Oceania

The Project for Introduction of Hybrid Power Generation System in the Pacific Island Countries

Final Report
(Attachment)

September 2023

Japan InternationalCooperation Agency (JICA)

Okinawa Enetech Co.,Inc.
Okinawa Electric Power Co.,Inc.

IM
JR
23-107

Annex C : KRIBATI Related Documents

Project Final Report

Contents of Attached Documents

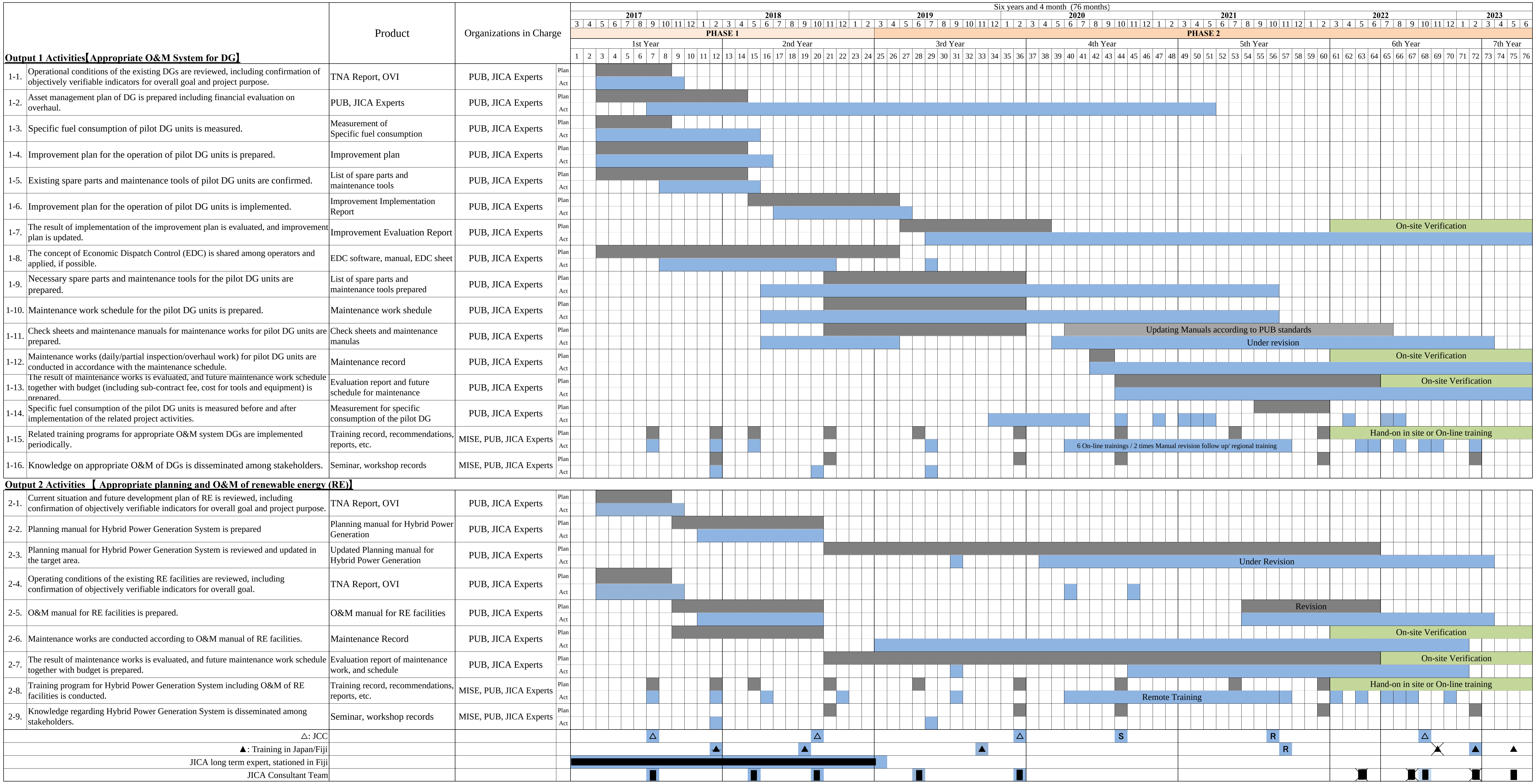
Annex C: Republic of Kiribati Related Documents

1 Training Schedule

June, 2023

Plan of Operation (PO)（活動実績）

Project Title: The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries
Project Term: March 2017 - June 2022 (Phase 1: March 2017 – February 2019 , Phase 2: March 2019 – June 2023)
Country: Kiribati
Target Area: Tarawa
Target Group: Related engineers and other technical staffs in the target area (MISE and PUB)



Six years and 4 month (76 months)
2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023
PHASE 1 | PHASE 2
1st Year | 2nd Year | 3rd Year | 4th Year | 5th Year | 6th Year | 7th Year

	Output 1 Activities【Appropriate O&M System for DG】	Product	Organizations in Charge		
1-1.	Operational conditions of the existing DGs are reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose.	TNA Report, OVI	PUB, JICA Experts	Plan Act	
1-2.	Asset management plan of DG is prepared including financial evaluation on overhaul.	PUB, JICA Experts	PUB, JICA Experts	Plan Act	
1-3.	Specific fuel consumption of pilot DG units is measured.	Measurement of Specific fuel consumption	PUB, JICA Experts	Plan Act	
1-4.	Improvement plan for the operation of pilot DG units is prepared.	Improvement plan	PUB, JICA Experts	Plan Act	
1-5.	Existing spare parts and maintenance tools of pilot DG units are confirmed.	List of spare parts and maintenance tools	PUB, JICA Experts	Plan Act	
1-6.	Improvement plan for the operation of pilot DG units is implemented.	Improvement Implementation Report	PUB, JICA Experts	Plan Act	
1-7.	The result of implementation of the improvement plan is evaluated, and improvement plan is updated.	Improvement Evaluation Report	PUB, JICA Experts	Plan Act	On-site Verification
1-8.	The concept of Economic Dispatch Control (EDC) is shared among operators and applied, if possible.	EDC software, manual, EDC sheet	PUB, JICA Experts	Plan Act	
1-9.	Necessary spare parts and maintenance tools for the pilot DG units are prepared.	List of spare parts and maintenance tools prepared	PUB, JICA Experts	Plan Act	
1-10.	Maintenance work schedule for the pilot DG units is prepared.	Maintenance work shedule	PUB, JICA Experts	Plan Act	
1-11.	Check sheets and maintenance manuals for maintenance works for pilot DG units are prepared.	Check sheets and maintenance manulas	PUB, JICA Experts	Plan Act	Updating Manuals according to PUB standards Under revision
1-12.	Maintenance works (daily/partial inspection/overhaul work) for pilot DG units are conducted in accordance with the maintenance schedule.	Maintenance record	PUB, JICA Experts	Plan Act	On-site Verification
1-13.	The result of maintenance works is evaluated, and future maintenance work schedule together with budget (including sub-contract fee, cost for tools and equipment) is prepared.	Evaluation report and future schedule for maintenance	PUB, JICA Experts	Plan Act	On-site Verification
1-14.	Specific fuel consumption of the pilot DG units is measured before and after implementation of the related project activities.	Measurement for specific consumption of the pilot DG	PUB, JICA Experts	Plan Act	
1-15.	Related training programs for appropriate O&M system DGs are implemented periodically.	Training record, recommendations, reports, etc.	MISE, PUB, JICA Experts	Plan Act	Hand-on in site or On-line training 6 On-line trainings / 2 times Manual revision follow up/ regional training
1-16.	Knowledge on appropriate O&M of DGs is disseminated among stakeholders.	Seminar, workshop records	MISE, PUB, JICA Experts	Plan Act	
	Output 2 Activities 【 Appropriate planning and O&M of renewable energy (RE)】				
2-1.	Current situation and future development plan of RE is reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose.	TNA Report, OVI	PUB, JICA Experts	Plan Act	
2-2.	Planning manual for Hybrid Power Generation System is prepared	Planning manual for Hybrid Power Generation	PUB, JICA Experts	Plan Act	
2-3.	Planning manual for Hybrid Power Generation System is reviewed and updated in the target area.	Updated Planning manual for Hybrid Power Generation	PUB, JICA Experts	Plan Act	Under Revision
2-4.	Operating conditions of the existing RE facilities are reviewed, including confirmation of objectively verifiable indicators for overall goal.	TNA Report, OVI	PUB, JICA Experts	Plan Act	
2-5.	O&M manual for RE facilities is prepared.	O&M manual for RE facilities	PUB, JICA Experts	Plan Act	Revision
2-6.	Maintenance works are conducted according to O&M manual of RE facilities.	Maintenance Record	PUB, JICA Experts	Plan Act	On-site Verification
2-7.	The result of maintenance works is evaluated, and future maintenance work schedule together with budget is prepared.	Evaluation report of maintenance work, and schedule	PUB, JICA Experts	Plan Act	On-site Verification
2-8.	Training program for Hybrid Power Generation System including O&M of RE facilities is conducted.	Training record, recommendations, reports, etc.	MISE, PUB, JICA Experts	Plan Act	Hand-on in site or On-line training Remote Training
2-9.	Knowledge regarding Hybrid Power Generation System is disseminated among stakeholders.	Seminar, workshop records	MISE, PUB, JICA Experts	Plan Act	
	△: JCC				△ △ △ S R △
	▲: Training in Japan/Fiji				▲ ▲ ▲ R ▲ ▲
	JICA long term expert, stationed in Fiji				
	JICA Consultant Team				

2 PDM

ATTACHMENT 4

Ver. 3, October, 2019

Project Design Matrix (PDM)

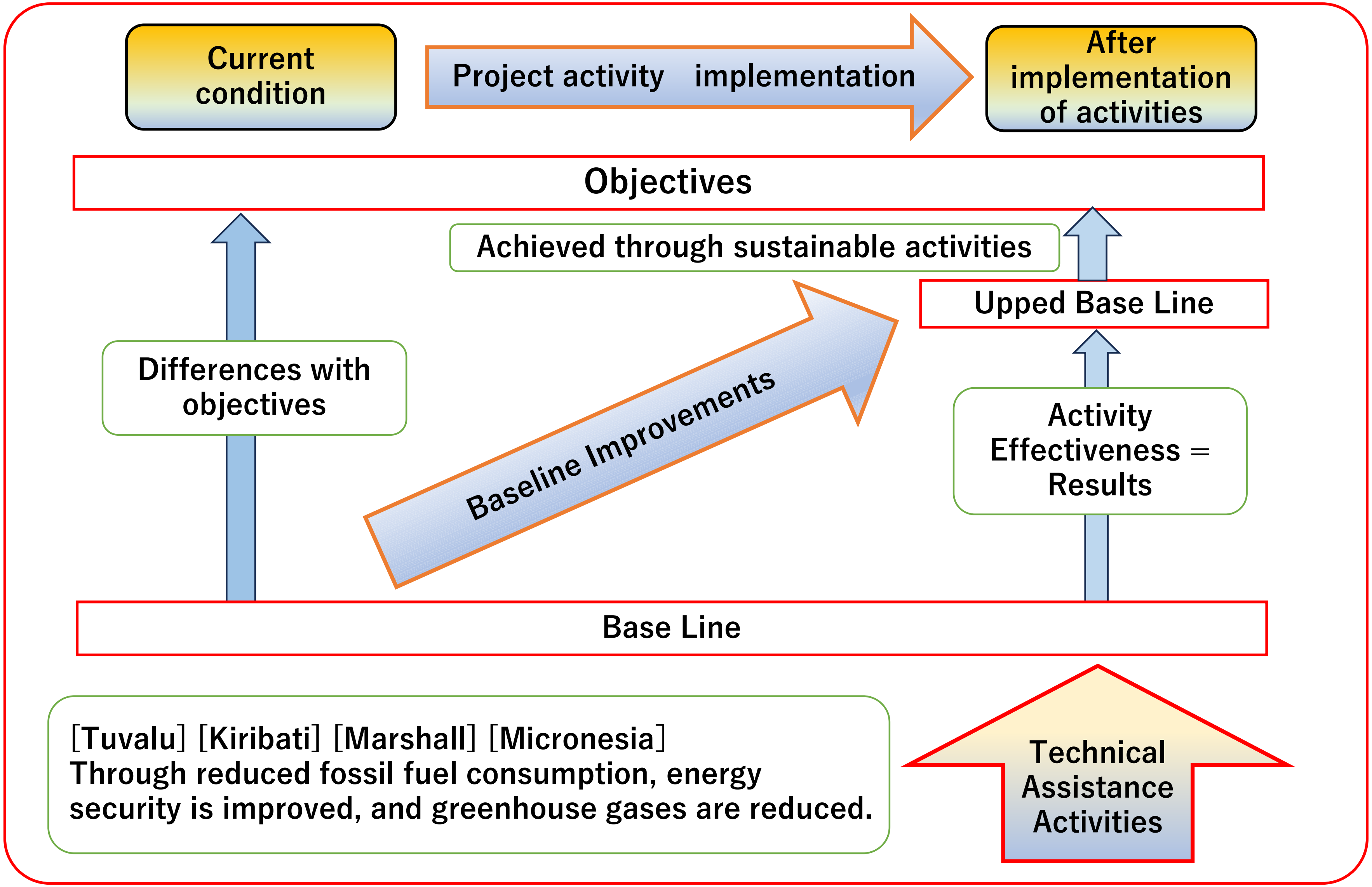
Project Title: The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries
Project Term : March 2017 - June 2022 (Five Years) (Phase 1: March 2017 – February 2019 , Phase 2: March 2019 – June 2022
Country: Republic of Kiribati
Target Area: Tarawa
Target Group: Related engineers and other technical staff in the target area (MISE and PUB)
MISE: Ministry of Infrastructure and Sustainable Energy PUB: Public Utilities Board

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal Energy security is improved and greenhouse gases are reduced through the reduction of fossil fuels consumption.	In comparison to the indicators at the time of baseline survey, 1. Reduced amount of CO2 emission of power utilities in the target area 2. Reduced amount of diesel fuel of power utilities in the target area 3. Increased capacity (kW) and actual generated energy (kWh) of renewable energy facilities of power utilities in the target area	1. to 3. Reports of C/P agencies	
Project Purpose Hybrid Power Generation System is introduced.	1. Improvement of specific fuel consumption of pilot DG units (better than the baseline data set at the beginning of the Project) 2. Improvement of performance ratio for RE power generation systems (better than the baseline data set at the beginning of the Project in consideration of aging deterioration of PV module) 3. Proper application of planning and O&M method of Hybrid Power Generation System	1. Record on specific fuel consumption of Pilot DG units by C/P, checked by Japanese experts 2. Record on operation of RE power generation systems 3. Evaluation by Japanese experts and C/P on plans and O&M of Hybrid Power Generation System	C/P agencies continue commitment to the Project by continuing budget allocation as well as assignment of personnel for the post- Project activities.
Outputs 1. Appropriate and economical system for O&M of Diesel Generators (DGs) is enhanced.	<Output 1> 1-1 Adequacy on the use of the work schedule, check sheets and manual for the maintenance work for the pilot DG units 1-2 Number of training participants who are conducting operation and maintenance of DG based on the learnings from the training program (target: 2)	1-1 Evaluation by Japanese experts and C/P on improvement of maintenance work (daily/partial inspection/overhaul work) for pilot DG units 1-2 Capacity assessment of trained maintenance staff and managers by Japanese experts	C/P agencies promote investment on renewable energy facilities based on the current national policy/plan.

2. Methodology for appropriate planning and O&M of Renewable Energy (RE) is established.	<Output 2> 2-1 Number of training participants who have been certified under the Project for the planning method of the Hybrid Power Generation System (target: 1) 2-2 Number of training participants who are conducting O&M of RE facilities based on the learnings from the training program (target: 2) 2-3 Preparation of related manuals for Hybrid Power Generation System 2-4 Adequacy of the use of the related manuals for Hybrid Power Generation System	2-1 Capacity assessment of trained staff and managers by Japanese experts 2-2 Capacity assessment of trained O&M staff and managers by Japanese experts 2-3 Evaluation by Japanese Experts on related manuals for Hybrid Power Generation System prepared by C/P 2-4 Evaluation by Japanese experts and C/P on the use of the related manuals for Hybrid Power Generation System	
Activities	**Inputs**		
<Output 1> 1-1 Operational conditions of the existing DGs are reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose. 1-2 Asset management plan of DG is reviewed including financial evaluation on overhaul. 1-3 Specific fuel consumption of pilot DG units is measured. 1-4 Improvement plan for the operation of pilot DG units is prepared. 1-5 Existing spare parts and maintenance tools of pilot DG units are confirmed. 1-6 Improvement plan for the operation of pilot DG units is implemented. 1-7 The result of implementation of the improvement plan is evaluated, and improvement plan is updated. 1-8 The concept of Economic Dispatch Control (EDC) is shared among operators and applied, if possible. 1-9 Necessary spare parts and maintenance tools for the pilot DG units are prepared. 1-10 Maintenance work schedule for the pilot DG units is prepared. 1-11 Check sheets and maintenance manuals for maintenance works for pilot DG units are prepared. 1-12 Maintenance works (daily/partial inspection/overhaul work) for pilot DG units are conducted in accordance with the maintenance schedule. 1-13 The result of maintenance works is evaluated, and future maintenance work schedule together with budget (including sub-contract fee, cost for tools and equipment) is prepared. 1-14 Specific fuel consumption of the pilot DG units is measured before and after implementation of the related project activities. 1-15 Related training programs for appropriate O&M system for DGs are implemented periodically. 1-16 Knowledge on appropriate O&M of DGs is disseminated among stakeholders. <Output 2> 2-1 Current situation and future development plan of RE is reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose. 2-2 Planning manual for Hybrid Power Generation System is prepared. 2-3 Planning manual for Hybrid Power Generation System is reviewed and updated in the target area.	**(Japanese side)** 1. Dispatch of the Japanese experts <JICA long term expert, stationed in Fiji > - Hybrid Power Generation System <JICA Consultant Team> -Team Leader / Operation & Maintenance of DG -Economic operation of DG -Maintenance support of DG (Mechanical expert) -Maintenance support of DG (Electrical expert) -O&M of RE power generation system -Integration of RE power generation system -Project Coordinator 2. Training in Japan and Fiji 3. Equipment -In accordance with necessity of activities	**(Kiribati side)** 1. Assignment of C/Ps -Project Director (P/D) -Project Manager (P/M) -Engineers in charge of O&M (Manager level) - Mechanical Staff - Electrical Staff - Planning officer, and others 2. Facilities and equipment -Project office 3.Recurrent costs - C/Ps' wages and allowances - C/Ps' domestic travel expense	**Preconditions** Contents of the current relevant policies on promotion of renewable energy and energy efficiency are not largely changed.

2-4 Operating conditions of the existing RE facilities are reviewed, including confirmation of objectively verifiable indicators for overall goal. 2-5 O&M manual for RE facilities is prepared. 2-6 Maintenance works are conducted according to O&M manual of RE facilities. 2-7 The result of maintenance works is evaluated, and future maintenance work schedule together with budget is prepared. 2-8 Training program for Hybrid Power Generation System including O&M of RE facilities is conducted. 2-9 Knowledge regarding Hybrid Power Generation System is disseminated among stakeholders.			

3 Workflow Chart



Current condition

Project activity　implementation

After implementation of activities

Objectives

Achieved through sustainable activities

Upped Base Line

Differences with objectives

Baseline Improvements

Activity Effectiveness ＝ Results

Base Line

[Tuvalu] [Kiribati] [Marshall] [Micronesia]
Through reduced fossil fuel consumption, energy security is improved, and greenhouse gases are reduced.

Technical Assistance Activities

4 JCC Meeting Records

4.1 1st JCC Meeting

MINUTES OF MEETING
BETWEEN
THE AUTHORITIES CONCERNED OF
THE GOVERNMENT OF REPUBLIC OF KIRIBATI
AND
JAPAN INTERNATIONAL COOPERATION AGENCY
FOR
THE FIRST JOINT COORDINATION COMMITTEE (JCC)
ON
THE PROJECT FOR INTRODUCTION OF HYBRID POWER GENERATION SYSTEM IN PACIFIC ISLAND COUNTRIES

Japan International Cooperation Agency (hereinafter referred to as “JICA”) and the authorities concerned of the Government of Kiribati (hereinafter referred to as “Kiribati side”) established a Joint Coordination Committee (hereinafter referred to as “JCC”) for the effective and successful implementation of the Project for Introduction of Hybrid Power Generation System in Pacific Island Countries (hereinafter referred to as “the Project”).

The first JCC on the Project was held on 20th September 2017, at the conference room of the Ministry of Infrastructure and Sustainable Energy (hereinafter referred to as “MISE”), chaired by Mr. Tioti Taaitee, Deputy Secretary (OIC) of MISE.

Tarawa, 2017

Tadayuki Ogawa Chief Advisor JICA Expert in Fiji	Benjamin Tokataake Secretary Ministry of Infrastructure and Sustainable Energy Republic of Kiribati
Hiroyuki Sawada Resident Representative JICA Fiji Office	Wayne Brearly CEO Public Utilities Board Republic of Kiribati

ANNEX

The Kiribati side and JICA (hereinafter referred to as "both sides") discussed on the issues including the contents of (i)Project Design Matrix (PDM), (ii)Plan of Operation (PO), and (iii)Project Monitoring Sheet, based on the Agenda attached hereto.

The both sides confirmed the main points as described below.

1. Amendment of R/D

The both sides agreed on the amendment of the Record of Discussion dated 16 November, 2016 (hereinafter referred to as "R/D") as follow. All other parts of R/D shall remain unchanged. This amendment will become effective on the date of signing of this Minutes of Meeting.

(1) Duration

1) Current Version
Five (5) years (tentatively November, 2016 – October, 2021) from the date of the first arrival of the JICA experts.

2) Amended Version
March, 2017 – June, 2022

(2) Reason of Amendment

JICA long-term expert stationed in Fiji has started his assignment since March 2017, and the assignment of JICA short-term expert team will last until June 2022.

2. Revision of PDM and PO

The both sides agreed on the revision of PDM and PO as attachment 4 and 5.

3. Project Organization

The both sides confirmed the formation of the Project Counterpart Team and assignment of the officials as described below. Those counterparts are core trainers in each task, and expected to disseminate technical knowledge and skills among other members in the organization periodically during the Project. The both sides also confirmed that Project Director and Project Manager agreed on the R/D shall be responsible for the coordination among the Project Counterpart Team.

➢ Project Counterparts (Core Trainers)

1) Operation and Maintenance of Diesel Engine Generators

- Kirite Uriam (Lead Hand Mechanical, PUB)

2) Plan for introduction of hybrid power generation systems

- Thomas Taoaba (Renewable Energy Planner, MISE)
- Tebwatia Takau (Generation Engineer, PUB)

3) Operation and Maintenance of Renewable Energy generation system

- Ubaitoi Teurakai (Energy Technician, MISE)

Bauro Mikaere (Instrumentation & PV supervisor, PUB)

4. Indicators (as the baseline of project evaluation)

(1) Overall Goal

Annual CO_2 emission of power utilities in the target area	15,857 t
Annual consumption of diesel fuel of power utilities in the target area	5,937 kL
Capacity (kW) and generated energy (kWh) of Renewable Energy facilities of power utilities in the target area	1,446 kW, 1,448 MWh (PEC+UAE)

(2) Project Purpose

Pilot DG units	Unit 3,4 and 5
Specific fuel consumption of pilot DG units	To be measured and updated after procurement of flow meter, if necessary
Performance ratio for RE power generation system	75% (PEC Fund)

5. Counterpart training in Japan

(1) Schedule

Counterpart Training in Japan is tentatively planned in February and October, 2018. Further training opportunities will be discussed later.

(2) Goal

The goal of the first training in February is to introduce general overview of power supply & demand situation in remote islands in Japan.

The second training in October will be designed to witness and learn the actual maintenance works of Diesel Engine Generators.

(3) Participants

The eligible participants for the first training are managers and higher staff responsible for the dissemination of Hybrid Power Generation System. (“Hybrid Power Generation System” is the system in which Diesel Engine Generators and Renewable Energy are operated and maintained properly to reduce consumption of fossil fuel and greenhouse gas emission.)

As a result of discussion, following counterparts are nominated as the participants for the first training.

1) Kireua B. Kaiea (Energy Planner, MISE)
2) Tenikoria Kataueа (Power Engineering Manager, PUB)

The participants for the second training would be the managers in charge of maintenance of Diesel Engine Generators. The selection of the participants shall be finalized by May, 2018.

ATTACHMENT 1	Agenda
ATTACHMENT 2	Lists of Participants
ATTACHMENT 3	Project Monitoring Sheet
ATTACHMENT 4	Project Design Matrix ver. 2
ATTACHMENT 5	Plan of Operation ver. 2

ATTACHMENT 1

Agenda for JCC Meeting

1. Opening Remarks by Mr. Tioti Taaitee, Deputy Secretary (OIC), Ministry of Infrastructure and Sustainable Energy

2. Explanation and confirmation on the following documents;
   (1) Project Design Matrix (PDM)
   (2) Plan of Operation (PO)
   (3) Project Monitoring Sheet

3. Explanation on the project implementation methodology

4. Confirmation on the Minutes of Meeting (M/M)

5. Closing Remarks by Mr. Shinya Tamio, Deputy Resident Representative of JICA Fiji Office

ATTACHMENT 2 List of Participants

Organization	Position	Name
Ministry of Infrastructure and Sustainable Energy	Deputy Secretary	Mr. Tioti Taaitee
Ministry of Infrastructure and Sustainable Energy	Energy Economist	Ms. Miriam I Tikana
Ministry of Infrastructure and Sustainable Energy	Renewable Energy Planner	Mr. Thomas Taoaba
Public Utilities Board	CEO	Mr. Wayne Brearly
Public Utilities Board	Power Engineering Manager	Mr.Tenikoria Katauea
Public Utilities Board	Project Manager	Mr.Tiaon Ankitino
JICA Fiji Office	Deputy Resident Representative	Mr. Shinya Tamio
JICA Fiji Office	Project Formulation Advisor	Ms. Atsumi Kani
JICA Fiji Office	Assistant Resident Representative	Ms. Akari Murao
JICA	Long Term Expert	Mr. Tadayuki Ogawa
JICA	Short Term Expert	Mr. Luis Kakefuku
JICA	Short Term Expert	Mr. Masanori Shimabuku
JICA	Short Term Expert	Mr. Yoshiharu Uechi
JICA	Short Term Expert	Mr. Toshiaki Kaneko

ATTACHMENT 3

PROJECT MONITORING SHEET

Project Title: The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries
Version of the Sheet: Ver.1

Name: Tadayuki OGAWA
Title: Chief Advisor
Submission Date: 20th September, 2017

I. Summary

1 Progress

1-1 Progress of Inputs

(1) Japanese side

1) Long term expert stationed in Fiji has worked in May to confirm the overall operation conditions of existing Diesel Generators (DGs) and Renewable Energy (RE) power generation systems in Kiribati.
2) Short term expert team arrived at Tarawa on 14th September, 2017. The team is looking into the current activities of operation and maintenance of DGs and RE power generation systems in Kiribati.

(2) Kiribati side

Members from MISE and PUB established a following team as the project implementation body.

1) Operation and Maintenance of Diesel Engine Generators
Kirite Uriam (Lead Hand Mechanical, PUB)

2) Plan for introduction of hybrid power generation systems
Thomas Taoaba (Renewable Energy Planner, MISE)
Tebwatia Takau (Generation Engineer, PUB)

3) Operation and Maintenance of RE power generation system
Lokea Itienang (Energy Technician)
Bauro Mikaere (Instrumentation & PV supervisor, PUB)

1-2 Progress of Activities

No.	Activity	Progress
Output 1: 1. Appropriate and economical system for O&M of Diesel Generators (DGs) is enhanced.		
1-1	Operational conditions of the existing DGs are reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose.	Questionnaire sheets were submitted by JICA expert to Kiribati counterparts to collect relevant information and to confirm the objectively verifiable indicators for overall goal and project purpose. As a result of this activity, Training Needs Assessment Report is under preparation by JICA expert.
1-2	Specific fuel consumption of pilot DG units is measured.	Specific fuel consumption was measured by PUB in June 2016. The latest figure shall be measured and updated after procurement of flow meter, if necessary.
1-3	Improvement plan for the operation of pilot DG units is prepared.	Detailed operation condition of DGs are under investigation by JICA experts and PUB. Following issues were confirmed by JICA experts; 1) Sludge incinerator is not working as oil burner needs to be replaced.
1-4	Existing spare parts and maintenance tools of pilot DG units are confirmed.	Existing spare parts and maintenance tools are under investigation.
1-7	The concept of Economic Dispatch Control (EDC) is shared among operators and applied, if possible.	Detailed operation condition of DGs are shared between JICA experts and PUB. The basic concept of EDC has been explained by JICA experts.
Output 2: Methodology for appropriate planning and O&M of renewable energy (RE) is established.		
2-1	Current situation and future development plan of RE is reviewed.	Same as activity 1-1
2-4	Operating conditions of the existing RE facilities are reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose.	Same as activity 1-1

1-3 Achievement of Output

Initial baseline survey and preparation work is undergoing for both Output 1 & 2.

1-4 Achievement of the Project Purpose

1-5 Changes of Risks and Actions for Mitigation

1-6 Progress of Actions undertaken by JICA

1-7 Progress of Actions undertaken by the Parties

1-8 Progress of Environmental and Social Considerations (if applicable)

1-9 Progress of Considerations on Gender/ Peace Building/ Poverty Reduction (if applicable)

1-10 Other remarkable/ considerable issues related/ affect to the Project (such as other

JICA's projects, activities of counterparts, other donors, private sectors, NGOs, etc.)

2 Delay of Work Schedule and/or Problems (if any)

2-1 Detail

2-2 Cause

2-3 Action to be taken

2-4 Roles of Responsible Persons/ Organization (JICA, the Parties, etc.)

3 Modification of the Project Implementation Plan

3-1 Plan of Operation

- ➢ Project period is updated based on the actual dispatch schedule of JICA Experts (March 2017 – June 2022).
- ➢ Implementation plan of each activity including trainings are also revised in accordance with the above update.

3-2 Other modifications on detailed implementation plan

II. **Project Monitoring Sheet I & II as Attached**

(Project Design Matrix and Plan of Operation)

ATTACHMENT 4

Ver. 2, September, 2017

Draft Project Design Matrix (PDM)

Project Title: The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries
Project Term : March 2017 - June 2022 (Five Years) (Phase 1: March 2017 – February 2019 , Phase 2: March 2019 – June 2022
Country: Republic of Kiribati
Target Area: Tarawa
Target Group: Related engineers and other technical staff in the target area (MPWU and PUB)
MPWU: Ministry of Public Works and Utilities PUB: Public Utilities Board

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal Energy security is improved and greenhouse gases are reduced through the reduction of fossil fuels consumption.	In comparison to the indicators at the time of baseline survey, 1. Reduced amount of CO2 emission of power utilities in the target area 2. Reduced amount of diesel fuel of power utilities in the target area 3. Increased capacity (kW) and actual generated energy (kWh) of renewable energy facilities of power utilities in the target area	1. to 3. Reports of C/P agencies	
Project Purpose Hybrid Power Generation System is introduced.	1. Improvement of specific fuel consumption of pilot DG units (better than the baseline data set at the beginning of the Project) 2. Improvement of performance ratio for RE power generation systems (better than the baseline data set at the beginning of the Project) 3. Proper application of planning and O&M method of Hybrid Power Generation System	1. Record on specific fuel consumption of Pilot DG units by C/P, checked by Japanese experts 2. Record on operation of RE power generation systems 3. Evaluation by Japanese experts and C/P on plans and O&M of Hybrid Power Generation System	C/P agencies continue commitment to the Project by continuing budget allocation as well as assignment of personnel for the post- Project activities.
Outputs 1. Appropriate and economical system for O&M of Diesel Generators (DGs) is enhanced.	<Output 1> 1-1 Adequacy on the use of the work schedule, check sheets and manual for the maintenance work for the pilot DG units 1-2 Number of training participants who are conducting operation and maintenance of DG based on the learnings from the training program	1-1 Evaluation by Japanese experts and C/P on improvement of maintenance work (daily/partial inspection/overhaul work) for pilot DG units 1-2 Capacity assessment of trained maintenance staff and managers by Japanese experts	C/P agencies promote investment on renewable energy facilities based on the current national policy/plan.

2. Methodology for appropriate planning and O&M of Renewable Energy (RE) is established.	<Output 2> 2-1 Number of training participants who learned the planning method of the Hybrid Power Generation System 2-2 Number of training participants who are conducting O&M of RE facilities based on the learnings from the training program 2-3 Preparation of related manuals for Hybrid Power Generation System 2-4 Adequacy of the use of the related manuals for Hybrid Power Generation System	2-1 Capacity assessment of trained staff and managers by Japanese experts 2-2 Capacity assessment of trained O&M staff and managers by Japanese experts 2-3 Evaluation by Japanese Experts on related manuals for Hybrid Power Generation System prepared by C/P 2-4 Evaluation by Japanese experts and C/P on the use of the related manuals for Hybrid Power Generation System	
Activities <Output 1> 1-1 Operational conditions of the existing DGs are reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose. 1-2 Asset management plan of DG is reviewed including financial evaluation on overhaul. 1-3 Specific fuel consumption of pilot DG units is measured. 1-4 Improvement plan for the operation of pilot DG units is prepared. 1-5 Existing spare parts and maintenance tools of pilot DG units are confirmed. 1-6 Improvement plan for the operation of pilot DG units is implemented. 1-7 The result of implementation of the improvement plan is evaluated, and improvement plan is updated. 1-8 The concept of Economic Dispatch Control (EDC) is shared among operators and applied, if possible. 1-9 Necessary spare parts and maintenance tools for the pilot DG units are prepared. 1-10 Maintenance work schedule for the pilot DG units is prepared. 1-11 Check sheets and maintenance manuals for maintenance works for pilot DG units are prepared. 1-12 Maintenance works (daily/partial inspection/overhaul work) for pilot DG units are conducted in accordance with the maintenance schedule. 1-13 The result of maintenance works is evaluated, and future maintenance work schedule together with budget (including sub-contract fee, cost for tools and equipment) is prepared. 1-14 Specific fuel consumption of the pilot DG units is measured before and after implementation of the related project activities. 1-15 Related training programs for appropriate O&M system for DGs are implemented periodically. 1-16 Knowledge on appropriate O&M of DGs is disseminated among stakeholders. <Output 2> 2-1 Current situation and future development plan of RE is reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose. 2-2 Planning manual for Hybrid Power Generation System is prepared. 2-3 Planning manual for Hybrid Power Generation System is reviewed and updated in the target area. 2-4 Operating conditions of the existing RE facilities are reviewed, including confirmation of objectively verifiable indicators for overall goal. 2-5 O&M manual for RE facilities is prepared.	**Inputs** **(Japanese side)** 1. Dispatch of the Japanese experts <JICA long term expert, stationed in Fiji > - Hybrid Power Generation System <JICA Consultant Team> -Team Leader / Operation & Maintenance of DG -Economic operation of DG -Maintenance support of DG (Mechanical expert) -Maintenance support of DG (Electrical expert) -O&M of RE power generation system -Integration of RE power generation system -Project Coordinator 2. Training in Japan and Fiji 3. Equipment -In accordance with necessity of activities	**(Kiribati side)** 1. Assignment of C/Ps -Project Director (P/D) -Project Manager (P/M) -Engineers in charge of O&M (Manager level) - Mechanical Staff - Electrical Staff - Planning officer, and others 2. Facilities and equipment -Project office 3.Recurrent costs - C/Ps' wages and allowances - C/Ps' domestic travel expense	**Preconditions** Contents of the current relevant policies on promotion of renewable energy and energy efficiency are not largely changed.

2-6 Maintenance works are conducted according to O&M manual of RE facilities. 2-7 The result of maintenance works is evaluated, and future maintenance work schedule together with budget is prepared. 2-8 Training program for Hybrid Power Generation System including O&M of RE facilities is conducted. 2-9 Knowledge regarding Hybrid Power Generation System is disseminated among stakeholders.			

ATTACHMENT 5

Ver. 2 September, 2017

Tentative Plan of Operation (PO)

Project Title: The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries
Project Term: March 2017 - June 2022 (Phase 1: March 2017 – February 2019 , Phase 2: March 2019 – June 2022
Country: Republic of Kiribati
Target Area: Tarawa
Target Group: Related engineers and other technical staffs in the target area (MPWU and PUB)

		Organizations in Charge	Five years (60 months)																																																														
			PHASE 1																								PHASE 2																																						
			1st Year												2nd Year												3rd Year												4th Year												5th Year												6th Year			
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
Output 1 Activities																																																																	
1-1.	Operational conditions of the existing DGs are reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose.	PUB, JICA Experts			■	■	■	■	■	■																																																								
1-2.	Asset management plan of DG is prepared including financial evaluation on overhaul.	PUB, JICA Experts			■	■	■	■	■	■	■	■	■	■	■	■																																																		
1-3.	Specific fuel consumption of pilot DG units is measured.	PUB, JICA Experts			■	■	■	■	■	■																																																								
1-4.	Improvement plan for the operation of pilot DG units is prepared.	PUB, JICA Experts			■	■	■	■	■	■	■	■	■	■	■	■																																																		
1-5.	Existing spare parts and maintenance tools of pilot DG units are confirmed.	PUB, JICA Experts			■	■	■	■	■	■	■	■	■	■	■	■																																																		
1-6.	Improvement plan for the operation of pilot DG units is implemented.	PUB, JICA Experts															■	■	■	■	■	■	■	■	■	■	■	■																																						
1-7.	The result of implementation of the improvement plan is evaluated, and improvement plan is updated.	PUB, JICA Experts																											■	■	■	■	■	■	■	■	■	■	■	■																										
1-8.	The concept of Economic Dispatch Control (EDC) is shared among operators and applied, if possible.	PUB, JICA Experts			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■																																						
1-9.	Necessary spare parts and maintenance tools for the pilot DG units are prepared.	PUB, JICA Experts																					■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■																												
1-10.	Maintenance work schedule for the pilot DG units is prepared.	PUB, JICA Experts																					■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■																												
1-11.	Check sheets and maintenance manuals for maintenance works for pilot DG units are prepared.	PUB, JICA Experts																					■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■																												
1-12.	Maintenance works (daily/partial inspection/overhaul work) for pilot DG units are conducted in accordance with the maintenance schedule.	PUB, JICA Experts																																										■	■																					
1-13.	The result of maintenance works is evaluated, and future maintenance work schedule together with budget (including sub-contract fee, cost for tools and equipment) is prepared.	PUB, JICA Experts																																												■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
1-14.	Specific fuel consumption of the pilot DG units is measured before and after implementation of the related project activities.	PUB, JICA Experts																																																							■	■	■	■	■	■				
1-15.	Related training programs for appropriate O&M system DGs are implemented periodically.	MPWU, PUB, JICA Experts							■					■			■						■							■								■								■									■							■				
1-16.	Knowledge on appropriate O&M of DGs is disseminated among stakeholders.	MPWU, PUB, JICA Experts												■									■															■								■																■				
Output 2 Activities																																																																	
2-1.	Current situation and future development plan of RE is reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose.	PUB, JICA Experts			■	■	■	■	■	■																																																								
2-2.	Planning manual for Hybrid Power Generation System is prepared.	PUB, JICA Experts									■	■	■	■	■	■	■	■	■	■	■	■																																												
2-3.	Planning manual for Hybrid Power Generation System is reviewed and updated in the target area.	PUB, JICA Experts																					■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
2-4.	Operation conditions of the existing RE facilities are reviewed, including confirmation of objectively verifiable indicators for overall goal.	PUB, JICA Experts			■	■	■	■	■	■																																																								
2-5.	O&M manual for RE facilities is prepared.	PUB, JICA Experts									■	■	■	■	■	■	■	■	■	■	■	■																																												
2-6.	Maintenance works are conducted according to O&M manual of RE facilities.	PUB, JICA Experts									■	■	■	■	■	■	■	■	■	■	■	■																																												
2-7.	The result of maintenance works is evaluated, and future maintenance work schedule together with budget is prepared.	PUB, JICA Experts																					■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
2-8.	Training program for Hybrid Power Generation System including O&M of RE facilities is conducted.	MPWU, PUB, JICA Experts							■					■			■						■							■								■								■									■							■				
2-9.	Knowledge regarding Hybrid Power Generation System is disseminated among stakeholders.	MPWU, PUB, JICA Experts																					■															■								■																■				
	△: JCC								△														△															△								△																△				
	▲: Training in Japan/Fiji													▲								▲								▲																▲									▲											
	JICA long term expert, stationed in Fiji		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■																																								
	JICA Consultant Team								■								■						■							■								■								■									■							■				

4.2 2nd JCC Meeting

MINUTES OF MEETING
BETWEEN
THE AUTHORITIES CONCERNED OF
THE GOVERNMENT OF REPUBLIC OF KIRIBATI
AND
JAPAN INTERNATIONAL COOPERATION AGENCY
FOR
THE SECOND JOINT COORDINATION COMMITTEE (JCC)
ON
THE PROJECT FOR INTRODUCTION OF HYBRID POWER GENERATION SYSTEM IN PACIFIC ISLAND COUNTRIES

Japan International Cooperation Agency (hereinafter referred to as "JICA") and the authorities concerned of the Government of Kiribati (hereinafter referred to as "Kiribati side") established a Joint Coordination Committee (hereinafter referred to as "JCC") for the effective and successful implementation of the Project for Introduction of Hybrid Power Generation System in Pacific Island Countries (hereinafter referred to as "the Project").

