Department of Resources and Development (R&D)
Pohnpei Utilities Corporation (PUC)
Federated States of Micronesia

PREPARATORY SURVEY REPORT

ON

THE PROJECT FOR

INTRODUCTION OF CLEAN ENERGY

BY SOLAR ELECTRICITY GENERATION SYSTEM

IN

THE FEDERATED STATES OF MICRONESIA

MARCH 2010

JAPAN INTERNATIONAL COOPERATION AGENCY

YACHIYO ENGINEERING CO., LTD.

ICONS INTERNATIONAL COOPERATION INC.

SHIKOKU ELECTRIC POWER CO., INC.

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PREFACE

Japan International Cooperation Agency (JICA) conducted the preparatory survey on the Project for Introduction of Clean Energy by Solar Electricity Generation System in the Federated States of Micronesia.

JICA sent to FSM a survey team from 13th July to 25th July, 2009.

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

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

I wish to express my sincere appreciation to the officials concerned of the Government of the Federated States of Micronesia for their close cooperation extended to the teams.

March 2010

Kazuhiro YONEDA
Director General
Industrial Development Department
Japan International Cooperation Agency

March 2010

LETTER OF TRANSMITTAL

We are pleased to submit to you the preparatory survey report on the Project for Introduction of Clean Energy by Solar Electricity Generation System in the Federated States of Micronesia.

This survey was conducted by the Consortium of Yachiyo Engineering Co., Ltd., ICONS International Cooperation Inc., and Shikoku Electric Power Co., Inc., under a contract to JICA, during the period from June, 2009 to March, 2010. In conducting the survey, we have examined the feasibility and rationale of the project with due consideration to the present situation of Federated States of Micronesia and formulated the most appropriate outline design for the project under Japan's Grant Aid scheme.

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

Very truly yours,

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

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

SUMMARY

SUMMARY

(1) Country Overview

The Federated States of Micronesia (hereinafter referred to as "FSM") is situated in the northern hemisphere of the Pacific Ocean; it comprises approximately 600 islands covering a land area of approximately 700 km^2 and possessing a population of 108,000 (according to statistics from 2008). FSM is composed of four states, namely Pohnpei, Chuuk, Kosrae and Yap. In 1986, FSM concluded the Compact of Free Association with the United States which guaranteed financial assistance by the US for a period of 15 years until 2001 while entrusting the US with the responsibility for the national defence and security of FSM. The Compact was renewed in December 2003, guaranteeing the continuation of financial support from the United States for another 20 years from 2004 to 2023. Economic assistance under the Compact amounted to approximately US$56,000,000 (approximately 15% of GDP) in 2005, making this an important source of funds for the FSM economy.

The major industries of FSM are fisheries and tourism. Possessing an exclusive economic zone of 25,000,000 square kilometers, FSM has constructed freezer facilities and processing plants and obtains the majority of its export revenues from fisheries, and fisheries exports to Japan account for 15.5% of total export value (2005). The number of foreign tourists visiting FSM in 2006 was approximately 19,136 of which Japanese accounted for 20% and Americans for 43%. Agriculture is an important subsistence industry and the main agricultural products are coconuts, taro potatoes, yams, bananas, cassava and bread, etc. Cash crops include exported are citrus fruits, bananas, betel nuts, copra and cava, etc.

(2) Background and Outline of the Requested Project

FSM Federal Government established an Energy Division under the Department of Resources and Development. The Division is in charge of implementation of energy programs and now developing a National Energy Policy. The Division is also acting as secretariat for the Association of Micronesian Utilities (AMU), and heads the FSM National Energy Workgroup. In addition, power corporations or public utility corporations on the state level compile energy and electricity plans, standards and specifications and run the operation and maintenance setup. Being an island nation, FSM depends exclusively on imports for its main energy resource of petroleum, and it relies almost 100% on diesel generation for its electricity supply. For this reason, becoming increasingly aware of climate change and feeling the impact of rising crude oil prices, the Government of FSM is faced with an urgent need to review its current dependency on diesel power generation and to diversify its power generation resources. In these circumstances, the Government of FSM has made it a priority to develop clean energy as e.g. represented by

photovoltaic (PV) power, and it has resolved to participate in the Cool Earth Partnership fund mechanism, which was proposed by Japan at the Davos Summit of January 2008.

In the Project target area of Pohnpei State, the Pohnpei Utilities Corporation (PUC) is responsible for operating the electric power utility. The PUC is 100% owned by the Pohnpei State Government according to State Law 2L-179-91 of 1991. However, neither the federal government nor the state government is in a position to offer supervise or regulate PUC, so the PUC is free to operate independently as a state owned corporation .. The PUC possesses a diesel power plant (Nanpohmal power station) and a hydropower plant (Nanpil power station). However, only the diesel power plant is in operating condition at the moment, and of the seven diesel generators at this plant, two are broken down and five are in operation.

The Government of FSM has promoted the introduction of Solar Home Systems (SHS) and PV systems to hospitals, schools and other public facilities in an effort to promote rural electrification on remote islands since the early1990s. Furthermore, in September 2008, 5 grid-connected PV systems similar to the one proposed in the Project was introduced to Kosrae State in the Support to the Energy Sector in Five ACP Pacific Islands (REP5) under support from the EU and 1 PV grid connected system was installed with funding from the Iceland Government. The EU had funded also PV off-grid systems on 11 outer islands in FSM, and two PV mini-grid systems have been installed in Yap funded under the same scheme. Also, in the Project area of Pohnpei State, PV street lights have been installed around the federal government building complex and College of Micronesia under support from China. In the Project here, the local side has requested that diffusion of grid-connected PV systems be promoted while utilizing the experience gained in these previous projects, and that preparations be made for the formation of a mechanism for realizing the utilization of clean energy appropriate for supporting the mitigation of climate change.

(3) Outline of the Study Findings and Contents of the Project

In response to the request, the Government of Japan decided to implement a preparatory survey for cooperation and consigned JICA to dispatch the Outline Design Study Team to FSM from July 11 to July 25, 2009. The Study Team reconfirmed and discussed the contents of the request with local officials, conducted surveys of the project sites and collected related materials. On returning to Japan, the Study Team examined the necessity of the Project, its social and economic effects and validity based on the local survey materials, and it compiled the outline design and implementation program for the optimum plan into the Draft Preparatory Survey Report. Based on this, JICA once more dispatched the Study Team to FSM in order to explain the Cooperation Preparatory Study Outline from December 5 to December 12, 2009.

In the Project compiled as a result of the Study, the Japanese side will procure and install grid-connected PV system to the project sites of Federal Government Complex (Capital) and College of Micronesia National Campus (COM-FSM) with a view to substituting a portion of the electricity currently generated by diesel engine with photovoltaic power, i.e. renewable energy. In doing so, the Project aims to promote future introduction of grid-connected PV system for enhancing its energy security and mitigating greenhouse gas emissions. Moreover, under the soft component, the Project intends to improve the maintenance capability of the Pohnpei Utilities Corporation (PUC), which will be responsible for the operation and maintenance of grid-connected PV systems, and support establishment of a maintenance framework that is suited to the grid-connected PV system to be introduced under the Project.

The following table shows an outline of the Project which was compiled based on the results of the field surveys and discussions with the FSM side.

Outline of the Project

	Procurement and installation of the following PV equipment	Quantity	
	Target site	Federal Government Complex (Capital)	College of Micronesia (COM-FSM)
Equipment Procurement and Installation Works Plan	Photovoltaic Module	1 set	1 set
	Mounting Structure for Photovoltaic Module	1 set	1 set
	Power conditioner	1 unit	1 unit
	Transformer	1 unit	1 unit
	Data management and monitoring system	1 set	1 set
	Storage Battery	1 unit	-
Equipment Procurement Plan	Replacement parts, maintenance tools and test equipment for the photovoltaic system	1 set	1 set

(4) Project Implementation Schedule and Rough Project Cost

In the event where the Project is implemented under the Japan's Program Grant Aid for Environment and Climate Change, the total cost of the Project will be determined before concluding the Exchange of Notes (E/N) and Grant Agreement (G/A) for the Project. The main item to be borne by the FSM side is: final connection of distribution cables to existing distribution lines, and so on. The implementation period of the Project including the implementation design is around 19.0 months.

(5) Verification of Project Validity

As a result of Project implementation, it will become possible to connect the PV system with the existing grid which supplies approximately 35,000 residents (according to the estimated figure in

2000) of Pohnpei State who currently receive power supply through the Pohnpei State power system. Through doing this, FSM will be able to promote the spread of clean energy as a climate change mitigation support measure. Accordingly, the Project is deemed to be highly valid for implementation under the Japan's Program Grant Aid for Environment and Climate Change.

The engineers of Pohnpei Utilities Corporation (PUC), which will be responsible for operating and maintaining the Project equipment following handover, possess basic operation and maintenance capacity acquired through working on existing diesel generation and distribution facilities. Furthermore, under the soft component of the Project, since it is intended to transfer appropriate operation and maintenance skills for the planned grid-connected PV system, it should be possible to secure the operation and maintenance capability required for the Project equipment, provided that the PUC allocates appropriate personnel and budget needed for O&M.

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

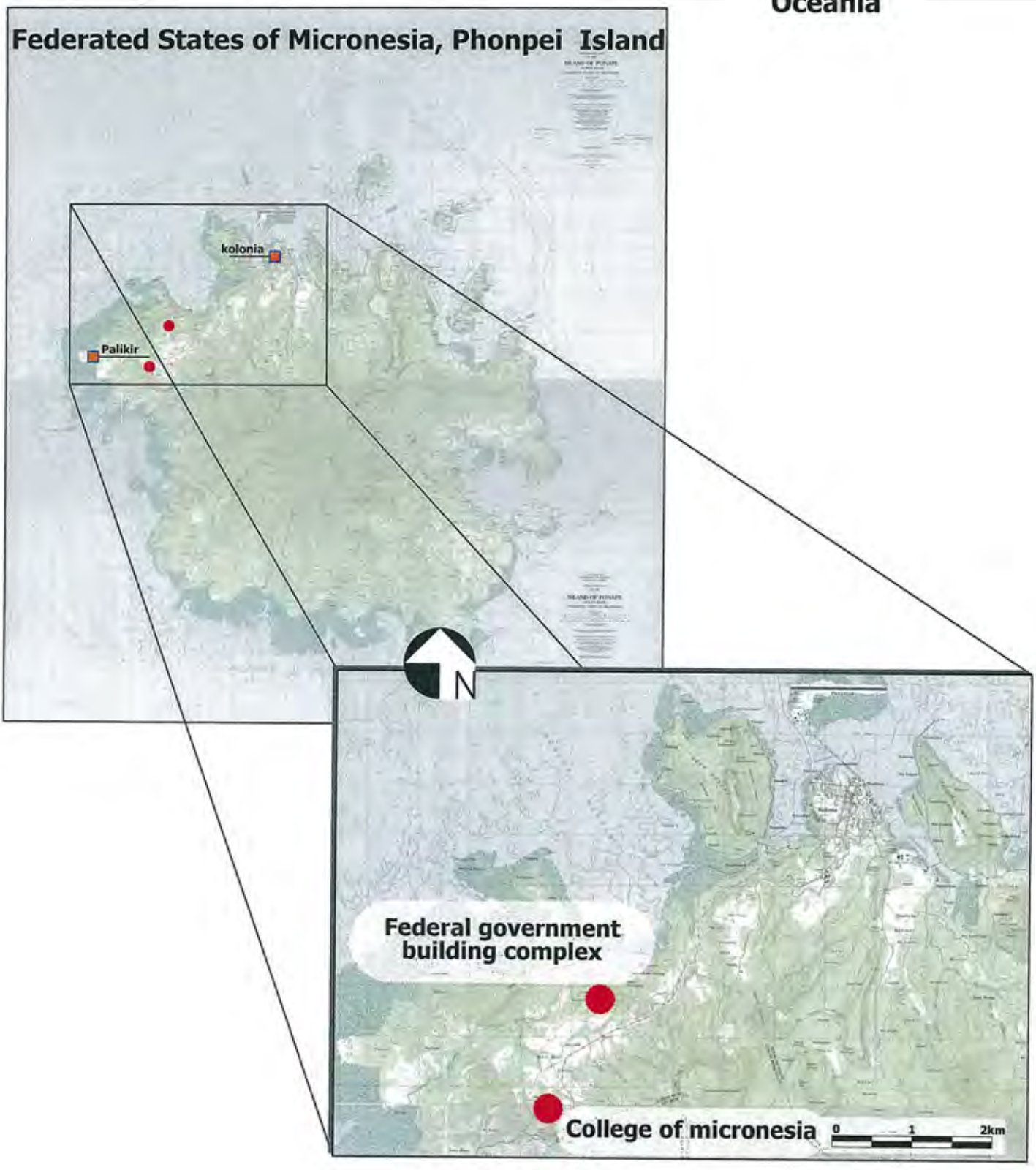
1) To ensure the stable operation of the grid-connected PV system, it will be necessary to strictly observe preventive maintenance measures such as implementing periodic site patrols and inspections and securing the onsite setup for protecting the photovoltaic modules against vandalism.

2) It will be necessary to swiftly appoint the engineers to participate in the Project soft component and OJT and to ensure that technology is transferred to other engineers who do not take part in the said training.

3) Concerning the grid-connected PV system that will be procured and installed by the Japanese side in the Project, it will be necessary to establish a power tariff scheme that enables future investment costs to be recovered, particularly in anticipation of renewals of the photovoltaic modules and power conditioners at the end of their expected service life.

CONTENTS

Oceania



LOCATION MAP
of Federated States of Micronesia

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ABBREVIATIONS

ADB	Asian Development Bank
CDM	Clean Development Mechanism
COM-FSM	College of Micronesia ,National Campus
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
E／N	Exchange of Notes
EPA	Pohnpei Environmental Protection Agency
EU	European Union
FSM	Federated States of Micronesia
G／A	Grant Agreement
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Green House Gas
IDP	Infrastructure Development Plan
IEC	International Electrotechnical Commission
IEA	International Energy Agency
IEE	Initial Environmental Examination
JAMSTEC	Japan Agency for Marine-Earth Science and Technology
JICA	Japan International Cooperation Agency
JIS	Japanese Industrial Standards
MRD	Ministry of Resources and Development
NEDO	New Energy and Industrial Technology Development Organization
O&M	Operation and Maintenance
OJT	On the Job Training
PNMDP	Palau 2020 National Master Development Plan
PUC	Pohnpei Utilities Corporation
PV	Photovoltaic
R&D	Department of Resources and Development
SCADA	Supervisory Control and Data Acquisition System
SDP	Strategic Development Plan
SHS	Solar Home System
SOPAC	South Pacific Applied Geoscience Commission

CHAPTER 1

BACKGROUND OF THE PROJECT

CHAPTER 1 BACKGROUND OF THE PROJECT

1.1 Background and Outline of the Requested Project

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

In view of this policy by the Government of Japan, JICA has established its basic support policy for climate change countermeasures in developing countries under the heading of “Direction of Climate Change Initiatives,” and within this it emphasizes the need to strengthen efforts for cooperation geared to raising the capacity of Pacific island nations to respond to climate change. Upon surveying support needs with a view to bolstering Japanese support for climate change countermeasures in the Pacific region, it was found that urgent needs exist for photovoltaic power generation projects in FSM, Palau, the Marshall Islands and Tonga. Based on this information, “the Project Formation Study for promoting Grant Aid Project for Environment and Climate Change (Photovoltaic Power) in the Pacific Region” was implemented from February to March 2009, assuming the promotion of the PV Project under Program Grant Aid for Environment and Climate Change. As a result, the needs and feasibility of project implementation in each country were confirmed and official written requests for projects under Japan's Program Grant Aid for Environment and Climate Change scheme were submitted by each country’s government.

The Study here has the following objectives: 1) to collect information relating to PV introduction and to reconfirm the detailed need and validity of cooperation, 2) to compile specific cooperation plans as Japan's Program Grant Aid for Environment and Climate Change in each country and to perform outline design corresponding to the available amount of grants, and 3) to estimate the rough project costs and prepare reference materials for tender documents.

1.2 Natural Conditions

(1) Climate

FSM has a marine tropical climate characterized by high temperatures and high humidity across its entire area. Meteorological conditions in Pohnpei State are described below.

(2) Temperature

Temperature is almost constant at around 26℃ throughout the year. According to meteorological data for FSM, the average temperature in 2008 was 26.9℃ with the maximum temperature being 27.6℃ and the minimum being 26.4℃.

(3) Humidity

Surrounded by ocean, FSM recorded a maximum humidity level of 87% in 2000 (2008 FSM Statistical Yearbook).

(4) Rainfall

Rain is apt to fall at any time of the year and the annual rainfall for 2008 was 4,789 mm according to the Preliminary Local Climatological Data by WSO Pohnpei. Looking at monthly data, the average rainfall is 399 mm with the highest figure being 744 mm (April) and lowest being 166 mm (August), and it can be seen that rainfall is particularly high in April and October.

(5) Geography

Covering a land mass of approximately 700 km^2, FSM is generally composed of four states, namely Pohnpei (approximately 345 km^2), which is home to the national capital, Chuuk (approximately 127 km^2), Kosrae (approximately 110 km^2) and Yap (approximately 118 km^2). The islands of FSM were formed by volcanic activity and are broadly divided by altitude. The high altitude islands are volcanic islands formed by volcano peaks rising out of the water, and Kosrae and Pohnpei are examples. In contrast, all the outer islands of Pohnpei, Chuuk and Yap are low atolls. Yap Island is an exception to these two types; it was formed by upheaval of the Asian Continent.

1.3 Environmental and Social Considerations

(1) Legal Systems related to Environmental and Social Consideration

The major laws and regulations related to the environment issue in FSM are as follows:

① Environmental Impact Assessment Regulations

② Pohnpei Environmental Protection Act (1992)

③ Historic and Cultural Preservation Act (2002)

④ Earthmoving Regulations

The necessary procedure for environmental impact assessment is stated in the Environmental Impact Assessment Regulations and can be summarized as follows:

① The project implementing body implements Initial Assessment (IA) according to the prescribed application format.

② The Pohnpei Environmental Protection Agency (EPA) reviews the above IA and determines whether or not the project has the potential to exert a major impact on the environment. If there is deemed to be a possibility of grave environmental impact being caused, the project implementing body is requested to submit an Environmental Impact Statement (EIS).

③ The project implementing body prepares a draft EIS that contains the designated items and submits it to the EPA.

④ The EPA publicly announces that the draft EIS is scheduled to undergo review and that it will receive comments on the EIS in writing for 60 days. Moreover, copies of the EIS will be presented to people who may possibly be affected by the project and people who are deemed to have an interest, and comments will be sought from them.

⑤ The EPA will hold a public hearing if deemed necessary.

⑥ The project implementing body will prepare the final version EIS upon responding to the comments received.

⑦ If the EPA deems the final version EIS to be appropriate, it will grant approval.

(2) Organizations concerned with Environmental Impact Assessment

1) Pohnpei Environmental Protection Agency (EPA)

As the agency responsible for the clerical procedures concerning environmental assessment, the EPA adjudicates the necessity for Initial Assessment (IA) and Environmental Impact Statement (EIS) for new projects and conducts review of the IA or EIS submitted by the project implementing body. When it deems an EIS to be required, it also discloses

information and stages public hearings as needed. In addition, the EPA is in charge of safe water supply, education, coral reef conservation, consumer protection and climate change issues, etc.

2) Department of Land and Natural Resources

This department is in charge of grasping current environmental conditions, preparing future plans and issuing authorization for using public land, etc. It is composed of four sections, i.e. the Survey and Topographical Map Section, the Public Land Section, the History Preservation and Culture Protection Section, and the Forest and Ocean Conservation Section.

(3) Environmental and Social Consideration Procedures for Project Implementation

Since the equipment to be procured and installed in the Project will be installed on the roof of an existing public building and a car park and the Project does not entail any new development, it will virtually generate no environmental impacts. The Study Team has explained the Project summary to the EPA and confirmed that the responsible government agency, i.e. the R&D, or the implementing agency, i.e. the PUC, will need to submit the following application documents to the EPA. Based on these documents, the EPA will decide whether or not it is necessary to implement the initial assessment (IA).

- EPA Earthmoving Permit Applications Form
- Copy of land ownership document or supporting document to use property
- Sketch, with dimensions
- Municipal Government Clearance
- Historic Preservation

The FSM introduced a private company for disposal of storage batteries to be installed for the office of the President, because there was no facilities and system for disposal or recycle for the batteries, called Pohnpei Waste Management Company (PWMC). The PWMC has been know by the EPA and has worked for exports waste products properly. The team and the EPA have confirmed that the batteries to be installed for the Project will be stored in the compound of the PWMC some time and will be exported by other companies with proper procedures.

According to an official in the EPA, it takes roughly three weeks from receipt of the above application documents for the environmental authorization application to be processed, however, since no environmental or social consideration problems are anticipated in the Project, it is likely that there will be no need to submit an Environmental Impact Statement (EIS) here. The Study Team has reconfirmed the above procedures with the FSM side with the field report and has confirmed that it will receive the necessary approval from the EPA by October 2009.

CHAPTER 2

CONTENTS OF THE PROJECT

CHAPTER 2 CONTENTS OF THE PROJECT

2.1 Basic Concept of the Project

2.1.1 Superior Objectives and Project Goals

FSM Federal Government established an Energy Division under the Department of Resources and Development. The Division is in charge of implementation of energy programs and now developing a National Energy Policy. The Division is also acting as secretariat for the Association of Micronesian Utilities (AMU), and heads the FSM National Energy Workgroup. In addition, power corporations or public utility corporations on the state level compile energy and electricity plans, standards and specifications and run the operation and maintenance setup. Regarding renewable energy policy, the Strategic Development Plan (SDP) formulated in 2005 purports the targets of achieving 10% of power supply in urban areas and 50% of power supply in provincial areas through renewable energy by 2020.

The Government of FSM, which regards the need to improve the current diesel-dependent supply setup as a matter of urgency and is concerned over climate change and unstable crude oil prices and transportation costs in the energy and electric power sector, views the development of PV power and other renewable clean energies as a high priority issue. For this reason, it decided to participate in the Cool Earth Partnership that was proposed by Japan as a new fund mechanism for climate change at the Davos summit in January 2008. As for the past introduction of PV systems, while FSM has already more than 20 years experience with Renewable Energy resources, similar grid-connected PV systems have not been introduced in Pohnpei State. Thus, it is difficult for staffs of the government in charge of policy-making or for the Pohnpei electric utility corporation to acquire adequate skills through their daily work, as they have not much exposure in the grid-connected PV systems. Accordingly, the Project here also includes support for the appropriate operation and maintenance of equipment and implementation of a soft component essential for realizing the cooperation effect.

In the Project, which constitutes part of the efforts to address climate change in the Pacific region, grid-connected PV system equipment (solar system: PV) will be procured and installed with a view to substituting a portion of power currently generated by diesel engine generator with renewable photovoltaic power. In doing so, the Project aims to promote future introduction of grid-connected PV system for enhancing its energy security and mitigating greenhouse gas emissions.

2.1.2 Outline of the Project

The Project aims to procure and install the PV system equipment, to connect the said system to the existing power grid and to thereby promote the introduction of renewable energy to the energy sector in FSM.

The cooperation basically covers the procurement and installation of the following equipment required for the target PV generating system.

Federal Government Complex (Capital)	College of Micronesia (COM-FSM)
➢ PV modules	➢ PV modules
➢ Mounting Structure for Photovoltaic Module (for the President's Office)	➢ Mounting Structure for Photovoltaic Module (for car park)
➢ Junction box	➢ Junction box
➢ Collecting box	➢ Collecting box
➢ Power conditioner	➢ Power conditioner
➢ Transformer	➢ Transformer
➢ Data management and monitoring system	➢ Data management and monitoring system
➢ Cables	➢ Cables
➢ PV system spare parts and maintenance tools	➢ PV system spare parts and maintenance tools
➢ Storage Battery	

2.2 Outline Design of the Japanese Assistance

2.2.1 Design Policy

2.2.1.1 Basic Concept

Based on the request from the FSM side, as a result of conducting the detailed site survey and examining the site environment and PV system capacity appropriate to the Project, grid-connected PV systems shall be procured and installed at the two Project sites of the Federal Government Complex (Capital) and College of Micronesia (COM-FSM) because of advertising effects for VIPs to visit the Federal Government Complex and students and visitors for the College of Micronesia (COM-FSM). The Equipment and materials to be installed for the Project shall be selected in view of some foreign models and to be suitable for the FSM for promotion of grid-connected PV systems. The PV system configuration should be along the Program Grant Aid for Environment and Climate Change of Japan.

2.2.1.2 Concept regarding Natural Conditions

(1) Temperature and Humidity

The annual average temperature in FSM is approximately 26℃ and humidity is extremely high at sometimes more than 80%. Since FSM has a marine tropical climate characterized by high

temperatures and high humidity throughout the year, the Project equipment shall basically comprise specifications suited to outdoor use in consideration of corrosion caused by rainfall.

(2) Salt Damage

Since the intended PV system sites are relatively close to the coastline, in consideration of salt damage countermeasures, anti-corrosion coating shall be applied to the outdoor PV module frames and the junction boxes, etc. used for making electrical wiring connections.

2.2.1.3 Concept regarding Social and Economic Conditions

Since most of the citizens of FSM are Christians, there are no religious customs that have a large impact on the construction schedule such as Ramadan in Islamic countries. However, concerning the Project sites, the Capital is used by federal government officials, important persons from other countries and business people, while the COM-FSM is used by school officials and students. Accordingly, it will be necessary to compile an implementation plan that takes such conditions into account.

2.2.1.4 Concept regarding Construction Situation, Procurement Conditions and Special Conditions or Customs in the Sector

FSM has no remarkable industries apart from agriculture and fisheries, so it relies almost completely on imports to provide daily necessities, building materials and equipment, etc. Infrastructure development is relatively good thanks to assistance by donors, for example, expansion of an international airport under support from Japan and other projects under Compact Infrastructure Grants. Since the road situation is also good, the environment for transporting equipment and executing works in the Project site is favorable.

2.2.1.5 Concept regarding Utilization of Local Contractors (Construction Companies and Consultants)

(1) Utilization of Local Contractors

Pohnpei State which is the location for the Project site has a number of construction companies, however, competition among the construction industry on limited land is intense and it is hard to establish stable orders. Pohnpei has also some solar energy companies who have experience with installing PV systems. Thus it will be relatively simple to sub-contract the constructing the PV module frame, installing the PV systems (under supervision) and implementing the civil engineering foundation works in the Project.

On the other hand, high-level engineers will be required in order to supervise the grid-connected PV systems and connect the system components under the Project, and since it is difficult to find such personnel in FSM, it will be necessary to dispatch engineers from Japan or other countries in order to conduct quality control, offer technical instruction and manage the works schedule.

(2) Utilization of Local Equipment and Materials

The aggregate, cement and reinforcing bars, etc. used in foundation works can be procured in FSM. Accordingly, when compiling the execution plan, locally procurable equipment and materials shall be utilized as much as possible. As for the main equipment, especially PV modules, Power Conditioners and Transformers, in the PV systems, should be expected to be procured from Japan under consideration in order to secure high reliability and easy maintenance based on compatibility with the existing grid.

2.2.1.6 Concept regarding Operation and Maintenance

FSM has so far introduced grid-connected PV systems to public facilities in Kosrae State under EU support, however, similar grid-connected PV systems have not been introduced in Pohnpei State. Thus, it is difficult for staffs of the government in charge of policy-making or an electric utility corporation to acquire adequate skills through their daily work. Therefore, it will be necessary to offer technical transfer on appropriate operation and maintenance to the Pohnpei Utilities Corporation (PUC) which will be responsible for operating the grid-connected PV system after completion of the Project.

Since the Project systems will be operated in connection with the existing distribution network, an appropriate operation and maintenance manual will be provided in the soft component, the operation and maintenance setup after commissioning will be proposed and measures will be taken to ensure that the system is operated effectively and efficiently.

2.2.1.7 Concept regarding Setting of Facilities and Equipment Grade

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

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

To ensure a design that is both technically and economically appropriate, standard products corresponding to NEC/IEC and other international standards shall be procured as far as possible. Equipment model types shall be kept to a minimum for the sake of ensuring compatibility and the minimum necessary equipment composition, specifications and quantities shall be selected. The connection points of the PV system for the Capital and the COM-FSM have been decided to be the distribution panel of the existing distribution system for both sites. The Japanese grant provides the PV system up to the panel and the material necessary for the connection. The final

connection work shall be done by PUC for both sites so that it is smooth to work power outage and PUC is familiar with the existing distribution facilities. For the Capital, The Japanese grant also provides and install a circuit breaker for prioritized loads for the President's office to be supplied power from the battery back-up system, and the FSM side shall select the prioritized loads and connect to the circuit breaker.

(2) Concept regarding technical level

Specifications of the equipment composing the PV system shall be selected in conformity with the technical level of the PUC which will be responsible for operation and maintenance after completion of the Project.

2.2.1.8 Concept regarding Construction Method, procurement Method and Works Schedule

Equipment procured in Japan and other third countries will primarily be transported to FSM by sea. The distance from the port in Pohnpei State to the Project sites of Capital and COM-FSM is roughly 40 minutes by car through downtown of Pohnpei. Accordingly, there shouldn't be any problems concerning overland transportation, however, since traffic in the city center is relatively heavy and congestion occurs during the morning, noon and evening peaks, it will be necessary to transport large objects other than these time frames.

The Capital and COM-FSM are only used by limited persons and are not frequently entered by the general public, however, it will be difficult to make the Project sites completely off limits and it will be necessary to display ample care when considering the temporary installation plan and execution plan. Moreover, since the Capital is a government facility, requests may arise for the sudden suspension of construction works and so on. Accordingly, it will be necessary to always take a flexible approach to work schedule management. Also, since high-level skills will be required in order to handle the PV system and carry out the equipment installation works and adjustments, from the viewpoint of ensuring quality control and keeping the intended schedule, it will be necessary to dispatch engineers from Japan or other countries in order to conduct technical instruction and schedule management.

2.2.2 Basic plan (Facility Plan / Equipment Plan)

2.2.2.1 Prerequisite of the plan

(1) Irradiance estimated

In State Weather Services of FSM, only general information such as ambient temperature, the amount of rainfall, rain or shine, etc. is collected. Irradiance data has not been taken. Therefore, the values of parameters for design were determined using the satellite observation data by Atmospheric Science Data Center of NASA. In general, FSM consists of a huge area with total

different climatologically conditions. While Yap and low laying atoll have a high irradiation value, Pohnpei and Kosrae, have a much lower value due to the rainfall and clouds.

Table 2.2.2-1 Global irradiance on the ground in Pohnpei state in FSM

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
Average (kWh/m^2/d)	4.97	5.57	5.91	5.79	5.44	5.33	5.51	5.54	5.66	5.29	5.03	4.83	**5.40**
Minimum (kWh/m^2/d)	4.03	4.68	4.55	5.10	4.30	4.69	4.90	4.54	4.64	4.39	4.28	4.01	4.51

Source： excerpt from Atmospheric Science Data in NASA

In the NASA observation data, the amount of solar radiation on the ground is estimated considering the optical thickness of cloud, cloud top height and cloudiness observed by a satellite as well as meteorological elements such as the amount of water vapor, ambient temperature, etc. Because the shape of the ground surface and geographic conditions are not considered in it, the value becomes larger than the irradiance directly measured on the ground generally. A conservative value should be calculated for the application to PV systems design. Therefore, the amount of solar radiation on the ground in FSM was estimated by comparing the observation data of global irradiance on the ground measured in Palau by JAMSTEC (Japan Agency for Marin-Earth Science and Technology) and NASA's data at the same location. As shown in Table 2.2.2-2, the minimum value of the monthly observation data of JAMSTEC in Palau is smaller by 17% than that of the monthly average irradiance of NASA. By applying this relationship to Pohnpei, the value corresponding to 83% of the monthly average irradiance of NASA is used as the base for the estimation of the generated-energy of PV systems.

Table 2.2.2-2 Comparison between Global irradiance on the ground in Pohnpei state in NASA and Global irradiance on the ground in Palau in JAMSTEC

[Unit:kWh/m2/day]

	Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Min.
Palau	NASA Average	4.60	4.98	5.70	5.90	5.40	4.60	4.75	5.03	4.92	4.81	4.59	5.00	4.59
	JAMSTEC	4.07	5.13	5.13	5.35	4.40	4.31	3.79	4.56	4.32	4.81	4.32	3.97	3.79
FSM	NASA Average	4.97	5.57	5.91	5.79	5.44	5.33	5.51	5.54	5.66	5.29	5.03	4.83	4.83
	Coverted data	4.13	4.62	4.91	4.81	4.52	4.42	4.57	4.60	4.70	4.39	4.17	4.01	4.01

Coefficient = 3.79 / 4.59 = 0.83

Source： created by JICA study team from Atmospheric Science Data in NASA and JAMSTEC Data in Palau

The places where PV panels will be installed this time are existing buildings and parking lots. Because the installation angle and azimuth of the panels differ depending on the site, an estimation method for inclined surface irradiance described in NEDO Report "Investigative study on the research, development and utilization system of PV generation utilization systems" (June, 2002; Japan Weather Association) is applied. Then, the inclined surface irradiance corresponding to the installation condition of the PV panel at each site is calculated as shown in Fig. 2.2.2-1, Fig. 2.2.2-2 and Table 2.2.2-3. Then, the estimated generated-energy of the grid-connected PV system introduced this time is calculated.

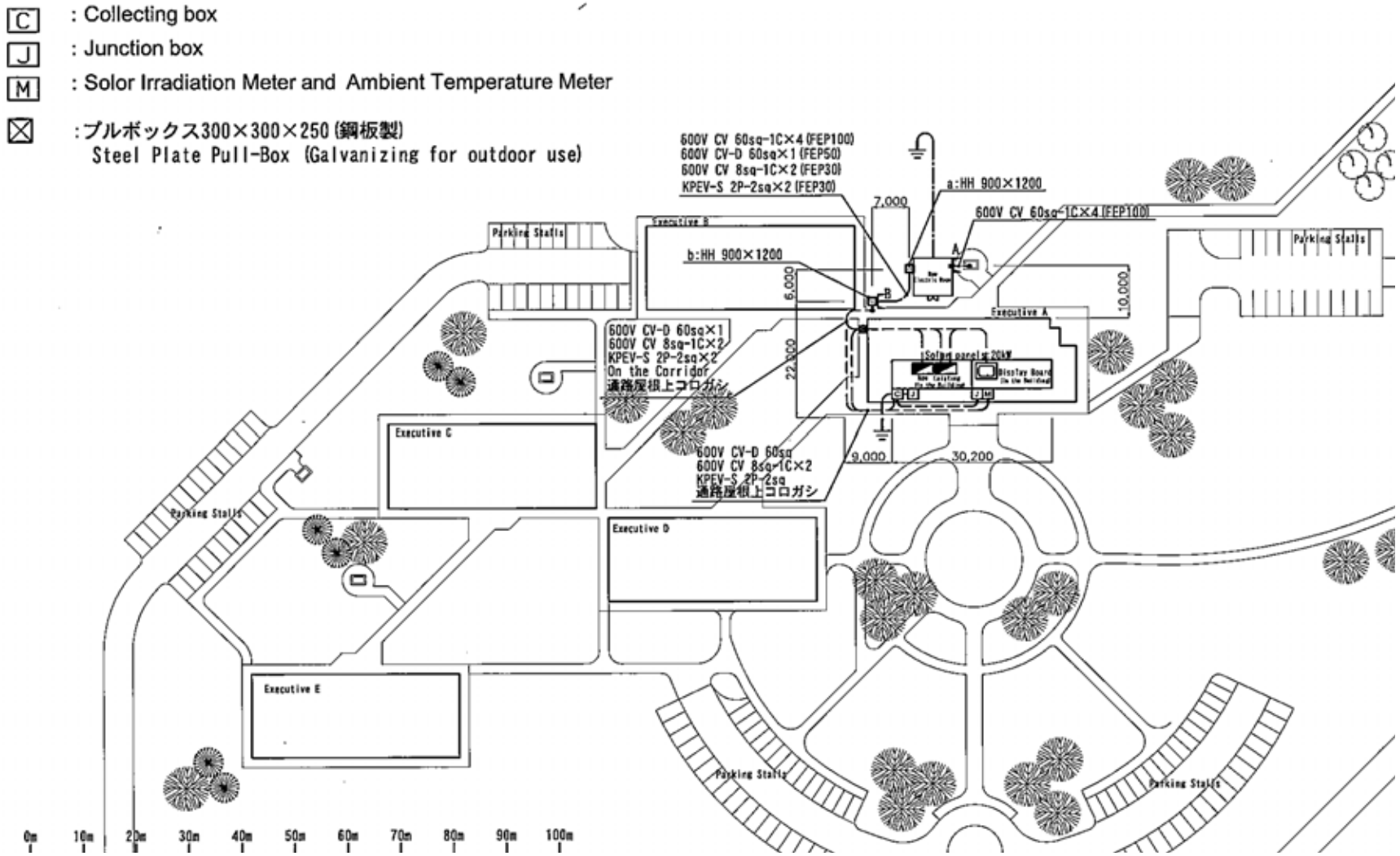


Fig. 2.2.2-1 PV system layout in Capital

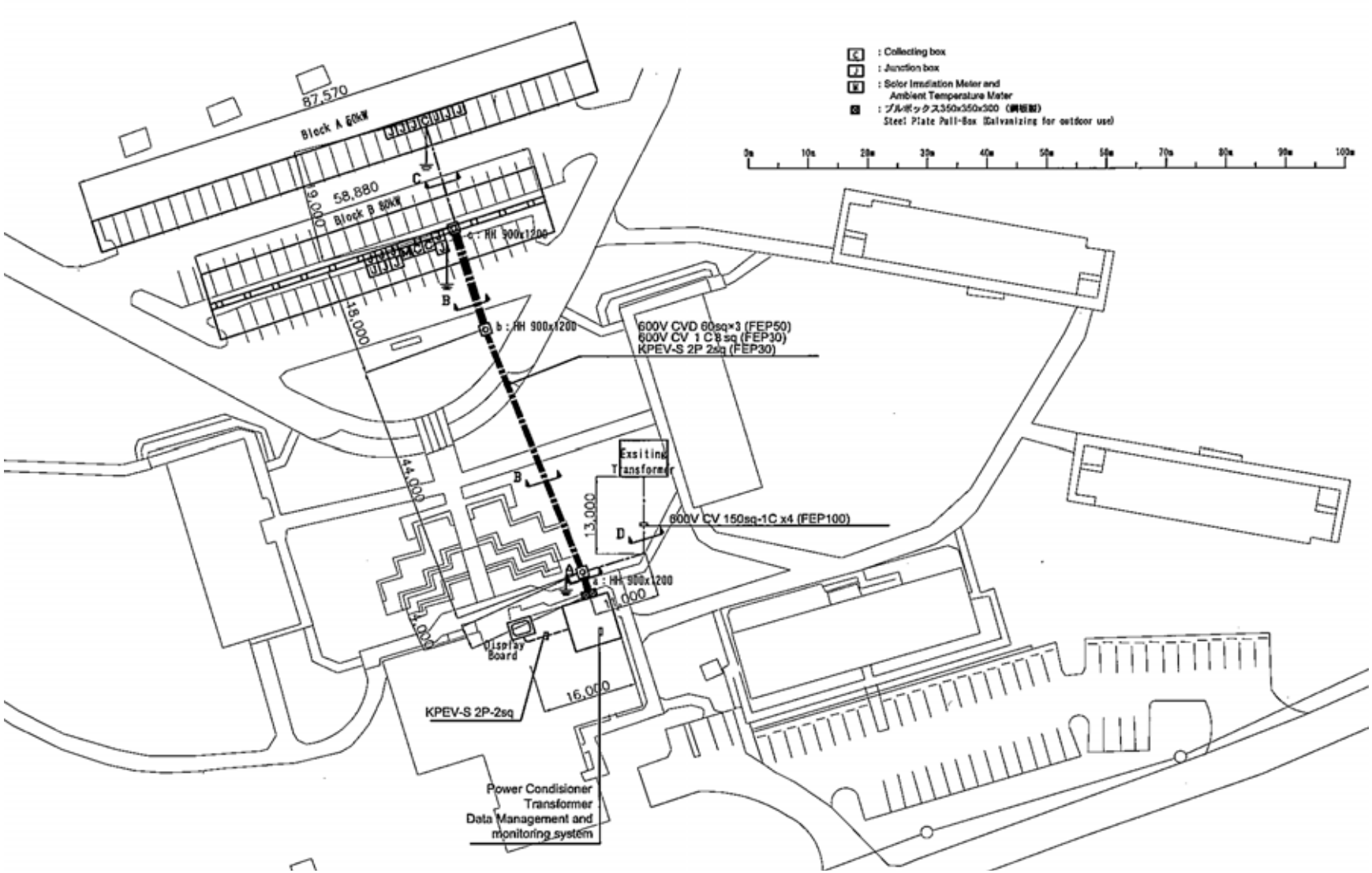


Fig. 2.2.2-2 PV system layout in COM-FSM

Table 2.2.2-3 Inclined surface irradiance for each site

[kWh/m^2/day]

Location	Angle [°]	Direction	月 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Horizontal grobal irradiance			4.13	4.62	4.91	4.81	4.52	4.42	4.57	4.6	4.7	4.39	4.17	4.01
Capital ①	34	S	4.50	4.71	4.54	3.99	3.46	3.23	3.38	3.67	4.14	4.28	4.43	4.44
Capital ②	5	S	4.21	4.66	4.87	4.70	4.38	4.26	4.41	4.48	4.63	4.39	4.23	4.10
Capital ③	5	SW	4.17	4.62	4.86	4.72	4.41	4.29	4.44	4.50	4.63	4.37	4.20	4.06
COM ①	5	NNW	3.94	4.45	4.78	4.76	4.53	4.46	4.60	4.58	4.61	4.25	3.99	3.81
COM ②	5	SSE	4.20	4.65	4.87	4.71	4.39	4.27	4.42	4.48	4.63	4.39	4.22	4.09

Source : created by JICA study team

(2) Influence of shadow by obstacles nearby

When the PV panel of PV system is installed, it is desirable to choose a place where solar radiation is not obstructed by a building, etc. nearby, considering the variation of the azimuth and angle of solar radiation that depends on season and time zone in order to generate power properly. In general, if direct sunlight is obstructed by an object and a PV array is covered by shadow, generated-energy may be decreased by 10 to 20% compared to the case there is no obstacles.

