	Rated Voltage(No Load at Normal Tapping)			
		HV	13800	V
		LV	480	V
5	Insulation Level			
	HV	Lighting Impulse	96	kV
		AC	38	kV
	LV	Lighting Impulse	-	kV
		AC	3	kV
6	Type OF Cooling		ONAN	
7	Type of Oil seals		NORG(NIRG)	
8	Impedance Volt at rated Current(76C)		5.96	%
9	Connection Symbol		YN.d1	
10	Temperature Rise			
		Oil	60	C
		Winding	65	C
11	Mass total		6500	kg
		Mineral Oil	1350	kg
		Coe and windings	3750	kg
12	Quatity of Mineral Oil		1500	L
13	Serial No.		TE4043-011	
14	Date		01.2003	
15	LV terminal		a/b/c	
		Voltage	480	V
		Current	3610	A
16	HV terminal		YN/A/B/C	
	HV terns		Sw-Position	Current
	105		1	120
	102+1/2		2	122
	100		3	126
	97+1/2		4	129
	95		5	132
17	Manufacturer		Maiden Singapore pte.Ltd.	

EGCP	Engein generator Control Package Woodword EGCO-2
EF IDMTL	Earth Fault Relay KASUGA IDMTL Type RSE052
ADR	Alternator Dif Relay DEIF RMC-131D
UVT	Under voltage trip Merlin Gerin

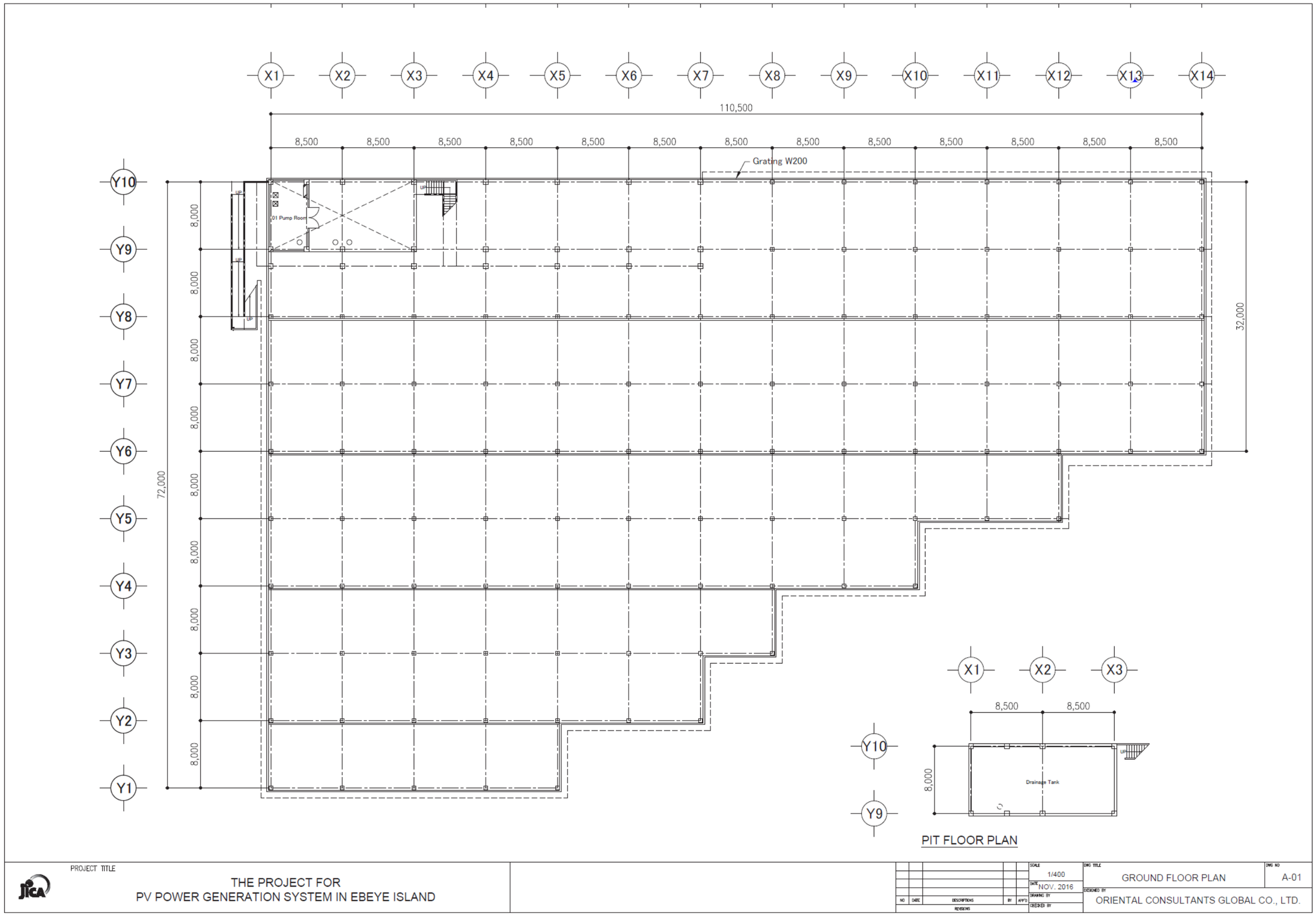
PROJECT TITLE

THE PROJECT FOR
PV POWER GENERATION SYSTEM IN EBEYE ISLAND

NO	DATE	DESCRIPTIONS	BY	APP'D	REVISIONS	SCALE	NONE	DWG TITLE	CONCEPTUAL KEY LINE DIAGRAM
						DATE			
						DRAWN BY		DESIGNED BY	ORIENTAL CONSULTANTS GLOBAL CO., LTD.
						CHECKED BY			

DWG NO PV-04

A-001(1) Plan



PROJECT TITLE

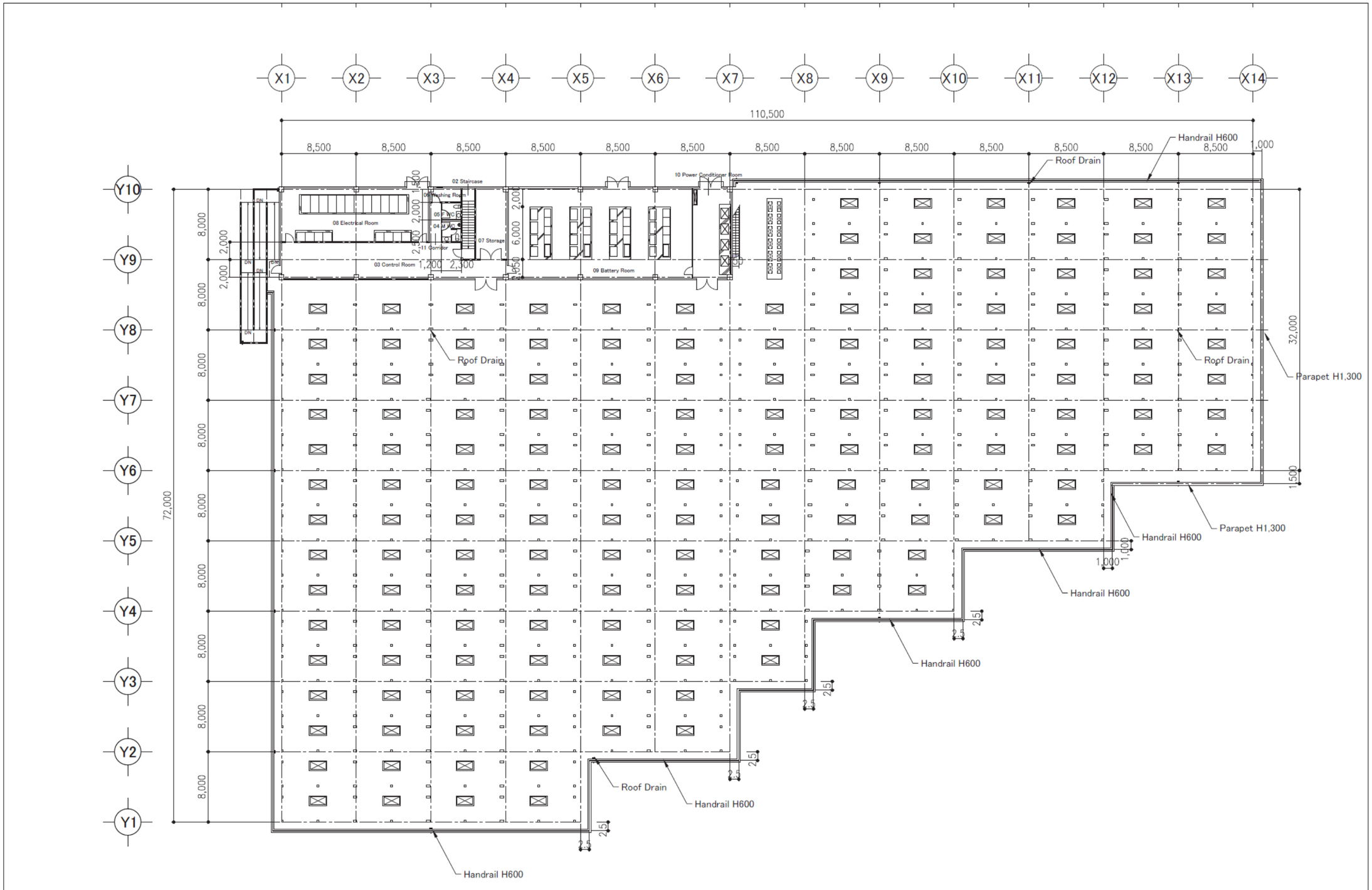
THE PROJECT FOR
PV POWER GENERATION SYSTEM IN EBEYE ISLAND

NO	DATE	DESCRIPTIONS	BY	APP'D
		REVISIONS		

SCALE 1/400
DATE NOV. 2016
DRAWING BY
CHECKED BY

DWG TITLE GROUND FLOOR PLAN
DWG NO A-01
DESIGNED BY ORIENTAL CONSULTANTS GLOBAL CO., LTD.

A-001(2) Plan



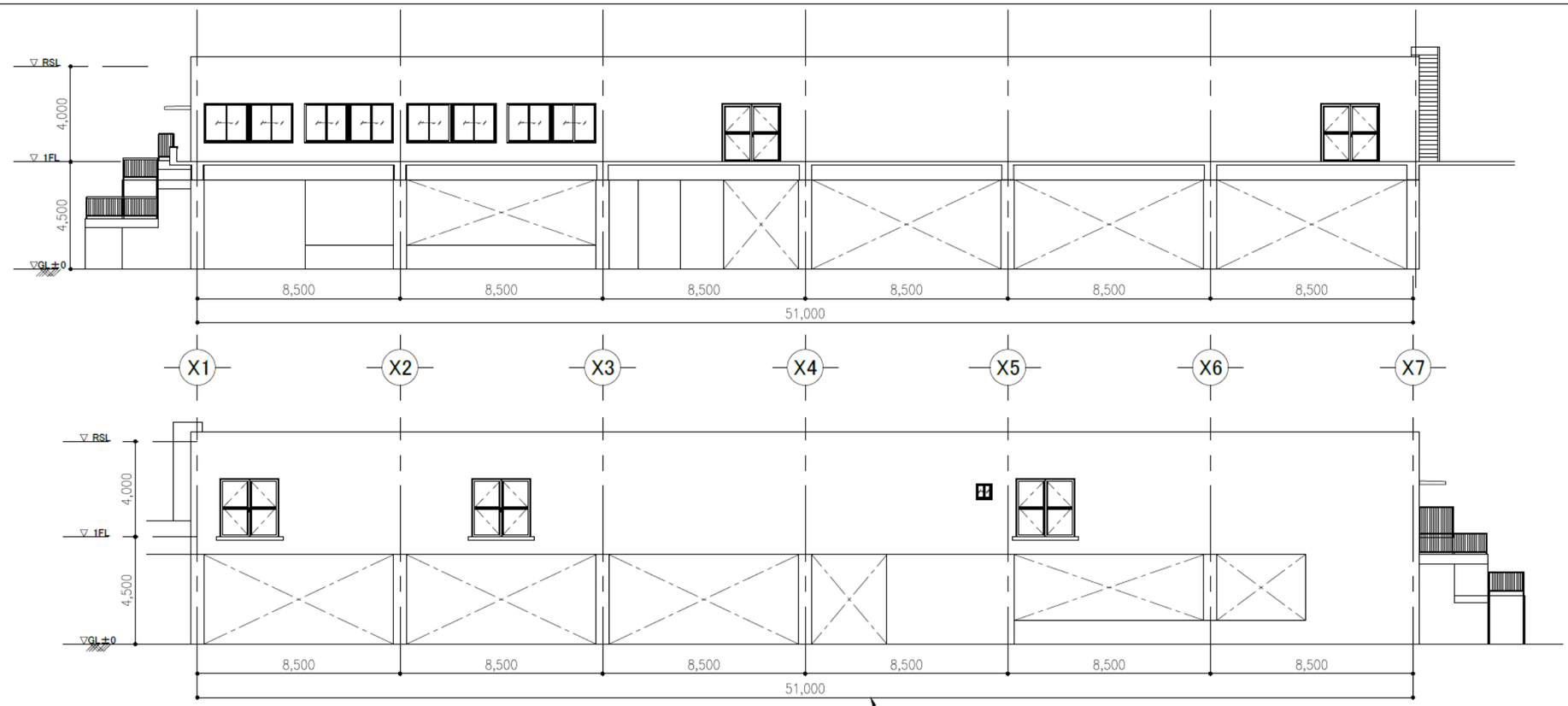
PROJECT TITLE

THE PROJECT FOR
PV POWER GENERATION SYSTEM IN EBEYE ISLAND

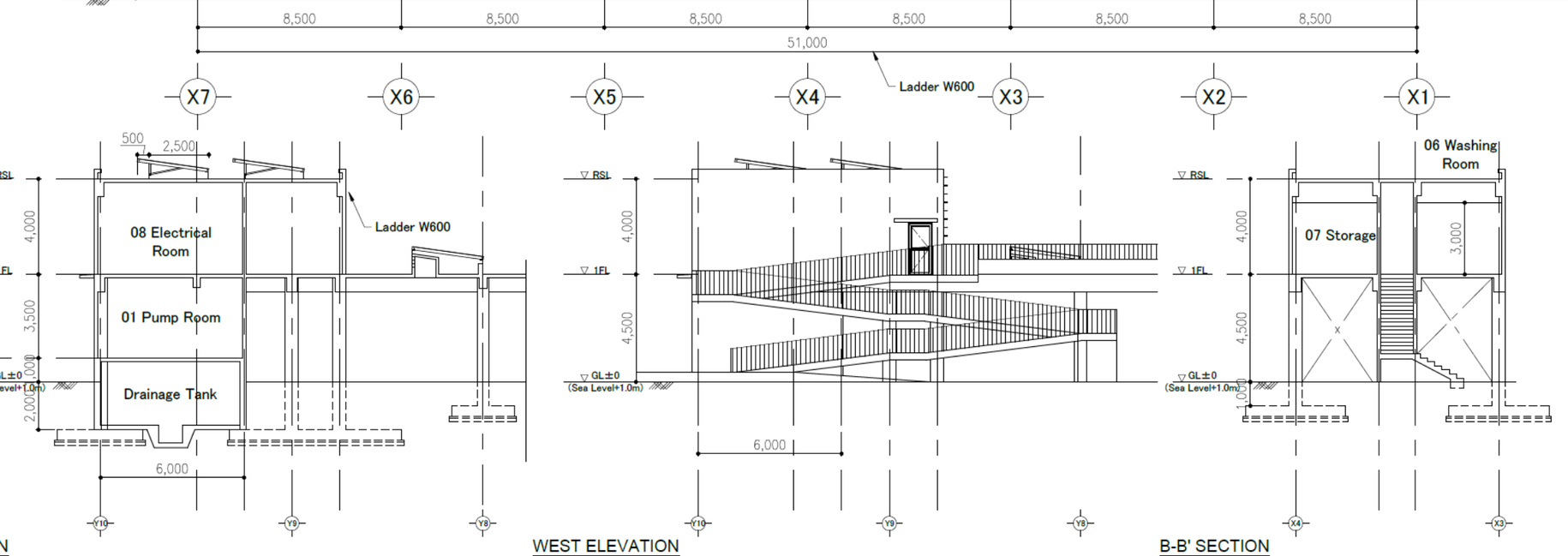
NO	DATE	DESCRIPTIONS	BY	APP'D
		REVISIONS		

SCALE	1/400
DATE	NOV. 2016
DRAWING BY	
CHECKED BY	
DWG TITLE	1ST FLOOR PLAN
DWG NO	A-01
DESIGNED BY	ORIENTAL CONSULTANTS GLOBAL CO., LTD.