The second JCC on the Project was held on 26th October 2018, at the conference room of the Ministry of Infrastructure and Sustainable Energy (hereinafter referred to as "MISE"), chaired by Mr. Arobati Brechtefeld, Deputy Secretary (OIC) of MISE.

As a result of the discussion on the second JCC, JICA and the Kiribati side agreed on the main points as described in the Annex attached hereto.

Tarawa, 22. November, 2018

小川 忠之

Tadayuki Ogawa
Chief Advisor
JICA Expert in Fiji

Arobati Brechtefeld
Deputy Secretary (OIC)
Ministry of Infrastructure and Sustainable Energy
Republic of Kiribati

Yukari Ono

Yukari Ono
Resident Representative
JICA Fiji Office

Wayne Brearly
CEO
Public Utilities Board
Republic of Kiribati

ANNEX

The Kiribati side and JICA (hereinafter referred to as "both sides") discussed on the issues including the contents of (i)Project Design Matrix (PDM), (ii)Plan of Operation (PO), and (iii)Project Monitoring Sheet, based on the Agenda attached hereto.

The both sides confirmed the main points as described below.

1. Confirmation of PDM, PO and Project Monitoring Sheet
   The both sides confirmed the latest version of PDM and PO as attachment 4 and 5. Also, the project monitoring sheet was agreed as attachment 3.

2. Project Organization
   The both sides confirmed the update of the Project Counterpart Team and assignment of the officials as described below. Those counterparts are core trainers in each task, and expected to disseminate technical knowledge and skills among other members in the organization periodically during the Project. These members should be remained as core trainers by 2022.

   ➢ Project Counterparts (Core Trainers)
   1) Operation and Maintenance of Diesel Engine Generators
   Kirite Uriam (Lead Hand Mechanical, PUB)
   Tebakabu Tion (Lead Hand Mechanical, PUB)

   2) Plan for introduction of hybrid power generation systems
   Thomas Taoaba (Renewable Energy Planner, MISE)
   Tebwatia Takau (Generation Engineer, PUB)
   Bauro Mikaere (Instrumentation & PV supervisor, PUB)

   3) Operation and Maintenance of Renewable Energy generation system
   Beria Oromita (Energy Technician, MISE)
   Lokea Itienang (Energy Technician, MISE)
   Tikoro Kirite (PV and instrumentation electrician, PUB)

3. Improvement Plan for the Operation of Pilot DG Units
   The Kiribati side agreed to implement following measures to improve the operation conditions of pilot DG units as explained in the letter issued on 20th June, 2018. The result of implementation of the improvement plan will be evaluated and updated in 2019 together with JICA Experts.

   (1) DG operation data shall be recorded and kept in soft data for further power system analysis, together with describing reasons of stop/start each unit.
   (2) Periodically (each 3～4 month) conduct internal cleaning for the generator, and during the overhaul of the engines conduct the washing of the generator stator and rotor using the appropriate cleaning liquid. It is requested to keep records including pictures showing condition of before and after the work.

(3) Specific fuel consumption of each unit should be periodically measured and monitored, the result of which will be reflected on unit dispatch schedule.
(4) Periodical patrol checklist for preventive maintenance should be enforced.

4. Third Country Training in Fiji

(1) Objective

Counterparts from FSM, RMI, Kiribati and Tuvalu will be invited to Fiji to conduct the 1st regional training under the Project in 2019. The participants will have an opportunity to exchange their views and opinions with other participants to improve their skills and knowledge. Trainers in Fiji will be supported by the Japanese Experts to deliver classroom lectures and hands-on trainings in accordance with curriculum. The result of the training will be evaluated to improve the training curriculum, textbooks & materials for the next training.

(2) Proposed training courses

As a result of the past trainings for trainers in Fiji, following training courses are proposed for the 1st regional training in Fiji.

1) Operation & Maintenance for Diesel Engine Generators
2) Grid Integration of Renewable Energy Generation Systems
3) Operation & Maintenance of Renewable Energy generation Systems (Solar PV)

Initially, the training for the above 2) and 3) will be held simultaneously as the participants are expected same in most countries.

(3) Venue

The possible venue of the training are listed as follows;
1) EFL Training Center
2) EFL Diesel Power plants (Vuda, Kinoya, etc.)
3) Solar PV plants (various)

5. Training Equipment

Following equipment has been handed over to the Kiribati side under the Project.

No.	Item	Quantity
1	Fuel flow meter	4
2	Pyranometer and thermometer	1
3	String tracer (IV curve tracer)	1
4	Cell line checker	1
5	Simulation software (HOMER Pro)	2 (MISE(1), PUB(1))

It is required for the Kiribati side to keep and utilize above equipment in an appropriate manner. In case of missing/malfunction of equipment, the Kiribati side is requested to inform JICA Experts immediately.

6. Hand Over of Manuals

Following manuals will be handed over to Kiribati side by March 2019, as a result of discussion and consultation with counterpart members.

1) Planning manual for Hybrid Power Generation System
2) Operation & Maintenance Manual for Solar PV System

It is very important that these manuals are fully utilized and revised as necessary after hand over. Therefore, the project counterpart members are requested to share the information and/or conduct training for other staff to apply these manuals in their daily works. The progress of activities will be monitored under the phase-2 period with the assistance by JICA Experts.

ATTACHMENT 1	Agenda for JCC Meeting
ATTACHMENT 2	Lists of Participants
ATTACHMENT 3	Project Monitoring Sheet ver.2
ATTACHMENT 4	Project Design Matrix ver. 2
ATTACHMENT 5	Plan of Operation ver. 2

ATTACHMENT 1

Agenda for JCC Meeting

1. Opening Remarks by Mr. Arobati Brechtefeld, Deputy Secretary, Ministry of Infrastructure and Sustainable Energy

2. Explanation and confirmation on the following documents;
   (1) Project Design Matrix (PDM)
   (2) Plan of Operation (PO)
   (3) Project Monitoring Sheet

3. Confirmation on the Minutes of Meeting (M/M)

4. Progress of Activities

5. Closing Remarks by Mr. Tadayuki Ogawa, Chief Advisor of the Project

ATTACHMENT 2 List of Participants

Organization	Position	Name
Ministry of Infrastructure and Sustainable Energy	Deputy Secretary	Mr. Arobati Brechtefeld
Ministry of Infrastructure and Sustainable Energy	Director of Energy	Ms. Mwaati Oten
Ministry of Infrastructure and Sustainable Energy	Renewable Energy Planner	Mr. Thomas Taoaba
Public Utilities Board	CEO	Mr. Wayne Brearly
Public Utilities Board	Power Engineering Manager	Mr. Tenikoria Katauea
JICA	Chief Advisor	Mr. Tadayuki Ogawa
JICA	Short Term Expert	Mr. Luis Kakefuku
JICA	Short Term Expert	Mr. Kaoru Ikehara
JICA	Kiribati Field Office	Mr. Takashi Ikeda

ATTACHMENT 3

PROJECT MONITORING SHEET

Project Title: The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries
Version of the Sheet: Ver.2
Project Term: March 2017 -June 2022

Name: Tadayuki OGAWA
Title: Chief Advisor
Submission Date: 26th October, 2018

I. Summary

1 Progress

1-1 Progress of Inputs

(1) Japanese side

1) Long term expert stationed in Fiji has worked in June to plan & coordinate the trainings for the operation and maintenance of Diesel Engine Generators (DEGs) and Renewable Energy (RE) power generation systems in Kiribati.
2) Short term expert team has worked in May & June to conduct the trainings for the operation and maintenance of Diesel Engine Generators (DEGs) and Renewable Energy (RE) power generation systems in Kiribati.
3) Counterpart training has been conducted in February and September in Okinawa, Japan inviting counterparts from 5 target countries.

(2) Kiribati side

In total 7 number of core trainers are registered under the Project, 4 from PUB and 3 from MISE staff. Facilities and equipment (e.g. training classrooms) for the trainings in Kiribati were provided by PUB.

1-2 Progress of Activities

No.	Activity	Progress
Output 1: 1. Appropriate and economical system for O&M of Diesel Generators (DGs) is enhanced.		
1-1	Operational conditions of the existing DGs are reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose.	The result of discussions and analysis for future training needs was compiled as "Training Needs Assessment Report" and submitted to all members in November 2017.
1-2	Asset management plan of DG is reviewed including financial evaluation on overhaul.	Draft asset management plan is under preparation by JICA Expert. PUB is requested to share detailed financial

		information for the evaluation.
1-3	Specific fuel consumption of pilot DG units is measured.	Specific fuel consumption was measured by PUB in May 2018 after installation of new flow meter. The figure is 0.273 L/kWh and confirmed as the baseline figure for project evaluation.
1-4	Improvement plan for the operation of pilot DG units is prepared.	Improvement plan was prepared and shared with Kiribati side in the letter issued on 20th June 2018, after discussion and confirmation with PUB representatives.
1-5	Existing spare parts and maintenance tools of pilot DG units are confirmed.	Existing spare parts and maintenance tools were confirmed in May 2018.
1-6	Improvement plan for the operation of pilot DG units is implemented.	Kiribati side is requested to implement the proposed improvement plan under consultation with JICA Expert.
1-8	The concept of Economic Dispatch Control (EDC) is shared among operators and applied, if possible.	The basic concept of EDC has been explained by JICA Expert in May 2018.
1-9	Necessary spare parts and maintenance tools for the pilot DG units are prepared.	Kiribati side is requested to prepare spare parts and maintenance tools in accordance with the advice by JICA Expert by December 2019.
1-10	Maintenance work schedule for the pilot DG units is prepared.	Draft maintenance work schedule is under preparation by JICA Expert. PUB is requested to share the schedule for overhaul works for pilot DG units.
1-11	Check sheets and maintenance manuals for maintenance works for pilot DG units are prepared.	Draft check sheets and maintenance manuals are under preparation by JICA Expert.
Output 2: Methodology for appropriate planning and O&M of renewable energy (RE) is established.		
2-1	Current situation and future development plan of RE is reviewed, including confirmation of objectively verifiable indicators for overall goal.	Same as activity 1-1
2-2	Planning manual for Hybrid Power Generation System is prepared.	Draft planning manual is under preparation by JICA Expert.
2-4	Operating conditions of the existing RE facilities are reviewed, including confirmation of objectively verifiable indicators for overall goal.	Same as activity 1-1 Objectively verifiable indicators for overall goal was confirmed at the 1st JCC meeting in 2017.
2-5	O&M manual for RE facilities is prepared.	Draft O&M manual is under preparation by JICA Expert.

1-3 Achievement of Output

(1) Output 1

Technical advice for the improvement of O&M of DGs has been provided by JICA Experts based on the initial survey of current conditions conducted in 2017. Also, classroom lecture has been provided to ensure appropriate and economical O&M of DGs with draft manuals and check sheets. In addition, counterpart training has been conducted with site visits and hands-on trainings to learn the necessary O&M of DGs in Japan. From now on the contribution from Kiribati side should be enhanced to implement the improved O&M of DGs based on the learnings from the advice and trainings by JICA Experts.

(2) Output 2

Technical advice for the appropriate planning and O&M of RE has been provided by JICA Experts based on the initial survey of current conditions conducted in 2017. Also, classroom lecture has been provided to ensure appropriate planning and O&M of RE with draft manuals and check sheets. In addition, counterpart training has been conducted with site visits and hands-on trainings to learn the methodology of planning and O&M of RE in Japan. From now on the contribution from Kiribati side should be enhanced to implement the improved planning and O&M of RE based on the learnings from the advice and trainings by JICA Experts.

1-4 Achievement of the Project Purpose

1-5 Changes of Risks and Actions for Mitigation

1-6 Progress of Actions undertaken by JICA

1-7 Progress of Actions undertaken by the Parties

1-8 Progress of Environmental and Social Considerations (if applicable)

1-9 Progress of Considerations on Gender/ Peace Building/ Poverty Reduction (if applicable)

1-10 Other remarkable/ considerable issues related/ affect to the Project (such as other JICA's projects, activities of counterparts, other donors, private sectors, NGOs, etc.)

2 Delay of Work Schedule and/or Problems (if any)

2-1 Detail

The delay was observed in implementation of activity 1-2 (Asset management plan of DG is prepared including financial evaluation on overhaul.).

2-2 Cause

The delay was caused mainly because it took long time to confirm the current financial structure of PUB. However, the delay is not critical in implementation of the project as it will not delay smooth implementation of successive activities.

2-3 Action to be taken

2-4 Roles of Responsible Persons/ Organization (JICA, the Parties, etc.)

3 Modification of the Project Implementation Plan

3-1 Plan of Operation

3-2 Other modifications on detailed implementation plan

II. Project Monitoring Sheet I & II as Attached

(Project Design Matrix and Plan of Operation)

ATTACHMENT 4

Ver. 2, September, 2017

Project Design Matrix (PDM)

Project Title: The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries
Project Term : March 2017 - June 2022 (Five Years) (Phase 1: March 2017 – February 2019 , Phase 2: March 2019 – June 2022
Country: Republic of Kiribati
Target Area: Tarawa
Target Group: Related engineers and other technical staff in the target area (MISE and PUB)
MISE: Ministry of Infrastructure and Sustainable Energy PUB: Public Utilities Board

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal Energy security is improved and greenhouse gases are reduced through the reduction of fossil fuels consumption.	In comparison to the indicators at the time of baseline survey, 1. Reduced amount of CO2 emission of power utilities in the target area 2. Reduced amount of diesel fuel of power utilities in the target area 3. Increased capacity (kW) and actual generated energy (kWh) of renewable energy facilities of power utilities in the target area	1. to 3. Reports of C/P agencies	
Project Purpose Hybrid Power Generation System is introduced.	1. Improvement of specific fuel consumption of pilot DG units (better than the baseline data set at the beginning of the Project) 2. Improvement of performance ratio for RE power generation systems (better than the baseline data set at the beginning of the Project) 3. Proper application of planning and O&M method of Hybrid Power Generation System	1. Record on specific fuel consumption of Pilot DG units by C/P, checked by Japanese experts 2. Record on operation of RE power generation systems 3. Evaluation by Japanese experts and C/P on plans and O&M of Hybrid Power Generation System	C/P agencies continue commitment to the Project by continuing budget allocation as well as assignment of personnel for the post- Project activities.
Outputs 1. Appropriate and economical system for O&M of Diesel Generators (DGs) is enhanced.	<Output 1> 1-1 Adequacy on the use of the work schedule, check sheets and manual for the maintenance work for the pilot DG units 1-2 Number of training participants who are conducting operation and maintenance of DG based on the learnings from the training program	1-1 Evaluation by Japanese experts and C/P on improvement of maintenance work (daily/partial inspection/overhaul work) for pilot DG units 1-2 Capacity assessment of trained maintenance staff and managers by Japanese experts	C/P agencies promote investment on renewable energy facilities based on the current national policy/plan.

2. Methodology for appropriate planning and O&M of Renewable Energy (RE) is established.	<Output 2> 2-1 Number of training participants who learned the planning method of the Hybrid Power Generation System 2-2 Number of training participants who are conducting O&M of RE facilities based on the learnings from the training program 2-3 Preparation of related manuals for Hybrid Power Generation System 2-4 Adequacy of the use of the related manuals for Hybrid Power Generation System	2-1 Capacity assessment of trained staff and managers by Japanese experts 2-2 Capacity assessment of trained O&M staff and managers by Japanese experts 2-3 Evaluation by Japanese Experts on related manuals for Hybrid Power Generation System prepared by C/P 2-4 Evaluation by Japanese experts and C/P on the use of the related manuals for Hybrid Power Generation System	
Activities	**Inputs**		
<Output 1> 1-1 Operational conditions of the existing DGs are reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose. 1-2 Asset management plan of DG is reviewed including financial evaluation on overhaul. 1-3 Specific fuel consumption of pilot DG units is measured. 1-4 Improvement plan for the operation of pilot DG units is prepared. 1-5 Existing spare parts and maintenance tools of pilot DG units are confirmed. 1-6 Improvement plan for the operation of pilot DG units is implemented. 1-7 The result of implementation of the improvement plan is evaluated, and improvement plan is updated. 1-8 The concept of Economic Dispatch Control (EDC) is shared among operators and applied, if possible. 1-9 Necessary spare parts and maintenance tools for the pilot DG units are prepared. 1-10 Maintenance work schedule for the pilot DG units is prepared. 1-11 Check sheets and maintenance manuals for maintenance works for pilot DG units are prepared. 1-12 Maintenance works (daily/partial inspection/overhaul work) for pilot DG units are conducted in accordance with the maintenance schedule. 1-13 The result of maintenance works is evaluated, and future maintenance work schedule together with budget (including sub-contract fee, cost for tools and equipment) is prepared. 1-14 Specific fuel consumption of the pilot DG units is measured before and after implementation of the related project activities. 1-15 Related training programs for appropriate O&M system for DGs are implemented periodically. 1-16 Knowledge on appropriate O&M of DGs is disseminated among stakeholders. <Output 2> 2-1 Current situation and future development plan of RE is reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose. 2-2 Planning manual for Hybrid Power Generation System is prepared. 2-3 Planning manual for Hybrid Power Generation System is reviewed and updated in the target area. 2-4 Operating conditions of the existing RE facilities are reviewed, including confirmation of objectively verifiable indicators for overall goal.	**(Japanese side)** 1. Dispatch of the Japanese experts <JICA long term expert, stationed in Fiji > - Hybrid Power Generation System <JICA Consultant Team> -Team Leader / Operation & Maintenance of DG -Economic operation of DG -Maintenance support of DG (Mechanical expert) -Maintenance support of DG (Electrical expert) -O&M of RE power generation system -Integration of RE power generation system -Project Coordinator 2. Training in Japan and Fiji 3. Equipment -In accordance with necessity of activities	**(Kiribati side)** 1. Assignment of C/Ps -Project Director (P/D) -Project Manager (P/M) -Engineers in charge of O&M (Manager level) - Mechanical Staff - Electrical Staff - Planning officer, and others 2. Facilities and equipment -Project office 3.Recurrent costs - C/Ps' wages and allowances - C/Ps' domestic travel expense	**Preconditions** Contents of the current relevant policies on promotion of renewable energy and energy efficiency are not largely changed.

2-5 O&M manual for RE facilities is prepared. 2-6 Maintenance works are conducted according to O&M manual of RE facilities. 2-7 The result of maintenance works is evaluated, and future maintenance work schedule together with budget is prepared. 2-8 Training program for Hybrid Power Generation System including O&M of RE facilities is conducted. 2-9 Knowledge regarding Hybrid Power Generation System is disseminated among stakeholders.			

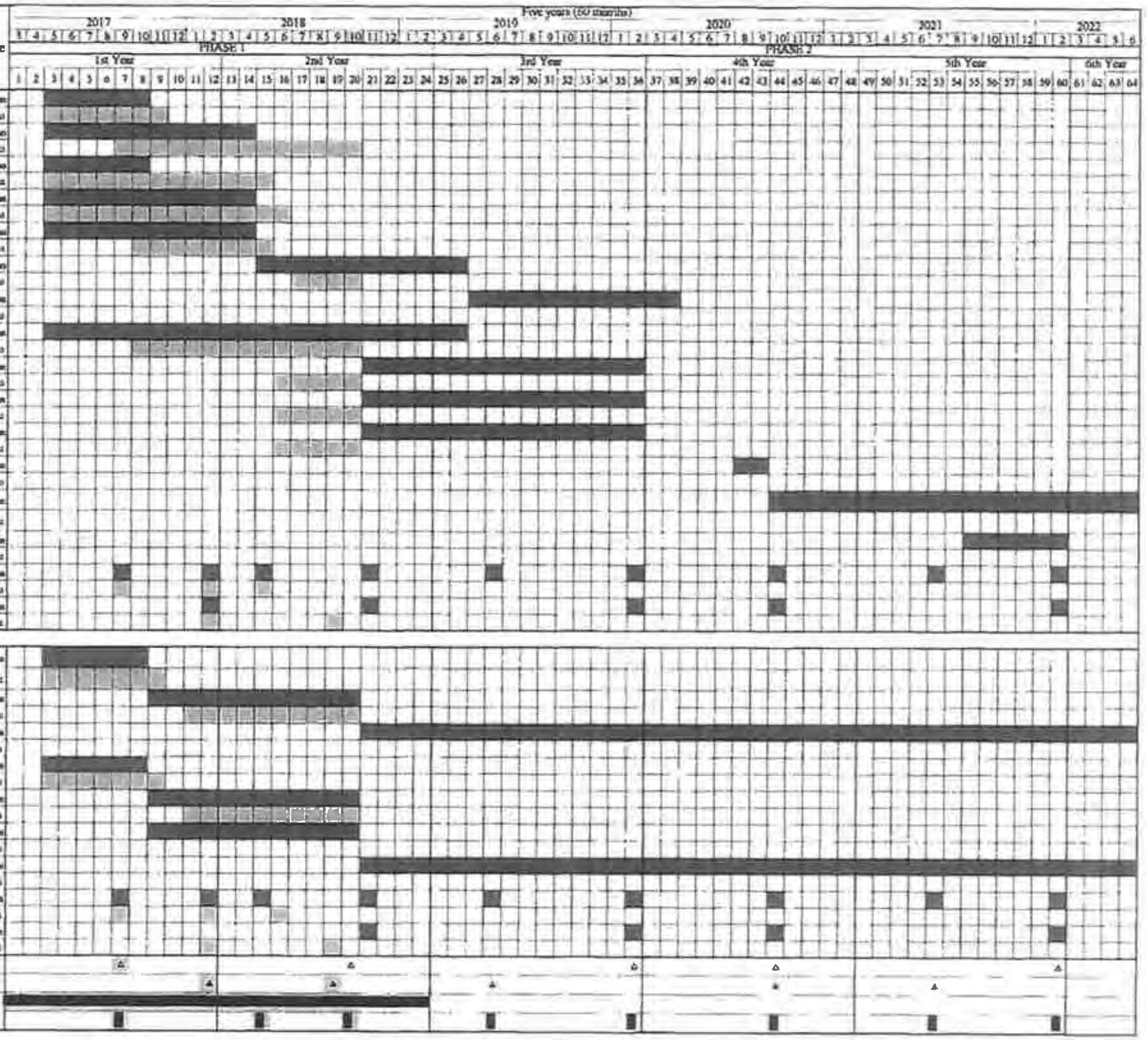
ATTACHMENT 5

Plan of Operation (PO)

Ver.2 October, 2018

Project Title: The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries
Project Term: March 2017 - June 2022 (Phase 1: March 2017 – February 2019 , Phase 2: March 2019 – June 2022)
Country: Kiribati
Target Area: Tarawa
Target Group: Related engineers and other technical staffs in the target area (MISE and PUB)

	Output 1 Activities **【Appropriate O&M System for DG】**	**Product**	**Organizations in Charge**	
1-1	Operational conditions of the existing DGs are reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose	TNA Report, OVI	PUB, JICA Experts	Plan Act
1-2	Asset management plan of DG is prepared including financial evaluation on overhaul.	PUB, JICA Experts	PUB, JICA Experts	Plan Act
1-3	Specific fuel consumption of pilot DG units is measured.	Measurement of Specific fuel consumption	PUB, JICA Experts	Plan Act
1-4.	Improvement plan for the operation of pilot DG units is prepared.	Improvement plan	PUB, JICA Experts	Plan Act
1-5.	Existing spare parts and maintenance tools of pilot DG units are confirmed	List of spare parts and maintenance tools	PUB, JICA Experts	Plan Act
1-6	Improvement plan for the operation of pilot DG units is implemented.	Improvement Implementation Report	PUB, JICA Experts	Plan Act
1-7	The result of implementation of the improvement plan is evaluated, and improvement plan is updated.	Improvement Evaluation Report	PUB, JICA Experts	Plan Act
1-8	The concept of Economic Dispatch Control (EDC) is shared among operators and applied, if possible.	EDC software, manual, EDC sheet	PUB, JICA Experts	Plan Act
1-9	Necessary spare parts and maintenance tools for the pilot DG units are prepared.	List of spare parts and maintenance tools prepared	PUB, JICA Experts	Plan Act
1-10.	Maintenance work schedule for the pilot DG units is prepared.	Maintenance work shedule	PUB, JICA Experts	Plan Act
1-11.	Check sheets and maintenance manuals for maintenance works for pilot DG units are prepared.	Check sheets and maintenance manulas	PUB, JICA Experts	Plan Act
1-12.	Maintenance works (daily/partial inspection/overhaul work) for pilot DG units are conducted in accordance with the maintenance schedule.	Maintenance record	PUB, JICA Experts	Plan Act
1-13.	The result of maintenance works is evaluated, and future maintenance work schedule together with budget (including sub-contract fee, cost for tools and equipment) is prepared.	Evaluation report and future schedule for maintenance	PUB, JICA Experts	Plan Act
1-14.	Specific fuel consumption of the pilot DG units is measured before and after implementation of the related project activities.	Measurement for specific consumption of the pilot DG	PUB, JICA Experts	Plan Act
1-15.	Related training programs for appropriate O&M system DGs are implemented periodically.	Training record, recommendations, reports, etc.	MISE, PUB, JICA Experts	Plan Act
1-16.	Knowledge on appropriate O&M of DGs is disseminated among stakeholders.	Seminar, workshop records	MISE, PUB, JICA Experts	Plan Act
	Output 2 Activities			
2-1	Current situation and future development plan of RE is reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose.	TNA Report, OVI	PUB, JICA Experts	Plan Act
2-2.	Planning manual for Hybrid Power Generation System is prepared	Planning manual for Hybrid Power Generation	PUB, JICA Experts	Plan Act
2-3.	Planning manual for Hybrid Power Generation System is reviewed and updated in the target area.	Updated Planning manual for Hybrid Power Generation	PUB, JICA Experts	Plan Act
2-4	Operating conditions of the existing RE facilities are reviewed, including confirmation of objectively verifiable indicators for overall goal.	TNA Report, OVI	PUB, JICA Experts	Plan Act
2-5	O&M manual for RE facilities is prepared.	O&M manual for RE facilities	PUB, JICA Experts	Plan Act
2-6	Maintenance works are conducted according to O&M manual of RE facilities.	Maintenance Record	PUB, JICA Experts	Plan Act
2-7.	The result of maintenance works is evaluated, and future maintenance work schedule together with budget is prepared.	Evaluation report of maintenance work, and schedule	PUB, JICA Experts	Plan Act
2-8.	Training program for Hybrid Power Generation System including O&M of RE facilities is conducted.	Training record, recommendations, reports, etc.	MISE, PUB, JICA Experts	Plan Act
2-9	Knowledge regarding Hybrid Power Generation System is disseminated among stakeholders.	Seminar, workshop records	MISE, PUB, JICA Experts	Plan Act
	△: JCC			
	▲: Training in Japan/Fiji			
	JICA long term expert, stationed in Fiji			
	JICA Consultant Team			



4.3 3rd JCC Meeting

MINUTES OF MEETING
BETWEEN
THE AUTHORITIES CONCERNED OF
THE GOVERNMENT OF REPUBLIC OF KIRIBATI
AND
JAPAN INTERNATIONAL COOPERATION AGENCY
FOR
THE THIRD JOINT COORDINATION COMMITTEE (JCC)
ON
THE PROJECT FOR INTRODUCTION OF HYBRID POWER GENERATION SYSTEM IN PACIFIC ISLAND COUNTRIES

Japan International Cooperation Agency (hereinafter referred to as "JICA") and the authorities concerned of the Government of Kiribati (hereinafter referred to as "Kiribati side") established a Joint Coordination Committee (hereinafter referred to as "JCC") for the effective and successful implementation of the Project for Introduction of Hybrid Power Generation System in Pacific Island Countries (hereinafter referred to as "the Project").

The third JCC on the Project was held on 3rd October 2019, at the conference room of the Ministry of Infrastructure and Sustainable Energy (hereinafter referred to as "MISE"), chaired by Ms. Saitofi Mika, Secretary of MISE.

As a result of the discussion on the third JCC, JICA and the Kiribati side agreed on the main points as described in the Annex attached hereto.

Tarawa, October 3rd, 2019

Signed by Luis Kakefuku
JICA Expert

Saitofi Mika
Secretary
Ministry of Infrastructure and Sustainable Energy
Republic of Kiribati

Yukari Ono

Yukari Ono
Resident Representative
JICA Fiji Office

Signed by Tenikoria Katauea
Generation Manager
Public Utilities Board
Republic of Kiribati

ANNEX

The Kiribati side and JICA (hereinafter referred to as "both sides") discussed on the issues including the contents of (i)Project Design Matrix (PDM), (ii)Plan of Operation (PO), and (iii)Project Monitoring Sheet, based on the Agenda attached hereto.

The both sides confirmed the main points as described below.

1. Confirmation of PDM, PO and Project Monitoring Sheet

   The both sides confirmed the latest version of PDM and PO as attachment 4 and 5. Also, the project monitoring sheet was agreed as attachment 3.

2. Project Organization

   The both sides confirmed the update of the Project Counterpart Team and assignment of the officials as described below. Those counterparts are core trainers in each task, and expected to disseminate technical knowledge and skills among other members in the organization periodically during the Project. These members should be remained as core trainers by 2022.

   - Project Counterparts (Core Trainers)

     1) Operation and Maintenance of Diesel Engine Generators
     Kirite Uriam (Lead Hand Mechanical, PUB)
     Tebakabu Tion (Lead Hand Mechanical, PUB)

     2) Plan for introduction of hybrid power generation systems
     Thomas Taoaba (Renewable Energy Planner, MISE)
     Tebwatia Takau (Generation Engineer, PUB)
     Bauro Mikaere (Instrumentation & PV supervisor, PUB)

     3) Operation and Maintenance of Renewable Energy generation system
     Beria Oromita (Energy Technician, MISE)
     Lokea Itienang (Energy Technician, MISE)
     Tikoro Kirite (PV and instrumentation electrician, PUB)

3. Improvement Plan for the Operation of Pilot DG Units (Update)

   The Kiribati side agreed to implement following updated measures to improve the operation conditions of pilot DG units as updated improvement plans after evaluation by JICA Expert. The result of implementation of the improvement plan will be evaluated together with JICA Experts.

   (1) Ensure periodical measurement and recording of specific fuel consumption of each unit, the result of which should be reflected on unit dispatch schedule. It is recommended to assign a responsible person in charge of measuring and recording the specific fuel consumption.

   (2) Periodical patrol checklist for preventive maintenance should be enforced. It is recommended to utilize the check sheet to perform the preventive

maintenance works systematically without asking the detailed instructions from the generation manager. Also it is advised to prepare reports of the work done and keep it to use as reference in case of sudden trouble.

(3) Small calibration works and replacement of meters etc. should be done to get more accuracy in measurements and efficient operation. Ensure to introduce periodical measurements of pressure, temperature, etc. by using measuring instruments procured under the Project.

4. Asset Management Plan

The draft asset management plan was prepared by JICA Expert Team for further review by the Kiribati side. The Kiribati side is requested to share the comments (if any) by the end of October, 2019.

5. Preparation for DEG overhaul works

Following lists and schedules have been prepared and agreed between JICA Expert Team and the Kiribati side.

(1) List of necessary spare parts and maintenance tools for the next overhaul works.
(2) Maintenance work schedule for pilot DG units

6. Supervision for DEG overhaul works

The both sides confirmed the supervision of the DEG overhaul work shall be carried out on DEG unit 5 from February 2020. In order to coordinate with related project activities in other countries, the Kiribati side is requested to keep updating the latest overhaul schedule with the JICA Expert at least two months before conducting the overhaul works.

7. Continued Update of Manuals

Following manuals have been handed over to Kiribati side by March 2019, as a result of discussion and consultation with counterpart members.

1) Planning manual for Hybrid Power Generation System
2) Operation & Maintenance Manual for Solar PV System
3) Maintenance Manual for DEG's

It is very important that these manuals are fully utilized and revised as necessary after hand over. Therefore, the project counterpart members are requested to share the information and/or conduct training for other staff to apply these manuals in their daily works. The Kiribati side confirmed the application of manuals in following occasions;

1) Planning hybrid power generation system by development partners (list below the name of projects)
2) Actual O&M works for solar PV system
(list below the location and date of those works)
3) Others

The progress of activities will be monitored under the phase-2 period with the assistance by JICA Experts.

ATTACHMENT 1	Agenda for JCC Meeting
ATTACHMENT 2	Lists of Participants
ATTACHMENT 3	Project Monitoring Sheet ver. 3
ATTACHMENT 4	Project Design Matrix ver. 3
ATTACHMENT 5	Plan of Operation ver. 3

ATTACHMENT 1

Agenda for JCC Meeting

1. Opening Remarks by Ms. Saitofi Mika, Secretary, Ministry of Infrastructure and Sustainable Energy

2. Explanation and confirmation on the following documents;
   (1) Project Design Matrix (PDM)
   (2) Plan of Operation (PO)
   (3) Project Monitoring Sheet

3. Confirmation on the Minutes of Meeting (M/M)

4. Progress of Activities

5. Closing Remarks by Mr. Luis Kakefuku, Team Leader, JICA Expert Team

ATTACHMENT 2 List of Participants

Organization	Position	Name
Ministry of Infrastructure and Sustainable Energy	Secretary	Ms. Saitofi Mika
Ministry of Infrastructure and Sustainable Energy	Director of Energy	Ms. Mwaati Oten
Ministry of Infrastructure and Sustainable Energy	Renewable Energy Planner	Mr. Thomas Taoaba
Public Utilities Board	Power Engineering Manager	Mr. Tenikoria Katauea
Public Utilities Board	Generation Enginee	Mr. Tebwatia Takau
JICA	JICA Expert	Mr. Luis Kakefuku
JICA	JICA Expert	Mr. Hideyasu Hokama

ATTACHMENT 3

PROJECT MONITORING SHEET

Project Title: The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries
Version of the Sheet: Ver.3 (Dec. 2018 – Oct. 2019)
Project Term: March 2017 -June 2022

Name: Ms.Saitofi Mika
Title: Project Director
Name: Mr. Tadayuki OGAWA
Title: Chief Advisor
Submission Date: 3rd October, 2019

I. Summary

1 Progress

1-1 Progress of Inputs

(1) Japanese side

1) JICA Expert Team together with Chief Advisor has worked in July 2019 to conduct lectures and on-site trainings for the operation and maintenance of Diesel Engine Generators (DEGs) in Kiribati.
2) JICA Expert Team also worked with Kiribati side in September 2019 to conduct lectures and on-site trainings for RE grid integration and operation and maintenance of solar PV systems.

(2) Kiribati side

In total 8 number of core trainers are registered under the Project, 5 from PUB and 3 from MISE staff. Facilities and equipment (e.g. training classrooms) for the trainings in Kiribati were provided by PUB.