It is ideal to check radiation obstacles from AM9:00 to PM3:00 at winter solstice when the shadow of obstacles become the longest. Shadow condition was checked in Capital and COM-FSM, which are the target area of this project. Consequently, it was confirmed in COM-FSM that no shadow which influenced the generated-energy appeared at the place where the PV panel was planned to be installed.

In Capital, shadow of trees around the place for the PV panel installation was checked. Although minor influence was seen, reduction of generation capacity caused by the shadow is judged to be very small because it is well predicted that the shadow will disappear by dropping leaves due to the change of seasons and by periodical pruning, and in addition, the duration of the appearance of the shadow on the place is not very long.

(3) Estimated generated-energy

As described in “3) Influence of shadow by obstacles nearby,” it is judged that there is no influence of shadow at the sites in “Capital” and “COM-FSM.” Thus, the reduction of the generated-energy by shadow is not considered in the following discussion.

For the calculation of the estimated generated-energy, the equation below is used. Inclined surface irradiance shown in Table 2.2.2-3 is used as monthly average irradiance. The capacity of the grid-connected PV system installed at each site is 20kW for the “Capital” and 140kW for the “COM-FSM”.

$Ep = \Sigma H_A / G_S * K * P$

(Σ denotes the integrated value of the estimated generated-energies calculated month by month.)

where

- Ep = estimated annual generated-energy (kWh/year)
- H_A = monthly average irradiance on the installation surface (kWh/m^2/day)
- G_S = irradiance in standard condition (kW/m^2) = 1 (kW/m^2)
- K = loss factor = Kd * Kt * η_{INV}
  - * DC correction factor Kd : including loss corrections for dust on the solar cell surface and the fluctuation of solar irradiance, and correction for difference in characteristics of solar cells. Kd is set to 0.8 this time.
  - * Temperature correction factor Kt : correction factor for the variation of conversion efficiency caused by the temperature rise of solar cells by solar radiation.

$Kt = 1 + \alpha (Tm - 25) / 100$

where α: max. output temperature factor (%・°C^{-1})

= - 0.5 (%・°C^{-1}) [crystals]

Tm : module temperature (°C) = Tav + ΔT

Tav : monthly average temperature (°C)

ΔT : module temperature rise (°C)

Backside open type	18.4
Roof installation type	21.5

  - * Inverter efficiency η_{INV} : AC/DC conversion efficiency of inverter. η_{INV} is set to 0.95 this time.

Table 2.2.2-4 Estimated annual generated-energy in Capital

Line① (20kW)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Ha:Monthly average insolation [kWh/㎡/day]	4.50	4.71	4.54	3.99	3.46	3.23	3.38	3.67	4.14	4.28	4.43	4.44	–
Monthly days	31	28	31	30	31	30	31	31	30	31	30	31	365
Hm:Monthly integrating insolation [kWh/㎡]	139.6	131.9	140.8	119.8	107.1	97.0	104.6	113.8	124.1	132.7	132.9	137.7	1482.1
Average of daily maximum temperature [℃]	30.8	30.8	30.7	30.6	30.3	30.7	31	31.7	30.9	31.4	30.8	31.1	–
Kt: temperature correction coeficient	0.8635	0.8635	0.864	0.865	0.866	0.864	0.8625	0.859	0.863	0.861	0.864	0.862	–
Ep: Estimated PV power generation (kWh)	1,833	1,731	1,849	1,575	1,410	1,274	1,372	1,486	1,628	1,735	1,744	1,804	**19,441**

Line② (30kW)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Ha:Monthly average insolation [kWh/㎡/day]	4.21	4.66	4.87	4.70	4.38	4.26	4.41	4.48	4.63	4.39	4.23	4.10	–
Monthly days	31	28	31	30	31	30	31	31	30	31	30	31	365
Hm:Monthly integrating insolation [kWh/㎡]	130.5	130.4	151.0	141.1	135.7	127.8	136.7	138.8	138.9	136.1	127.0	127.1	1621.2
Average of daily maximum temperature [℃]	30.8	30.8	30.7	30.6	30.3	30.7	31	31.7	30.9	31.4	30.8	31.1	–
Kt: temperature correction coeficient	0.8635	0.8635	0.864	0.865	0.866	0.864	0.8625	0.859	0.863	0.861	0.864	0.862	–
Ep: Estimated PV power generation (kWh)	2,570	2,567	2,975	2,782	2,680	2,517	2,688	2,719	2,733	2,670	2,500	2,498	**31,899**

Line③ （20kW）

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Ha：Monthly average insolation [kWh/㎡/day]	4.17	4.62	4.86	4.72	4.41	4.29	4.44	4.50	4.63	4.37	4.20	4.06	_
Monthly days	31	28	31	30	31	30	31	31	30	31	30	31	365
Hm：Monthly integrating insolation [kWh/㎡]	129.3	129.5	150.6	141.6	136.6	128.8	137.7	139.4	139.0	135.5	125.9	125.8	1619.5
Average of daily maximum temperature [℃]	30.8	30.8	30.7	30.6	30.3	30.7	31	31.7	30.9	31.4	30.8	31.1	–
Kt: temperature correction coeficient	0.8635	0.8635	0.864	0.865	0.866	0.864	0.8625	0.859	0.863	0.861	0.864	0.862	–
Ep: Estimated PV power generation (kWh)	1,696	1,700	1,978	1,860	1,798	1,691	1,805	1,821	1,823	1,772	1,652	1,648	**21,244**

Total （70kW）

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Ep: Estimated PV power generation (kWh)	6,099	5,998	6,801	6,217	5,887	5,483	5,865	6,025	6,185	6,178	5,895	5,950	**72,584**

Source： created by JICA study team

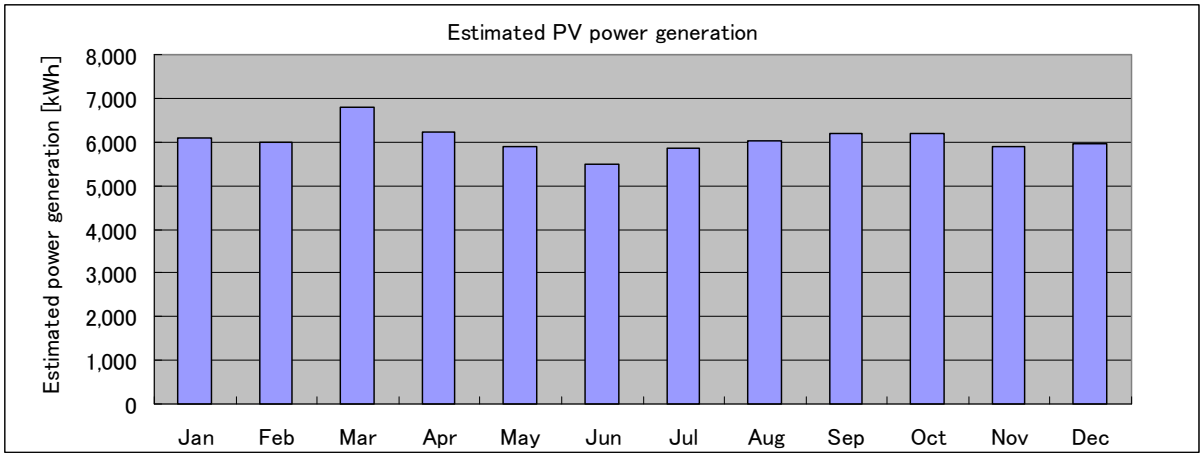


Fig. 2.2.2-3　Estimated annual generated-energy in Capital

Table 2.2.2-5　Estimated annual generated-energy in COM-FSM

Line①（30kW）

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Ha：Monthly average insolation [kWh/㎡/day]	3.94	4.45	4.78	4.76	4.53	4.46	4.60	4.58	4.61	4.25	3.99	3.81	_
Monthly days	31	28	31	30	31	30	31	31	30	31	30	31	365
Hm：Monthly integrating insolation [kWh/㎡]	122.1	124.5	148.2	142.9	140.5	133.7	142.6	142.1	138.4	131.8	119.7	118.2	1604.7
Average of daily maximum temperature [℃]	30.8	30.8	30.7	30.6	30.3	30.7	31	31.7	30.9	31.4	30.8	31.1	–
Kt: temperature correction coeficient	0.8635	0.8635	0.864	0.865	0.866	0.864	0.8625	0.859	0.863	0.861	0.864	0.862	–
Ep: Estimated PV power generation (kWh)	2,403	2,450	2,920	2,816	2,773	2,633	2,804	2,782	2,724	2,586	2,358	2,324	**31,574**

Line②（30kW）

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Ha：Monthly average insolation [kWh/㎡/day]	4.20	4.65	4.87	4.71	4.39	4.27	4.42	4.48	4.63	4.39	4.22	4.09	_
Monthly days	31	28	31	30	31	30	31	31	30	31	30	31	365
Hm：Monthly integrating insolation [kWh/㎡]	130.2	130.2	150.9	141.3	136.0	128.1	137.0	139.0	139.0	135.9	126.7	126.8	1620.9
Average of daily maximum temperature [℃]	30.8	30.8	30.7	30.6	30.3	30.7	31	31.7	30.9	31.4	30.8	31.1	–
Kt: temperature correction coeficient	0.8635	0.8635	0.864	0.865	0.866	0.864	0.8625	0.859	0.863	0.861	0.864	0.862	–
Ep: Estimated PV power generation (kWh)	2,564	2,563	2,973	2,785	2,684	2,523	2,694	2,722	2,735	2,667	2,494	2,491	**31,894**

Total（60kW）

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Ep: Estimated PV power generation (kWh)	4,967	5,013	5,893	5,601	5,458	5,156	5,498	5,505	5,458	5,253	4,851	4,815	**63,469**

Source： created by JICA study team

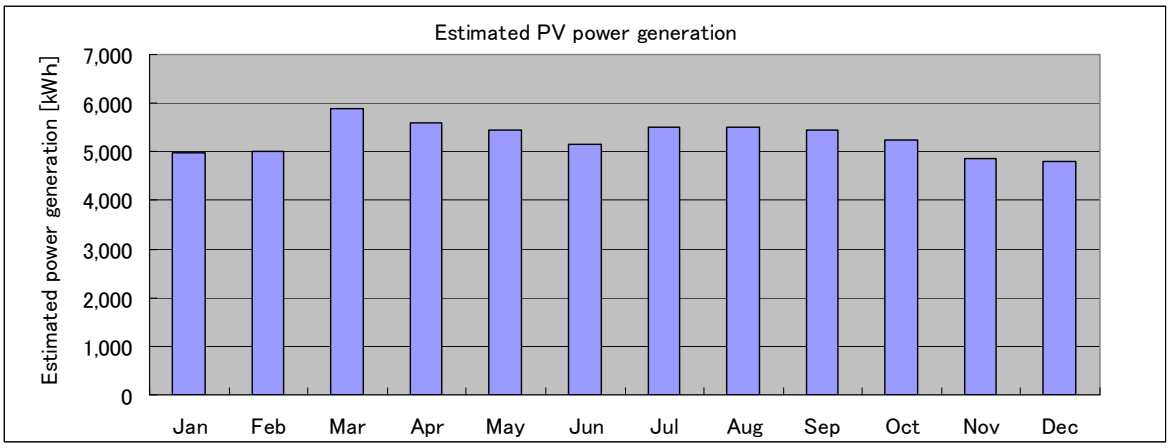


Fig. 2.2.2-4　Estimated annual generated-energy in COM-FSM

(4)　Introduction model of grid-connected PV systems

The proposed introduction models of a grid-connected PV system assumed under the Project are shown in Table 2.2.2-6. ①and ② are the cases of introduction as PUC's facilities, while ③ and ④ are the cases of introduction by private companies (other than PUC) or citizens as their own facilities. By the discussion with the FSM side, the followings were decided. The target sites of this project are “Capital” and “COM-FSM.” PUC becomes the owner of the facilities, and takes charge of the O&M in the same manner as ordinary power system. Because the owner of

the lands of these two sites is the government of FSM and COM-FSM, MOU will be concluded between MPIIC and PUC, and the O&M system, electricity tariff, etc. are determined in the MOU. Thus, the project is proposed to be implemented by the model of ②. In this introduction model, as PUC carries out O&M of the grid-connected PV system introduced under the Project, it can acquire design / operation knowhow of the grid-connected PV system, and build up sufficient experience to discuss and evaluate its economic efficiency. Therefore, this is considered to be an ideal model, also from the viewpoint of introduction and dissemination of grid-connected PV systems after the Project.

Table 2.2.2-6 Expected models of the introduced grid-connected PV system in FSM

No.	Introduction model	Installation site	PV facility owner	Characteristics, issue, requirement, etc.
①	PUC installs PV facilities in its building as its facilities.	Building, etc. of PUC	PUC	▪ Because both PV facilities and surrounding ones are PUC's, PV installation design is easy. ▪ Flexibility in PV installation location.
②	PUC installs its PV facilities on the roof, etc. of the building of other entity, renting the place.	Building, etc. of other entity	PUC	▪ Constraint in PV installation place may exist. Rent may be needed based on the agreement. ▪ Consultation on O&M and security is needed. ▪ Negotiation on electricity tariff considering rent, etc. is needed.
③	A building owner installs PV facilities as its power source, and sells surplus energy to PUC.	Building, etc. of other entity	Owner of building, etc.	▪ Because the facilities are used for private purpose regularly, reverse power flow of surplus energy is small, and thus influence on distribution lines is small. ▪ Technical requirements on equipment to be added for grid connection, such as protective equipment, should be decided based on impartial standards such as guidelines. ▪ Surplus energy purchase system should be prepared.
④	An entity other than PUC (owner of a building, etc.) installs PV facilities for wholesale power supply to PUC.	Building, etc. of other entity	Owner of building, etc.	▪ In the case large-scale PV facilities are connected to an existing distribution line, addition of overvoltage prevention equipment, etc. should be considered in advance. ▪ System for wholesale power transaction should be prepared.

Source： created by JICA study team

(5) Laws and regulations required for introduction of a grid-connected PV system

Laws and regulations required for introduction of a grid-connected PV system, which is the target facility of this program, were ascertained. Consequently, as shown in Table 2.2.2-7, securing the power quality of the existing grid, public safety, etc. is extracted as check items in "technical aspects," while how to treat the amount of generated-energy of the introduced PV system, and agreements on the O&M system of it are extracted as check items in "institutional aspects."

Table 2.2.2-7 Check items in laws and regulations when the grid-connected PV system of this project is introduced

Requisites to be checked		
Technical aspects	Power quality	: whether or not there are regulations on the influence of the introduced PV system on the electricity of the existing grid (voltage, frequency, flicker and harmonics) other than NEC
	Safety protection	: requisites to be especially considered to secure safety, such as a protective relay to be added for the grid-connection
	Grid connection point	: requisites on classification regarding the grid-connection voltage class (high-voltage or low-voltage connection), and on the facilities for connection
Institutional aspects	Approvals and licenses on installation of generation facilities, and regulations on installation contractors and reverse power flow	
	Measuring method for energy generated by a grid-connected PV system, and how to treat the amount of generated-energy and electricity tariff.	
	O&M organization and system for the introduced PV system.	

Source: created by JICA study team

For power quality (voltage, frequency, flicker and harmonics), it was confirmed that there were definite standards for voltage and frequency shown below in FSM, but there were no standards for flicker and harmonics at present.

<Voltage standards>

120V±10%, 220V±10%

<Frequency standards>

60Hz±2Hz (about ±3.3%)

For safety protection, it was confirmed that there was no particular equipment (protective relay, etc.) that must be added specially for the grid-connection. However, because only the outgoing distribution feeder at the power plant is equipped with a protective relay at present, it was determined to adopt an islanding prevention function for prevention of facility damage caused by the fault inside the premises of consumers, and securing public safety.

For the grid connection point, it was confirmed that there was no definite voltage classification based on power demand. Due to restriction on the existing facilities, low-voltage connection was chosen in “Capital”, while low-voltage connection was chosen in “COM-FSM.”

For the approvals and licenses on the installation of generating facilities, prior notification and pre-operation inspection is required when a consumer installs an emergency generator. However, it is not required for the Project because the PV systems will be owned by PUC. For reverse

power flow, the power flow will all enter the distribution line directly in this case, not passing through the consumers facilities. However, it was confirmed that there was no institutional problem because the facilities will be owned by PUC.

A watt-hour meter will be installed at the grid connection point to measure the energy supplied to the distribution line from the grid-connected PV system. The FSM side is requested to discuss and determine how to treat the amount of generated energy (and electricity tariff) hereafter.

The O&M organization and system will be established in collaboration with the FSM side, carrying out technical transfer on elements concerning O&M in the soft-component.

As mentioned above, all items except for the issues to be prepared by FSM side have already been checked. As a result of the study, it is judged that no preparation for the law and regulations is required for the grid-connected PV system installed in the project. If a law or institution against which we must take measures is laid down in FSM in the future, we need to do it. However, it was agreed that the FSM side had the responsibility to do it in such a case.

(6) Necessity of enhancing the distribution system

When the necessity of enhancing the distribution system is examined, the following two points should be considered after the grid-connected PV system is introduced.

① Distribution facilities (transformers and distribution lines) on the upstream of the grid connection point do not become overloaded.

② Distribution line voltage at the grid connection point does not go out of the standard voltage regulation.

The target site of the project is “Capital” and “COM-FSM.” The capacities of each grid-connected PV system introduced are 20kW and 140kW. Both sites are supplied with power from Pohnpei power plant with 13.8kV distribution lines. Its voltage is dropped from 13.8kV to 208V (single phase: 120V) by a distribution transformer.

The grid-connection point is the 13.8kV high-voltage distribution line for “Capital,” while it is the secondary side (low-voltage side) terminal of the power receiving transformer for “COM-FSM.”

1) Federal Government Complex (Capital)

① Distribution facilities (transformers and distribution lines) on the upstream of the grid connection point do not become overloaded.

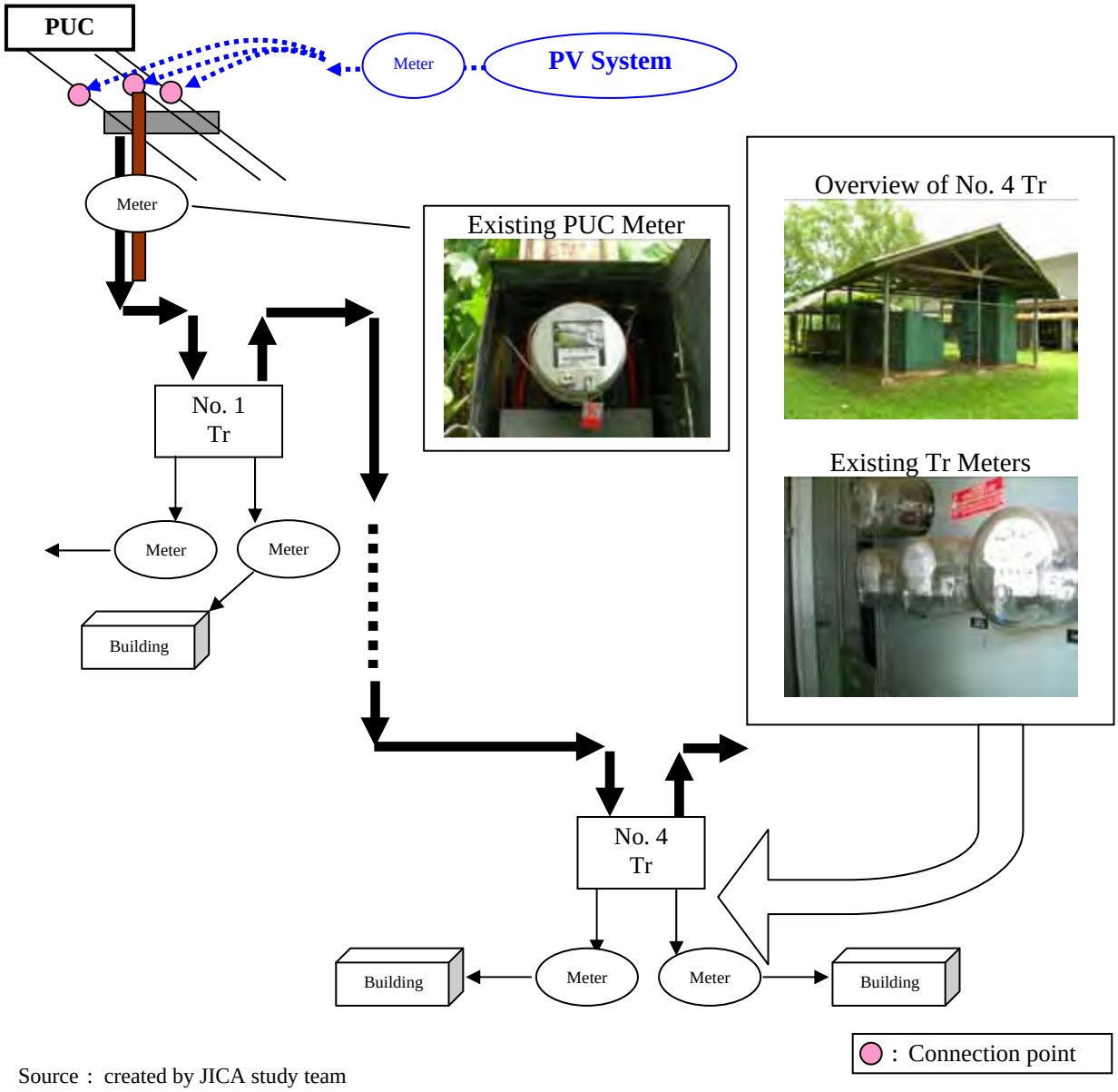
The capacity of the grid-connected PV system installed in Capital is 20kW. Considering the output decrease by the temperature rise of the PV module, the efficiency of the inverter, etc, it is assumed that the maximum PV generation output is 56kW and the maximum current from the introduced grid-connected PV system to 13.8kV distribution line is about 2.3A. Under the most severe assumption that the magnitude of the reverse power flow into the existing grid is the maximum generation output of the grid-connected PV system, it was confirmed that the distribution facilities (transformers and distribution lines) on the upstream of the grid connection point did not become overloaded.

"Capital" is supplied with power from Pohnpei power plant with the 13.8kV distribution line. The type of conductor used for the 13.8kV distribution line is ACSR336.4mils only, and its allowable current is 519A, as shown in Table 2.2.2-8. Therefore, "the reverse power flow current at the maximum PV generation output" 2.3A ≤ "the allowable current of the conductor with the minimum allowable current in the distribution feeder for grid connection" 519A. Since the condition is satisfied, it is judged that there is no problem in the capacity of the existing distribution lines.

Table 2.2.2-8 Specifications of the distribution line from Nanpohnmal plant to Capital

Power plant	Distribution line	Type of conductor	Allowable current
Pohnpei power plant	13.8kV	ACSR336.4mils	519A

Source : According to the hearing survey at PUC



Source： created by JICA study team

Fig. 2.2.2-5 Connection point of the introduced grid-connected PV system in Capital

② Distribution line voltage at the grid connection point does not go out of the standard voltage regulation.

In this examination, it is enough to confirm that the power-receiving voltage at the closest general low-voltage customer does not go out of the standard voltage regulation, considering the distribution line from Nanpohnmal power plant to the grid-connection point. In the examination, it should be confirmed that when generated power is supplied from the grid-connected PV system to the existing grid under light load condition, the power-receiving voltage at the closest general low-voltage customer does not exceed the upper limit of the standard voltage regulation. For that purpose, data of the type, size and allowable current of the conductors, and that of the load of

the target distribution line under a light load, etc., are necessary. The load management conditions of PUC were surveyed in this study. Consequently, it was found that these necessary data had not been acquired in FSM and the examination at a light load was difficult. In this examination, therefore, under a severer condition where all loads are disconnected from the distribution line, in other word, under a condition where generated power is supplied from the grid-connected PV system to the no-load distribution line, it is confirmed that the power-receiving voltage at the closest general low-voltage customer does not exceed the upper limit of the standard voltage regulation. Here, the examination is done based on the sending end voltage at Nanpohnmal power plant, which is the beginning point of the distribution line. The distribution line system in FSM has a loop configuration. However, because it was confirmed by a hearing survey in PUC that the switching was done only when a fault occurs, the examination is made for the ordinary distribution system.

In the system, “Capital” is supplied with power from Nanpohnmal power plant with a 13.8kV distribution line, and the distance between them is about 4km. The type of conductor used for the 13.8kV distribution line is ACSR336.4mils only. The specifications are shown in Table 2.2.2-9. The PV generation output is the rated output with a power factor of 1.0. As for the standard voltage, the standard of FSM (120V±10%) is used. Under these conditions, it is confirmed that the power-receiving voltage at the closest general low-voltage customer does not go out of the standard voltage regulation.

Table 2.2.2-9 Examination result on the distribution line voltage at the grid-connection point and the closest general low-voltage customer

Distance between Pohnpei power plant to the Capital	Sending end voltage	Type of Conductor	R [Ω/km]	Reverse power flow current from PV	Voltage rise at high voltage	Power-receiving voltage at the closest low-voltage customer
3.98km	13.8kV	ACSR336.4 mils	0.512	2.3A	5V	120.1V

Source： created by JICA study team based on a hearing survey in PUC

The result of this examination shows that the power-receiving voltage at the closest general low-voltage customer is 120.1V when reverse power flow occurs from the grid-connected PV system to the no-load distribution line. Since the value is lower than the upper limit of the standard voltage regulation (132V), it is judged that there is no problem.

Based on the above examination results, it is judged that reinforcement of the distribution system is not needed.

2) College of Micronesia (COM-FSM)

① Distribution facilities (transformers and distribution lines) on the upstream of the grid connection point do not become overloaded.

The capacity of the grid-connected PV system installed in COM-FSM is 140kW. Considering the output decrease by the temperature rise of the PV module, the efficiency of the inverter, etc, it is assumed that the maximum PV generation output is 48kW and the maximum current from the introduced grid-connected PV system to 13.8kV distribution line is about 2.0A. Under the most severe assumption that the magnitude of the reverse power flow into the existing grid is the maximum generation output of the grid-connected PV system, it was confirmed that the distribution facilities (transformers and distribution lines) on the upstream of the grid connection point did not become overloaded.

(a) Capacity of the power-receiving transformer

The grid-connected PV system of COM-FSM is connected on the secondary side (low-voltage side; Y connection; 208V) of the power-receiving transformer (Transformer No.3) of an existing building. The capacity is 300kVA.

Since “the maximum PV generation output” 60kVA ≤ “the capacity of the power-receiving transformer” 300kVA, it is judged that there is no problem in the capacity of the power-receiving transformer.

(b) Capacity of the distribution line

The distribution lines down to the power-receiving transformer of COM-FSM are composed of overhead distribution line and underground distribution line.

The type of wire used for the 13.8kV overhead distribution line from Nanpohnmal power plant to COM-FSM is ACSR336.4mils only, and its allowable currents is 519A, as shown in Table 2.2.2-10.

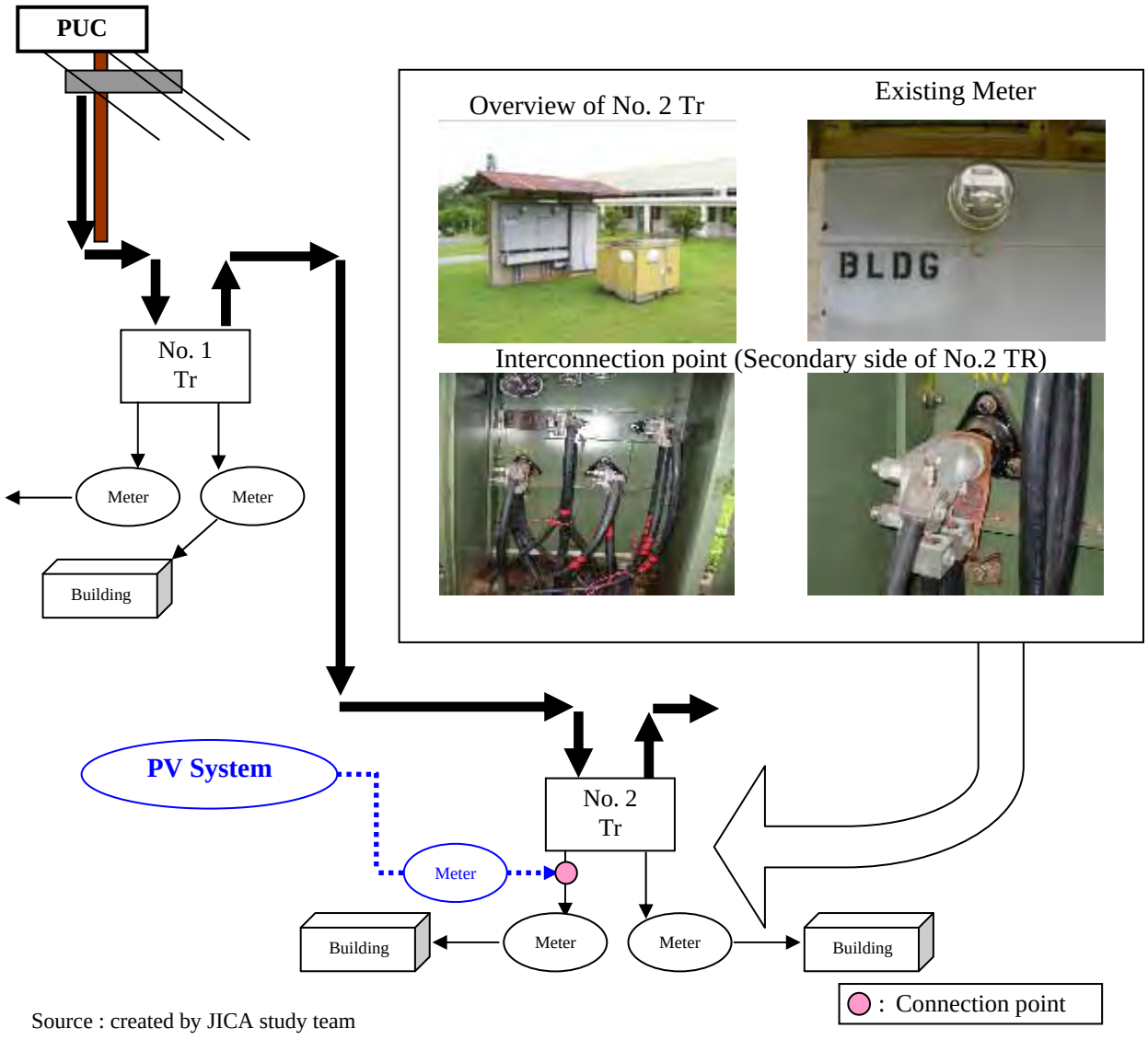
The condition is satisfied because “the reverse power flow current at the maximum PV generation output” 2.0A ≤ “the allowable current of the wire with the minimum allowable current in the distribution feeder for grid connection” 519A. Thus, it is judged that there is no problem in the capacity of the existing overhead distribution line.

Table 2.2.2-10 Overhead distribution line from Nanpohnmal power plant to COM-FSM

Power plant	Distribution line	Type of conductor	Allowable current
Nanpohnmal power plant	13.8kV	ACSR336.4mils	519A

Source： created by JICA study team based on a hearing survey in PUC

The case of the underground distribution line section (from the leading-in pole to the power-receiving transformer) is as follows: The 60kW grid-connected PV system to be introduced this time is connected to the secondary side (low-voltage side) terminal of the power-receiving transformer of "COM-FSM," as shown in Fig. 2.2.2-6. The section uses 15kV MV-90 XLPE, and its allowable current is 155A. Therefore, it is judged that the line can sufficiently withstand the maximum current of the reverse power flow of the grid-connected PV system (2.0A).



Source : created by JICA study team

Fig. 2.2.2-6 Connection point of the introduced grid-connected PV system in COM-FSM

② Distribution line voltage at the grid connection point does not go out of the standard voltage regulation.

In this examination, it suffices to confirm that the power-receiving voltage at the closest general low-voltage customer does not go out of the standard voltage regulation, considering the distribution line from Nanpohnmal power plant to the grid-connection. In the examination, it should be confirmed that when reverse power flow occurs from the grid-connected PV system to the existing grid under light load condition, the power-receiving voltage at the closest general low-voltage customer does not exceed the upper limit of the standard voltage regulation. For that purpose, data of the type, size and allowable current of the wires, and that of the load of the target distribution line under a light load, etc., are necessary. The load management conditions of PUC were surveyed in this study. Consequently, it was found that these necessary data had not been acquired in FSM and the examination at a light load was difficult. In this examination, therefore, under a severer condition where all loads are disconnected from the distribution line, in other word, under a condition where reverse power flow occurs from the grid-connected PV system to the no-load distribution line, it is confirmed that the power-receiving voltage at the closest general low-voltage customer does not exceed the upper limit of the standard voltage regulation. Here, the examination is done based on the sending end voltage at Pohnpei power plant, which is the start point of the distribution line. The distribution line system in FSM has a loop configuration. However, because it was confirmed by a hearing survey in PUC that the switching was done only when a fault occurs, the examination is made for the ordinary distribution system here.

In the system, “COM-FSM” is supplied with power from Nanpohnmal power plant with a 13.8kV distribution line, and the distance between them is about 7km. The type of conductor used for the 13.8kV distribution line is ACSR336.4mils only. The specifications are shown in Table 2.2.2-11. The PV generation output is the rated output with a power factor of 1.0. As for the standard voltage, the standard of FSM (120V±10%) is used. Under these conditions, it is confirmed that the power-receiving voltage at the closest general low-voltage customer does not go out of the standard voltage regulation.

Table 2.2.2-11 Examination result on the distribution line voltage at the grid-connection point and the closest general low-voltage customer

Distance between Pohnpei power plant to COM-FSM	Sending end voltage	Type of Conductor	R [Ω/km]	Reverse power flow current from PV	Voltage rise at high voltage	Power-receiving voltage at the closest low-voltage customer
6.78km	13.8kV	ACSR336.4mils	0.512	2.0A	7V	120.1V

Source： created by JICA study team based on a hearing survey in PUC

The result of this examination shows that the power-receiving voltage at the closest general low-voltage customer is 120.1V when reverse power flow occurs from the grid-connected PV system to the no-load distribution line. Since the value is lower than the upper limit of the standard voltage regulation (132V), it is judged that there is no problem.

Based on the above examination results, it is judged that reinforcement of the distribution system is not needed.

(7) Examination on power quality

When a grid-connected PV system is introduced, power quality should be examined in parallel with examination on the necessity of distribution system reinforcement. “Flicker” and “harmonics” are considered to be the examination items concerning power quality. However, as a result of a hearing investigation at PUC, it was found that there were no definite power quality standards currently. In addition, it is judged that there would be no generation sources of these two items because there are no big factories in the grid of FSM. Thus, the examination on power quality was omitted in this study. As for harmonics, however, measures against it have already been taken in general purpose grid-connection inverters in Japan. Thus, it was determined that the specifications in accordance with the Japanese guidelines on harmonics suppression measures should be required as the specifications for the target facilities of the Project.

(8) Allowable capacity of the introduced grid-connected PV system

The output of a PV system fluctuates according to the fluctuation of solar radiation. In the case a PV system is connected to a grid, it is required to verify that the fluctuation component can be absorbed by controlling the existing generating system, and the power quality can be maintained within the standard range. Here, it is examined whether or not a capacity of 160kW, which is the total capacity of the grid-connected PV systems that are planned to be introduced in the Project, can be introduced into the existing grid. The examination method is as follows: The allowable capacity of the introduced grid-connected PV system, against the existing grid, is calculated, and whether or not the allowable capacity is larger than the actual system capacity is checked.