SOUTH ELEVATION



NORTH ELEVATION



A-A' SECTION

WEST ELEVATION

B-B' SECTION

PROJECT TITLE

THE PROJECT FOR
PV POWER GENERATION SYSTEM IN EBEYE ISLAND

NO	DATE	DESCRIPTIONS / REMARKS	BY	APP'D

SCALE 1/200
DATE NOV. 2016
DRAWING BY
CHECKED BY

DWG TITLE MONITORING BUILDING SECTION & ELEVATION
DWG NO A-02
REVIEWED BY ORIENTAL CONSULTANTS GLOBAL CO., LTD.

2-2-4 Implementation plan

2-2-4-1 Implementation Policy

1) Implementation structure

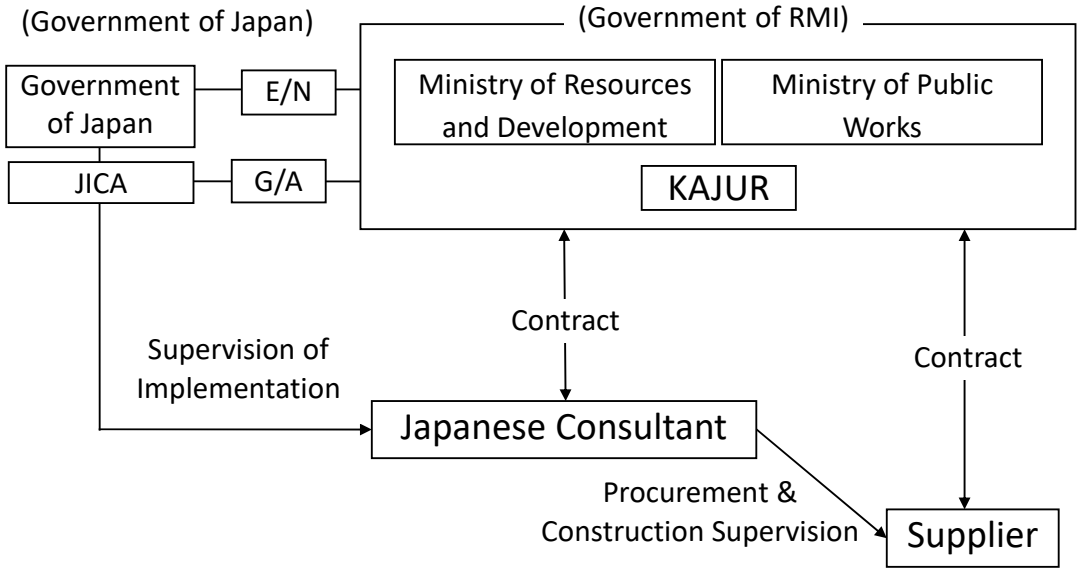


Figure 2-5 Implementation structure of the Project

2) Construction policy

Construction is conducted based on the following policies:

① Scaffolding for exterior work
② Earthwork utilizes the pit excavation method. Backfilling shall use pit excavated soil. This soil is used in this project site.
③ A concrete plant is installed in Ebeye Island. Ready mixed-concrete is transported by a truck mixer, and hit by the pump.
④ The project will not use waterproof layer, but will place densely concrete as a protection for degradation, except the roof of the monitoring building.
⑤ Parts made of iron like handrail are galvanized.
⑥ External doorway is made of steel, and the sash is made of aluminum.
⑦ Glass blocks are used to get light to the lower part of the frame structure supporting the panels.

3) Procurement Plan

a) Local procurement of equipment and materials

The general materials for the frame structure such as cement, concrete aggregate, reinforcing bar, and timber for the construction are distributed in the RMI; the materials can be procured without import.

b) Procurement of equipment from third country

There are not materials to be imported from third country

c) Japan procurement of equipment and materials

The materials for the PV system that are not available in Marshall Islands should be imported from overseas. The main procurement materials in this project are the PV modules, the power conditioner, the battery system, and EMS, the grid interconnection facilities, etc. All of them are procured from Japan.

Table 2-10 List of suppliers for equipment

Material List	Local	Japan	Other country
PV system		○	
Building equipment		○	
Heavy machine	○		
Mobile concrete pump		○	
Cement	○		
Concrete aggregate	○		
Reinforcement	○		
Concrete masonry	○		
Timbers	○		

2-2-4-2 Implementation Conditions

1) Notice Matters in the Construction

The construction of the frame structure will be done prior to installation of the PV system in an efficient way. Also, since experience with PV system in the RMI is unusual, Japanese engineers will assist local engineers in the process of unpacking, importing, assembling, installing the works, adjustment/test operation, initial operation, and general operation.

2) Notice Matters in the Procurement

The procurement materials imported from overseas are basically shipped by a shipping line; the transport period has to be taken into consideration. The transportation between the port of Ebeye and the site is done by truck. The road conditions from the port to the site should be taken into consideration, and 20 feet-containers shall import all materials.

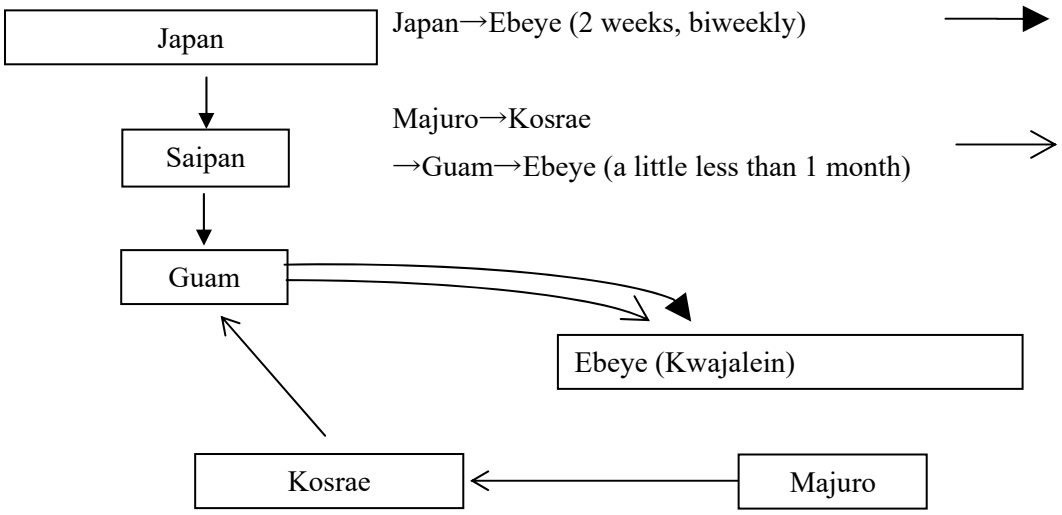


Figure 2-6 Shipping Route of the Shipping Line

2-2-4-3 Scope of Works

The scope of works by Japan and the RMI in this project is shown in the table below.

Table 2-11 Scope of Works by the Project and the RMI Side

No.	Components	To be covered by Japan	To be covered by The RMI
1	Provision of site for the installation of the PV system		●
2	Provision of site for the construction of the frame structure and building		●
3	Removal of equipment and materials in the project site		●
4	Design the PV system, procurement of the materials	●	
5	Tax exemption		●
6	Packing and transportation of the equipment	●	
7	Inland equipment transportation, loading, installation and adjustment	●	
8	Design and construction of the frame structure and building	●	
9	Rainfall drainage facilities	●	
10	Provision of space for temporary storage of equipment and construction materials and approach road during implementation period		●
11	Installation of the construction site office	●	
12	Installation of external fence		●
13	Water supply and drainage facilities		●
14	Laying the drainage families through the main sewage pipe to the first box in the site		●
15	Interconnection work with existing power plant/grid		●
16	Conducting the acceptance test of the PV system		●
17	Personnel selection for the operation of the PV system		●
18	Conducting the soft component	●	
19	Proper operation of power generation facilities based on the soft component		●
20	Holding a stakeholder meeting		●
21	Procedure of approval for the environmental management plan		●
22	Cost of operation and maintenance including exchanging the materials		●

2-2-4-4 Consultant Supervision

The Japanese consultant will engage in the supervision and procurement of the following activities:

a. Ensure that the contents of the technical specifications are fulfilled in the 4 main facilities that are included in the system (1. The PV system, 2. The battery system, 3. EMS, 4. Grid interconnection facility), and confirm that they work properly as a whole.

b. The consultant will monitor the progress of the installation works appropriately, and supervise them, so it secures the quality of the installation and completion within term of the works.

c. The consultant will supervise the procurement engineers to plan the instruction of the initial and general operation in order to enable KAJUR engineers and technical staffs to adjust, operate, and test the materials.

d. Sharing of information with suppliers and taking safety measures.

Based on this plan, the consultant will dispatch the site representative for the supervision of the construction and procurement. Furthermore, in Japan, the consultants will test the equipment to be shipped during their production. After that, they ensure that the procured equipment fulfil the required specifications. The contents of operation control duties of the consultants are as follow:

① Confirmation and approval of manufacturing drawings, and necessary documents for equipment and materials
② Attending factory tests
③ Supervising the progress and safety control of the supplier
④ Attending equipment installation, adjustment and trial-run
⑤ Approval of acceptance test procedures and plans
⑥ Attending the acceptance testing (final inspection) and issuing of completion certificates
⑦ Executing technical assistance (Soft Component)
⑧ Preparation of monthly and completion reports to be submitted to the related organizations

2-2-4-5 uality Control Plan

1) Inspection and Acceptance Test Implementation Plan (equipment work)

a) Basic Policy

During the manufacturing period of the equipment, the Consultant will review all shop drawings for the equipment and installation and construction works to be submitted by the contractor in terms of conformity with the contract documents and technical specifications and give necessary approvals.

Additionally, during the period of the installation and construction works, the consultant will check the statement of methodology including implementation structure, installation and constructions schedules, sequence of installation and construction, and so on, and provide the approvals.

b) Quality inspection by the consultant

Regarding the quality test of the materials, the following test and should be conducted:

i. Factory inspection
Prior to the shipment of the equipment out of the factory, each and all equipment are to be inspected as to their conformity with required specifications and performance tests.

ii. Collation inspection prior to shipment
Though quantities of the principal equipment are to be confirmed at the time of the factory inspection, quantities of all equipment are also to be confirmed during collation inspection prior to shipment to be conducted by a third party inspection agency. The place for inspection is the manufacturer's packing warehouse.

iii. Acceptance test and handover
After the operation instruction finished, the implementing body will verify whether the system has the capacity and the function according to the required specifications. The consultant shall attend the verification. The inspection shall be done onsite after the installation of the system. After the inspection, the implementing body, the consultant, and the procurement engineer will check the results, and finally the system should be delivered to the implementing body.

2) Quality Control Plan (Construction Work)

a) Basic Policy

At the time of preparation of the proposed tender documents, the outline design drawings are to be prepared after reviewing construction details using local materials and widely adopted local construction methods giving consideration to the construction situation in the RMI and the maintenance cost. As for the technical specifications, reference is made to the Japanese Architectural Standard Specification (JASS), Japan Industrial Standard (JIS), British Standard (BS), and American Society for Testing and Materials (ASTM) and so on in order to secure high quality of the construction and installation works.

During the construction period, the consultant will check all the submittals from the contractor such as the frame structures, construction plans, the construction schedules, and shop drawings in terms of conformity of such submittals with the contract documents and technical specifications, and provide necessary approvals.

b) Quality inspection by the Consultant

On site, the consultant will review and/or examine the statement of methodology and material sample in terms of conformity of the construction materials and construction quality with the relevant technical specifications and give necessary approvals prior to the commencement of each category of the construction work. And, after the commencement of each category of the construction work, the consultant will conduct inspections as necessary in accordance with check sheets highlighting important check points prepared based on the approved statement of methodology.

Although all construction materials used for the project can be procured locally, random inspection is to be conducted as necessary in order to secure the required quality in addition to obtaining manufacturer's warranties

The consultants will inspect the following items in order to ensure the quality of the construction.

i. Inspection for Frame structure work (Concrete inspection)

The construction procedure plan considering the concrete placement and the curing plan is established to the installation of the frame structure, and the consultant confirms them. The inspection methodology for the quality control of the concrete (items to manage, the inspection method, etc.) are as follow;

Table 2-12 Materials required for concrete

Material	Management Item	Method of inspection
Cement	Hydration heat, etc.	Melting heat method
Sand, gravel, rubble	Size distribution	Sieving
	Absolute density	Specific gravity and absorbing rate test
	Alkali reactivity	Alkali reactivity test
Water	Organic impurities, etc.	Water quality test

Table 2-13 Trial mix for ready-mixed concrete

Item to be inspected	Investigation Method
Assumption of compressive strength	Compression tester
Slump value	Slump cone
Temperature of the concrete	Thermometer
Air quantity	Manometer
Chloride quantity	Quantab

Table 2-14 Inspection before casting concrete

Management Item	Investigation Method
Time taken for mixing and casting concrete	Collate finish time
Slump value	Slump cone
Temperature of the concrete	Thermometer
Air quantity	Manometer
Chloride quantity	Quantab

Table 2-15 Inspection of the completed concrete Work

Management Item	Investigation Method
Compressive strength for structural concrete	Compression tester
Finish precision (plumbing)	Scale
Finish precision (Slavic horizontal degree)	Level, scale
Finish state	Visual inspection

ii. Reinforcing work inspection

The consultant confirms the certificate of steel materials test submitted by the supplier. Also, the consultant examines the layout drawing of the reinforcing rod (including the drawing of some reinforcing rods processing), the reinforcing rod construction study will be conducted for each part. Their coupling, fixation, number, getting covered thickness are the items of the inspection.

2-2-4-6 Procurement Plan

1) Procurement Plan

The items for the PV system will be procured in consideration of the interface, compatibility, and security of the system. Furthermore, all the main procurement equipment in the project, such as the PV modules, the power conditioner, the battery system, the EMS, and the grid interconnection facilities, will be procured from Japan.

The procurement contract includes responsibility for design, manufacture, coating, factory testing and inspection, packing, transportation, installation, testing by the suppliers, acceptance inspection pursuant to the specification of equipment prepared by the consultant, and delivery after fully confirming the operation by site tests and inspection. The suppliers will obtain approval for inland transportation and installation, prepare necessary materials for work at each site, and fully discuss with the executing agency.

2) Transportation Plan

a) Procurement Equipment and Materials from Japan

The Ebeye port is well maintained and located nearby the project site; the loading for the equipment shall be the Ebeye port. The equipment from Japan is shipped by marine transportation, from Japanese principal ports.

b) Transportation Method of the Equipment

The equipment is transported by truck from the Ebeye port to the project site. In consideration of route conditions is the equipment will be carried by 20 feet containers. It takes about 10 minutes to carry the containers from the Ebeye port to the project site.

2-2-4-7 Operational Guidance Plan

As the PV system planned in this project is a novelty for KAJUR staff, the initial operation guidance and operation guidance are planned.

2-2-4-8 Soft Component (Technical Assistance) Plan

1) Necessity of the Soft Component Works (technical assistance)

It is indispensable for KAJUR's staff and related people to understand and be familiar with the PV system proposed since it is the first time for KAJUR to install this kind of technologies. In addition, in order to implement an appropriate maintenance and management system, it is important to build new work flows related to the handling of the collected electricity data and related weather data. This will enhance the generation of a high quality solar power generation management/ maintenance management manual.

The expected increase of the sea level is a thread for many countries with low elevation levels (less than 2m) as the RMI. Because of this threat, the RMI Government has interest in improving the environmental awareness of local citizens as well as to educate them in renewable energy, especially regarding the PV system to be installed.

2) Goals of the Soft Component

In order to ensure the smooth operation of the PV system, the following soft component goals were established:

a) The trainees obtain the ability to appropriately operate and maintain the PV system
b) Creation of an organization that can self-diagnose and fix problems of the system
c) The trainees obtain the ability to establish and use a report system for the following data: generated electricity, solar radiation, temperature, etc.
d) Increase the renewable energy awareness of the RMI residents.

3) Expected Results of the implementation of the soft components

Soft components implementation is focused on exercises using the installed equipment. The following table shows the results of the soft component of the project and the items to be checked in order to achieve the expected results.