1-2 Progress of Activities

No.	Activity	Progress
Output 1: 1. Appropriate and economical system for O&M of Diesel Generators (DGs) is enhanced.		
1-1	Operational conditions of the existing DGs are reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose.	The result of discussions and analysis for future training needs was compiled as "Training Needs Assessment Report" and submitted to all members in November 2017.
1-2	Asset management plan of DG is reviewed	Draft asset management plan was

	including financial evaluation on overhaul.	submitted to PUB by October, 2019.
1-3	Specific fuel consumption of pilot DG units is measured.	Specific fuel consumption was measured by PUB in May 2018 after installation of new flow meter. The figure is 0.273 L/kWh and confirmed as the baseline figure for project evaluation.
1-4	Improvement plan for the operation of pilot DG units is prepared.	Improvement plan was prepared and shared with Kiribati side in the letter issued on 20th June 2018, after discussion and confirmation with PUB representatives.
1-5	Existing spare parts and maintenance tools of pilot DG units are confirmed.	Existing spare parts and maintenance tools were confirmed in May 2018.
1-6	Improvement plan for the operation of pilot DG units is implemented.	Improvement plan has been implemented by April 2019 under consultation with JICA Expert.
1-8	The concept of Economic Dispatch Control (EDC) is shared among operators and applied, if possible.	The basic concept of EDC has been explained by JICA Expert in May 2018.
1-9	Necessary spare parts and maintenance tools for the pilot DG units are prepared.	Kiribati side prepared spare parts and maintenance tools in accordance with the advice by JICA Expert by June 2019.
1-10	Maintenance work schedule for the pilot DG units is prepared.	Draft maintenance work schedule is under preparation by JICA Expert. PUB is requested to share the schedule for overhaul works for pilot DG units.
1-11	Check sheets and maintenance manuals for maintenance works for pilot DG units are prepared.	Draft check sheets and maintenance manuals was provided by JICA Expert in the training of July 2019.
1-15	Related training programs for appropriate O&M system for DGs are implemented periodically.	Related training in Kiribati was conducted twice in 2019.
1-16	Knowledge on appropriate O&M of DGs is disseminated among stakeholders	1st Seminar was held in Kiribati in July 2019.
Output 2: Methodology for appropriate planning and O&M of renewable energy (RE) is established.		
2-1	Current situation and future development plan of RE is reviewed, including confirmation of objectively verifiable indicators for overall goal.	Same as activity 1-1
2-2	Planning manual for Hybrid Power Generation System is prepared.	Draft planning manual was prepared by JICA Expert and shared with Kiribati side for further update in February 2019.
2-3	Planning manual for Hybrid Power Generation System is reviewed and updated in the target area.	Kiribati side is requested to keep reviewing and updating the manual under consultation with JICA Expert.
2-4	Operating conditions of the existing RE facilities are reviewed, including confirmation of objectively verifiable indicators for overall goal.	Same as activity 1-1 Objectively verifiable indicators for overall goal was confirmed at the 1st JCC meeting in 2017.
2-5	O&M manual for RE facilities is prepared.	Draft planning manual was prepared by JICA Expert and shared with Kiribati side for further update in February 2019
2-6	Maintenance works are conducted according to	Kiribati side is requested to keep reviewing

	O&M manual of RE facilities.	and updating the manual under consultation with JICA Expert.
2-8	Training program for Hybrid Power Generation System including O&M of RE facilities is conducted.	Related training in Kiribati will be conducted twice in total in 2019 and 2020.
2-9	Knowledge regarding Hybrid Power Generation System is disseminated among stakeholders.	1st Seminar was held in Kiribati in July 2019.

1-3 Achievement of Output

(1) Output 1

Technical advice for the improvement of O&M of DGs has been provided by JICA Experts based on the initial survey of current conditions conducted in 2017. Also, classroom lecture & hands-on trainings have been provided to ensure appropriate and economical O&M of DGs with draft manuals and check sheets. In addition, counterpart training has been conducted with site visits and hands-on trainings to learn the necessary O&M of DGs in Japan.

Unfortunately, major faults of Unit 4 stator coil have been observed in 2018 and 2019. Therefore, further contribution from Kiribati side should be expected to implement the improved O&M of DGs based on the learnings from the advice and trainings by JICA Experts.

(2) Output 2

Technical advice for the appropriate planning and O&M of RE has been provided by JICA Experts based on the initial survey of current conditions conducted in 2017. Also, classroom lecture & hands-on trainings have been provided to ensure appropriate planning and O&M of RE with draft manuals and check sheets. In addition, counterpart training has been conducted with site visits and hands-on trainings to learn the methodology of planning and O&M of RE in Japan.

"Planning manual for Hybrid Power Generation System" and "O&M manual for RE facilities" shall be utilized and updated in accordance with the current O&M practices by MISE and PUB. Also, the results of O&M works for all solar PV systems shall be recorded and shared with JICA Expert Team. Therefore, further contribution from Kiribati side should be expected to implement the improved planning and O&M of RE based on the learnings from the advice and trainings by JICA Experts.

1-4 Achievement of the Project Purpose

(Indicator 1) Improvement of specific fuel consumption of pilot DG units

The baseline figure for the specific fuel consumption is 0.273 L/kWh, while the measurement in 2018 resulted in the figure of 0.263 L/kWh. It is expected that those figures will be further improved after the planned overhaul works.

(Indicator 2) Improvement of performance ratio for RE power generation systems

The baseline figure for the performance ratio for PEC PV is 75%, while the measurement in 2018 resulted in the figure of 70.6%. Further analysis and additional measures will be needed to improve the performance ratio.

(Indicator 3) Proper application of planning and O&M method of HPGS

Planning manual and simulation tool (HOMER) have been utilized for the introduction of additional solar PV and battery system under the financial assistance by ADB.

1-5 Changes of Risks and Actions for Mitigation

1-6 Progress of Actions undertaken by JICA

1-7 Progress of Actions undertaken by the Parties

1-8 Progress of Environmental and Social Considerations (if applicable)

1-9 Progress of Considerations on Gender/ Peace Building/ Poverty Reduction (if applicable)

1-10 Other remarkable/ considerable issues related/ affect to the Project (such as other JICA's projects, activities of counterparts, other donors, private sectors, NGOs, etc.)

2 Delay of Work Schedule and/or Problems (if any)

2-1 Detail

The delay was observed in implementation of activity 1-2 (Asset management plan of DG is prepared including financial evaluation on overhaul.).

2-2 Cause

The delay was caused mainly because it took long time to confirm the current financial structure of PUB. However, the delay is not critical in implementation of the project as it will not delay smooth implementation of successive activities.

2-3 Action to be taken

2-4 Roles of Responsible Persons/ Organization (JICA, the Parties, etc.)

3 Modification of the Project Implementation Plan

3-1 Plan of Operation

3-2 Other modifications on detailed implementation plan

4 Preparation of Government of Kiribati toward after completion of the Project

Government of Kiribati and PUB will be further requested to utilize and update the related manuals and tools for the planning and O&M of Hybrid Power Generation System. Also, those core trainers who have participated in the training in Kiribati and Fiji need to continue on the OJT for other staff inside the organization (MISE, PUB) to share the necessary skills and knowledge for the introduction of Hybrid Power Generation System.

II. **Project Monitoring Sheet I & II as Attached**

(Project Design Matrix and Plan of Operation)

ATTACHMENT 4

Ver. 3, October, 2019

Project Design Matrix (PDM)

Project Title: The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries
Project Term : March 2017 - June 2022 (Five Years) (Phase 1: March 2017 – February 2019 , Phase 2: March 2019 – June 2022
Country: Republic of Kiribati
Target Area: Tarawa
Target Group: Related engineers and other technical staff in the target area (MISE and PUB)
MISE: Ministry of Infrastructure and Sustainable Energy PUB: Public Utilities Board

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal Energy security is improved and greenhouse gases are reduced through the reduction of fossil fuels consumption.	In comparison to the indicators at the time of baseline survey, 1. Reduced amount of CO2 emission of power utilities in the target area 2. Reduced amount of diesel fuel of power utilities in the target area 3. Increased capacity (kW) and actual generated energy (kWh) of renewable energy facilities of power utilities in the target area	1. to 3. Reports of C/P agencies	
Project Purpose Hybrid Power Generation System is introduced.	1. Improvement of specific fuel consumption of pilot DG units (better than the baseline data set at the beginning of the Project) 2. Improvement of performance ratio for RE power generation systems (better than the baseline data set at the beginning of the Project in consideration of aging deterioration of PV module) 3. Proper application of planning and O&M method of Hybrid Power Generation System	1. Record on specific fuel consumption of Pilot DG units by C/P, checked by Japanese experts 2. Record on operation of RE power generation systems 3. Evaluation by Japanese experts and C/P on plans and O&M of Hybrid Power Generation System	C/P agencies continue commitment to the Project by continuing budget allocation as well as assignment of personnel for the post- Project activities.
Outputs 1. Appropriate and economical system for O&M of Diesel Generators (DGs) is enhanced.	<Output 1> 1-1 Adequacy on the use of the work schedule, check sheets and manual for the maintenance work for the pilot DG units 1-2 Number of training participants who are conducting operation and maintenance of DG based on the learnings from the training program (target: 2)	1-1 Evaluation by Japanese experts and C/P on improvement of maintenance work (daily/partial inspection/overhaul work) for pilot DG units 1-2 Capacity assessment of trained maintenance staff and managers by Japanese experts	C/P agencies promote investment on renewable energy facilities based on the current national policy/plan.

2. Methodology for appropriate planning and O&M of Renewable Energy (RE) is established.	<Output 2> 2-1 Number of training participants who have been certified under the Project for the planning method of the Hybrid Power Generation System (target: 1) 2-2 Number of training participants who are conducting O&M of RE facilities based on the learnings from the training program (target: 2) 2-3 Preparation of related manuals for Hybrid Power Generation System 2-4 Adequacy of the use of the related manuals for Hybrid Power Generation System	2-1 Capacity assessment of trained staff and managers by Japanese experts 2-2 Capacity assessment of trained O&M staff and managers by Japanese experts 2-3 Evaluation by Japanese Experts on related manuals for Hybrid Power Generation System prepared by C/P 2-4 Evaluation by Japanese experts and C/P on the use of the related manuals for Hybrid Power Generation System	
Activities <Output 1> 1-1 Operational conditions of the existing DGs are reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose. 1-2 Asset management plan of DG is reviewed including financial evaluation on overhaul. 1-3 Specific fuel consumption of pilot DG units is measured. 1-4 Improvement plan for the operation of pilot DG units is prepared. 1-5 Existing spare parts and maintenance tools of pilot DG units are confirmed. 1-6 Improvement plan for the operation of pilot DG units is implemented. 1-7 The result of implementation of the improvement plan is evaluated, and improvement plan is updated. 1-8 The concept of Economic Dispatch Control (EDC) is shared among operators and applied, if possible. 1-9 Necessary spare parts and maintenance tools for the pilot DG units are prepared. 1-10 Maintenance work schedule for the pilot DG units is prepared. 1-11 Check sheets and maintenance manuals for maintenance works for pilot DG units are prepared. 1-12 Maintenance works (daily/partial inspection/overhaul work) for pilot DG units are conducted in accordance with the maintenance schedule. 1-13 The result of maintenance works is evaluated, and future maintenance work schedule together with budget (including sub-contract fee, cost for tools and equipment) is prepared. 1-14 Specific fuel consumption of the pilot DG units is measured before and after implementation of the related project activities. 1-15 Related training programs for appropriate O&M system for DGs are implemented periodically. 1-16 Knowledge on appropriate O&M of DGs is disseminated among stakeholders. <Output 2> 2-1 Current situation and future development plan of RE is reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose. 2-2 Planning manual for Hybrid Power Generation System is prepared. 2-3 Planning manual for Hybrid Power Generation System is reviewed and updated in the target area.	**Inputs** **(Japanese side)** 1. Dispatch of the Japanese experts <JICA long term expert, stationed in Fiji > - Hybrid Power Generation System (Completed by March 2019) <JICA Consultant Team> -Team Leader / Operation & Maintenance of DG -Economic operation of DG -Maintenance support of DG (Mechanical expert) -Maintenance support of DG (Electrical expert) -O&M of RE power generation system -Integration of RE power generation system -Project Coordinator 2. Training in Japan and Fiji 3. Equipment -In accordance with necessity of activities	**(Kiribati side)** 1. Assignment of C/Ps -Project Director (P/D) -Project Manager (P/M) -Engineers in charge of O&M (Manager level) - Mechanical Staff - Electrical Staff - Planning officer, and others 2. Facilities and equipment -Project office 3.Recurrent costs - C/Ps' wages and allowances - C/Ps' domestic travel expense	**Preconditions** Contents of the current relevant policies on promotion of renewable energy and energy efficiency are not largely changed.

2-4 Operating conditions of the existing RE facilities are reviewed, including confirmation of objectively verifiable indicators for overall goal. 2-5 O&M manual for RE facilities is prepared. 2-6 Maintenance works are conducted according to O&M manual of RE facilities. 2-7 The result of maintenance works is evaluated, and future maintenance work schedule together with budget is prepared. 2-8 Training program for Hybrid Power Generation System including O&M of RE facilities is conducted. 2-9 Knowledge regarding Hybrid Power Generation System is disseminated among stakeholders.			

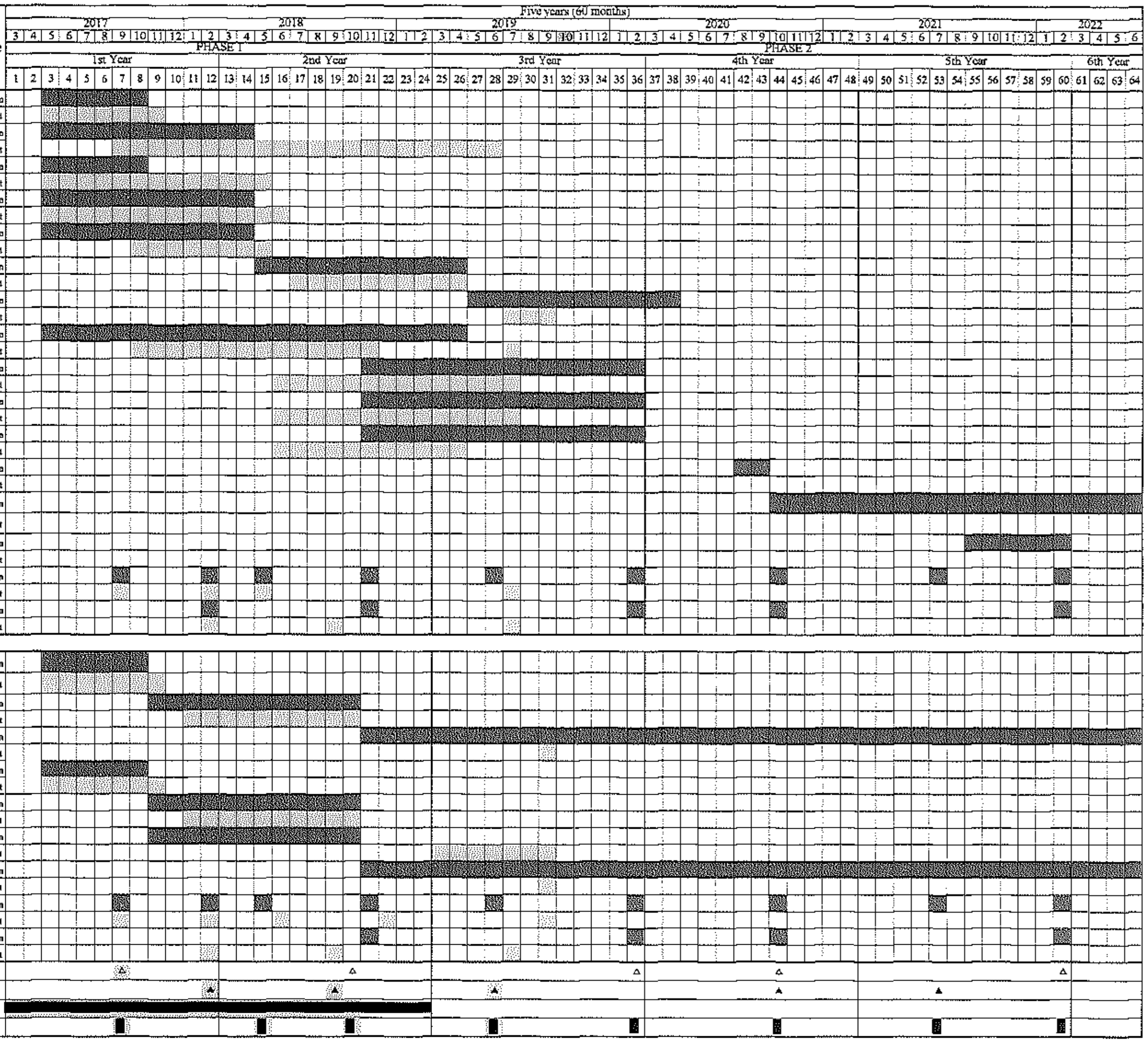
ATTACHMENT 5

Ver.4 October, 2019

Plan of Operation (PO)

Project Title: The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries
Project Term: March 2017 - June 2022 (Phase 1: March 2017 – February 2019 , Phase 2: March 2019 – June 2022)
Country: Kiribati
Target Area: Tarawa
Target Group: Related engineers and other technical staffs in the target area (MISE and PUB)

	Output 1 Activities 【Appropriate O&M System for DG】	Product	Organizations in Charge	
1-1.	Operational conditions of the existing DGs are reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose.	TNA Report, OVI	PUB, JICA Experts	Plan Act
1-2.	Asset management plan of DG is prepared including financial evaluation on overhaul.	PUB, JICA Experts	PUB, JICA Experts	Plan Act
1-3.	Specific fuel consumption of pilot DG units is measured.	Measurement of Specific fuel consumption	PUB, JICA Experts	Plan Act
1-4.	Improvement plan for the operation of pilot DG units is prepared.	Improvement plan	PUB, JICA Experts	Plan Act
1-5.	Existing spare parts and maintenance tools of pilot DG units are confirmed.	List of spare parts and maintenance tools	PUB, JICA Experts	Plan Act
1-6.	Improvement plan for the operation of pilot DG units is implemented.	Improvement Implementation Report	PUB, JICA Experts	Plan Act
1-7.	The result of implementation of the improvement plan is evaluated, and improvement plan is updated.	Improvement Evaluation Report	PUB, JICA Experts	Plan Act
1-8.	The concept of Economic Dispatch Control (EDC) is shared among operators and applied, if possible.	EDC software, manual, EDC sheet	PUB, JICA Experts	Plan Act
1-9.	Necessary spare parts and maintenance tools for the pilot DG units are prepared.	List of spare parts and maintenance tools prepared	PUB, JICA Experts	Plan Act
1-10.	Maintenance work schedule for the pilot DG units is prepared.	Maintenance work shedule	PUB, JICA Experts	Plan Act
1-11.	Check sheets and maintenance manuals for maintenance works for pilot DG units are prepared.	Check sheets and maintenance manulas	PUB, JICA Experts	Plan Act
1-12.	Maintenance works (daily/partial inspection/overhaul work) for pilot DG units are conducted in accordance with the maintenance schedule.	Maintenance record	PUB, JICA Experts	Plan Act
1-13.	The result of maintenance works is evaluated, and future maintenance work schedule together with budget (including sub-contract fee, cost for tools and equipment) is prepared.	Evaluation report and future schedule for maintenance	PUB, JICA Experts	Plan Act
1-14.	Specific fuel consumption of the pilot DG units is measured before and after implementation of the related project activities.	Measurement for specific consumption of the pilot DG	PUB, JICA Experts	Plan Act
1-15.	Related training programs for appropriate O&M system DGs are implemented periodically.	Training record, recommendations, reports, etc.	MISE, PUB, JICA Experts	Plan Act
1-16.	Knowledge on appropriate O&M of DGs is disseminated among stakeholders.	Seminar, workshop records	MISE, PUB, JICA Experts	Plan Act
Output 2 Activities				
2-1.	Current situation and future development plan of RE is reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose.	TNA Report, OVI	PUB, JICA Experts	Plan Act
2-2.	Planning manual for Hybrid Power Generation System is prepared	Planning manual for Hybrid Power Generation	PUB, JICA Experts	Plan Act
2-3.	Planning manual for Hybrid Power Generation System is reviewed and updated in the target area.	Updated Planning manual for Hybrid Power Generation	PUB, JICA Experts	Plan Act
2-4.	Operating conditions of the existing RE facilities are reviewed, including confirmation of objectively verifiable indicators for overall goal.	TNA Report, OVI	PUB, JICA Experts	Plan Act
2-5.	O&M manual for RE facilities is prepared.	O&M manual for RE facilities	PUB, JICA Experts	Plan Act
2-6.	Maintenance works are conducted according to O&M manual of RE facilities.	Maintenance Record	PUB, JICA Experts	Plan Act
2-7.	The result of maintenance works is evaluated, and future maintenance work schedule together with budget is prepared.	Evaluation report of maintenance work, and schedule	PUB, JICA Experts	Plan Act
2-8.	Training program for Hybrid Power Generation System including O&M of RE facilities is conducted.	Training record, recommendations, reports, etc.	MISE, PUB, JICA Experts	Plan Act
2-9.	Knowledge regarding Hybrid Power Generation System is disseminated among stakeholders.	Seminar, workshop records	MISE, PUB, JICA Experts	Plan Act
	△: JCC			
	▲: Training in Japan/Fiji			
	JICA long term expert, stationed in Fiji			
	JICA Consultant Team			



4.4 4th JCC Meeting

MINUTES OF MEETING BETWEEN THE AUTHORITIES CONCERNED OF THE GOVERNMENT OF REPUBLIC OF KIRIBATI AND JAPAN INTERNATIONAL COOPERATION AGENCY FOR THE FOURTH JOINT COORDINATION COMMITTEE (JCC) ON THE PROJECT FOR INTRODUCTION OF HYBRID POWER GENERATION SYSTEM IN PACIFIC ISLAND COUNTRIES

Japan International Cooperation Agency (hereinafter referred to as "JICA") and the authorities concerned of the Government of Kiribati (hereinafter referred to as "Kiribati side") established a Joint Coordination Committee (hereinafter referred to as "JCC") for the effective and successful implementation of the Project for Introduction of Hybrid Power Generation System in Pacific Island Countries (hereinafter referred to as "the Project").

The fourth JCC on the Project was held on 29th October 2021, through the on-line arrangement connecting stakeholders of Kiribati and JICA side. The meeting was chaired by Dr. Farran Redfern, Secretary of the Ministry of Infrastructure and Sustainable Energy (hereinafter referred to as "MISE").

The both parties acknowledge and agree that the signing of this Minutes of Meeting may be executed by electronic signature, which is considered as an original signature, and therefore has the same force and effect as an original signature. "Electronic signature" includes faxed versions of an original signature or electronically scanned and transmitted versions (e.g., via pdf) of an original signature.

As a result of the discussion on the fourth JCC, JICA and the Kiribati side agreed on the main points as described in the Annex attached hereto.

Tarawa, October 29th, 2021

⑦

小川 忠之

Ogawa Tadayuki
Chief Advisor
JICA Senior Advisor

17/11/21

Dr. Farran Redfern
Secretary
Ministry of Infrastructure and Sustainable Energy
Republic of Kiribati

Mayumi Amaike

Amaike Mayumi
Resident Representative
JICA Fiji Office

James Young

James Young
Chief Executive Officer
Public Utilities Board
Republic of Kiribati

JRY

ANNEX

The Kiribati side and JICA (hereinafter referred to as "both sides") discussed on the issues including the contents of (i)Project Design Matrix (PDM), (ii)Plan of Operation (PO), and (iii)Project Monitoring Sheet, based on the Agenda attached hereto.

The both sides confirmed the main points as described below.

1. Extension of Project Period

   It was recommended by JICA Expert to conduct supplementary trainings and meetings at site, in addition to on-line supports, since hands-on trainings at site have been postponed due to COVID-19 pandemic since March 2020. Even though JICA Expert team has been trying to implement on-line support to complete the project activities, some activities related to the training for maintenance of DEG and solar PV system require face-to-face instructions at site in Kiribati.

   The both Parties agreed to process the required procedures for the extension of the Project period by one year, up to June 2023.

2. Confirmation of PDM, PO and Project Monitoring Sheet

   The both sides confirmed the latest version of PDM and PO as attachment 4 and 5. Also, the project monitoring sheet was agreed as attachment 3.

3. Project Organization

   The both sides confirmed the update of the Project Counterpart Team and assignment of the officials as described below. Those counterparts are core trainers in each task, and expected to disseminate technical knowledge and skills among other members in the organization periodically during the Project. These members should be remained as core trainers by 2023.

   - Project Counterparts (Core Trainers)

     1) Operation and Maintenance of Diesel Engine Generators
     Tebwatia Takau (Generation Engineer, PUB)
     Tebakabu Tion (Lead Hand Mechanical, PUB)
     Kirite Uriam (Lead Hand, Mechanical, PUB)

     2) Plan for introduction of hybrid power generation systems
     Simon Reiher (Urban Energy Planner, MISE)
     Mary Rui (Solar PV engineer, PUB)
     Bauro Mikaere (Instrumentation & control engineer, PUB)

     3) Operation and Maintenance of Renewable Energy generation system
     Beria Oromita (Energy Technician, MISE)
     Burennata Teinamotuna (Energy Technician, MISE)
     Mary Rui (Solar PV engineer, PUB)
     Tikoro Uriam (Solar PV technician, PUB)

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4. Continued Revision & Update of Manuals

The Kiribati side has been working to revise and update following manuals by July 2022, under supervision by JICA Expert.

1) Planning manual for Hybrid Power Generation System
2) Operation & Maintenance Manual for Solar PV System
3) Maintenance Manual for DEGs

It is very important that these manuals are continuously utilized and revised as necessary. Therefore, the project counterpart members are requested to share the information and/or conduct training for other staff to apply these manuals in their daily works. The Kiribati side confirmed the application of manuals in following occasions;

1) Planning hybrid power generation system by development partners
   (STREP Project, ADB)
2) Actual O&M works for solar PV system
   (Monthly inspection of PV system)
3) Actual O&M works for DEGs
   (Applied for overhaul works and monthly/quarterly/annual inspections)

ATTACHMENT 1	Agenda for JCC Meeting
ATTACHMENT 2	Lists of Participants
ATTACHMENT 3	Project Monitoring Sheet ver. 5
ATTACHMENT 4	Project Design Matrix ver. 4
ATTACHMENT 5	Plan of Operation ver. 6.2

4.5 5th JCC Meeting

MINUTES OF MEETING
BETWEEN
THE AUTHORITIES CONCERNED OF
THE GOVERNMENT OF REPUBLIC OF KIRIBATI
AND
JAPAN INTERNATIONAL COOPERATION AGENCY
FOR
THE FIFTH JOINT COORDINATION COMMITTEE (JCC)
ON
THE PROJECT FOR INTRODUCTION OF HYBRID POWER GENERATION SYSTEM IN PACIFIC ISLAND COUNTRIES

Japan International Cooperation Agency (hereinafter referred to as “JICA”) and the authorities concerned of the Government of Kiribati (hereinafter referred to as “Kiribati side”) established a Joint Coordination Committee (hereinafter referred to as “JCC”) for the effective and successful implementation of the Project for Introduction of Hybrid Power Generation System in Pacific Island Countries (hereinafter referred to as “the Project”).

The fifth JCC on the Project was held on 7th October 2022, at the conference room of the Ministry of Infrastructure and Sustainable Energy (hereinafter referred to as “MISE”), chaired by Ms. Moanibou Aareke Muller, Assistant Secretary of MISE.

As a result of the discussion on the fifth JCC, JICA and the Kiribati side agreed on the main points as described in the Annex attached hereto.

Tarawa, October 7th, 2022

MM

小川 忠之

Ogawa Tadayuki
Chief Advisor
JICA Senior Advisor

For Dr. Farran Redfern
Secretary
Ministry of Infrastructure and Sustainable Energy
Republic of Kiribati

Mayumi Amaike

Amaike Mayumi
Resident Representative
JICA Fiji Office

James Young
Chief Executive Officer
Public Utilities Board
Republic of Kiribati

ANNEX

The Kiribati side and JICA (hereinafter referred to as "both sides") discussed on the issues including the contents of (i)Project Design Matrix (PDM), (ii)Plan of Operation (PO), and (iii)Project Monitoring Sheet, based on the Agenda attached hereto.

The both sides confirmed the main points as described below.

1. Confirmation of PDM, PO and Project Monitoring Sheet

   The both sides confirmed the latest version of PDM and PO as attachment 4 and 5. Also, the project monitoring sheet was agreed as attachment 3.

2. Project Organization

   The both sides confirmed the update of the Project Counterpart Team and assignment of the officials as described below. Those counterparts are core trainers in each task, and expected to disseminate technical knowledge and skills among other members in the organization periodically during the Project. These members should be remained as core trainers by the end of the project period.

   ➢ Project Counterparts (Core Trainers)

   1) Operation and Maintenance of Diesel Engine Generators
   Teebwatia Takau (Generation Engineer, PUB)
   Tebakabu Tion (Lead Hand Mechanical, PUB)
   Kirite Uriam (Lead Hand, Mechanical, PUB)

   2) Plan for introduction of hybrid power generation systems
   Simon Reiher (Urban Energy Planner, MISE)
   Thomas Taoaba (Rural Energy Planner, MISE)
   Mary Rui (Solar PV engineer, PUB)
   Bauro Mikaere (Instrumentation & control engineer, PUB)

   3) Operation and Maintenance of Renewable Energy generation system
   Beria Oromita (Energy Technician, MISE)
   Burennata Teinamotuna (Energy Technician, MISE)
   Mary Rui (Solar PV engineer, PUB)
   Tikoro Uriam (Solar PV technician, PUB)

3. Improvement Plan for the Operation of Pilot DG Units

   The Kiribati side agreed to implement following measures to improve the operation conditions of pilot DEG units. The result of implementation of the improvement plan will be confirmed with JICA Experts by the end of the Project.

   (1) DEG operation data shall be recorded and kept in soft data for further power system analysis, together with describing reasons of stop/start each unit.
   (2) Periodically (each 3～4 month) conduct internal cleaning for the generator,

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and during the overhaul of the engines conduct the washing of the generator stator and rotor using the appropriate cleaning liquid. It is requested to keep records including pictures showing condition of before and after the work. It is requested to install the dust filter that JICA Expert team will send in the cooling air intake of the generator to prevent fast internal soiling.

(3) Specific fuel consumption of each unit should be periodically measured and monitored, the result of which will be reflected on unit dispatch schedule and in the setting of maintenance schedule for the fuel system related devices.

(4) Periodical patrol checklist for preventive maintenance should be enforced.

4. Third Regional Training in Fiji

(1) Objective

Counterparts from FSM, RMI, Kiribati and Tuvalu will be invited to Fiji to conduct the 3rd regional training under the Project tentatively in February 2023. The participants will have an opportunity to exchange their views and opinions with other participants to improve their skills and knowledge. Trainers in Fiji will be supported by the Japanese Experts to deliver classroom lectures and hands-on trainings in accordance with curriculum. The result of the training will be evaluated to improve the training curriculum, textbooks & materials for future trainings.

(2) Venue

The possible venue of the training are listed as follows. If COVID 19 situation does not allow, the training would be conducted online.

1) EFL Training Center
2) EFL Diesel Power plants (Vuda, Kinoya, etc.)
3) Solar PV plants (various)

(3) Participants

It is requested to appoint the same participants as the 1st & 2nd regional training from MISE and PUB. Counterpart members who joined the 2nd regional training is listed as below.

1) Operation & Maintenance for Diesel Engine Generators
Teebwatia Taakau, Bauro Mikaele

2) Grid Integration of Renewable Energy Generation Systems, Operation & Maintenance of Renewable Energy generation Systems (Solar PV)
Bauro Mikaele, Mary Rui, Thomas Taoaba, Simon Reiher

5. Training Equipment

Following equipment has been already handed over to the Kiribati side under the Project.

No.	Equipment Name	Model No.	Qty	Date of Handover
1	Fuel flow meter	RC25CFFM2	4	2018/5/1
2	Pyranometer & thermometer	SPST-A-F2	1	2018/6/21
3	StringTracer(I-V curve tracer)	SPST-A2A-Y1	1	2018/6/21
4	Cell Line Checker (Fault module detector)	SPLC-A-Y1	1	2018/6/21
5	HOMER PRO (PUB)		1	(2018/10/26)
6	HOMER PRO (MISE)		1	(2018/10/26)
7	Digital Pressure Calibrator※	DPI800S	1	(2018/12/12)
8	Digital multimeter※	TY710	1	(2018/12/12)
9	Digital thermometer※	TX1001	1	(2018/12/12)
10	Instrumentation signal measurement / generator※	CA150	1	(2018/12/12)
11	Ohm meter※	240633J	1	(2018/12/12)
12	Air compressor kit	PV 211	1	(2018/12/12)
13	Air hose	1 m × 2 1.5 m × 1	1	(2018/12/12)
14	Various types of fittings	(1/8, 1/4, 3/8, 1/2, 3/4, 1)	1	(2018/12/12)

※ with calibration certificate

Adding to above equipment, JICA is going to provide below equipment to improve PUB maintenance works in DEG and RE.
It is required for the Kiribati side to keep and utilize above equipment in an appropriate manner. In case of missing/malfunction of equipment, the Kiribati side is requested to inform JICA Experts immediately.

No.	DG Equipment name	Model	Qty.	Manufacturer
1	Battery HiTester	BT3554	1	HIOKI
2	Clamp on AC/DC HiTester	3285	1	HIOKI
3	Radiation thermometer	FT3701	1	HIOKI
4	Battery hydrometer	—	1	—
5	Vibration measuring instrument	TA415EB	1	TASCO
6	Digital panel meter	K3MA-J DC24V	6	OMRON
7	DC input converter	WVS-AAA-P DC110V	6	M-SYSTEM
8	VILEDON air filter (W1.6m×30m×8mm)	PS/150N	1	JAPAN VILENE COMPANY, LTD.

No.	RE Equipment name	Model	Qty.	Manufacturer
9	Thermographic Camera	TiS55+	1	Fluke
10	Digital Multimeter	DT4254	1	HIOKI
11	Mower	MEM428	1	Makita
12	High pressure washer	JCE-1408UDX	1	KOSHIN
13	Insulation resistance tester	IR4053-11	1	HIOKI

6. Continued Revision & Update of Manuals

   Both sides confirmed that the Kiribati side completed to revise and update following manuals by the end of December 2022, under supervision by JICA Expert.

   1) Planning manual for Hybrid Power Generation System
   2) Operation & Maintenance Manual for Solar PV System
   3) Maintenance Manual for DEGs

   Also, it is necessary that these manuals are continuously utilized and revised periodically in accordance with the progress of activities. Therefore, the project counterpart members are requested to share the information and/or conduct training for other staff to apply these manuals in their daily works.

7. Supervision for DEG overhaul works

   Both sides confirmed the supervision of the Unit #5 overhaul work shall be commenced by the middle of January 2023. In order to coordinate with related project activities in other countries, the Kiribati side is requested to keep updating the latest overhaul schedule with the JICA Expert as early as possible before conducting the overhaul works. MOU shall be concluded in advance between PUB and JICA to confirm the scope of works by JICA Expert.

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ATTACHMENT 1

Agenda for JCC Meeting

1. Opening Remarks by Ms. Moanibou Aareke Muller, Assistant Secretary, Ministry of Infrastructure and Sustainable Energy

2. Explanation and confirmation on the following documents;
   (1) Project Design Matrix (PDM)
   (2) Plan of Operation (PO)
   (3) Project Monitoring Sheet

3. Confirmation on the Minutes of Meeting (M/M)

4. Progress of Activities

5. Closing Remarks by Mr. Ogawa Tadayuki, Chief Advisor of the Project

ATTACHMENT 2 List of Participants

Organization	Position	Name
Ministry of Infrastructure and Sustainable Energy	Assistant Secretary	Ms. Moanibou Aareke Muller
Ministry of Infrastructure and Sustainable Energy	Head of Energy Planning Unit	Ms. Miriam Toatara
Ministry of Infrastructure and Sustainable Energy	Renewable Energy Planner	Mr. Thomas Taoaba
Public Utilities Board	Chief Executive Officer	Mr. James Young
Public Utilities Board	Generation Engineer	Mr. Teebwatia Takau
JICA Fiji Office	Assistant Resident Representative	Mr. Iwatani Makumo
JICA Kiribati Field Office	Project Formulation Advisor	Mr. Matsui Nobuaki
JICA	Chief Advisor	Mr. Ogawa Tadayuki
JICA	JICA Expert	Mr. Luis Kakefuku
JICA	JICA Expert	Mr. Hokama Hideyasu

ATTACHMENT 3

To RR of JICA Fiji Office

PROJECT MONITORING SHEET

Project Title: The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries
Version of the Sheet: Ver.6 (Oct. 2021 – Sep. 2022)
Project Term: March 2017 –June 2023
Country: Kiribati

Name: Dr. Farran Redfern
Title: Project Director
Name: Mr. OGAWA Tadayuki
Title: Chief Advisor
Submission Date: 7th October , 2022

I. Summary

1 Progress

1-1 Progress of Inputs

(1) Japanese side

1) Since March 2019, Chief Advisor has been based in Japan and assists JICA expert team & Kiribati counterparts to continuously upgrade skills and knowledge mainly through on-line support.
2) Due to the spread of COVID-19, JICA expert team has been working for on-line remote trainings since June 2020. In total nine (9) remote sessions were held for O&M of Diesel Engine Generator (DG) and another eight (8) sessions were conducted for grid integration of RE, O&M of PV facilities, also for the follow-up of revising manuals DG three (3) remote sessions, RE four (4) remote sessions were held.

(2) Kiribati side

In total 10 number of core trainers are registered under the Project, 7 from PUB and 3 from MISE staff. Facilities and equipment (e.g., training classrooms) for the trainings in Kiribati were provided by PUB. Four (4) core trainers from PUB and one (1) from MISE participated in the 1st regional training in Fiji in 2019.

For the on-line support sessions including the 2nd Regional Training, 144 trainers (cumulative total (DG:78 trainers, RE 66 trainers)) joined until the end of August2022.

ATTACHMENT 3

1-2 Progress of Activities

No.	Activity	Progress
Output 1: 1. Appropriate and economical system for O&M of Diesel Generators (DGs) is enhanced.		
1-1	Operational conditions of the existing DGs are reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose.	The result of discussions and analysis for future training needs was compiled as "Training Needs Assessment Report" and submitted to all members in November 2017.
1-2	Asset management plan of DG is reviewed including financial evaluation on overhaul.	Final Report for the asset management plan was submitted to PUB in July, 2021.
1-3	Specific fuel consumption of pilot DG units is measured.	Specific fuel consumption was measured by PUB in May 2018 after installation of new flow meter. The figure is 0.273 L/kWh and confirmed as the baseline figure for project evaluation. According to PUB reports, average values of SFC measured between October 2021 to June 2022 is shown below DG3: 0.2765 L/kWh DG4: 0.2629 L/kWh DG5: 0.2738 L/kWh AVG: 0.2758 L/kWh
1-4	Improvement plan for the operation of pilot DG units is prepared.	Improvement plan was prepared and shared with Kiribati side in the letter issued on 20th June 2018, after discussion and confirmation with PUB representatives.
1-5	Existing spare parts and maintenance tools of pilot DG units are confirmed.	Existing spare parts and maintenance tools were confirmed in May 2018.
1-6	Improvement plan for the operation of pilot DG units is implemented.	Improvement plan has been implemented by April 2019 under consultation with JICA Expert.
1-7	The result of implementation of the improvement plan is evaluated, and improvement plan is updated.	Updated improvement plan has been implemented since April 2019. JICA expert team confirmed the improvements in the last on-line training and the updated plan is under preparation. Additional budget is considered necessary to complete some proposed items.
1-8	The concept of Economic Dispatch Control (EDC) is shared among operators and applied, if possible.	The basic concept of EDC has been explained by JICA Expert in May 2018.
1-9	Necessary spare parts and maintenance tools for the pilot DG units are prepared.	Kiribati side prepared spare parts and maintenance tools in accordance with the advice by JICA Expert by June 2019.
1-10	Maintenance work schedule for the pilot DG units is prepared.	Draft maintenance work schedule is under preparation by JICA Expert. PUB is requested to share the schedule for overhaul works for pilot DG units.