In view of securing power quality, the following two methods are considered as the examination methods on the allowable capacity of the introduced grid-connected PV system against the existing grid:

Step 1 : Examination on restrictions in view of grid operation

Step 2 : Examination on restrictions in view of distribution line operation

With regard to Step 2, as examined in "7) Necessity of enhancing the distribution system," it is judged that there is no restriction in view of distribution line operation. Hence, the examination result on Step 1 is explained below.

Step 1 : Examination on restrictions in view of grid operation

As mentioned in 2-2-3 (4), power supply in Pohnpei Island is all covered by seven diesel generators in Nanpohnmal power plant at present. The operation method of the generators was investigated. The result is as follows: Equipment which can remotely monitor and control the whole power plant or the whole system has not been introduced. To change the number of operating generators properly, the total output of the power plant is recorded on the hour, and the operator starts / stops the generators empirically according to the data so that a reserve capacity of about 1 to 4MW can be secured anytime. In order to respond to short-period load fluctuations, the diesel generator of Caterpillar is equipped with an electronic governor, while that of Daihatsu is equipped with a mechanical one. A governor free operation is possible in both of them. It was found that the drooping rate had been set separately by generator as shown in the table below, and an order of priority for load response had been determined.

Table 2.2.2-12 Drooping rate of each diesel generators

UNIT	Governor Type	INSTALLED CAPACITY kW	AVAILABLE CAPACITY kW	Speed Droop %
CAT #4	Electric	1135	800	N/A
CAT #5	Electric	1135	0	N/A
CAT #6	Electric	1135	800	N/A
DAI #7	Mechanical	2500	1900	1.7
DAI #8	Mechanical	2500	0	N/A
DAI #9	Mechanical	2500	1600	2
DAI #10	Mechanical	2500	1700	2.5

However, because the fluctuation governing-speed is low especially in the mechanical governors, the operators monitor the frequency fluctuation 24 hours in three shifts, and control the output manually when the frequency changes rapidly. According to the result of a hearing survey in

PUC, the frequency control standard is 60±2Hz (±3.3%). Thus, if the drooping rates of all the generators are 3.3% or lower, it is presumed theoretically that no problem will arise as far as the total amount of the load fluctuation and the PV output fluctuation is within the reserve capacity of the operating diesel engine generators. However, as a conservative way, the allowable capacity of the introduced grid-connected PV system is evaluated here using the frequency deviation target value in Japan, 60±0.2Hz (±0.3%).

In view of suppressing the fluctuations in a grid, severer conditions are as follows: the load is lighter; the number of operating generators is fewer; and generators with greater drooping rates are operating. According to the demand records of recent years, the minimum demand is 2,500kW. Therefore, it can be assumed that the condition is severest when two generators, #9 and #10, are operating.

As for the maximum load fluctuation, the largest value in the demand fluctuation record taken hourly is 2,300kW according to the above demand records of recent years. On the assumption that the short-term fluctuation is not larger than the fluctuation during five minutes, the value is presumed to be about 190kW (≒ 2,300kW / 60 *5).

The allowable output fluctuation range when the generator #9 with an available output of 1,600kW and the generator #10 of 1,700kW are in a governor free operation state is calculated as follows, considering that the frequency deviation target value is 60±0.2Hz (±0.3%) and the drooping rates of these generators are 2% and 2.5% respectively.

1,600kW * (0.3 * 2.5 / (2 + 2.5)) + 1,700kW * (0.3 * 2 / (2 + 2.5)) ≒ 490kW

The following relationship should be satisfied.

Fluctuation of PV generation output (kW) + Fluctuation of demand (kW) ≤ Allowable output fluctuation of diesel generators operating at a light load (kW)

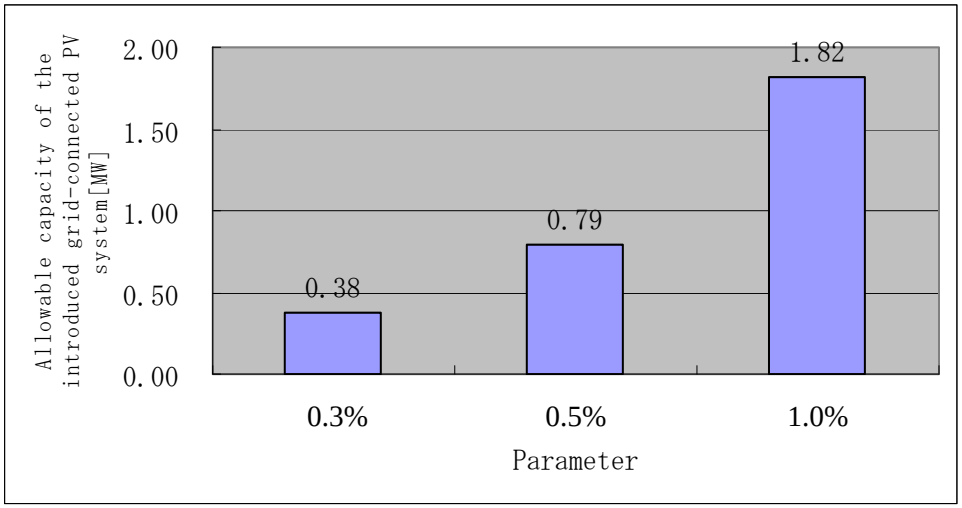
Thus, the allowable fluctuation of the PV generation output is calculated as follows:

Allowable fluctuation of the PV generation output ≤ 490kW - 190kW = 300kW

Assuming that the fluctuation range of the PV generation output is 10 to 90% of the rated capacity based on the past verified examples, the allowable capacity of the grid-connected PV system introduced into the existing grid is calculated to be about 375kW. From this result, it was confirmed that there was no problem in the grid-connected PV systems of 160kW (20kW + 140kW) that would be introduced by the Project.

This examination was done based on the frequency deviation target value in Japan, which was a severe value as power quality. The allowable capacity of the introduced grid-connected PV system changes by the change of the target value. Thus, a sensitivity analysis was conducted using the allowable frequency fluctuation rate as the parameter. The values below were used for the parameter.

① 60±0.2Hz (±0.3%) : frequency deviation target value in Japan
② 60±0.3Hz (±0.5%) : medium value
③ 60±0.6Hz (±1.0%) : frequency deviation target value in Thailand and Malaysia, where relatively sophisticated electricity infrastructures have been constructed in Southeast Asia



Source： created by JICA study team

Fig. 2.2.2-7 Relationship between the allowable frequency fluctuation rate and the allowable capacity of the introduced PV generating system

(9) Laws and regulations on reinforcement of the existing facilities and buildings

FSM has adopted the US law and regulations on reinforcement of the existing facilities and buildings, as well as laws and regulations on the structure, fire fighting, etc. concerning constructions of new facilities and buildings. In general, the U.S. standards are applied correspondingly. However, because application of the standards of the donor country is permitted in the case of a foreign assistance, reinforcement of the existing buildings and construction of new facilities in the Project will be designed based on the standards in Japan, but shall not conflict with the standards and regulations in Pohnpei State and FSM.

2.2.2.2 Overall Plan

The scale and specifications of the Project facilities and equipment shall be planned according to the following conditions.

(1) Climate and Site Conditions

Table 2.2.2-13 Climate and Site Conditions

(a) Altitude[*1]	37.5m
(b) Ambient temperature (maximum)[*1]	31.0˚C
(c) Ambient temperature (minimum)[*1]	21.8 ˚C
(d) Relative humidity (maximum)[*2]	87 %
(e) Monthly maximum rainfall [*2]	985.5 mm
(h) Maximum wind velocity [*3]	110 mile / hour

Source : *1 Preliminary Local Climatological Data (WSO Pohnpei)
*2 2008 FSM Statistical Yearbook
*3 Design Standard by Department of Transportation, Communication & Infrastructure

(2) Electrical System Conditions

① Distribution voltage : (Intermediate voltage) 3 phase 4 wire 13.8 kV (maximum 14.52 kV)
(Low voltage) 3 phase 4 wire 208-120 V

② Frequency : 60 Hz

③ Maximum shorting capacity : 13.8 kV system, 12.5 kA

④ Ground line : 13.8 kV, neutral point multiple grounding

⑤ Ground resistance : 10 Ω or less

⑥ Color : NEC standard

(3) Facilities Plan Conditions

Since the PV module frames to be installed in the Project will also act as sunshades for car parks, the minimum required support frame will be designed upon considering building clearance with vehicles and securing of the maximum possible electric energy from the natural conditions. Moreover, in view of the need for power distribution and consumption, the layout plan shall be designed so that the shortest possible distance to the existing electrical rooms is obtained.

The panel support frame to be installed on the roof of the President Office will be directly attached to the existing roof and base layer. Therefore, upon carefully investigating the existing roof, the ideal and sound fittings for the existing sub-layer will be selected to ensure safety against upward force of wind load.

Since the Federal Government Complex in Palikir has no space to house the electric equipment needed for the Project such as transformer and power conditioner, a new electric room (single story around 4.3 m x 2.8 m) will be planned within the complex.

2.2.2.3 Outline of the Basic Plan

(1) Basic Plan

Table 2.2.2-14 shows the basic plan of the Project based on the basic design concept described above (see 2.2.1).

Table 2.2.2-14 Outline of the Basic Plan

	Procurement and installation of the following PV equipment	Quantity	
	Project site	Federal Government Complex (Capital)	College of Micronesia (COM-FSM)
Equipment procurement and installation plan	PV Module	1 set	1 set
	Mounting Structure for Photovoltaic Module	1 set	1 set
	Power conditioner	1 unit	1 unit
	Transformer	1 unit	1 unit
	Data management and monitoring system	1 set	1 set
	Storage Battery	1 unit	-
Equipment procurement plan	Replacement parts, maintenance tools and test equipment for the photovoltaic system	1 set	1 set

(2) Equipment Procurement Quantities

The quantities of the main equipment to be procured in the Project are as shown in Table 2.2.2-15.

Table 2.2.2-15 Quantities of Major Equipment

	Procurement and installation of the following PV equipment	Quantity	
	Project site	Federal Government Complex (Capital)	College of Micronesia (COM-FSM)
Equipment procurement and installation plan	PV Module	20 kWp	140 kWp
	Mounting Structure for Photovoltaic Module	1 set	1 set
	Junction box	2 units	14 units
	Collecting box	1 unit	3 units
	Power conditioner	1 unit	1 unit
	Transformer	1 unit	1 unit
	Data management and monitoring system	1 set	1 set
	Storage Battery	1 unit	-
	Wiring materials, grounding work materials	1 set	1 set
Equipment procurement plan	Replacement parts, maintenance tools and test equipment for the photovoltaic system	1 set	1 set

Concerning the reserve materials, the design quantity shall be multiplied by the reserve factor upon considering breakages, etc. during ocean and inland transportation and installation. The reserve factor will be decided in consideration of experiences in similar overseas works. In the case of PV power generation, since an unexpected failure in just one panel can prevent power generation in a whole string of connected panels, it is difficult to guarantee performance. Since the Project will be implemented under the Government of Japan's Environment and Climate Change Program Grant Aid scheme, the design quantity multiplied by 3% (reserve amount) shall be procured to ensure that the installation work is finished in a short time and that performance after installation is guaranteed.

(3) Outline Specifications of Equipment

Existing standards in FSM will as far as possible be applied to the PV and distribution equipment procured and installed by the Japanese side. In addition to paying attention to the ease of equipment operation and maintenance following completion of the Project, the number of specification items will be limited and standard design models will be adopted with a view to reducing the installation time. The PV module for the Project shall be mounted on the steel frame designed for the roof of the President's office for the Capital and car park for the COM-FSM and should be considered architectural limit of strength and installation space. The PV module shall be crystal silicon type in consideration of long performance and reliability from the aspect of saving the future maintenance and replacement of PV modules.

Table 2.2.2-16 Specifications for PV Module

Equipment	Specifications	Required Specifications
1. PV module	(1) Applicable standard	IEC and equivalent standards
	(2) Environment of use	High humidity and Salt damage area
	(3) Ambient temperature	+40℃ or less
	(4) Installation method	Car park roof installation, Gabled roof
	(5) Type	Crystal silicon; each module must have a blocking / by-pass diode
	(6) Module efficiency	12% or higher
	(7) Module capacity	210W / module or more

Table 2.2.2-17 Specifications for Mounting Structure for Photovoltaic Module

Equipment	Specifications	Required Specifications
2. Mounting Structure for PV Module	(1) Support method	Steel frame
	(2) Environment of use	Salt damage area
	(3) Material	SS400 hot dip zinc finish
	(4) Base Frame	C type channel or equivalent (for Capital)
	(5) Panel Frame	Angle type channel or equivalent

Table 2.2.2-18 Specifications for Junction Box

Equipment	Specifications	Required Specifications
3. Junction box	(1) Structure	Outdoor use (IP 65), wall mount type
	(2) Environment of use	High humidity and Salt damage area
	(3) Ambient temperature and humidity	+40℃ or less, 80% or more
	(4) Maximum input voltage	String unit nominal open voltage (V_{OC}) or more
	(5) Input circuits	Number of sub-array unit parallel lines or more
	(6) Input current	Module nominal short circuit current (I_{SC}) per circuit or higher
	(7) Output circuits	1 circuit
	(8) Output current	Sub-array nominal short circuit current (I_{SC}) or higher
	(9) Internal devices	- Wiring circuit breaker: Number of circuits - Reverse flow prevention diode: Each string - Induced lightning protector: All input and output circuits, between wires, between earth

Table 2.2.2-19 Specifications for Collecting Box

Equipment	Specifications	Required Specifications
4. Collecting box * 1 junction box; or this can be omitted if the number of power	(1) Structure	Outdoor use (IP 65) , wall mount type
	(2) Environment of use	High humidity and Salt damage area
	(3) Ambient temperature and humidity	+40℃ or less, 80% or more
	(4) Maximum input voltage	String unit nominal open voltage (V_{OC}) or more

Equipment	Specifications	Required Specifications
conditioner input circuits exceeds the number of junction boxes.	(5) Input circuits	Number of junction boxes to be connected or more
	(6) Input current	Junction box output current or more
	(7) Output circuits	1 circuit
	(8) Output current	Sub-array nominal short circuit current x Number of input circuits or more
	(9) Internal devices	- Wiring circuit breaker: Number of circuits - Induced lightning protector: All input and output circuits, between wires, between earth

Table 2.2.2-20 Specifications for Power Conditioner

Equipment	Specifications	Required Specifications
5. Power conditioner	(1) Structure	Indoor, vertical standing type
	(2) Ambient temperature and humidity	+40℃ or less, 80% or more
	(3) Main circuit system	Self-excited voltage inverter
	(4) Switching system	High frequency PWM
	(5) Insulation system	Commercial frequency insulation transformer type
	(6) Cooling system	Forced air cooling
	(7) Rated input voltage	String maximum output voltage (Vpmax)
	(8) Input operation voltage range	The string maximum output voltage (Vpmax) and nominal open voltage (V_{OC}) shall be within range.
	(9) Input circuits	The number of collecting boxes or more
	(10) Output electricity system	3 ϕ 3W
	(11) Rated output	30 kW (Capital) 100kW (COM)
	(12) Rated input voltage	DC 300V
	(13) Rated output voltage	AC 202V
	(14) Rated frequency	60Hz
	(15) AC output current distortion factor	Total current 5% or less, each order 3% or less
	(16) Power control system	Maximum Power Point Tracking (MPPT)
	(17) Rated power conversion efficiency	90% or more
	(18) Control functions	- Automatic start/stop, soft start - Automatic voltage regulation - Control for input / output current - Control for output power (by external output signal)
	(19) Grid-connected protective functions	- Over Voltage Relay (OVR) - Under Voltage Relay (UVR) - Over Frequency Relay (OFR) - Under Frequency Relay (UFR) All setting values and times can be adjusted. Blocking duration after power recovery can be adjusted.
	(20) Islanding operation detection function	Both Active and Reactive method for detection. Islanding detection can be masked by switching operation.

Equipment	Specifications	Required Specifications
	(21) Outside signal	- Status information, failure information, and measurement information - Communication interfaces (RS485)
	(22) Grid Back-up Board (for Capital)	Indoor, vertical standing type Rated input voltage: DC 300V Overcharge protection Overdischarge protection Change-over switch Timer Switch

Table 2.2.2-21 Specifications for Transformer

Equipment	Specifications	Required Specifications
6. Transformer	(1) Structure	Indoor, vertical self standing
	(2) Rated output	50kVA (Capital), 200 kVA (COM-FSM)
	(3) Primary voltage	3 ϕ 4W AC208V
	(4) Secondary voltage	3 ϕ 3W AC200V
	(5) Frequency	60 Hz
	(6) Insulation class	Class B
	(7) Vector group	Y-Δ (Yd1)
	(8) Tap Changer	Primary side: 3 taps, Secondary side: 3 taps

Table 2.2.2-22 Specifications for Medium-Voltage Power Incoming Unit

Equipment	Specifications	Required Specifications
7. Storage Battery	(1) Structure	Indoor, vertical self standing
	(2) Ambient temperature and humidity	+ 45℃ or less, 70% or more
	(3) Storage Capacity	1000Ah or more
	(4) System output voltage	DC 240V
	(5) Others	With steel lack for storage

Table 2.2.2-23 Specifications for Data management and monitoring system

Equipment	Specifications	Required Specifications
8. Data management and monitoring system	(1) Pyranometer 1) Applicable standard 2) Sensitivity	 ISO9060 Second class or equivalent 6~8 mV/ (W▪m^2)
	(2) Thermometer 1) Type 2) Shape 3) Temperature range of use	 Measurement resistor Pt100Ω 4wire With simple shelter -40℃~+60℃
	(3) Signal Transducer box 1) Structure 2) Material 3) Input signals	 Outdoor use, wall mount type Steel (Powder Coating) Pyranometer (0-10mV), thermometer (Pt100Ω)

Equipment	Specifications	Required Specifications
	4) Output signals	4-20mA x 2
	5) Power source	AC120V
	6) Housed equipment	Pyranometer signal converter, thermometer signal converter, wiring circuit breaker, induced lightning protector
	(4) Monitoring system (site side)	
	1) Data monitoring method	
	- Monitoring period	6 seconds
	- Data collection items	Inclined solar irradiance, temperature, PV power generation
	2) Equipment	- Instrumentation monitoring device (RS485→RS232C conversion) - Uninterrupted power supply (to counter instantaneous stoppage) - Necessary rack or box
	3) Soft specifications (server side)	- Display for both momentary and accumulated value, graph and table, status information, failure information, save function for protective device information
	4) Display board	- Indoor use, wall mount type - Real-time power generation (kW), daily accumulated power generation (kWh), daily accumulated CO_2 reduction (kg)
	(5) Remote monitoring system	
	1) Specifications	
	- Site side data management	Site side data is transmitted to the server and data is saved on a dedicated server.
	- Data browsing	Web browser display via the internet
	- Data download	Form data download and display and printing of forms and graphs
	2) Data access	For registered user and password management (by FSM side)

Table 2.2.2-24 Specifications for Cables and Wires

Equipment	Specifications	Required Specifications
9. Wiring materials Module ~ Junction box	(1) Applicable standard (2) Model (3) Size	NEC, JIS, JEC, JEM or equivalent ① HEM - CE cable single end (+) with connector ② HEM - CE cable single end (-) with connector ③ HEM - CE cable single end (+) (-) with connector ① 3.5sq-1C ② 3.5sq-1C ③ 3.5sq-1C
Junction box ~ Collecting box	(1) Applicable standard (2) Model (3) Size	NEC, JIS, JEC, JEM or equivalent 600V CVD 14mm^2
Collecting box ~ Power conditioner	(1) Applicable standard (2) Model (3) Size	NEC, JIS, JEC, JEM or equivalent 600V CVD 60mm^2
Power conditioner ~ Transformer	(1) Applicable standard (2) Model (3) Size	NEC, JIS, JEC, JEM or equivalent 600V CV-1C 150mm^2
Transformer ~ Existing distribution panel (COM-FSM)	(1) Applicable standard (2) Model (3) Size (4) Others	NEC, JIS, JEC, JEM or equivalent 600V CV-1C 150mm^2 Terminal equipment for TR secondary, cable termination materials
Power Conditioner ~ Signal Transducer box, Power Conditioner ~ Display board	(1) Applicable standard (2) Model (3) Size	NEC, JIS, JEC, JEM or equivalent 600V CV-1C 8mm^2
Communication cable	(1) Applicable standard (2) Model (3) Size	NEC, JIS, JEC, JEM or equivalent KPEV-S 2P 2 mm^2
Ground works materials	(1) Applicable standard (2) Model (3) Sizes (4) Others	NEC, JIS, JEC, JEM or equivalent 600V IV 38 mm^2, 22 mm^2, 3.5 mm^2 Earth rod, grounding terminal, connector

Table 2.2.2-25 Outline of Underground Conduits and Hand-hole

Equipment	Specifications	Required Specifications
1. Underground conduits	(1) Standard (2) Type (3) Others	NEC, JIS, JEC, JEM or equivalent Flexible Electrical Conduit Warning tape
2. Hand-hole	(1) Type (2) Size (3) Lid	Cast-in-place concrete, FC21 900 x 900 x 1200 Cast iron (φ 600)

(4) PV System Frame Installation Method

The PV system will be installed on car park roofs, however, rather than attaching to the roof members, the system frame will be directly attached to steel support beams. Equipment

maintenance will be carried out from underneath, so no maintenance space in particular will be provided on top. Part of the support frame newly installed at COM-FSM will be a pedestrian corridor roof in the same style as the car park roof.

The support frame to be installed on the existing President Office will be attached to the roof. The frame position will be decided so that the PV supporting frame can be attached under the same conditions. Since maintenance will be performed from the top, space shall be provided between panels.

(5) Structural reinforcement of Existing Facilities and Buildings

The main frame of the President Office is RC structure and since the attached panels will only weigh around 500 N/m^2 even including the supporting frame, there will be no need for strengthening in particular. The overall weight will increase by approximately 60 kN, however, judging from the estimated allowable bearing capacity, there will be no need to strengthen the foundations.

(6) Support Frame Plan

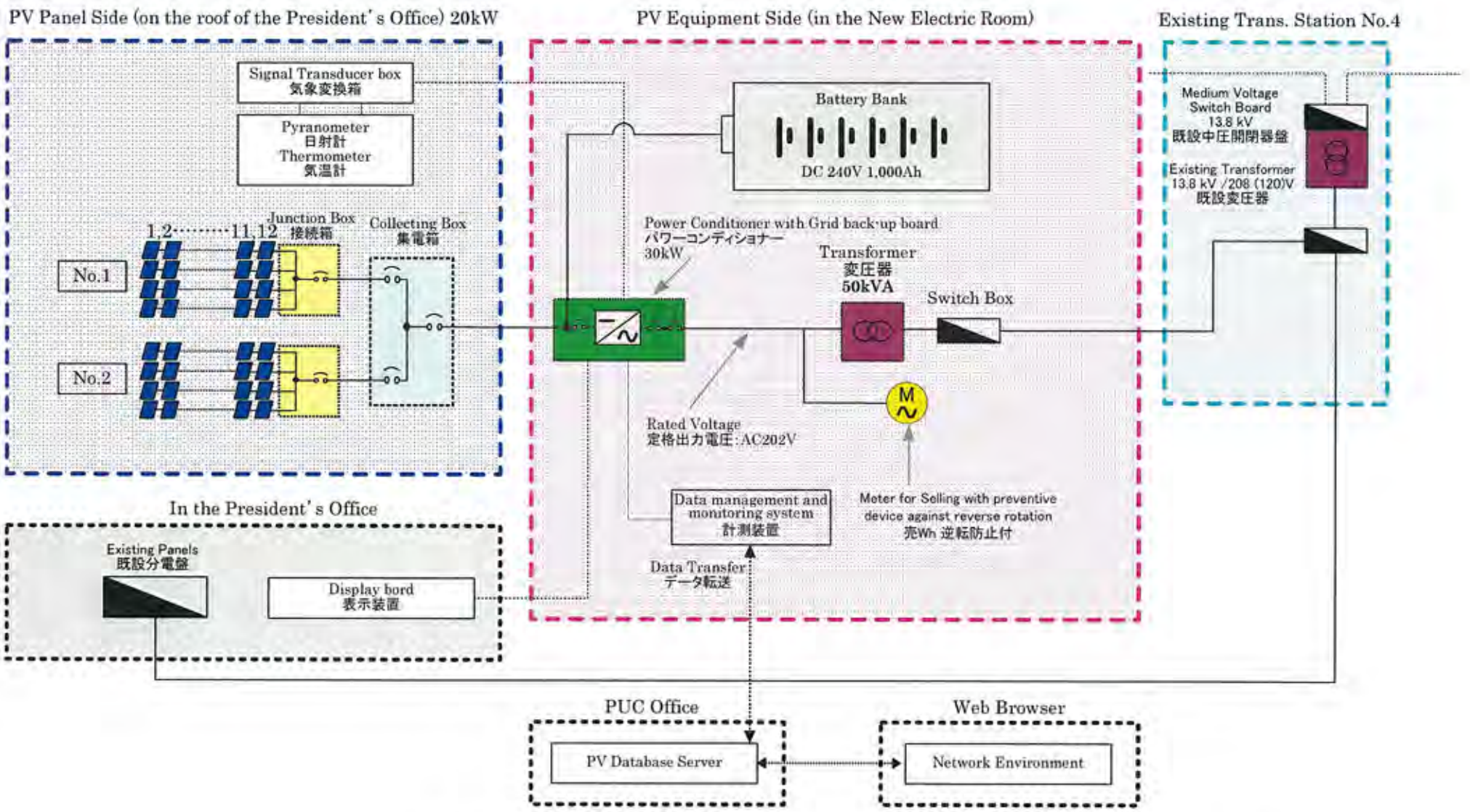
In view of the implementation schedule and the fact that the works will be executed in a car park required for everyday work, the main frame will be a steel skeleton. Height of the support frame and the beam jutting length will be kept to a minimum to allow enough building clearance for small passenger vehicles to park and in consideration of the arrangement of solar panel and shade in the parking area. All steel members will be coated with hot dip zinc (galvanizing) to provide protection against salt damage. Individual footing will be adopted for the foundations assuming the ground bearing capacity to be $50kN/m^2$ around design GL-1.0m based on the as-built drawings of the existing government office buildings.

2.2.3 Outline Design Drawings

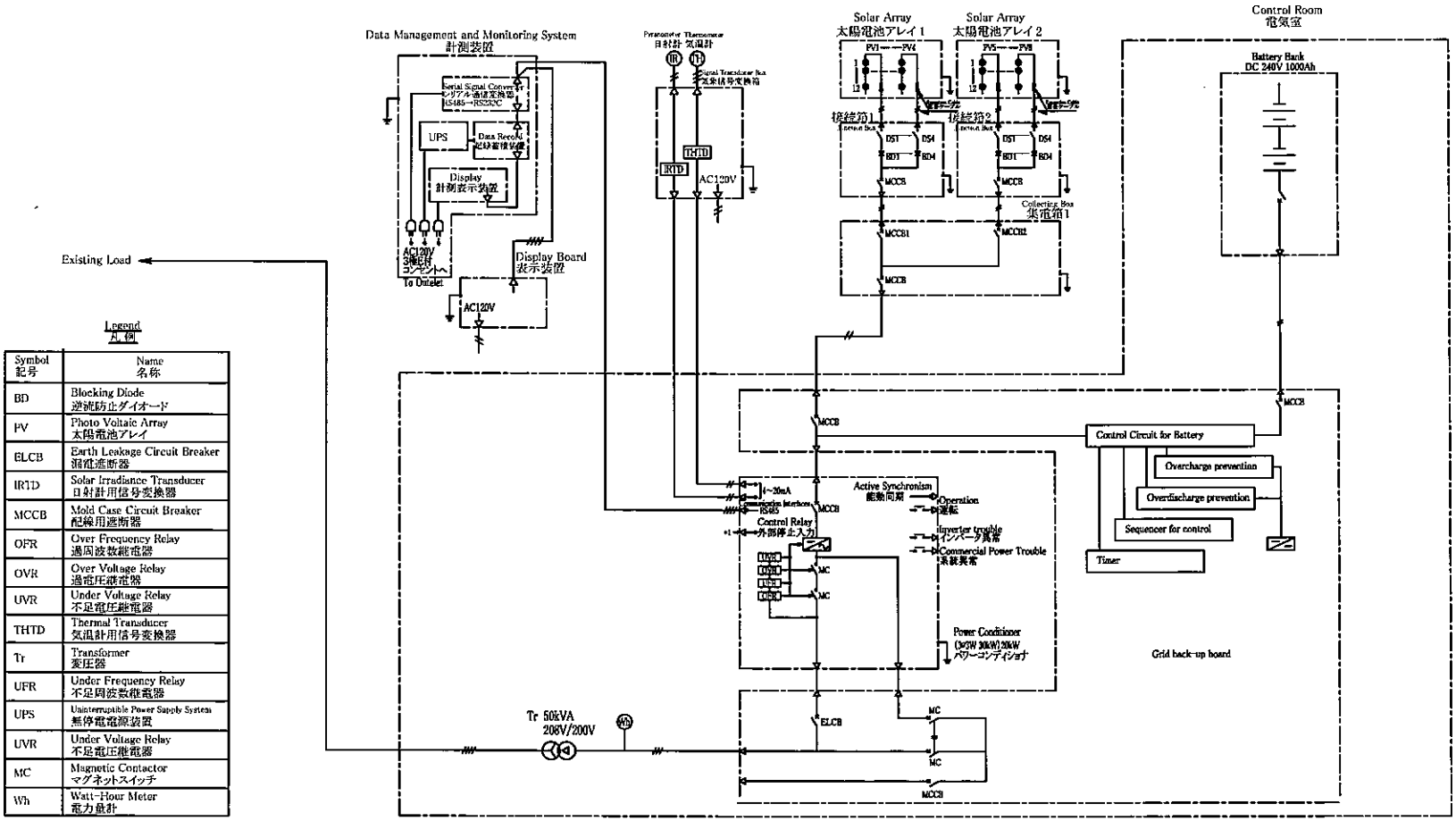
The outline design drawings for the Project are as follows.

Drawing List (Federated States of Micronesia)

Outline drawings for Federal Government Complex		
Category	DWG. No.	Drawing Title
System Diagram	M-S-01	System Diagram for Federal Government Complex
Single Line Diagram for PV System	M-E-01	Single Line Diagram for Federal Government Complex
Layout Plan for PV Modules	M-L-01	Layout Plan for PV Modules for Federal Government Complex
Layout Plan for PV Equipment	M-EQ-01	Layout Plan for Equipment for Federal Government Complex
Cable Route Plan	M-C-01	Cable Route Plan for Federal Government Complex
Architectural Drawing	M-A-01	Layout of the Support Frame for Federal Government Complex
	M-A-02	Support Frame 20A Roof Plan for Federal Government Complex
	M-A-03	Burial Plan for Cable Pipe and Hand-Hole for Federal Government Complex
Outline drawings for College of Micronesia - FSM		
Category	DWG. No.	Drawing Title
System Diagram	M-S-02	System Diagram for College of Micronesia - FSM
Single Line Diagram for PV System	M-E-02	Single Line Diagram for College of Micronesia - FSM
Layout Plan for PV Modules	M-L-02	Layout Plan for PV Modules for College of Micronesia - FSM
Layout Plan for PV Equipment	M-EQ-02	Layout Plan for Equipment for College of Micronesia - FSM
Cable Route Plan	M-C-02	Cable Route Plan for College of Micronesia - FSM
Architectural Drawing	M-A-11	Layout of the Support Frame for College of Micronesia - FSM
	M-A-12	Support Frame 80A for College of Micronesia - FSM
	M-A-13	Support Frame 80A Foundation, Roof Beam Plan for College of Micronesia - FSM
	M-A-14	Support Frame 80A Framing Elevation, Foundation Detail for College of Micronesia - FSM
	M-A-15	Support Frame 50A for College of Micronesia - FSM
	M-A-16	Support Frame 50A Foundation, Roof Beam Plan for College of Micronesia - FSM
	M-A-17	Support Frame 50A Framing Elevation, Foundation Detail for College of Micronesia - FSM
	M-A-18	Burial Plan for Cable Pipe and Hand-Hole for College of Micronesia - FSM

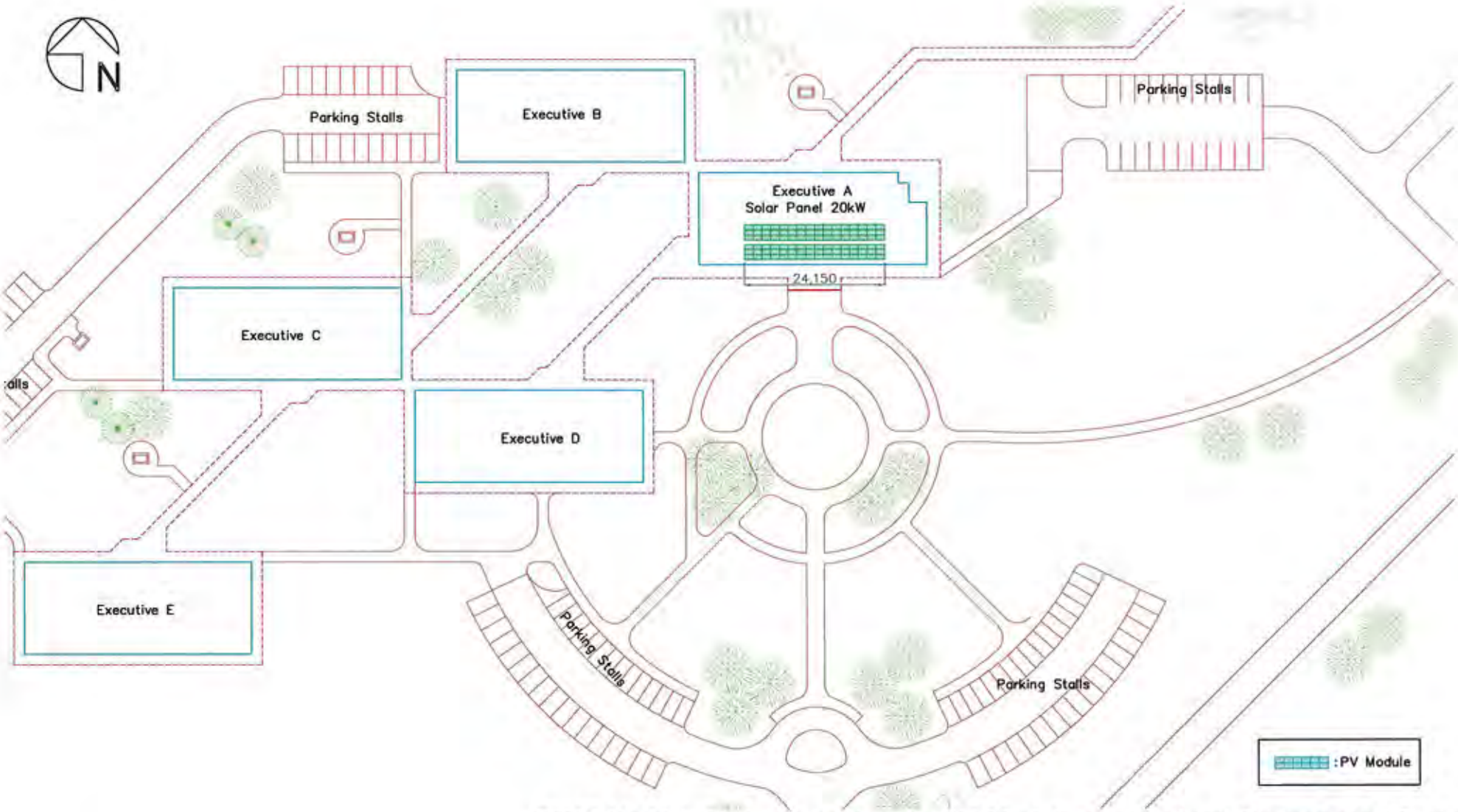


DWG.No.M-S-01 : System Diagram for Federal Government Complex
連系PVシステム構成図(Federal Government Complex)

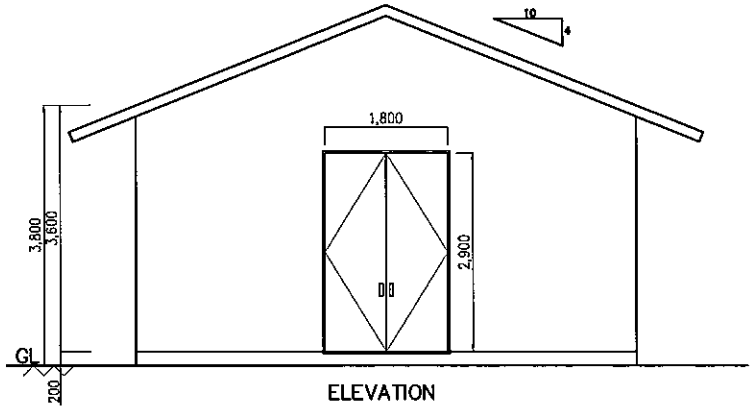


DWG.No.M-E-01:Single Line Diagram for Federal Government Complex

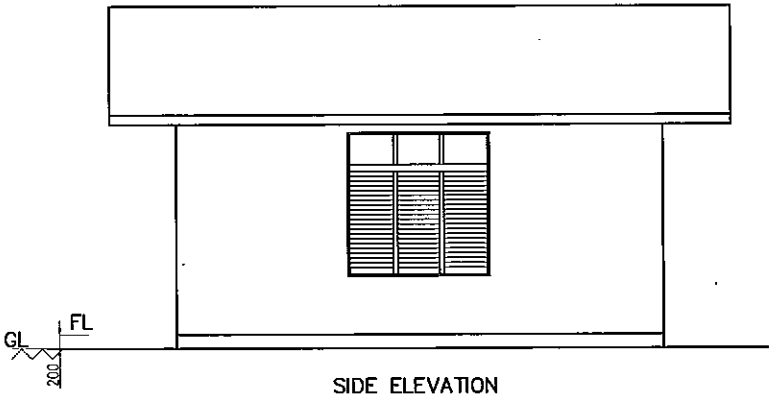
DWG.No.M-E-01:連系PVシステム単線図(Federal Government Complex)