Table 2-16 Soft component results and checklist of activities

Results	Items to be checked
1. The trainees obtain the ability to appropriately operate and maintain the PV system	・ Preparation of the maintenance inspection sheet and related exercises. ・ Establishment of standards and procedures for changing PV panels ・ Construction of the maintenance management structure. ・ Comprehension of the condition of the battery system. Especially to understand the decline of the storage capacity over time. ・ Creation of maintenance financial plan
2. Creation of an organization that can self-diagnose and resolve the problems of the system	・ Create a problem detection procedure ・ Creation of a framework for problem response ・ Practice to solve problems with the introduced equipment
3. The trainees obtain the ability to establish and use a report system for the following data: generated electricity, solar radiation, temperature, etc.	・ Acquisition of electricity generation and weather data etc. / creation of recording table ・ Construction of monitoring system ・ Training exercises on monitoring and reporting (KAJUR will share the monitoring report with the consultant during the implementation period until the soft component is finished, and the consultant provides necessary advice)
4. Increase the renewable energy awareness of the RMI residents	・ Preparation of the facility outline explanation panel ・ Hosting environmental education events (1st session) for local residents

4) Activities included in the Soft Component

In order to achieve the above mentioned results, the following activities will be carried out.

Result 1: The trainees obtain the ability to appropriately operate and maintain the PV system

In order to achieve high standards for the maintenance of the PV system as well as the replacement of PV panels, the consultant will prepare a draft rule package and will organize discussions and exercises based on those rules and help to finalize the working manuals.

Discussions and exercises regarding the condition of the battery system will also be organized. Especially to understand the decline of the storage capacity over time as well as the efficiency improvement of diesel operation.

Result 2: Creation of an organization that can self-diagnose and resolve the problems of the PV system

In order to spread knowledge regarding how to detect defective parts of the PV system and how to solve potential problems, the consultant will prepare a draft rule package and will organize discussions and exercises based on those rules and help to finalize the working manuals.

Result 3: The trainees obtain the ability to establish and use a report system for the following data: generated electricity, solar radiation, temperature, etc.

EMS will be utilized in order to measure energy generation and weather data. A draft of the handling procedure (prepared by consultant) will be used for the discussions and exercises based on those procedures. Assistance to finalize the working manuals is also going to be provided. The exercises will be performed and monitored based on written letters.

Result 4: Increase the renewable energy awareness of Marshall Islands residents

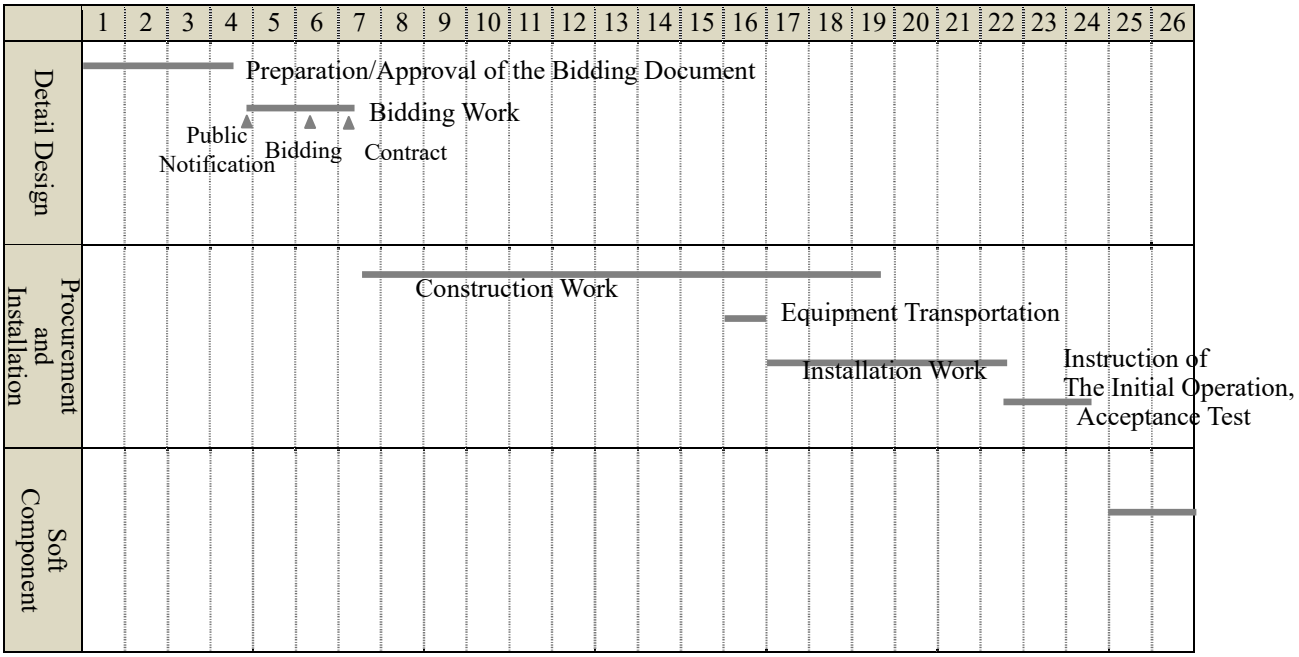
In order to increase the environmental awareness of local residents, public lectures will be organized (prepared by consultant) including fundamental information on renewable energy and materials for this project. Lectures will also include discussion. In addition, KAJUR will carry out the first facility tour event for local residents based on publicity material.

At the same time, a panel that comprehensively summarizes the facility outline of the photovoltaic power generation system will be prepared.

2-2-4-9 Implementation Schedule

In case the procurement and installation of the PV systems goes as planned, the implementation schedule should be as follows:

Table 2-17 Implementation schedule



2-3 Obligations of Recipient Country

Upon the implementation of the project as a grant aid project by Japan, the following steps are taken:

1) Undertakings to be borne by Marshall Side

a) Tax Exemption

The Marshall Authority will exempt customs duties, domestic taxes and other charges for Japanese nationals entering into the recipient country to procure and install equipment and materials based on the procurement contract of the Project and to implement various activities. The Marshall Authority will also facilitate prompt processing of customs clearance of procured equipment and materials, and exempt import duties and VAT for such equipment and materials.

b) Giving Facilities

Japanese who are involved in the works that are provided based on the approved contract and who are related with the contract shall be secured to offer the steps to stay in the RMI to contribute to the works.

c) Banking Arrangement (B/A), Authorization to Pay (A/P)

The Marshall Authority will open a bank account in its name at a Japanese bank and issue Authorization to Pay (A/P) to the bank. Based on the Banking Arrangement (B/A), the Marshall side should bear advising commissions of an Authorization to Pay (A/P) and payment commissions to the Bank.

d) Environmental assessment

The Environmental Protection Agency (herein after referred to "EPA") is the construction supervisory authority of the environmental impact assessment in Marshall Islands. Even though it is unnecessary to conduct an environmental impact assessment analysis for this project, it will be necessary to take the test of Earthmoving Application by EPA before starting the construction phase of the project; this is expected to take 30 days. In addition to the investigation, the Environmental Management Plan is required. Those requests are applied by KAJUR.

2) Works by Marshall Islands Side

a) The Sewer Connection Construction

The sewage drainage from the building on the upper part of the frame structure will be connected with the main public sewage pipe in the northern public road in the site. The construction from the main sewage pipe to the first box in the site will be undertaken by KAJUR.

b) The Construction of Fences

The fences will be constructed around the project site by KAJUR.

c) Site clearance

The removal of the equipment in the project site will be done by KAJUR.

2-4 Operation and Maintenance Plan

The operation and maintenance of the PV system and the main items to check, clean, maintain and manage are as follow.

1) Operation and Maintenance Plan

The operation and maintenance plan is constructed by 15 staff: a manager, an engineer, three linemen, two machinists, and eight operators.

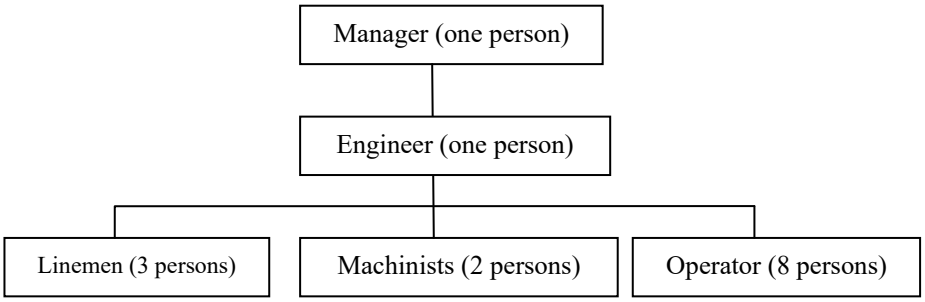


Figure 2-7 Operation and Maintenance Plan for the PV System by KAJUR

2) Periodic Inspection

The daily and periodic inspection, and the cleaning will be conducted and lead by the operators. The inspection of the items established by the manufacturer that was in charge of the installation of the PV system at the time of the installation of the initial operation and the general operation will be checked periodically.

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

The RMI owes the following expense items, and it is estimated to be approximately 28,700 US dollars in total.

i. Sewage connection construction: approx. 1,700 US Dollars
ii. Construction of the fences: approx. 15,000 US Dollars
iii. Clearance of the project site: approx. 7,000 US Dollars
iv. Earthmoving Application fee: approx. 5,000 US Dollars

2-5-2 Operation and Maintenance Cost

The capital materials are the PV system, the battery system, the EMS, and the grid interconnection facility. The operation and maintenance costs to be increased /decreased by the project are the following items:

1) Reduction of diesel power generators operation through the installation of the photovoltaic power generation system
2) Labor cost to secure and manage the PV system
3) Consumable costs

1) Reduction of diesel power generators operation through the installation of the photovoltaic power generation system

With the installation of the proposed PV system, a reduction of fuel consumption is expected. The reduction will be equivalent to the amount of fuel required to generate 707MWh. KAJUR's diesel consumption for electricity production is of 4.14 kWh /l. With the introduction of the PV system a fuel reduction of approximately 170,000 liters per year is expected. Since KAJUR is purchasing diesel at about 0.93 US Dollar / liter, it is expected that the fuel cost will be reduced by approximately 158,100 US Dollars per year.

2) Labor cost to secure and manage the PV system

The PV system needs maintenance and daily and periodic inspections. 15 workers are going to be in charge of this. KAJUR officers are expected to carry out maintenance management activities, so an increase of the labor cost of the maintenance staff is expected.

It will cost about 3,000US Dollars per year for the cleaning of the PV panels.

3) Consumable Costs

It is estimated that the replacement of the ink cartridge in the printer to operate EMS costs about 50 US Dollars per a year.

The operation and maintenance costs mentioned above are shown in the Table 5-1.Thanks to the reduction of the costs of the operation of the diesel power generators, the maintenance and management cost of the PV system can be provided.

Table 2-18 Maintenance and operation costs

Expense Items	Price (US Dollar)
(1) Reduction of the operation of the diesel power generators	-158,100
(2) Labor cost to secure and manage the photovoltaic power generation system	3,000
(3) Consumable Costs for printout	50
Total	-155,050

Chapter 3 Project Evaluation

Chapter 3 Project Evaluation

3-1 Preconditions to implement the project

1) Land use for the installation of the PV system

The land for the installation of the PV system of this project will be provided by KAJUR, so it is unnecessary to acquire new land. The cleaning and removal of the old equipment will be under responsibility of Marshall Islands.

2) Environment related permissions

The Environmental Protection Agency (EPA) is the construction supervisory authority of the environmental impact assessment in Marshall Islands. Even though it is unnecessary to conduct an environmental impact assessment analysis for this project, it will be necessary to take the test of Earthmoving Application by EPA before starting the construction phase of the project. Marshall side will have the responsibility to conduct such studies.

3) Tax exemption

The Marshall Authority will exempt customs duties, domestic taxes and other charges for Japanese nationals entering into the recipient country to procure and install equipment and materials based on the procurement contract of the Project and to implement various activities. The Marshall Authority will also facilitate prompt processing of customs clearance of procured equipment and materials, and exempt import duties and VAT for such equipment and materials.

4) Grid interconnection work

The grid interconnection works will be under responsibility of the Marshall Islands side.

5) Fence construction and sewer connection works

The Fence construction and sewer connection works will be under responsibility of the Marshall Islands side.

3-2 Necessary Inputs by Recipient Country

1) Maintenance and construction system

The operation and maintenance of the PV system will be responsibility of KAJUR. KAJUR will arrange a team of 15 members consisting of a manager, an engineer, operators, linemen and machinists.

2) Supplementation and strengthening of other JICA's projects

In addition to this project in Marshall Islands, renewable energy projects for the pacific region

are planned. The introduction of Hybrid Power Generation system is expected for 2017-2022, together with the development and management of microgrid technologies.

3-3 Important Assumptions

1) Guidelines for the introduction of renewable energies

The introduction of renewable energy will influence the existing distribution grid as well as its customers. It is important for Marshall Islands to establish a grid interconnection guideline as proposed in the “Project on the Formulation of Self-Sufficient Energy Supply System” conducted by JICA during the period of 2013-2015.

2) Other Donors cooperation

The World Bank is preparing a grant aid project for the construction of PV systems in Majuro. The RMI is receiving assistance from international institutions and countries in order to develop infrastructure. Collaboration with international institutions can enhance the results of future projects.

3-4 Project Evaluation

3-4-1 Relevance

1) Consistency with Marshall Island’s National Policy

The RMI established The National Energy Policy and Energy Action Plan (NEPEAP) in September 2009, aiming to cover 20% of power supply with renewable energy sources by 2020. The installation of the PV system introduced in this project is aligned with NEPEAP objectives and will contribute to the achievement of its energy targets.

2) Consistency with JICA’s Cooperation Policy

The Japanese Development Cooperation Policy for the RMI (December 2012) has established "Overcoming Vulnerabilities" and "Environment and Climate Change" as priority areas for its assistance.

Infrastructure development to strengthen the economic growth is part of the “Overcoming Vulnerabilities” and climate change countermeasures are part of the “Environment and Climate Change” priority.

This project is also consistent with JICA’s Country Analysis Paper (December 2012) for the Pacific region, where it was mentioned the importance of projects related to the maintenance of the lifeline facilities of energy for the RMI.

3-4-2 Effectiveness

1) Reduction of CO_2 due to power generation with renewable sources (Quantitative results)

As a result of the introduction of renewable power sources is possible to increase the amount of power generated and to reduce CO_2 emissions at the same time.

Table 3-1 Expected power generation and CO_2 reductions

Item	Base value (2017)	Goal value (2022) (3 years after project completion)
System Capacity (kW)	0	600
Annual energy generation (Net generation) (MWh/year)	0	707.3
Diesel reduction (kL/year)	0	170
Expected reduction of CO_2 (tCO_2/year)	0	441

2) Renewable energy expansion (Qualitative results)

It will be the first time for Ebeye to install a grid connected PV system. This project is considered as an example for the spreading of renewable energies across the country.

Additionally, the soft component of this project will contribute to the development of a group of professional technicians in charge of performing maintenance management and troubleshooting technology transfer related to grid interconnected photovoltaic power generation system.

3) Environmental awareness (Qualitative results)

Technology transfer related to the improvement of the environmental awareness will be provided as part of the soft component. Additionally, the design of this project will allow visitors, such as tourists, children and students to visit the PV system, so it is expected to raise the environmental awareness of all society members.

Based on the reasons stated above, the validity of this project is high and its implementation is expected to succeed.

Annexes

Annex 1. Member List of the Study Team

Member List of
The Preparatory survey for the Project for Installation of
Solar Electricity Generation System in Ebeye Island

Preparatory Survey 1 (July 7-July 22, 2016)

1.	Takeshi NAITO	Planning Management	Energy and Mining Group, Industrial Development and Public Policy Department Japan International Cooperation Agency (JICA)
2.	Hirotsugu KATO	Chief Consultant/ Photovoltaic Power Generation System Planner	Oriental Consultants Global co., ltd
3.	Ado KAMAGATA	Configuration of Control Equipment/Equipment Introduction Plan	Oriental Consultants Global co., ltd
4.	Kiyotaka TSUKIMOTO	Grid Analysis	Kyushu Electric Power co., Inc.
5.	Yoshifumi MITSUNAGA	Diesel Power Generator Operation	Kyushu Electric Power co., Inc.
6.	Soichiro HAYASHI	Facility Plan/Natural Condition Survey	Oriental Consultants Global co., ltd
7.	Wataru MORIMOTO	Procurement Plan/ Cost Estimation	Oriental Consultants Global co., ltd
8.	Mai SUZUKI	Environmental Impact Assessment	Oriental Consultants Global co., ltd

Preparatory Survey 2 (Sep. 3-Sep.11, 2016)

1.	Shigeru SUGIYAMA	Team Leader	Energy and Mining Group, Industrial Development and Public Policy Department Japan International Cooperation Agency (JICA)
2.	Takeshi NAITO	Planning Management	Energy and Mining Group, Industrial Development and Public Policy Department Japan International Cooperation Agency (JICA)
3.	Hitotsugu KATO	Chief Consultant/ Photovoltaic Power Generation System Planner	Oriental Consultants Global co., ltd
4.	Ado KAMAGATA	Configuration of Control Equipment/Equipment Introduction Plan	Oriental Consultants Global co., ltd
5.	Kiyotaka TSUKIMOTO	Grid Analysis	Kyushu Electric Power co., Inc.
6.	Yoshifumi MITSUNAGA	Diesel Power Generator Operation	Kyushu Electric Power co., Inc.