1-11	Check sheets and maintenance manuals for maintenance works for pilot DG units are prepared.	Draft check sheets and maintenance manuals was provided by JICA Expert in the training of July 2019. The manual revision has started in June 2020, updating the contents according to PUB standards.
1-12	Maintenance works (daily/partial inspection/overhaul work) for pilot DG units are conducted in accordance with the maintenance schedule.	On-line support for overhaul works for unit #3 was done and evaluated. PUB is now under preparation for the overhaul works for unit #5 which will be supported by JICA Expert.
1-13	The result of maintenance works is evaluated, and future maintenance work schedule together with budget (including sub-contract fee, cost for tools and equipment) is prepared.	The result of the OH in the unit #3 was evaluated, future maintenance work schedule and necessary budget are in preparation.
1-14	Specific fuel consumption of the pilot DG units is measured before and after implementation of the related project activities.	The SFC of the unit 3 before the OH was 0.2776L/kWh (75%load), after the OH SFC=0.269 L/kWh (85% load) Next verification in unit 5 planned to do during the OH. Recent August 2022 data are: Unit 3 : 0.2726 L/kWh Unit 4 : 0.2767 L/kWh Unit 5: 0.2750 L/kWh
1-15	Related training programs for appropriate O&M system for DGs are implemented periodically.	From Sept. 2021 to Sep. 2022, three (3) on-line trainings, one (1) regional training were carried out with 33 cumulative total participants.
1-16	Knowledge on appropriate O&M of DGs is disseminated among stakeholders	1st Seminar was held in Kiribati in July 2019.
Output 2: Methodology for appropriate planning and O&M of renewable energy (RE) is established.		
2-1	Current situation and future development plan of RE is reviewed, including confirmation of objectively verifiable indicators for overall goal.	Same as activity 1-1
2-2	Planning manual for Hybrid Power Generation System is prepared.	Draft planning manual was prepared by JICA Expert and shared with Kiribati side for further update in February 2019. The manual revision has started in June 2020, updating the contents according to PUB standards.
2-3	Planning manual for Hybrid Power Generation System is reviewed and updated in the target area.	Currently Kiribati side is requested to update the manuals under consultation with JICA Expert team. Updating is going on and it is planned to finish it at the end of December 2022.
2-4	Operating conditions of the existing RE facilities are reviewed, including confirmation of objectively verifiable indicators for overall goal.	Same as activity 1-1 Objectively verifiable indicators for overall goal were confirmed at the 1st JCC meeting in 2017.
2-5	O&M manual for RE facilities is prepared.	Draft O&M manual was prepared by JICA Expert and shared with Kiribati side for

		further update in February 2019. The manual revision has started in June 2020, updating the contents according to Kiribati standards. Updating is planned to finish in December 2022.
2-6	Maintenance works are conducted according to O&M manual of RE facilities.	Kiribati side is requested to keep reviewing and updating the manual according to the results of maintenance works, as well as consulting with the JICA expert team.
2-7	The result of maintenance works is evaluated, and future maintenance work schedule together with budget is prepared.	Yet to be commenced
2-8	Training program for Hybrid Power Generation System including O&M of RE facilities is conducted.	From Oct. 2021 to Sep. 2022, one (1) on-line training, four (4) manual updating follow-up meeting and one (1) regional training was carried out with 15 cumulative total participants.
2-9	Knowledge regarding Hybrid Power Generation System is disseminated among stakeholders.	1st Seminar was held in Kiribati in July 2019.

(Remarks) Yellow-highlighted activities have already been completed. Underlined parts are the activities conducted during the period of this Monitoring Sheet

1-3 Achievement of Output

(1) Output 1

Technical advice for the improvement of O&M of DGs has been provided by JICA Experts based on the initial survey of current conditions conducted in 2017. Also, classroom lecture & hands-on trainings have been provided to ensure appropriate and economical O&M of DGs with draft manuals and check sheets. In addition, counterpart training has been conducted with site visits and hands-on trainings to learn the necessary O&M of DGs in Japan. Since June 2020, on-line support by JICA Experts has been carried out to monitor the progress of related activities. This on-line support includes periodical meetings with counterparts and managers in addition to a series of training sessions.

As a result of this JICA Experts trainings, from October 13 to December 1 of 2021, Unit #3 was overhauled by the PUB staff under the online guidance of the JICA Expert Team. Even though on-site instructions were not provided, it was a remarkable event as the PUB team could complete the works without assistance by overseas supervisors for the first time.

Unfortunately, major faults of Unit 4 stator coil have been observed in 2018 and 2019. Therefore, further contribution from Kiribati side (e.g., periodical cleaning of alternators) should be expected to implement the improved O&M of DGs based on the learnings from the advice and trainings by JICA Experts. In addition, Kiribati side is encouraged to work for updating and revising related manuals under the on-line support by JICA Experts.

(Indicator 1-1) Adequacy on the use of the work schedule, check sheets and manual for the maintenance work for the pilot DG units
(Achievement) Draft check sheets and maintenance manuals are under revision according to Kiribati standards. Draft maintenance work schedule is under preparation to be finalized once the Kiribati side determine the actual work period.
(Indicator 1-2)Number of training participants who are conducting operation and maintenance of DG based on the learnings from the training program (target: 2)
(Achievement) Three core counterparts are expected to continue working for the operation and maintenance of DG based on the learnings from the training program.

(2) Output 2
Technical advice for the appropriate planning and O&M of RE has been provided by JICA Experts based on the initial survey of current conditions conducted in 2017. Also, classroom lecture & hands-on trainings have been provided to ensure appropriate planning and O&M of RE with draft manuals and check sheets. In addition, counterpart training has been conducted with site visits and hands-on trainings to learn the methodology of planning and O&M of RE in Japan. Since June 2020, on-line support by JICA Experts has been carried out to monitor the progress of related activities. This on-line support includes periodical meetings with counterparts and managers in addition to a series of training sessions.

"Planning manual for Hybrid Power Generation System" and "O&M manual for RE facilities" shall be utilized and updated in accordance with the current O&M practices by MISE and PUB. Also, the results of O&M works for all solar PV systems shall be recorded and shared with JICA Expert Team. Therefore, further contribution from Kiribati side should be expected to implement the improved planning and O&M of RE based on the learnings from the advice and trainings by JICA Experts.

(Indicator 2-1) Number of training participants who have been certified under the Project for the planning method of the Hybrid Power Generation System (target: 1)

(Achievement) Three core counterparts have been working for the related activities of planning Hybrid Power Generation System.

(Indicator 2-2) Number of training participants who are conducting O&M of RE facilities based on the learnings from the training program (target: 2)

(Achievement) Four core counterparts are expected to continue working for the operation and maintenance of RE based on the learnings from the training program.

(Indicator 2-3) Preparation of related manuals for Hybrid Power Generation System

(Achievement) Draft planning manual together with O&M manual was prepared by JICA Expert and Kiribati side is currently working for further revision in accordance with Kiribati standards.

(Indicator 2-4)Adequacy of the use of the related manuals for Hybrid Power Generation System

(Achievement) Already draft O&M manual with related check sheets are utilized for the operation and maintenance of existing solar PV systems.

1-4 Achievement of the Project Purpose

(Indicator 1) Improvement of specific fuel consumption of pilot DG units

The baseline figure for the specific fuel consumption is 0.263 L/kWh (average for unit #3, 4, and 5), while the measurement average in the unit #3 in the period June 2021 to October 2021 was 0.2779 L/kWh and after the OH in November 2021 resulted in the figure of 0.269 L/kWh. We can see that PUB improved the SFC figure after the OH works compared with baseline value. JICA Experts also expect the same result after the next overhaul works in the unit #5.

(Indicator 2) Improvement of performance ratio for RE power generation systems

The baseline figure for the performance ratio for PEC PV is 75%, while the measurement in the period January to July 2022 shows an average of 60 %. It is due to the fact that several number of PCSs have been under repair during the period. JICA Experts recommend as improvement measures the cleaning of the panels surface once every two months and continued inspections to avoid shadowing.

Also, the average performance ratio and improvement measures of other facilities are described below:

UAE PV 65.87%, TCH 56.4%, KGV 61.36%, KIT 35.1% and BSC 73.8%.

- TCH PV facility

  During April to May in 2022, PR measurement were not taken due to a possible failure of the SMA manufactured cluster controller. PUB did not use original spare to restore the power generation of the facility. JICA Experts recommended PUB to take contact with SMA for more detailed technical assistance. Also, in August, lightning arrestor failed and PUB together with JICA Experts are currently studying the possibility of replacing them using arrestors of UAE PV facility.

- KGV PV facility

  PR values were around 60% between January and March, but dropped to 50% in April due to a trip of one inverter and cracks of six(6) panels. The cause of this cracks is unknown, perhaps broken by stone throwing. Panels were replaced with spares and currently the PR is 70.6% and there are no big issues in the facility. JICA Experts recommended PUB to make 2 or 3 periodicals patrolling per month to make visual inspection.

- BSC PV facility

  The facility has been a corona isolation facility since mid-May 2022 and is not accessible to make the measurements.

JICA Experts recommend to include the I-V curve measured with the instrument provided by JICA Experts team in the inspection reports.

(Indicator 3) Proper application of planning and O&M method of HPGS

Planning manual and simulation tool (HOMER) have been utilized for the introduction of additional solar PV and battery system under the financial assistance by ADB.

1-5 Changes of Risks and Actions for Mitigation

N/A

1-6 Progress of Actions undertaken by JICA

N/A

1-7 Progress of Actions undertaken by the Parties

N/A

1-8 Progress of Environmental and Social Considerations (if applicable)

N/A

1-9 Progress of Considerations on Gender/ Peace Building/ Poverty Reduction (if applicable)

Two female engineers from PUB are working for planning & maintenance of PV system, and they lead the PUB team during the remote trainings and related activities at site.

1-10 Other remarkable/ considerable issues related/ affect to the Project (such as other JICA's projects, activities of counterparts, other donors, private sectors, NGOs, etc.)

Embassy of Japan in Fiji will procure generators and related equipment for Bikenibeu P/S under Japan's Grant Aid for the Economic and Social Development Programme. In addition, new Feasibility Study for introducing floating solar and other productive uses of electricity has been launched by ADB.

2 Delay of Work Schedule and/or Problems (if any)

2-1 Detail

Even though on-line support activities have been undertaken and the obvious delay is not expected, it has been difficult to confirm the progress of some activities at site, especially those related to the maintenance of DEGs. In addition, originally the second regional training was scheduled in 2020, but it has been postponed to 2021 due to the extended COVID-19 pandemic.

2-2 Cause

The issue was caused by the global COVID-19 pandemic and international border restrictions as a consequence.

2-3 Action to be taken

Kiribati side is requested to accelerate the revision of manuals (both DEG and RE) and conduct maintenance works in accordance with the manuals by the end of 2022. JICA Expert will assist the Kiribati side to establish the future maintenance work schedule together with budget.

2-4 Roles of Responsible Persons/ Organization (JICA, the Parties, etc.)

N/A

3 Modification of the Project Implementation Plan

3-1 Plan of Operation

N/A

3-2 Other modifications on detailed implementation plan

N/A

4 Preparation of Government of Kiribati toward after completion of the Project

Government of Kiribati and PUB will be further requested to utilize and update the related manuals and tools for the planning and O&M of Hybrid Power Generation System. Also, those core trainers who have participated in the training in Kiribati and Fiji need to continue on the OJT for other staff inside the organization (MISE, PUB) to share the necessary skills and knowledge for the introduction of Hybrid Power Generation System.

II. Project Monitoring Sheet I & II as Attached

(Project Design Matrix and Plan of Operation)

ATTACHMENT 4

Ver. 4, October, 2021

Project Design Matrix (PDM)

Project Title: The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries
Project Term : March 2017 - June 2023 (Six Years) (Phase 1: March 2017 – February 2019 , Phase 2: March 2019 – June 2023
Country: Republic of Kiribati
Target Area: Tarawa
Target Group: Related engineers and other technical staff in the target area (MISE and PUB)
MISE: Ministry of Infrastructure and Sustainable Energy PUB: Public Utilities Board

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal Energy security is improved and greenhouse gases are reduced through the reduction of fossil fuels consumption.	In comparison to the indicators at the time of baseline survey, 1. Reduced amount of CO2 emission of power utilities in the target area 2. Reduced amount of diesel fuel of power utilities in the target area 3. Increased capacity (kW) and actual generated energy (kWh) of renewable energy facilities of power utilities in the target area	1. to 3. Reports of C/P agencies	
Project Purpose Hybrid Power Generation System is introduced.	1. Improvement of specific fuel consumption of pilot DG units (better than the baseline data set at the beginning of the Project) 2. Improvement of performance ratio for RE power generation systems (better than the baseline data set at the beginning of the Project in consideration of aging deterioration of PV module) 3. Proper application of planning and O&M method of Hybrid Power Generation System	1. Record on specific fuel consumption of Pilot DG units by C/P, checked by Japanese experts 2. Record on operation of RE power generation systems 3. Evaluation by Japanese experts and C/P on plans and O&M of Hybrid Power Generation System	C/P agencies continue commitment to the Project by continuing budget allocation as well as assignment of personnel for the post- Project activities.
Outputs 1. Appropriate and economical system for O&M of Diesel Generators (DGs) is enhanced.	<Output 1> 1-1 Adequacy on the use of the work schedule, check sheets and manual for the maintenance work for the pilot DG units 1-2 Number of training participants who are conducting operation and maintenance of DG based on the learnings from the training program (target: 2)	1-1 Evaluation by Japanese experts and C/P on improvement of maintenance work (daily/partial inspection/overhaul work) for pilot DG units 1-2 Capacity assessment of trained maintenance staff and managers by Japanese experts	C/P agencies promote investment on renewable energy facilities based on the current national policy/plan.

2. Methodology for appropriate planning and O&M of Renewable Energy (RE) is established.	<Output 2> 2-1 Number of training participants who have been certified under the Project for the planning method of the Hybrid Power Generation System (target: 1) 2-2 Number of training participants who are conducting O&M of RE facilities based on the learnings from the training program (target: 2) 2-3 Preparation of related manuals for Hybrid Power Generation System 2-4 Adequacy of the use of the related manuals for Hybrid Power Generation System	2-1 Capacity assessment of trained staff and managers by Japanese experts 2-2 Capacity assessment of trained O&M staff and managers by Japanese experts 2-3 Evaluation by Japanese Experts on related manuals for Hybrid Power Generation System prepared by C/P 2-4 Evaluation by Japanese experts and C/P on the use of the related manuals for Hybrid Power Generation System	
Activities <Output 1> 1-1 Operational conditions of the existing DGs are reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose. 1-2 Asset management plan of DG is reviewed including financial evaluation on overhaul. 1-3 Specific fuel consumption of pilot DG units is measured. 1-4 Improvement plan for the operation of pilot DG units is prepared. 1-5 Existing spare parts and maintenance tools of pilot DG units are confirmed. 1-6 Improvement plan for the operation of pilot DG units is implemented. 1-7 The result of implementation of the improvement plan is evaluated, and improvement plan is updated. 1-8 The concept of Economic Dispatch Control (EDC) is shared among operators and applied, if possible. 1-9 Necessary spare parts and maintenance tools for the pilot DG units are prepared. 1-10 Maintenance work schedule for the pilot DG units is prepared. 1-11 Check sheets and maintenance manuals for maintenance works for pilot DG units are prepared. 1-12 Maintenance works (daily/partial inspection/overhaul work) for pilot DG units are conducted in accordance with the maintenance schedule. 1-13 The result of maintenance works is evaluated, and future maintenance work schedule together with budget (including sub-contract fee, cost for tools and equipment) is prepared. 1-14 Specific fuel consumption of the pilot DG units is measured before and after implementation of the related project activities. 1-15 Related training programs for appropriate O&M system for DGs are implemented periodically. 1-16 Knowledge on appropriate O&M of DGs is disseminated among stakeholders. <Output 2> 2-1 Current situation and future development plan of RE is reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose. 2-2 Planning manual for Hybrid Power Generation System is prepared. 2-3 Planning manual for Hybrid Power Generation System is reviewed and updated in the target area.	**Inputs** **(Japanese side)** 1. Dispatch of the Japanese experts <JICA long term expert, stationed in Fiji > - Hybrid Power Generation System (Completed by March 2019) <JICA Consultant Team> -Team Leader / Operation & Maintenance of DG -Economic operation of DG -Maintenance support of DG (Mechanical expert) -Maintenance support of DG (Electrical expert) -O&M of RE power generation system -Integration of RE power generation system -Project Coordinator 2. Training in Japan and Fiji 3. Equipment -In accordance with necessity of activities	**(Kiribati side)** 1. Assignment of C/Ps -Project Director (P/D) -Project Manager (P/M) -Engineers in charge of O&M (Manager level) - Mechanical Staff - Electrical Staff - Planning officer, and others 2. Facilities and equipment -Project office 3.Recurrent costs - C/Ps' wages and allowances - C/Ps' domestic travel expense	**Preconditions** Contents of the current relevant policies on promotion of renewable energy and energy efficiency are not largely changed.

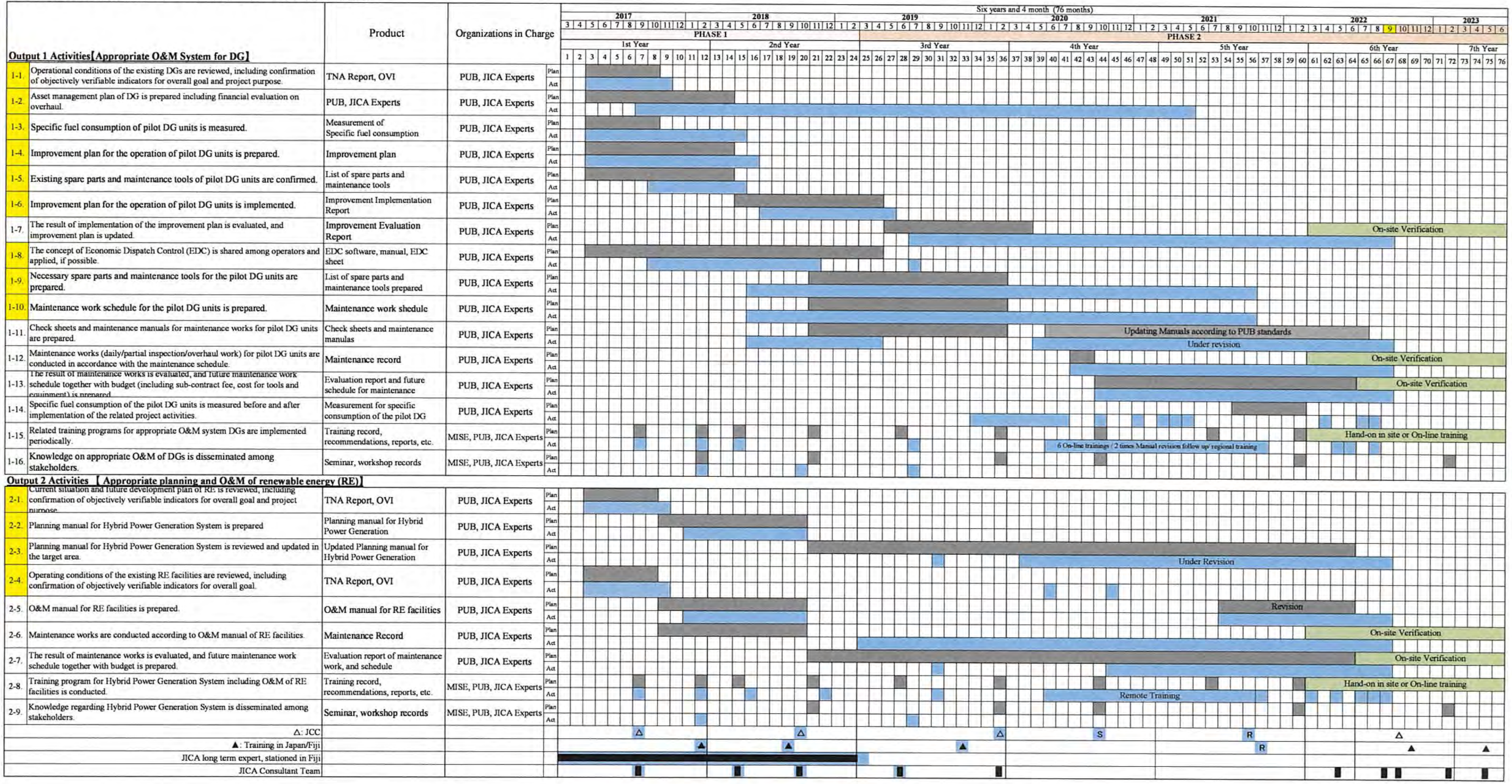
2-4 Operating conditions of the existing RE facilities are reviewed, including confirmation of objectively verifiable indicators for overall goal. 2-5 O&M manual for RE facilities is prepared. 2-6 Maintenance works are conducted according to O&M manual of RE facilities. 2-7 The result of maintenance works is evaluated, and future maintenance work schedule together with budget is prepared. 2-8 Training program for Hybrid Power Generation System including O&M of RE facilities is conducted. 2-9 Knowledge regarding Hybrid Power Generation System is disseminated among stakeholders.			

ATTACHMENT 5

September, 2022

Plan of Operation (PO)

Project Title: The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries
Project Term: March 2017 - June 2022 (Phase 1: March 2017 – February 2019 , Phase 2: March 2019 – June 2023)
Country: Kiribati
Target Area: Tarawa
Target Group: Related engineers and other technical staffs in the target area (MISE and PUB)



		Product	Organizations in Charge		Six years and 4 month (76 months)
Output 1 Activities【Appropriate O&M System for DG】					
1-1.	Operational conditions of the existing DGs are reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose.	TNA Report, OVI	PUB, JICA Experts	Plan	
				Act	
1-2.	Asset management plan of DG is prepared including financial evaluation on overhaul.	PUB, JICA Experts	PUB, JICA Experts	Plan	
				Act	
1-3.	Specific fuel consumption of pilot DG units is measured.	Measurement of Specific fuel consumption	PUB, JICA Experts	Plan	
				Act	
1-4.	Improvement plan for the operation of pilot DG units is prepared.	Improvement plan	PUB, JICA Experts	Plan	
				Act	
1-5.	Existing spare parts and maintenance tools of pilot DG units are confirmed.	List of spare parts and maintenance tools	PUB, JICA Experts	Plan	
				Act	
1-6.	Improvement plan for the operation of pilot DG units is implemented.	Improvement Implementation Report	PUB, JICA Experts	Plan	
				Act	
1-7.	The result of implementation of the improvement plan is evaluated, and improvement plan is updated.	Improvement Evaluation Report	PUB, JICA Experts	Plan	On-site Verification
				Act	
1-8.	The concept of Economic Dispatch Control (EDC) is shared among operators and applied, if possible.	EDC software, manual, EDC sheet	PUB, JICA Experts	Plan	
				Act	
1-9.	Necessary spare parts and maintenance tools for the pilot DG units are prepared.	List of spare parts and maintenance tools prepared	PUB, JICA Experts	Plan	
				Act	
1-10.	Maintenance work schedule for the pilot DG units is prepared.	Maintenance work shedule	PUB, JICA Experts	Plan	
				Act	
1-11.	Check sheets and maintenance manuals for maintenance works for pilot DG units are prepared.	Check sheets and maintenance manulas	PUB, JICA Experts	Plan	Updating Manuals according to PUB standards
				Act	Under revision
1-12.	Maintenance works (daily/partial inspection/overhaul work) for pilot DG units are conducted in accordance with the maintenance schedule.	Maintenance record	PUB, JICA Experts	Plan	On-site Verification
				Act	
1-13.	The result of maintenance works is evaluated, and future maintenance work schedule together with budget (including sub-contract fee, cost for tools and equipment) is prepared.	Evaluation report and future schedule for maintenance	PUB, JICA Experts	Plan	On-site Verification
				Act	
1-14.	Specific fuel consumption of the pilot DG units is measured before and after implementation of the related project activities.	Measurement for specific consumption of the pilot DG	PUB, JICA Experts	Plan	
				Act	
1-15.	Related training programs for appropriate O&M system DGs are implemented periodically.	Training record, recommendations, reports, etc.	MISE, PUB, JICA Experts	Plan	Hand-on in site or On-line training
				Act	6 On-line trainings / 2 times Manual revision follow up/ regional training
1-16.	Knowledge on appropriate O&M of DGs is disseminated among stakeholders.	Seminar, workshop records	MISE, PUB, JICA Experts	Plan	
				Act	
Output 2 Activities 【Appropriate planning and O&M of renewable energy (RE)】					
2-1.	Current situation and future development plan of RE is reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose.	TNA Report, OVI	PUB, JICA Experts	Plan	
				Act	
2-2.	Planning manual for Hybrid Power Generation System is prepared	Planning manual for Hybrid Power Generation	PUB, JICA Experts	Plan	
				Act	
2-3.	Planning manual for Hybrid Power Generation System is reviewed and updated in the target area.	Updated Planning manual for Hybrid Power Generation	PUB, JICA Experts	Plan	
				Act	Under Revision
2-4.	Operating conditions of the existing RE facilities are reviewed, including confirmation of objectively verifiable indicators for overall goal.	TNA Report, OVI	PUB, JICA Experts	Plan	
				Act	
2-5.	O&M manual for RE facilities is prepared.	O&M manual for RE facilities	PUB, JICA Experts	Plan	Revision
				Act	
2-6.	Maintenance works are conducted according to O&M manual of RE facilities.	Maintenance Record	PUB, JICA Experts	Plan	On-site Verification
				Act	
2-7.	The result of maintenance works is evaluated, and future maintenance work schedule together with budget is prepared.	Evaluation report of maintenance work, and schedule	PUB, JICA Experts	Plan	On-site Verification
				Act	
2-8.	Training program for Hybrid Power Generation System including O&M of RE facilities is conducted.	Training record, recommendations, reports, etc.	MISE, PUB, JICA Experts	Plan	Hand-on in site or On-line training
				Act	Remote Training
2-9.	Knowledge regarding Hybrid Power Generation System is disseminated among stakeholders.	Seminar, workshop records	MISE, PUB, JICA Experts	Plan	
				Act	
	△: JCC				△ △ △ S R △
	▲: Training in Japan/Fiji				▲ ▲ ▲ R ▲ ▲
	JICA long term expert, stationed in Fiji				
	JICA Consultant Team				

5 Training Needs Assessment (TNA)

5.1 Training Needs Assessment Report

Training Needs Assessment Report
for the Introduction of
Hybrid Power Generation System
in The Republic of Kiribati

October, 2017

JICA Expert

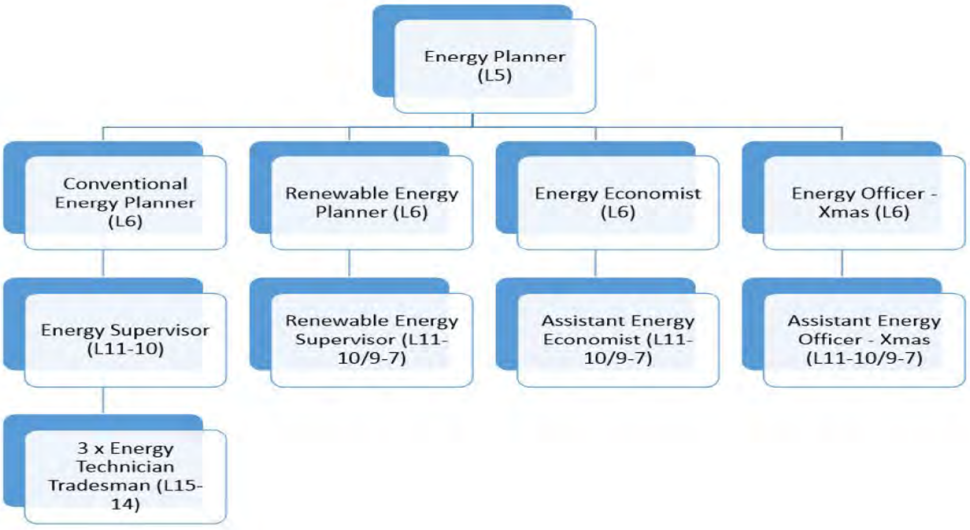
Table of Contents

1. Organization of counterparts

(1) Ministry of Public Works and Utilities (MPWU)

Energy Planning Unit under MPWU is responsible for the establishment of energy policy, legislation of energy laws, tariff regulation, planning for the outer island electrification. Total number of staff as of May, 2017 is 10. There is no future plan to hire new staff, as the number of staff is deemed appropriate for the organization.

As the engineers/ technicians of Energy Planning Unit is responsible for training operators for hybrid systems in outer islands, staff from the Energy Planning Unit are involved for the related training activities under the Project.

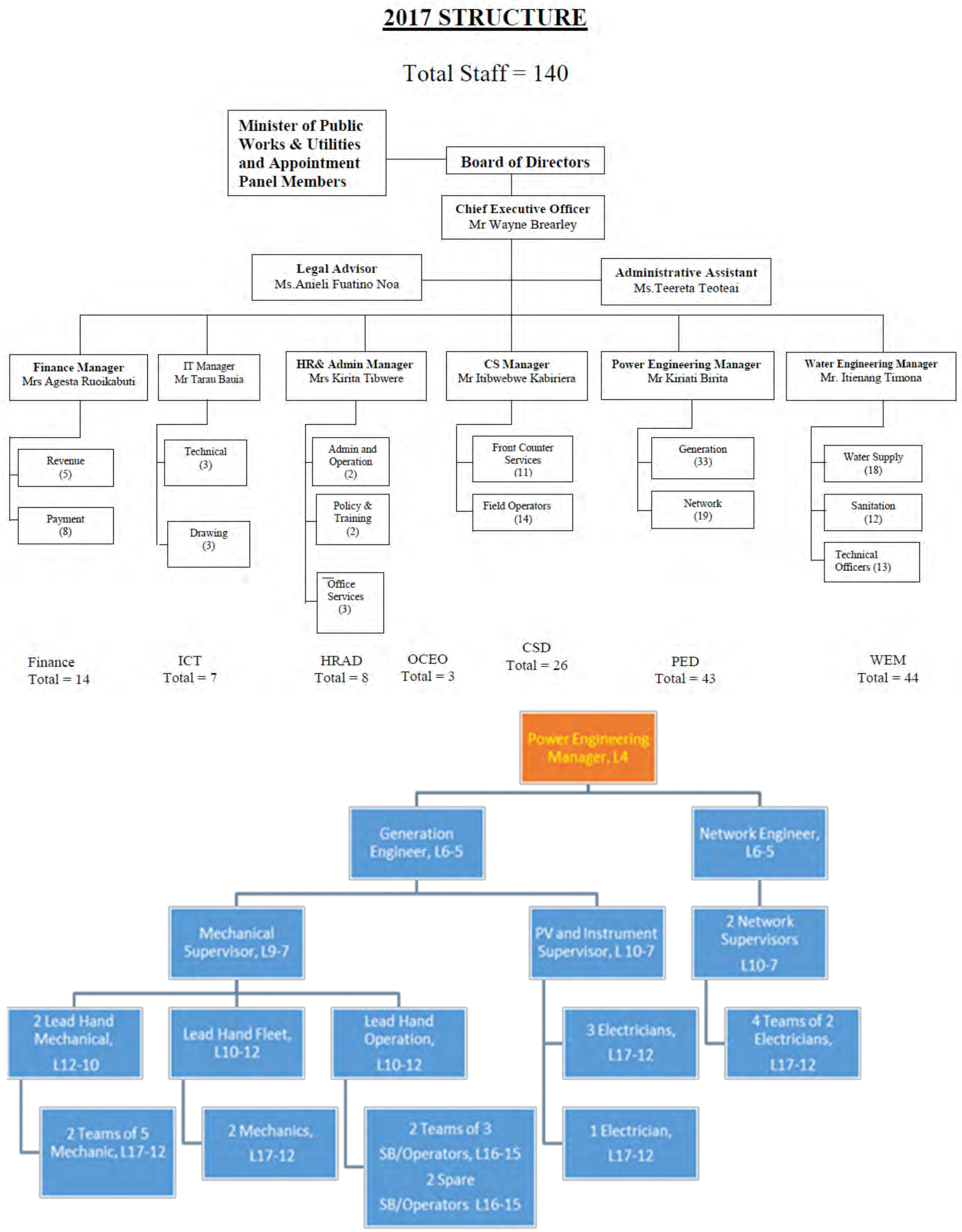


(Source: MPWU)

Fig.1 Organization Chart of Energy Planning Unit

(2) Public Utilities Board (PUB)

PUB was established in 1977, under the electricity act with the basic function to provide electricity, water supply and sewerage/ waste water. Total number of staff is 140, and 43 staff are working for Power Engineering Department as of May 2017. Under the Manager of Power Engineering, 31 staff are working for power plant, and 11 staff are working for distribution system. 5 electrical staff for power plants are also working for solar PV systems. There are three engineers but others are mainly graduates of vocational schools such as Kiribati Institute of Technology (KIT).



(Source:　PUB)

Fig.2　Organization Chart of PUB

In order to work for the power plants, staff are required to obtain MQR (Minimum Qualification Requirement) defined as below.

1) Certificate (mechanical engineering)
2) Diploma (marine engineering, class 5)
3) Diploma (mechanical or electrical engineering)
4) Degree (mechanical or electrical engineering)

The above 1) and 2) are almost in the same level. According to three years human resource development plan (2017~2019), PUB is intended to increase staff in the 3) and 4) level targeting 5 diploma holders in mechanical engineering, through supporting study abroad such as in Fiji National University .

2. Operation & maintenance conditions of Diesel Engine Generators (DGs)

Tarawa Island, the main island of Kiribati, has two power stations: Betio Power Station and Bikenibeu Power Station. Bikenibeu Power Station is a power station that was built in 2002 with the assistance of Japan. The 4 total DG units installed in the two power stations supply power to a demand of about 4.0 MW. The table below shows the DG unit composition.

The specification of DG units installed in Tarawa is described on Table 1 below.

Table 1 Specification of DG units in Tarawa

Unit №			1	3	4	5
Engine	Manufacturer		Daihatsu Diesel			
	Model No.		6DK-28	6DK-28	6DK-28	6DK-28
	Serial No.		DK628Z0168	DK628Z0187	DK628Z0188	DK628Z0300
Generator	Manufacturer		Nishishiba Electric			
	Model No.		NTAKL	NTAKL	NTAKL	NTAKL
	Serial No.		960123A1A	860080A1A-1	960080A1A-2	960155A1A
Output (kW)	Rated output		1250	1400	1400	1400
	Operation Range	Max.	1100	1300	1300	1300
		Min.	500	500	500	500
Generator voltage			11kV			
Fuel type			Diesel oil			
revolution (rpm)			750			
Governor control (Droop /Isochronous)			Droop	Isochronous		
Type of Control (AFC, ALC, etc.)			Automatic (during daytime) Manual (during night time)			
Automatic Start / Stop			Manual			
Cooling system			Radiator			
Installed year			2003	2002	2002	2005
Actual service life (h)			74,862	99,574	94,931	57,893

(Source: PUB)

Daytime peak demand is expected in weekdays while three DGs are operated except for early morning. On the other hand, night time peak demand is expected in weekends while three DGs are operated only during night time. It is desirable to use Unit 1 at Betio Power Station as the base unit as it has better fuel efficiency than the other units, but due to its exhaust gas temperature constraint, they are forced to operate it at approximately 900 kW.

Table 2 Combination of DG units in operation

Period	Hours	Combination of units（Unit No. is specified in bracket）
Weekdays	6:00～17:30	Standard combination is (1,3,4), and other combinations such as (3,4,5),(1,3,5) and (1,4,5) are also employed.
	17:30～24:00	Ditto
	24:00～6:00	Combination of either (1.3) or (1,4) is employed.
Weekends	6:00～17:30	Combination of either (1.3) or (1,4) is employed.
	17:30～24:00	Standard combination is (1,3,4), and other combinations such as (3,4,5),(1,3,5) and (1,4,5) are also employed.
	24:00～6:00	Combination of either (1.3) or (1,4) is employed.

(Source: PUB)

PUB decides combination of DG units as on Table 2, in consideration of test results of specific fuel consumption in every three months. Test results of June 2016 is shown on Table 3. Fuel consumption of unit 5 is higher in all operation range. Fuel consumption of unit 3 in higher loading (75%,90%) is better than other units.

Table 3 Test result of specific fuel consumption

（Unit：kWh/L(L/kwh)）

Unit No.	50%	75%	90%
1	3.83(0.261)	4(0.250)	3.55(0.281)
3	3.93(0.254)	3.8(0.263)	3.94(0.253)
4	3.93(0.254)	3.54(0.282)	3.52(0.284)
5	3.39(0.294)	3.6(0.277)	3.52(0.284)

(Source: PUB)

Manual start/stop control of DG units is employed for all units. As for the output control at Bikenibeu P/S, operators can select either manual or automatic setting which will try to take a balance of running hours of each engine. Under normal operation, automatic setting is selected during daytime to accommodate solar PV systems, while manual setting is usually preferred during nighttime to allow operation of unit 1 at Betio. It needs to be confirmed whether this automatic operation taking a balance of operation hours meets the objective of economic operation by multiple number of gensets as in EDC system. The new EMS system under installation will enable optimum scheduling and dispatching all DGs and PV systems in Tarawa, incorporating PV output forecast function. Also there is a plan of installing two new high-speed DGs (650kVA x 2) at Betio P/S. This plan will help to decrease the minimum operating capacity of DG sets to increase the penetration of PV system in Tarawa.

Periodical maintenance works are implementing by PUB staff only for every 6000, 12000, and 18000 hours of operation. Major overhaul works are supervised by Daikai for every 24000 hours of operation. Before it was required to invite supervisors from Daikai for every periodical maintenance works, but now PUB staff is certified by Daikai to conduct all maintenance works other than major overhaul, after completion of training at Daikai Singapore.