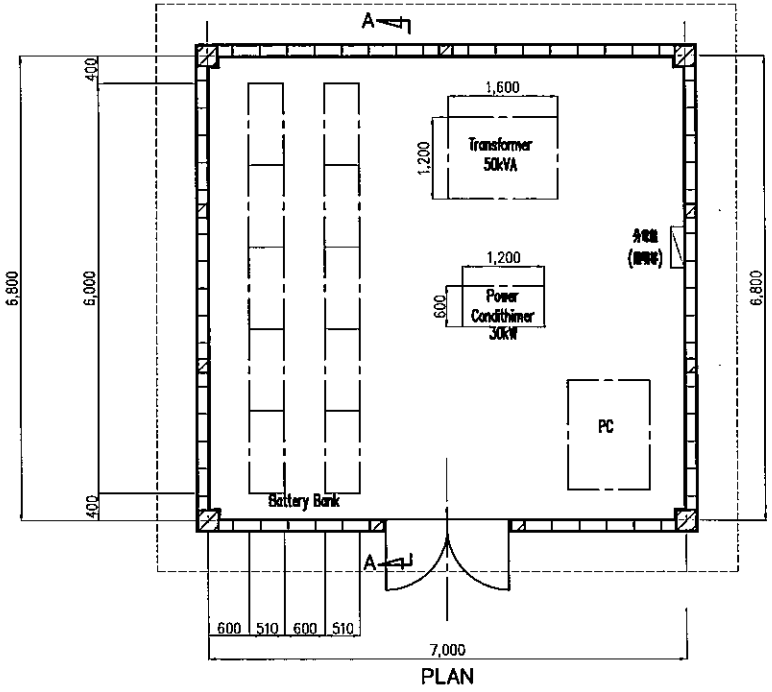
DWG.No.M-L-01:Layout Plan for PV Modules for Federal Government Complex
DWG.No.M-L-01:連系PVパネル配置図(Federal Government Complex)



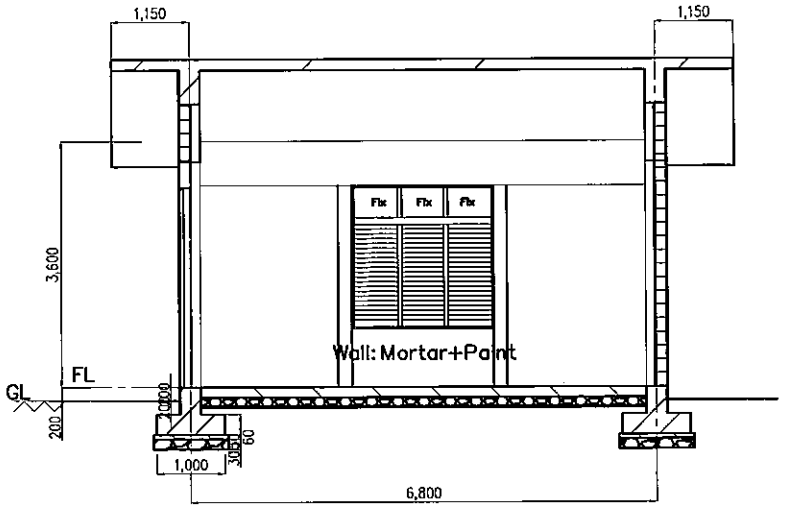
ELEVATION



SIDE ELEVATION



PLAN



A–A SECTION

Electric Room
Scale 1:100

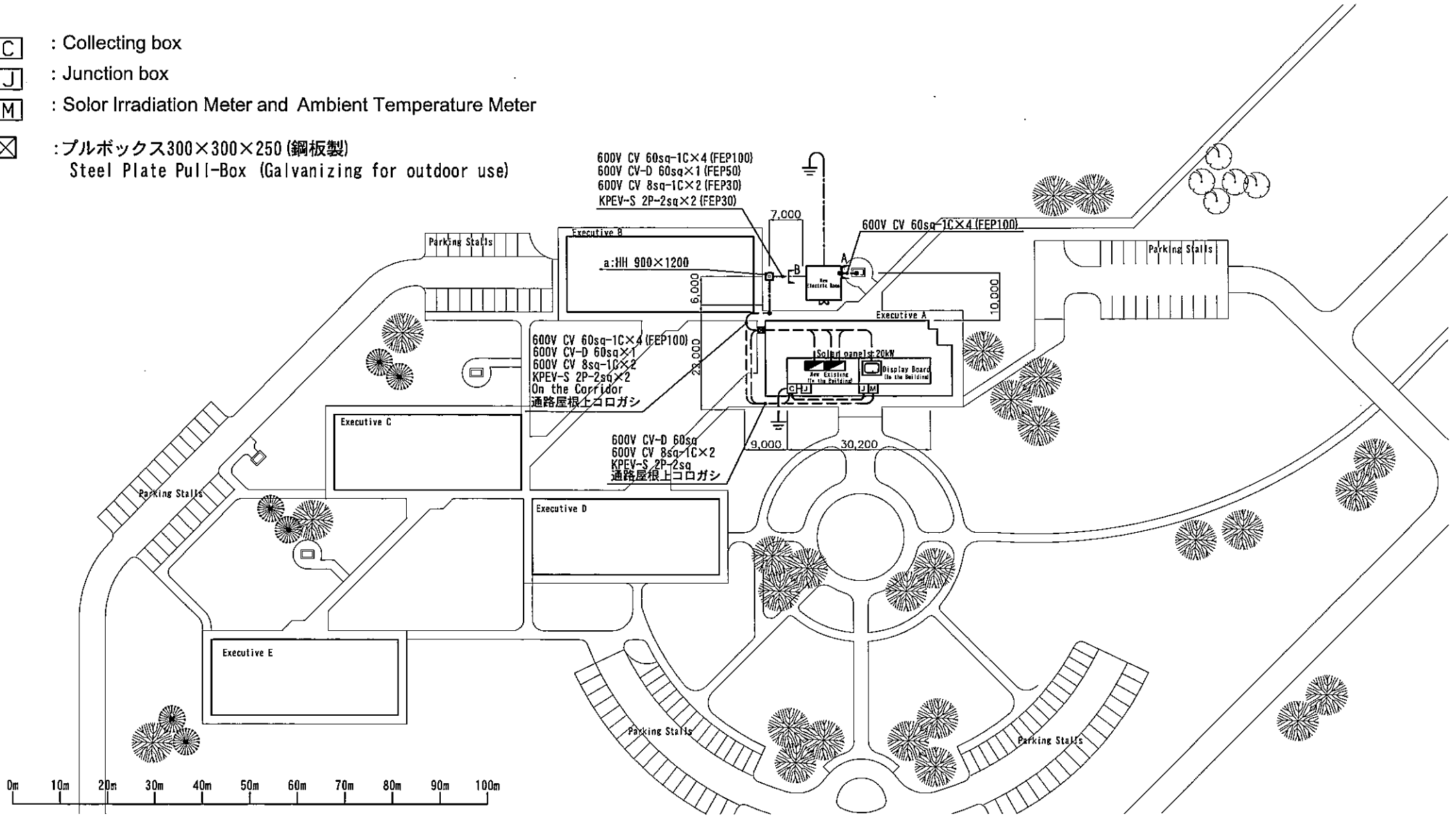
DWG.No.M-EQ-01:Layout Plan for Equipment for Federal Government Complex
DWG.No.M-EQ-01:連系PVシステム機器配置図(Federal Government Complex)

C : Collecting box

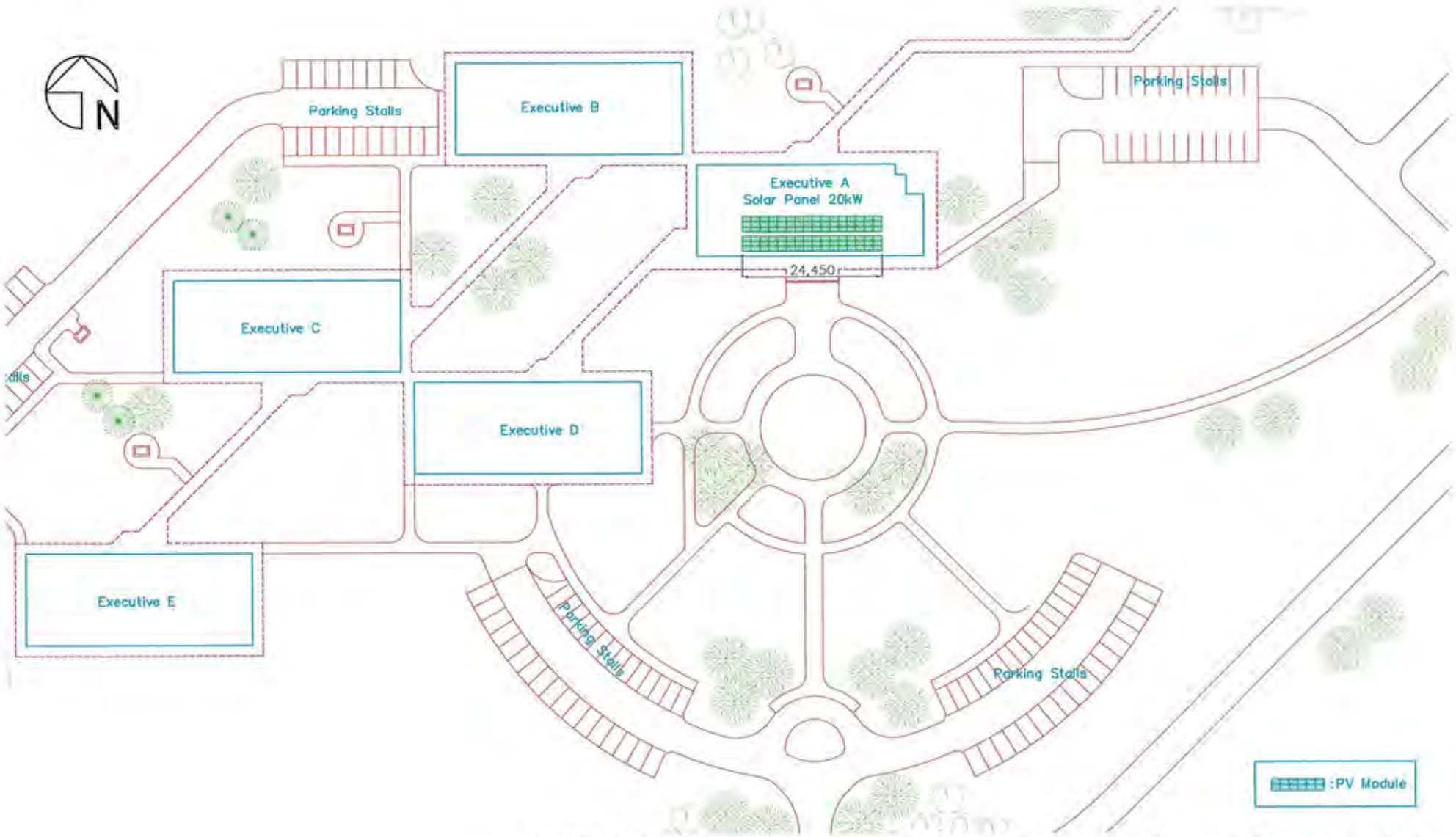
J : Junction box

M : Solor Irradiation Meter and Ambient Temperature Meter

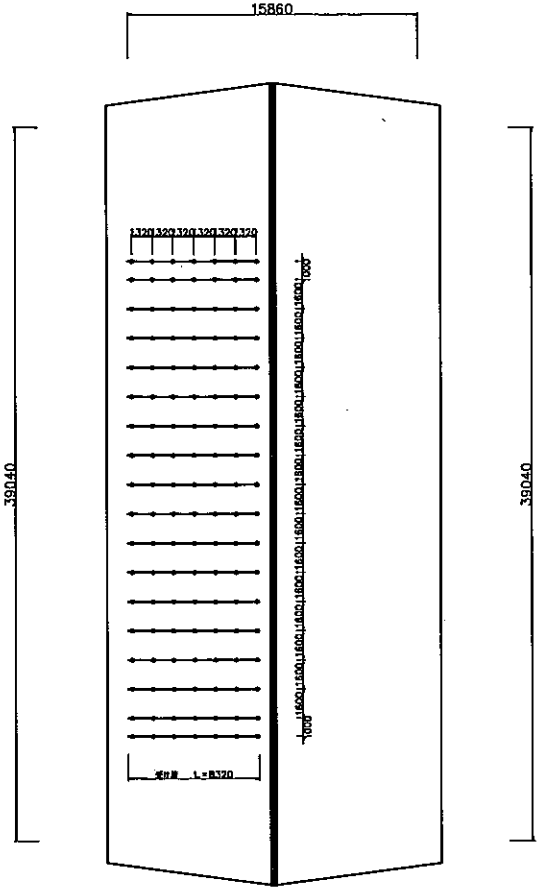
⊠ :プルボックス300×300×250 (鋼板製)
Steel Plate Pull-Box (Galvanizing for outdoor use)



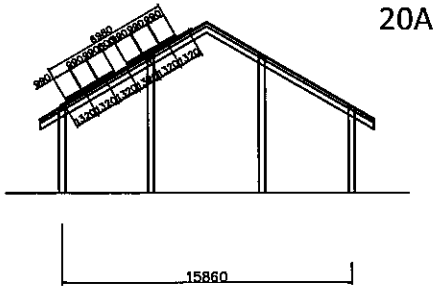
DWG.No.M-C-01: Cable Route Plan for Federal Government Complex
DWG.No.M-C-01: ケーブルルート計画図(Federal Government Complex)

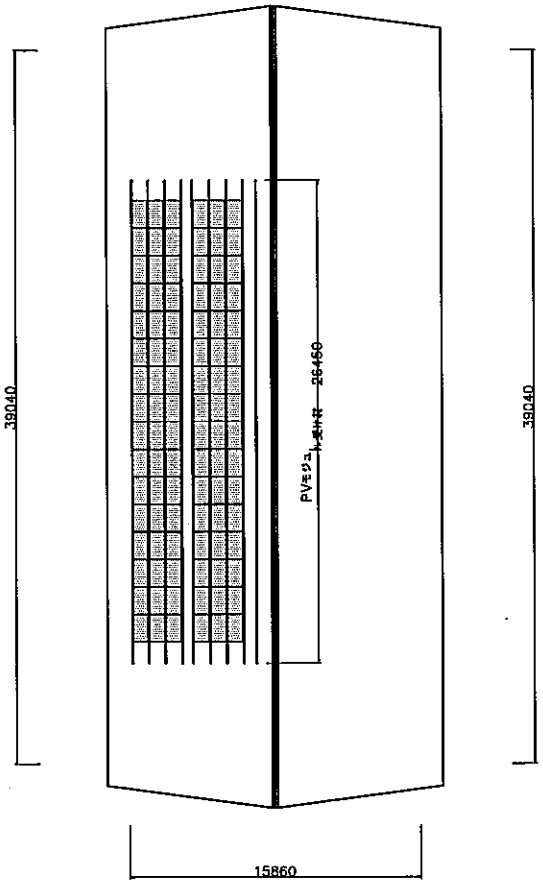


DWG.No.M-A-01:Layout of the Support Frame for Federal Government Complex
DWG.No.M-A-01:支持架台位置図(Federal Government Complex)



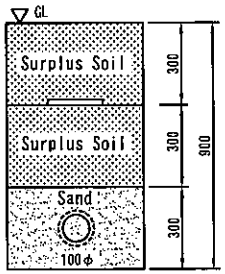
20A FRAME ROOF





ROOF Plan

DWG.No.M-A-02:Support Frame 20A Roof Plan for Federal Government Complex
DWG.No.M-A-02:支持架台20A ROOF平面図(Federal Government Complex)



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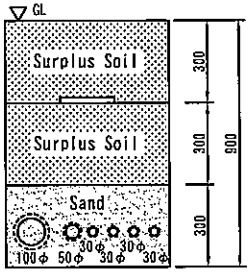
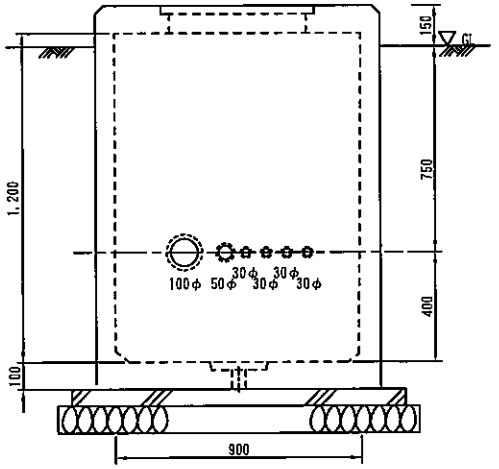
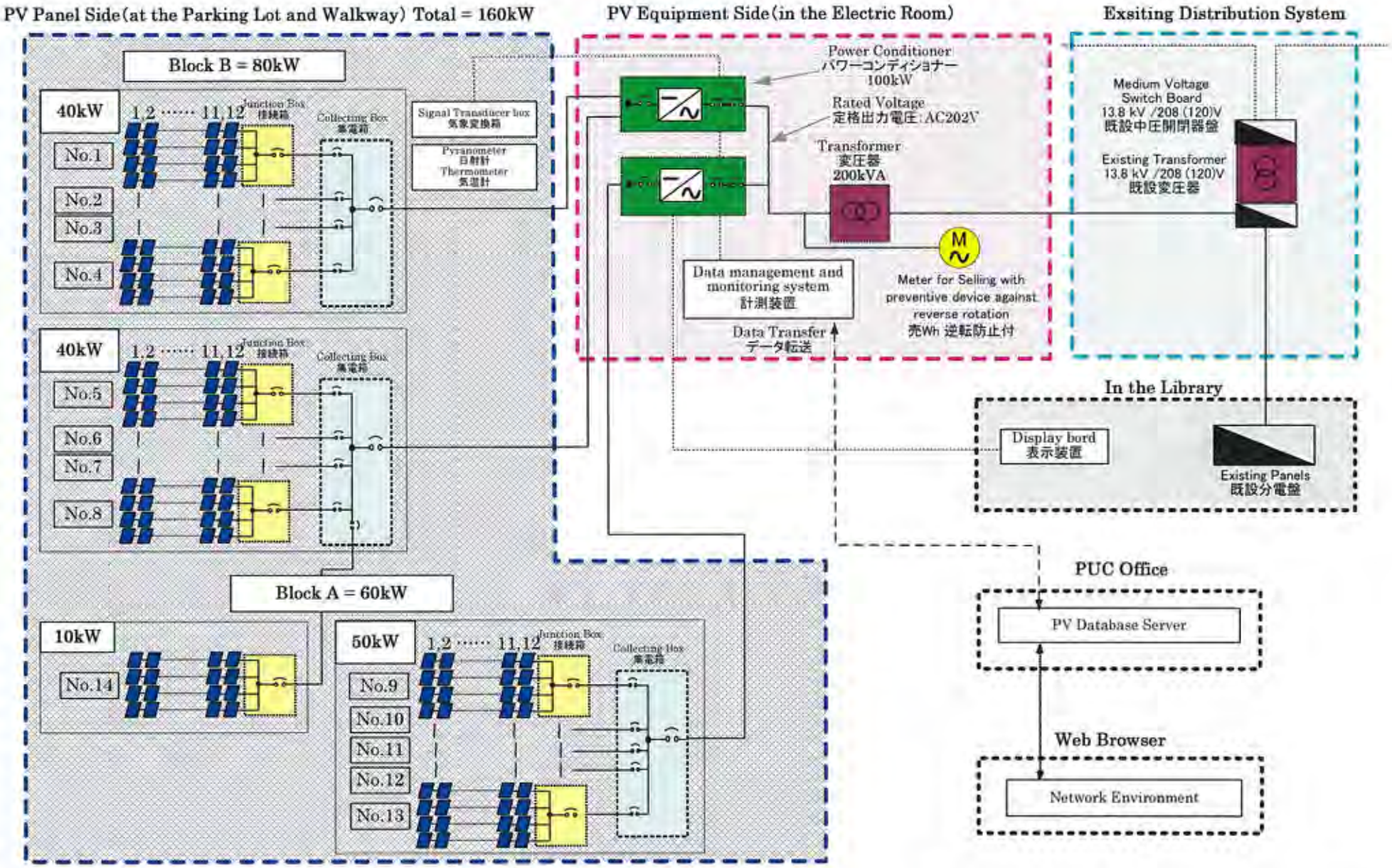


B: HH900x900x1200

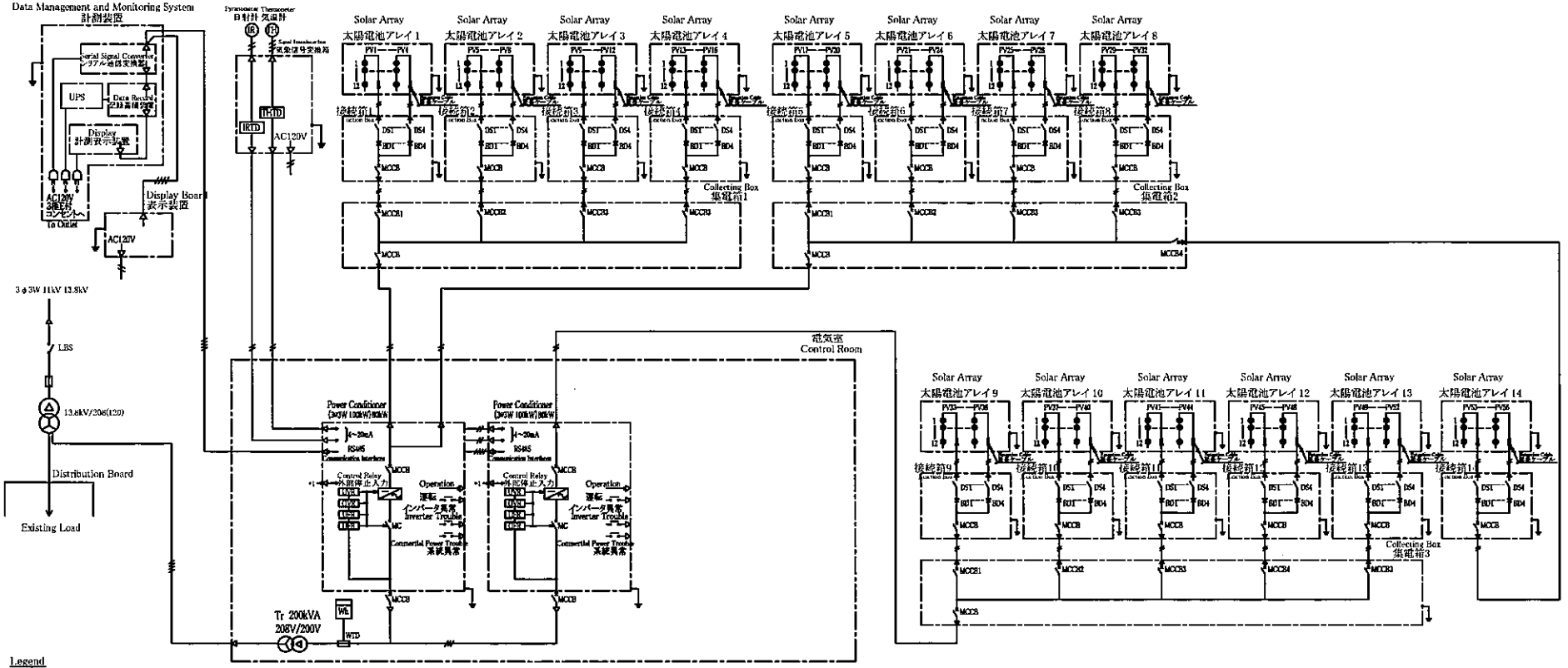


a: HH900x900x1200
<1Place>
<1箇所>

DWG.No.M-A-03:Burial Plan for Cable Pipe and Hand-Hole for Federal Government Complex
DWG.No.M-A-03:埋設ケーブル及びハンドホール断面図(Federal Government Complex)



DWG.No.M-S-02 :System DIiagram for College of Micronesia - FSM
連系PVシステム構成図(College of Micronesia - FSM)



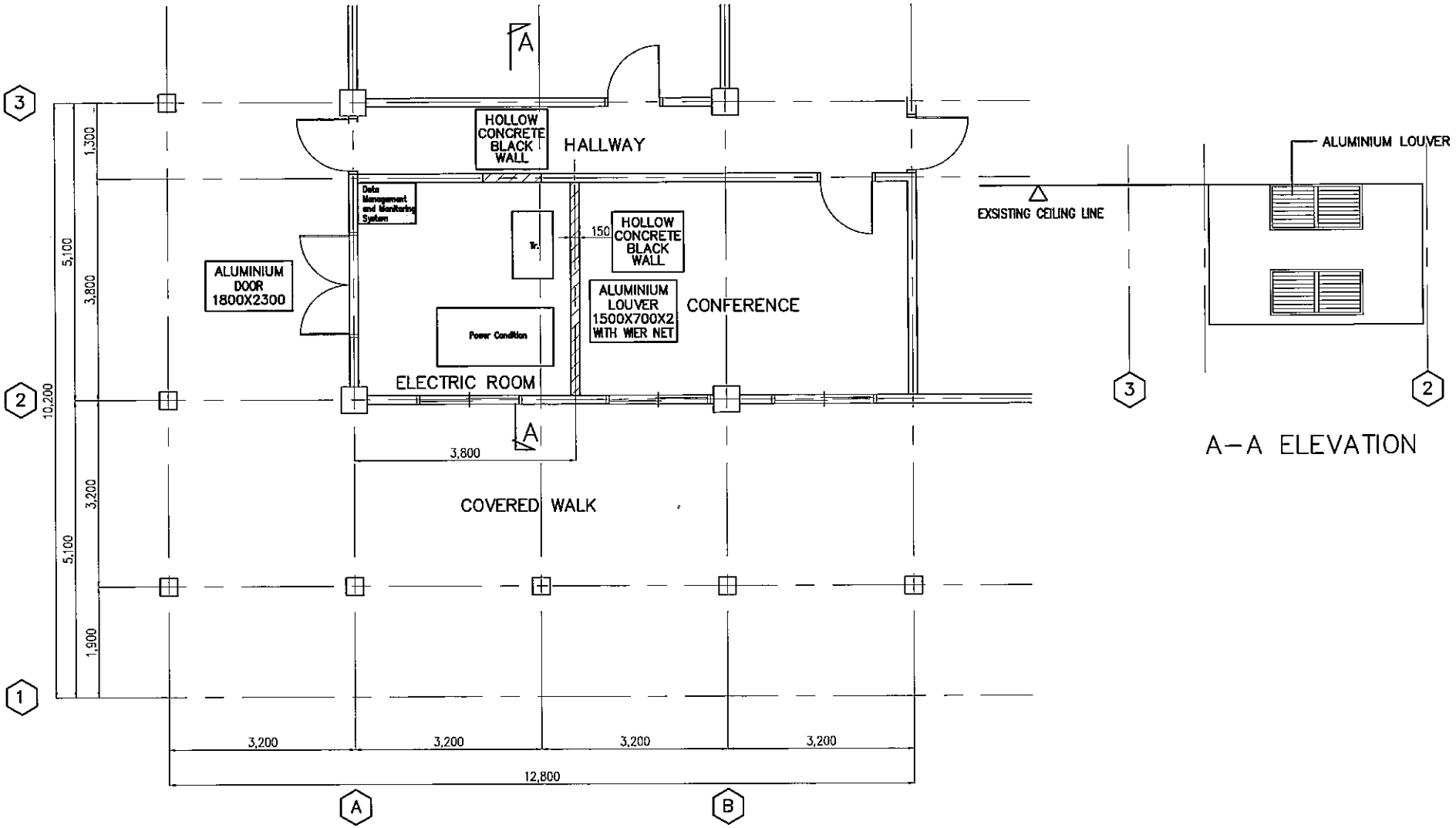
Legend
凡例

Symbol 記号	Name 名称	Symbol 記号	Name 名称	Symbol 記号	Name 名称	Symbol 記号	Name 名称	Symbol 記号	Name 名称	Symbol 記号	Name 名称
BD	Blocking Diode 逆流防止ダイオード	THTD	Thermal Transducer 気温計用信号変換器	MCCB	Mold Case Circuit Breaker 配線用遮断器	UVR	Under Voltage Relay 不足電圧継電器	OVR	Over Voltage Relay 過電圧継電器	Wh	Watt-Hour Meter 電力量計
LBS	Load Break Switch 高圧負荷開閉器	Tr	Transformer 変圧器	OFR	Over Frequency Relay 過周波数継電器	VCT	Voltage Current Transformer 計器用変圧変流器	PV	Photo Voltaic Array 太陽電池アレイ	WTD	Watt Transducer 電力用信号変換器
ELCB	Earth Leakage Circuit Breaker 漏電遮断器	UFR	Under Frequency Relay 不足周波数継電器	IRTD	Solar Irradiance Transducer 日射計用信号変換器	UPS	Uninterruptible Power Supply System 無停電電源装置				

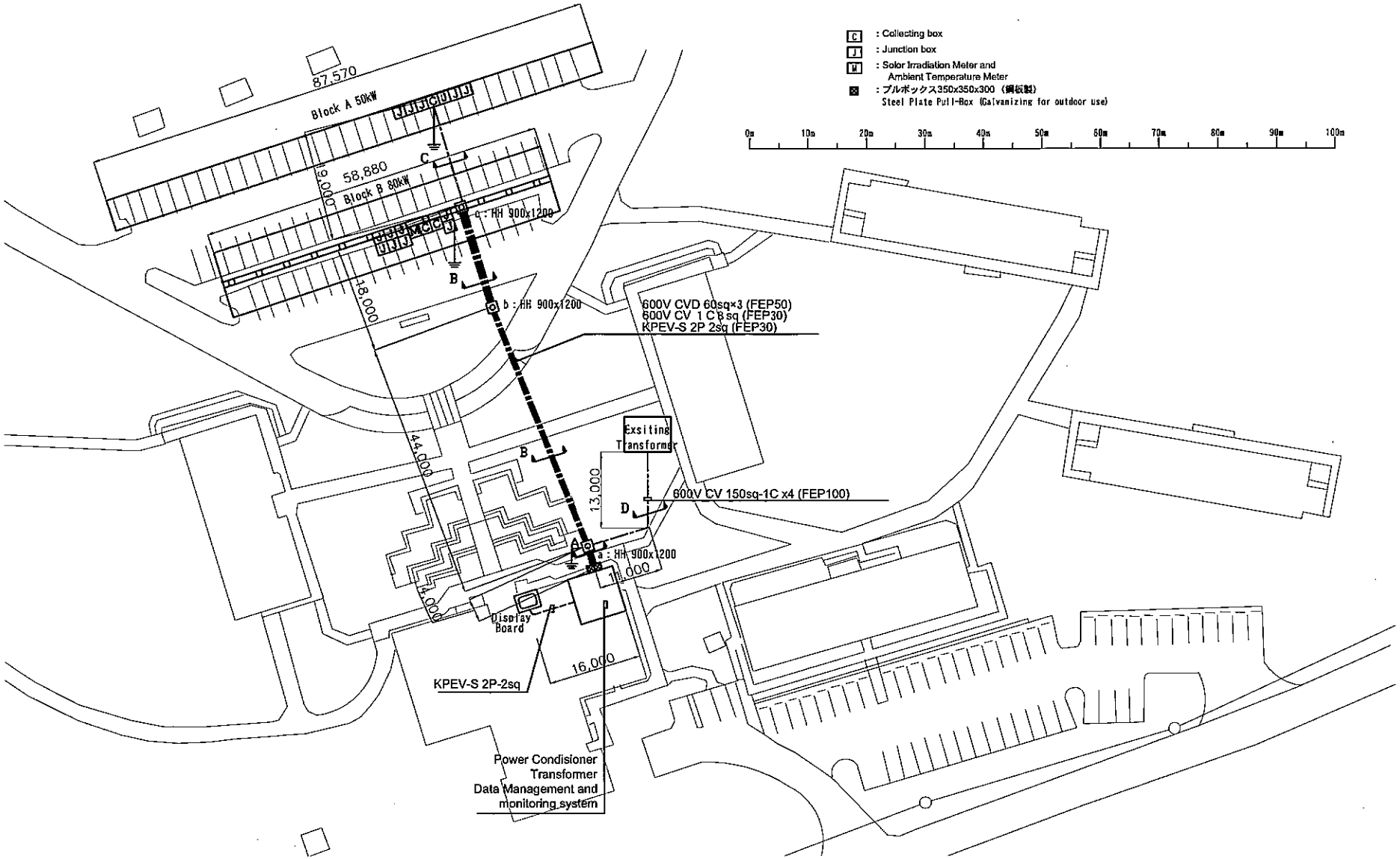
DWG.No.M-E-02:Single Line Diagram for College of Micronesia - FSM

DWG.No.M-E-02:連系PVシステム単線図(College of Micronesia) - FSM

DWG.No.M-L-02:Layout Plan for PV Modules for College of Micronesia - FSM
DWG.No.M-L-02:連系PVパネル配置図(College of Micronesia - FSM)



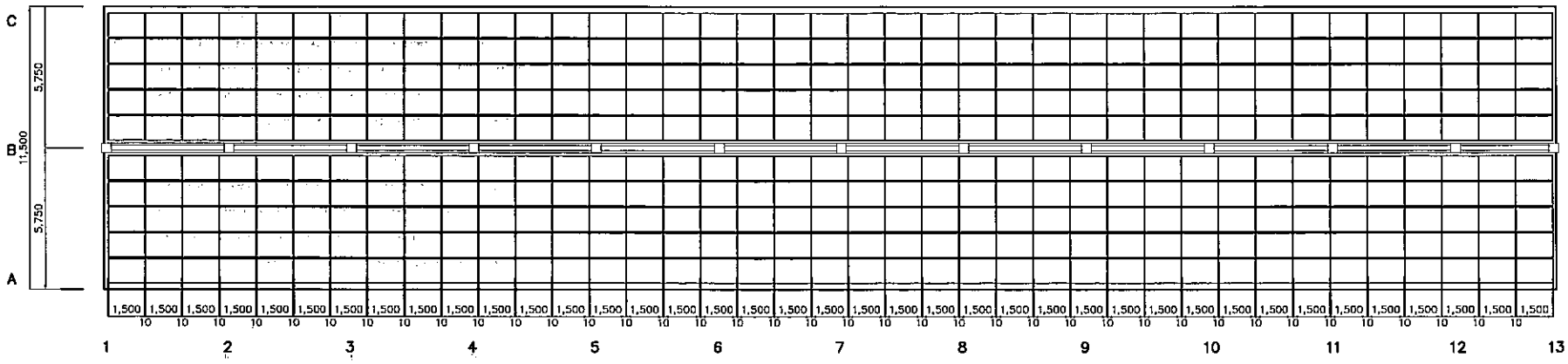
DWG.No.M-EQ-02:Layout Plan for Equipment for College of Micronesia - FSM
DWG.No.M-EQ-02:連系PVシステム機器配置図(College of Micronesia) - FSM



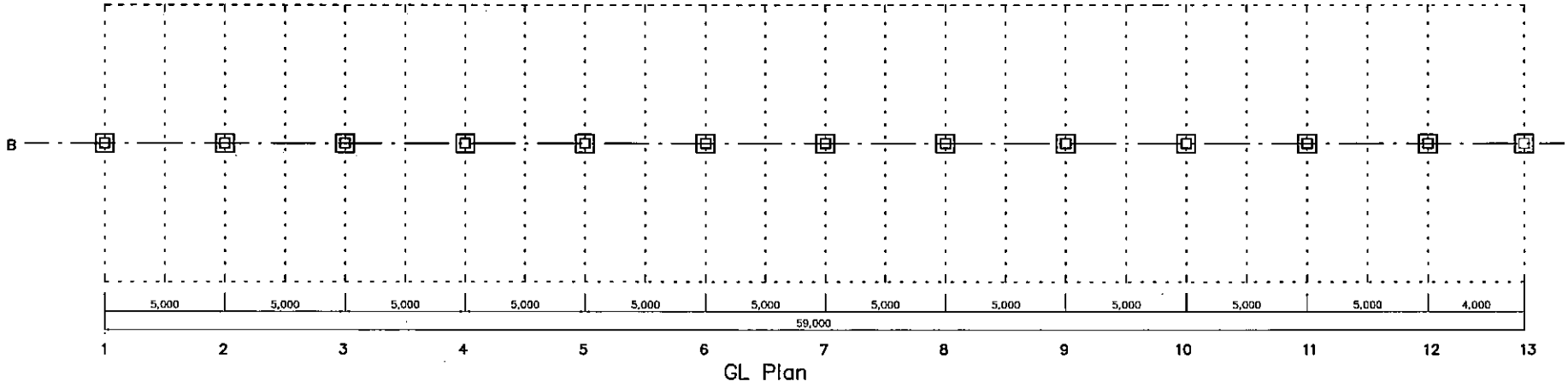
DWG.No.M-C-02:Cable Route Plan for College of Micronesia - FSM

DWG.No.M-C-02:ケーブルルート計画図(College of Micronesia) - FSM

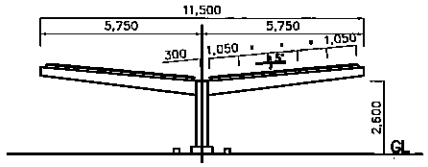
DWG.No.M-A-11:Layout Plan for PV Modules for College of Micronesia - FSM
DWG.No.M-A-11:連系PVパネル配置図(College of Micronesia) - FSM