7.	Soichiro HAYASHI	Facility Plan/Natural Condition Survey	Oriental Consultants Global co., ltd
8.	Wataru MORIMOTO	Procurement Plan/ Cost Estimation	Oriental Consultants Global co., ltd
	Mai SUZUKI	Environmental Impact Assessment	Oriental Consultants Global co., ltd

Preparatory Survey 3 (July 17-July 22, 2017)

1.	Nobuaki MATSUI	Team Leader	Resident Representative Marshall Islands Office Japan International Cooperation Agency (JICA)
2.	Takeshi NAITO	Planning Management	Energy and Mining Group, Industrial Development and Public Policy Department Japan International Cooperation Agency (JICA)
3.	Hirotsugu KATO	Chief Consultant/ Photovoltaic Power Generation System Planner	Oriental Consultants Global co., ltd
4.	Mitsukage YAMADA	Vice Chief Consultant	Oriental Consultants Global co., ltd
5.	Soichiro HAYASHI	Facility Plan/Natural Condition Survey	Oriental Consultants Global co., ltd
6.	Kiyotaka TSUKIMOTO	Grid Analysis	Kyushu Electric Power co., Inc.
7.	Yoshifumi MITSUNAGA	Diesel Power Generator Operation	Kyushu Electric Power co., Inc.

Annex 2. Study Schedule

2. Study Schedule

Preparatory Survey 1 (July 7-July22, 2016)

Date		Officials	Consultants						
		Planning Management	Chief Consultant/ Photovoltaic Power Generation System Planner	Configuration of Control Equipment/ Equipment Introduction Plan	Grid Analysis	Diesel Power Generator Operation	Facility Plan/ Nagural Condition Survey	Procurement Plan/ Cost Estimation	Environmental Impact Assessment
		Takeshi NAITO	Hirotsugu KATO	Ado KAMAGATA	Kiyotaka TSUKIMOTO	Yoshifumi TSUKINAGA	Soichiro HAYASHI	Wataru MORIMOTO	Mai SUZUKI
7-Jul	Thu		Narita-Guam				Narita-Guam		
8-Jul	Fri		Guam-Majuro		Fukuoka-Hawaii		Guam-Majuro		
9-Jul	Sat		Inspection of Facility for Installation of PV		Hawaii-Majuro		Inspection of Facility for Installation of PV		
10-Jul	Sun	Japan-Guam	Team MTG		Team MTG				
11-Jul	Mon	Guam-Majuro	Meeting with MPW and Senator Paul		Meeting with MPW and Senator Paul			Procurement Survey	Meeting with MPW and Senator Paul
12-Jul	Tue	JICA	Majuro-Guam		JICA				
		Courtesy visit to the Embassy			Site Survey		Courtesy visit to the Embassy	Procurement Survey	Site Survey
13-Jul	Wed		Guam-Narita		Meeting with MRD, MPW, EPA, NOAA/ Collecting Information				
14-Jul	Thu	Majuro-Kwajalein		Narita-Guam	Majuro-Kwajalein			Majuro-Guam	
		Meeting with KAJUR			Meeting with KAJUR				
15-Jul	Fri	Office of Chief Secretary/ Meeting with KAJUR		Guam-Kwajalein	Office of Chief Secretary/ Meeting with KAJUR	Kwajalein-Honolulu	Office of Chief Secretary/ Meeting with KAJUR	Guam-Narita	
16-Jul	Sat	Kwajalein-Guam		Site Survey			Site Survey		
17-Jul	Sun	Guam-Narita		Team MTG Site Survey			Team MTG Site Survey		
18-Jul	Mon			Meeting with KAJUR			Meeting with KAJUR		
19-Jul	Tue			Meeting with KAJUR			Meeting with KAJUR		
20-Jul	Wed			Meeting with KAJUR	Ebeye-Honolulu		Meeting with KAJUR		
21-Jul	Thu			Ebeye-Guam	Honolulu-Narita		Ebeye-Guam		
22-Jul	Fri			Guam-Narita			Guam-Narita		

Preparatory Survey 2 (Aug. 29-Sep. 11, 2016)

Date		Officials		Consultant						
		Team Leader	Planning Management	Chief Consultant/ Photovoltaic Power Generation System Planner	Configuration of Control Equipment/ Equipment Introduction Plan	Grid Analysis	Diesel Power Generator Operation	Facility Plan/ Nagural Condition Survey	Procurement Plan/ Cost Estimation	Environmental Impact Assessment
		Shigeru SUGIYAMA	Takeshi NAITO	Hirotsugu KATO	Ado KAMAGATA	Kiyotaka TSUKIMOTO	Yoshifumi TSUKINAGA	Soichiro HAYASHI	Wataru MORIMOTO	Mai SUZUKI
29-Aug	Mon					Narita-Honolulu				
30-Aug	Tue			Narita-Guam		Honolulu-Majuro		Narita-Guam		
31-Aug	Wed			Guam-Majuro				Guam-Majuro		
				Team MTG		Team MTG				
1-Sep.	Thu			JICA	Narita-Guam	JICA				
				MRD, MPW		MRD, MPW			EPA, NOAA	
2-Sep.	Fri			JICA Majuro Hospital	Guam-Ebeye	JICA Majuro Hospital			Procurement Survey	EPA
3-Sep.	Sat			Majuro-Kwajalein		Majuro-Kwajalein				
				Team MTG						
4-Sep.	Sun	Narita-Guam		Site Survey						
5-Sep.	Mon	Guam-Ebeye		Meeting with KAJUR, Chief Secretary Office, KALGOV						
									Meeting with EPA	
6-Sep.	Tue	Congruent meeting with KAJUR, Chief Secretary Office, KALGOV							Kwajalein-Guam	
		Meeting with KAJUR								
7-Sep.	Wed	Meeting with KAJUR							Procurement Survey	Guam-Narita
		Kwajalein-Majuro								
8-Sep.	Thu	JICA, MPW, MRD							Procurement Survey	
		ADB, MOF, NTA								
9-Sep.	Fri	Conclusion of Minutes								
		Team MTG				Majuro-Honolulu		Team MTG		
10-Sep.	Sat	Majuro-Guam				Honolulu-Narita		Majuro-Guam		
11-Sep.	Sun	Guam-Narita						Guam-Narita		

Preparatory Survey 3 (July 9-July 23, 2017)

Date		Officials		Consultant				
		Team Leader	Planning Management	Chief Consultant/ Photovoltaic Power Generation System Planner	Vice Chief Consultant	Facility Plan/ Nagural Condition Survey	Grid Analysis	Diesel Power Generator Operation
		Nobuaki MATSUI	Takeshi NAITO	Hirotsugu KATO	Mitsukage YAMADA	Soichiro HAYASHI	Kiyotaka TSUKIMOTO	Yoshifumi TSUKINAGA
9 July	Sun					Narita-Guam	Fukuoka-Honolulu	
10 July	Mon					Guam-Majuro	Honolulu-Kwajalein	
11 July	Tue					Meeting with JICA	Site Survey	
						MEC, Majuro Hospital		
12 July	Wed					MEC, Majuro Hospital	Meeting with KAJUR/ Site Survey	
						Meeting with EPA, MPW, MRD		
13 July	Thu					Majuro-Kwajalein	Meeting with KAJUR/ Site Survey	
						Meeting with Chief Secretary Office		
14 July	Fri					Meeting with KAJUR		
						Site Survey	Kwajalein-Majuro	
15 July	Sat					Site Survey	Site Survey	Majuro-Honolulu
16 July	Sun		Narita-Guam	Narita-Honolulu		Site Survey	Site Survey	Honolulu-Narita
17 July	Mon		Guam-Majuro	Honolulu-Majuro		Kwajalein-Majuro		
		Meeting with JICA				Meeting with JICA		
18 July	Tue	Meeting with JICA		Honolulu-Majuro		Meeting with JICA		
		Minutes Discussion						
19 July	Wed	Meeting with NTA		Meeting with NTA	Site Survey	Meeting with NTA	Site Survey	
20 July	Thu	Meeting with ADB, MOF		Meeting with ADB, MOF				
21 July	Fri	Minutes Discussion						
		Courtesy visit to the Embassy			Team MTG	Courtesy visit to the Embassy	Team MTG	
				Majuro-Honolulu			Majuro-Honolulu	
22 July	Sat		Majuro-Guam	Honolulu-Narita		Majuro-Guam	Honolulu-Narita	
23 July	Sun					Guam-Narita		

Annex 3. List of Parties Concerned

in the Recipient Country

3. List of Parties Concerned in the Recipient Country

Preparatory Survey 1 (July 7-July 22, 2016)
Preparatory Survey 2 (Aug. 29-Sep.11, 2016)
Preparatory Survey 3 (July 9-July 23, 2017)

1. Embassy of Japan

Hideyuki MITSUOKA	Ambassador Extraordinary and Plenipotentiary
Hiroshi WATANABE	Counsellor
Chizuru SEKI	Economic Advisor / Researcher

2. JICA Marshall Office

Nobuaki MATSUI	Resident Representative
Noriaki NIWA	Acting Resident Representative
Manami KANEKO	Volunteer Coordinator

3. Kwajalein Atoll Joint Utility Resources (KAJUR)

Romeo Alfred	General Manager
Kitlang Kabua	Special Adviser
Edward Bobo	Project Management Unit Manager
Martha William	Acting Finance Operations Division Manager
Daniel Tokeak	Plant Engineer

4. Senator

David Paul	Senator

5. MPW

Anthony M. Muller	The Ministry
Malia Heine	Acting secretary
Catalino Kijiner	Secretary
Jeff Zebedy	Assistant Secretary
Melvin Dacillo	PMU Manager
William Reiher	Officer
Malvin V Dacillo	Officer
Rodrigo Hamandez III	Officer

6. MRD

Walter Myazoe, Jr.	Assistant Energy Planner
Alfred Alfred Jr.	Officer
Rebecca Lorennji	Secretary
Angeline Heine	Energy Planner, Energy Planning Division
Walter Myazoe	Chief, Trade & Investment
Benjamin S. Wakefield	Assistant National Energy Planner

7. Office of the Chief Secretary

Abacca Anjain-Maddison	Deputy Chief Secretary
Masao Halmi, Jr.	Senior Disaster Coordinator

8. Kwajalein Atoll Local Government

Fredzy Mawicong	Acting Mayor
Capelle Antipas	City Cleark
Scott B. Paul	City Manager
Andy Ordonez	Special Assistant
Wesley Lemari	Assistant Director of PW

9. EPA

Julius Lucky	Deputy general manager
Lani Milne	EPA Division Chief
Aaron Lanqinlur	Waste sector officer
Odrikawa A. Jatios	Deputy General Manager

10. MEC

Jack Chong Gum	General Manager
Steve Wakefield	Chief Technical Officer
Ronnie Bungitak	Plant Engineer

11. NTA

Yoshi T Kaneko	Vice President & COO

12. NOAA

Reggie White	Director Weather Service Office
Lee Jacklick	Officer

13. MOF

Ted Michael	Chief of Customs
Jennifer Y. Tseng	
Maybelline Andon	

14. KALGOV

Fredzy Mawicong	Acting Mayor
Capelle Antipas	City Cleark
Andy Ordonez	Special Assistant

Annex 4. Minutes of Discussions (M/D)

Minutes of Discussions
on the Preparatory Survey for the Project for
PV Power Generation System in Ebeye Island, Republic of Marshall Islands

In response to the request from the Government of Republic of Marshall Islands (hereinafter referred to as "RMI"), the Government of Japan decided to conduct a Preparatory Survey for the Project for PV Power Generation System in Ebeye Island (hereinafter referred to as "the Project"), and entrusted the Preparatory Survey to Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent the Preparatory Survey Team for the Outline Design (hereinafter referred to as "the Team") to RMI, headed by Mr. Shigeru Sugiyama, Deputy Director General, Department of Industrial Development and Public Policy Department, JICA, and is scheduled to stay in the country from 2 to 9 September, 2016.

The Team held a series of discussions with the officials concerned of the Government of RMI and conducted a field survey in the Project area. In the course of the discussions, both sides have confirmed the main items described in the attached sheets. The Team will proceed to further works and prepare the Preparatory Survey Report.

Majuro, 9 September, 2016

Shigeru Sugiyama
Leader
Preparatory Survey Team
Japan International Cooperation Agency
Japan

Rebecca Lorennji
Secretary
Ministry of Resources and Development
Republic of Marshall Islands

Kitlang Kabua
Special Advisor to Senior Management
Kwajalein Atoll Joint Utility Resources
Republic of Marshall Islands

Catalino Kijiner
Secretary
Ministry of Public Works
Republic of Marshall Islands

ATTACHEMENT

1. Objective of the Project
   The objective of the Project is to improve sustainability of power supply and reduce fossil fuel consumption by construction photovoltaic generation system in Ebeye, thereby contributing to environmental policy and climate change strategy of RMI.

2. Title of the Preparatory Survey
   Both sides confirmed the title of the Preparatory Survey as "the Preparatory Survey for the Project for PV Power Generation System in Ebeye Island".

3. Project Site
   Both sides confirmed that the site of the Project is in Ebeye, which is shown in Annex 1.

4. Line Agency and Executing Agency
   Both sides confirmed the line agency and executing agency as follows:
   4-1. The line agency is Ministry of Resources and Development, which would be the agency to supervise the executing agency.
   4-2. The executing agency is Kwajalein Atoll Joint Utility Resources (hereinafter referred to as "KAJUR"). The executing agency shall coordinate with all the relevant agencies to ensure smooth implementation of the Project and ensure that the Undertakings are taken by relevant agencies properly and on time. The organization charts are shown in Annex 2.

5. Items requested by the Government of RMI
   5-1. As a result of discussions, both sides confirmed that the items requested by the Government of RMI are as follows:
   - Installation of photovoltaic generation system
   - Technical transfer for operation and maintenance of generation system

   5-2. JICA will assess the appropriateness of the above requested items through the survey and will report findings to the Government of Japan. The final components of the Project would be decided by the Government of Japan.

6. Japanese Grant Scheme
   6-1. RMI side understands the Japanese Grant Scheme and its procedures as described in Annex 3 and Annex 4, and necessary measures to be taken by the Government of RMI.
   6-2. RMI side understands to take the necessary measures, as described in Annex 6, for smooth implementation of the Project, as a condition for the Japanese Grant to be implemented. The detailed contents of the Annex 6 will be worked out during the survey and shall be agreed no later than by the Explanation of the Draft Preparatory Survey Report.
   The contents of Annex 6 will be used to determine the following:
   (1) The scope of the Project.
   (2) The timing of the Project implementation.
   (3) Timing and possibility of budget allocation.
   Contents of Annex 6 will be updated as the Preparatory Survey progresses, and will finally be the Attachment to the Grant Agreement.

7. Schedule of the Survey
   7-1. JICA will prepare a draft Preparatory Survey Report in English and dispatch a mission to RMI in order to explain its contents around January 2017.
   7-2. If the contents of the draft Preparatory Survey Report is accepted in principle and the Undertakings are fully agreed by the RMI side, JICA will complete the final report in English and send it to RMI

around May 2017.

7-3. The above schedule is tentative and subject to change.

8. Environmental and Social Considerations

8-1. RMI side confirmed to give due environmental and social considerations during implementation of the Project, and after completion of the Project, in accordance with the JICA Guidelines for Environmental and Social Considerations (April, 2010).

8-2. The Project is categorized as "B" because the Project is not located in a sensitive area, nor has sensitive characteristics, nor falls into sensitive sectors under the JICA guidelines for environmental and social considerations April 2010, and its potential adverse impacts on the environment are not likely to be significant. RMI side confirmed to conduct the necessary procedures concerning the environmental assessment (including stakeholder meetings, Environmental Impact Assessment (EIA) /Initial Environmental Examination (IEE) and information disclosure,etc.) and make EIA/IEE report of the Project. The EIA/IEE approval shall be received from the responsible authorities and submitted to JICA by the end of November 2016.