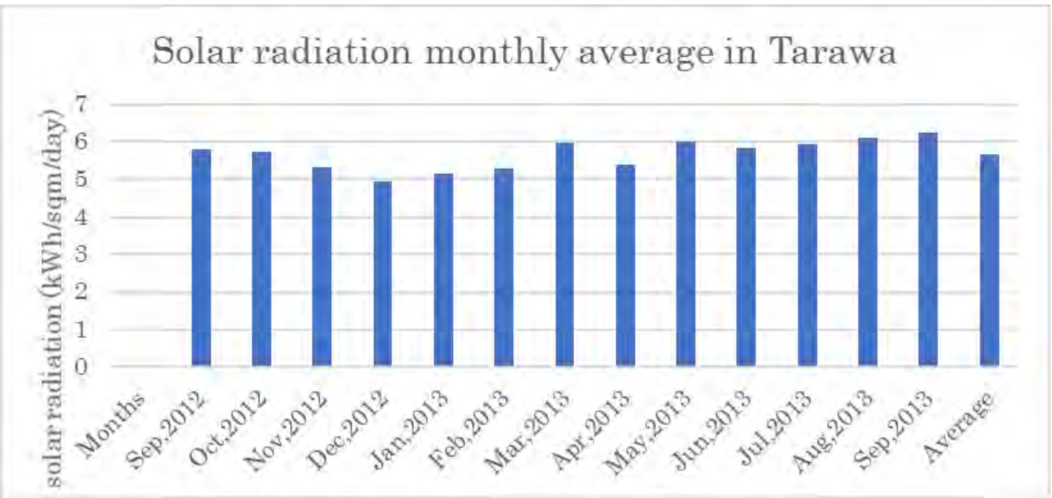
- The ComAp control system (integrated in August 2015) is used to conduct semi-automatic operation in isochronous mode. Although frequency control is automatic operation, the start and stop of the generator is carried out manually. Starting is performed by checking the status of the generator on-site. With the system described above, fully automatic operation is now also possible. In order to align the timing of the overhaul, the operating times of the 3 generators are managed such that they are nearly the same. They are attempting to align the operation times from the idea that they can reduce cost by having Daikai (maintenance contractor) perform overhaul on all units on one dispatch.
- Since the DG output of Betio Power Station cannot be monitored at Bikenibeu Power Station, an operator at one station calls an operator at the other station to confirm output. There are plans to integrate SCADA and EMS in the future to enable monitoring the entire Tarawa Island grid in real time.
- For the operation method of Betio Power Station, since the alarm of the exhaust gas temperature (480°C) is activated when the DG output is raised to 900 KW or more (rated: 1,250 kW), output is limited. Since the DGs at Betio Power Station have good fuel efficiency, they are operated as base load; Bikenibeu Power Station is responsible for frequency regulation. Further, start and disconnection and output increases and decreases are performed by commands conveyed by telephone from Bikenibeu Power Station.
- For management of operating time and overhaul, their approach is to manage Unit 3 and Unit 4 such that their operating times are the same. (Unit 1 and Unit 5 were installed at different times.) Overhaul for all 4 units are performed at the same time so as to reduce cost and time. Since it takes three to six months to order spare parts, this point must also

be taken into account in timing the overhaul.

- As a measure for PV out fluctuations, there are plans to deploy 1.2 MW (650 kW × 2 Cummins units) high-speed diesel generators. Generation Engineer Manager believed the introduction of storage battery systems should be avoided as they have a large environmental impact.

3. Current situation and future development plan of RE power generation system

Annual average solar radiation is 5.67kWh/m^2/day in Tarawa as a result of measurement on the ground, which is almost 1.5 times of the figure in Tokyo. Initially, off-grid Solar Home Systems (SHS) were installed in remote islands in over 20 years before. Nowadays more than 2000 SHS have been installed, and accounts about 17% of total households in Kiribati.



(Source: PUB)

Fig.3 Monthly average solar radiation in Tarawa

Recently grid-connected PV systems have been installed in Tarawa as shown on Table 4. These PV systems are owned, operated and maintained by PUB. PV systems at Bikenibeu Power Station and Bonriki Airport are connected with 11kV grid, while PV systems funded by the WB are connected with LV grid. They were installed in several different locations to expect the smoothing effect of PV power output by cloud motions. In addition, there are several customers who have installed their PV systems on the roof-top. Necessary legislation to introduce net-metering system is under discussion, which may accelerate introduction of small-scale distributed PV systems in Tarawa.

Table 4 Grid-connected PV systems in Tarawa

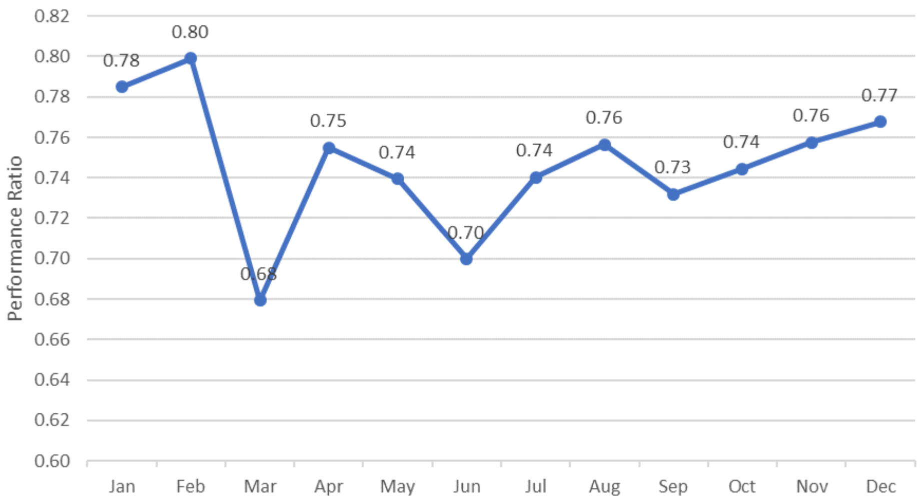
No.	Project site	Installed Capacity (kW)	Commissioned by	Fund
1	Bikenibeu Power Staton	400	2015	PEC
2	Bonriki Airport	500	2015	UAE
3	4 different sites in Betio (Kiribati Institute of Technology、Sports Complex) and Bikenibeu (KG5 school, Nawerewere Hospital)	546	2016	WB, Australia
Total		1,446		

(Source: PUB)

4. Operation & maintenance conditions of RE power generation system

According to PUB, there have been no issue of power system operation such as frequency fluctuation after introduction of PV systems. The allowable range of frequency fluctuation is defined as 50Hz±5%.The control system installed by ComAp adjusts power output of DG sets in accordance with the power demand and output from PV systems (UAE+PEC). It is expected that dynamic spinning reserve function of ComAp control system enables system frequency under regulation, but further analysis is undertaking to verify the reason why high penetration is realized without affecting power system quality. During the daytime weekend, the penetration of PV systems reach over 40%. Now the new Energy Management System (EMS) is under installation, which makes it possible to remotely control all DG sets and PV systems in Tarawa. In addition, cloud camera will be installed in Betio and Bikenibeu, which enables more precise forecast of power output from PV systems. PUB has been suffering from under voltage for LV customers due to long distance cables, which may be mitigated by interconnecting PV systems on the LV systems.

The surface of PV arrays is cleaned for PEC and UAE systems, and measuring data such as insulation resistance and grounding resistance are taken periodically. The performance ratio was calculated for PEC system as shown on Fig.4, based on the actual measurement of solar irradiation and energy production per month. The average figure is 75%, which can be judged under normal operation conditions. However, the figure goes very high and low depending on month. It is expected there might be some errors in the measurement of solar irradiation or energy production. In case of UAE system, the annual average of performance ratio is 85% assuming the same monthly irradiation as PEC system. Usually, the performance ratio would fall between 75% and 85%, so we need to check the reliability of those data, too.



(Source: Compiled data from PUB)

Fig.4 Performance ratio for PEC PV system

5. Current capacity and training needs assessment

(1) Operation & maintenance of DGs

- Diesel engine maintenance staff have the capacity to perform overhaul works, but a supervisor is required due they are incapable of performing final checks (checks performed by using measuring instruments, etc.).
- Although there are some staff graduated as mechanical engineering at the University of Fiji, the majority of the staff were educated at vocational schools in Kiribati.Staff who joined a few years ago as mechanical maintenance personnel have educational needs.
- The electrical staff have high educational needs. (They have no experience checking protective relays, alternator cleaning, etc.)
- They need education on how to use the measuring equipment. (They don't know how to replace blown fuses.)
- The knowledge and skill of the PUB staff on inspection is likely to be at the standard level. In this Project, it is necessary to educate them about the matters that are considered effective in Kiribati by comparing the method and content of inspection with those in Okinawa.
- Regarding to the operation of DG’s, operators are lacking knowledge on efficient operation. (In order to prevent reliance on automatic control)
- Operators of the power plant need increase knowledge in DG operation which takes into account reserve capacity for demand fluctuation and specific fuel consumption.

Others O&M education needs is as below

- Safety Works
- importance and necessity of maintenance(daily check)

- Maintenance C,D,E, according to the running hours recommended by manufacturer.
- Follow up after maintenance works (spare parts stock, management of the used hours of spare parts, etc.)
- Knowledge on the expected life and maintenance of each part.
- Cost reduction through management of DG operating time, stable operation through risk distribution, and maintenance cost distribution.

(2) Grid integration of RE power generation system

- Engineers needs increase basic knowledge on power system characteristics.
- Since they lack the capacity to analyze the current power system, they are unable to estimate the RE integration capacity, and thus cannot come up with a stable integration plan.
- Since there are plans to build a hybrid system in Christmas Island, the need for education on a hybrid system that combines DGs and RE is expected to increase.
- There are plans to integrate a SCADA system which will enable monitoring Betio Power Station and Bikenibeu Power Station simultaneously in the future. (Currently, Betio cannot be monitored.) Therefore, the dissemination of RE is expected to expand in the future. To that end, it is believed that there is a need for education on short-period and long-period fluctuations of RE in the integration capacity.

(3) Operation & maintenance of RE power generation system

- It is proposed to conduct a survey on PV facilities which are currently not operating to determine which modules are sound, and from the results, rewire them to promote utilization. They need education for how to conduct this surveys and how to rewire the facility.

6. Summary

For DG operation, Bikenibeu Power Station is operated using the ComAp control system (integrated in August 2015) to conduct frequency control in isochronous mode. In addition, specific fuel consumption for all generators including Betio Power Station is managed, and operational improvements such as generator operation based on this were being made.

According to the results of the analysis of the supply and demand data, it may be possible to improve fuel consumption by reducing the excess reserve capacity (number of units in operation) by enhancing the constant monitoring of power supply capacity. A study is needed to determine whether or not monitoring enhancements such as displaying real-time supply-demand status as trend graphs in the SCADA system and EMS to be introduced is possible.

Having personnel other than the contractor (Daikai) such as PUB maintenance personnel implement the maintenance cycle recommended by the engine manufacturer (Daihatsu) in the future would enable creating a difference in operating times as in the power plants of the remote islands in Okinawa and distributing the increase and decrease of maintenance costs (parts, labor, etc.).

In addition, by confirming each engine's efficiency and occurrence of defects, the maintenance interval could be extended to 4000 hours, but the detailed measurement inspection of all replacement parts is needed.

End

5.2 Questionnaire

Okinawa Enetech
October 2017

Project of Introduction of Hybrid Power generation system in PICs
Survey Questionnaire

No.	Questionnaire / Information Required
Ⅰ	**COUNTRY ENERGY POLICY RELATED INFORMATION**
1	National Energy Strategy and Action Plan in latest version
2	National electrification plan (diesel, renewable energy, etc.)
3	National energy efficiency and conservation plan
4	National plan for climate change mitigation
5	Current regulatory framework on power sector
6	Organizational chart of the Ministry of Energy
7	List of donor’s projects (title, year, duration, budget, contents, etc.)
8	Energy expansion plan.
9	Information of energy efficiency and conservation project (donor, objective, method, implemented year, project title, etc.)
10	
Ⅱ	**STANDARD, LAWS, and REGULATIONS**
1	Standards, regulations, rules, guideline for power supply
2	Standards, regulations, rules, guideline for distribution
3	Standards, regulations for RE grid interconnection
4	Laws and restrictions in constructions of new power generation facilities.
5	(Environment, real state, forest, security, etc.)
6	IPP or PPP power plant situation (if any)
7	Current activity on demand side management.
8	Current activity on awareness raising for energy efficiency and conservation
9	Guideline for Environmental Impact Assessment (EIA).
10	
Ⅲ	**RENEWABLE ENERGY RELATED DATA**
1	Meteorological data
	・Solar Irradiation (1 year / hour or minute data)
	・Wind Speed（m/s、1year/ hour or minute data）
	・Ambient Temperature (1year/ hour)
	・Precipitation

2	Potential map and data (solar irradiation, wind, hydro, biomass, etc.)
3	Data of existing solar PV system (location, type, capacity, number of user, purpose, implement agency, installed year, etc.)
4	Solar power generation data (1year/ 1 hour)
5	Data of existing wind generation system (location, type, capacity, number of users, implement agency, installed year, etc.)
6	Wind power generation data (1year/ 1 hour)
7	Data of existing Hydro generation system (location, type, capacity, number of users, implement agency, installed year, etc.)
8	Hydro power generation data (1year/ 1 hour)
9	Data of existing biomass generation system (location, type, capacity, number of users, implement agency, installed year, etc.)
10	Biomass power generation data (1year/ 1 hour)
11	Regulation or Manuals on renewable system
12	List of ongoing and future RE project
13	List of resource engineers on renewable technologies.
14	List of local providers of RE products
15	O&M of and the supply chain of PV components (DC lights, battery, controller, inverter, etc.)
16	Environmental impact caused by existing PV and renewable technologies.
17	Cost of installation of PV facilities (US/ kW)
Ⅳ	**DIESEL POWER STATION and DISTRIBUTION FACILITIES**
1	Installed capacity, power output, configurations, etc.(Existing and Planning)
	・Manufacturer, specifications, actual service life.
	・Capacity (kw) of each
	・Limitations in max, and min output during operation
	・Generator active capacity (kVa), efficiency.
	・Monthly, yearly power generation(kwh) and total fuel consumption.
	・Fuel type and consumption curve or consumption amount at 25%, 50%,
	75%, 100% of rated output of each engine
2	Peripheral equipment of each diesel generator
	・Heat balance flow sheet and calculations.(cooling system)
	・Specifications of each equipment.
3	Power plant fuel storage capacity
4	Drawings of Power plant layout.
5	Utilities flow chart (fuel oil, lubricant oil, cooling water, air, wastes oil, etc.)
6	Electrical wire diagram drawing of the power station.
7	Transmission and Distribution line diagram drawings (Feeders)
8	Manual of each diesel generators

9	Cost of installation of DEG facilities (US/ kW)
10	
V	**POWER STATION OPERATION AND MAINTENANCE**
1	Operation standard (Voltage, Frequency) , Fluctuation tolerance (±、%)
2	Records of power generation (kwh). (Past 5 years)
3	Peak load (kw).
4	Daily, monthly, and yearly load curve. (kW) (past 5 years)
5	Power generation (kW) data (1 year/ 1hour each)
6	Consumption of fuel (monthly, year)
7	Power consumption amount at the power plant.
8	Losses (power generation, transmission)
9	Failure, shutdown, technical problems, etc. (cause)
10	Type of control in diesel power generation (AFC, ALC, Load shedding, isochronous, other)
11	Regulations in air pollution (NOx, Sox, dust), sound level, vibration, etc.
12	Power plant operation management (flow chart, personnel numbers, position)
13	Cost of power generation (US/kWh)
14	Power tariff structure and procedure of the tariff setting
15	Cost of Fuel (US/ L)
16	Study of improved efficiency in power plants efficiency
17	Power plant Maintenance management (flow chart, personnel numbers, position)
18	Maintenance cycle of diesel generators
19	Works of each kind of maintenance
20	Spare parts procurements
21	Workshop for maintenance
22	Cost of maintenance and works duration.
23	Training system for operators and power plant staffs.
24	
25	

❒ **Existing units' data**

	Diesel Generator No.	1	2	3	4	5	6	7	8
Engine	Manufacturer								
	Model No.								
	Serial No.								
	Rated output								
	Current max. output								
	Current min. output								

	Revolutions rpm								
	Fuel type								
	Governor control (Droop/Isochronous)								
	Cooling system								
	Installed year								
Generator	Manufacturer								
	Type								
	Model No.								
	Serial No.								
	Voltage								
Other	Fuel consumption [L]								
	Generation cost [USD/kWh]								
	Fuel cost [USD/L]								
	Failure record								
	Current status								

5.3 DG Training Curriculum

DG Training Curriculum for Kiribati

Subject		Contents
1.Basic Knowledge of DEG power generation	1	・Understanding of Diesel Generators type, structure, operation principle and characteristic.
	2	・Diesel engine performance curve, efficiency during operation, heat balance diagram.
	3	・Understanding of mechanical devices on Diesel power generation. Purpose, type, characteristics of each device.
		1) Cylinder head, valves, rocker arm, pushing rod, springs
		2) Piston, rings, connecting rod, pin
		3) Cylinder liner
		4) Crankshaft, camshaft, main bearings, fly wheel
		5) Turbocharger
		6) Governor
		7) Intercooler (air, oil)
		8) Pumps, radiators and others
	4	・Understanding of electrical components on Diesel power generation. Purpose, type, characteristics etc. of each electrical panels, etc.
		1) Generator & Exciter
		2) Transformer
		3) Circuit breaker
		4) Control panel / alarms / CT, PT's
		5) Power center, AVR, AFC, Synchronous board
		6) Electrical drawings, single line diagram
		7) Device number / protection relays
		8) Others electrical components
	5	・Understanding of each utilities in diesel power plants
		1) Fuel System
		2) Lubricant oil system
		3) Cooling water
		4) Air system
		5) Exhaust gas
2.Operation of DEG's	1	・Operation and control method of diesel power generation facilities (governor free, automatic control devices, etc.)
	2	・Operating Procedure of Diesel Power Plant
		1) Operation precautions
		2) Patrol inspection
	3	・Supply and Demand Management
		1) Efficient operation
		2) System frequency adjustment

		3) Voltage management
		4) Power reserve
	4	・Diesel generator Economical load distribution operation
		(EDC technology (basic knowledge・application))
	5	・Power generation data sorting、analysis（Power generation amount, output、fuel consumption amount and rate, operation parameters of diesel engine operation）
	6	・Diesel generation operation data record sheet
	7	・Financial analysis of power plant operation
	8	・Trouble Shooting
3.Maintenance of DEG's	1	・Safety work training
	2	・Periodical inspection (Mechanical)
		Types of inspections, contents, check sheet
	3	・Periodical inspection (Electrical)
		Types of inspections, contents, check sheet
	4	・Overhaul of Diesel Generator and Auxiliary Equipment
		1) Purpose & process
		2) Washing & Inspection of parts (Dye penetrant test)
		3) Engine maintenance standards
		4) Assembly
		5) Centering adjustment
		6) Start-up and commissioning
	5	・Drawing up of maintenance manual
	6	・Verification, modification, addition of notes in the maintenance manual(electrical / mechanical)
	7	・Maintenance plan（spare parts verification, management, consumables, schedule, etc.)
	8	・Handling of mechanical measurement equipment（OJT)
		1) Calipers, micrometers, dial gauge
		2) Noise meter
		3) Vibrometer
		4) Torque wrench
		5) Pmax device & Others
	9	・Handling of electrical measurement equipment（OJT)
		1) Electroscope
		2) Multi-meter
		3) Tester
		4) Digital Pressure Calibrator
		5) Instrumentation signal measurement / generator
		6) Ohm meter & Others

	10	・Maintenance works report writing, keeping and supervision
	11	・Disassembly & Inspection of each section of diesel generators, troubleshooting.（mechanical and electrical OJT）
	12	・Planning of maintenance works
	13	・Maintenance works report writing
	14	・Improvements in power plant facilities

5.4 Renewable Energy Training Curriculum

RE Training Curriculum for Kiribati

Subject		**Contents**	
RE O&M	**1. Formulation/ Explanation / Update of manual**	(1)	Operation & Maintenance of System
		(2)	patrol check and periodic inspection
		(3)	Daily check
		(4)	Periodic Inspection
		(5)	Development of the check sheet
		(6)	Updating of maintenance manual according to the system condition of each country .(Joint work)
			Verification of operational condition of the updated maintenance manual, comments.(Follow up from Project team)
			Periodic monitoring of the operational condition of the manual.(Joint work)
	2. Operation practice of the measuring equipment	(1)	String tracer
		(2)	Cell line checker
		(3)	Insulation resistance tester
		(4)	Infrared camera
	3. Trouble shooting	(1)	Confirmation method of disconnection between the module
		(2)	Influence of the shadow
		(3)	Introduction for trouble example ①(Tuval)
	4. Future O&M Work plan (draw it up with a budget)	(1)	Confirmation of existing plan
			1) Actual organization chart
			2) Actual budget for annual maintenance
			3) Actual content of works
		(2)	Future planning
			1) Future donor's support contents
			2) Future strengthen of the organization
			3) Future budget for maintenance
			4) Planning of work
		(3)	Finalization of the future planning with the counter part
RE Integration	**1. Formulation/ Explanation / Update of manual of Hybrid generation plan**	(1)	Variability of RE(Solar & Wind)generation system
			1)Power system basis and power quality
		(2)	Impact on the grid operation by integrating RE generation systems
			1)Frequency fluctuation
			2)Voltage Fluctuation
			3)Excess Energy

		(3)	Countermeasures for the mitigation of RE impact on the grid
			1)Grid Code
			2)Frequency fluctuation(Algebraic method, other simulation software)
			3)Voltage Fluctuation
			4)Excess of energy (HOMER software)
		(4)	Planning methodology for the Roadmap of RE integration
			1)Planning Methodology overview
			2)Inputs and assumption
			3)Consideration according to the system capacity. (reliability, service quality)
			4)Roadmap for small-grid to integrate RE generation system
			5)RE integration road map for large scale grid.
		(5)	1)Update of the manual according to the condition of the country, working with the counterpart,
			2)Follow up of the updated manual, implementation condition, by the project team
			3)Monitoring in the use of the manual together with the CP
	2. System Simulation	(1)	Overview
		(2)	Model case ① (Power system simulation in Hateruma island)
	3. Grid Connection of RE And Operation	(1)	Grid code (Interconnection requirement)
		(2)	Grid interconnection procedures
		(3)	Introduction for Operation and Output control
	4. Examples of Improvement in Okinawa for dissemination of RE	(1)	Miyako island Mega Solar Demonstration Research
		(2)	Overview of the MG set Demonstration Research in Hateruma island
		(3)	Abu Mega Solar Demonstration Research
		(4)	Ogimi Wind Power Demonstration Research
		(5)	Case study ①（Hybrid system in Yonaguni island)
	5. Use of Battery Storage in Power systems	(1)	Overview
		(2)	Overview of Batterie's output and capacity
	6. PV system plan and design	(1)	Study for number of panels in series and parallel (10kW PV system)
		(2)	Design of frame and array
		(3)	Estimation of yearly PV power generation
		(4)	Study of System Composition
	7. Performance ratio	(1)	Overview

		(2)	Inspection and Evaluation of Monitoring results
	8. HOMER	(1)	Overview
		(2)	Practice ①（Input of demand data)
		(3)	Practice ②（Analysis of long-term fluctuation)
		(4)	Practice ③（Calculation of the facilities capacity for PV, Wind turbine, Battery storage)
		(5)	Data gathering and Modeling

6 Training record (On-site, remote)

6.1 Training Schedule

Training Schedule for Kiribati

1.Common Event

Year	Manth / Day	Remarks	JCC Meeting	Contents
2017 (H29)	September, 20th		6	1st JCC Meeting
2018 (H30)	October, 26th		4	2nd JCC Meeting
2019 (R1)	October, 3rd		5	3rd JCC Meeting
2020 (R2)	July, 16th	3		1st Meeting with manager class (Remote)
	October, 2nd	2		2nd Meeting with manager class (Remote)
2021 (R3)	February, 25th	2		3rd Meeting with manager class (Remote)
	September, 9th	3		4th Meeting with manager class (Remote)
	October, 29th	6		4th JCC Meeting (Remote)
2022 (R4)	October, 7th		4	5th JCC Meeting
2023 (R5)	—	—	—	—
Total		16	19	
Grand Total		35		

2.DG O&M Training

Year	Manth / Day	On-Site Training	Remote Training	Regional Training	Training Japan	Manual Revision	Seminar	Contents
2017 (H29)	Sep. 18th	0						1st On-Site Training
2018 (H30)	May, 25th	52						3rd On-Site Training (13P×4days)
	Sep. 26th				34			Kumejima Is. OH training（2P×17Days）
	Dec. 7th	45						5th On-Site Training (9P×5days)
2019 (R1)	July, 16th	40						1st On-Site Training (10P×4days) Phase2
	July, 19th						3	1st Seminar
	Oct. 1st	52						5th On-Site Training (13P×4days) Phase2
	Nov. 18th			10				1st Regional Training (Fiji) (2P×5days)

2020 (R2)	June, 17th		6					1st DG Remote Training
	July, 30th		9					2nd DG Remote Training
	Aug. 19th		5					3rd DG Remote Training
	Oct. 14th		7					4th DG Remote Training
2021 (R3)	Jan. 19th		7					5th DG Remote Training
	May, 12th					6		1st DG O&M Manual revision follow-up
	May, 18th		8					6th DG Remote Training
	July, 7th					3		2nd DG O&M Manual revision follow-up
	Sep. 1st		3					7th DG Remote Training
	Oct. 25th		20					DG3 OH Back-up Meeting (2P×10days)
	Nov. 15th			25				2nd Regional Training (Remote) (1P×8days,1P×7days,1P×6days,1P×4days)
2022 (R4)	May, 23rd		2					8th DG Remote Training/DG O&M Manual revision follow-up
	Aug. 4th		7					9th DG Remote Training/DG O&M Manual revision follow-up
	Oct. 4th	45						9th On-Site Training (9P×5days)
	Nov. 5th					2		3rd DG O&M Manual revision follow-up
2023 (R5)	Feb. 13th			10				3rd Regional Training (Fiji) (2P×5days)
	June, 20th						3	2nd Seminar (Remote)
Total		234	74	45	34	11	6	
Grand Total		404						

3.RE Integration / PV O&M Training

Year	**Manth / Day**	**On-Site Training**	**Remote Training**	**Regional Training**	**Training Japan**	**Manual Revision**	**Seminar**	**Contents**
2017 (H29)	Sep. 18th	0						1st On-Site Training
2018 (H30)	June, 19th	24						3rd On-Site Training (6P×4days)
	Oct. 23rd	20						5th On-Site Training (4P×4days, 2P×2days)
2019 (R1)	July, 19th						3	1st Seminar
	Sep. 10th	28						4th On-Site Training (7P×4days) Phase2
	Nov. 25th			15				1st Regional Training (Fiji) (3P×5days)
2020 (R2)	June, 25th		2					1st RE Remote Training
	July, 30th		8					2nd RE Remote Training

	Aug. 26th		6					3rd RE Remote Training
	Sep. 4th		7					3rd RE Remote Training supplementary lecture
	Nov. 4th		7					4th RE Remote Training
2021 (R3)	Feb. 10th		4					5th RE Remote Training
	May, 20th					4		1st RE O&M Manual revision follow-up
	June, 9th		4					6th RE Remote Training
	Aug. 18th					5		2nd RE O&M Manual revision follow-up
	Sep. 15th		4					7th RE Remote Training
	Nov. 29th			15				2nd Regional Training (Remote) (1P×3days,1P×4days,1P×8days)
2022 (R4)	Mar. 29th					1		3rd RE O&M Manual revision follow-up
	May, 19th					2		4th RE O&M Manual revision follow-up
	June, 28th		1					8th RE Remote Training/RE O&M Manual revision follow-up
	Aug. 23rd					1		5th RE O&M Manual revision follow-up
	Dec. 2nd					1		6th RE O&M Manual revision follow-up
2023 (R5)	Feb. 20th			15				3rd Regional Training (Fiji) (3P×5days)
	June, 20th						4	2nd Seminar (Remote)
Total		72	43	45	0	14	7	
Grand Total		181						

6.2 Training Report

On-site Training (Phase 2)

6.2.1 1st Seminar Report

THE PROJECT FOR INTRODUCTION OF HYBRID POWER　GENERATION SYSTEM IN PACIFIC ISLAND COUNTRIES Seminar in Kiribati

～Japan's contribution to promoting renewable energy～

23rd, July 2019

１．Summary

Meeting name：

THE PROJECT FOR INTRODUCTION OF HYBRID POWER　GENERATION SYSTEM IN PACIFIC ISLAND COUNTRIES Seminar in Kiribati

Japan's contribution to promoting renewable energy

Date：

Friday, July 19, 2019 9:30-12:30

Sponsorship：

Japan International Cooperation Agency (JICA)

Venue：

MISE Conference Room

２．Participants

Opening Remarks：

Ms. Saitofi Mika　:　MISE Secretary

Speakers：

Mr. Thomas Taoaba　:　MISE Energy Planner
Mr. Tenikoria Katauea　: PUB Generation Manager
Mr. Teebwatia Taakau　:　PUB Engineer
Mr. Tadayuki Ogawa　:　JICA
Mr. Luis Kakefuku　:　JICA Expert Team

Closing Remarks：

Mr. Gidion Mafal　:　MISE Energy Planner

Participant：

14 persons

３． Background and Purpose

Most Pacific Island countries use imported fuel (diesel) for power generation, which means that overall electricity prices are higher than in developed countries. In addition, from the perspective of promoting mitigation measures to combat climate change, they have adopted a policy of actively introducing renewable energy (renewable energy) power sources, mainly solar power. Against the backdrop of the above, JICA is planning a five-year project titled "Pacific Region Hybrid Power Generation System Introduction Project" starting in 2017, targeting five countries: Fiji, Kiribati, Tuvalu, Micronesia, and the Marshall Islands.

①Improve the ability to operate and maintain existing diesel electric generation facilities (DEGs)

②Optimal integration of renewable energy (RE) generation facilities and improvement of maintenance and management capabilities

and contribute to the reduction of fossil fuel consumption and greenhouse gas emissions in Pacific Island countries.

The purpose of this seminar was to introduce the project's activities to stakeholders other than counterparts (especially to senior management) and to share information on efforts to promote the introduction of renewable energy in other countries.

４． Contents

The seminar was attended by about 14 people, including the Secretary of the Ministry of Infrastructure and Energy.

Keynote speeches were given by Mr. Thomas Taoaba (MISE, in charge of local energy planning), Mr. Tenikoria Katauea and Mr. Teebwatia Taakau (PUB), Mr. Tadayuki Ogawa (JICA expert), and Luis Kakefuku (JICA short-term expert). Mr. Tadayuki Ogawa (JICA expert) and Mr. Luis Kakefuku (JICA short-term expert) delivered keynote addresses. They also introduced the progress of the "Pacific Region Hybrid Power Generation System Installation Project".

Throughout the seminar, the participants were introduced to the status of Kiribati's power system operation and future development plans, the knowledge gained from the training in Okinawa (Japan) in the "Pacific Region Hybrid Power System Introduction Project," and the research and demonstration technologies currently being implemented in Okinawa to solve problems that arise in small-scale power systems.

５． Documents

・“PED 1st Quarter Progress Presentation”

・“Introduction of technical knowledge acquired during the RE training in Japan”

・“Training In Okinawa Japan On Diesel Power Generation
The Training was On Diesel Power Generator Overhaul and was held in Kumejima Island one of Okinawa Outer Island”

・“Hybrid Islands Program – Smart Energy Integration for Resilient Islands”

・“The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries”

・“Overview of the MG set Demonstration Research Aimed at Maximizing RE Penetration in Hateruma

Island”

６． Seminar Scene

	
View of the venue	MISE Secretary （Opening Remarks）
	
MISE Rural Energy Planner (Keynote Speech)	PUB Generation Manager (Keynote Speech)
	
PUB Power generation engineer (Keynote Speech)	MISE Conversional of Energy Planner (Keynote Speech)

７．Point of Each Speech

〇Ms. Saitofi Mika　:　MISE Secretary

Opening Remarks.

As Kiribati is working to expand renewable energy as a countermeasure against global warming, this project is making a significant contribution, and we would like to thank the Japanese government for this support.

The project team has provided capacity building to Kiribati engineers through on-the-job training as well as desktop training, and we are grateful to them for providing equipment and materials. Their activities have also helped in the next step planning in the PUB jurisdiction.

We would like to ask for the continued cooperation of all concerned for the success of the project.

〇Mr. Thomas Taoaba　:　MISE Energy Planner

Speech on Kiribati's power system operation and future development plans.

Photos and explanations were provided to give a good understanding of the training situation.

〇Mr. Tenikoria Katauea　: PUB Generation Manager

He gave a speech titled "Technical Knowledge Obtained in Training in Japan," as he participated in a training course in Japan last year.

Photos and explanations were provided to give a clear picture of the training.

〇Mr. Teebwatia Taakau　:　PUB Engineer

He gave a speech about the DG overhaul training in Kumejima, Okinawa.

Photos and explanations provided a good overview of the training situation.

〇Mr. Tadayuki Ogawa　:　JICA

The objectives of JICA's Hybrid Power Generation Project in Pacific countries (target countries: Fiji, Tuvalu, Kiribati, Micronesia, and the Marshall Islands), as well as the Japanese training and training activities conducted to date, ongoing activities, and future plans were explained.

He explained that the activities of Diesel Generators (DG) and Renewable Energies (RE) are aimed at the expansion of the introduction of hybrid power generation systems and the establishment of appropriate and economical operation and management systems and methodologies for renewable energy (RE) and appropriate planning and operation and management, respectively, in order to reduce fossil fuel costs and greenhouse gas emissions.

〇Mr. Luis Kakefuku　:　JICA Expert Team

An overview of the MG set demonstration study aimed at maximizing RE on Hateruma Island, Okinawa, Japan was presented.

On the small island, where diesel generators (DG) are the main power source, the introduction of renewable energy is effective in reducing fuel costs, but DG has a lower operating limit, and the MG set has functions equivalent to DG with no lower operating limit. He also mentioned the achievement of 100% RE operation as a result of the demonstration test.

〇Mr. Gidion Mafal　:　MISE Energy Planner

Closing Remarks.

Thank you for organizing the seminar.

Human resource development for maintenance of PV and DG facilities has been an issue, and we are very grateful for the training provided by this project for maintenance, repair, and management of facilities.

End

THE PROJECT FOR INTRODUCTION OF HYBRID POWER GENERATION SYSTEM IN PACIFIC ISLAND COUNTRIES

Seminar in Kiribati

～Japan's contribution to promoting renewable energy～

Friday, July19th 2019 / 9:30 - 12:30

Venue： MISE meeting room

【Program】

10:00 ～ 10:05 Guest greeting (Secretary, MISE, Ms. Saitofi Mika)
10:05 ～ 10:35 Project introduction (including PR video) (JICA Chief Advisor, Mr. Tadayuki Ogawa）
10:35 ～ 11:00 Project progress report（JICA Expert Team leader Mr. Luis Kakefuku）

11:00-12:00 Keynote speech

① 「Efforts to introduce renewable energy in Kiribati」
（Ministry of Infrastructure and Sustainable Energy・RE Planner Mr. Thomas Taoaba ） (15minutes)

② 「Introduction of technical knowledges acquired during the RE training in Japan」
(Training period: Feb 15th 2018 ～ Mar 3rd 2018)
（Public Utilities Board・Generation Manager Mr. Tenikoria Kataueа）
(15minutes)

③ 「Introduction of technical knowledges acquired during the DGs Overhaul training in Kumejima Is, Okinawa Japan」
(Training period: Sep 26th 2018 ～ Oct 23rd 2018)
(Public Utilities Board・Power generation engineer Mr. Teebwatia Taakau & PV & Instrumentation Supervisor Mr. Bauro Mikaere）
(15minutes)

④ 「Efforts to introduce renewable energy in the remote islands of Okinawa」
（JICA Expert Team leader Luis Kakefuku）
(15minutes)

12:00 ～ 12:15 Q＆A session
12:15 ～ 12:20 Closing remarks（Urban Energy planner Mr. Tiaon Ankitino）
12:30 ～ 13:30 Lunch

Participant list

No.	Organization	Position	Name
1	Ministry of Infrastructure and Sustainable Energy	Secretary, MISE,	Ms. Saitofi Mika
2	Ministry of Infrastructure and Sustainable Energy	Conversional of Energy	Ms. Mwaati Oten
3	Ministry of Infrastructure and Sustainable Energy	Rural Energy Planner	Mr. Thomas Taoaba
	Ministry of Infrastructure and Sustainable Energy	Urban Energy planner	Mr. Tiaon Ankitino
4	Ministry of Infrastructure and Sustainable Energy	Other staff working for the project	
5	Public Utilities Board	Chief Executive Officer	Mr. Wayne Brearly
6	Public Utilities Board	Generation Manager	Mr. Tenikoria Katauea
7	Public Utilities Board	Power generation engineer	Mr. Teebwatia Taakau
8	Public Utilities Board	PV & Instrumentation Supervisor	Mr. Bauro Mikaere
9	JICA Fiji Office	Coordinator	Mr. Ikeda Takashi
10	JICA	Chief Advisor	Mr. Tadayuki Ogawa
11	JICA	Short Term Expert	Mr. Luis Kakefuku
12	JICA	Short Term Expert	Mr. Hideyasu Hokama
13	JICA	Short Term Expert	Mr. Miyagi Ken
14	JICA	Short Term Expert	Mr. Oshiro Riki
15	JICA	Short Term Expert	Mr. Miyazato Masaji
16	JICA	Short Term Expert	Mr. Kakazu Tokumitsu
17			

Attachment

・Introduction to the Hybrid Island Program

1st Seminar for The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries

JICA ’s Cooperation for Energy Sector in Pacific Island Countries

“Hybrid Islands Program – Smart Energy Integration for Resilient Islands”

TADAYUKI OGAWA (Chief Advisor)

Japan International Cooperation Agency (JICA)

CONTENTS

Hybrid Islands Program
- Leaders' Declaration (PALM8) in May 2018-

The Leaders stressed the importance of continued efforts, including investments, to reduce GHG emissions and promote energy efficiency and the effective use of renewable energy

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Prime Minister Abe expressed Japan's intention to support the FICs' (Forum Island Countries) efforts to achieve low carbon development through continued implementation of the "Hybrid Island Programme."