Roof plan



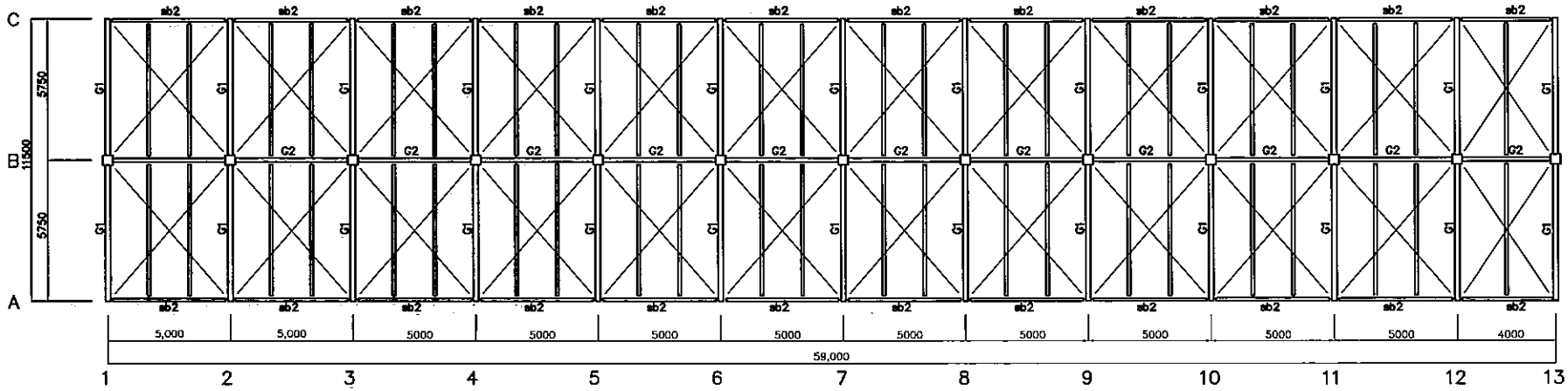
GL Plan



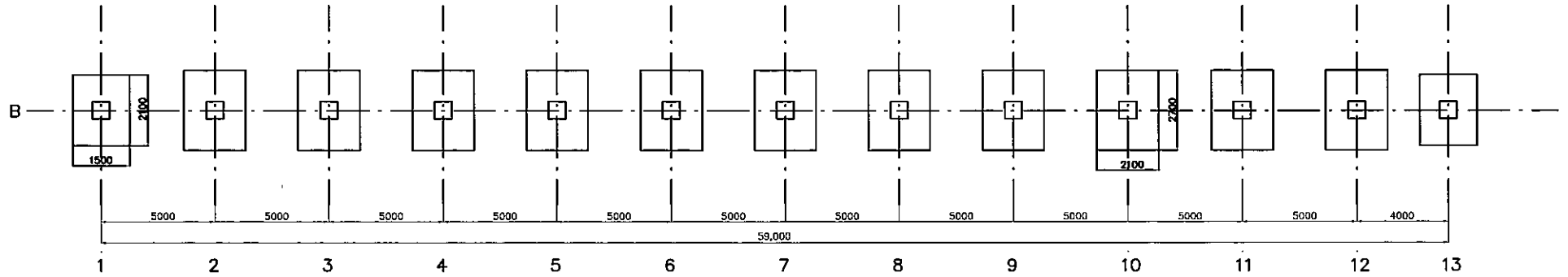
Elevation

DWG.No.M-A-12 : Support Frame 80A for College of Micronesia - FSM

DWG.No.M-A-12 : 支持架台 80A (College of Micronesia) - FSM

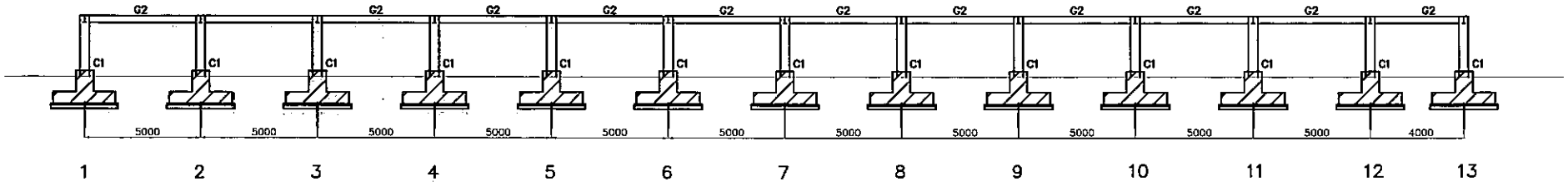


Beam plan

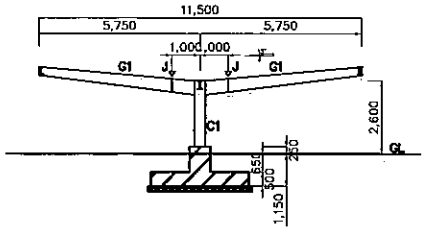


Foundation plan

DWG.No.M-A-13 : Support Frame 80A Foundation,Roof Beam Plan for College of Micronesia - FSM
DWG.No.M-A-13 : 支持架台 80A 基礎、屋根梁伏図 (College of Micronesia) - FSM



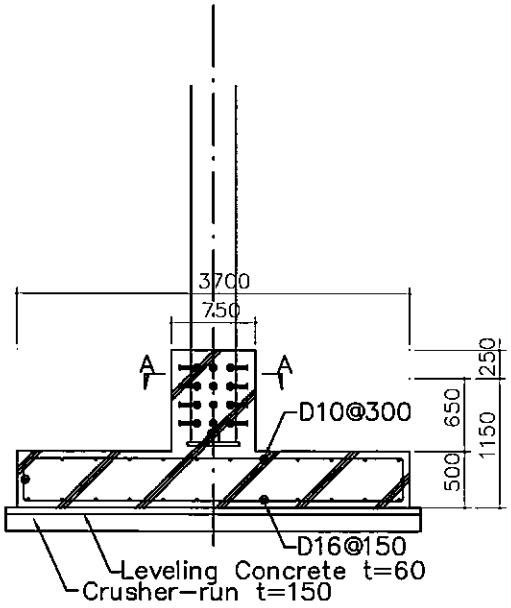
UB Framing elevation



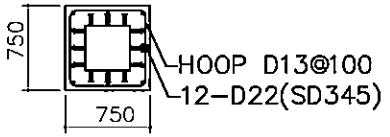
1–13 Framing Elevation

LIST

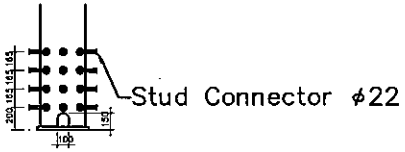
C1	H.-400x400x
G1	BH-500~300x200x9x19 (SM490)
G2	H-300x150x6.5x9 (SM490)
sb1	H-250x125x6x9 (SS400)
sb2	H-250x125x6x9 (SS400)
HV1	I-M20



Foundation detail

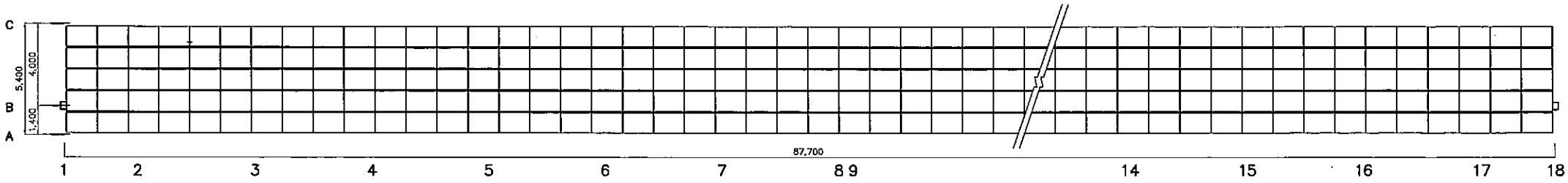


A–A Section

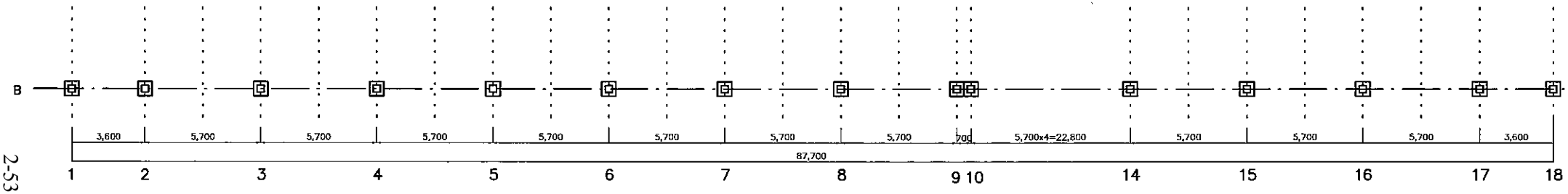


DWG.No.M-A-14 : Support Frame 80A Framing Elevation,Foundation Detail for College of Micronesia - FSM

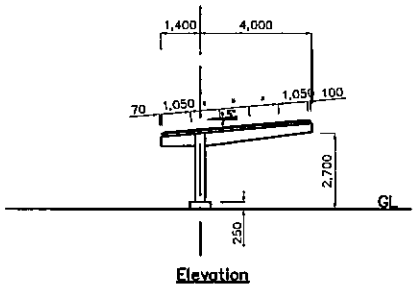
DWG.No.M-A-14 : 支持架台 80A 軸組、基礎詳細図 (College of Micronesia) - FSM



Roof plan

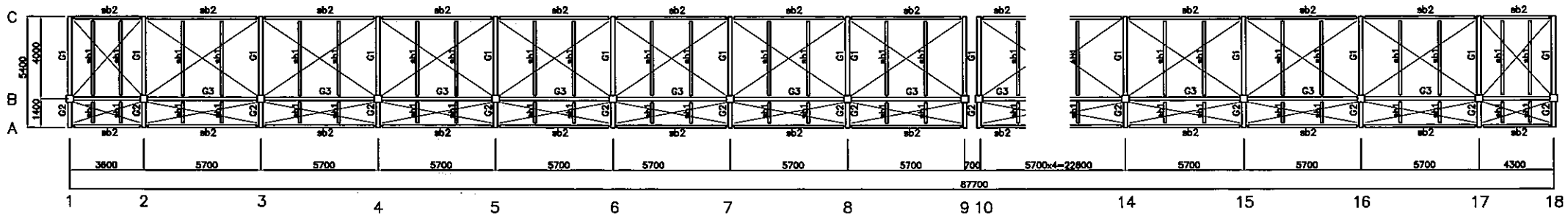


GL Plan

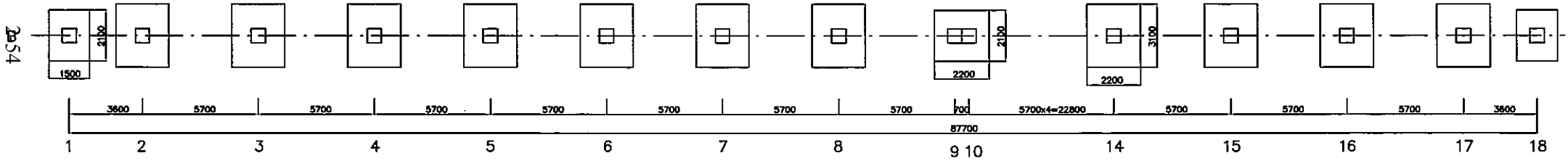


Elevation

DWG.No.M-A-15 : Support Frame 50A for College of Micronesia - FSM
DWG.No.M-A-15 : 支持架台 50A (College of Micronesia) - FSM

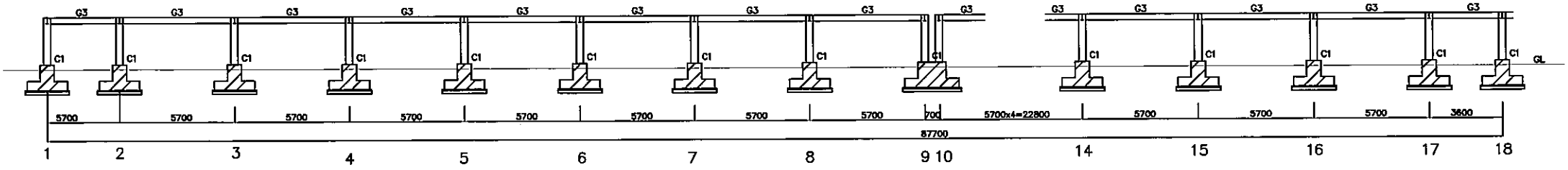


Beam plan

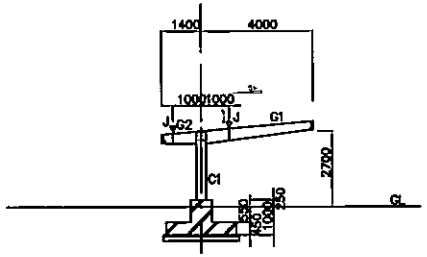


UFoundation plan

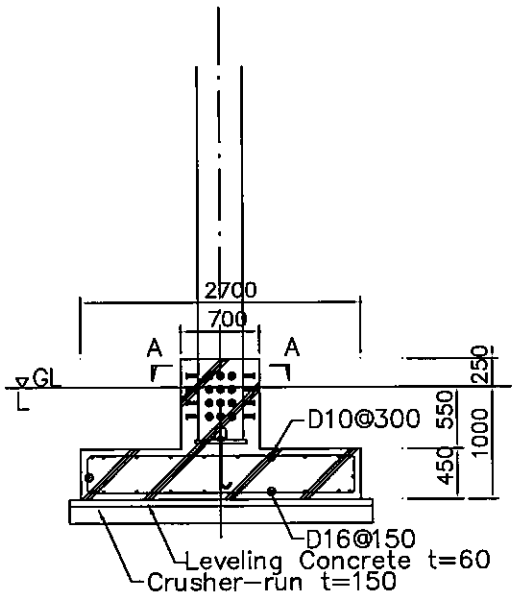
DWG.No.M-A-16 : Support Frame 60A Foundation,Roof Beam Plan for College of Micronesia - FSM
DWG.No.M-A-16 : 支持架台 60A 基礎、屋根梁伏図 (College of Micronesia) - FSM



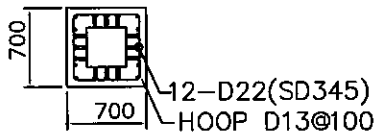
UB Framing elevation



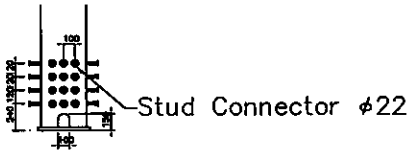
1–14 Framing Elevation



Foundation detail



A–A Section

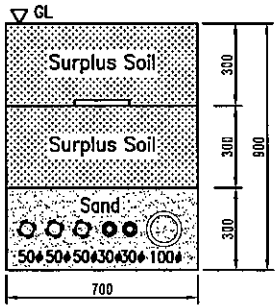


LIST

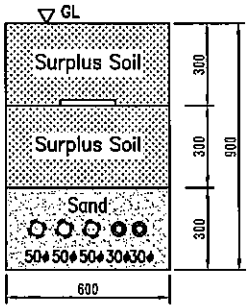
C1	組.-350x350x19
G1	BH-450~300x200x9x16
G2	H-450x200x9x14
G3	H-300x150x6.5x9
sb1	H-200x100x5.5x8
sb2	H-250x125x6x9
HV1	I-M20

DWG.No.M-A-17 : Support Frame 50A Framing Elevation,Foundation Detail for College of Micronesia - FSM

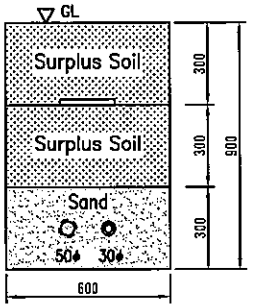
DWG.No.M-A-17 : 支持架台 50A 軸組、基礎詳細図 (College of Micronesia) - FSM



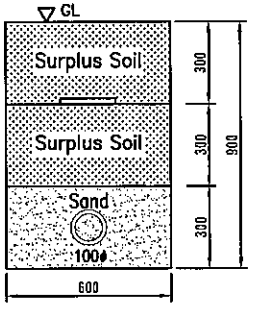
A: HH900x900x1200



B: HH900x900x1200



C: HH900x900x1200



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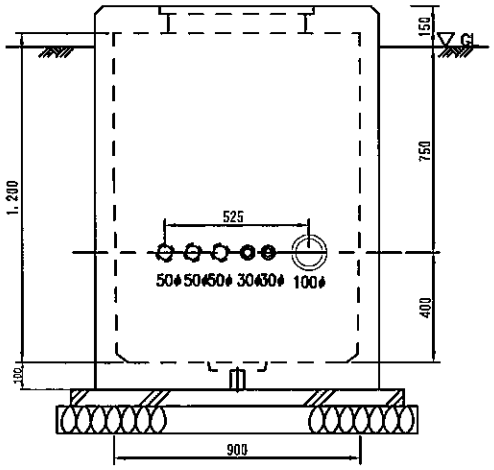

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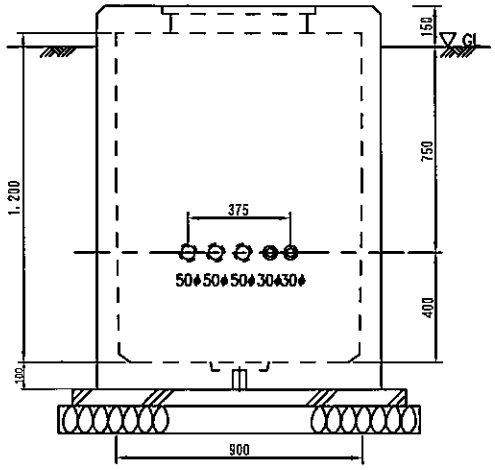

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DWG.No.M-A-18:Burial Plan for Cable Pipe and Hand-Hole for College of Micronesia - FSM
DWG.No.M-A-18:埋設ケーブル及びハンドホール断面図(College of Micronesia) - FSM

2.2.4 Implementation Plan

2.2.4.1 Concept of Equipment Procurement Supervision by the Procurement Management Agent

The Project will be implemented based on the Government of Japan's Program Grant Aid for Environment and Climate Change. According to this, the Project will receive approval by the Government of Japan and the two countries' governments will sign the Exchange of Notes (E/N) before the Project progresses to implementation stage. The Procurement Management Agent will be recommended to the FSM side by the Government of Japan, while the Department of Resources and Development (R&D) as the responsible organization will manage the main works to ensure that the contract (tender and equipment procurement) is appropriately and smoothly executed. The R&D will also administer funds on behalf of the Government of FSM.

(1) Implementation Setup

After conclusion of the Exchange of Notes (E/N) and Grant Agreement (G/A) for the Project, the Government of FSM will entrust bidding and contracting of the consultant and suppliers to the Procurement Management Agent. Also, the consultant and suppliers will implement their respective duties upon binding contracts with the Procurement Management Agent.

(2) Responsible Organization

The responsible organization will be the Department of Resources and Development (R&D).

(3) Implementing Agency

The implementing agency for the Project is the Pohnpei Utilities Corporation (PUC). The Project will be implemented in accordance with a Program Grant Aid for Environment and Climate Change based on the Agent Agreement that is concluded between the R&D – the responsible organization on the FSM side – and the Japanese Procurement Management Agent.

Other related agencies on the FSM side are as indicated below, and it will be necessary to fully share information and coordinate with each agency in the implementation stage. When coordinating with each agency, it has been confirmed that the R&D will act as the primary contact.

- Department of Foreign Affairs
- Department of Transport, Communication and Infrastructure
- College of Micronesia (COM-FSM)

So far Japan has implemented numerous general grant aid projects in the fishing port and electric power sectors in FSM while the R&D is currently engaged in procurement of diesel fuel as the responsible government agency based on the procurement agent approach. Therefore, the R&D should be able to realize smooth project implementation through collaborating with the PUC, i.e. the implementing agency. Also, the main agencies on the FSM side and the Government of Japan will establish an intergovernmental conference composed of representatives from each to discuss the items that require confirmation at government level.

The Project implementation setup is indicated below.

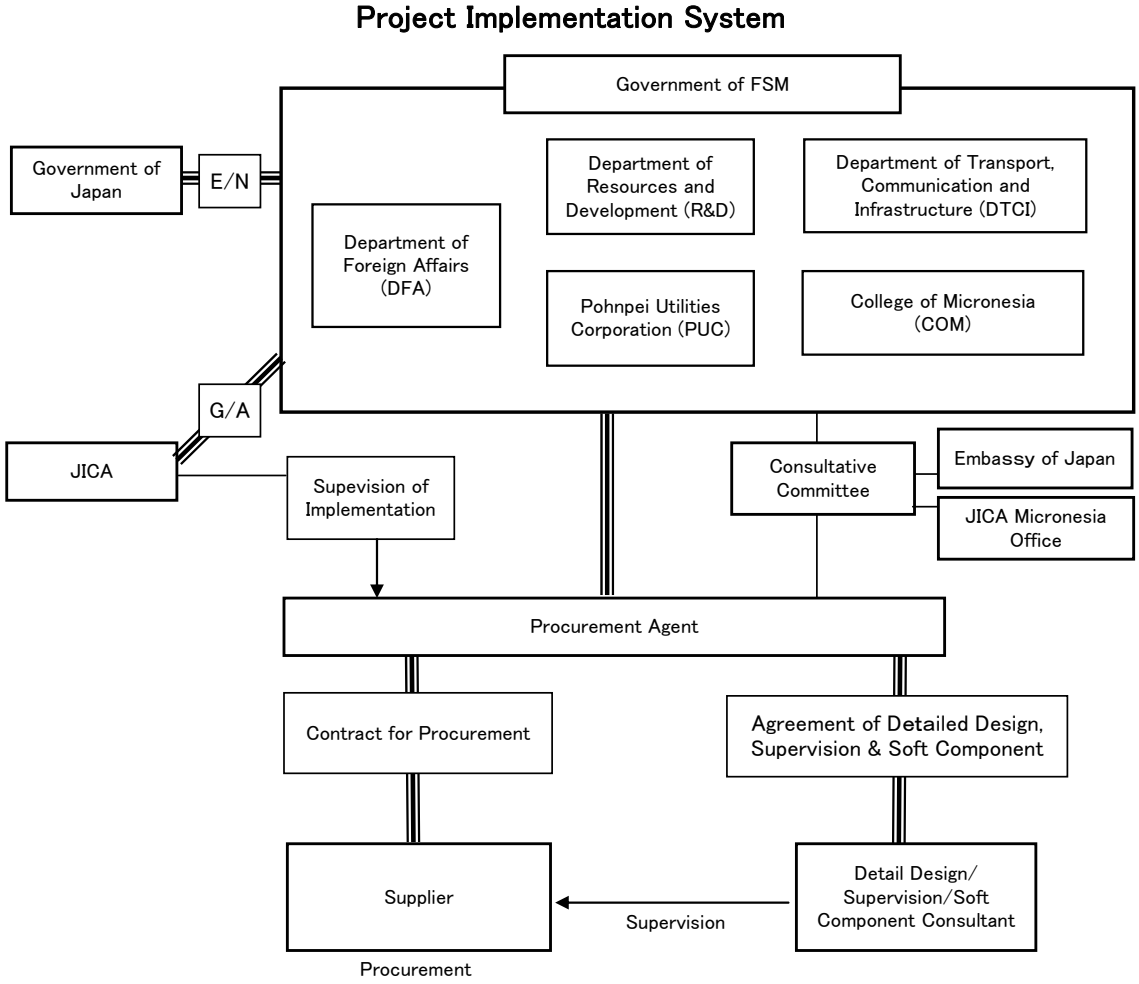


Fig. 2.2.4-1 Implementation Framework

(4) Procurement Management Agent

1) Implementation Contents

The Procurement Management Agent will prepare the tender documents for equipment procurement, thereby initiating the tender management proceedings and procurement operations for the Project. The Procurement Management Agent, which will be recommended to the FSM side by the Government of Japan, will implement and execute general supervision to ensure that the Project components are appropriately and smoothly implemented.

Concerning tender work supervision, the Procurement Management Agent will prepare documents concerning the Agent Agreement, Banking arrangements and the Contract. Also it will distribute the Tender Documents and conduct related works to the tender, evaluation and concluding the Contract with the Contractor.

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

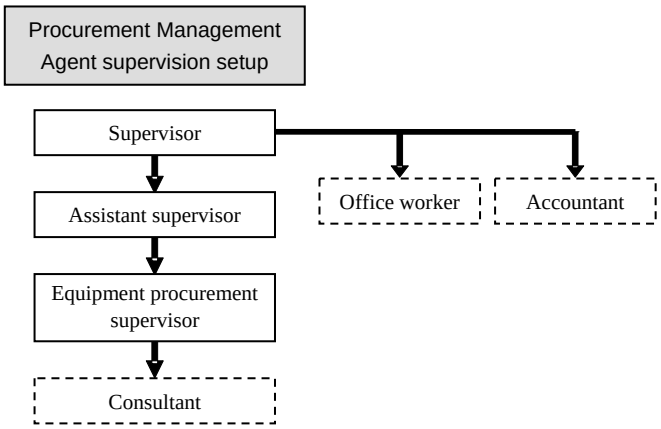
2) Implementation Setup

- Tender work management period

  The Procurement Management Agent will compile the tender documents, confirm equipment specifications and evaluate the tendering firms. The Procurement Management Agent will hire local staff, since the necessary procedures and regulations on the procurement in Palau shall be considered. Moreover, since it will be necessary to receive and answer technical questions on the tender documents and appropriately evaluate the technical proposals by tenderers, the Japanese consultant will assist in the technical parts.

- Works supervision period

  The Procurement Management Agent will conduct general management works during the period, however, this will only comprise checking of key points. Instead, Japanese consultant will provide the works supervision throughout the period under supervision by the Procurement Management Agent.



(5) The Consultant for the Supervision of Procurement and Construction Works

The technical consultant will be appointed by the Procurement Management Agent to supervise the procurement and construction works. The Consultant will supervise the quality of work, implementation schedule and safety, etc. of facilities construction, confirm quality, functions, performance and quantities in the equipment procurement, and check for exterior damage, etc. during the transportation of equipment. If it discovers any problems, it will immediately prepare a report and discuss countermeasures with related officials. Moreover, the Consultant in charge of construction supervision will assess the progress of the works done by the Contractor.

(6) The Contractor

The Contractor which shall be selected by the Procurement Management Agent by tender must fully understand and promptly and certainly execute the contents of the Contracts they conclude with the Agent.

2.2.4.2 Implementation Conditions

(1) Construction Conditions and Technical Transfer in FSM

General construction contractors and electricity works companies can be found in FSM, meaning that it is possible to locally procure transportation vehicles and construction equipment and order the distribution equipment installation works and underground cable works to local contractors. However, since the Project is being implemented as Japan's Program Grant Aid for Environment and Climate Change, which requires high quality installation in a short time, it will be essential to dispatch Japanese or foreign engineers to ensure schedule control, quality control and safety control.

Furthermore, since FSM has limited experience of grid-connected PV system installation works and highly skilled engineers are required when installing equipment and conducting adjustments

and tests, etc. after installation, it will be hard to find local personnel for skilled supervisors. Accordingly, when implementing the installation work, it is desirable that the Japanese contractor shall sub-contract with local contractors to procure local laborers and works equipment, while dispatching engineers from Japan or other countries. Moreover, the engineers will conduct technical transfer technical transfer through On-the-Job Training (OJT) for the FSM engineers during the installation period.

(2) Utilization of Local Equipment and Materials

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

(3) Safety Measures

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

(4) Tax Exemptions

In order to receive exemptions of customs charges and tariffs on the Project equipment, the contractor will need to give advance notification to the Ministry of Finance via the R&D. Doing this will enable exemption of tariffs and domestic taxes, however, it has been confirmed that this is not an advance rebate system but rather a total exemption scheme whereby the Implementing Agency in FSM avoids any tax burden.

(5) Transportation

Equipment carried to Pohnpei by sea is usually landed and undergoes customs clearance at the country’s only international port of Pohnpei. There are three transport company agents at this port, i.e. Caroline Fishing Company, PT&S and Federated Shipping Company. Equipment transported from Japan will be packed in such a way that it can withstand the long sea voyage, landing at port, inland transportation to the Project site and storage.

2.2.4.3 Scope of Works (Procurement, Installation and Construction)

According to the Japan's Program Grant Aid for Environment and Climate Change, Table 2.2.4-1 shows the detailed scope of works on the Japanese and FSM sides.

Table 2.2.4-1 Scope of Works on the Japanese and FSM Side

No.	Item	Japan	FSM	Remarks
1	Securing of the equipment installation site		●	N/A
2	Ground leveling and removal of obstructions on the equipment installation site		●	N/A
3	Installation of fences and gates		●	N/A
4	Parking area works		●	N/A
5	Road works			
	(1) Inside the site	●		
	(2) Outside the site (access road)		●	N/A
6	Facilities construction works and equipment installation	●		Including temporary installation works in line with the facilities construction
7	Electrical, water supply and sanitary works			
	(1) Electrical works			
	a) Power line extension works		●	Extension to the electric energy integrating meter (primary side)
	b) Indoor wiring works (lighting, sockets, etc.)	●		(Secondary side)
	c) Installation of power receiving panel	●		
	(2) Water supply works			
	a) City water (public water supply) works		●	Extension to the Project site
	b) Indoor piping and receiving tank installation works	●		
	(3) Drainage works			
	a) Sewage mains works (sanitary sewage and storm water)		●	N/A
	b) Indoor wiring and pit works	●		
	(4) Gas supply works			
	a) Gas main works (to site)		●	N/A
	b) Indoor piping and pit works	●		
	(5) Telephone and IT works			
	a) Trunk line works (to site)		●	
	b) Indoor wiring and pit works	●		
	(6) Procurement and installation of furniture (desks, chairs) and other equipment			
	a) General furniture		●	N/A
	b) Project instruments	●		
8	Commission for opening of bank account based on the B/A		●	
9	Handling of transport and customs clearance procedures and taxes			
	(1) Responsibility for ocean transport (air transport) of products related to procured equipment to the recipient country (FSM)	●		
	(2) Tax burden and customs clearance procedures at the port of unloading in FSM		●	
	(3) Transportation of procured equipment, etc. from the port of unloading to the inland site in FSM	●	●	Contractor's responsibility
	(4) Exemption or bearing of domestic value added tax on procured construction materials and equipment in FSM		●	
10	OJT concerning operation and maintenance of facilities and procured equipment	●		FSM side will select the personnel who will receive OJT
11	Operation and maintenance of facilities and procured equipment		●	
12	Other costs not covered by the grant aid		●	N/A

Note : B/A: Banking Arrangement

● : Indicates the scope of responsibility regarding each item.

2.2.4.4 Consultant Supervision

Based on the scheme of the Government of Japan's Program Grant Aid for Environment and Climate Change, the Consultant will organize a consistent project team to smoothly conduct the detail design

and construction supervision work taking the result of the outline design into consideration. The Consultant will permanently assign at least one engineer to the Project site during the construction supervision stage in order to conduct schedule control, quality control, performance control and safety control. Furthermore, the experts in Japan will attend factory inspections and pre-shipment inspections of equipment and materials manufactured in Japan with a view to preventing any troubles occur after the delivery of equipment and materials to FSM.

(1) Basic Concept of Construction Supervision

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

The important points to be considered for the supervision works are described below.

(2) Schedule Control

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

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

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

③ Confirmation of temporary installation works and preparations for construction machinery

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

(3) Quality and Performance Control

Supervision will be carried out based on the following items to determine whether the manufactured, delivered and installed equipment and materials and constructed facilities satisfy the required quality and performance stated in the contract documents. In cases where quality and performance may not be ensured, the Consultant will immediately demand that the contractor make amendments, revisions or corrections.

① Checking of shop drawings and specifications of equipment and materials

② Attendance of factory inspections of equipment and materials and checking of the inspection results

③ Checking of packing, transportation and on-site temporary storage methods

④ Checking of shop drawings and installation guidelines of equipment and materials

⑤ Checking of trial operation, adjustment, test and inspection guidelines of equipment and materials

⑥ Supervision of the installation works for equipment and materials, and the attendance of trial operations, adjustments, tests and inspections

⑦ Checking of drawings for equipment installation work and shop drawings with actual works performance

(4) Safety Control

Discussions and cooperation with responsible officers of the contractor will be exercised for the safety control during the construction period in order to prevent site accidents and accidents affecting third parties. Important points to be considered in safety control on the site are as follows:

① Establishment of safety control regulations and appointment of manager

② Prevention of accidents through implementation of periodic inspections of construction machinery

③ Planning of the works vehicles and construction machinery operating routes and thorough enforcement of slow driving

④ Encouragement of laborers to utilize cooperate benefits and holidays

(5) Works Supervisor

The contractor will implement the PV module and frame construction works, the procurement and installation of PV equipment and materials and the installation of distribution and communications cables. In order to implement these works, the contractor will employ a subcontractor(s) in FSM. Therefore, since the contractor will need to ensure that the subcontractor(s) complies with the works schedule, quality, performance and safety measures prescribed in the contract, it will dispatch an engineer who has experience of similar projects in overseas countries to provide guidance and advice on the site.

2.2.4.5 Quality Control Plan

The Consultant's construction supervisor will carry out supervision and checking based on the following items to ensure that the contractor secures the quality of equipment and materials for the Project and the performance for implementation and installation stipulated in the contract documents (technical specifications and implementation design drawings, etc.). In cases where doubts arise over quality and performance, the supervisor will immediately demand that the contractor make amendments, revisions or corrections.

① Checking of shop drawings and specifications of equipment and materials

② Attendance of plant inspections of equipment and materials and checking of plant inspection results

③ Checking of packing, transportation and on-site temporary storage methods

④ Checking of shop drawings and installation guidelines of equipment and materials

⑤ Checking of trial operation, adjustment, test and inspection guidelines of equipment and materials

⑥ Supervision of the installation works of equipment and materials and attendance of trial operations, adjustments, tests and inspections

⑦ Checking of construction drawings with the actual work performance on site

⑧ Checking of completion drawings

2.2.4.6 Procurement Plan

The PV modules and power conditioners to be procured and installed in the Project are not manufactured in FSM. As for the grid-connected PV system that was introduced to the state government building, etc. in Kosrae State under support from the EU, PV modules made by Scheuten Glass of Germany were adopted. However, this PV module manufacturer has no branch office or agent in FSM, etc. Accordingly, when selecting the supplier of PV equipment in the Project, it will be necessary to take local conditions, ease of operation and maintenance by local engineers, and existence of the post-installation setup for procuring spare parts and responding to breakdowns, etc. into account.

Also, the diesel power plant managed by PUC uses diesel engine generators (2.5 MW x 4 units, Daihatsu engines, Toshiba generators) and Aichi Electric transformers that were introduced under Japan's grant aid in 1994

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

(1) Locally procured equipment and materials

Works equipment and materials including cement, sand, concrete aggregate, reinforcing bars, timber, gasoline, diesel oil, works vehicles, cranes, trailers and other temporary installation equipment

(2) Equipment and materials procured in Japan

PV modules, power conditioner, grid-connection transformer, display unit, wiring materials, etc.

2.2.4.7 Operational Guidance Plan

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

In order to advance the plan of guidance smoothly, the PUC (the implementing agency) will need to hold close communications and discussions with the Japanese consultant and contractor to appoint a full-time engineer to take part in the OJT. The appointed engineer will need to convey skills to other employees who cannot participate in the Project and cooperate with enhancing the maintenance capability of the PUC.

2.2.4.8 Soft Component (Technical Assistance) Plan

(1) Background

Although the power supply and demand situations in FSM differ depending on states, around-the-clock power supply is basically secured. Because almost all of the power supply in the country depends on diesel power generation, and the price of crude oil, which is mainly used as fuel for power generation, is rising, departure from the primary energy dependence is considered a major challenge. Thus, a policy of positively introducing renewable energy (PV generation) is clearly described in a National Energy Policy, and the government positively cooperates with this project.

The Project sites are “Capital” and “COM-FSM.” The primary responsible organization for the Project is “Energy Division” of “Department of Resources and Development (R&D)” of the Government of FSM, and the implementing agency is Pohnpei Utilities Corporation (PUC). PUC takes charge of all the electricity businesses in Pohnpei State. It is composed of five departments under five executives elected by the Pohnpei State Government: Administrative Services, Budget and Finance, Water and Sewerage, Power Transmission and Distribution, and Power Generation

Department. It has a total of 136 workers as of July, 2009. PUC is incorporated, and is owned 100% by Pohnpei State Government according to “State Law 2L-179-91” laid down in 1991. It is run independently from the government, as a (public company) semi-governmental organization.

As for the past introduction of PV systems, while Pohnpei has already more than 15 years experience with PV off-grid systems, grid-connected PV systems have not been introduced in Pohnpei State. Thus, it is judged to be difficult for staffs of the government in charge of policy-making or an electric utility corporation responsible for the Project to master adequate skills through their daily work. For the operation and maintenance of a grid-connected PV system, collaboration with the local utility is indispensable. In addition, in view of future dissemination it would be desirable to transfer technology to local utility corporations. It would take a certain time for the staffs to sufficiently learn the O&M concept and method on grid-connected PV systems. However, for continuous and smooth O&M of the grid-connected PV system introduced by the Project, we think it is essential to adequately implement proper technical transfer into the implementing agency of the Project, PUC, over the broad-and-shallow range from a basic level on PV generation to an application level on the O&M of PV facilities, dividing the process into several steps and confirming the establishment of knowledge.

(2) Target

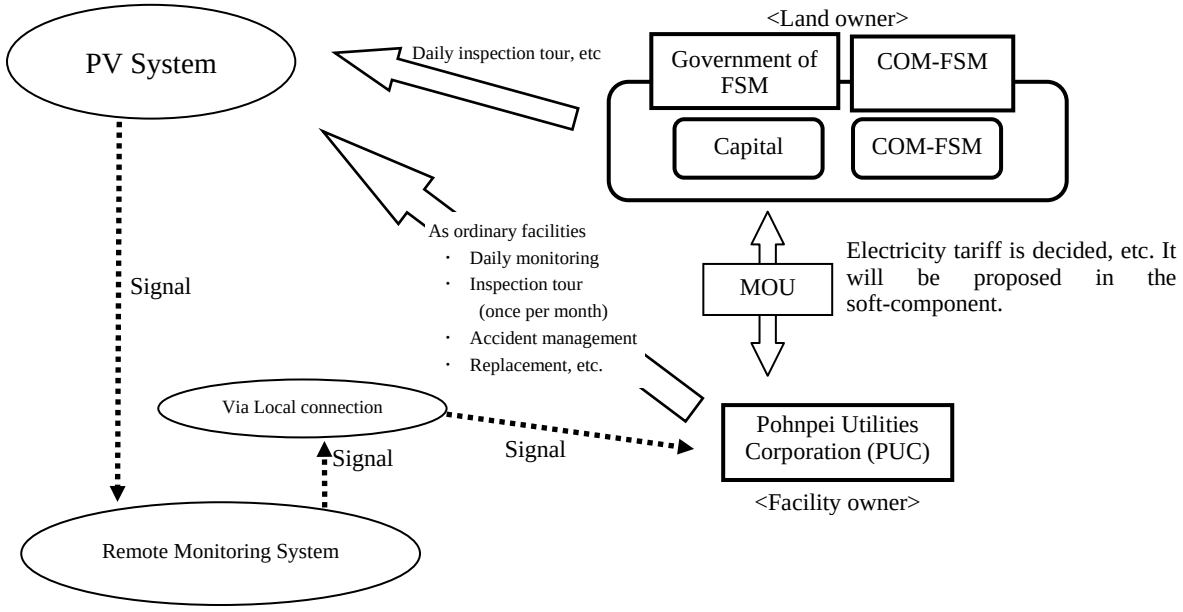
The goal is that PUC, the implementing agency of the Project, comes to be able to implement continuous and smooth O&M assuming PUC owns the facilities based on the O&M manual.

(3) Expected Operation and Maintenance Organization

In FSM, the “stand-alone PV system” and the “grid-connected PV system” have already been introduced. The target of this study is the “grid-connected PV system,” and the system having introduced with support from EU serves as very good references to discuss the technical support on the O&M of the target facilities of this Project. From this viewpoint, proposals to establish the O&M system suited for the grid-connected PV system introduced in this project are presented as below.

It is judged to be proper to establish an original O&M system in this project, taking into consideration of the O&M system by EU assistance. Specifically speaking, it is judged to be desirable that the government of FSM, which is the land owner of both sites, and Pohnpei Utilities Corporation (PUC), which is the facility owner, should participate in the O&M system as shown in Fig. 2.2.4-2. As for maintenance, PUC takes charge of it in the same manner as ordinary power system. It is desirable that the government of FSM and PUC determine the tariff for the energy generated in the grid-connected PV system, etc., and conclude MOU. The most

appropriate O&M system, the tariff between PUC and the government of FSM, etc. will be reviewed in the soft-component based on the MOU, and proposals will be presented.