9. Other Relevant Issues

9-1. RMI side clarified it's intention of the request to maximizing output by photovoltaic power generation system within the foot print of the Project site while maintaining the operability of the system. It also explained that it was preferable that photovoltaic power generation system would reduce the frequency of operating three diesel generators at same time for the sake of better fuel efficiency, and giving wider operational flexibility since there are only three diesel generators and it is unavoidable to implement load shedding during the repair/overhaul of the diesel generators.

9-2. RMI side provided JICA side with copy of the current land lease contract which includes the Project site. RMI side also explained that the said lease contract will be renewed as of October 2016 and copy of relevant document will be provided when Draft Outline Design mission arrives.

9-3. JICA side explained that land clearance of the Project site is one of important conditions to be fulfilled by RMI side for commencing the procurement process, it requested KAJUR to provide realistic clearance schedule on or before the arrival of the forthcoming Draft Outline Design mission.

9-4. There is a plan to remove exciting telecom tower erected in the Project site. RMI side will provide JICA side the information of removal plan/progress in due course. Both sides agreed that layout design does not require to set aside space for access road for heavy vehicle.

9-5. RMI side explained the Project site is no longer serving as a water catchment pond, therefore rain water should be discharged immediately to ensure access to photovoltaic power generation equipment all the time and to maintain suitable sanitary condition. Accordingly JICA side will include water discharge facility in the project.

9-6. JICA side explained that some of existing equipment need to be modified to integrate with new photovoltaic power generation system, KAJUR expressed no objection in principle though it needs to examine the detailed drawings, and it promised to provide necessary permission and safety measurement.

9-7. RMI side strongly requested JICA side to consider including technical transfer of operation and maintenance of photovoltaic power generation system. It also requested several phases of trainings i.e. theory and fundamental knowledge during the procurement, a few times of practical training after the photovoltaic power generation system is put in operation. JICA side took note of it and would consider the request.

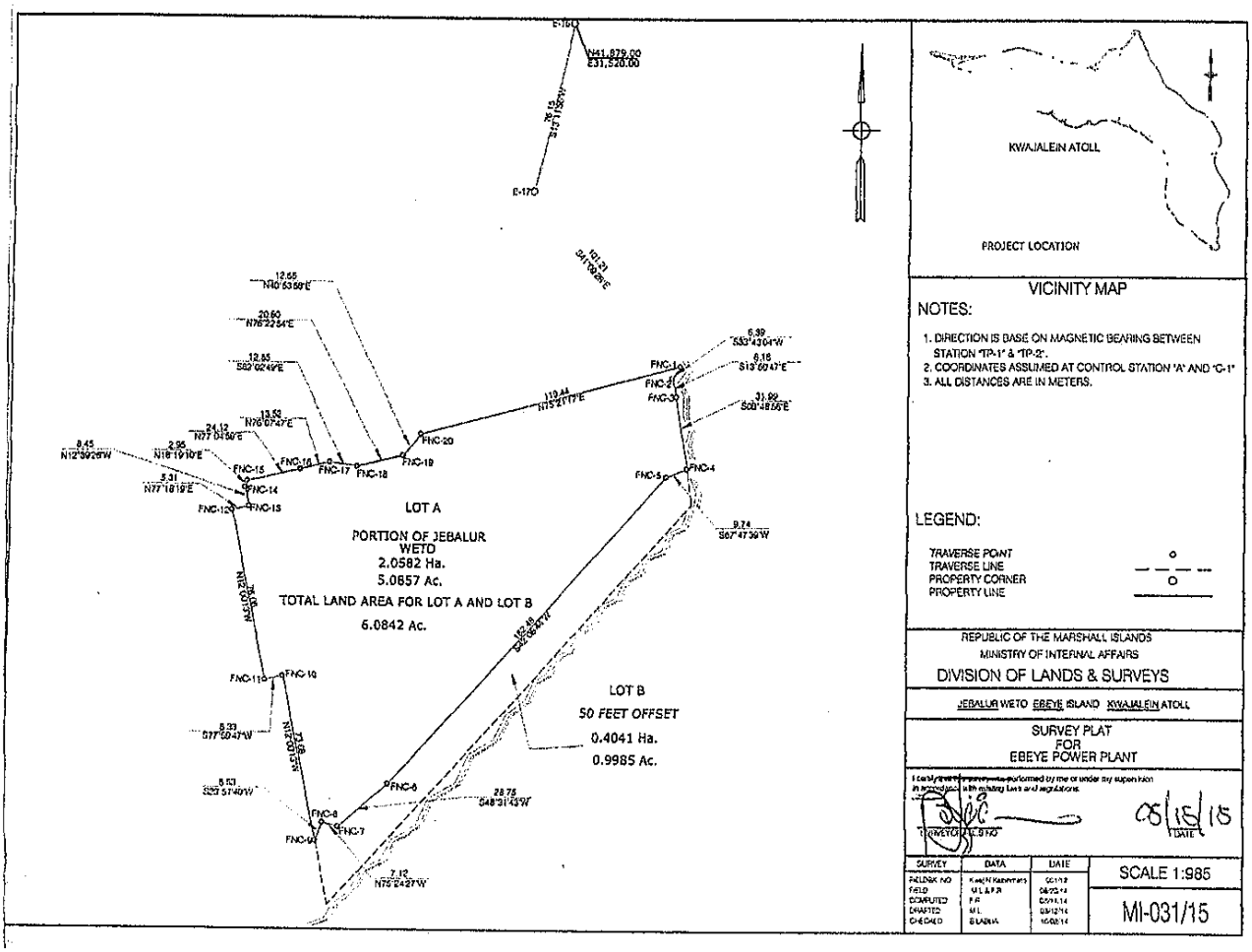
9-8. RMI side requested that both detailed and user-friendly quick manual for operation and maintenance including trouble-shooting be prepared by the contractor.

9-9. RMI side expressed its willingness to accept visitors within the solar power plant as a mean to provide opportunity to learn about power supply facilities with a focus of photovoltaic power generation. In this regard, RMI side requested JICA side to study site layout incorporating such aspect. RMI side also requested JICA side to assist in materializing guided tour as part of technical

transfer. JICA side took note of it and would consider the request.

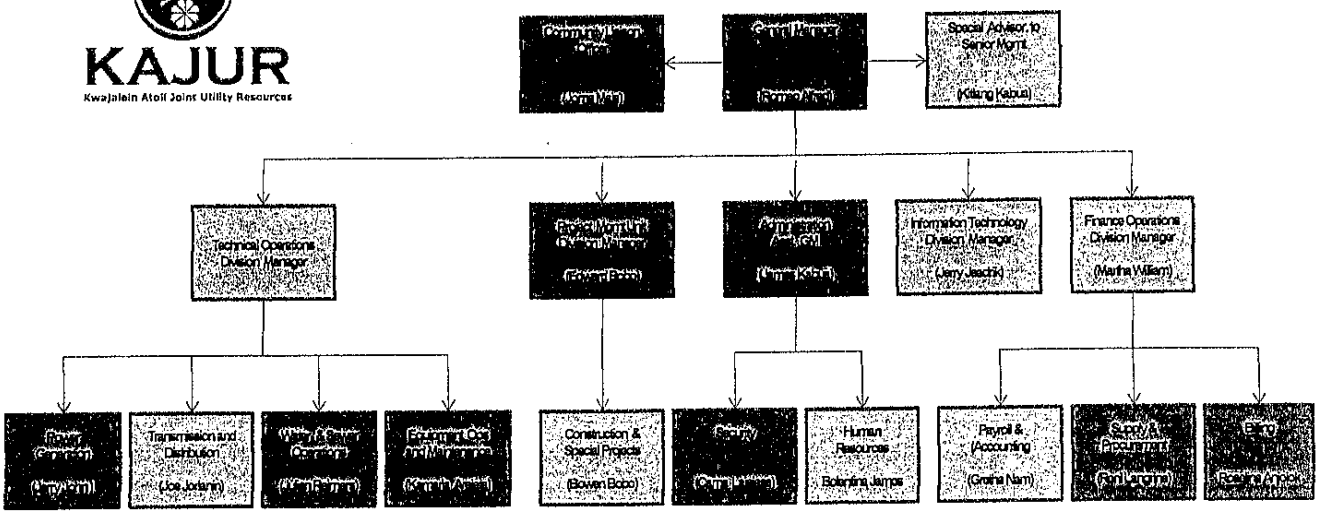
Annex 1 Project Site
Annex 2 Organization Chart
Annex 3 Japanese Grant
Annex 4 Flow Chart of Japanese Grant Procedures
Annex 5 Financial Flow of Japanese Grant
Annex 6 Major Undertakings to be taken by Each Government

Annex 1 Project site



Annex 2 Organization Chart

KAJUR
Kwajalein Atoll Joint Utility Resources



Annex 3

JAPANESE GRANT

The Japanese Grant (hereinafter referred to as the "Grant") is non-reimbursable fund provided to a recipient country to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for its economic and social development in accordance with the relevant laws and regulations of Japan. The Grant is not supplied through the donation of materials as such.

Based on a JICA law which was entered into effect on October 1, 2008 and the decision of the GOJ, JICA has become the executing agency of the Japanese Grant for Projects for construction of facilities, purchase of equipment, etc.

1. Grant Procedures

The Grant is supplied through following procedures :

- Preparatory Survey
  - The Survey conducted by JICA
- Appraisal &Approval
  - -Appraisal by the GOJ and JICA, and Approval by the Japanese Cabinet
- Authority for Determining Implementation
  - -The Notes exchanged between the GOJ and a recipient country
- Grant Agreement (hereinafter referred to as "the G/A")
  - -Agreement concluded between JICA and a recipient country
- Implementation
  - -Implementation of the Project on the basis of the G/A

2. Preparatory Survey

(1) Contents of the Survey

The aim of the preparatory Survey is to provide a basic document necessary for the appraisal of the Project made by the GOJ and JICA. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of relevant agencies of the recipient country necessary for the implementation of the Project.
- Evaluation of the appropriateness of the Project to be implemented under the Grant Scheme from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of an outline design of the Project.
- Estimation of costs of the Project.

The contents of the original request by the recipient country are not necessarily approved in their initial form as the contents of the Grant project. The Outline Design of the Project is confirmed based on the guidelines of the Japanese Grant scheme.

JICA requests the Government of the recipient country to take whatever measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization of the recipient country which actually implements the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country based on the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA employs (a) consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

(3) Result of the Survey

JICA reviews the Report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the appropriateness of the Project.

3. Japanese Grant Scheme

(1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes(hereinafter referred to as "the E/N") will be singed between the GOJ and the Government of the recipient country to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Government of the recipient country to define the necessary articles, in accordance with the E/N, to implement the Project, such as payment conditions, responsibilities of the Government of the recipient country, and procurement conditions.

(2) Selection of Consultants

In order to maintain technical consistency, the consulting firm(s) which conducted the Survey will be recommended by JICA to the recipient country to continue to work on the Project's implementation after the E/N and G/A.

(3) Eligible source country

Under the Grant, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. The Grant may be used for the purchase of the products or services of a third country, if necessary, taking into account the quality, competitiveness and economic rationality of products and services necessary for achieving the objective of the Project. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm are limited to "Japanese nationals", in principle.

(4) Necessity of "Verification"

The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals, in principle. Those contracts shall be verified by JICA. This "Verification" is deemed necessary to fulfill accountability to Japanese taxpayers.

(5) Major undertakings to be taken by the Government of the Recipient Country

In the implementation of the Grant Project, the recipient country is required to undertake such necessary measures as Annex. The Japanese Government requests the Government of the recipient country to exempt all customs duties, internal taxes and

other fiscal levies such as VAT, commercial tax, income tax, corporate tax, resident tax, fuel tax, but not limited, which may be imposed in the recipient country with respect to the supply of the products and services under the verified contract, since the Grant fund comes from the Japanese taxpayers.

(6) "Proper Use"

The Government of the recipient country is required to maintain and use properly and effectively the facilities constructed and the equipment purchased under the Grant, to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Grant.

(7) "Export and Re-export"

The products purchased under the Grant should not be exported or re-exported from the recipient country.

(8) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account under the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"), in principle. JICA will execute the Grant by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank to JICA under an Authorization to Pay (A/P) issued by the Government of the recipient country or its designated authority.

(9) Authorization to Pay (A/P)

The Government of the recipient country should bear an advising commission of an Authorization to Pay and payment commissions paid to the Bank.

(10) Environmental and Social Considerations

The Government of the recipient country must carefully consider environmental and social impacts by the Project and must comply with the environmental regulations of the recipient country and JICA Guidelines for Environmental and Social Consideration (April, 2010) .

(11) Monitoring

The Government of the recipient country must take their initiative to carefully monitor the progress of the Project in order to ensure its smooth implementation as part of their responsibility in the G/A, and must regularly report to JICA about its status by using the Project Monitoring Report (PMR).

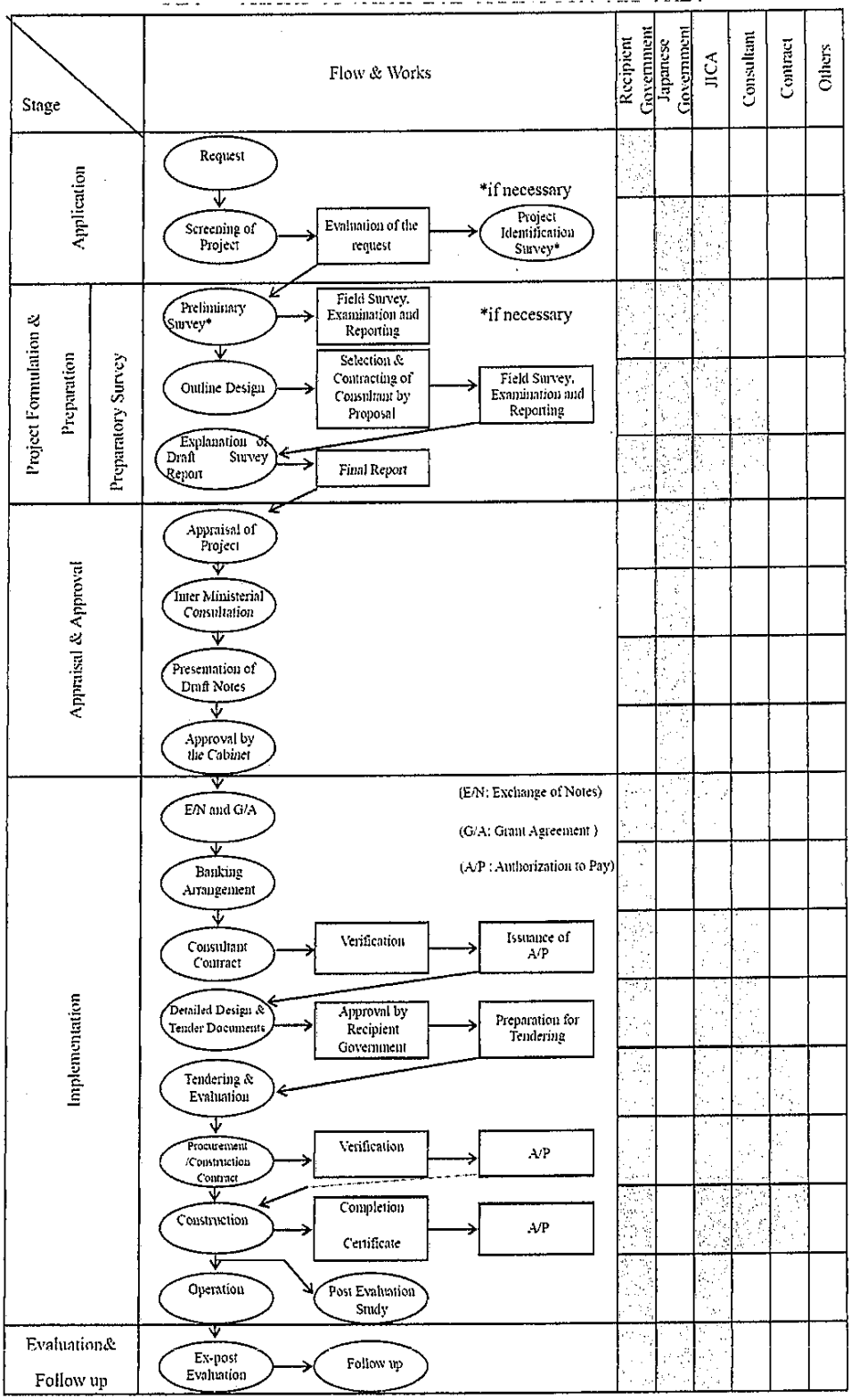
(12) Safety Measures

The Government of the recipient country must ensure that the safety is highly observed during the implementation of the Project.