(Article 25)

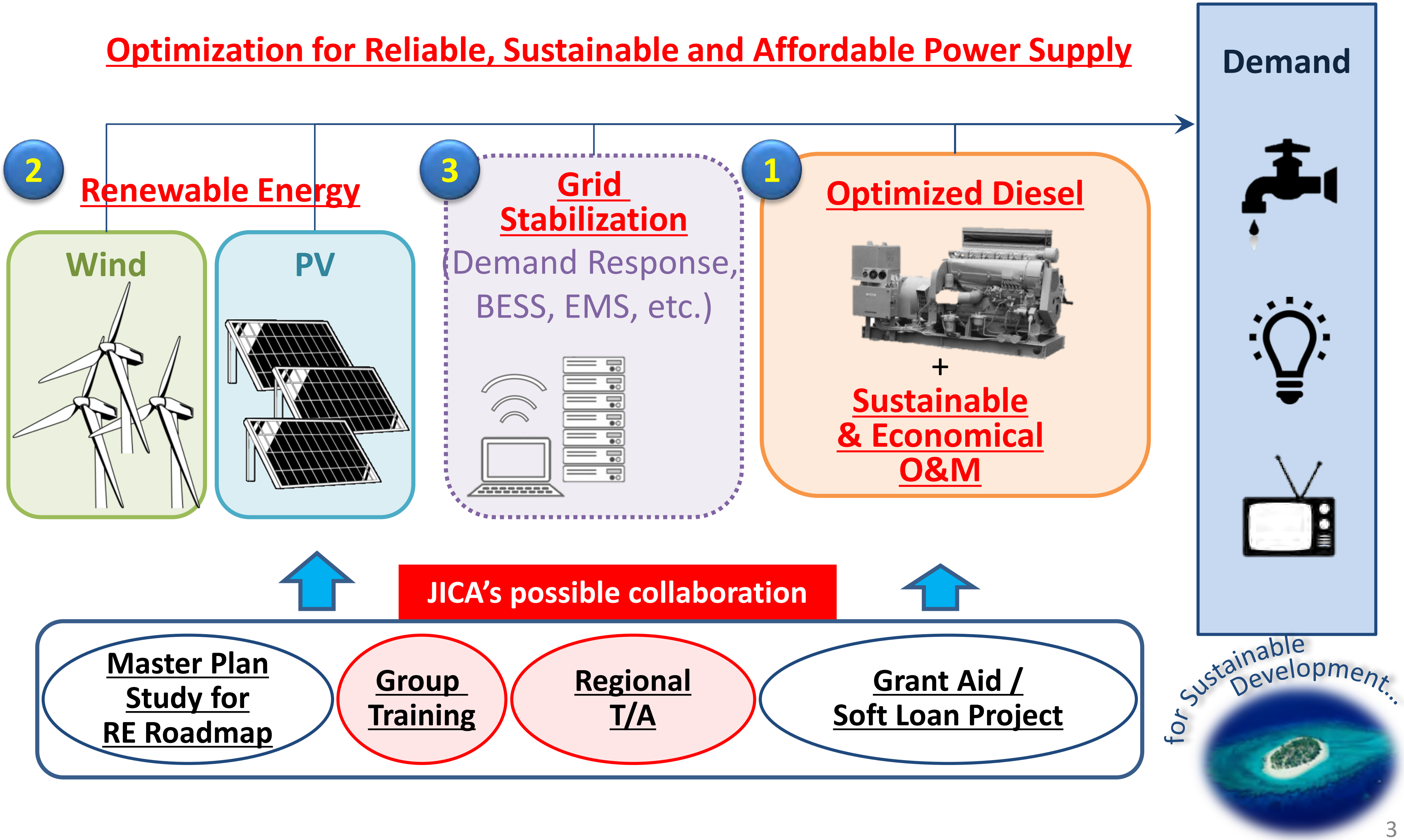
PALM8

Pacific Islands Leaders Meeting
Commitment to the Pacific
from Iwaki, Fukushima

(Resource) Website of Ministry of Foreign Affairs of Japan

Hybrid Islands Program

Hybrid Power Generation System (HPGS)



Optimization for Reliable, Sustainable and Affordable Power Supply

2 **Renewable Energy**

Wind

PV

3 **Grid Stabilization**

(Demand Response, BESS, EMS, etc.)

1 **Optimized Diesel**

\+

Sustainable & Economical O&M

Demand

JICA's possible collaboration

- **Master Plan Study for RE Roadmap**
- **Group Training**
- **Regional T/A**
- **Grant Aid / Soft Loan Project**

JICA’s Regional Approach

For Sustainable Development…

Expansion of RE Integration through Regional Approach

(1) Create New Value through Knowledge Co-creation

JICA is not just relocating technology to PICs, but also promoting new approach to “Think together”, “Accumulate new knowledge” and “Create new value” with the people in PICs.

(2) Regional Approach for Human Resource Development

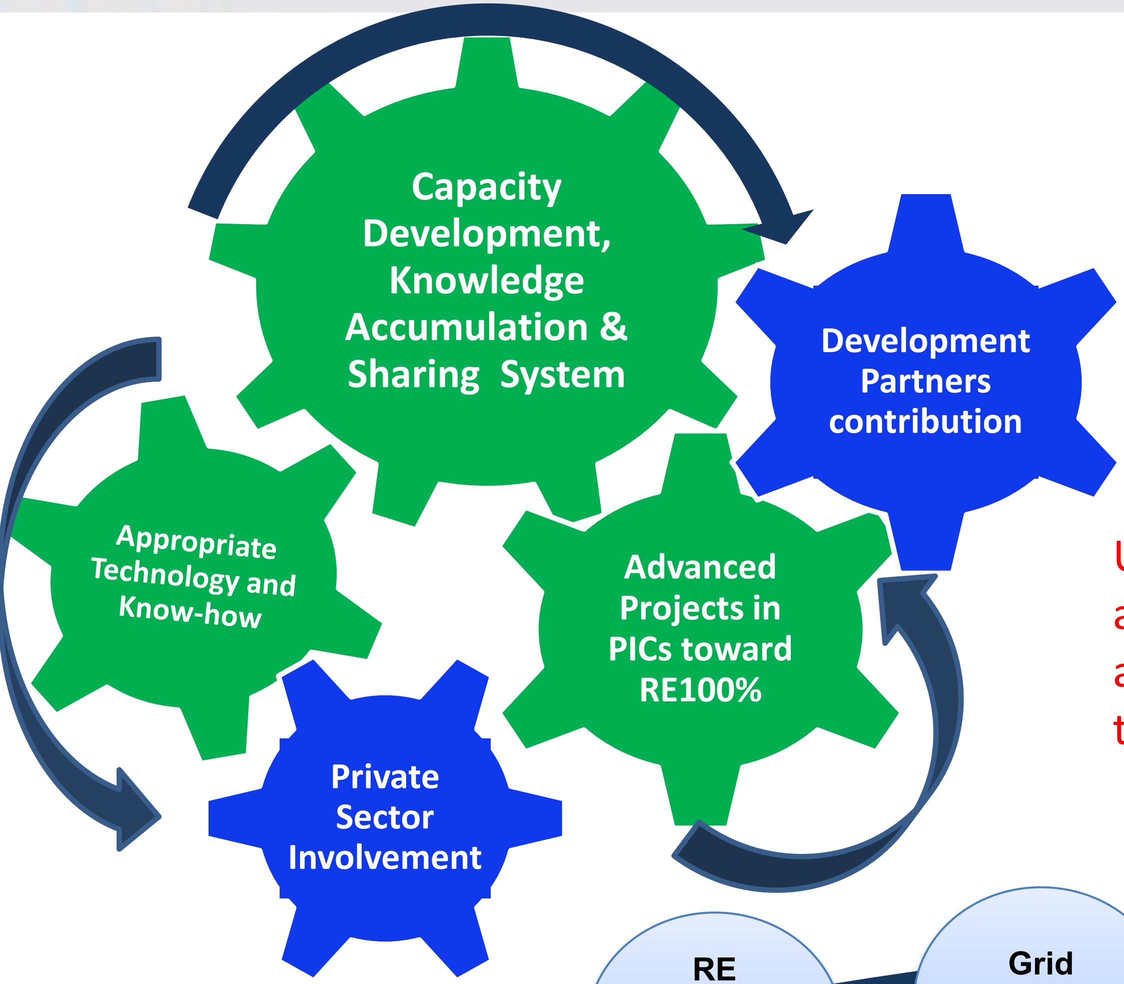
Regional Technical Cooperation Project is on-going for the establishment of regional training system at EFL Training Center in Fiji with FSM, RMI, Kiribati and Tuvalu.

- **Training for Grid Integration of RE generation systems**
- **Training for Operation and Maintenance of RE generation systems**
- **Training for Operation and Maintenance of DEGs**

(3) RE Integration Roadmap & Promotion of Private Sector Investments

Technical Cooperation for the introduction of RE Roadmap together with acceleration of private sector investments is ongoing in Palau and Solomon Islands.

JICA's Regional Approach



Capacity Development, Knowledge Accumulation & Sharing System

Development Partners contribution

Appropriate Technology and Know-how

Advanced Projects in PICs toward RE100%

Private Sector Involvement

Useful Technology and know-how from advanced RE projects shall be accumulated within PICs and shared in the region.

Reinforcement of existing power system

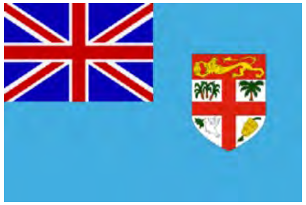
RE Integration Assessment

Grid Stabilization

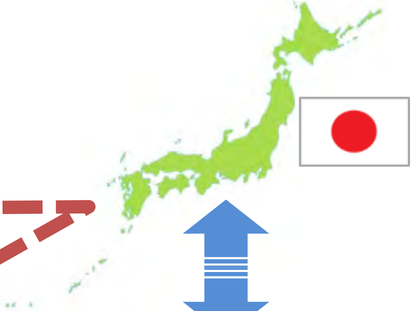
Transformation of core power supply to RE

RE target of each country

JICA’s Regional Approach



Concept of Region-wide Training
“Regional Center of Excellence” at EFL Lautoka Training Center



- **Know-how and experience of region-wide training**
- **Training of trainers in Fiji (lecture & hands-on)**
- **Advise on training materials**

- **Region-wide training**
- **Training for core trainers (classroom, hands-on)**
- **Follow-up after training**

Not only countries conducting JICA’s on-going project but also Samoa, Solomon Islands, Tonga, Vanuatu and more ･･･

Fiji as Hub

- Training center in place
- Experienced & skilled trainers (EFL, DOE)
- Collaboration with PPA

Interactive learnings

Among multiple Counterpart

Member Countries

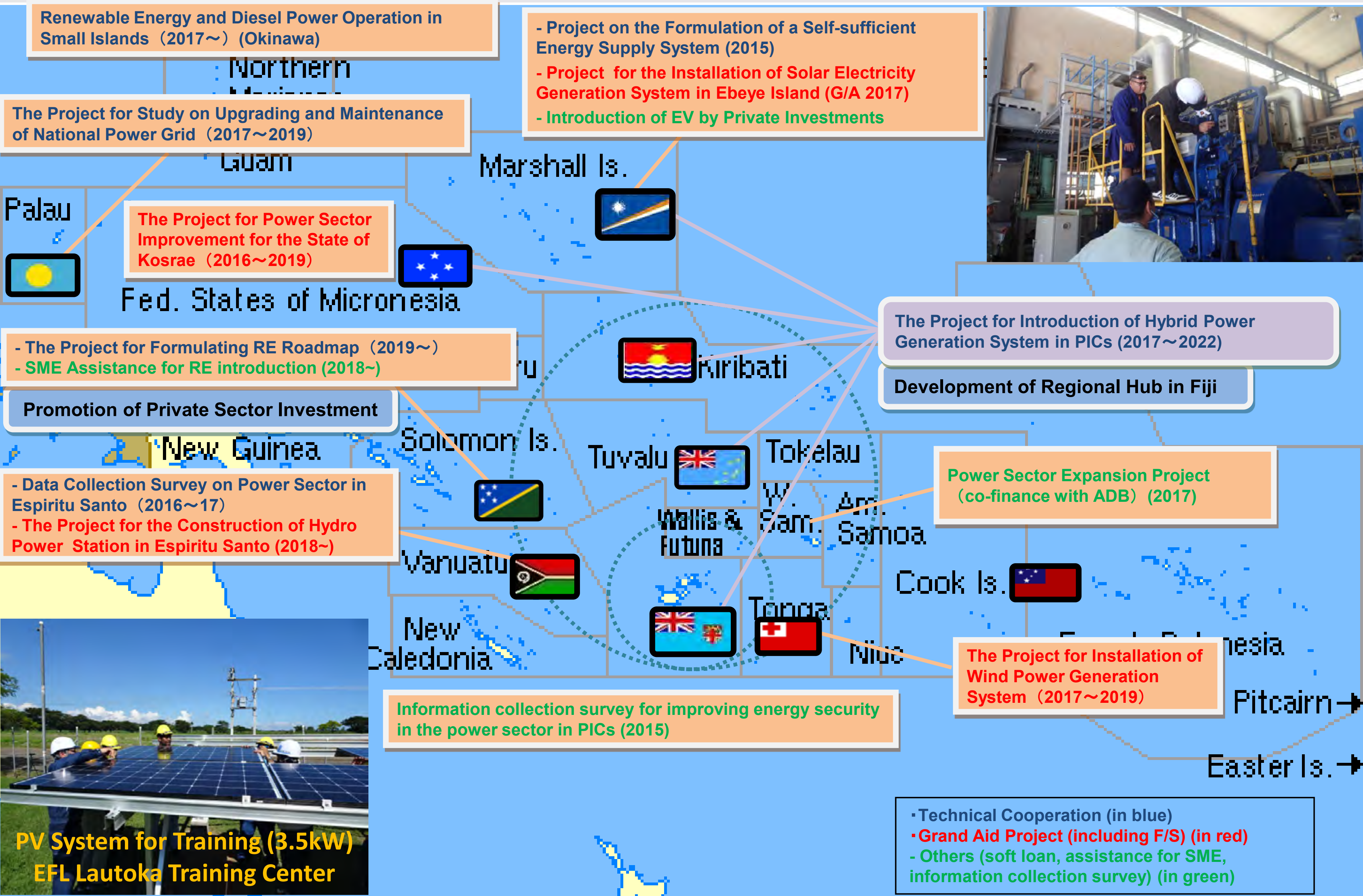
- Similarity of Member Countries
- Lacking training resources
- Higher cost if individual trainings are conducted

PV System for Training (3.5kW)
EFL Lautoka Training Center

Development Partners

- **Training needs**
- **Core trainers**
- **Existing situation and future plan**
- **Feedback after training**

Hybrid Islands Program



Renewable Energy and Diesel Power Operation in Small Islands（2017～）(Okinawa)

The Project for Study on Upgrading and Maintenance of National Power Grid（2017～2019）

The Project for Power Sector Improvement for the State of Kosrae（2016～2019）

- Project on the Formulation of a Self-sufficient Energy Supply System (2015)
- Project for the Installation of Solar Electricity Generation System in Ebeye Island (G/A 2017)
- Introduction of EV by Private Investments

The Project for Introduction of Hybrid Power Generation System in PICs (2017～2022)

Development of Regional Hub in Fiji

- The Project for Formulating RE Roadmap（2019～）
- SME Assistance for RE introduction (2018~)

Promotion of Private Sector Investment

- Data Collection Survey on Power Sector in Espiritu Santo（2016～17）
- The Project for the Construction of Hydro Power Station in Espiritu Santo (2018~)

Power Sector Expansion Project（co-finance with ADB）(2017)

The Project for Installation of Wind Power Generation System（2017～2019）

Information collection survey for improving energy security in the power sector in PICs (2015)

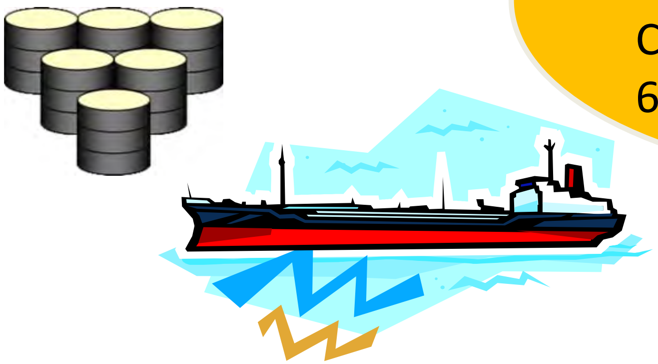
PV System for Training (3.5kW)
EFL Lautoka Training Center

- ･Technical Cooperation (in blue)
- ･Grand Aid Project (including F/S) (in red)
- Others (soft loan, assistance for SME, information collection survey) (in green)

Expected Achievements under Hybrid Islands Program (2022)

Reduction of 11,167 tCO2/year

Contribution to NDC target
60% GHG reduction by 2030



Reduction of 4,179 kL/year
(Diesel fuel consumption)

100 or more engineers / technicians will be trained.

(Remarks: Figures indicative for all PICs covered under the Program)

Project Highlights (1) : <Palau>The Project for Study on Upgrading and Maintenance Improvement of National Power Grid

Palau's National Target for RE

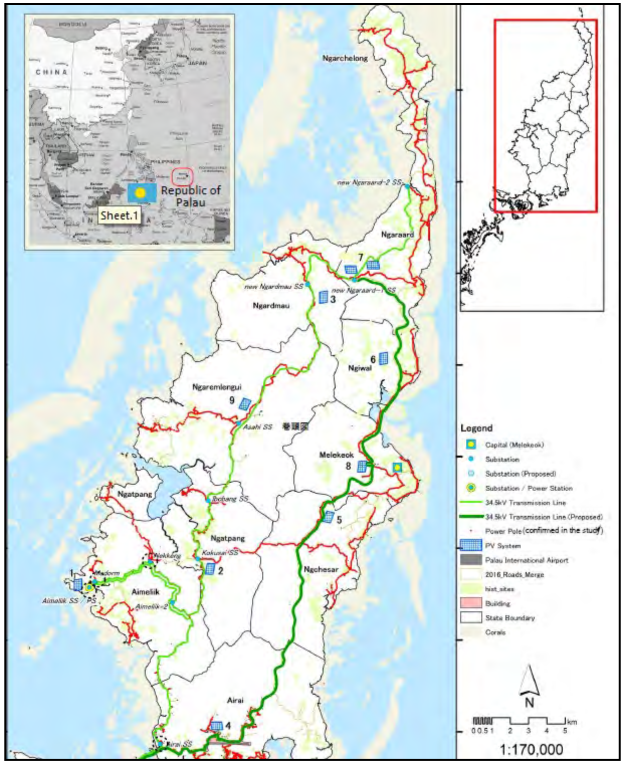
Generating 45% of its energy from Renewable Sources by 2025

Updating of Road Map for RE45% in 2025

- Consideration of both short & long-term output fluctuation
- Necessary measures for grid stabilization
- Technical transfer of the above investigation for grid stabilization

Setting of Power System Development plan up to 2025 based on the RE45% scenario

- Power Demand Forecast
- Study on transmission and distribution system expansion plan
- Strategic Environment Assessment



Investment Plan for Power System Development to achieve RE45%

- Pre-feasibility Study
- Estimation of financial investment and an investment schedule with recommendation on sources and methodologies of funding (IPP etc)

Project Highlights (2) : <Solomon Islands>
The Project for Formulating Renewable Energy Road Map

Facing Issues of Solomon

- **High Electricity Tariff (approx. 80 cents/kWh)**
- **Challenging RE Target**
- Low Electrification Rate

Formulation of Roadmap for RE Development

- Consideration of RE potential and development plan
- Measures for grid stabilization (with less storage)
- Measures for enable the actual implementation of the roadmap, including promotion of private investment

Multiple scenarios to achieve challenging RE targets with minimum cost will be formulated, including RE 100% Scenario

Enabling Environment is the Key!

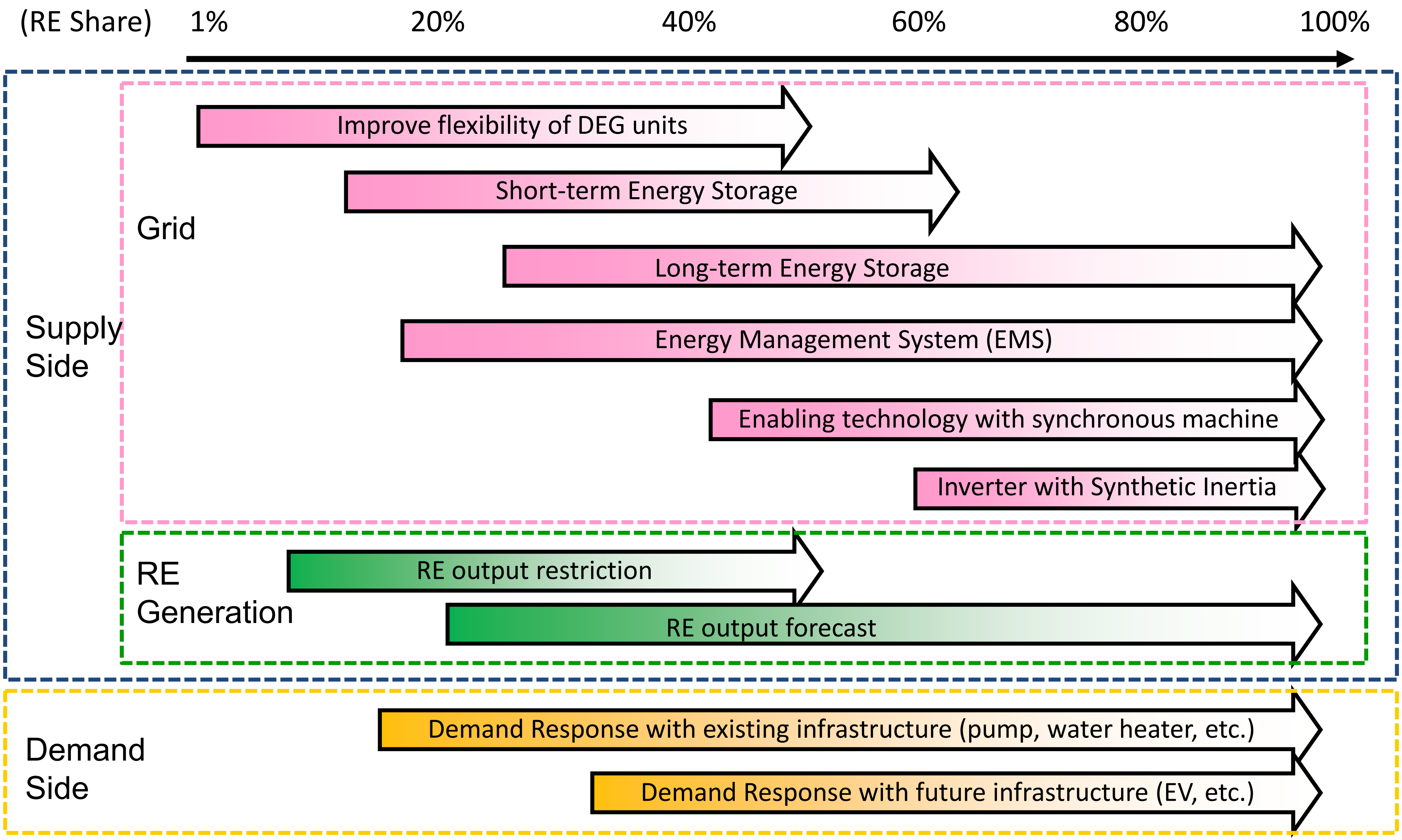
- **Goal:** To promote RE development in Solomon Islands through formulation of the roadmap, which is technically reliable and financially practicable.
- **Project Area:** Honiara Grid
- **Target Year:** 2030
- **Status:** Record of Discussion (R/D) was signed on 3rd June, 2019.

3 Pillars of the Project:

- ☐ Supply Side
- ☐ Demand Side
- ☐ Private Invest

Project Highlights (2) : <Solomon Islands>
The Project for Formulating Renewable Energy Road Map

Measure to be Considered in Increasing Renewable Energy Contribution



Project Highlights (3) : <Vanuatu> The Project for the Construction of Hydropower Station in Espiritu Santo Island

Vanuatu's National Target for RE

Generating 100% of its energy from Renewable Sources by 2030

Espiritu Santo Island – Mainly supplied by existing hydropower plants, but recently increasing dependency on high-cost imported fuel due to demand growth

- **Goal:** To decrease dependence on high-cost imported fuel, through the construction of hydropower station.
- **Project Site:** Sarakata River, Espiritu Santo Island
- **Component:** 1,000kW Hydropower station (run-of-river type)

Status: 1st Phase: 2018 – 2019/3 (information collection stage)

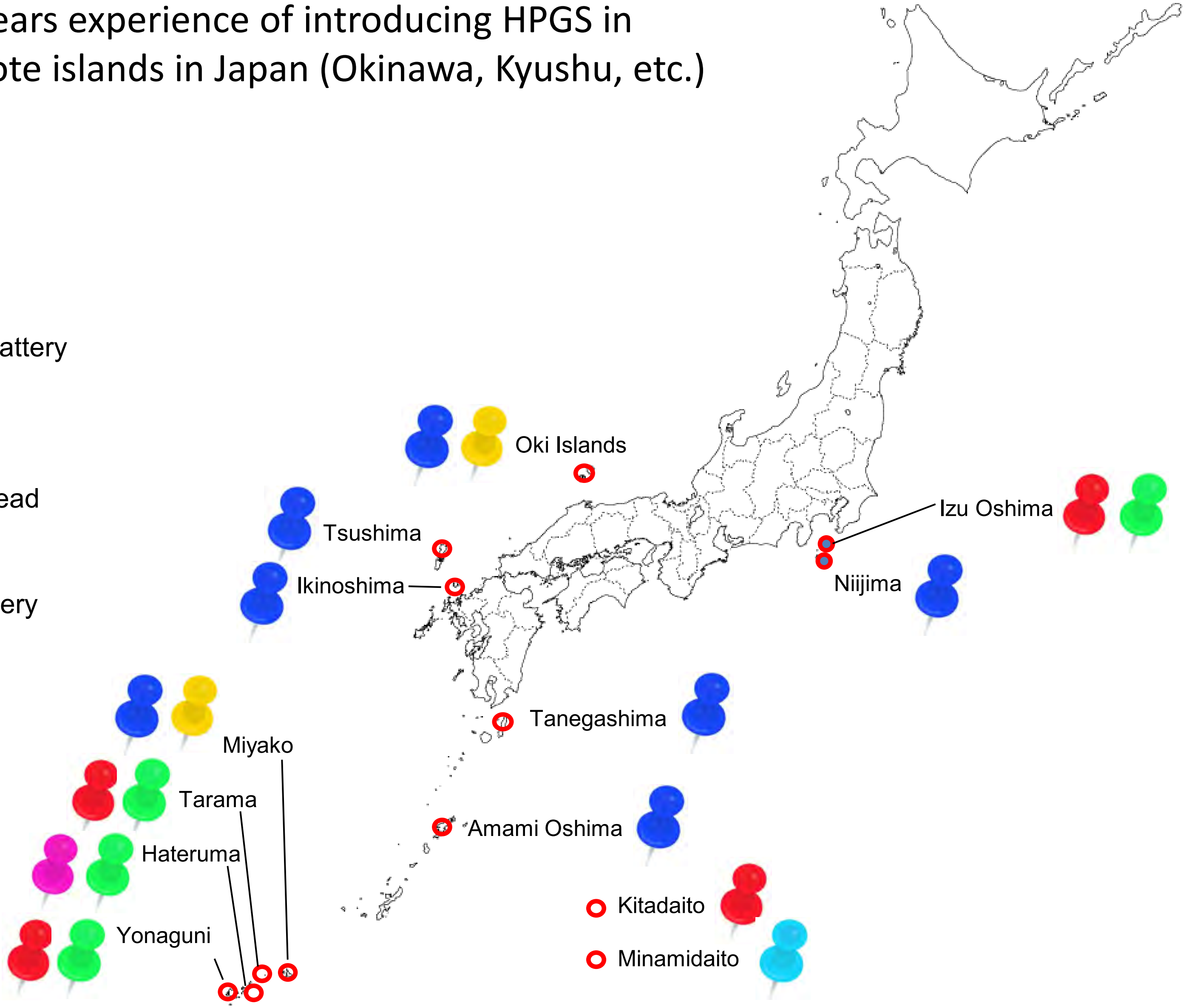
2nd Phase: 2019 – 2020 (Outline design stage)

→ Supporting promotion of RE through Grant Project

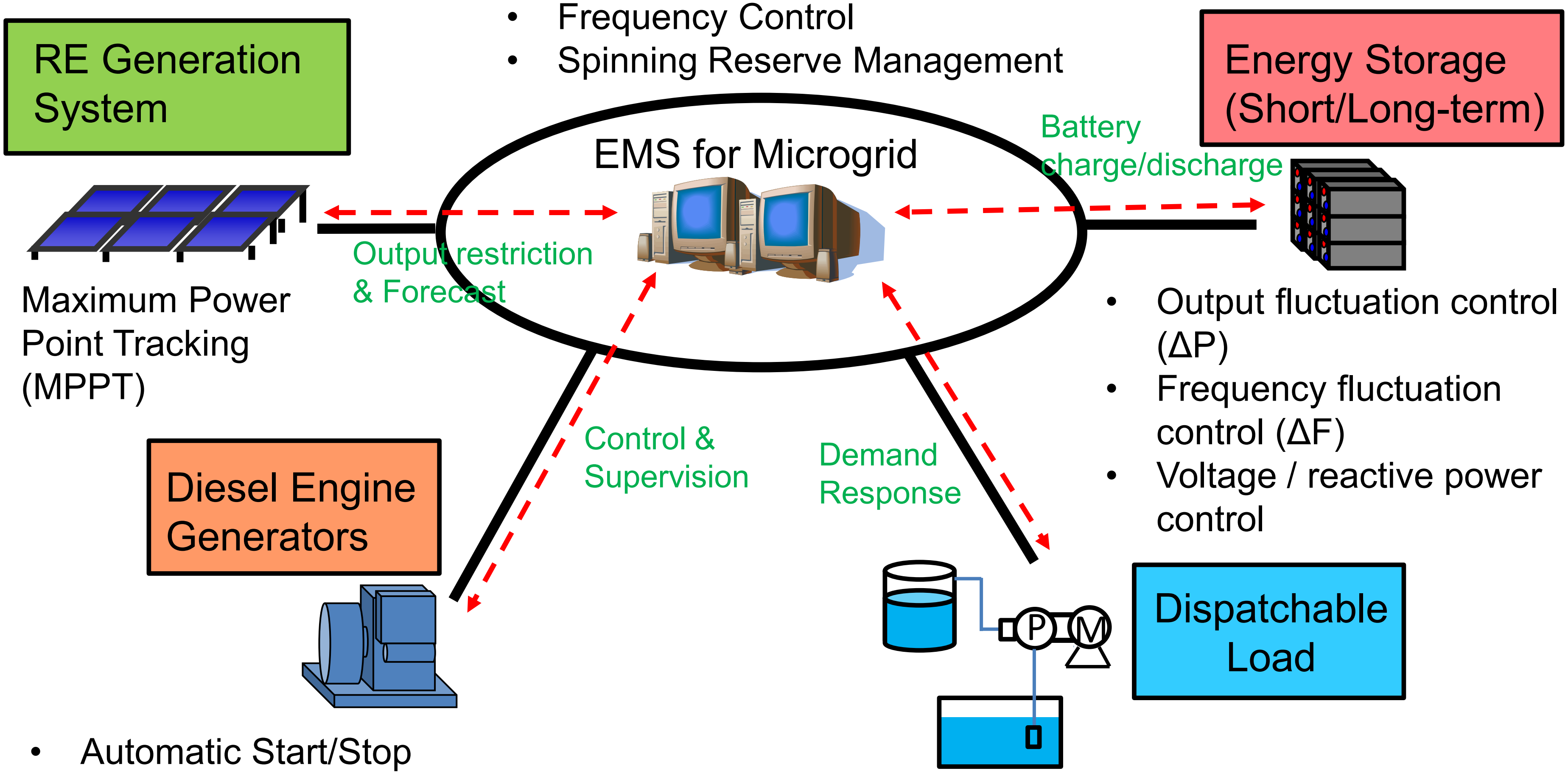
Hybrid Power Generation System (HPGS) in Japan

20 years experience of introducing HPGS in remote islands in Japan (Okinawa, Kyushu, etc.)

- Li-ion Battery
- Li-ion Capacitor
- Nickel Hydrogen Battery
- Fly Wheel
- Valve Regulated Lead Acid Battery
- Sodium Sulfur Battery



Hybrid Power Generation System (HPGS) in Japan



EMS for Microgrid

- Demand Forecast
- Economic Dispatch Control
- Frequency Control
- Spinning Reserve Management

RE Generation System

- Maximum Power Point Tracking (MPPT)

Energy Storage (Short/Long-term)

- Output fluctuation control (ΔP)
- Frequency fluctuation control (ΔF)
- Voltage / reactive power control

Diesel Engine Generators

- Automatic Start/Stop
- Isochronous Control (GF/LFC)
- Optimization of unit power output & specific fuel consumption

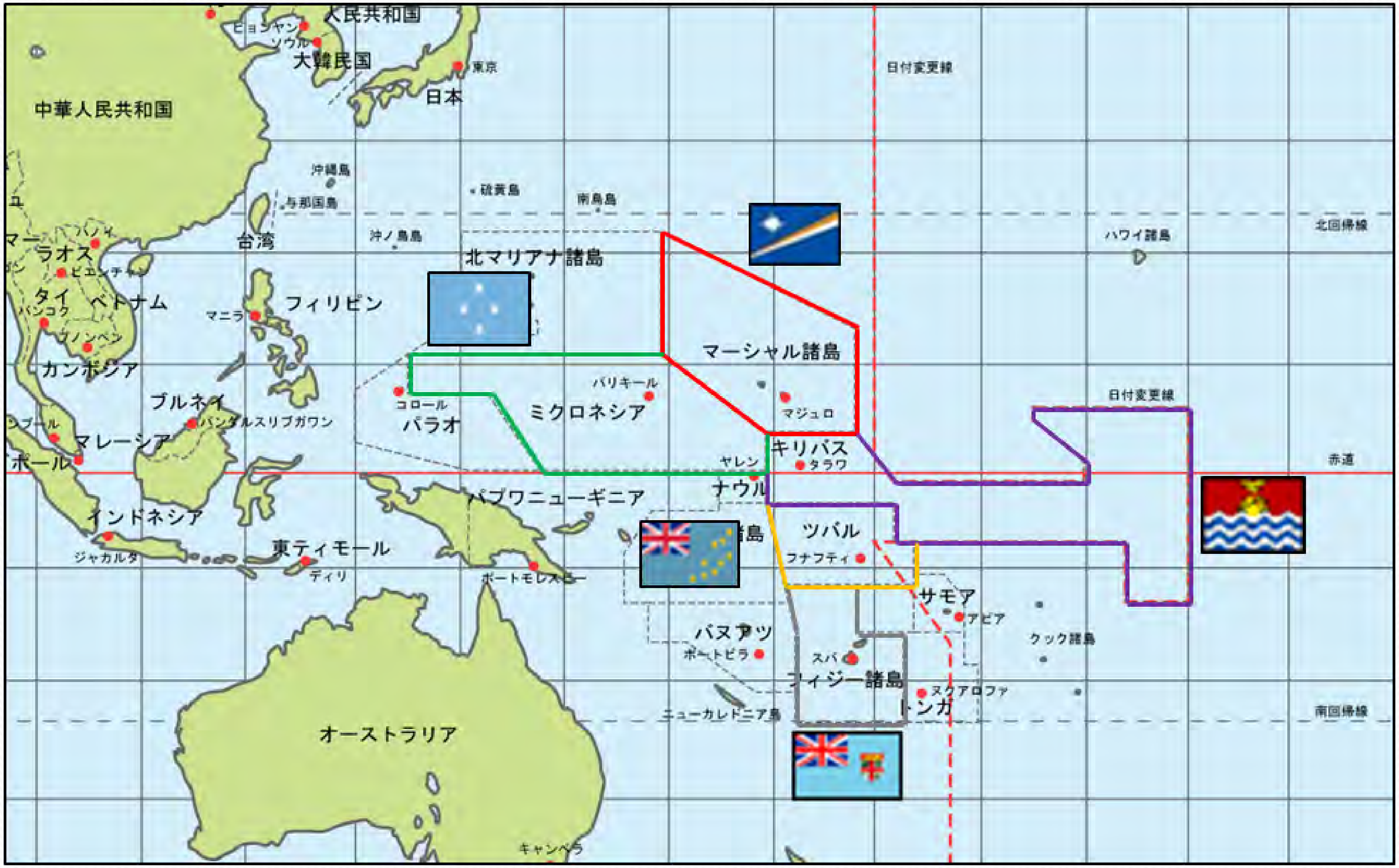
Dispatchable Load

- Communication through optical fiber or smart meter
- Remote control in response to the request by grid operator

Attachment

- **Project Progress Report**

The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries



Okinawa Enetech Co., Inc.

Okinawa Electric Power Co., Inc.

■ INDEX

1. Project Objective

■ Project design matrix for Kiribati

Project purpose

1. Hybrid Power Generation System is introduced

Overall Goal

Energy security is improved and greenhouse gases are reduced through the reduction of fossil fuels consumption

Outputs

1. Appropriate and economical system for O&M of Diesel Generators (DGs) is enhanced.
2. Methodology for appropriate planning and O&M of Renewable Energy (RE) is established.

1. Project Objective

■ Project design matrix for Kiribati

Activities ＜Output 1＞

1-1 Operational conditions of the existing DGs are reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose.
1-2 Asset management plan of DG is reviewed including financial evaluation on overhaul.
1-3 Specific fuel consumption of pilot DG units is measured.
1-4 Improvement plan for the operation of pilot DG units is prepared.
1-5 Existing spare parts and maintenance tools of pilot DG units are confirmed.
1-6 Improvement plan for the operation of pilot DG units is implemented.
1-7 The result of implementation of the improvement plan is evaluated, and improvement plan is updated.
1-8 The concept of Economic Dispatch Control (EDC) is shared among operators and applied, if possible.
1-9 Necessary spare parts and maintenance tools for the pilot DG units are prepared.
1-10 Maintenance work schedule for the pilot DG units is prepared.
1-11 Check sheets and maintenance manuals for maintenance works for pilot DG units are prepared.
1-12 Maintenance works (daily/partial inspection/overhaul work) for pilot DG units are conducted in accordance with the maintenance schedule.
1-13 The result of maintenance works is evaluated, and future maintenance work schedule together with budget (including sub-contract fee, cost for tools and equipment) is prepared.
1-14 Specific fuel consumption of the pilot DG units is measured before and after implementation of the related project activities.
1-15 Related training programs for appropriate O&M system for DGs are implemented periodically.
1-16 Knowledge on appropriate O&M of DGs is disseminated among stakeholders.