Source： created by JICA study team

Fig. 2.2.4-2　O&M system in this project (proposed)

(4) Current Problems and their Solutions

Table 2.2.4-2 Current problems and measures for improvement

Current problems	Measures for improvement	Necessary soft-component
▪ The necessary structure for O&M of grid-connected PV system is not established	▪ PUC establishes the O&M system within PUC.	▪ Make a proposal on the segmentalization and specification of O&M system, and discuss it with the persons concerned.
▪ Technical knowledge and skills for grid-connected PV system is not enough	▪ Prepare the O&M manual of the grid-connected PV system.	▪ Support implementation guidance on the manual.
▪ The concept and methodology for O&M of grid-connected PV system is not established	▪ Implement technical training on PV systems including the "independent type" and "grid-connected type." ▪ Implement training on monitoring, such as the monitoring method, periodical inspection method, etc.	▪ Conduct proper technical training on PV systems. ▪ Conduct proper technical training on monitoring.
▪ Trouble-shooting for grid-connected PV system is difficult	▪ Create the O&M manual including troubleshooting ▪ Conduct implementation guidance on the manual and educational activities so that the O&M are properly done.	▪ Support implementation guidance on the manual. ▪ ditto
▪ Electricity tariff structure for grid-connected PV system is not established	▪ Determine most appropriate electricity tariff.	▪ Make a proposal on most appropriate electricity tariff, and discuss it with the person concerned.

Source： created by JICA study team

(5) Outcomes

1) The O&M manual of the grid-connected PV system introduced in this project, including troubleshooting, is created.

2) Basic knowledge on the grid-connected PV system installed under the Project is acquired, and the O&M of the facilities is carried out continuously.

3) The most appropriate tariff structure is determined according to need, and a continuous and smooth O&M system is established.

(6) Contents of implementation

As the soft-component of the Project, a broad and shallow range training will be implemented covering from a basic level on PV generation to an application level on the O&M of PV facilities. Table 2.2.4-3 shows the specific contents, which are divided into Category 1 to 4. The implementation process is a total of four times, one category at one time.

Table 2.2.4-3 Contents of training

Category	Specific contents (purpose)	Man Month	
1. Establishment of the O&M system	1.1 Clarification of the responsibility of individuals who carry out the O&M	0.25MMx2persons	Total 1.00MMx2persons
	1.2 Proposal on the most appropriate electricity tariff	0.25MMx2persons	
	1.3 Creation of the O&M manual in collaboration with FSM side	0.50MMx2persons	
2. Technical training	2.1 Principle and basic knowledge of PV systems	0.25MMx2persons	Total 1.25MMx2persons
	2.2 Characteristics of grid-connected PV systems	0.25MMx2persons	
	2.3 Matters to be examined when a grid-connected PV system is introduced.		
	2.4 Installation	0.25MMx2persons	
	2.5 Inspection		
	2.6 Operation		
	2.7 Maintenance		
	2.8 Troubleshooting	0.50MMx2persons	
3. Institutional Training	3.1 Collection method of electricity tariff	0.25MMx2persons	Total 0.75MMx2persons
	3.2 Optimizing O&M manual	0.25MMx2persons	
	3.3 Evaluation of the O&M system	0.25MMx2persons	
4. Monitoring	4.1 Optimizing monitoring method	0.25MMx2persons	Total 1.00MMx2persons
	4.2 Periodical inspection	0.25MMx2persons	
	4.3 Evaluation items	0.25MMx2persons	
	4.4 Report of monitoring results	0.25MMx2persons	
Total		4.00MMx2persons	

Source： created by JICA study team

(7) Implementation schedule

The implementation process is shown in Fig. 2.2.4-3. The training is implemented in accordance with the category shown in Table 2.2.4-3. The implementation time of each category is as follows:

Category 1 : Implemented before the installation of facilities because this training is done to facilitate the establishment of the O&M system, and because, by clarifying the O&M system before the facility installation, awareness as the person in charge can be raised at the time of installation.

Category 2 : Implemented in the middle of the installation work because this training, concerning the installation, inspection, operation, etc., is done using actual facilities.

Category 3 : Implemented before the operation of the facilities starts because this training is related to the O&M manual, etc., that should be prepared before the start of the operation.

Category 4 : Implemented about four months after the completion of the installation because the focus of this training is to confirm that the FSM side can carry out the O&M by themselves.

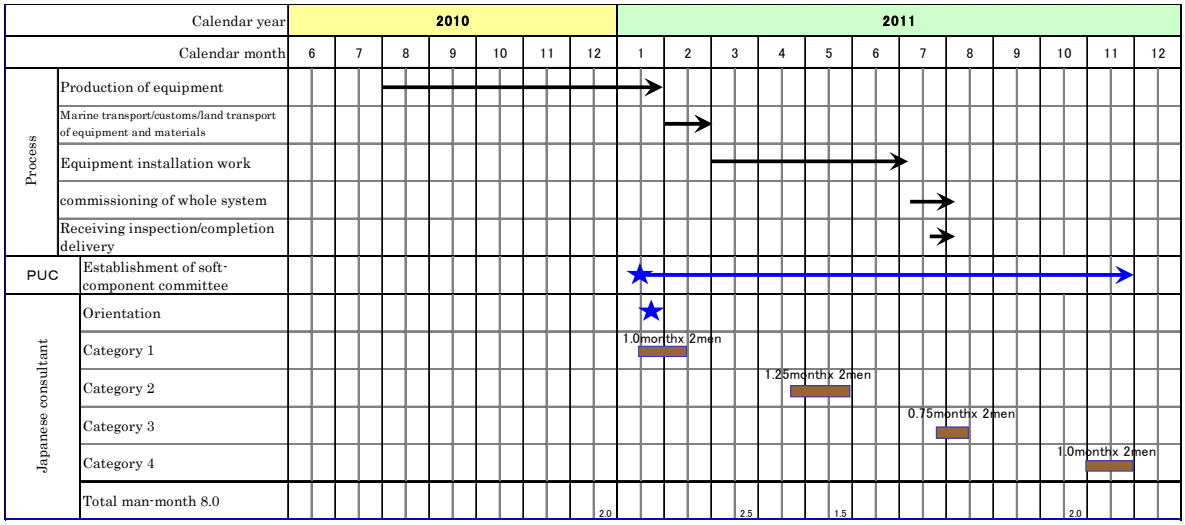


Fig. 2.2.4-3 Implementation process

2.2.4.9 Implementation Schedule

The Project implementation schedule was compiled as follows based on the scheme of the Government of Japan's Program Grant Aid for Environment and Climate Change.

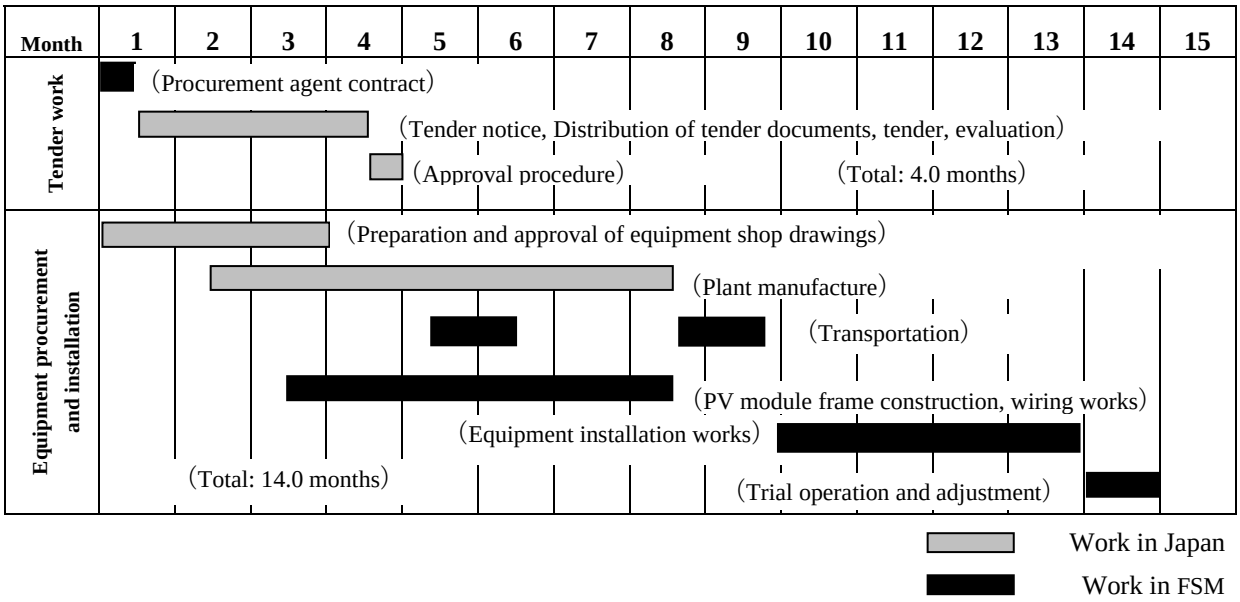


Fig. 2.2.4-4 Project Implementation Schedule Sheet

2.3 Obligations of Recipient Country

When it comes to implementing the Project, in addition to the scope of works on the FSM side indicated in 2.2.4-3 Scope of Works, Procurement and Installation, items to be implemented or borne by the FSM side are as follows.

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

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

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

(4) To exempt Japanese nationals from taxes and tariffs, etc. that are ordinarily levied in FSM on products and services supplied based on authorized contracts.

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

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

(7) To attend equipment and materials inspections on site and to appoint an engineer and skilled workers as counterparts for the transfer of operation and maintenance skills

(8) To formulate the power interruption plan required during the equipment installation works and to implement the necessary procedures for it

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

(10) To secure a disposal site for excavated earth, sewage, waste oil and recovered equipment and materials during the works period

(11) To implement final connections of low voltage distribution cables and existing distribution panel for outgoing from the PV equipment to be procured and installed by the Japanese side. However, the materials (terminal lugs and bolts, etc.) required for terminating the cables and connecting them will be procured by the Japanese side.

(12) To offer safety guidance and education to local residents

2.4 Project Operation Plan

2.4.1 Daily Inspection and Periodic Inspection Items

Since the PV system to be procured and installed under the Project will play an important part in promoting renewable energy power generation in FSM in the future, it will be necessary to establish a setup for appropriate and long-term maintenance by the PUC. Table 2.4.1-1 and Table 2.4.1-2 show the items that need to be covered in daily inspections and periodic inspections of major equipment in standard PV systems. It should be noted, however, that these inspection items will be renewed via maintenance support in the soft component while taking into account the maintenance setup in FSM.

Table 2.4.1-1 Routine Inspection Items for Standard Equipment

Inspection Target	Inspection Item	Result
Solar cell array	Surface dirt, damage	
	Frame corrosion, rust	
	External wiring damage	
Junction box	External box corrosion, rust	
	External wiring damage	
Power conditioner	External box corrosion, rust	
	External wiring damage	
	Noise, odor during operation	
	Blockage of the ventilation outlet filter	
	Installed environment (humidity, temperature, etc.)	
Grounding	Wiring damage	
Power generation situation	Confirmation of normal operation via support instrumentation and displays	

Table 2.4.1-2 Periodic Inspection Items for Standard Equipment

Inspection Target	Inspection Item	Result	Measurement Test and Result
Solar cell array	Surface dirt, damage		Insulation resistance MΩ
	Frame corrosion, rust		
	External wiring damage		Open voltage V
	Grounding wire damage, ground wire looseness		
Junction box	External box corrosion, rust		Insulation resistance MΩ
	External wiring damage		
	Grounding wire damage, ground wire looseness		
Power conditioner	External box corrosion, rust		Display section operations
	External wiring damage		
	Noise, odor during operation		Insulation resistance MΩ
	Blockage of the ventilation outlet filter		
	Installed environment (humidity, temperature, etc.)		
	Grounding wire damage, ground wire looseness		
Grounding	Wiring damage		Grounding resistance Ω

2.4.2 Spare Parts Purchase Plan

(1) Spare Parts Categories

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

① Replacement parts : Parts required for replacement due to breakdown of equipment part

② Emergency spare parts : Necessary replacement equipment during an emergency which involves malfunction of the distribution system due to equipment failure

(2) Selection Criteria for Each Category

1) Replacement parts

These parts experience no periodic wear or degradation in everyday operation, however, assuming them to be repair parts with a high possibility of damage, adopt 100% of the amount projected to be necessary per year.

In case of accidents on a PV module connected in series, the strung PV modules shall not perform properly and may affect to another module in order not to be able to generate power and consequently 3% of designed number of PV modules shall be procured as replacement parts.

2) Emergency spare parts

A power conditioner will be procured as an emergency spare part since this could cause major interference to the PV system and would be difficult to quickly repair on site, if damaged for some unforeseen and unexpected reason. Under the Project, from the viewpoint of procuring the minimum necessary equipment, generated power will diminish if problems arise in solar cells. In the PV system, since the publicity effect of the display board on ordinary users is great, therefore any damage would adversely affect the public image and affect the maintenance capacity of the implementing agency, it is necessary to take steps to mitigate the effects.

Moreover, since it is difficult for FSM side to implement quick repairs of equipment on site with its existing technical levels, it will need to replace damaged equipment in order to get the system working again. However, since the implementing agency responsible for operation and maintenance in the Project does not possess the necessary equipment for conducting replacement, it will be necessary to procure a power conditioner as an emergency spare part for replacement.

(3) Test Instruments and Maintenance Tools

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

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

Equipment	Unit	Quantity	
		Capital	COM-FSM
1. Replacement parts			
1.1 Distribution circuit breaker 50A	Unit	2	2
1.2 Distribution circuit breaker 225A	Unit	1	1
1.3 24-hour timer	Unit	1	1
1.4 AC/DC converter	Unit	1	1
1.5 PV module	Set	3	20
2. Emergency spare parts			
2.1 Power conditioners (30kW)	Unit	1	
2.2 Power conditioners (100kW)	Unit		1
3. Test instruments			
3.1 Digital multi meter	Unit	1	1
3.2 Insulation resistance tester	Unit	1	1
3.3 Voltage detector (low voltage)	Unit	1	1
3.4 Clamp meter	Unit	1	1
3.5 Power Quality Analyzer	Unit	1	
4. Maintenance tools			
4.1 Driver set	Unit	2	2
4.2 Nipper, 150 type	Unit	2	2
4.3 Pliers, 150 type	Unit	2	2
4.4 Terminal pressure fitting pliers	Unit	2	2
4.5 Hammer	Unit	1	1
4.6 Card tester	Unit	1	1
4.7 Socket wrench (9 ~ 21)	Set	1	1
4.8 Conduction tools	Unit	1	1
4.9 Correction paint	Can	2	2
4.10 Anti-rust agent (zinc)	Can	2	2

2.5 Project Cost Estimation

2.5.1 Initial Cost Estimation

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

(1) Costs to be borne by the FSM Side Approx. 6,300 US$ (Approx. ¥ 0.63 million)

The contents and costs to be borne by the FSM side are as follows:

① Final connection works of low voltage distribution cable to existing distribution panel:

Approx. 1,000 US$ (Approx. ¥ 0.1 million)

② Payment of commission to Japanese bank for opening bank account:

Approx. 5,300 US$ (Approx. ¥ 0.53 million)

(2) Estimation criteria

①	Estimation point:	:	July 2009
②	Exchange rate	:	1 US$ = 96.59 yen (TTS average value from January to June 2009)
③	Works and procurement period	:	The detailed design, and procurement and installation period for the equipment is shown in the implementation schedule.
④	Other points	:	The Project will be implemented in accordance with the Grant Aid Scheme of the Government of Japan.

2.5.2 Operation and Maintenance Costs

The equipment to be procured in the Project is basically maintenance-free, however, it will be necessary to always keep replacement parts available in case of breakdowns as was mentioned earlier (see 2.4.2). Moreover, in cases of periodic inspections or when abnormal situations or breakdowns occur, it will be necessary to dispatch PUC engineers and thereby incur personnel expenses. Therefore, the FSM side will need to budget for the following operation and maintenance expenses (annual) to ensure that no problems arise in the operation and maintenance of equipment.

① Personnel expenses Approx. 4,000 US$ (Approx. ¥ 0.4 million)

② Expenses for fuel const for periodic and emergency inspections:
Approx. 200 US$ (Approx. ¥ 0.02 million)

Total Approx. 4,200 US$ (Approx. ¥ 0.42 million)

Since the above cost amounts to no more than approximately 1.2% of the distribution system operation and maintenance budget of PUC in 2008 (approximately 355,000 US$/year), there should be no major problem in securing the operation and maintenance costs for the Project.

2.6 Other Relevant Issues

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

(1) To ensure the stable operation of the grid-connected PV system, it will be necessary to strictly observe preventive maintenance measures such as implementing daily and periodic site patrols and inspections and securing the onsite setup for protecting the photovoltaic modules.

(2) It will be necessary to swiftly appoint the engineers to participate in the Project soft component and OJT and to ensure that skills are transferred to other engineers who do not take part in the said training.

(3) Concerning the grid-connected PV system that will be procured and installed by the Japanese side under the Project, it will be necessary to establish a power tariff scheme that enables future investment costs to be recovered, particularly in anticipation of replacement of the photovoltaic modules and power conditioner at the end of their expected service life.

CHAPTER 3

PROJECT EVALUATION AND RECOMMENDATIONS

CHAPTER 3 PROJECT EVALUATION AND RECOMMENDATIONS

3.1 Project Effects

The anticipated effects of Project implementation are as follows.

(1) Direct Effects

Current Conditions and Problems	Project Countermeasures (Requested Japanese Assistance)	Project Effect and Degree of Impact
The Government of FSM regards breaking away from a heavy dependence on diesel fuel in the energy and electric power sector to be an urgent issue, and it is also concerned over climate change, unstable crude oil prices and transportation costs. Accordingly, it regards development of renewable clean energies, primarily photovoltaic power, as a priority policy. However, the Pohnpei Utilities Corporation (PUC), which is responsible for electricity supply in Pohnpei, does not possess sufficient operation and maintenance capacity in the renewable energy field.	Procure and install grid-connected PV systems (connected to existing distribution lines) at the Project sites of the Federal Government Complex (Capital) and College of Micronesia (COM-FSM). Moreover, via the soft component, improve the operation and maintenance capacity of the PUC, which will be responsible for operating and maintaining the grid-connected PV systems.	(1) Reduction of diesel fuel consumption The power generated by the grid-connected PV systems procured and installed in the Project will enable the operating capacity of existing diesel generating equipment to be reduced, thereby enabling approximately 37 kl of diesel consumption to be saved every year. (2) Reduction of CO_2 emissions In line with reduction in the operating capacity of diesel generating equipment, CO_2 emissions will be cut by approximately 98 tons per year. (3) Improvement of operation and maintenance capability Operation and maintenance capability for connecting the Project systems to the existing distribution grid and conducting safe and stable operation will be improved.

(2) Indirect Effects

Current Conditions and Problems	Project Countermeasures (Requested Japanese Assistance)	Project Effect and Degree of Impact
Grid-connected PV systems are already operating in FSM: these were installed at the airport and government offices, etc. in Kosrae State under the Support to the Energy Sector in Five ACP Pacific Islands project by the European Union (EU).	Procure and install grid-connected PV systems (connected to existing distribution lines) at the Project sites of the Federal Government Complex (Capital) and College of Micronesia (COM-FSM).	Through installing a grid-connected PV system at the Capital, it is anticipated that the benefits and understanding of PV systems and renewable energy will be shared among the President, Federal Government staff, State Government staff and ordinary citizens. Meanwhile, in the case of COM-FSM, it will be possible to install the grid-connected system on the parking area in front of the country's largest library which is a focal point for students and researchers. In doing so, the system can be expected to provide an effective demonstration of the technology to students and researchers who will work on future PV systems. Since Project implementation will spread awareness of the potential of PV power to all parts of society, this will facilitate further dissemination in the future.

3.2 Recommendations

3.2.1 Issues and Recommendations to be tackled by the FSM side

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

(1) To ensure the stable operation of the grid-connected PV system, it will be necessary to strictly observe preventive maintenance measures such as implementing daily and periodic site patrols and inspections and securing the onsite setup for guarding the photovoltaic modules.

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

(3) Concerning the grid-connected PV system that will be procured and installed by the Japanese side in the Project, it will be necessary to establish a power tariff scheme that enables future investment costs to be recovered, particularly in anticipation of renewals of the photovoltaic modules and power conditioner at the end of their expected service life.

3.2.2 Collaboration with Technical Cooperation and Other Donors

Similar grid-connected PV systems were installed at the airport and government offices, etc. in Kosrae State under the Support to the Energy Sector in five ACP Pacific Islands (Rep-5) by the EU. In this project, technical support (training in capacity building) concerning operation and maintenance of the grid-connected PV systems was conducted in classroom and practical training, and these contents can be referred to when implementing the soft component in the Project.

APPENDICES

1. MEMBER LIST OF THE STUDY TEAM

APPENDIX 1 MEMBER LIST OF STUDY TEAM

< 1st Field Survey >

Name	Assigned Work	Current Position
Teiji TAKESHITA	Leader	Executive Advisor to the Director General, Secretariat of Japan Overseas Cooperation Volunteers, JICA
Hiroshi MURAYAMA	Planning Management	Assistant Director, Grant Aid Project Management Division 1, Financing Facilitation and Procurement Supervision Department, JICA
Ryo TSUJIMOTO	Procurement Management	Chief Representative, Crown Agents
Tadayuki OGAWA	Chief Consultant / Solar Power System / Environmental and Social Considerations	Yachiyo Engineering Co., Ltd.
Fumikazu DOI	Grid-connected PV System 3/ Related Institutional Framework and Standard 3	Shikoku Electric Power Co., Inc.
Yoshitetsu FUJISAWA	Grid-connected PV System 1/ Related Institutional Framework and Standard 1	Shikoku Electric Power Co., Inc.
Masahiko YAMAGUCHI	Equipment and Facilities Planning	Yachiyo Engineering Co., Ltd.
Makoto ABE	Procurement Planning / Cost Estimation	Yachiyo Engineering Co., Ltd.
Teruo KURUMADA	Architectural Design	Yachiyo Engineering Co., Ltd.
Yousuke TSURUOKA	Coordinator	Yachiyo Engineering Co., Ltd.

< 2nd Field Survey >

Name	Assigned Work	Current Position
Shinichi HAMADA	Leader	Resident Representative JICA Micronesia Office
Takafumi YASUMOTO	Planning Management	Assistant Director, Grant Aid Project Management Division 3, Financing Facilitation and Procurement Supervision Department, JICA
Tadayuki OGAWA	Chief Consultant / Solar Power System 1/ Environmental and Social Considerations 1	Yachiyo Engineering Co., Ltd.
Kaname MOTOKI	Deputy Chief Consultant / Solar Power System 2/ Environmental and Social Considerations 2	ICONS International Cooperation Co., Ltd.
Fumikazu DOI	Grid-connected PV System 3/ Related Institutional Framework and Standard 3	Shikoku Electric Power Co., Inc.
Yoshitetsu FUJISAWA	Grid-connected PV System 1/ Related Institutional Framework and Standard 1	Shikoku Electric Power Co., Inc.
Makoto ABE	Procurement Planning / Cost Estimation	Yachiyo Engineering Co., Ltd.

< 2nd Field Survey >

Name	Assigned Work	Current Position
Hiroyuki KOBAYASHI	Leader	Director Natural Resources and Energy Conservation Division, Natural Resources and Energy Group, Industrial Development Department, JICA
Tadayuki OGAWA	Chief Consultant / Solar Power System 1/ Environmental and Social Considerations 1	Yachiyo Engineering Co., Ltd.
Makoto ABE	Procurement Planning / Cost Estimation	Yachiyo Engineering Co., Ltd.

2. STUDY SCHEDULE

APPENDIX 2 SURVEY SCHEDULE

< 1st Field Survey >

No.	Date	Day of the week	Survey Contents		Stay at
			Official	Consultant Members	
			Mr. Teiji TAKESHITA, Mr. Hiroshi MURAYAMA, and Mr. Ryo TSUJIMOTO	Mr. Tadayuki OGAWA, Mr. Yoshitetsu FUJISAWA, Mr. Fumikazu DOI ,Mr. Yosuke TSURUOKA, Mr. Masahiko YAMAGUCHI, Mr. Makoto ABE, and Mr. Teruo KURUMADA	
1	Jul. 12	Sun		• Sorting of data and information collected • Market Survey • Trip [Tokyo (10:30) → Guam (15:00) by CO962] Trip [Guam (18:50) → Koror (19:50) by CO953] (Mr. Doi)	Koror
2	Jul. 13	Mon		• Trip [Koror (01:45) → Guam (04:40) by CO954] • Trip [Guam (08:20) → Pohnpei (12:58) by CO956] • 14:30~Courtesy call to EOJ and JICA Micronesia Office	Pohnpei
3	Jul.14	Tue		• 9:30~ FSM-JICA Project Team Meeting • Site Survey at Palikir, Power Stations and Distribution Lines Courtesy call and meeting with Department of Foreign Affairs (DFA) • Courtesy call and meeting with Department of Resource and Development (DRD) • Courtesy call and meeting with Pohnpei State Government • Courtesy call and meeting with Pohnpei Utility Corporation (PUC) • Site Survey at Palikir, Power Stations and Distribution Lines	Pohnpei
4	Jul. 15	Wed		• Meeting with PUC • Site Survey at Capital and College of Micronesia	Pohnpei
5	Jul. 16	Thu		• Site Survey at Power Station and Distribution Lines • Meeting with DRD, PUC, etc.	Pohnpei
6	Jul. 17	Fri		• Site Survey at Capital and College of Micronesia • Meeting with DER, PUC, COM, EPA	Pohnpei
7	Jul. 18	Sat		• Sorting of data and information collected • Market Survey	Pohnpei
8	Jul. 19	Sun	Arrival at Pohnpei	• Sorting of data and information collected • Market Survey	Pohnpei
9	Jul. 20	Mon	• Courtesy call and meeting with Department of Foreign Affairs(DFA) • Courtesy call and meeting with Department of Resources and Development(R&D) • Courtesy call and meeting with Pohnpei State Government	• Courtesy call and meeting with Department of Foreign Affairs(DFA) • Meeting with DRD, PUC, etc. • Market Survey	Pohnpei
10	Jul. 21	Tue	• 10:00~ Courtesy call to EOJ • Meeting with PUC: Explanation and Discussion with PUC for the selection of project site	• Meeting with DRD, PUC, etc. • Market Survey	Pohnpei

11	Jul. 22	Wed	• Meeting with FSM Project team: Explanation and Discussion on Minutes of Discussions(M/D) • Market Survey, Confirmaiton on the procedures for EIA and others	• Explanation and Discussion on Minutes of Discussion (M/D) • Market Survey, Confirmation on the procedures for EIA, and others	Pohnpei
12	Jul. 23	Thu	• Meeting with FSM Project team: Explanation and Discussion on Minutes of Discussions(M/D)	• Ditto • Trip [Pohnpei (15:00) → Guam (17:20) by CO957] Trip [Guam (11:50) → Tokyo (14:45) by CO961] (Mr. Tsuruoka)	Pohnpei
13	Jul 24	Fri	• Signing of M/D • 15:00~ Report to EOJ and JICA Micronesia Office on the result of first field survey	• Signing of M/D and field Report • Report to EOJ and JICA Palau Office on the result of first field survey	Pohnpei
14	Jul. 25	Sat.	Departure for Japan	• Trip [Pohnpei (15:00) → Guam (17:20) by CO957]	Guam
15	Jul. 26	Sun.		• Trip [Guam (08:00) → Kansai (10:45) by NW83] (Mr. Doi)	
				• Trip [Guam (11:50) → Tokyo (14:45) by CO961]	

< 2nd Field Survey >

No.	Date	Day of the week	Survey Contents		Stay at
			Official	Consultant Members	
			Mr. Takafumi YASUMOTO	Mr. Tadayuki OGAWA, Mr. Kaname MOTOKI, Mr. Yoshitetsu FUJISAWA, Mr. Fumikazu DOI, and Mr. Makoto ABE	
1	Dec. 5	Sat		• Trip [Majuro (10:55) → Pohnpei (14:20) CO957]	Pohnpei
2	Dec. 6	Sun	• Trip [Tokyo (11:05) → Guam (15:35) CO962] • Trip [Guam (19:40) → Pohnpei (00:35) CO958]	• Sorting of data and information collected • Market Survey	Pohnpei
3	Dec. 7	Mon	• Courtesy call to Department of Foreign Affairs • Courtesy call to EOJ and JICA Micronesia Office • Courtesy call and meeting with Department of Resource and Development (R&D) to explain the Survey schedule and Draft Minutes of Discussion (M/D)		Pohnpei
4	Dec. 8	Tue	• Meeting with R&D to discuss M/D • Courtesy call and meeting with Pohnpei Utilities Corporation (PUC) to explain the Survey schedule and Draft Minutes of Discussion (M/D)		Pohnpei
5	Dec. 9	Wed	• Continued discussion on M/D • Technical confirmation with PUC		Pohnpei
6	Dec. 10	Thu	• Discussion with R&D and PUC on M/D and Draft Final Report • Site Survey		Pohnpei
7	Dec. 11	Fri	• Signing on M/D • Discussion with R&D and PUC on the technical issue of Draft Final Report • Site Survey • Reporting to EOJ and JICA Micronesia Office		Pohnpei
8	Dec. 12	Sat.	• Trip [Pohnpei (15:00) → Guam (17:20) CO957]	• Trip [Pohnpei (15:00) → Guam (17:20) CO957] • Trip [Guam (19:55) → Koror (22:25) CO953]	Koror
9	Dec. 13	Sun.	• Trip [Guam (07:20) → Tokyo (09:55) CO961]		

< 3rd Field Survey >

No.	Date	Day of the week	Survey Contents		Stay at
			Official	Consultant Members	
			Mr. Hiroyuki KOBAYASHI	Mr. Tadayuki OGAWA, and Mr. Makoto ABE	
1	Feb. 9	Tue		• Trip [Tokyo (11:05) → Guam (15:35) CO962]	Guam
2	Feb. 10	Wed		• Trip [Guam (08:20) → Pohnpei (12:58) CO956] • Courtesy Call to EOJ and JICA Micronesia Office	Pohnpei
3	Feb. 11	Thu		• Sorting of data and information collected • Market Survey • Site Survey	Pohnpei
4	Feb. 12	Fri		• Sorting of data and information collected • Market Survey • Site Survey	Pohnpei
5	Feb. 13	Sat.		• Sorting of data and information collected	Pohnpei
6	Feb. 14	Sun.	• Trip [Guam → Pohnpei]	• Sorting of data and information collected	Pohnpei
7	Feb. 15	Mon.	• Courtesy call to Department of Foreign Affairs • Courtesy call and meeting with Department of Resource and Development (R&D) and PUC to explain Draft Minutes of Discussion (M/D)		Pohnpei
8	Feb. 16	Tue.	• Discussion with R&D and PUC on M/D and Draft Final Report • Market Survey		Pohnpei
9	Feb. 17	Wed.	• Discussion with R&D and PUC on M/D and Draft Final Report		Pohnpei
10	Feb. 18	Thu.	• Signing on M/D • Reporting to EOJ and JICA Micronesia Office • Trip [Pohnpei (15:00) → Guam (17:20) CO957]		Guam
11	Feb. 19	Fri.	• Trip [Guam (07:20) → Tokyo (09:55) CO961]		

3. LIST OF PARTIES CONCERNED IN THE RECIPIENT COUNTRY

3. List of Parties Concerned in the Recipient Country

Organization and Name	Position
Department of Resources and Development	
Mr. Marion Henry	Assistant Secretary
Mr. Hubert K.Yamada	Assistant Secretary
Mr. Peter JM Konings	Renewable Energy Advisor
Department of Foreign Affairs	
Mr. Lorin S. Robert	Secretary
Ms. Jane Chigiyal	Deputy Secretary
Mr. Kandhi A. Elieisar	Assistant Secretary
Mr. Brendy H. Carl	Deputy Assistant Secretary
Department of Finance	
Mr. Joan Nuss	Assistant Secretary
Ms. Maggi Samo	Customs and Tax Administration Officer
Department of Transportation, Communications and Infrastructure	
Mr. Phillip Joseph	Assistant Secretary
Mr. Henry Tionqco	Engineer
Mr. Benster Sepastian	Electric Engineer
Mr. Wilmer Kilmete	Architect
Mr. Daniel Rebehem	
Office of Environment and Emergency Management (OEEM)	
Mr. Antholino Neth	FSM Public Assistant
Mr. Joe Konno	
Pohnpei Environmental Protection Agency	
Mr. Donna Scheuring	Environmental Consultant
Mr. Charles Lohn	Environmental Educator
Mr. Nelson Henry, Jr.	Pollution Control Supervisor
Mr. Henry Susaia	Environmental Specialist

College of Micronesia National Campus (COM-FSM)

Mr. Spensin James	President
Mr. Joseph Habuchmai	Vice President
Mr. Francisco W. Mendiola	Director of Facilities and Security
Mr. Alfred Olter	Project Manager

Pohnpei Utilities Corporation (PUC)

Mr. Feliciano M. Perman	GM/CEO
Mr. Esmond Moses	Strategy Planning
Ms. Carleen Solomon	Assistant GM
Mr. Nixon Anson	Special Assistant GM
Mr. John T,Martin	Acting Assistant GM
Mr. Dackson Solomon	Assistant GM

Embassy of Japan

Mr. Shoji Sato	Ambassador of Japan
Mr. Genichi Terasawa	Counselor
Ms. Mariko Harada	Second Secretary/Development Assistance Officer
Ms. Takako Takeda	Advisor/Researcher

JICA Micronesia Office

Mr. Shinichi Hamada	Resident Representative
Mr. Yosuke Fukushima	Project Formulation Advisor

4. MINUTES OF DISCUSSIONS

Minutes of Discussions
on the Preparatory Survey
on the Project for Clean Energy Promotion Using Solar Photovoltaic System
in the Federated States of Micronesia

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

JICA sent to Federated States of Micronesia (hereinafter referred to as "FSM") the Preparatory Survey Team (hereinafter referred to as "the Team"), headed by Mr. Teiji Takeshita, JICA Headquarters, and is scheduled to stay in the country from 13th to 25th July as the Preparatory Survey.

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

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

Pohnpei, 24 July, 2009

Mr. Teiji Takeshita
Leader
Preparatory Survey Team
Japan International Cooperation Agency

Mr. Hubert K. Yamada
Assistant Secretary, Energy Division
Department of Resources and Development
Federated States of Micronesia

Mr. Feliciano M. Perman
General Manager
Pohnpei Utilities Corporation

witnessed by;

Mr. Lorin S. Robert
Secretary
Department of Foreign Affairs
Federated States of Micronesia

ATTACHMENT

1. Objective of the Preparatory Survey

Based on the result of the previous project formulation study conducted by JICA and the official request from the Government of FSM following items are covered under the Preparatory Survey.

(1) To identify the components of the requested Project

(2) To appraise and evaluate the technical and viability of the Project

(3) To prepare the outline design of the Project and reference document for further consideration.

2. Objective of the Project

The objective of the Project is to promote clean energy utilization and achieve emissions reductions by installing the photovoltaic system to be connected to the Pohnpei State grid.

3. Responsible Organization and Implementing Agency

The responsible organization is the Department of Resources and Development (R&D). The organization chart of the responsible department is shown in Annex-1.

FSM side agrees to coordinate the parties concerned and assign the appropriate implementing agency not later than the end August, 2009 and inform the result to the JICA Micronesia Office. The team replied that until the consent above is not concluded, JICA regards the sustainability of the Project is insufficient and cannot recommend implementation of the Project to GoJ.

4. Project Component

4-1. As a result of the discussions, requested major component was confirmed as below.

(1) Photovoltaic (PV) Module (Panel) (total capacity is about 180kW)

(2) Junction Box

(3) Power Conditioner

(4) Data collecting and display device

(5) Other relevant component to complete PV installation

(6) Training for operation and maintenance of PV system

4-2. Project sites are both (1) Federal Government complex in Pohnpei and (2) the College of Micronesia National Campus in Pohnpei as shown in Annex-2. The capacity of PV module is approximately 90kW for each site.

4-3. The FSM side explained that there is no duplication between the contents of the Project and any other plans or projects of other donors or the FSM side in the same project site.

4-4. JICA will assess the appropriateness of the request and will report the findings to the Government of Japan.

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

The FSM side understood the Japan's Program Grant Aid for Environment and Climate Change scheme explained by the Team as described in Annex-3, 4 and 5.

6. Schedule of the Study

(1) JICA will prepare the draft report and reference document in English and dispatch a mission to FSM in order to explain their contents at the end of November, 2009.

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

7. Other Relevant Issues

7-1 Major Undertakings to be taken by Each Government

The FSM side acknowledges the major undertakings as shown in Annex-6(1) and agrees to provide at its own expense. In detail, the FSM side should be responsible for following issues as described in Annex-6(2);

(1) Environmental and Social Considerations

The Team explained the outline of JICA Environmental and Social Considerations Guideline (hereinafter referred to as "the JICA Guideline") to the FSM side. The FSM side took the JICA Guideline into consideration, and all environmental permissions would be obtained no later than December 2009.

(2) The tariff structure for power generated by PV system shall be determined by the FSM side by the end of December 2009.

(3) Authorization based on the Related Laws and Regulations

The FSM side, if necessary, shall be responsible for obtaining necessary authorization based on related laws and regulations for the operation of the Grid-Connected PV system.

(4) Customs and Tax exemption

The FSM side agreed that the FSM side shall be responsible for the exemption of all customs, tax, levies and duties incurred in FSM for implementation of the Project.

(5) Permission of Land Acquisition / Usage

The Government of FSM owns the land mentioned below. Therefore, land acquisition from the private sector is not necessary for implementation of the Project.

Also, R&D agreed to obtain permission of the usage of necessary land or facilities from the related organizations for installation of the equipment.

(a) Securing necessary land

- for PV Modules
- for underground cables between PV Modules and Power Conditioners
- for Power Conditioners

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

- Approximately 20m^2 areas within each site.

(6) The FSM side shall ensure the security of all concerned Japanese nationals working for the Project, if deemed necessary.

(7) Operation and Maintenance

The FSM side agrees to secure the necessary budget and personnel for the Operation and Maintenance of Grid-Connected PV system procured and installed under the Project.

7-2 Proper use of Equipment and Materials

Any parties involved in operation and the maintenance of the system shall properly use the equipment and materials provided under the Project during and after implementation of the Project.