end

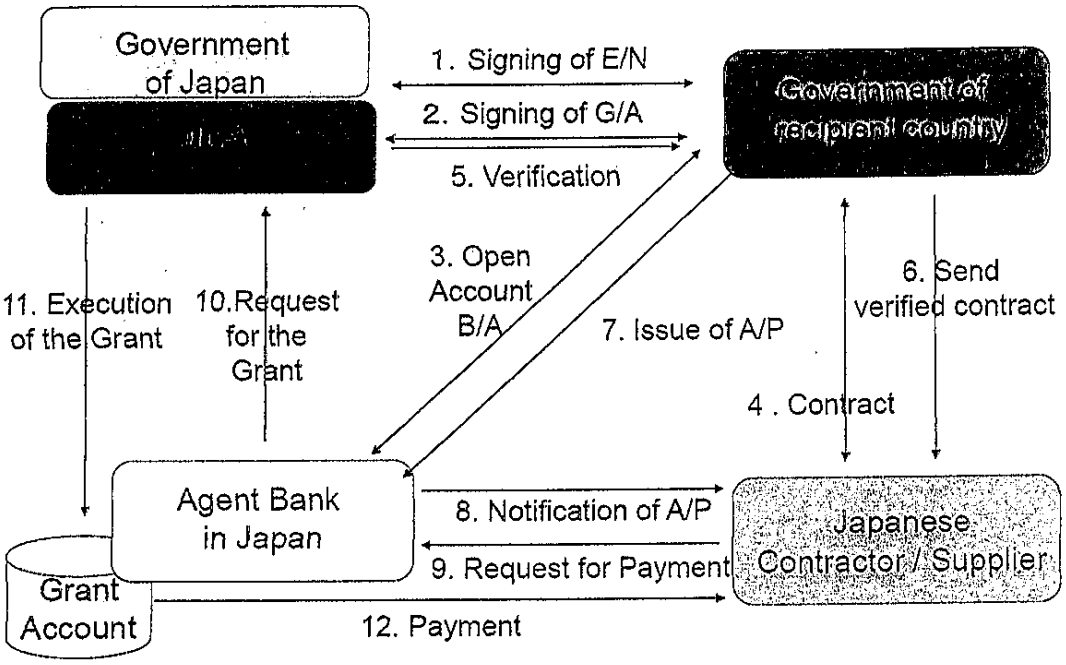
Annex 4

FLOW CHART OF JAPANESE GRANT PROCEDURES



Annex 5

Financial Flow of Grant Aid (A/P Type)



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Annex 6

Major Undertakings to be taken by Each Government

1. Before the Tender

NO	Items	Deadline	In charge	Cost	Ref.
1	To open Bank Account (Banking Arrangement (B/A))	within 1 month after G/A			
2	To approve IEE/EIA	within 1 month after G/A			
3	To implement EIA	before start of the construction			
4	To secure the following lands	within 1 month after G/A			
5	To obtain the planning, zoning, building permit	before notice of the tender document			
6	To clear the following sites	within 1 month after G/A			

2. During the Project Implementation

NO	Items	Deadline	In charge	Cost	Ref.
1	To bear the following commissions to a bank of Japan for the banking services based upon the B/A				
	1) Advising commission of A/P	within 1 month after the singing of the contract			
	2) Payment commission for A/P	every payment			
2	To ensure prompt unloading and customs clearance at the port of disembarkation in recipient country				
	1) Tax exemption and customs clearance of the products at the port of disembarkation	during the Project			
	2) Internal transportation from the port of disembarkation to the project site	during the Project			

3	To accord Japanese nationals and/or physical persons of third countries whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work	during the Project			
4	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the Products and/or the Services be exempted. Such customs duties, internal taxes and other fiscal levies mentioned above include VAT, commercial tax, income tax and corporate tax of Japanese nationals, resident tax, fuel tax, but not limited, which may be imposed in the recipient country with respect to the supply of the products and services under the verified contract	during the Project			
5	To bear all the expenses, other than those to be borne by the Grant Aid, necessary for construction of the facilities as well as for the transportation and installation of the equipment	during the Project			
6	To implement EMP and EMoP	during the construction			
7	To submit results of environmental monitoring to JICA, by using the monitoring form, on a quarterly basis as a part of Project Monitoring Report	during the construction			
8	To implement RAP (livelihood restoration program, if needed)	for a period based on livelihood restoration program			
9	To implement social monitoring, and to submit the monitoring results to JICA, by using the monitoring form, on a quarterly basis as a part of Project Monitoring Report - Period of the monitoring may be extended if affected persons' livelihoods are not sufficiently restored. Extension of the monitoring will be decided based on agreement between *Implementation Agency of RMI* and JICA.	- until the end of livelihood restoration program (In case that livelihood restoration program is provided) *- for two years after land acquisition and resettlement complete (In case that livelihood restoration program is not provided)*			

3. After the Project

NO	Items	Deadline	In charge	Cost	Ref.
1	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid 1) Allocation of maintenance cost 2) Operation and maintenance structure 3) Routine check/Periodic inspection	After completion of the construction			
2	To implement EMP and EMoP	for a period based on EMP and EMoP			
3	To submit results of environmental monitoring to JICA, by using the monitoring form, semiannually - The period of environmental monitoring may be extended if any significant negative impacts on the environment are found. The extension of environmental monitoring will be decided based on the agreement between *Implementation Agency of RMI* and JICA.	for three years after the Project			

(B/A: Banking Arrangement, A/P: Authorization to pay, N/A: Not Applicable)

Major Undertakings to be Covered by the Japanese Grant

No	Items	Deadline	Cost Estimated (Million Japanese Yen)*	
1	To construct xx facility and provide equipment		XX.XX	
	1) To ensure prompt unloading and customs clearance at the port of disembarkation in recipient country			
	a) Marine(Air) transportation of the products from Japan to the recipient country			
	b) Internal transportation from the port of disembarkation to the project site			
	2) To construct facilities			
	3) To provide equipment with installation and commissioning			
2	To implement detailed design, tender support and construction supervision (Consultant)		YY.YY	
3	Contingencies		ww.ww	
	Total		ZZ.ZZ	

*; The cost estimates are provisional. This is subject to the approval of the Government of Japan.

Minutes of Discussions
on the Preparatory Survey for
The Project for Installation of Solar Electricity Generation System in Ebeye Island
(Explanation on Draft Preparatory Survey Report)

With reference to the minutes of discussions signed between Kwajalein Atoll Joint Utility Resources and the Japan International Cooperation Agency (hereinafter referred to as "JICA") on 9 September, 2016 and in response to the request from the Government of Republic of Marshall Islands (hereinafter referred to as "RMI") dated 20 May, 2016, JICA dispatched the Preparatory Survey Team (hereinafter referred to as "the Team") for the explanation of Draft Preparatory Survey Report (hereinafter referred to as "the Draft Report") for the Project Project for Installation of Solar Electricity Generation System in Ebeye Island (hereinafter referred to as "the Project"), headed by Mr. Nobuaki MATSUI, Resident Representative, JICA/JOCV Marshall Islands Office from 11 to21 July, 2017.

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

Majuro, 24 July, 2017

Mr. Nobuaki MATSUI
Preparatory Survey Team
Japan International Cooperation Agency
Japan

Ms. Kitlang KABUA
Special Advisor to Senior Management
Kwajalein Atoll Joint Utility Resources
Republic of Marshall Islands

Ms. Angeline C. HEINE
National Energy Planner
Ministry of Resources and Development
Republic of Marshall Islands

Mr. Catalino KIJINER
Secretary
Ministry of Works, Infrastructure and Utilities
Republic of Marshall Islands

ATTACHEMENT

1. Objective of the Project
   The objective of the Project is to reduce fossil fuel consumption and supply electricity stably by construction of solar electricity generation system in Ebeye Island, thereby contributing to reduce CO2 emission.

2. Title of the Preparatory Survey
   Both sides confirmed the title of the Preparatory Survey as "the Preparatory Survey for the Project for Installation of Solar Electricity Generation System in Ebeye Island".

3. Project site
   Both sides confirmed that the site of the Project is in Ebeye Island, which is shown in Annex 1.

4. Responsible authority for the Project
   Both sides confirmed the authorities responsible for the Project are as follows:

   4-1. The Kwajalein Atoll Joint Utility Resources will be the executing agency for the Project (hereinafter referred to as "the Executing Agency"). The Executing Agency shall coordinate with all the relevant authorities to ensure smooth implementation of the Project and ensure that the undertakings for the Project shall be taken care by relevant authorities properly and on time. The organization charts are shown in Annex 2.

   4-2. The line ministry of the Executing Agency is the Ministry of Resources and Development and the Ministry of Works, Infrastructure and Utilities. They shall be responsible for supervising the Executing Agency on behalf of the Government of RMI.

5. Contents of the Draft Report
   After the explanation of the contents of the Draft Report by the Team, the RMI side agreed to its contents.

6. Cost estimate
   Both sides confirmed that the cost estimate including the contingency described in the Draft Report is provisional and will be examined further by the Government of Japan for its approval. The contingency would cover the additional cost against natural disaster, unexpected natural conditions, etc.

7. Confidentiality of the cost estimate and technical specifications
   Both sides confirmed that the cost estimate and technical specifications in the Draft Report should never be duplicated or disclosed to any third parties until all the contracts under the Project are concluded.

8. Timeline for the project implementation
   The Team explained to the RMI side that the expected timeline for the project implementation is as attached in Annex 3.

9. Expected outcomes and indicators
   Both sides agreed that key indicators for expected outcomes are as follows. The RMI side will be responsible for the achievement of agreed key indicators targeted in year

2022 and shall monitor the progress based on those indicators.
[Quantitative indicators]
Increase the capacity of solar electricity generation system (kW) and the amout of capable power supply (MWh/year)
Reduce the amout of fossil fuel consumption (kl/year) and CO2 emission by fossil fuel combustion
[Qualitative indicators]
Stable power supply

10. Technical assistance ("Soft Component" of the Project)
Considering the sustainable operation and maintenance of the products and services granted through the Project, following technical assistance is planned under the Project. The RMI side confirmed to deploy necessary number of counterparts who are appropriate and competent in terms of its purpose of the technical assistance as described in the Draft Report.

11. Undertakings of the Project
Both sides confirmed the undertakings of the Project as described in Annex 4. With regard to exemption of customs duties, internal taxes and other fiscal levies as stipulated in (2) 5 of Annex 4, both sides confirmed that such customs duties, internal taxes and other fiscal levies include VAT, commercial tax, income tax and corporate tax, which shall be clarified in the bid documents by KAJUR during the implementation stage of the Project.
The RMI side assured to take the necessary measures and coordination including allocation of the necessary budget which are preconditions of implementation of the Project. It is further agreed that the costs are indicative, i.e. at Outline Design level. More accurate costs will be calculated at the Detailed Design stage.
Both sides also confirmed that the Annex 4 will be used as an attachment of G/A.

12. Monitoring during the implementation
The Project will be monitored by the Executing Agency and reported to JICA by using the form of Project Monitoring Report (PMR) attached as Annex 5. The timing of submission of the PMR is described in Annex 4.

13. Project completion
Both sides confirmed that the project completes when all the facilities constructed and equipment procured by the grant are in operation. The completion of the Project will be reported to JICA promptly, but in any event not later than six months after completion of the Project.

14. Ex-Post Evaluation
JICA will conduct ex-post evaluation after three (3) years from the project completion, in principle, with respect to five evaluation criteria (Relevance, Effectiveness, Efficiency, Impact, Sustainability). The result of the evaluation will be publicized. The RMI side is required to provide necessary support for the data collection.

15. Items and measures to be considered for the smooth implementation of the Project

16. Schedule of the Study
JICA will finalize the Preparatory Survey Report based on the confirmed items. The

report will be sent to the RMI side around November, 2017.

17. Environmental and Social Considerations

The Team explained that 'JICA Guidelines for Environmental and Social Considerations (April 2010)' (hereinafter referred to as "the Guidelines") is applicable for the Project. The Project is categorized as C because the Project is likely to have minimal adverse impact on the environment under the Guidelines.

18. Other Relevant Issues

18-1. Disclosure of Information

Both sides confirmed that the Preparatory Survey Report from which project cost is excluded will be disclosed to the public after completion of the Preparatory Survey. The comprehensive report including the project cost will be disclosed to the public after all the contracts under the Project are concluded.

18-2. Relocation of the tower for cellphone system network in the Site

National Telecomunication Authority (hereinafter referred to as "NTA"), the owner of tower for cellphone system network in the Site, will relocate the tower to their property due to aging of the tower structure and clear the foundation of tower by the middle of December, 2017. Both parties confirmed that KAJUR will follow the progress of this relocation, prompt NTA to implement as scheduled and conduct necessary administrative procedures to utilize the land (approx. 200m2) where the tower has been installed for the Project.

18-3. Site Clearance

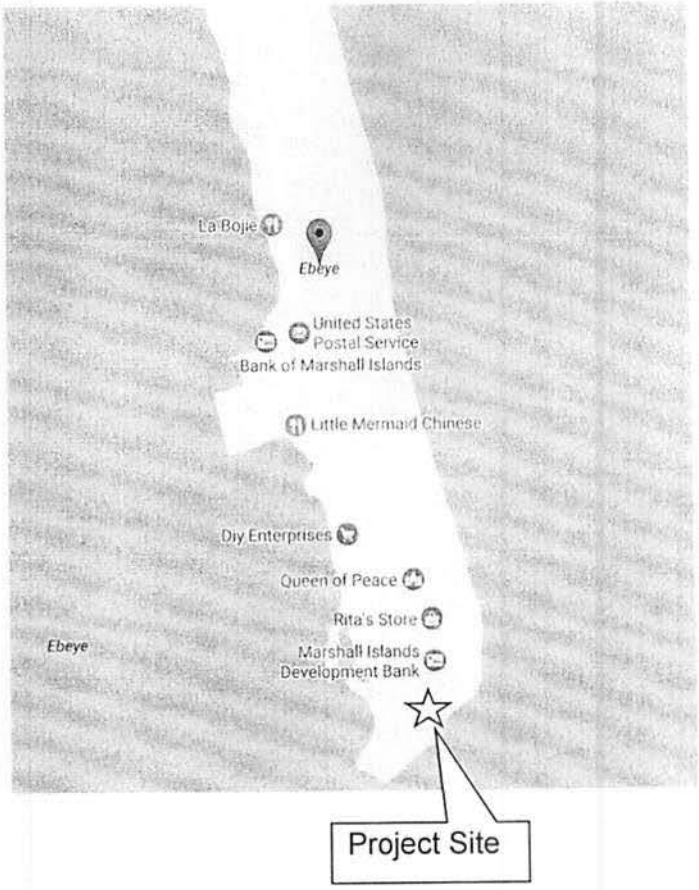
Both sides confirmed that KAJUR will conduct site clearance by utiliziging heavy equipments in collaboration with Office of Cheif Secretary and Kwajalein Atoll Local Governement within three months after the signing of G/A.

18-4. Sharering information of upgrading existing diesel power plant in Ebeye Island

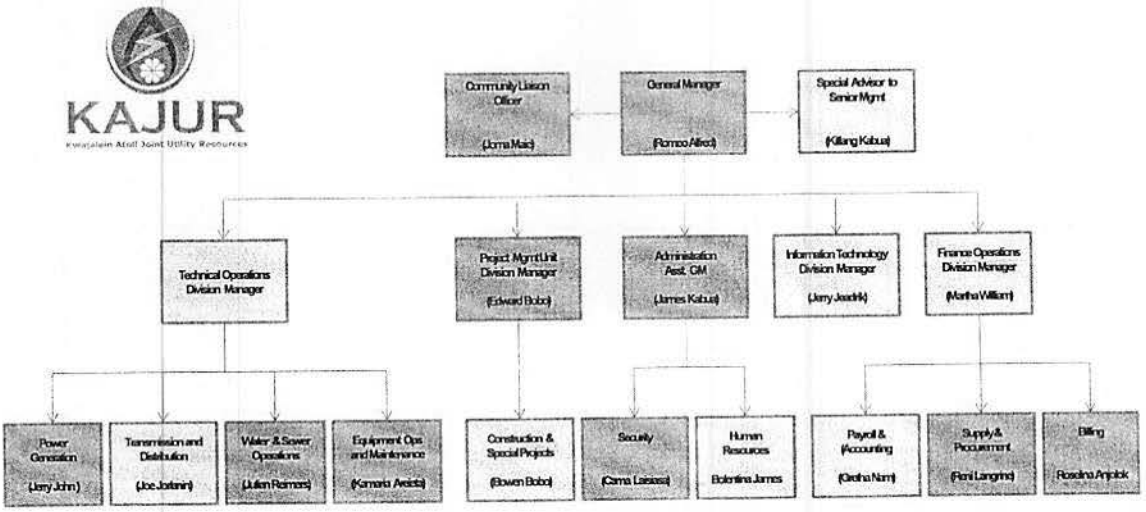
Both sides confirmed that other projects for upgrading existing diesel power plant in Ebeye Island under consideration by RMI side may affect design of the Project. KAJUR will share information properly with JICA about progress of these projects.