1. Project Objective

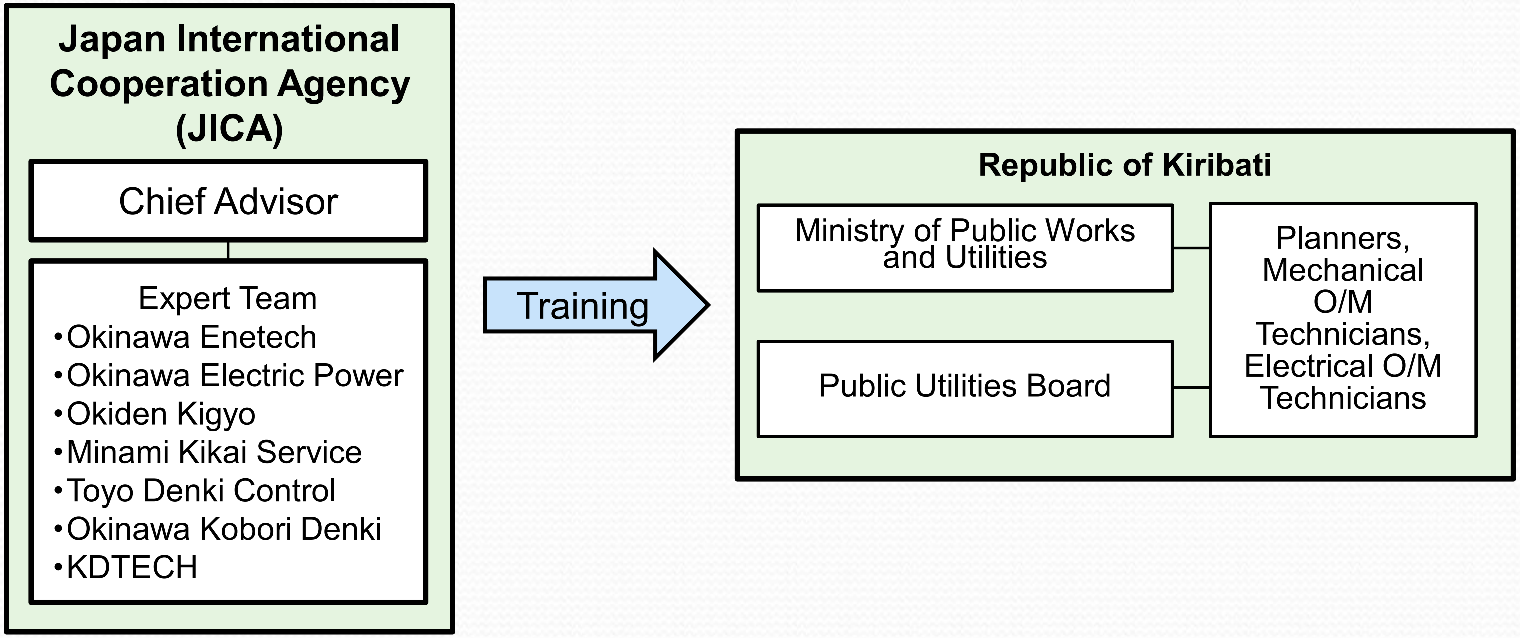
■ Project design matrix for Kiribati

Activities ＜Output 2＞

2-1 Current situation and future development plan of RE is reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose.
2-2 Planning manual for Hybrid Power Generation System is prepared.
2-3 Planning manual for Hybrid Power Generation System is reviewed and updated in the target area.
2-4 Operating conditions of the existing RE facilities are reviewed, including confirmation of objectively verifiable indicators for overall goal.
2-5 O&M manual for RE facilities is prepared.
2-6 Maintenance works are conducted according to O&M manual of RE facilities.
2-7 The result of maintenance works is evaluated, and future maintenance work schedule together with budget is prepared.
2-8 Training program for Hybrid Power Generation System including O&M of RE facilities is conducted.
2-9 Knowledge regarding Hybrid Power Generation System is disseminated among stakeholders.

3. Project Introduction

■ Project Cooperative Structure for FSM, Marshall, Kiribati & Tuvalu



Japan International Cooperation Agency (JICA)

Chief Advisor

Expert Team
- Okinawa Enetech
- Okinawa Electric Power
- Okiden Kigyo
- Minami Kikai Service
- Toyo Denki Control
- Okinawa Kobori Denki
- KDTECH

Training

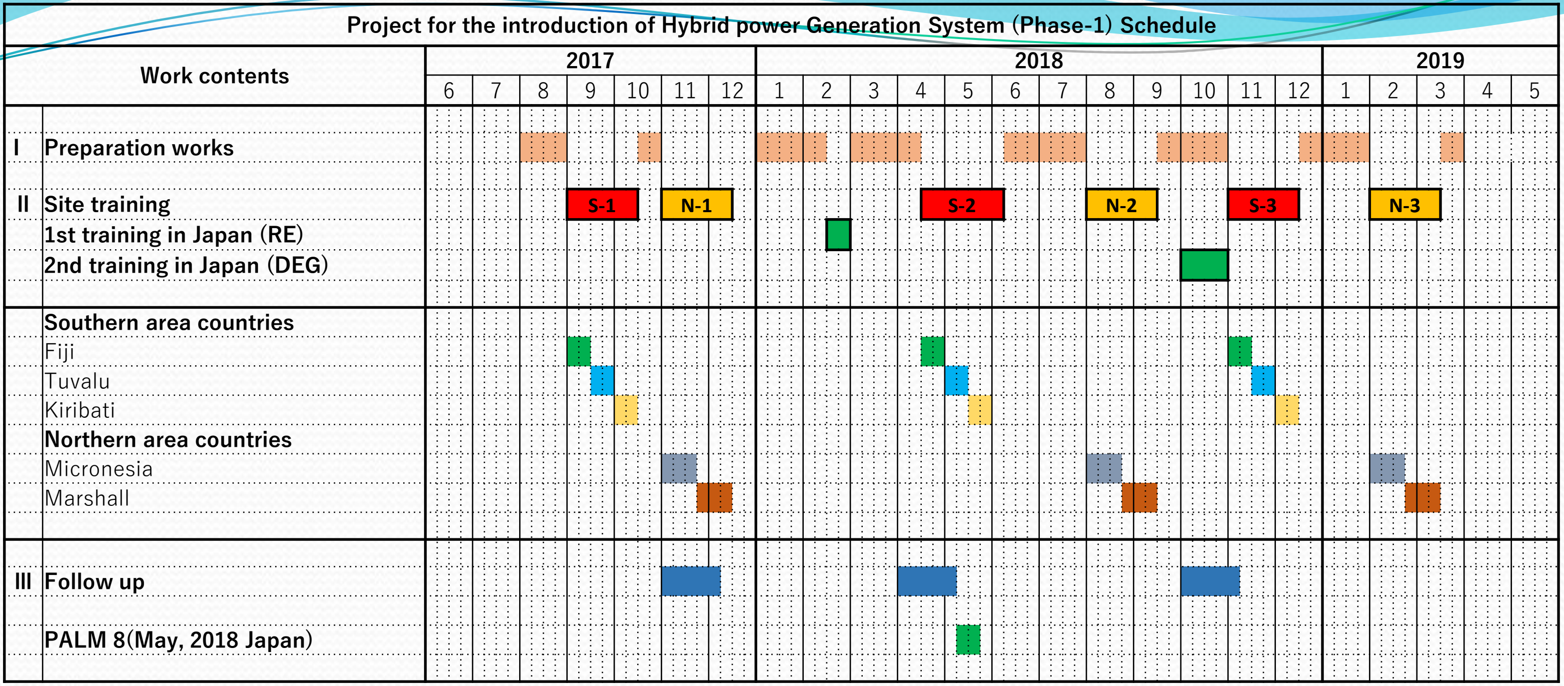
Republic of Kiribati

Ministry of Public Works and Utilities

Public Utilities Board

Planners, Mechanical O/M Technicians, Electrical O/M Technicians

2. Project Cooperation schedule (Phase 1)



Project for the introduction of Hybrid power Generation System (Phase-1) Schedule

	Work contents	2017							2018												2019				
		6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
I	**Preparation works**			■		■			■	■	■	■		■	■		■	■		■	■		■		
II	**Site training**				S-1	S-1	N-1	N-1				S-2	S-2	S-2		N-2	N-2		S-3	S-3		N-3	N-3		
	1st training in Japan (RE)									■															
	2nd training in Japan (DEG)																	■							
	Southern area countries																								
	Fiji				■							■							■						
	Tuvalu				■								■						■						
	Kiribati					■							■							■					
	Northern area countries																								
	Micronesia						■									■						■			
	Marshall						■	■								■	■					■	■		
III	**Follow up**						■	■				■	■					■	■						
	PALM 8(May, 2018 Japan)												■												

	Contents (Diesel O＆M / RE O&M / RE Implementation)	Training period in Kiribati
1	Survey of the conditions power generation (RE and DEG's) system	9/14 to 9/24 (2017)
2	Training in Japan(Visit to Hybrid systems in Okinawa / Japan RE devices manufacturer/ RE research institutes)	Japan : 02/16 to 03/02 (2018)
3	Lectures in basic knowledge of RE and DEG'S operation and maintenance. Hand on training.	DEG: 05/24 to 05/31 RE: 06/18 to 06/25
4	Training in overhaul of DEG in Okinawa remote island power station	Japan(Okinawa) 09/27 to 10/22
5	Preparation of the manual for O&M of DEG's and RE facilities	DEG: 12/06 to 12/15 RE: 10/22 to 10/28

3. Project progress in Kiribati

3.1 Survey of the conditions power generation (RE and DEG's) system

3. Project progress

3.2 First training in Japan : February 16th to March 2nd (RE training)

INTRODUCTION OF HYBRID POWER GENERATION SYSTEM IN PACIFIC ISLAND COUNTRIES

Counterpart training in Japan Schedule Plan

Date		time			item	Contents
2/15	Thu		～			Moving to Japan
2/16	Fri		～		Lecture	AM Briefing
			～		Lecture	PM Seminar
2/17	Sat		～			
2/18	Sun		～			
2/19	Mon	10:00	～	10:30	Courtesy Visit	Courtesy Visit to Okinawa Enetech president
		10:30	～	11:00	Courtesy Visit	Courtesy Visit to Okinawa Electric Power president, deputy president.
		11:00	～	12:00	Lecture	Training program orientation, interchange of opinions
		13:30	～	14:00	Courtesy Visit	Courtesy Visit to Okiden Kigyo president
		14:00	～	16:00	Site Visit	Technical Training Center / Power Supply Center
2/20	Tue	10:00	～	12:00	Presentation	Okinawa Mainland Grid, Grid stabilization Technology
		13:00	～	14:00	Presentation	Presentation of Okinawa Remote Island Hybrid system technology
		14:00	～	15:00	Presentation	Presentation of Okinawa Remote Island EDC
		15:00	～	16:00	Presentation	Presentation of proof research project of Solar and wind power in Okinawa
2/21	Wed	7:30	～	17:00	Site Visit	Visit to Tarama Is hybrid system(PV+ WT)facility
2/22	Thu	10:00	～	12:00	Site Visit	Miyako Energy Management System(EMS)
		13:00	～	15:00	Site Visit	Miyako mega solar facility
2/23	Fri	10:00	～	16:00	Site Visit	Visit to Abu mega solar facility and Ogimi Wind power facility in Okinawa mainland
2/24	Sat	11:45	～	13:45	Move	Moving to Osaka
		14:30	～	16:00	Move	Moving to Kyoto
2/25	Sun	9:30	～	14:30	Site Visit	Sightseeing of Kyoto
2/26	Mon	10:00	～	12:00	Site Visit	Nissin Electric(Renewable Energy Control System)
		12:00	～	15:00	Move	Moving to Nagoya
		15:00	～	17:00	Site Visit	Hitachi Chemical(Industrial Batteries)
2/27	Tue	10:00	～	17:00	Move	Moving to Fukushima
2/28	Wed	10:00	～	15:00	Site Visit	Fukushima Renewable Energy Institute, AIST(Advanced Industrial Science and Technology
		17:00	～	19:00	Move	Moving to Tokyo
3/1	Thu	10:00	～	12:00	Site Visit	Central Research Institute of Electric Power Industry(CRIEPI)
3/2	Fri	9:00	～	10:00	Courtesy Visit	JICA Headquarters
		10:00	～	11:00		Evaluation meeting
		11:30	～	12:00		Closing ceremony
3/3	Sat		～			Moving to respective countries
3/4	Sun		～			

3. Project progress

3.2 First training in Japan : February 16th to March 2nd (RE training)

1. Lectures from Okinawa Electric Power Co.

2. Visit to Okinawa remote island Hybrid power generation facilities
   (Tarama Wind Turbine Hybrid System/Stabilizer/Photovoltaic System)

3. Project progress

3.2 First training in Japan :   February 16th to March 2nd (RE training)

3. Visit to Okinawa remote island Hybrid power generation facilities (Miyako Mega Solar System)

4. Visit to Okinawa mainland RE power generation facilities (Ogimi WT Wind Turbine Demonstration Facilities , Abu Mega solar)

3. Project progress

3.2 First training in Japan :   February 16th to March 2nd (RE training)

5. Visit to Nissin Electric Co. Control Device Factory (Kyoto)

6. Hitachi Chemical Co. Batteries manufacturer Plant (Nagoya)

3. Project progress

3.2 First training in Japan : February 16th to March 2nd (RE training)

7. Visit to National Institute of Advanced Industrial Science and Technology (AIST), Fukushima Renewable Energy Institute AIST (FREA)

8. Visit to the Central Research Institute of Electric Power Industry (CRIEPI)

3. Project progress

3.2 First training in Japan : February 16th to March 2nd (RE training)

9. Visit to JICA main office (Tokyo)

3. Project progress in Kiribati

3.3 Lectures in basic knowledge of DEG's & RE operation and maintenance. Hand on training.

3. Project progress

3.4 Second training in Japan : September 27th to October 22nd (DEG overhaul training in Kume Is., Okinawa)



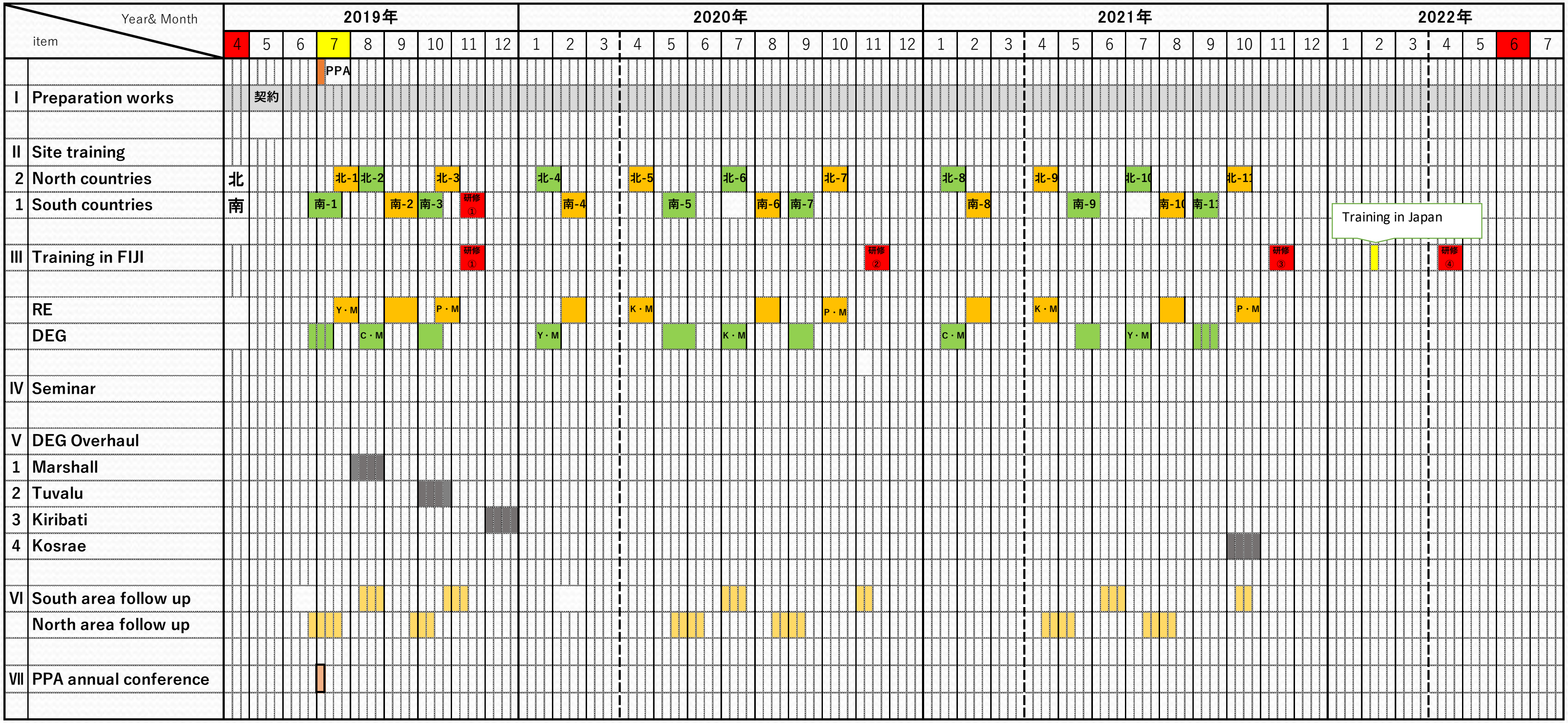



3. Project progress in Kiribati

3.5 Lectures in basic knowledge of DEG’s & RE operation and maintenance.

Hand on training. (Last training in the 1st phase)

4. Project Schedule (Phase 2)



Project for the introduction of Hybrid power Generation System (Phase-2) Schedule

	Year& Month item	2019年									2020年												2021年												2022年						
		4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7
					PPA																																				
Ⅰ	Preparation works		契約																																						
Ⅱ	Site training																																								
2	North countries	北			北-1	北-2		北-3			北-4			北-5			北-6			北-7			北-8			北-9			北-10			北-11									
1	South countries	南			南-1		南-2	南-3	研修 ①			南-4			南-5			南-6	南-7					南-8			南-9			南-10	南-11										
Ⅲ	Training in FIJI								研修 ①												研修 ②												研修 ③			Training in Japan ▨		研修 ④			
	RE				Y・M		▨	P・M				▨		K・M				▨		P・M				▨		K・M				▨		P・M									
	DEG				▨	C・M		▨			Y・M				▨		K・M		▨				C・M				▨		Y・M		▨										
Ⅳ	Seminar																																								
Ⅴ	DEG Overhaul																																								
1	Marshall					▨																																			
2	Tuvalu							▨																																	
3	Kiribati									▨																															
4	Kosrae																															▨									
Ⅵ	South area follow up					▨		▨	▨								▨				▨							▨				▨									
	North area follow up			▨	▨		▨	▨							▨	▨		▨	▨							▨	▨		▨	▨											
Ⅶ	PPA annual conference				▨																																				

Thank you very much for your kindly support to this project

ありがとうございました。

Okinawa Enetech Co., Inc. **Okinawa Electric Power Co., Inc.**

Attachment

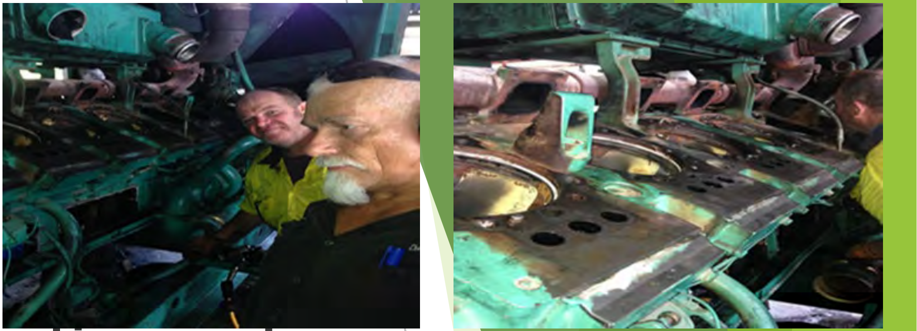
- **Status of Kiribati power system operation and future development plan**

PED 1st Quarter Progress Presentation

Content

- Progress on key activities: Jan – Mar 2019
- Load shedding schedule
- Planned Activities: April – June 2019
- Asset performance status
- Power generation forecast
- Improvement plan
- Commissioned project
- Development plan & Energy project
- Appendix

Progress on key activities: Jan-Mar 2019



- Further repair work on DG2
- Blower room fan replacement done
- Inspection & Training 400KW solar PV system delivered
- HV & LV preventative maintenance work ongoing
- Diesel Plant preventative maintenance work ongoing
- DG1 radiator follow up ongoing
- Cable hauling tooling ongoing
- Electrical tooling ongoing
- DG’s maintenance spares ongoing
- Load shedding ongoing

Load Shedding Schedule

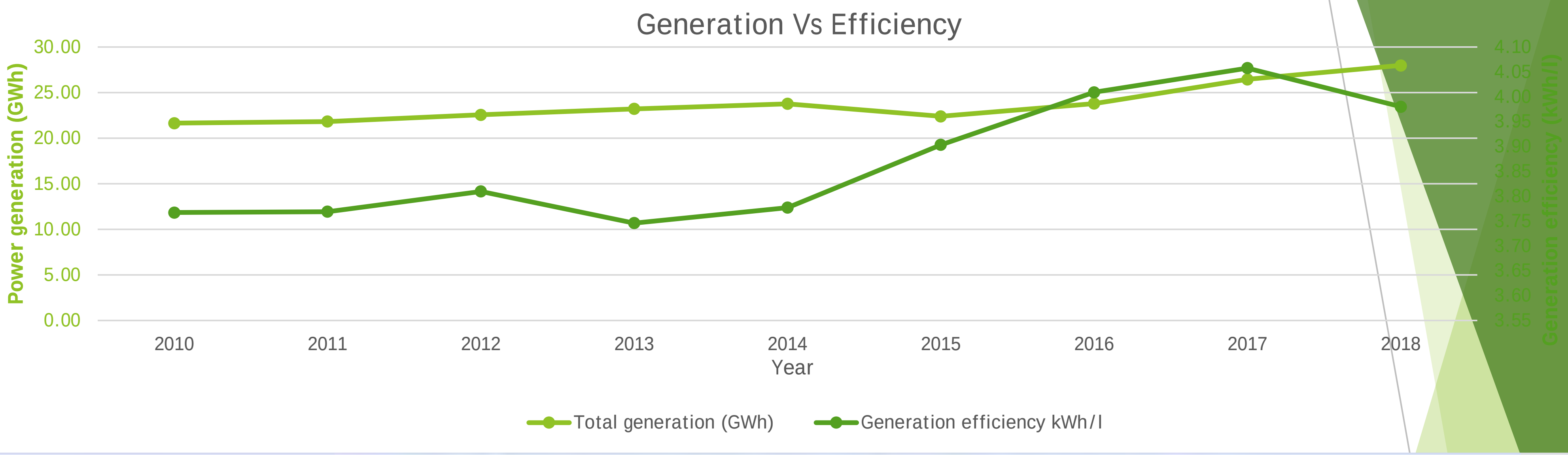
Load Shedding Shedule		Actions			Day		Evening		Comments
		off from D/Box	off from Tx	Priority Areas	08:00-12:00-13:00-16:00		16:00-20:00-24:00		
1	Betio Lodge 1	√			🟨	🟨			
2	Betio Lodge 2	√			🟨	🟨			
3	Moel Trading	√			🟨	🟨			
4	Coral Ace	√			🟨	🟨			
5	Taotin Bairi & Teaoraereke	√			🟨	🟨			
6	Fair Price	√			🟨	🟨			
7	Botique Hotel	√			🟨	🟨			
8	Utirerei Hotel	√			🟨	🟨			
9	FEMA lodge	√			🟨	🟨			
10	NZ high Commission	√			🟨	🟨			
11	Australian High Commission	√			🟨	🟨			
12	Kiribati Port Authority	√			🟨	🟨			
13	USP	√			🟨	🟨			
14	Momon Eita	√			🟨	🟨			
16	Hopital Admin Building	√					🟦	🟦	*Off after work Until morning*
17	Punja's	√			🟨	🟨			
18	Government Ministries & offices			√			🟦	🟦	*off after work until morning*
19	Hospital wards & OT			√					
20	Schools			√			🟦	🟦	*off after work until morning*
21	Police HQ			√					
22	Marine Guard			√					
23	Air Port			√					
24	Bonriki Pumping Station			√					
25	Domestic			√					*This will depend on the grid load otherwise 4hr load shedding rotation will be applicable*
26	Sewerage pumping stations			√					

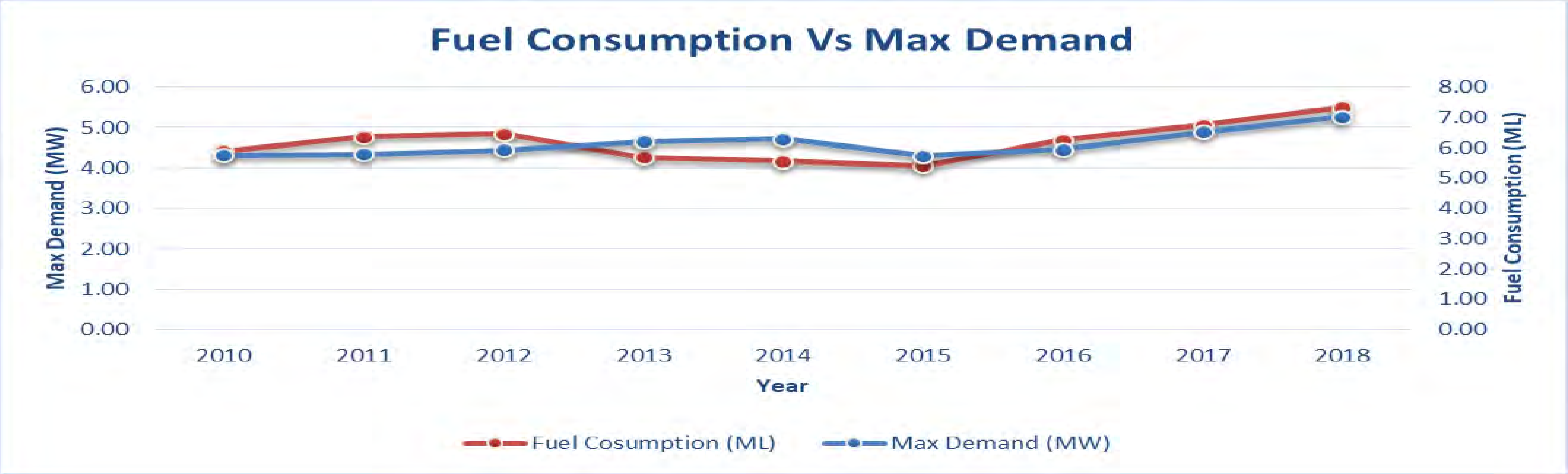
Planned activities; April -June 2019

- Replacement of Isolation Rubber on DG4
- Load shedding on the network
- Commissioning 1020KVA Cummins engine
- SCADA system upgrade & communication link repair works
- Low Voltage cable upgrade
- Data collection on Substation loads on the Network
- Preventative maintenance work on all diesel Plants
- Data collection on solar PV systems
- Facility Clean up

Asset Performance status

Generation





Asset Performance status

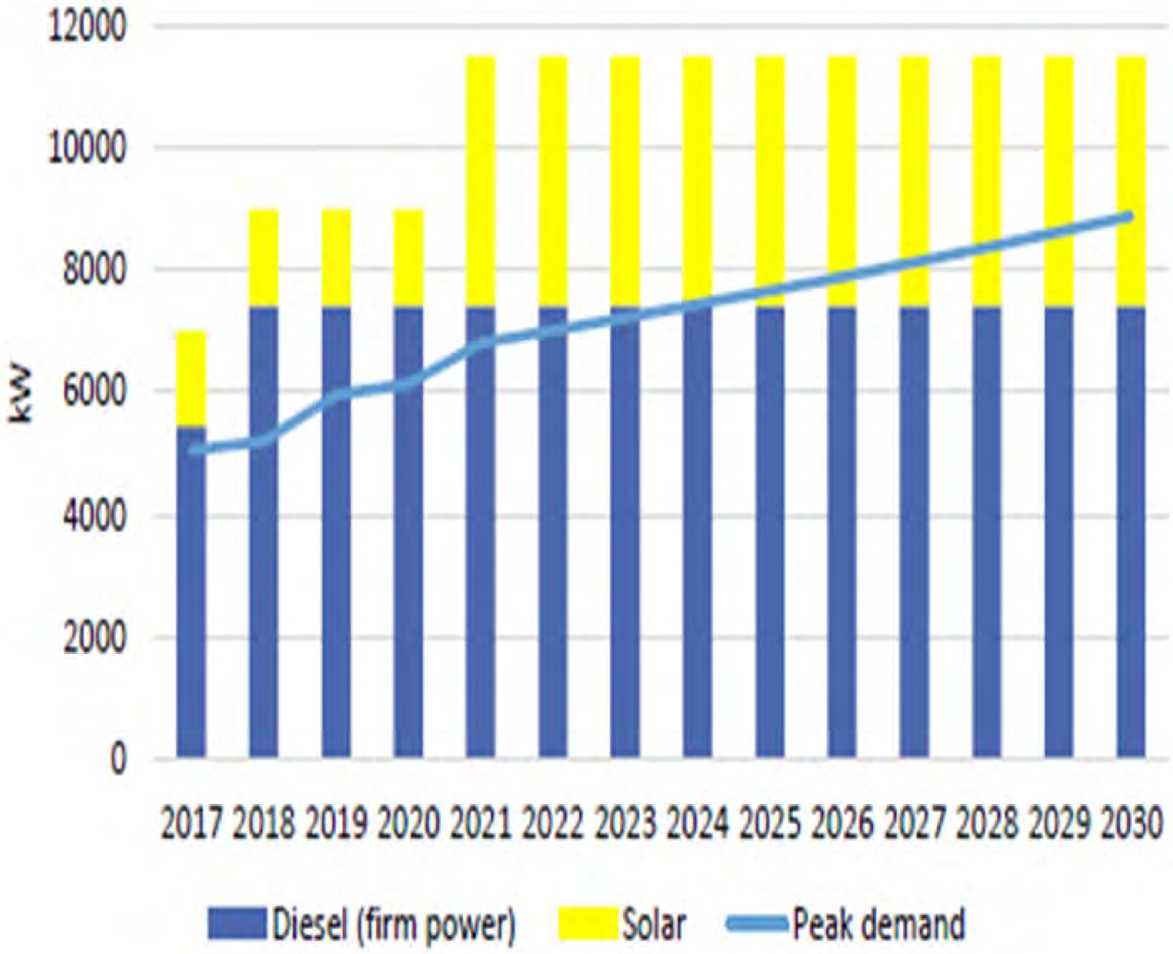
Electrical Distribution Network

Solar PV Plant 2018	PEC	UAE	TCH	KGV	KIT	BSC
Rated Capacity of PV System (KW	400	500	217	217	159	138
Annual Power Generated by PV System (KWh)	50536	72859	28469	18705	17083	19375
Annual Average Solar Radiation (kwh/m2/day)	5.88	6.39	6.34	6.48	6.17	5.95
Number of days per year	365	365	365	365	365	365
Performance Ratio (%)	71	75	77	75	71	78

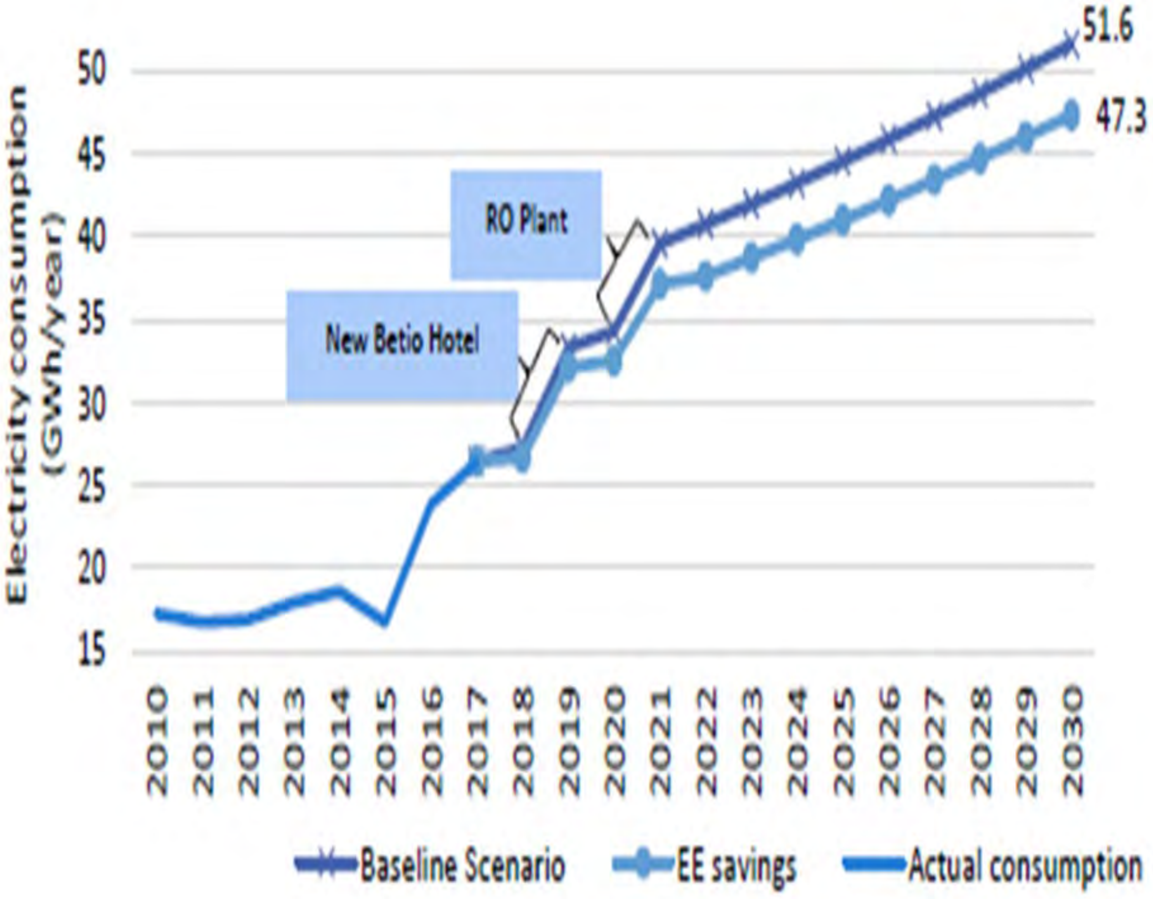
Units	Network						Generation					
	SAIDI			SAIFI			SAIDI			SAIFI		
	Planned	Unplanned	Total	Planned	Unplanned	Total	Planned	Unplanned	Total	Planned	Unplanned	Total
Minute/Event	2027.14	193.16	2220.30	6.12	0.44	6.55	0.00	1231.46	1231.46	0.00	4.84	4.84
Hours/Event	33.79	3.22	37.00	0.10	0.01	0.11		20.52	20.52	0.00	0.08	0.08

Power Generation Forecast

Electricity Supply Vs Peak Demand



Electricity Demand Forecast Scenario



Improvement Plan

- Bikenibeu Power stations renovation
- Bikenibeu Power Station Pavement Construction
- DG2 condition assessment
- Base load Genset stator cleaning
- HHO equipment installation on DG5
- DG1 cooling water radiator replacement
- DG's engine Overhaul

Rusted Roof

Pavement Location

DG Stator

HHO Machine

Commissioned Projects

Location	System/Donor	Capacity	Commissioning Dates
Bikenibeu P/S	#1 Solar PV PEC Fund	400 KW	March 2015
Bonriki Pump Station	#2 Solar PV UAE	500KW	September 2015
Nawerewere Hospital TCH	#3a Solar PV WB	217KW	September 2016
KGV & EBS	#3b Solar PV WB	217KW	September 2016
Betio KIT	#3C Solar PV WB	159KW	September 2016
Betio Sport Complex	#3d Solar PV WB	137KW	September 2016
HV Network Phase 1	#4 HV Substation MFAT	5.8MVa	November 2017
Betio P/S	#5 Back up Genset MFAT	625KW	April 2018
PUB Network	#6 SCADA & EMS WB	Data Acquisition & Monitoring Control	August 2018
HV Network Phase	#7 HV Substation MFAT	3.75MVa	October2018

Development Plan & Energy Projects

Development Plan

- Rehabilitation of LV Network
- Rehabilitation Betio Power Station
- Procuring of Base Load Generator
- Establishing of Network Security Policy
- Optic Fibre Installation

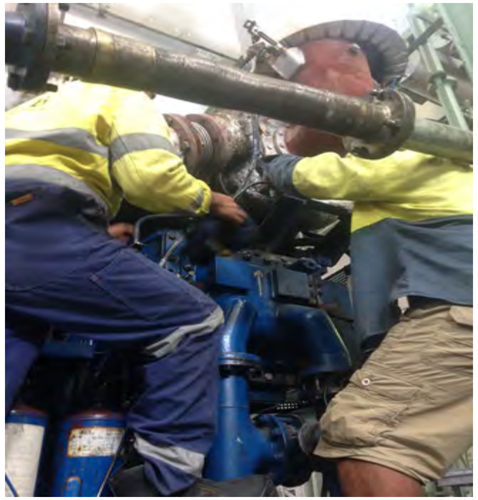
Energy Projects

- 2.5 MW Solar Project & Smoothing Storage
- 4.1 MW Solar & Storage Battery
- 1MW OTEC Pilot