7-3 Procurement of Equipment and Materials

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

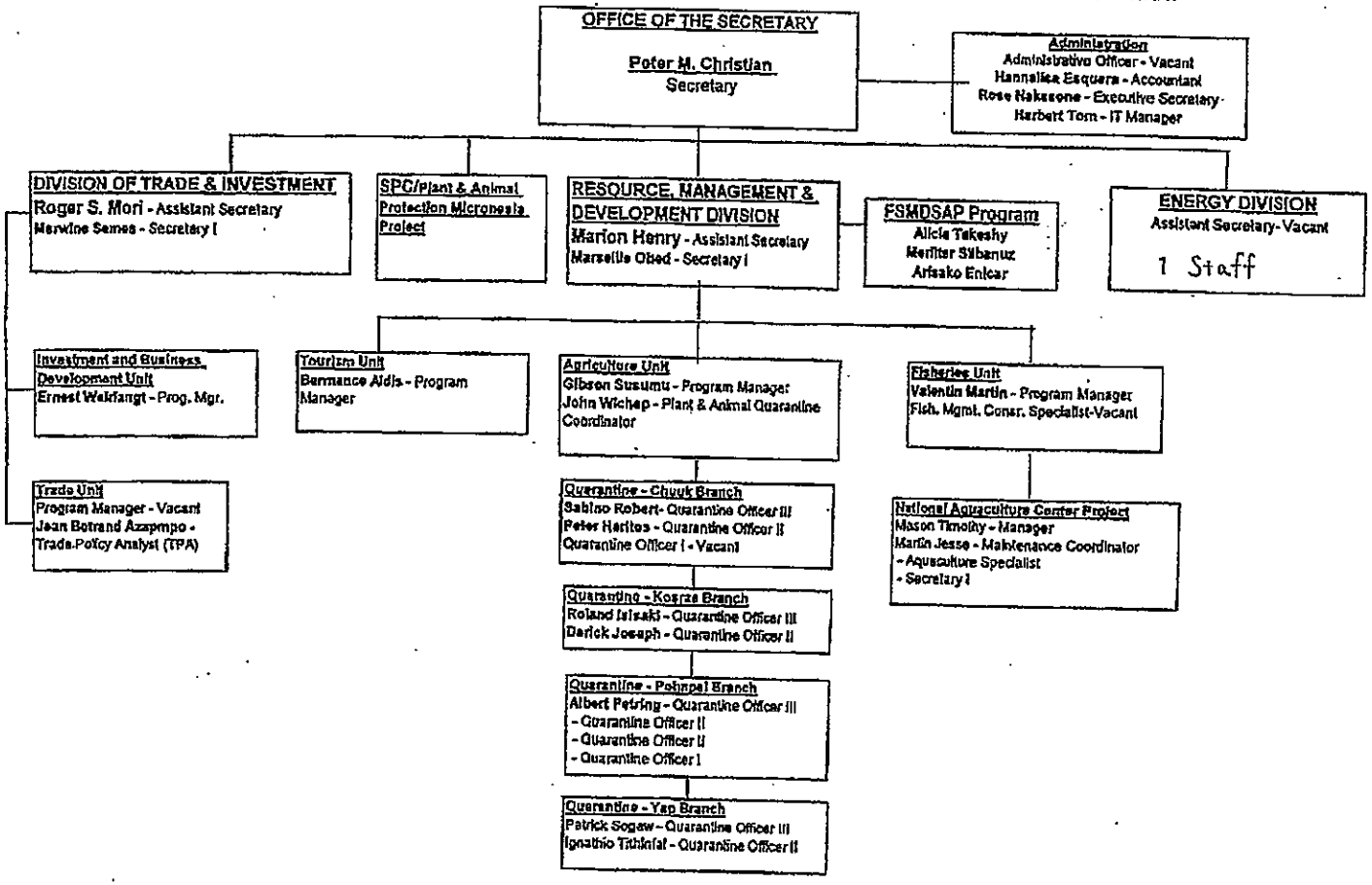
7-4 The FSM side shall provide necessary counterpart personnel to the Team during the period of their studies in the FSM.

<List of Annex>

Annex-1 Organization Chart of Department of Resources and Development
Annex-2 Project site / Candidate site of the Project
Annex-3 Japan's Environment Program Grant Aid Scheme
Annex-4 Flow of Funds for Project Implementation
Annex-5 Project Implementation System
Annex-6(1) Major Undertakings to be taken by Each Government
Annex-6(2) Demarcation of major undertakings
Annex-7 Terms of Reference of the Consultative Committee (Provisional)

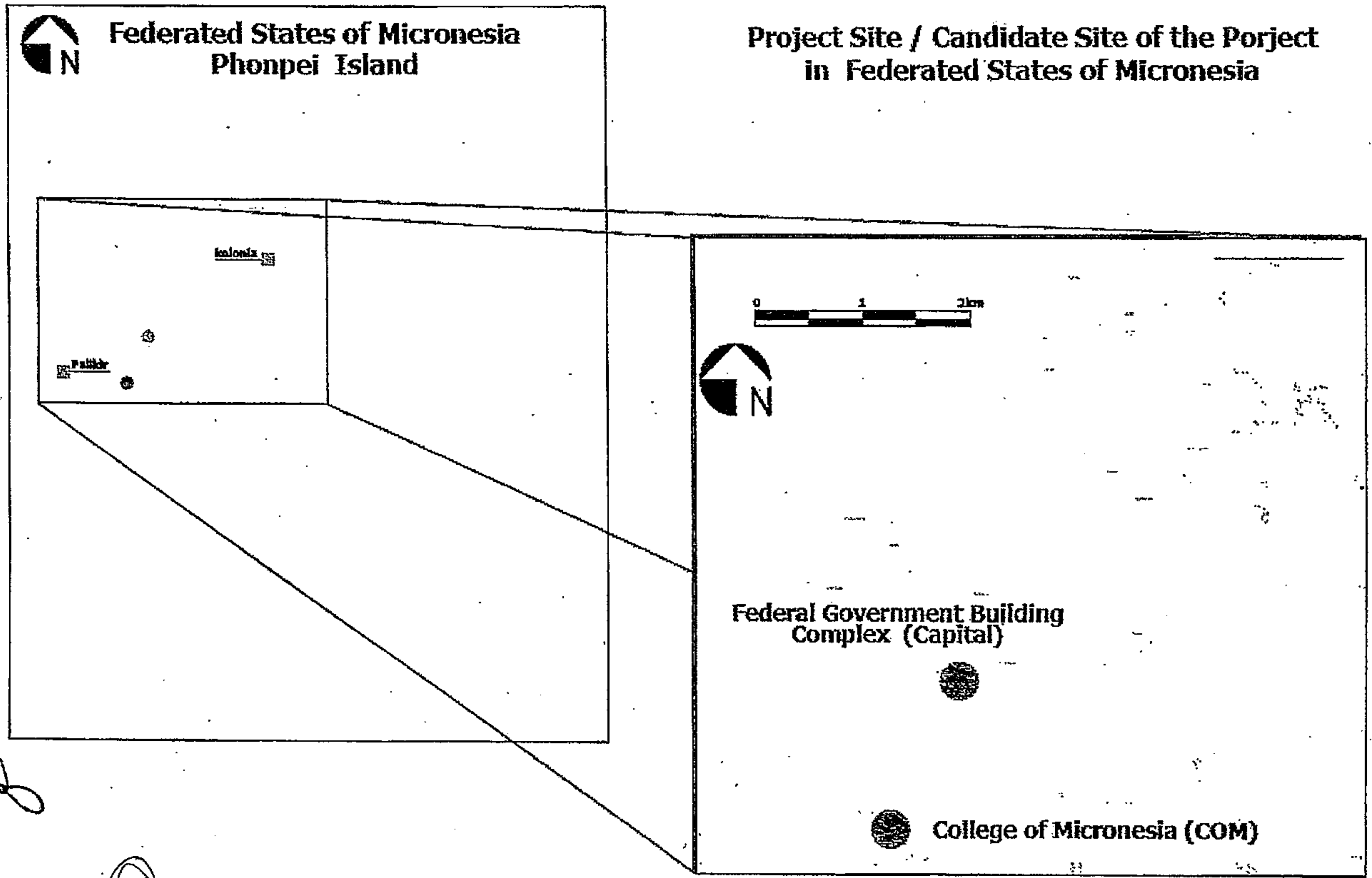
As of July 2009

PROPOSED DEPARTMENT OF RESOURCES AND DEVELOPMENT ORGANIZATIONAL CHART



Annex-1

Project Site / Candidate Site of the Porject in Federated States of Micronesia



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

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

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

1. Procedures for GAEC

GAEC is executed through the following procedures.

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

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

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

Thirdly, the Government of Japan appraises the project to see whether it is suitable for Japan's GAEC, based on the Survey report prepared by JICA, and the results are then submitted to the Cabinet for approval.

Fourthly, the project, once approved by the Cabinet, becomes official with the Exchange of Notes (E/N) signed by the Governments of Japan and the Recipient.

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

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

2 Preparatory Survey

1) Contents of the Survey

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

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

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

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

2) Selection of consulting firms

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

3. Implementation of GAEC after the E/N

1) Exchange of Notes (E/N)

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

2) Details of Procedures

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

Essential points to be agreed are outlined as follows:

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

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

a) The Agent

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

b) Agent Agreement

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

c) Approval of the Agent Agreement

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

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

d) Payment Methods

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

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

e) Products and Services Eligible for Procurement

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

f) Selection of firms

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

The same applies for any individual consultants who will be involved in the Project and provide services necessary for the training and guidance related to the Project.

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

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

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

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

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

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

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

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

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

k) Additional procurement
If there is any remaining balance after the competitive and/or selective tendering and/or direct negotiation for a contract, and if the Recipient would like to procure additional items, the Agent is allowed to conduct this additional procurement, following the points mentioned below:
(1) Procurement of same products and services
When the products and services to be additionally procured are identical with the initial

tender and a competitive tendering is judged not efficient, additional procurement can be conducted by a negotiated contract with the successful tenderer of the initial tender.

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

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

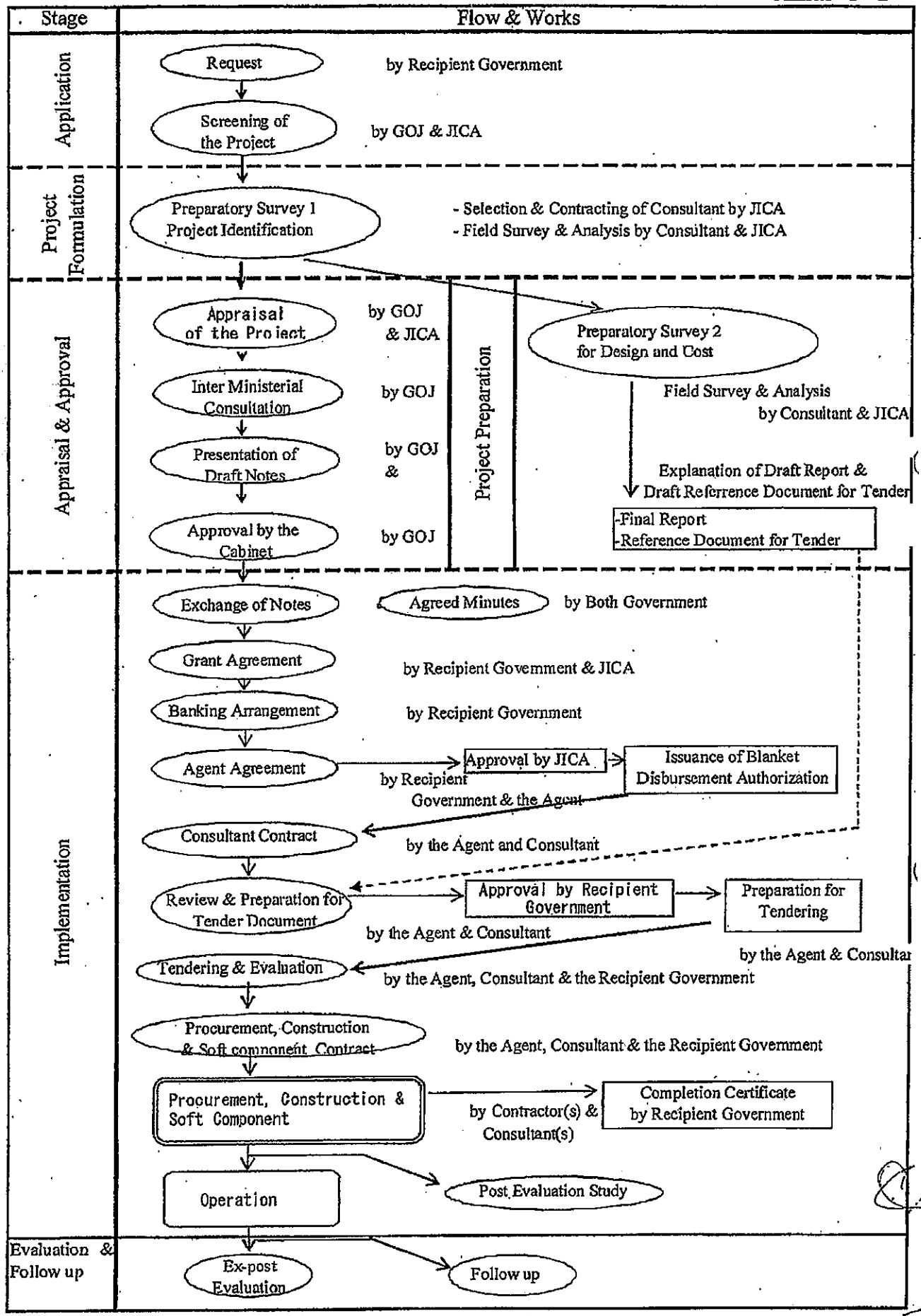
m) Terms of Payment
The contract will clearly state the terms of payment. The Agent will make payment from the "advances," against the submission of the necessary documents from the firm on the basis of the conditions specified in the contract. When the services are the object of procurement, the Agent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

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

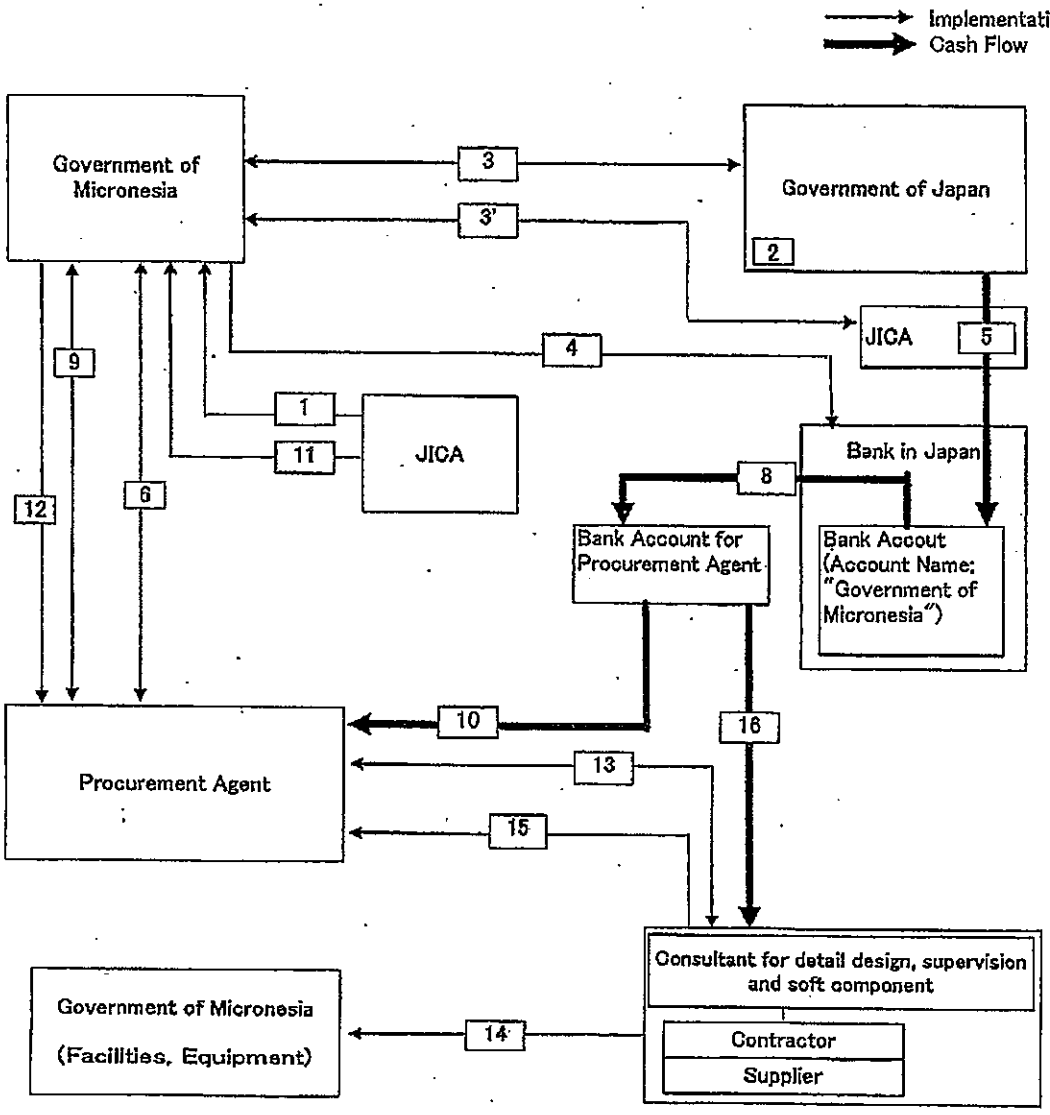
a) To secure land necessary for the sites of the Project and to clear, level and reclaim the land prior to commencement of the Project.
b) To provide facilities for distributing electricity, water supply and drainage and other incidental facilities in and around the sites.
c) To ensure all the expense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

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

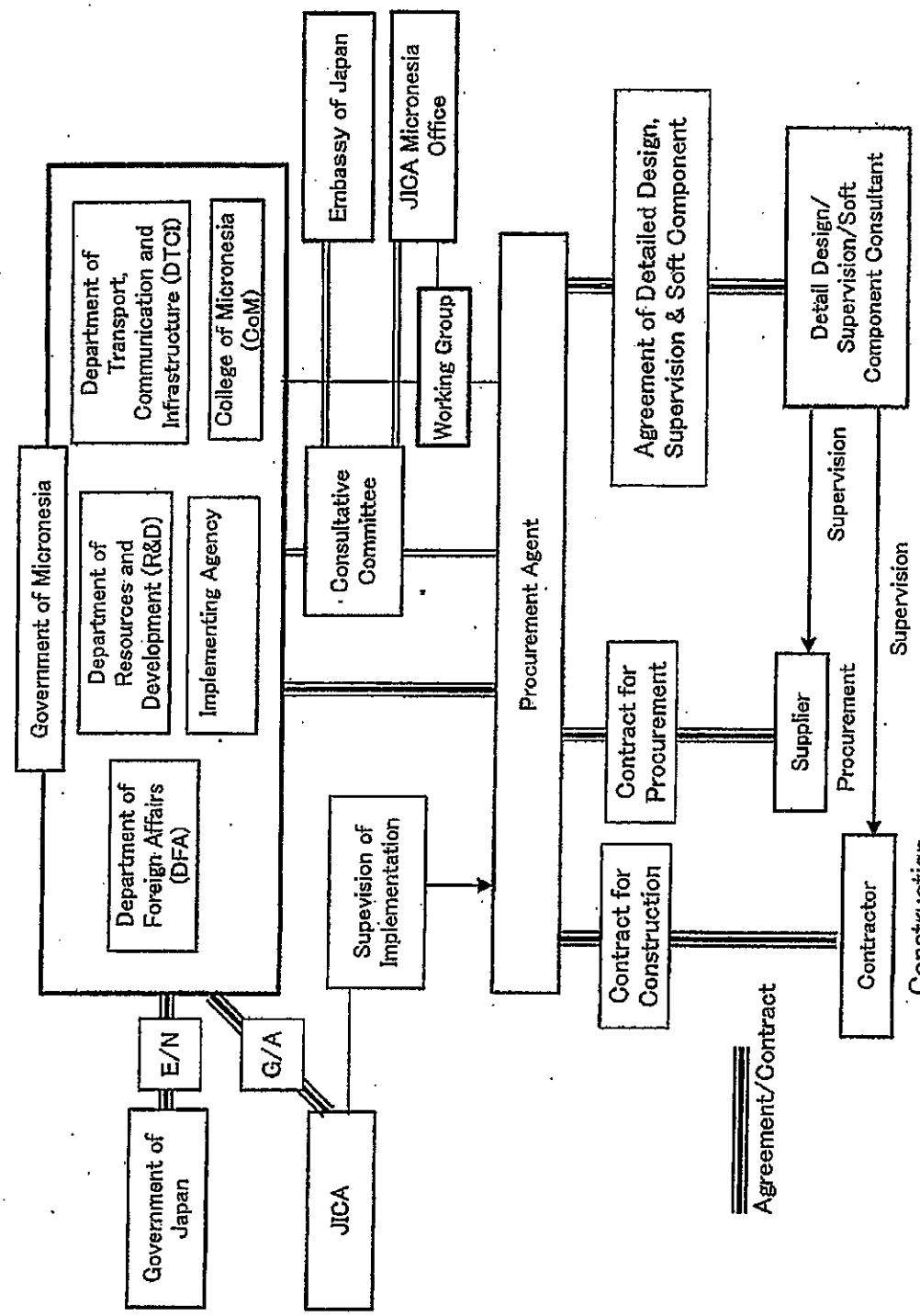
6) "Export and Re-export" of products
The products purchased under the Grant and its accrued interest will not be exported or re-exported from the Recipient.


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

Flow of Funds for Project Implementation



Project Implementation System



Annex-6(1)

Major undertakings to be taken by each Government

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

Demarcation of major undertakings

Stage/	Item	DFA	R&D	Implementing agency	DTCI & COM	Deadline (Tentative)
Agreements						
1	Exchange of Notes	○				Oct.2009
2	Grant Agreement	○				Oct.2009
3	Agent Agreement	○				Nov.2009
4	Banking Arrangement (including payment for Bank Commission)					by Dept of Finance, Nov.2009
Official Approval / License						
5	Environmental Certificates		○	○		Dec. 2009
6	Determination of the tariff structure for power generated by PV system			○		Consult with DTCI and COM, Dec. 2009
7	Authorization based on the Related Laws and Regulations for the operation of the Grid-Connected PV system.			○		Dec. 2009, if necessary
Procurement Stage						
8	Customs and Tax exemption		○			Before shipment
Installation Stage						
9	Permission to use necessary land		○			Nov.2009
10	Approval to secure temporary stockyard during installation of the equipment and materials		○			Nov.2009
11	Ensure the security of all concerned Japanese nationals working for the Project	○	○			-
Operation Stage						
12	Daily patrol and sweeping at each project site to protect equipment from vandalism and keep the site clean.			○	○	
13	Daily monitoring to check the operation condition of PV system (generated power, voltage, current and alarms) through remote monitoring system at PUC Headquarters			○		
14	Monthly patrol to clean the surface of PV modules and check corrosion & rusting of Power Conditioner, Junction box and other			○		
15	Trouble shooting, and coordinate with manufactures in case of fault			○		

Notes; DFA (Department of Foreign Affairs, FSM)
R&D (Department of Resources and Development, FSM)
DTCI (Department of Transportation, Communication and Infrastructure, FSM)
COM (Collage of Micronesia)

Annex- 7

Terms of Reference of the Consultative Committee (Provisional)

1. To promote smooth and sustainable implementation of the Project through coordination among parties concerned to the Project.

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

3. To discuss the modifications of the Project, including modification of the design of the facility.

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

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

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

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

Minutes of Discussions
on
the Preparatory Survey (Outline Design Study)
on
The Project for Introduction of Clean Energy by Solar Electricity Generation System in the Federated States of Micronesia

(Explanation on Draft Final Report)

In December 2009, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Preparatory Survey Team on the Project for Clean Energy Promoting Using Solar Photovoltaic System (hereinafter referred to as "the Project") in the Federated States of Micronesia (hereinafter referred to as "FSM"), and through discussions, field survey and technical examination of the results of the survey in Japan, JICA prepared a Draft Final Report of the Preparatory Survey (Outline Design Study).

In order to explain and to consult with the concerned officials of the Government of FSM on the component of the Draft Final Report, JICA sent FSM the Draft Final Report Explanation Team (hereinafter referred to as "the Team"), which is headed by Mr. Shinichi HAMADA, Representative of Office of FSM, JICA, from 5th December 2009 to 12th December 2009.

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

Pohnpei, 11th December, 2009

Mr. Shinichi HAMADA
Leader
Preparatory Survey Team
Japan International Cooperation Agency
JAPAN

Mr. Hubert K. Yamada
Assistant Secretary, Energy Division
Department of Resources and Development
Federated States of Micronesia

Mr. Feliciano M. Perman
General Manager
Pohnpei Utilities Corporation

witnessed by:

Mr. Lorin S. Robert
Secretary
Department of Foreign Affairs
Federated States of Micronesia

ATTACHMENT

1. Components of the Draft Final Report

The Department of Resources and Development (hereinafter referred to as "R&D"), the Department of Foreign Affairs and Pohnpei Utilities Corporation (hereinafter referred to as "PUC") agreed and accepted in principle the components of the Draft Final Report explained by the Team.

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

The FSM side understood components of the Minutes of Discussion signed by both sides on 24th July, 2009 (hereinafter referred to as "the previous M/D"), and would take the necessary measures confirmed on the previous M/D for smooth implementation of the Project following procedures of the Program Grant Aid for Environment and Climate Change of the Government of Japan as shown in **Annex-1**.

3. Confirmation of progress made for the previous M/D

3-1. Project sites and minimum capacity of PV module

The team explained that the capacity of PV module has to be reduced by 30kW at COM due to the budgetary constraint. The team also explained that as a result of detailed cost estimation after the 1st field survey, actual price estimation was higher than that was expected.

The team proposed that project sites and the minimum capacity of PV module are as follows and requested FSM side to consider this reallocation by 18th of December, 2009.

The result of the consideration shall be informed to JICA Micronesia Office in writing.

Project Site	total capacity of PV module
Federal Government complex in Pohnpei	90kW
The College of Micronesia National Campus in Pohnpei	60kW

3-2. Implementing Agency

The FSM side agreed that the PUC shall be the Implementing Agency of the Project.

4. Items of Equipment to be procured

The Team explained that the items of equipment to be procured as shown in **Annex-2** based on the result of the Preparatory Survey conducted in June and July, 2009.

5. Procurement Process of the Project

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

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

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

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

the Outline Design.

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

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

6. Project Cost

The FSM side agreed that the Project cost should not exceed the upper limit of amount agreed on the E/N. Both sides also confirmed that the Project cost contains procurement cost of equipment, the cost for transportation up to the Project Site, installation cost, the Agent fee, and the cost for soft component for the technical support of operation and maintenance of equipment. The team explained that the breakdown of the Project cost estimation shall not be described in view of confidentiality.

7. Confidentiality of the Project

7.1. Detailed specifications of the Facilities

Both sides confirmed that all the information related to the Project including detailed drawings and specifications of the facilities and equipment and other technical information shall not be released to any outside parties before conclusion of the contract(s) for the Project.

7.2. Confidentiality of the Cost Estimation

The Team explained the cost estimation of the Project as described in **Annex-3**. Both sides agreed that the Project Cost Estimation should never be duplicated or released to any outside parties before conclusion of all the contract(s) for the Project. The FSM side understood that the Project Cost Estimation attached as **Annex-3** is not final and is subject to change by the result of examination through revision of the Outline Design Study.

8. The Consultative Committee

The FSM side understood that the R&D will chair the Committee in order to facilitate consultation and procurement process. The Terms of Reference of the Committee was settled in Annex-8 of the previous M/D.

The members of the Committee are as follows:

(1) Representative of Department of Resources and Development (Chair)
(2) Representative of Department of Foreign Affairs
(3) Representative of Department of Transport, Communication and Infrastructure
(4) Representative of College of Micronesia-FSM
(5) Representative of Pohnpei Utilities Corporation
(6) Representative of JICA Micronesia Office

The first meeting of the Committee shall be held immediately after the JICA's approval of the Agent Agreement which shall be concluded between Department of Foreign Affairs and the Procurement Agent. The employment of the Agent shall be agreed between the two Governments. Further meetings shall be held upon request of either the FSM side or the Japanese side. The Procurement Agent may advise both sides on the necessity to call a meeting of the Committee.

9. Other Relevant Issues

9-1. Undertakings required by the Recipient Country

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

(1) Land usage for PV system

The FSM side agreed to complete all necessary procedures for official land usage for the following equipment and materials for PV system by the 15th of January, 2010.

1) for PV Modules
2) for underground cables
3) for Power Conditioners and other Equipment
4) for temporary Storage yard for PV Equipment and Materials to be used for the Project(up to the end of the installation work)

The FSM side shall send the photocopy of the following two letters of consent to JICA Micronesia Office.

1) The letter from Department of Transport, Communication and Infrastructure to R&D for the property of Federal Government complex.
2) The letter from COM to R&D for the property of COM.

(2) Generated Energy by PV system

The Japanese side shall assist the FSM side through soft component during the implementation of the Project. The necessary tariff structure for power generated by PV system shall be determined by the FSM side.

(3) Environmental and Social Considerations

The FSM side shall be responsible for obtaining necessary permission by Pohnpei Environmental Protection Agency (EPA) by the 15th of January, 2010. The FSM side shall report the result to JICA Micronesia Office. The Team shall provide necessary data and information for the application.

(4) Application of the Related Laws and Regulations

The FSM side agreed the structural design for the installation of PV system shall comply with the Architectural Regulation in Japan, but shall not conflict with the regulation in Pohnpei State and FSM.

Electrical design for Grid-connected PV system should be done in accordance with JIS/IEC-NEC. Should there be any conflicts, NEC code should be applied.

The FSM side agreed that the PUC shall be responsible for the application of related laws and regulations for the operation of the Grid-Connected PV system for interconnection with the distribution lines before commissioning of the Project. The Japanese side shall assist the FSM side to introduce necessary procedures through soft component during the implementation of the Project.

(5) Customs and Tax Exemption

The FSM side agreed that the R&D shall be responsible for the exemption and/or reimbursement of all customs, tax, levies and duties incurred in FSM for the implementation of the Project.

(6) Assignment of Counterpart Personnel

1) Overall project management

The FSM side agreed to assign necessary personnel for Overall project management.

- At least four staff from FSM side

2) Soft Component

The FSM side agreed to assign necessary personnel for O&M of the equipment in accordance with the soft component plan proposed by the Team.

- At least five staff from PUC

(7) Banking Arrangement

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

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

(8) The final connection work

The final connection work of medium and low voltage power cables with the existing distribution system shall be done by FSM side. Japanese side is responsible for the procurement of necessary terminal equipment for the same connection work.

(9) Arrangement for the remote monitoring system

All necessary work for the Internet connection(LAN) for the proposed new electrical room in Federal Government Complex , College of Micronesia and PUC's main office shall be arranged by the FSM side.

The necessary payment for the Internet connection shall be borne by the FSM side.

(10) PUC's concern

PUC pointed out that it supports the project. However, due to its current financial position it is very concerned about committing anything that may add any financial burden on its system. Because PUC understands the responsibilities that they have surrounding the implementation of the project, PUC wishes to stress particularly to the FSM National Government the need to ensure that this aspect of its responsibility is addressed accordingly by the FSM National Government.

The FSM National Government acknowledged the concern raised by PUC and will resolve jointly with PUC.

9.2 Ownership and Operation and Maintenance (O&M) Responsibilities of Equipment

The FSM side has reconfirmed that the PUC is an owner of equipment, and responsible for Operation and Maintenance (O&M) of equipment. The Team explained that the FSM side as a whole was requested to secure necessary budget and personnel for the O&M of Grid-connected PV system procured and installed under the Project.

9.3 Final Report

The FSM side agreed that the Final Report should never be duplicated in any form nor released to any other party(s), because the Final Report is confidential document as it contains information related to the tender.

<List of Annex>

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

Annex-2 List of Equipments

Annex-3 Project Cost Estimation (Confidential)

Annex – 1

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

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

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

1. Procedures for GAEC

GAEC is executed through the following procedures.

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

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

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

Thirdly, the Government of Japan appraises the project to see whether it is suitable for Japan's GAEC, based on the Survey report prepared by JICA, and the results are then

submitted to the Cabinet for approval.

Fourthly, the project, once approved by the Cabinet, becomes official with the Exchange of Notes (E/N) signed by the Governments of Japan and the Recipient.

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

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

2. Preparatory Survey

1) Contents of the Survey

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

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

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

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

2) Selection of consulting firms

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

3. Implementation of GAEC after the E/N

1) Exchange of Notes (E/N)

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

2) Details of Procedures

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

Essential points to be agreed are outlined as follows:

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

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

a) The Agent

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

b) Agent Agreement

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

c) Approval of the Agent Agreement

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

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

d) Payment Methods

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

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

accrued interests excluding the Agent's fees.

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

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

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

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

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

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

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

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

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

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

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

k) Additional procurement
If there is any remaining balance after the competitive and/or selective tendering and/or

direct negotiation for a contract, and if the Recipient would like to procure additional items, the Agent is allowed to conduct this additional procurement, following the points mentioned below:

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

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

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

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

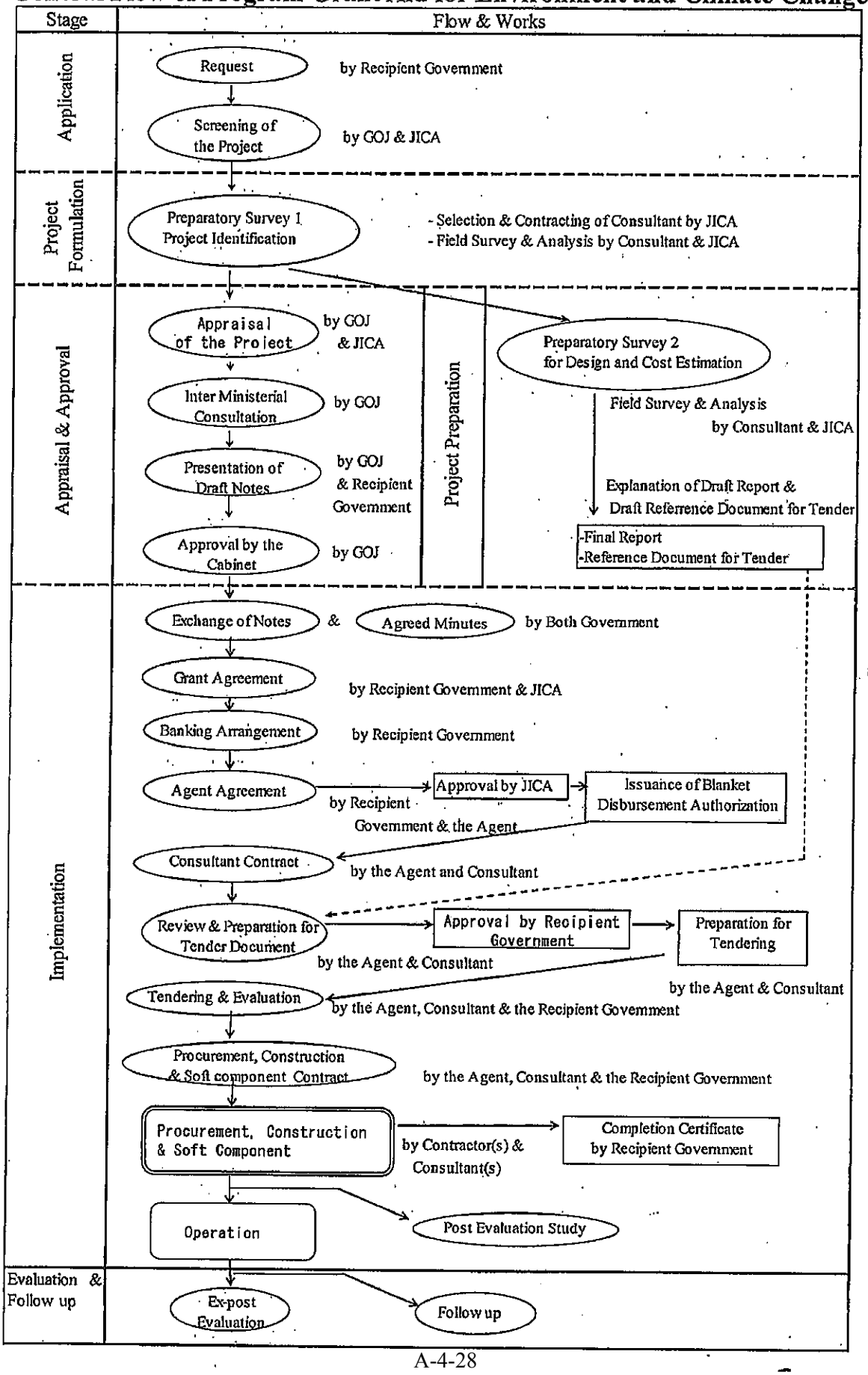
4) Undertakings required by the Government of the Recipient Country
In the implementation of the Grant Aid Project, the Recipient is required to undertake necessary measures as the following:

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

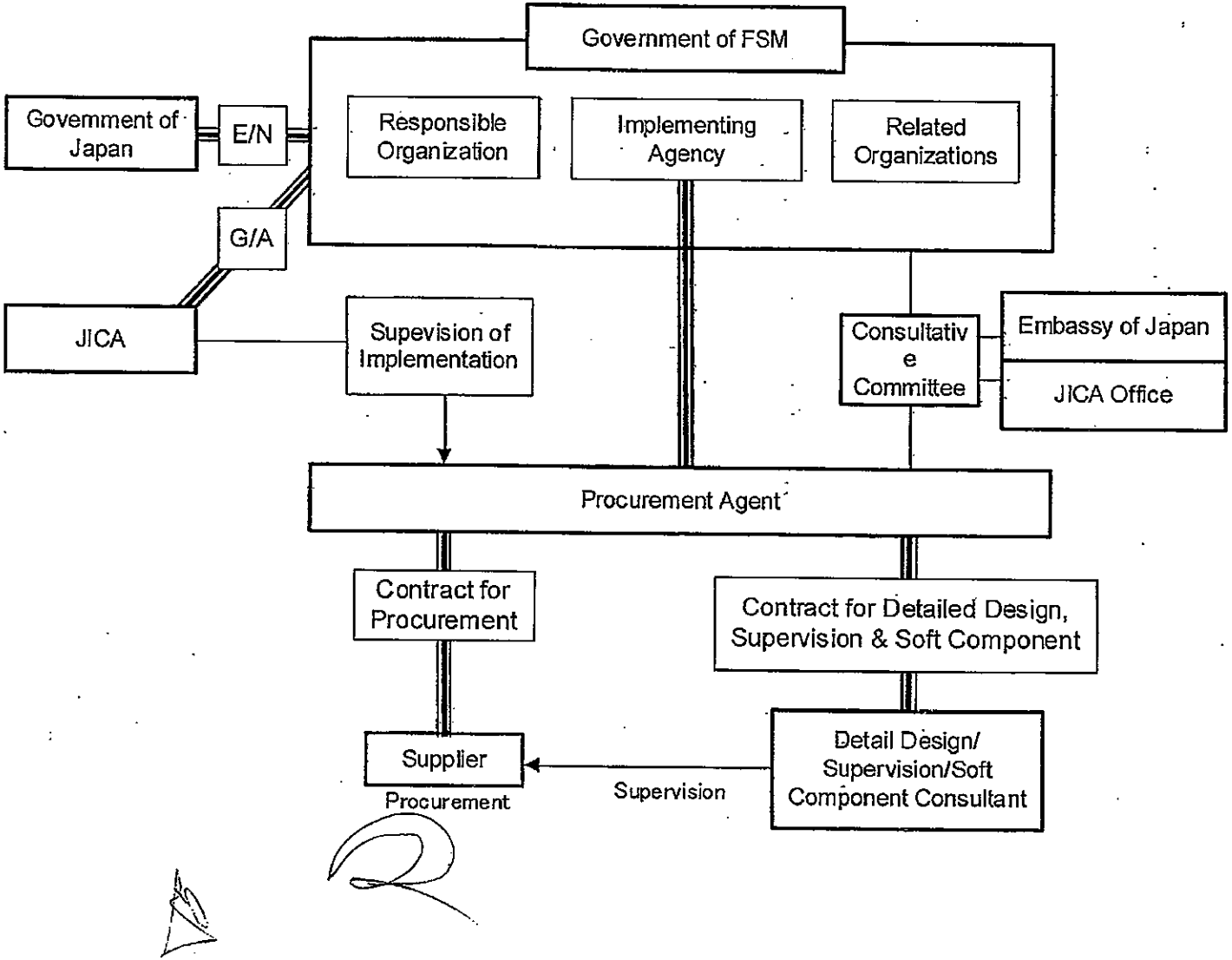
5) "Proper use of funds"
The Recipient is required to operate and maintain the facilities constructed and equipment purchased under the Grant Aid properly and effectively and to assign personnel necessary for this operation and maintenance as well as to bear all the expenses other than those covered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