Annex 1 Project Site
Annex 2 Organization Chart
Annex 3 Project Implementation Schedule
Annex 4 Major Undertakings to be taken by the Government of RMI
Annex 5 Project Monitoring Report (template)

Annex 1 Project Site



Annex 2
Organization Chart of KAJUR



Annex 3. Timeline for the project implementation

Year	2017	2018	2019	2020
① Detail Design	Dec	June		
② Construction and Procurement Supervision		July	Nov	
③ Soft Component			Dec	Nov
④ One Year Inspection				Nov

Annex 4

Major Undertakings to be taken by Government of RMI

1. Specific obligations of the Government of RMI which will not be funded with the Grant

(1) Before the Tender

NO	Items	Deadline	In charge	Cost (Thousand USD)	Ref.
1	To open Bank Account (Banking Arrangement (B/A))	within 1 month after G/A	MOF		
2	To issue Authorization to Pay (A/P) to a bank in Japan (the Agent Bank) for the payment to the consultant	within 1 month after the signing of the contract	MOF		
3	To secure and clear the project sites, include 1) to prompt NTA to relocate the tower for cellphone system network in the Site 2) to conduct necessary administrative procedures to utilize the land where the tower has been installed for the Project. 3) to remove abolished heavy equipments	within 3 months after the signing of G/A	KAJUR	2.2	
4	To obtain the planning, zoning, building, electricity, telephone, water supply, sewage permit (Inc. Earthmoving Application)	before notice of the tender document	KAJUR	5	
5	To submit Project Monitoring Report (with the result of Detail Design)	before preparation of bidding documents	KAJUR		

(2) During the Project Implementation

This Page is closed due to the confidentiality.

2. Other obligations of the Government of RMI funded with the Grant

This Page is closed due to the confidentiality.

*: The cost estimates are provisional. This is subject to the approval of the Government of Japan.

SAMPLE of Project Monitoring Report

Project Monitoring Report

on

The Project for Installation of Solar Electricity Generation System

in Ebeye Island

Grant Agreement No. XXXXXXX 20XX, Month

Organization Information

Authority (Signer of the G/A)	_____ Person in Charge _____ (Division) _____ Contacts Address: _____ Phone/FAX: _____ Email: _____
Executing Agency	_____ Person in Charge _____ (Division) _____ Contacts Address: _____ Phone/FAX: _____ Email: _____
Line Agency	_____ Person in Charge _____ (Division) _____ Contacts Address: _____ Phone/FAX: _____ Email: _____

Outline of Grant Agreement:

Source of Finance	Government of Japan: Not exceeding JPY _____ mil. Government of RMI: _____
Project Title	The Project for Installation of Solar Electricity Generation System in Ebeye
E/N	Signed date: Duration:
G/A	Signed date: Duration:

1: Project Description

1-1 Project Objective

The objective of the Project is to reduce fossil fuel consumption and supply electricity stably by construction solar electricity generation system in Ebeye Island, thereby contributing to reduce CO2 emission.

1-2 Necessity and Priority of the Project

- Consistency with development policy, sector plan, national/regional development plans and demand of target group and the recipient country.

1-3 Effectiveness and the indicators

- Effectiveness by the project

Quantitative Effect (Operation and Effect indicators)		
Indicators	Original (Yr)	Target (Yr)
Capacity of solar electricity generation system (kW) and the amout of capable power supply (MWh/year)		
The amout of fossil fuel consumption (kl/year) and CO2 emission by fossil fuel combustion		
Qualitative Effect		
Stable power supply		

2: Project Implementation

2-1 Project Scope

Table 2-1-1a: Comparison of Original and Actual Location

Location	**Original:** *(M/D)* **Attachment(s):Map**	**Actual:** *(PMR)* **Attachment(s):Map**

Table 2-1-1b: Comparison of Original and Actual Scope

Items	Original	Actual
	·PV module (More than 600 kW), Power conditioner for PV (More than 600 kW and 4 partitions), Battery (600kW - more than 30 minutes × 2 units), Power	

	conditioner for battery (2 pairs × 2 units), Set of EMS and Set of grid interconnection facilities	

2-1-2 Reason(s) for the modification if there have been any.

(PMR)

2-2 Implementation Schedule

2-2-1 Implementation Schedule

Table 2-2-1: Comparison of Original and Actual Schedule

Items	Original		Actual
	DOD	G/A	
Cabinet Approval	11/2017		-
E/N	11/2017		
G/A	11/2017		
Detailed Design	12/2017-3/2018		
Tender Notice	4/2018		
Tender	6/2018		
Installarion of Equipement	7/2018-11/2019		
Project Completion Date	11/2019		
Defect Liability Period	11/2020		

*Project Completion was defined as Check-out of Construction work at the time of G/A.

2-2-2 Reasons for any changes of the schedule, and their effects on the project.

2-3 Undertakings by each Government

2-3-1 Major Undertakings

See Attachment 2.

2-3-2 Activities

See Attachment 3.

2-3-3 Report on RD

See Attachment 4.

2-4 Project Cost

2-4-1 Project Cost

Table 2-4-1a Comparison of Original and Actual Cost by the Government of Japan

(Confidential until the Tender)

Items			Cost (Million Yen)	
	Original	Actual	Original	Actual
Equipment	PV module (More than 600 kW), Power conditioner for PV (More than 600 kW and 4 partitions), Battery (600kW - more than 30 minutes × 2 units), Power conditioner for battery (2 pairs × 2 units), Set of EMS and Set of grid interconnection facilities			
Consulting Services				
Total				

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar = Yen

Table 2-4-1b Comparison of Original and Actual Cost by the Government of RMI

Items			Cost (Million USD)	
	Original	Actual	Original	Actual
Total				

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar = (local currency)

2-4-2 Reason(s) for the wide gap between the original and actual, if there have been any, the remedies you have taken, and their results.

(PMR)

2-5 Organizations for Implementation

2-5-1 Executing Agency:

- Organization's role, financial position, capacity, cost recovery etc,
- Organization Chart including the unit in charge of the implementation and number of employees.

Original: *(M/D)*
Actual, if changed: *(PMR)*

2-6 Environmental and Social Impacts

- The results of environmental monitoring as attached in Attachment 5 in accordance with Schedule 4 of the Grant Agreement.

- The results of social monitoring as attached in Attachment 5 in accordance with Schedule 4 of the Grant Agreement.
- Information on the disclosed results of environmental and social monitoring to local stakeholders, whenever applicable.

3: Operation and Maintenance (O&M)

3-1 O&M and Management

- Organization chart of O&M
- Operational and maintenance system (structure and the number ,qualification and skill of staff or other conditions necessary to maintain the outputs and benefits of the project soundly, such as manuals, facilities and equipment for maintenance, and spare part stocks etc)

Original: *(M/D)*

Actual: *(PMR)*

3-2 **O&M Cost and Budget**

- The actual annual O&M cost for the duration of the project up to today, as well as the annual O&M budget.

Original: *(M/D)*

4: Precautions (Risk Management)

- Risks and issues, if any, which may affect the project implementation, outcome, sustainability and planned countermeasures to be adapted are below.

Original Issues and Countermeasure(s): *(M/D)*	
Potential Project Risks	Assessment
1.	Probability: H/M/L
(Description of Risk)	Impact: H/M/L
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action during the Implementation:
	Contingency Plan (if applicable):
2.	Probability: H/M/L
(Description of Risk)	Impact: H/M/L
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action during the Implementation:

	Contingency Plan (if applicable):
3.	Probability: H/M/L
(Description of Risk)	Impact: H/M/L
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action during the Implementation:
	Contingency Plan (if applicable):
Actual issues and Countermeasure(s)	
(PMR)	

5: Evaluation at Project Completion and Monitoring Plan

5-1 Overall evaluation

Please describe your overall evaluation on the project.

5-2 Lessons Learnt and Recommendations

Please raise any lessons learned from the project experience, which might be valuable for the future assistance or similar type of projects, as well as any recommendations, which might be beneficial for better realization of the project effect, impact and assurance of sustainability.

5-3 Monitoring Plan for the Indicators for Post-Evaluation

Please describe monitoring methods, section(s)/department(s) in charge of monitoring, frequency, the term to monitor the indicators stipulated in 1-3.

Attachment

1. Project Location Map
2. Undertakings to be taken by each Government
3. Monthly Report
4. Report on RD
5. Environmental Monitoring Form / Social Monitoring Form
6. Monitoring sheet on price of specified materials (Quarterly)
7. Report on Proportion of Procurement (Recipient Country, Japan and Third Countries)
   (Final Report Only)

Attachment 6

Monitoring sheet on price of specified materials

1. Initial Conditions (Confirmed)

	Items of Specified Materials	Initial Volume A	Initial Unit Price (¥) B	Initial total Price C=A×B	1% of Contract Price D	Condition of payment	
						Price (Decreased) E=C−D	Price (Increased) F=C+D
1	Item 1	●●t	●	●	●	●	●
2	Item 2	●●t	●	●	●		
3	Item 3						
4	Item 4						
5	Item 5						

2. Monitoring of the Unit Price of Specified Materials

(1) Method of Monitoring : ●●

(2) Result of the Monitoring Survey on Unit Price for each specified materials

	Items of Specified Materials	1st ●month, 2015	2nd ●month, 2015	3rd ●month, 2015	4th	5th	6th
1	Item 1						
2	Item 2						
3	Item 3						
4	Item 4						
5	Item 5						

(3) Summary of Discussion with Contractor (if necessary)

-
-
-

Report on Proportion of Procurement (Recipient Country, Japan and Third Countries)

(Actual Expenditure by Construction and Equipment each)

	Domestic Procurement (Recipient Country) A	Foreign Procurement (Japan) B	Foreign Procurement (Third Countries) C	Total D
Equipment Cost	(A/D%)	(B/D%)	(C/D%)	
Design and Supervision Cost	(A/D%)	(B/D%)	(C/D%)	
Total	(A/D%)	(B/D%)	(C/D%)	

Annex 5. Soft Component Plan

Contents

1. Outline of the soft component

1.1. Background

The Republic of Marshall Islands (herein after referred to as RMI) has a high dependency on fossil fuels and more than 99% of the electricity supply depends on diesel generation using imported fuel (Department of the Interior, Office of Insular Affairs 2013). This situation represents a threat to the economy and energy security of the country as fuel prices are unstable and transportation costs are very high. The country has a vulnerable power supply as the infrastructure is old, the fuel expensive and sometimes weather very extreme, causing frequently blackouts.

In order to improve this situation, The RMI established "The National Energy Policy and Energy Action Plan (herein after referred to as NEPEAP)" in September 2009, aiming to cover 20% of the power supply with renewable energy sources by 2020.

At the moment, the introduction of PV systems is advancing in the Capital city, Majuro, but in order to achieve the above mentioned energy goal, it is necessary to introduce renewable energies into other areas of the country. People in Ebeye Island rely on rain water tanks on their house and desalination equipment which is maintained by Kwajalein Atoll Joint Utility Resources (herein after referred to KAJUR) to get drinking water. Especially when drought happens, stable power supply to the desalination equipment is an important requirement to ensure water supply, and for its correct functioning it requires a secure power source. Nowadays this power is produced by diesel; the introduction of the PV system will give KAJUR more security in the future.

In this context, equipment and materials for the PV system will be procured and technical assistance for the operation and maintenance will be provided. As requested from RMI, this project will provide technical assistance for the inspection, troubleshooting and environmental education related to PV technologies for local people.

Table 1-1 Outline of the project

Equipment procurement for PV system		
Equipment	Use of power generated	Importance
PV system	To interconnect and supply the power generated by sunlight.	Energy security in The RMI is very weak and the country has an aggressive target to achieve a 20% share of renewable energy by 2020.
Technical assistance for the PV system (Soft Component)		
Technical assistance	Training on basic technical knowledge of PV systems and on the operation and maintenance, including inspection and troubleshooting.	KAJUR has no experience with PV systems. In order to address the technical transfer for the operation and management of the proposed system, the implementation of technical assistance will provide the basic standards and rules for its correct operation.

The PV system will consist of plural units with two buses for each set, considering security measures in case a defect were to happen, ensuring power supply from the PV system. The PV system will be connected to the existing diesel generator and to the existing generation line.

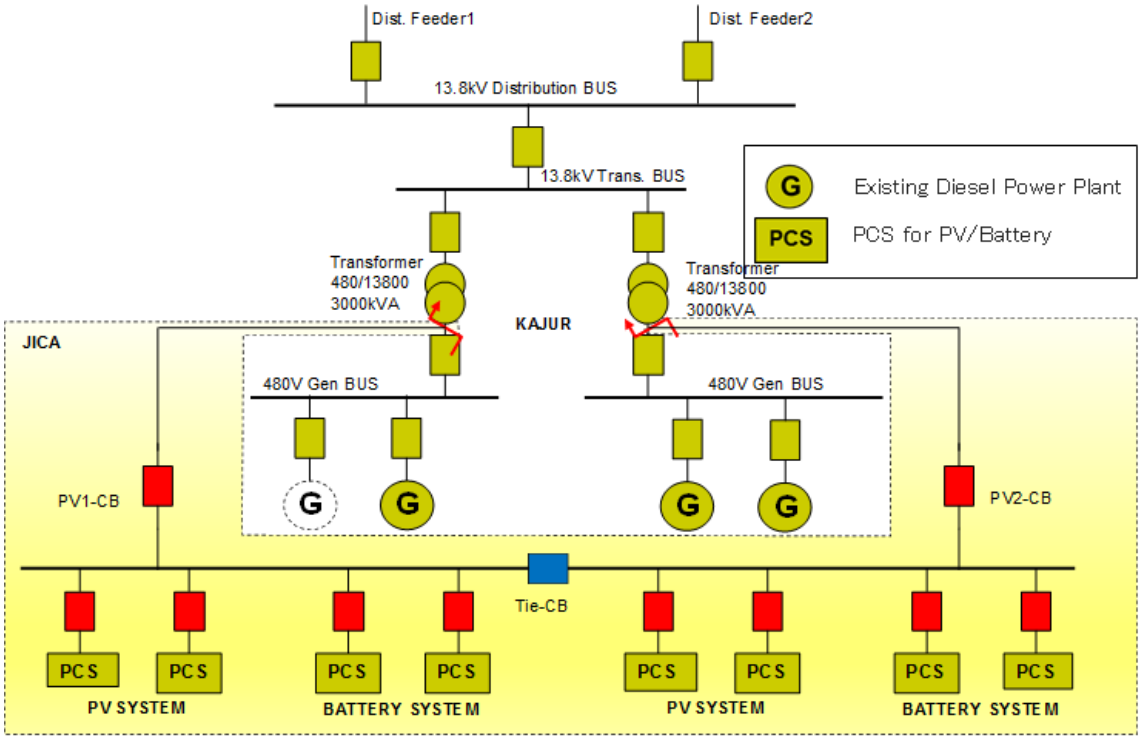


Figure 1- 1Components of the PV System

Table 1-2 Outline of the Plan

Responsible Agency	Ministry of Resources and Development (MRD), Ministry of Public Works (MPW)
Executing Agency	KAJUR
Location	Inside KAJUR's site
Land Owner	KAJUR
Generation Capacity	Approx. 600kW
Installation Area	Approx. 6,000 m^2
Account of Power	Interconnection to the lines in Ebeye Islands

1.2. Importance and necessity of the implementation of the Soft Component

It is indispensable for KAJUR's staff and related people to understand and be familiar with the PV system proposed since it is the first time for KAJUR to install this kind of technology. As there are no standards and rules for its operation, management, inspection and troubleshooting the Soft component of this project is very important.

Furthermore, the work flow consisting of collection, compilation, analysis and recording regarding the PV system and the meteorological data must be formulated to achieve a proper maintenance.

This project will establish an operation and maintenance manual covering all aspects mentioned above and implement the soft component, aiming to achieve the smooth and sustainable operation of the system.

In addition, the RMI expects to face severe effects on the land by the increase of the sea level caused by global warming. In this sense, the RMI want to continuously provide environmental education related to PV power/ renewable energies to local people. This project also provides technical assistance for environmental education.

1.3. Organization for the operation and maintenance of the system

Organization for Operation

Kwajalein Atoll Joint Utility Resources (KAJUR):

KAJUR was founded as a Public corporation to conduct generation, transmission, distribution and water and sewerage activities in Kwajalein Island. KAJUR will implement the operation and maintenance, including the inspection and troubleshooting, of the PV system to be installed by this project.

Marshall Energy Company (MEC):

MEC was found as a State electric enterprise in 1984 provide generation and transmission service in Majuro, Wotje and Jaluit. MEC cooperates with MRD to implement the installation, operation and maintenance of renewable energy at remote places and provide technical assistance to KAJUR. In this sense, MEC shares the content of soft component.

Consultant:

The consultant will implement the soft component to ensure the sustainability of the project outcomes. The Consultant will receive e-mail notices regarding the condition and maintenance of the PV system during a year and will advise KAJUR to improve the effects of the soft component.

Supplier:

The Supplier will implement the initial operation and operational instruction before conducting the soft component.

2. Objectives of the Soft Component

The objectives of the soft component the following ones;

i. The trainees obtain the ability to appropriately operate and maintain the PV system

ii. Creation of an organization that can self-diagnose and fix problems of the PV system

iii. The trainees obtain the ability to establish and use a report system for the following data: generated electricity, solar radiation, temperature, etc.

iv. Increase the renewable energy awareness of the RMI residents.

3. Evaluation Methods

Soft components implementation is focused on exercises using the installed equipment. The following table shows the results of the soft component of the project and the items to be checked in order to achieve the expected results.

Table 3-1 Outcomes and Evaluation Methods of the Training

Results	Items to be checked
1. The trainees obtain the ability to appropriately operate and maintain the PV system	・ Preparation of the maintenance inspection sheet and related exercises. ・ Establishment of standards and procedures for changing PV panels ・ Construction of the maintenance management structure ・ Comprehension of the condition of the battery system. Especially to understand the decline of the storage capacity over time. ・ Creation of maintenance financial plan
2. Creation of an organization that can self-diagnose and resolve the problems of the PV system	・ Create a problem detection procedure ・ Creation of a framework for problem response ・ Practice to solve problems with the introduced equipment
3. The trainees obtain the ability to establish and use a report system for the following data: generated electricity, solar radiation, temperature, etc.	・ Acquisition of electricity generation and weather data etc. / creation of recording table ・ Construction of monitoring system ・ Training exercises on monitoring and reporting (KAJUR will share the monitoring report with the consultant during the implementation period until the soft component is finished, and the consultant provides necessary advice)
4. Increase the renewable energy awareness of the RMI residents	・ Preparation of the facility outline explanation panel ・ Hosting environmental education events (1st session) for local residents

4. Activities included in the Soft Component

In order to achieve the above mentioned results, the following activities will be carried out;

Result 1: The trainees obtain the ability to appropriately operate and maintain the PV system

In order to achieve high standards for the maintenance of the PV system as well as the replacement of PV panels, the consultant will prepare a draft rule package and will organize discussions and exercises based on those rules and help to finalize the working manuals.

Discussions and exercises regarding the condition of the battery system will also be organized. Especially to understand the decline of the storage capacity over time as well as the efficiency improvement of diesel operation.

Result 2: Creation of an organization that can self-diagnose and resolve the problems of the PV system

In order to spread knowledge regarding how to detect defective parts of the PV system and how to solve potential problems, the consultant will prepare a draft rule package and will organize discussions and exercises based on those rules and help to finalize the working manuals.

Result 3: The trainees obtain the ability to establish and use a report system for the following data: generated electricity, solar radiation, temperature, etc.

EMS will be utilized in order to measure energy generation and weather data. A draft of the handling procedure (prepared by consultant) will be used for the discussions and exercises based on those procedures. Assistance to finalize the working manuals is also going to be provided. The exercises will be performed and monitored based on written letters.

Result 4: Increase the renewable energy awareness of Marshall Islands residents

In order to increase the environmental awareness of local residents, public lectures will be organized (prepared by consultant) including fundamental information on renewable energy and materials for this project. Lectures will also include discussion. In addition, KAJUR will carry out the first facility tour event for local residents based on publicity material.

At the same time, a panel that comprehensively summarizes the facility outline of the PV system will be prepared.

4.1 Activity Schedule

The overall and detailed schedule of the soft component of this project is shown in the tables bellow.

The activities related to the Result 1, Result 2, Result 3 and Result 4, will be carried out by 4 specialists with experience in;

Control and Maintenance of the PV system, Control and maintenance of the battery system, Control and maintenance of EMS/diesel generators, and education regarding PV system and renewable energies.

Table 4-1 Draft Schedule of Soft Component

1st week	2nd week	3rd week	4th week	5th week	6th week	7th week	8th week
【Result 1】Operation and Maintenance (For Manager/Engineer Class)							
【Result 2】Self- diagnose of failures (For Operator Class)							
		【Result 3】Report system for PV system (For all)					
					【Result 4】Environmental awareness (For all)		

Table 4-2 Activity schedule for each expected result of the soft component

Result 1: The trainees obtain the ability to appropriately operate and maintain the PV system

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8
	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun
AM		Travel	Introduction of the maintenance system and presentation of study cases	Introduction of the maintenance system	Introduction of the basics of a PV system and electricity standards.	Development of the basics of a PV system and electricity standards ②	Holiday	Holiday
PM	Departure from Japan	Arrival at site	Discussion based on the study cases	Construction of the maintenance system	Development of the basics of a PV system and electricity standards①	Development of the basics of a PV system and electricity standards ③	Holiday	Holiday

Day 9	Day 10	Day 11	Day 12	Day 13	Day 14	Day 15
Mon	Tue	Wed	Thu	Fri	Sat	Sun
Introduction of the basics of a battery system and it standards	Introduction of the basics of a battery system and it standards	Introduction of the basics and standards of the EMS	Practice based on the developed basics and standards①	Preparation of the procedure book for changing PV panels	Holiday	Holiday
Introduction of the basics of a battery system and it standards	Introduction of the basics of a battery system and it standards	Introduction of the basics and standards of the EMS	Practice based on the developed basics and standards②	Practice to change PV panels	Holiday	Holiday
Day 16	Day 17	Day 18	Day 19	Day 20		
Mon	Tue	Wed	Thu	Fri		
Introduction of the cases of financial plan for operation and maintenance	Consideration of financial plan① (Utilizing the monitoring data)	Arrangement as the operation and maintenance manual	Departure in the Site	Arrival in Japan		
Workshop for battery system characteristics and electric generation capacity	Consideration of financial plan② (Utilizing the monitoring data)	・Review and summary	Travel			

Result 2: Creation of an organization that can self-diagnose and resolve the problems of the PV system

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8
	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun
AM		Travel	Introduction of potential failures of the system. Study cases	Introduction of system examples for the malfunction of the system	Check points for the early detection of failures(PV)①	Check points for the early detection of failures (battery)①	Holiday	Holiday
PM	Departure in Japan	Arrive at the Site	Discussion based on the cases	Construction of the correspondence system	Check points for the early detection of failures (PV) ②	Check points for the early detection of failures (battery)②	Holiday	Holiday

Day 9	Day 10	Day 11	Day 12	Day 13	Day 14	Day 15
Mon	Tue	Wed	Thu	Fri	Sat	Sun
Check points for the early detection of failures EMS)	Checking practice ①	Introduction of diagnostic method of failures based on check points①	Construction of the diagnostic method for failures①	Practice of self-diagnose of failures based on the check points①	Holiday	Holiday
Arrangement of the check points for the early detection of the malfunction of the system	Checking practice ②	Introduction of diagnostic method of failures based on check points②	Construction of the diagnostic method for failures②	Practice of self-diagnose of failures based on the check points②	Holiday	Holiday
Day 16	Day 17	Day 18	Day 19	Day 20		
Mon	Tue	Wed	Thu	Fri		
Construction of rules for the malfunction of the system ①	Practice to respond to the malfunction of the system ①	Preparation of the operation and maintenance manual	Departure	Arrival in Japan		
Construction of rules for the malfunction of the system②	Practice to respond to the malfunction of the system ②	Review and summary	Travel			

Result 3: The trainees obtain the ability to establish and use a report system for the following data: generated electricity, solar radiation, temperature, etc.

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8
	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun
AM		Travel	Introduction of monitoring cases utilizing EMS	Introduction of cases of monitoring system	Confirmation of the monitoring contents	Construction of the monitoring form①	Holiday	Holiday
PM	Departure of Japan	Arrival at site	Discussion based on the cases	Construction of the monitoring system	Introduction of the monitoring form	Construction of the monitoring form②	Holiday	Holiday
		Day 9	Day 10	Day 11	Day 12	Day 13	Day 14	Day 15
		Mon	Tue	Wed	Thu	Fri	Sat	Sun
		Practice of monitoring (PV)	Practice of monitoring (diesel power generator)	Monitoring about meteorological conditions/changes of demand and PV system①	Monitoring about meteorological conditions/changes of demand and PV system②	Monitoring about meteorological conditions/changes of demand and PV system③	Holiday	Holiday
		Practice of monitoring (battery)	Practice of monitoring (meteorological data)	Arrangement of the monitoring results/ Input to the form①	Arrangement of the monitoring results/ Input to the form②	Arrangement of the monitoring results/ Input to the form③	Holiday	Holiday
		Day 16	Day 17	Day 18	Day 19	Day 20		
		Mon	Tue	Wed	Thu	Fri		
		Construction of the reporting system with the monitoring contents	Use of the monitoring data for the financial plan	Arrangement for the operation and maintenance manual	Departure	Arrival in Japan		
		Practice to report the monitoring contents	Use of the monitoring data for the financial plan	Review and summary	Travel			

Result 4: Increase the renewable energy awareness of Marshall Islands residents

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8
	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun
AM		Travel	Basic knowledge about global warming① Scientific basis	Basic knowledge on renewable energy and current condition of renewable energy in other island countries	Making panels to explain the outline of the PV system①	Calculation of the reduction of greenhouse gas by the PV system①	Holiday	Holiday
PM	Departure of Japan	Arrival at Site	Spreading scientific basics of global warming	Spreading information about renewable energy and its situation in island countries	Making panels to explain the outline of the PV system②	Calculation of the reduction of greenhouse gas by the PV system②	Holiday	Holiday
		Day 9	Day 10	Day 11	Day 12	Day 13	Day 14	Day 15
		Mon	Tue	Wed	Thu	Fri	Sat	Sun
		Practice for the explanation of benefits of the PV generation system①	Workshop preparation for the improvement of environmental awareness to society	Preparation of the workshop event①	Holding the workshop	Summarizing the comments from the participants of the workshop Postscript/modification to the publicity matter	Departure	Arrival in Japan
		Practice for the explanation of benefits of the PV generation system②	Presentation rehearsal	Preparation of the workshop event②	Holding the workshop	Publication from the enrollees Review Summary	Travel	

4.3. Results of the soft component

As a result of the soft component, Marshall Islands has its own Manual for the Control and Maintenance of PV systems. The contents of the manual are shown below;

- Standards and rules for the inspection and maintenance of PV systems, early detection of failures and troubleshooting.
- Standards and rules for the early detection of failures in the PV system, machinery and grid interconnection system
- Standards and rules for the inspection and maintenance of the battery system, early detection of failures and troubleshooting.
- Standards and rules for the early detection of failures in the battery system and related machinery
- Procedures to handle information regarding the power generated, solar radiation, temperature data processing data, etc. and its correct maintenance and management
- Report format for the monitoring results
- Basic information on renewable energy and materials to increase public awareness on this subject

4.4. Implementation resources

The target groups of the soft component are KAJUR、MEC、MRD, further details are shown in the table below;

Table 4-3 Implementation Resources

Marshall Islands	Japan
Target group: KAJUR: 10 persons (manager×1, engineer×1, linemen×2, mechanitians×2, operators×4) MEC: 5 persons MRD: 1 person Total: 16 persons	Specialist: Maintenance/System interconnection of PV system: 1.01MM Maintenance of battery system: 1.01MM Maintenance of EMS/Diesel power generator: 1.76MM Public Awareness on PV system/Renewable energy: 1.01MM

Table 4-4 Soft Component Staff Planning

Staff	Grade	Content	Japan M/M	Site M/M	Total M/M	Transit frequency
Maintenance/System interconnection of PV system	3	Collection of data in case of malfunction, Creation of the basics draft and rules	0.25		0.25	1
		Technical support about soft component at the site		0.66	0.66	
		Report production	0.10		0.10	
Sub Total			0.35	0.66	1.01	1
Maintenance of battery system	3	Collection of data in case of malfunction, Creation of the basics draft and rules	0.25		0.25	1
		Technical support about the soft component at the site		0.66	0.66	
		Report production	0.10		0.10	
Sub Total			0.35	0.66	1.01	1
Maintenance of EMS/Diesel power generator	3	Collection of data in case of malfunction, creation of the draft manual	0.25		0.25	1
		Technical support about the soft component at the site		0.66	0.66	
		Monitor the PV system/Technical support from Japan	0.75		0.75	
		Report production	0.10		0.10	
Sub Total			1.1	0.66	1.76	1
Increase awareness towards PV power generation system/renewable energy	3	Collection of data, Creation of draft publication documents	0.25		0.25	1
		Technical support about the soft component at the site		0.50	0.50	
		Report production	0.10		0.10	
Sub Total			0.35	0.50	0.85	1
Total			2.15	2.48	4.63	4

5. Implementation resources of the soft component - procurement method

5.1. Japanese consultants

It is indispensable for KAJUR's staff and related people to understand and be familiar with the PV system proposed since it is the first time for KAJUR to install this kind of technology, the soft component of the project will be provided by experienced Japanese consultants. The experience of the professionals is shown in the table below;

Table 5-1 Experience and Ability required to the specialists

Specialist	Field	Experience	Ability
Maintenance/System interconnection of PV system	PV system, System interconnection	Similar training in the past	Excellent communication skills
Maintenance of battery system	Battery system		
Maintenance of EMS/diesel power generator	Processing the information system and data of power/meteorology, Diesel power generator		
Increase the awareness on PV system/renewable energy	Renewable energy education		

5.2. Method for the selection of professionals

The consultants will select professionals with experience operating PV systems, storage battery systems and diesel generators in Japan or overseas, to be the training instructor.

6. Implementation process of the soft component

The implementation process of the soft component is shown in the table below;

Table 6-1 Implementation Schedule

Number of months per activity	1	2	3	4	5	6	7	8	9	10	11	12
Preparation in Japan	0.25 M/M											
Maintenance/System interconnection of PV system	0.66 M/M											
Maintenance of battery system	0.66 M/M											
Maintenance of EMS/diesel power generator		0.66 M/M				0.75 M/M						
Monitoring/Technical support from Japan												
Increase awareness towards PV power generation system/renewable energy		0.50 M/M										
Summarizing in Japan			0.1 M/M									

7. Soft-component outcomes

The outcomes of the soft-component of this project are shown in the table below;

The soft-component report is expected to be attached in the final report.

Table 7-1 Deliverables List

1. Final Report
    1. Plan and Implementation of Activities
    2. Plan and Accomplishment of Outputs/goals
    3. Factors that have affected the correct accomplishment of goals
    4. Problems regarding the development of the project and recommendations for the sustainability of the outputs
    5. Other materials, such as manuals, etc.

2. Completion Report (written in Japanese, to be submitted to JICA, according to the guideline of soft component completion report)
    1. Summary of the Project (Project name, E/N execution date, E/N budget, and agreement price of consultant's service)
    2. Summary of the soft component (cost, background, objectives, outcomes, planned activities, experts, participants from Marshal Islands, implementation agency (period and M/M), activity result, achievement situation of the result)
    3. Necessary improvement and recommendation to achieve objectives and sustain the project
    4. Attached documents (Implementation schedule of soft component, resume of soft component employee, list of participants from Marshall Islands, attendance book of training, deliverables list)
    5. Reference material (deliverables list (Completion report to the client, composed manuals, text, results of understanding test), movies prepared to the publication, pictures, newspapers)

8. Responsibility of the implementing agency

In order that the equipment to be introduced by the project will be effectively and continuously utilized, KAJUR is required to implement the following items;

- KAJUR is required to revise the instruction manual if necessary
- KAJUR is required to endeavor to develop human resources continuously to keep the sustainability of the above mentioned activities.
- Based on the training try to solve problems when occur.