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

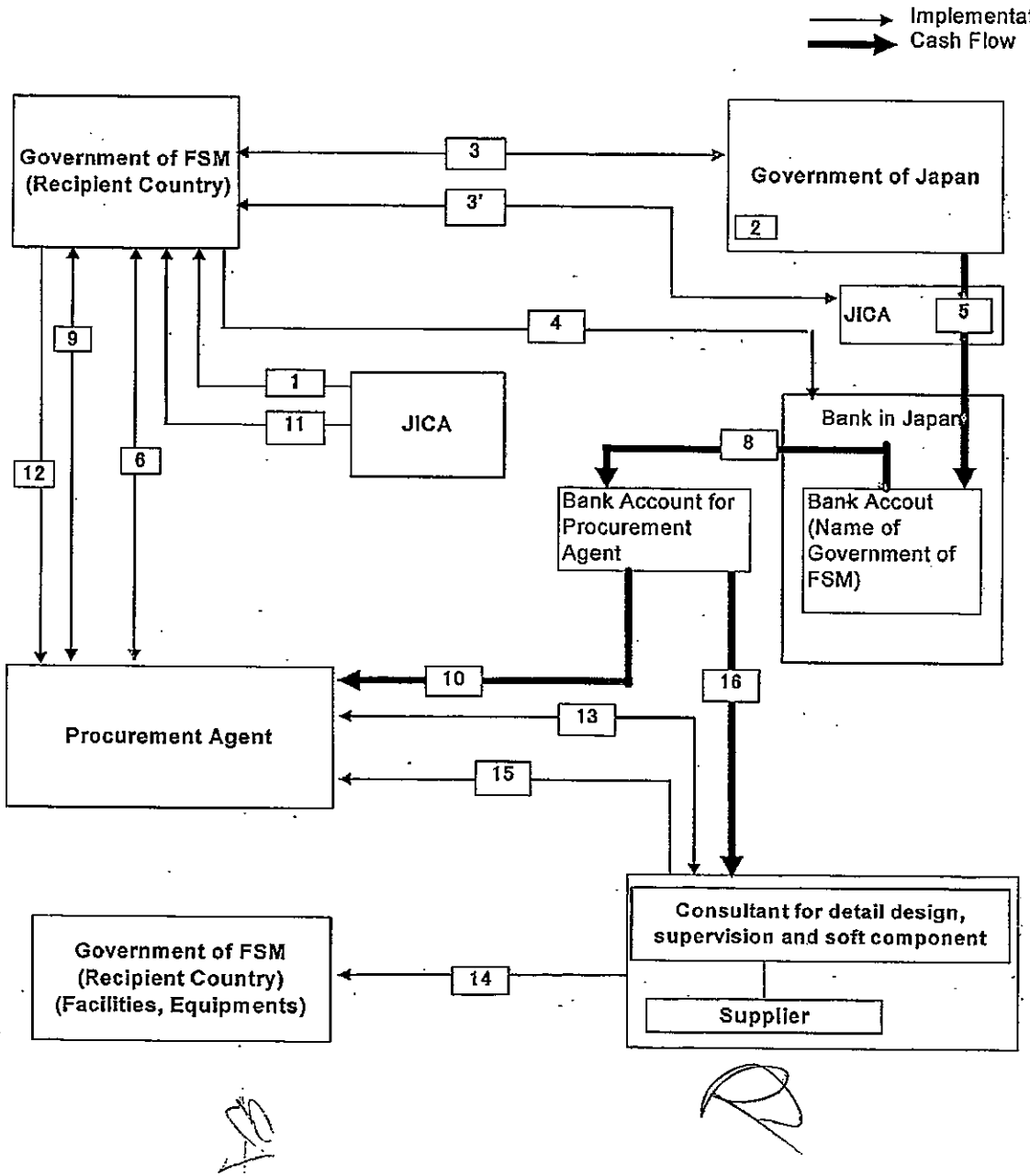
General Flow of Program Grant Aid for Environment and Climate Change



Project Implementation System



Flow of Funds for Project Implementation



1 Preparatory Survey / Reference Document for Tender

2 Approval of Cabinet

3 Signing of Exchange of Notes (E/N)

3' Signing of Grant Agreement (G/A)

4 Banking Arrangement (B/A)

5 Disbursement of Funds from the Government of Japan

6 Signing of Agent Agreement (A/A)'+BDA

7 N/A

8 Transfer of Funds

9 Decision of Project Components

10 Payment of Remuneration for Agent

11 Recommendation of Consultant for Detail Design/Supervision (JICA→Government of FSM)

12 Recommendation of Consultant for Detail Design / Supervision (Government of FSM→Procurement Agent)

13 Conclusion of Contract

14 Construction and Procurement

15 Application for Payment

16 Payment

Annex –2

List of Equipments

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

Item No.	Name of Equipment	Quantity	Final Delivery Point (Site)
1	Photovoltaic Module	90 kW	Federal Government Complex
		60 kW	COM
2	Mounting structure for Photovoltaic Module	1 lot	Federal Government Complex
		1 lot	COM
3	Junction Box	10 unit	Federal Government Complex
		6 unit	COM
4	Collecting Box	3 unit	Federal Government Complex
		2 unit	COM
5	Power conditioner	1 unit	Federal Government Complex
		1 unit	COM
6	Transformer	1 unit	Federal Government Complex
		1 unit	COM
7	Display board	1 unit	Federal Government Complex
		1 unit	COM
8	Data management and monitoring system	1 lot	Federal Government Complex
		1 lot	COM
9	Medium Voltage Switchgear Panel	1 lot	Federal Government Complex
10	Cables and Conduits	1 lot	Federal Government Complex
		1 lot	COM
11	Test Equipment	1 lot	Federal Government Complex
		1 lot	COM
12	Maintenance Tools	1 lot	Federal Government Complex
		1 lot	COM
13	Spare Parts	1 lot	Federal Government Complex
		1 lot	COM

Annex – 3

Project Cost Estimation (Confidential)

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

1. Cost to be borne by the Japanese side: approximately ¥ 527.5 million

Item	Amount (Million Japanese Yen)
1.1 Cost of equipment and materials and transportation	236.7
1.2. Installation and Construction Work	214.7
2. Procurement Agent & Consulting Services Fee	76.1
Total (1.1+1.2+2)	527.5

2. Cost to be borne by the FSM side: US$ 7,300(approximately ¥ 0.73 million)

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

Item	Amount
1. Final connection work with the existing distribution system	2,000 US$ (Approximately ¥0.20 million)
2. Payment of commission to Japanese bank	5,300 US$ (Approximately ¥0.53 million)
Total (1+2)	7,300 US$ (Approximately ¥0.73 million)

3. Conditions for estimation
   (1) Time of estimation: July 2009
   (2) Foreign exchange rate: 1 US$ = ¥ 96.59
   (3) Others:

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

Minutes of Discussions
on the Preparatory Survey
on the Project for Introduction of Clean Energy by Solar Electricity Generation System
in the Federated States of Micronesia

The Japan International Cooperation Agency (hereinafter referred to as "JICA") has been conducting the Preparatory Survey (hereinafter referred to as "the Survey") on the Project for Introduction of Clean Energy by Solar Electricity Generation System in the Federated States of Micronesia (hereinafter referred to as "the Project") since July 2009.

As a part of the Survey, JICA sent a mission team, headed by Mr. Hiroyuki Kobayashi, Director of Natural Resources and Energy Conservation Division, JICA, (hereinafter referred to as "the Team") to the Federated States of Micronesia (hereinafter referred to as "FSM") from 10th February to 18th February 2010, in order to confirm the outline design of the Project and the necessary procedures for the implementation of the Project.

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

As the results of the discussions and the field survey, both sides confirmed the main items described on the attached sheet.

Pohnpei, 18th February, 2010

Mr. Hiroyuki Kobayashi
Leader
Mission Team
Japan International Cooperation Agency

Mr. Hubert K. Yamada
Assistant Secretary, Energy Division
Department of Resources and Development
Federated States of Micronesia

Mr. Feliciano M. Perman
General Manager
Pohnpei Utilities Corporation

witnessed by;

Mr. Lorin S. Robert
Secretary
Department of Foreign Affairs
Federated States of Micronesia

Mr. Spensin James
President
College of Micronesia-FSM

ATTACHMENT

1. Confirmation on the outline design of the Project

1-1 Project sites and minimum capacity of photovoltaic (PV) module

Both sides confirmed that the project sites and the minimum capacities of PV module are as follows;

Project site	Total capacity of PV module
Federal Government complex in Pohnpei	20kW
The College of Micronesia-FSM, National Campus in Pohnpei	140kW

1-2 Interconnection point of PV system in the Federal Government complex

Both sides agreed that the PV system to be installed at the President's office in the Federal Government complex will be interconnected with the low voltage network at the President's Office building.

1-3 Installation of the batteries back-up system in the Federal Government complex

Both sides agreed that the batteries back-up facility of the maximum capacity of 1000 Ah (240V) and Power Conditioner (30kW) will be installed in the PV system at the President's Office, in order to ensure electricity supply while Pohnpei Utilities Corporation's (PUC) grid is out.

Concerning a collection system of disposed batteries in Pohnpei, FSM side explained that the existing collection system operated by Pohnpei Waste Management Company shall be applied in the Project in order to avoid environmental negative impacts caused by disposed batteries.

1-4 Operation and maintenance responsibility of equipment

Both sides understand that PUC is to own the equipment and be responsible for operation and maintenance of the system including the batteries back-up system. The Government of FSM will, if necessary, provide PUC financial support, especially for replacement of the equipment such as the batteries.

Both sides agreed that the methods of operation and maintenance as well as maintenance tools will be provided to the staff of PUC. The necessary manual will be provided as a soft component of the Project. Both sides agreed that maintenance staff of COM-FSM will also participate in the Soft Component. COM-FSM proposed to be one of candidate venues for the Soft Component.

2. Necessary procedures for the Project implementation

The Team requested FSM side to complete all necessary procedures for the implementation of the Project concerning "Land usage for PV system" and "Environmental and Social Considerations", which were described in 9.9-1(1) and 9.9-1(3) in the previous M/D signed at 11th December, by the middle of March 2010. FSM side agreed on it.

2-1 The Team reconfirmed to FSM side that there is 12 months warrantee period for the system.

2-2 The FSM side raised the concern for the design of the car parking at COM-FSM and stressed to take into account of heavy rain at the site.

<List of Annex>

Annex-1 Revised list of equipments

Annex-2 Revised layout of PV system

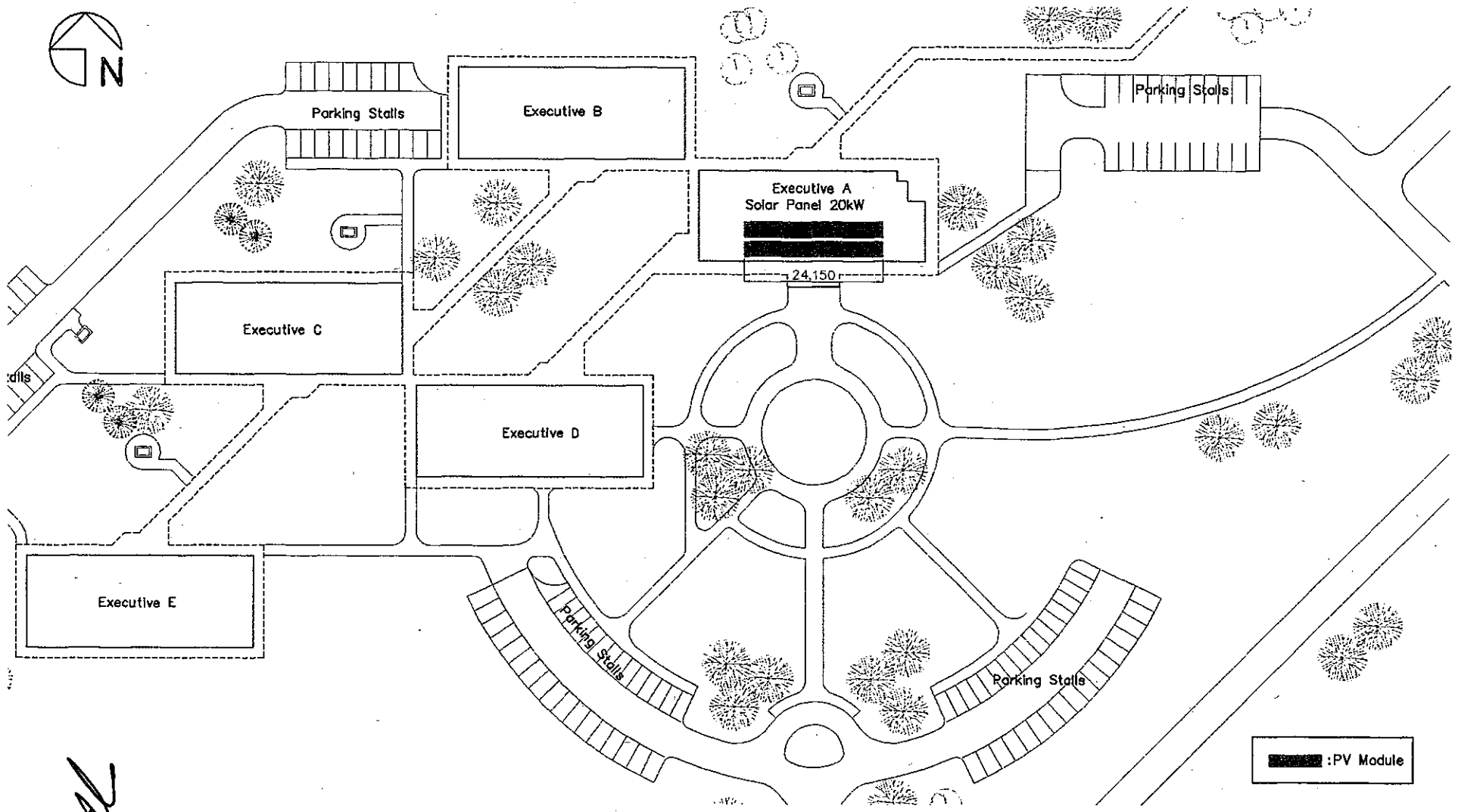
Annex –1

Revised List of Equipments

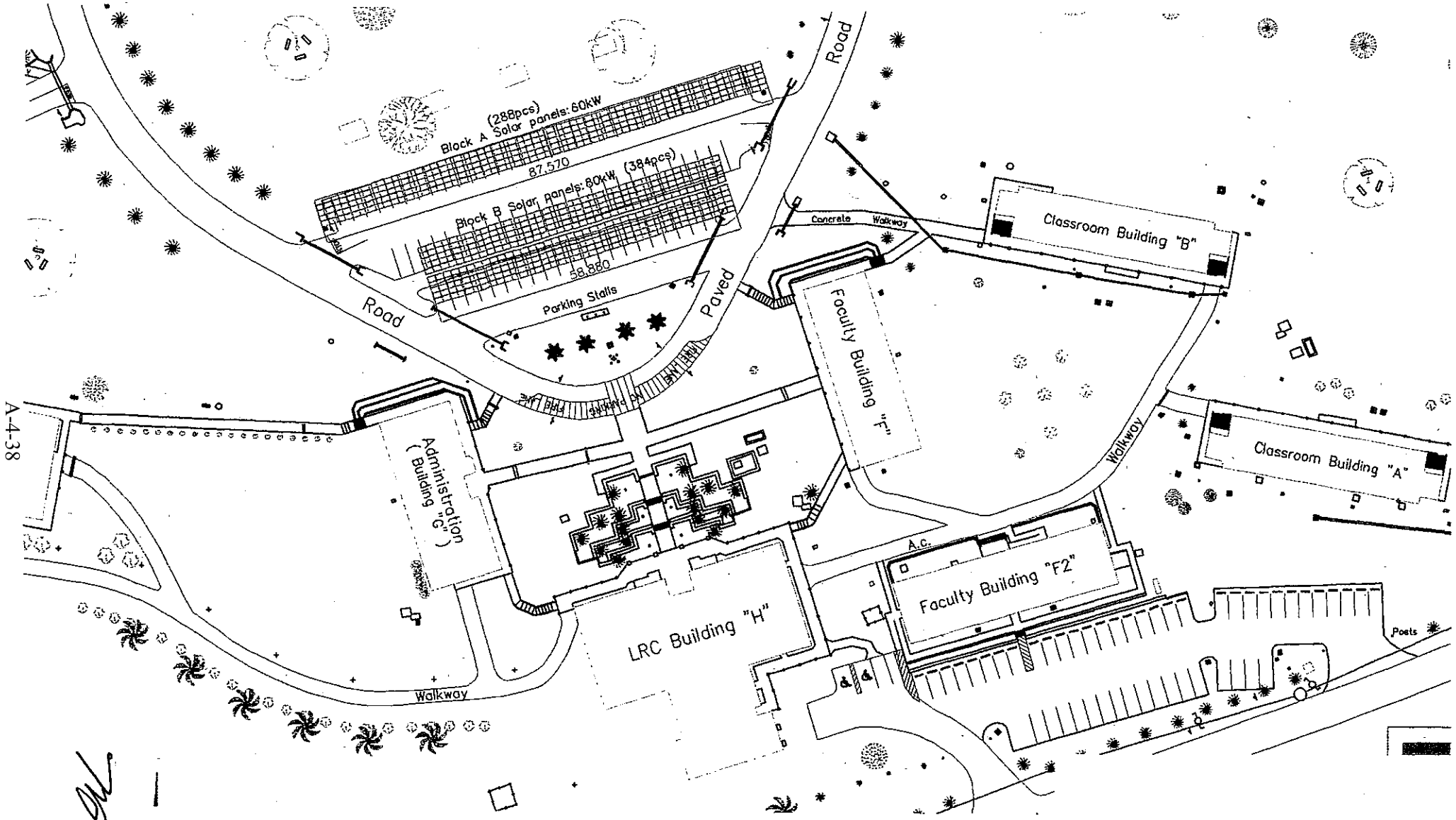
The following table shows a list of equipments procured under the Project.

Item No.	Name of Equipment	Quantity	Final Delivery Point (Site)
1	Photovoltaic Module	20 kW	Federal Government Complex
		140 kW	COM-FSM
2	Mounting structure for Photovoltaic Module	1 lot	Federal Government Complex
		1 lot	COM-FSM
3	Junction Box	2 unit	Federal Government Complex
		14 unit	COM-FSM
4	Collecting Box	1 unit	Federal Government Complex
		3 unit	COM-FSM
5	Power conditioner	1 unit	Federal Government Complex
		2 unit	COM-FSM
6	Transformer	1 unit	Federal Government Complex
		1 unit	COM-FSM
7	Display board	1 unit	Federal Government Complex
		1 unit	COM-FSM
8	Data management and monitoring system	1 lot	Federal Government Complex
		1 lot	COM-FSM
9	Battery Back-up System	1 lot	Federal Government Complex
10	Cables and Conduits	1 lot	Federal Government Complex
		1 lot	COM-FSM
11	Test Equipment	1 lot	Federal Government Complex
		1 lot	COM-FSM
12	Maintenance Tools	1 lot	Federal Government Complex
		1 lot	COM-FSM
13	Spare Parts #	1 lot	Federal Government Complex
		1 lot	COM-FSM

The details shall be described in the Final Report of the Preparatory Survey



Annex - 2 :Layout Plan for PV Modules for Federal Government Complex



Annex - 2 :Layout Plan for PV Modules for College of Micronesia

5. SOFT COMPONENT

(TECHNICAL ASSISTANCE) PLAN

5. Soft Component Plan

(1) Background

Although the power supply and demand situations in FSM differ depending on states, around-the-clock power supply is basically secured. Because almost all of the power supply in the country depends on diesel power generation, and the price of crude oil, which is mainly used as fuel for power generation, is rising, departure from the fossil fuel dependence is considered a major challenge. Thus, a policy of positively introducing renewable energy (Ex; PV generation) is clearly described in "National Climate Action Plan (1997)," which is the official energy policy of the federal government, and the government positively cooperates with the Plan of the Program Grant Aid for Environment and Climate Change (the Project) which will introduce the grid-connected PV system.

The Project sites are "Capital" and "COM." The primary responsible organization for the Project is "Energy Office" of "Department of Resources and Development (R&D)" of the Government of FSM, and the implementing agency is Pohnpei Utilities Corporation (PUC). PUC takes charge of all the electricity businesses in Pohnpei State. It is composed of five departments under five executives elected by the Pohnpei State Government: Administrative Services, Budget and Finance, Water and Sewerage, Power Transmission and Distribution, and Power Generation Department. It has a total of 136 workers as of July, 2009. PUC is not privatized or incorporated, and is owned 100% by Pohnpei State Government according to "State Law 2L-179-91" laid down in 1991. It is run independently from the government, as a quasi-governmental organization.

As for the past introduction of PV systems, the systems have not been introduced in Pohnpei State. Thus, it is judged to be difficult for staffs of the R&D Energy Office or the PUC in charge of management of electric facilities of the Project site to master adequate skills through their daily work. For the operation and maintenance of a grid-connected PV system, collaboration with the local utility is indispensable. In addition, in the view of the future dissemination of the grid-connected PV system in FSM, it would be desirable to transfer the technology to the local electric utility corporations. It would take some time for the staffs to sufficiently learn the O&M concept and methodology on grid-connected PV systems. However, the proper technical transfer on the O&M of the introduced facilities into the implementing agency of the Project, PUC, over the broad-and-shallow range from a basic level on PV generation to an application level on the O&M of PV facilities, dividing the process into several steps and confirming the establishment of knowledge will be able to promote the continuous and smooth O&M of the grid-connected PV system introduced by the Project,.

The current issues concerning the O&M of PV system are as follows;

- ✓ The necessary structure for O&M of grid-connected PV system is not established.
- ✓ Technical knowledge and skills for grid-connected PV system is not enough.
- ✓ The concept and methodology for O&M of grid-connected PV system is not established.
- ✓ Trouble-shooting for grid-connected PV system is difficult.
- ✓ Electricity tariff structure for grid-connected PV system is not established.

Table - 1　Current problems and measures for improvement

Current problems	Measures for improvement	Necessary soft-component
▪ The necessary structure for O&M of grid-connected PV system is not established	▪ PUC establishes the O&M system within PUC.	▪ Make a proposal on the segmentalization and specification of O&M system, and discuss it with the persons concerned.
▪ Technical knowledge and skills for grid-connected PV system is not enough	▪ Prepare the O&M manual of the grid-connected PV system.	▪ Support implementation guidance on the manual.
▪ The concept and methodology for O&M of grid-connected PV system is not established	▪ Implement technical training on PV systems including the "independent type" and "grid-connected type." ▪ Implement training on monitoring, such as the monitoring method, periodical inspection method, etc.	▪ Conduct proper technical training on PV systems. ▪ Conduct proper technical training on monitoring.
▪ Trouble-shooting for grid-connected PV system is difficult	▪ Create the O&M manual including troubleshooting ▪ Conduct implementation guidance on the manual and educational activities so that the O&M are properly done.	▪ Support implementation guidance on the manual. ▪ ditto
▪ Electricity tariff structure for grid-connected PV system is not established	▪ Determine most appropriate electricity tariff.	▪ Make a proposal on most appropriate electricity tariff, and discuss it with the person concerned.

Source: created by JICA study team

(2) Goal

The goal is that PUC, the implementing agency of the Project, comes to be able to implement continuous and smooth O&M assuming PUC owns the facilities based on the O&M manual.

(3) Outcome

1) The O&M manual of the grid-connected PV system introduced in the Project, including troubleshooting, is created.
2) Basic knowledge on the grid-connected PV system introduced in the Project is acquired, and the O&M of the facilities is carried out continuously.
3) The most appropriate electricity tariff is determined (if necessary), and a continuous and smooth O&M system is established.

The following activities will be implemented to achieve the above outcomes.

In Pohnpei State, it is the first case to introduce the grid-connected PV system under the Project. Accordingly, the PUC does not have the technical knowledge on the grid-connected PV systems yet. Therefore, training covering a broad range from a basic level on PV generation to an application level on the O&M of PV facilities is implemented in the Project. Table 2 shows the specific contents which are divided into Category 1 to 4. The implementation process of each category is implemented in certain intervals to promote the steady and efficient settlement and is implemented four times totally.

Concerning the necessary number of days, the implementation contents are covered broadly from the documentation (ex. manuals) with mutual cooperation with FSM to the technical transfer and the confirmation of the settlement. Therefore, the one week is considered as the minimum unit of the necessary number of days in order to follow the steps of this plan steadily. And concerning the member of the consultant, the necessary members are 2 persons (1 manager and 1 staff), because in the preparation of the manuals, the formation of 2 teams can promote the efficiency of the work and in the lecture, 1 staff as the lecturer and other staff as the assistance can promote the effective lecture.

Table 2 Contents of training

Category	Specific contents (purpose)	Man Month	
1. Establishment of the O&M system	1.1 Clarification of the responsibility of individuals who carry out the O&M	0.25MMx2persons	Total 1.00MMx2persons
	1.2 Proposal on the most appropriate electricity tariff	0.25MMx2persons	
	1.3 Creation of the O&M manual in collaboration with FSM side	0.50MMx2persons	
2. Technical training	2.1 Principle and basic knowledge of PV systems	0.25MMx2persons	Total 1.25MMx2persons
	2.2 Characteristics of grid-connected PV systems	0.25MMx2persons	
	2.3 Matters to be examined when a grid-connected PV system is introduced.		
	2.4 Installation	0.25MMx2persons	
	2.5 Inspection		
	2.6 Operation		
	2.7 Maintenance		
	2.8 Troubleshooting	0.50MMx2persons	
3. Institutional Training	3.1 Collection method of electricity tariff	0.25MMx2persons	Total 0.75MMx2persons
	3.2 Optimizing O&M manual	0.25MMx2persons	
	3.3 Evaluation of the O&M system	0.25MMx2persons	
4. Monitoring	4.1 Optimizing monitoring method	0.25MMx2persons	Total 1.00MMx2persons
	4.2 Periodical inspection	0.25MMx2persons	
	4.3 Evaluation items	0.25MMx2persons	
	4.4 Report of monitoring results	0.25MMx2persons	
Total		4.00MMx2persons	

Source: created by JICA study team

(4) Method to confirm the achievement of outcome

The implementation schedule shall be divided into 4 steps. Category 1-4 in Table 2 shall be conducted in each step. The achievement of each step shall be confirmed and evaluated as follows;

Category 1: Evaluation and instruction for O&M Manual

Category 2: Making Report for the Item 2.1-2.3 in Table 2, and making report and technical evaluation for the Item 2.4-2.8 in Table 2

Category 3: Interview survey to O&M staff and evaluation of the actual field work

Category 4: Interview survey to O&M staff and evaluation of the actual field work

(5) Activity for Soft Component

1) Content

The implementation contents of the soft component in order to understand and implement the specific methods of the O&M for the introduced grid-connected PV system are shown in Table 2.

2) Implementation of Orientation

Collaboration work with PUC which is the implementing agency of the Project is indispensable for the implementation of soft component. The Consultant will hold the orientation to explain and obtain consents on the objectives, contents, activity schedule of the soft component to the FSM side.

The participants for the orientation shall include R&D Energy Office, staff from the Capital and COM in addition to the PUC, and the necessary information shall be informed to the concerned persons which are not included in the soft component committee. For example, the concerned persons in the site shall understand the basic points for the O&M of the system as the site owner for introducing the PV system and shall provide the cooperation to construct the communication routes to PUC in case fault occurs.

3) Establishment of Soft Component Committee

Soft component committee shall be established mainly by PUC in order to implement the soft component and promote the sustainable operation of the system. The committee shall act as the liaison function of the soft component, and shall be periodically held in order to ensure sustainable operation and maintenance of the PV system during the implementation of the

Project. The committee shall be considered as the opportunity to check the progress of the soft component, exchange opinion and discuss among concerned parties.

And the consultant shall support FSM to carry on the elements of the soft component committee in this plan, if FSM will judge the carrying on the elements of the soft component committee is necessary.

4) O&M Manual

During the implementation of the Project, PUC is requested to work out the O&M Manual in collaboration with the Consultant. In order to draw the initiative from FSM side, PUC shall be the main body to make the draft of the Manual while the Consultant will evaluate, provide necessary comments and feedback on it. The Manual shall also contain the method for trouble-shooting.

(6) Procurement of necessary resources for Soft Component

In order to implement the soft component effectively and efficiently, the soft component committee shall be established. The soft component committee, together with close collaboration with the Consultant, shall be the main body for the operation and maintenance of PV system after installation of the Project. The Committee shall be composed of approximately five members from PUC staff (staff in charge of O&M and his or her manager). Proposed framework for the implementation of soft component is shown as follows.

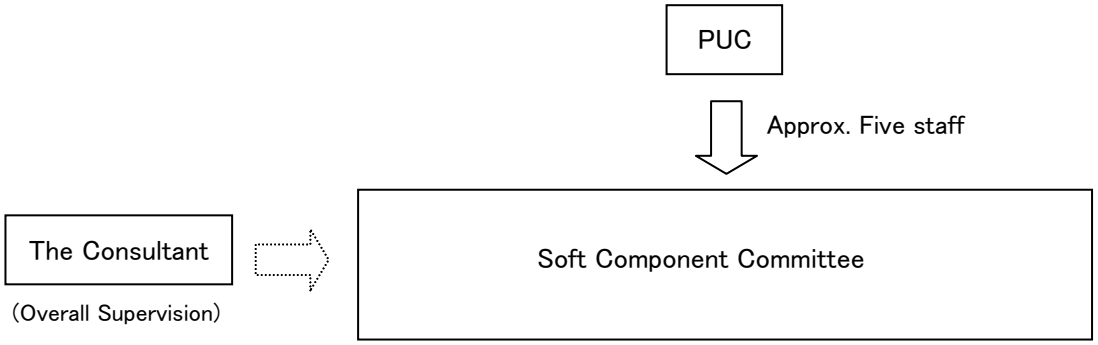


Figure - 1 Proposed Framework for the implementation of Soft Component

Table - 3 The Role and Responsibility of each Party

Responsible Party	Japanese Consultant	PUC
Member of Soft Component Committee	2 staff	Approx. 5 staff (O&M staff and Managers)
Operation Method for Soft Component Committee	Management of the overall progress	➢ Management of the overall work ➢ Actual O&M
Electricity Tariff	Propose	Examination and final decision
Guidance of the Project	Explanation	Main body
O&M Manual	Advice	Making Draft
Follow-up for O&M	Management and guidance	Submission of the result
Reporting to	Embassy of Japan in FSM and JICA Office	Japanese Consultant

The introduced grid-connected PV system in the Project is going to be the Japanese products and is going to conform to the guidelines for technical requirements of the interconnection concerning power quality in Japan. Therefore, it is desirable that the implementer in this plan is Japanese consultant who knows the guideline totally.

(7) Implementation Schedule for the Soft Component

The implementation process is shown in Figure 2. The training is implemented according to the category shown in Table 2. The implementation time of each category is as follows:

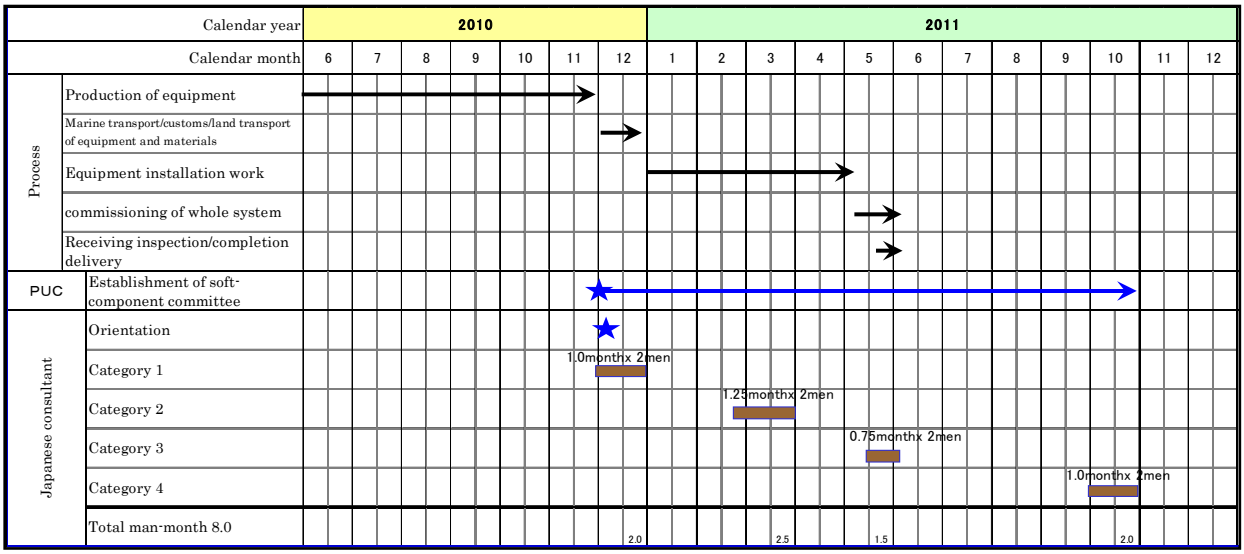
Category 1 : Implemented before the installation of facilities because this training is done to facilitate the establishment of the O&M system, and because, by clarifying the O&M system before the facility installation, awareness as the person in charge can be raised at the time of installation.

Category 2 : Implemented in the middle of the installation work because this training, concerning the installation, inspection, operation, etc., is done using actual facilities.

Category 3 : Implemented before the operation of the facilities starts because this training is related to the O&M manual, etc., that should be prepared before the start of the operation.

Category 4 : Implemented approximate four months after the completion of the installation because the focus of this training is to confirm that the FSM side can carry out the O&M by themselves.

The O&M structure shall be established from the beginning in the Project, because the equipment and materials are newly procured and installed under the Project. Therefore, the soft component shall be commenced before the installation works start.



*The progress report will be submitted after each category

Figure - 2 Proposed Schedule for the implementation of Soft Component

(8) Output of the Soft Component

Following output shall be obtained through implementation of the soft component.

1) Record for holding the Orientation
2) Minutes of Discussion for the Soft Component Committee
3) Progress Report
4) Report to confirm the actual understanding
5) Result of the interview survey to O&M staff and actual work progress by the O&M staff
6) O&M Manual

(9) Required Responsibility to the FSM side

1) PUC shall establish the Soft Component Committee.
2) PUC shall prepare necessary work space and rooms.

3) PUC shall provide necessary staff for the implementation of the soft component.

4) Soft Component Committee shall work out the O&M Manual in coordination with the Consultant.

5) PUC shall examine and determine the most appropriate electricity tariff for the introduced Grid-connected PV system based on the proposal by the Consultant.

6) PUC shall appropriately operate and maintain the Grid-connected PV system based on the O&M Manual.

7) PUC shall submit the report of the result and the progress of the operation and maintenance to Japanese Consultant during the period specified under the O&M Manual.

6. EXPECTED BENEFITS OF THE PROJECT

APPENDIX 6 Expected Benefits of the Project

(1) Reduction effect of diesel fuel consumption

Fuel consumption per unit generated-energy (kWh) was calculated as follows based on the operation records of the diesel generation facilities in Nanpohnmal diesel power plant from 2004 to 2008 obtained from PUC.

Table 3-2-4-1 Fuel consumption in the diesel power plant

FY	Exported power	Fuel consumption [litter]	Fuel cost [US Dollar]	Unit fuel consumption [litter / kWh]	Unit fuel cost [US Dollar / kWh]
2004	38,920,480	10,677,445	4,074,718	0.274	0.105
2005	37,590,730	10,309,913	3,977,759	0.274	0.106
2006	36,751,090	10,167,915	6,162,076	0.277	0.168
2007	36,499,450	10,196,966	8,484,587	0.279	0.232
2008	34,395,740	9,548,553	11,183,601	0.278	0.325
Average	36,831,498	10,180,158	6,776,548	0.276	0.187

Source : created by JICA study team based on a material from PUC

Using the average fuel consumption per kWh over 2004 to 2008, 0.276 litter/kWh, and annual fuel reduction is calculated as follows:

Annual fuel reduction [litter]
= (Annual generated-energy in Capital [kWh] + Annual generated-energy in COM [kWh]) × 0.276 [litter/kWh]
= (72,548 + 63,469) × 0.276
= 37,541 litter

Fuel reduction during six years from the introduction of the facilities to 2016, which is the target year of this project, is calculated as follows:
Fuel reduction until 2016 =37,541 litter × 6 years =225,246 litter

(2) Reduction effect of CO2 emission

Based on the yearly diesel fuel reduction calculated in 1), the reduction effect of CO_2 emission is calculated using the following factor.

CO2 reduction [kg] = CO2 emission factor of light oil * Diesel oil reduction
= 2.62 [kg-CO2/liter] * Diesel oil reduction [liter]
* The emission factor is cited from "Guideline for the calculation of the amount of emission" by Global Environment Bureau of the Ministry of the Environment (March, 2007).

Annual CO_2 emission reduction [kg] = 2.62 [kg-CO_2/liter] ×Annual diesel fuel reduction [litter]

= 2.62 × 37,541
= 98,357 [kg]

Therefore, the following amount of CO_2 emission reduction is possible during six years from 2011 to 2016.

CO_2 emission reduction until 2016 [ton] = Annual CO_2 emission reduction [kg] /1000 × 6 years
= 98,357 / 1000 × 6
= 590 [ton]