2,5 MW Site

500KW Solar Farm
UAE

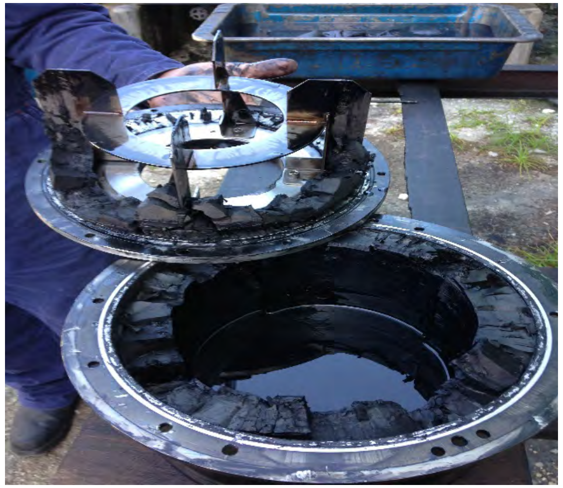
Appendix

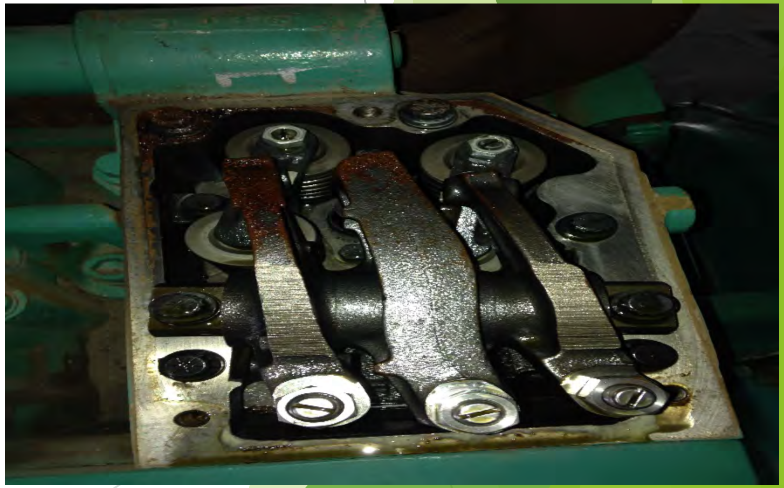


Vibration damper coupling for Flywheel – 8 units

Rubber

Should be in one piece





Attachment

- **Introduction of technical knowledge acquired during training in Japan**

HYBRID POWER GENERATION TRAINING

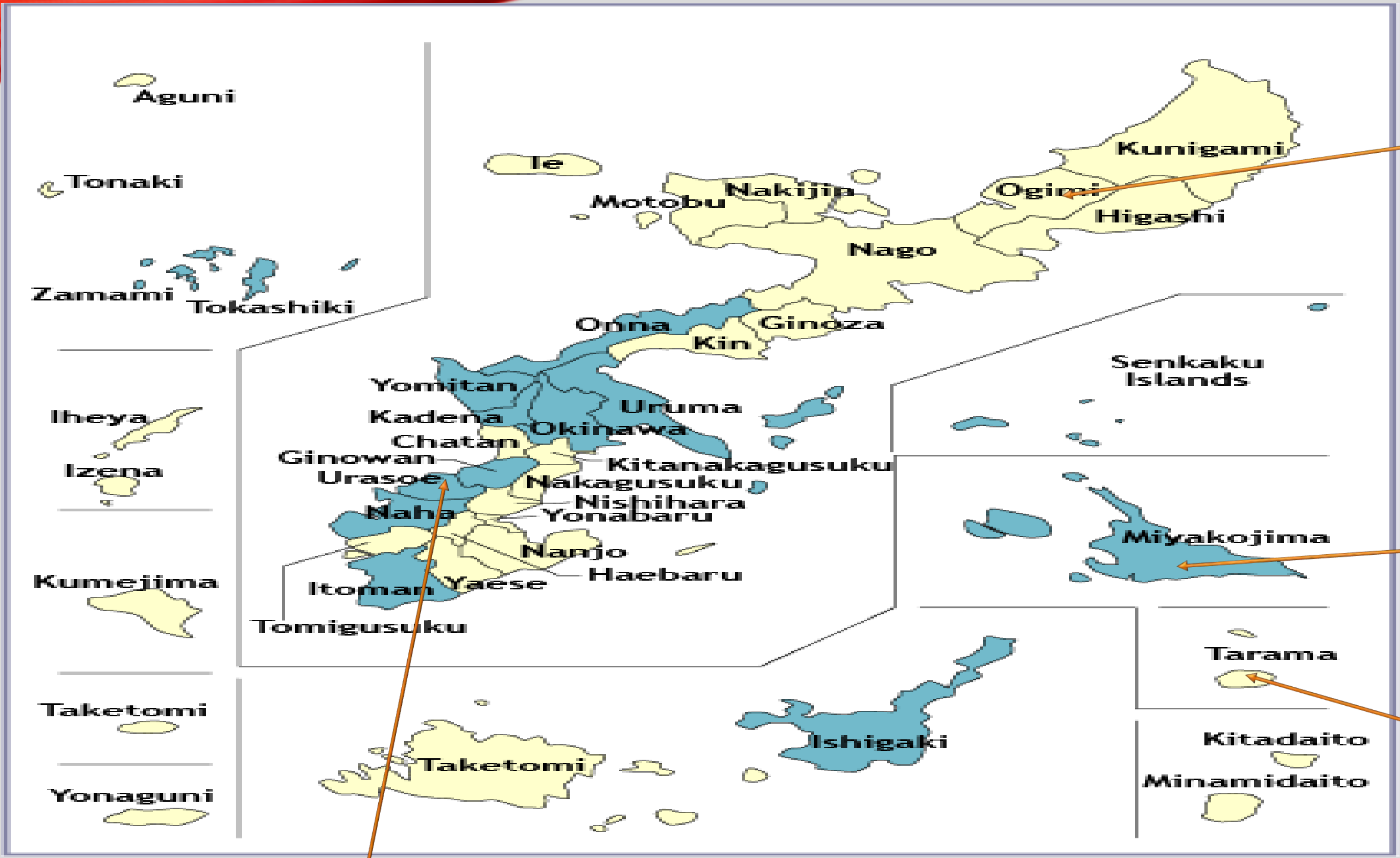
CONTENT

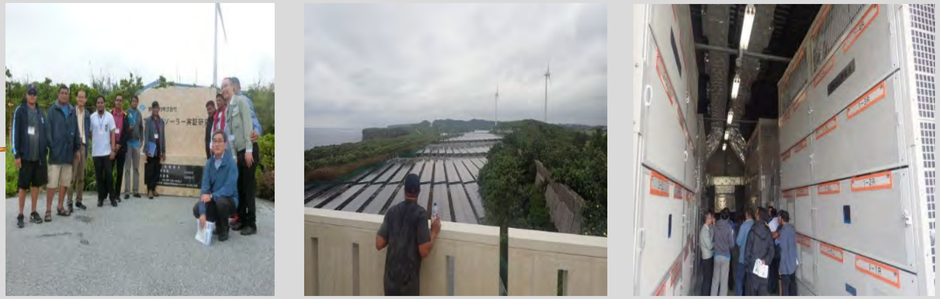
- Introduction of Hybrid Power system by JICA
- Hybrid Power system technical training & facilities site visit
- Determining max level of VRE penetration
- Technical challenge integrating VRE
- VRE expansion variable solution
- Type of support studies for VRE integration
- JICA Hybrid Power generation progress Activities

INTRODUCTION

- Introduction of hybrid power generation system (HPGS) to Pacific Island countries was initiated by JICA in 2017
- 13 participant from PIC was invited to Okinawa to attend training on HPGS introducing how the system work in relation by reducing fossil fuel consumption and greenhouse gas emission
- HPGS is support a 5 years program throughout the PIC to improve energy security and reduce use of fossil fuel and greenhouse emission .
- Components of hybrid Power system comprise of solar PV, wind energy, Battery storage system integrating with diesel generators
- Through the capacity building on HPGS all PIF country will enable improve appropriate O&M of diesel generators.
- Enable to establish appropriate O&M planning for hybrid Power system for future expansion of VRE

TECHNICAL FACILITIES SITE VISIT






AIST
国立研究開発法人産業技術総合研究所
福島再生可能エネルギー研究所
Fukushima Renewable Energy Institute
LOW / HILLS / MOUNTAINS
China
North Korea
Sea of Japan (East Sea)
Seoul
South Korea
Islands in dispute (Japan & Russia)
HOKKAIDO
Sapporo
Kushiro
Hakodate
Aomori
Akita
Morioka
Niigata
Shinano River
Sendai
Nagano
Nagoya
Kyoto
Mito
Mount Fuji
Tokyo
Hiroshima
Kobe
Lake Biwa
Fukuoka
Yokohama
Osaka
Nagasaki
Kochi
SHIKOKU
Izu Archipelago
Kagoshima
Miyazaki
KYUSHU
East China
Islands
300 km
©GraphicMaps

DETERMINING MAX LEVEL OF VRE PENETRATION

- Phase 1 – 1%

➢ Initial integration stage where rules of RE & grid interconnection are established

- Phase 2 – 10-15%

➢ Total instantaneous load of RE penetration can be describe as low and no significant integration issues expected at this stage but need grid connection studies for future development of RE.

- Phase 3 – 25%

➢ At this stage a challenge was faced by the output fluctuation adversely affect generator operation and the issues also factor in this expansion are the short term output fluctuation and Long term fluctuation. Short term fluctuation meaning the diesel plant reserve capacity cannot adsorb steep output due to weather condition therefore a output fluctuation measure are required.

- Phase 4 – 100%

➢ RE integration is very hard to achieve since it comes with also of challenges in terms of grid issues i.e. Frequency and Voltage fluctuation etc.

TECHNICAL CHALLENGE INTEGRATING VRE

- Sufficient firm capacity

➢Ensuring there is enough of generation adequacy

- Power Quality

➢Maintaining power quality is defined within acceptable limits

- System stability

➢This involve the frequency, voltage and transient stability issue with high penetration of VRE

- Protection System

➢Ensuring right protection device is installed to prevent short circuit current issues on the grid

VRE EXPANSION VARIABLE SOLUTION

- Infrastructure Investment
  - ➢ Diversification of RE installation
  - ➢ Flexible generating units
  - ➢ Energy storage system
  - ➢ Interconnection with neighbouring system
  - ➢ Distribution automation and smart grid technology

- Operational Measures
  - ➢ Demand- response programme
  - ➢ Enhanced generation dispatch and control
  - ➢ Automatic power controller and network monitoring
  - ➢ Short term RE production forecast

- Generator requirement capability
  - ➢ Grid code requirement for integration of VRE

TYPE OF SUPPORT STUDIES FOR VRE INTEGRATION

- Generation Studies

➢ Generation Adequacy

➢ Sizing of operation reserves

➢ Generation Scheduling

- Network Studies

Two Types

▪ Static

➢ Load Flow

➢ Static security assessment

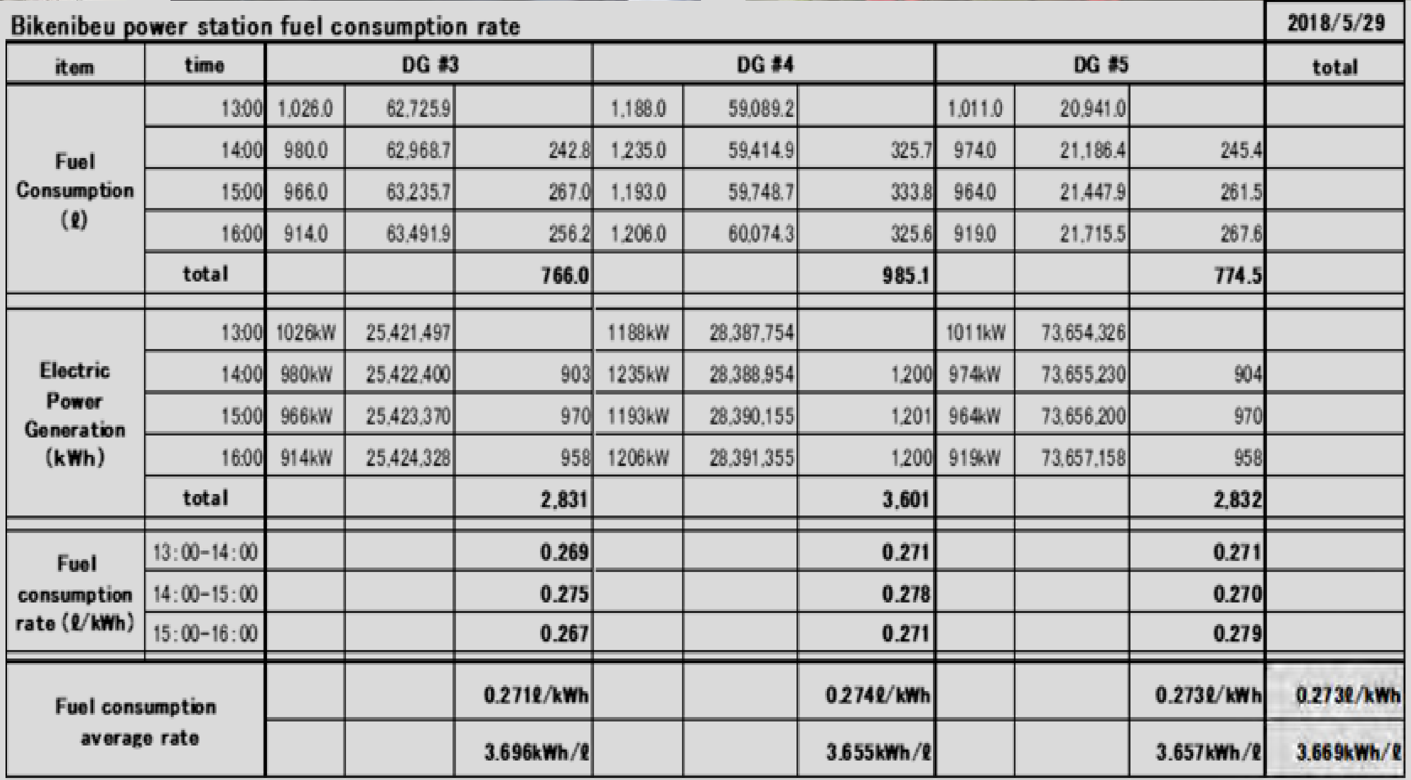
➢ Short-circuit currents

▪ Dynamics

➢ System Stability

JICA PROGRESS ACTIVITIES

- 2018 DG Training May 24th - 31st



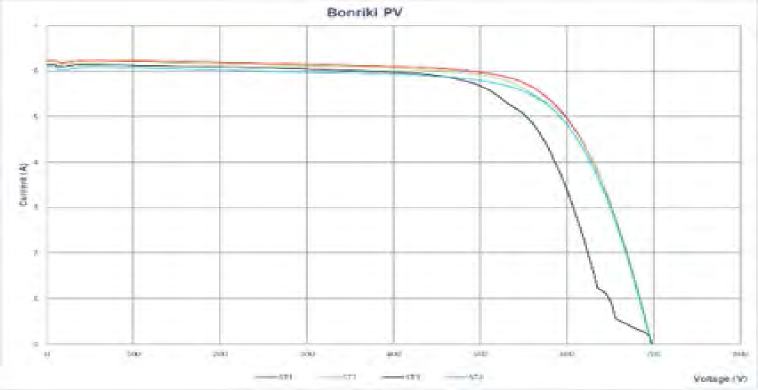
Bikenibeu power station fuel consumption rate

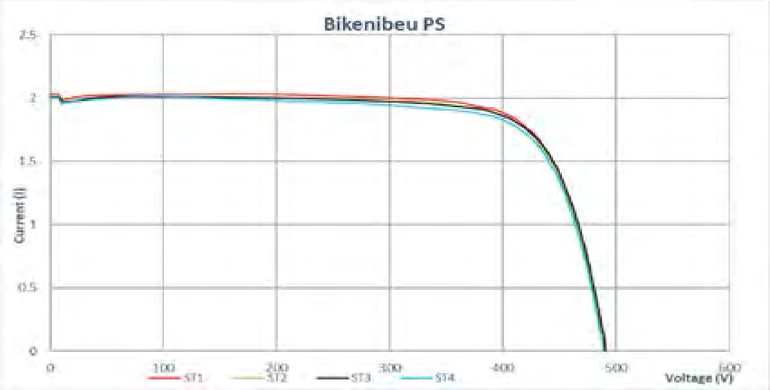
2018/5/29

item	time	DG #3			DG #4			DG #5			total
Fuel Consumption (ℓ)	13:00	1,026.0	62,725.9		1,188.0	59,089.2		1,011.0	20,941.0		
	14:00	980.0	62,968.7	242.8	1,235.0	59,414.9	325.7	974.0	21,186.4	245.4	
	15:00	966.0	63,235.7	267.0	1,193.0	59,748.7	333.8	964.0	21,447.9	261.5	
	16:00	914.0	63,491.9	256.2	1,206.0	60,074.3	325.6	919.0	21,715.5	267.6	
	total			766.0			985.1			774.5	
Electric Power Generation (kWh)	13:00	1026kW	25,421,497		1188kW	28,387,754		1011kW	73,654,326		
	14:00	980kW	25,422,400	903	1235kW	28,388,954	1,200	974kW	73,655,230	904	
	15:00	966kW	25,423,370	970	1193kW	28,390,155	1,201	964kW	73,656,200	970	
	16:00	914kW	25,424,328	958	1206kW	28,391,355	1,200	919kW	73,657,158	958	
	total			2,831			3,601			2,832	
Fuel consumption rate (ℓ/kWh)	13:00-14:00			0.269			0.271			0.271	
	14:00-15:00			0.275			0.278			0.270	
	15:00-16:00			0.267			0.271			0.279	
Fuel consumption average rate				0.271ℓ/kWh			0.274ℓ/kWh			0.273ℓ/kWh	0.273ℓ/kWh
				3.696kWh/ℓ			3.655kWh/ℓ			3.657kWh/ℓ	3.669kWh/ℓ

SOLAR PV TRAINING

- Combine training on solar PV system with MISE staff May 24-31 2018
- Basic lecturers on PV solar system and how to use measuring instrument in measure IV curve for PV solar Plant.





DG TRAINING IN OKINAWA

- Second training Japan in Okinawa September 27th – October 22nd 2018
- DG overhaul training & stator overhaul procedures in Kume Is. Okinawa

SIMULATION SOFTWARE TRAINING

- End of phase 1 October 22nd -29th 2018
- Solar PV O&M training

THANK YOU FOR ATTENTION

Go Seicho Arigatogozaimashita

Attachment

- **Technical knowledge acquired during the OH training of Diesel Generators on Kumejima**

The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries

Diesel power generation facility overhaul training

JFY 2018

Teebwatia Taakau & Bauro Mikaere
PUBLIC UTILITIES BOARD (PUB)

INDEX

1. Training Purpose

Integrating variable RE, it is necessary to improve the implementation structure for the appropriate and economical operation and maintenance of the diesel generators (DEG) which maintain the stability of the system to which the RE is connected and respond to output fluctuations as the main power source in order to deploy a hybrid power generation system.

With the aim of implementing a more effective technology transfer, in the Training in Japan, not only will technologies and expertise on DG maintenance cultivated in the remote islands of Okinawa be introduced, but the trainees will actually jointly perform maintenance where possible (OJT).

■ Introduction of technologies on DG maintenance distinctive to the remote islands of Okinawa

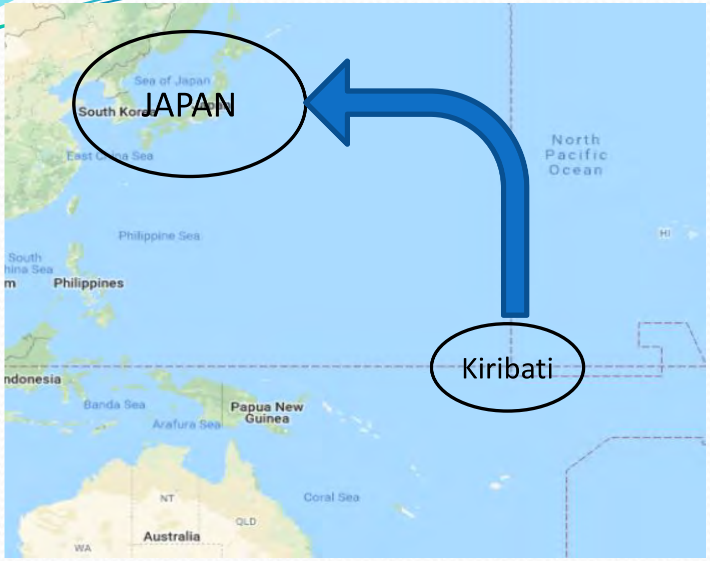
2. Training Schedule & Venue

Course Period in Japan
September 26, 2018 - October 22, 2018

September, 2018						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
						1
2	3	4	5	6	7	8
9	10	11		13	14	15
16	17	18		20	21	22
23	24	25	26	27	28	29
30						

October, 2018						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28		30	31			

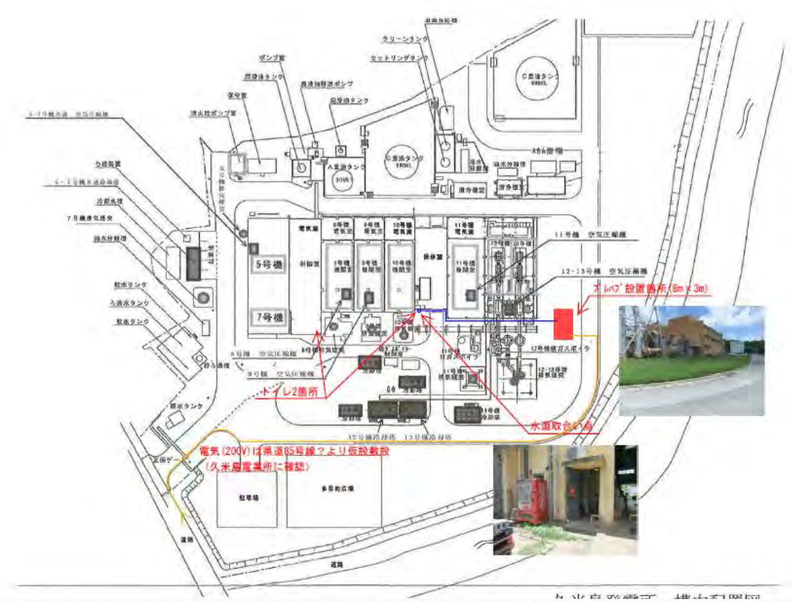
2. Training Schedule & Venue



Okinawa prefecture
Kume island

Area: 59.53 km 2
Population : 10,000

2. Training Schedule & Venue



Kumejima power station
Authorized Maximum output : 16,500 kW
Number of units : 7 DEG (0.5MW～4MW）
Peak load : aprox. 9.90MW

3. Expectation from this training

- ➢ Through this training, trainees should gain knowledge of DG maintenance methods in Okinawa, especially in the remote islands.
- ➢ Have improved knowledge on efficient maintenance of DGs, management of spare parts, and preventive maintenance.
- ➢ Have a general understanding of the electric utility and efforts to improve efficiency in the remote islands of Okinawa.

&

- ◆ Able to supervise and read drawings for major component of the generator.
- ◆ Understand the importance and role of every single component of the engine.
- ◆ Understand how to read special instrument that are used to read clearance.
- ◆ Know how to make decision in relation to condition monitoring maintenance.
- ◆ Able to manage any maintenance work on generators.
- ◆ Understand all incorporated systems used on generators.

4. Training contents

Mechanical maintenance

- Overview of periodical inspection
- Maintenance of cylinder head
- Maintenance of piston
- Maintenance of cylinder liner
- Maintenance of main bearing
- Maintenance of filters
- Maintenance of air cooler, primary and secondary cooling system, lubricating oil cooler
- Maintenance of equipment attached to the engine
- Maintenance of auxiliary equipment
- Maintenance of supercharger
- Maintenance of accessory control equipment
- Protective device test
- Trial run/commissioning

4. Training contents

Electrical maintenance

- Overview of periodical inspection
- Maintenance of DC power supply unit
- Generator inspection (measurement of insulation resistance, cover removal, filter replacement and washing, internal inspection, air gap measurement)
- Protection relay (single unit) test
- Meter calibration test
- Integrating wattmeter test
- Inspection and cleaning of each type of panel (visual inspection of relays, etc., checking for loose cable terminals, cleaning inside the board, switching of the sequencer, measurement of insulation resistance of the auxiliary equipment)
- Trial run/commissioning, recording data

5. Training pictures (Mechanical)

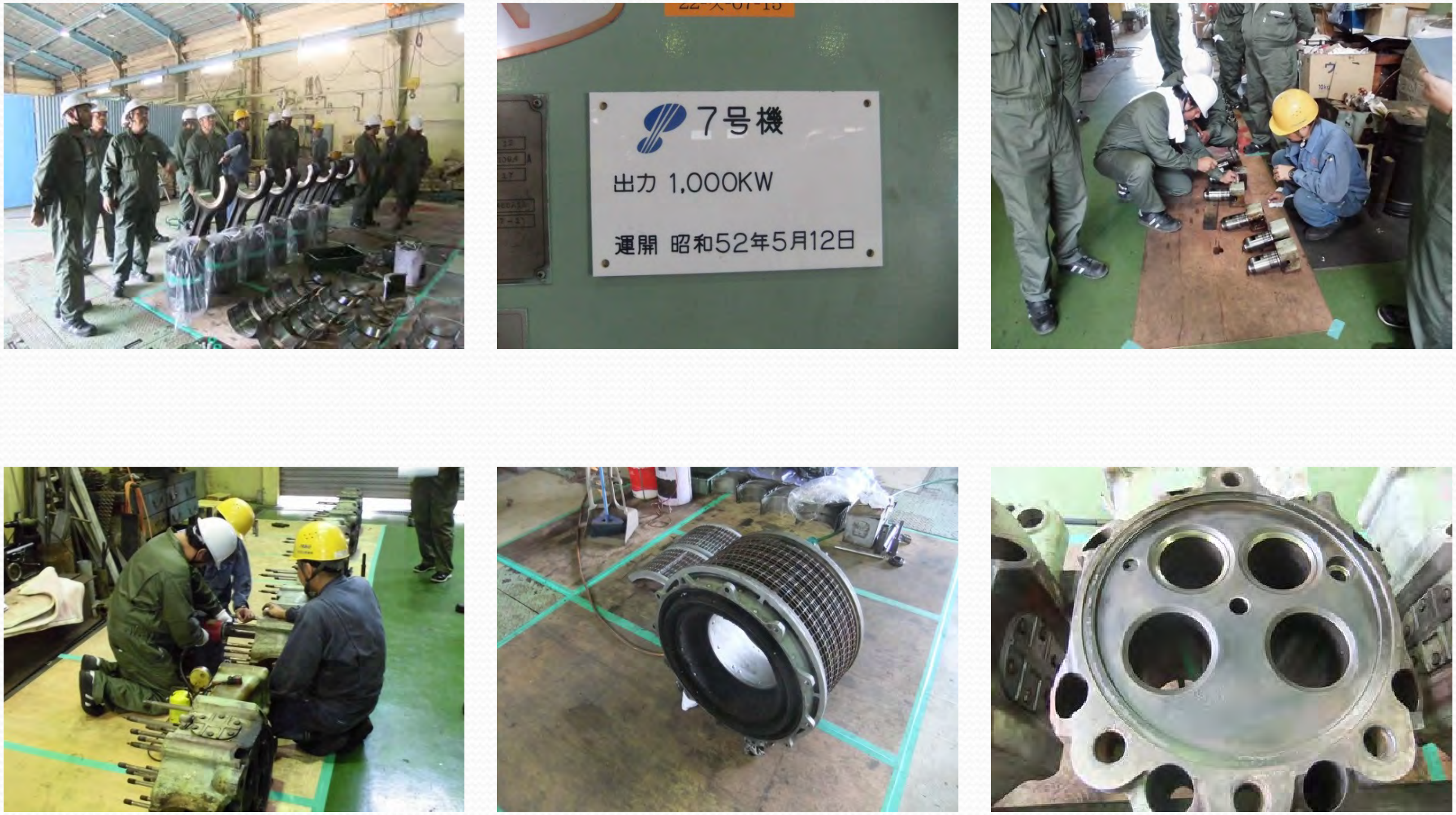
Country report seminar

Welcome to Kumejima city

5. Training pictures (Mechanical)

Meeting, engine part dissasembly

5. Training pictures (Mechanical)



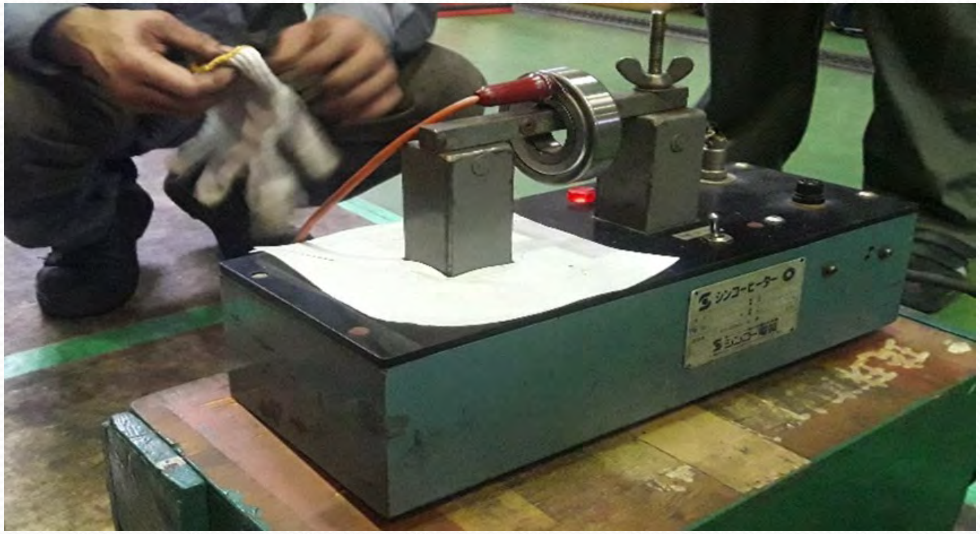
Engine part disassembly, check, cleaning

5. Training pictures (Mechanical)

Engine part measurement, dye penetrant test

5. Training pictures (Mechanical)

5. Training pictures (Mechanical)



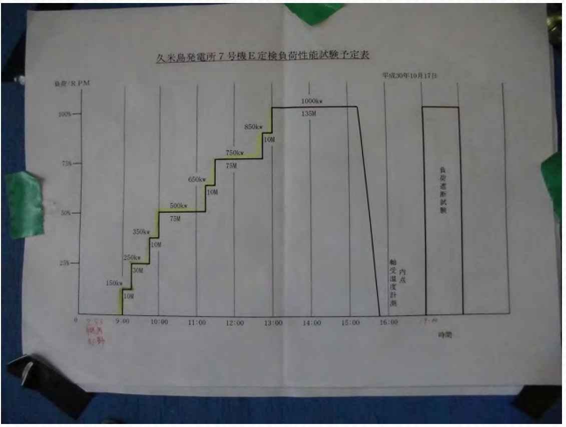
5. Training pictures (Electrical)

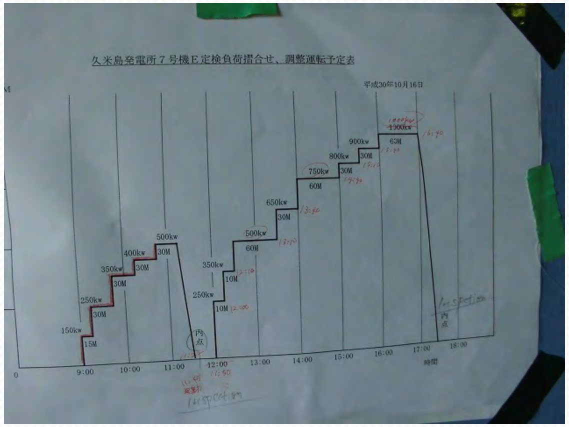
Meetings, sequence exercise, inspection of electrical boards

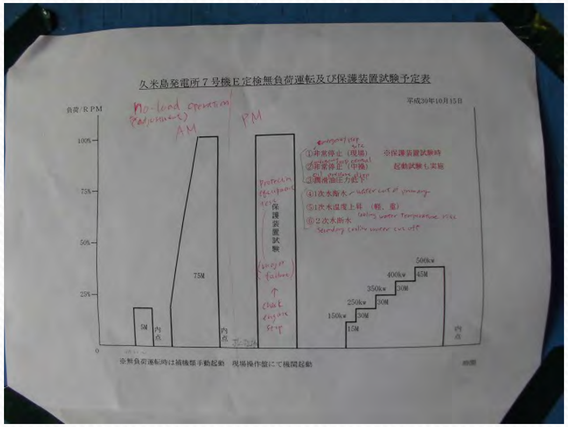
5. Training pictures (Electrical)

Alternator washing, checking of electric motors, battery storage

5. Training pictures (Electrical)





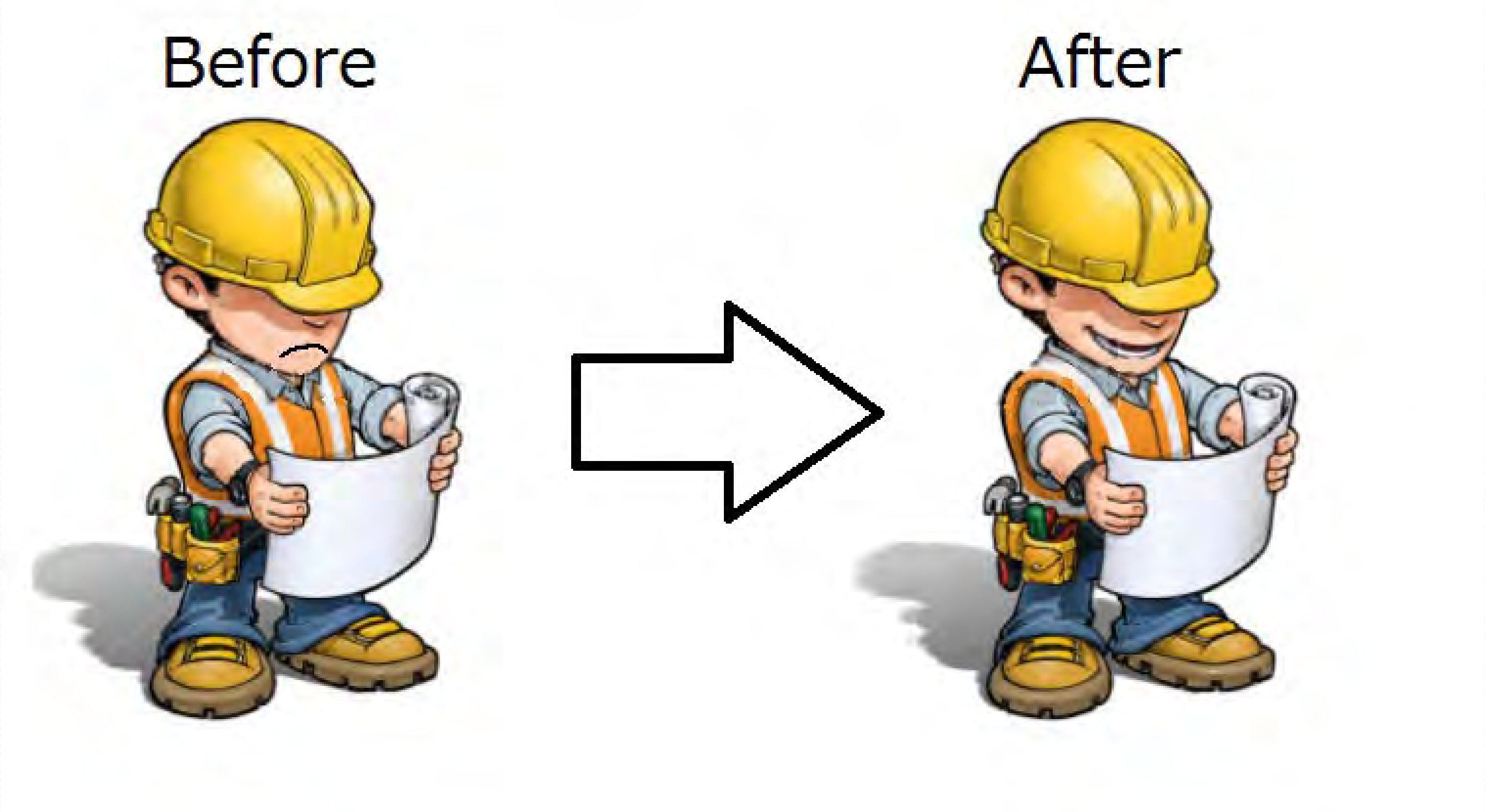


Heat run, load rejection test

5. Other visit in Kumejima during the training period

OTEC facility,
Kumejima high school,
Others.

5. Training pictures (Closing ceremony)



Thanks

PUB

Remote Training

6.2.2 Minutes of the 1st Meeting with Managers

1st Minutes of Discussion with Managers (Kiribati)

Date	Thursday, July 16, 2020 11:00-14:00
Venue	Okinawa Enetech Conference Room (via Zoom) PUB (Kiribati) and MISE (Kiribati) personnel PCs
Attendees	JICA Headquarters: Mr. Ogawa, JICA Fiji Office: Mr. Eguchi Okinawa Enetech: Mr. Kakefuku, Mr. Shimabuku, Mr. Hokama (rec), Mr. Nakamura, Mr. Gaja, Mr. Hashimoto Observers: Mr. Fujita, Mr. Uezu Okinawa Electric Power Company: Mr. Kuniba, Mr. Shimabukuro, Mr. Shiohama SMAECO: Mr. Masaru Miyagi KDTech: Mr. Watanabe PUB: GM Tenikoria Katauea MESE: Tiaon Aukitino, Tebateki Thomas Taoaba
Materials	・0. Agenda ・1. PO HPGS(Kiribati) ・2. DG Remote Training Report Kiribati ・3. RE Remote Training Report Kiribati ・4. Remote Trainig Schedule for Kiribati ・5. Training Curriculum (DG&RE) ・6. DG Remote Training Time Schedule ・7. RE Remote Training Time Schedule

Minutes

1. Greetings (11:15〜11:20) Mr. Ogawa, Mr. Eguchi, Mr. Watanabe

2. Plan of Operation (PO) (11:20〜11:45)

- Please share PUB DG's OH schedule (Kakefuku)
  → OH is scheduled in the following order in July: DG#3 ⇒DG#1 ⇒DG#5. (Mr. Tenikoria)
- What is the status of the airport PV? (Kakefuku)
  →The replacement of the fiber optic cable has not been completed yet. (Mr. Tenikoria)
- What are your plans for Kiribati's future power system plan (10-20 years) (Mr. Ogawa)
  → A ZOOM meeting between Kakefuku and Mr. Tenikoria will be held to confirm the contents. (Kakefuku)
- What is the status of revisions to the O&M manual and daily check sheet. (Kakefuku)
  → They are currently being revised according to the conditions in Kiribati. (Mr. Tenikoria)
  → We want to confirm this in the training session next week. (Kakefuku)
- How about Power generation cost (Mr. Tiaon)
  → As for asset management, I submitted it to the Secretary Ms. MIKA before, but I will send it to Mr. Tiaon again although the maintenance cost is not included. (Kakefuku)

3. Remote Training Report (11:45〜12:10)

- Because several participant used only one PC during the training, I think that is very difficult for them see the slides clearly, so could you please prepare a projector and other equipment. (Kakefuku)

- Why the connectivity was poor during DG training, but good during RE training. (Mr. Ogawa)
  →There are times when connectivity is poor due to the provider service. (Mr. Tenikoria)
- We would like all core trainers to participate in the next RE training session. (Mr. Ogawa)
  → OK (Mr. Tenikoria)
- Tell us about the advantages and disadvantages of online training. (Mr. Eguchi)
  → There are times when the Internet connection is poor. (Mr. Tenikoria)
  → How about the use of Pocket WiFi. (Kakefuku)
  → It is a provider service issue so there will be no difference. (Mr. Tenikoria)
- In the next training session, we plan to use videos, etc. to improve the quality of the training, but I would like to hear your thoughts.
  → Because it is difficult to prepare equipment for online training, would JICA be able to provide support? (Mr. Tiaon)
  → Could MISE members join the training with Mr. Tenikoria at the Bikenibeu Power Plant? (Mr. Ogawa)
  →Need confirmation from Thomas and others. (Mr. Tiaon)
  → What kind of equipment do you need? (Mr. Eguchi)
  → We would like a room equipped with cameras, speakers, microphones, etc. if possible. (Mr. Tiaon)
  → Is such equipment available in Kiribati? (Mr. Eguchi)
  → We will check. (Mr. Tiaon)
  → Would it be okay for them to come to the JICA Kiribati Office for training? (Ogawa)
  → The conference room is only big enough for 5 or 6 people. I will check with the JICA Kiribati Office. (Mr. Eguchi)

4. Next remote training session content (12:10～12:15)
   - This schedule overlaps with DG's OH schedule. (Mr. Tenikoria)
     → Please attend the training (3h) as much as possible. (Kakefuku)

5. Other (12:15～12:25)
   - Currently, we are conducting remote training since we cannot travel due to COVID-19, but we would like to improve the content of the remote training in the future, but if you have any suggestions or requests, please let us know so we can incorporate them in the training. (Kakefuku)
   - We would like more training on HOMER. (Mr. Tion)

End

July 16th, 2020
JICA Expert team

Agenda for Zoom Meeting

1. Opening Remarks by JICA Expert Mr. Ogawa Tadayuki

2. Explanation and confirmation of the Plan of Operation (PO)

3. Overview of the Remote Training
   - Training participants
   - Training contents
   - Implementation status (WiFi, usability, request, etc.)
   - Next remote training contents
   - Request for specific lectures or training

4. Closing Remarks

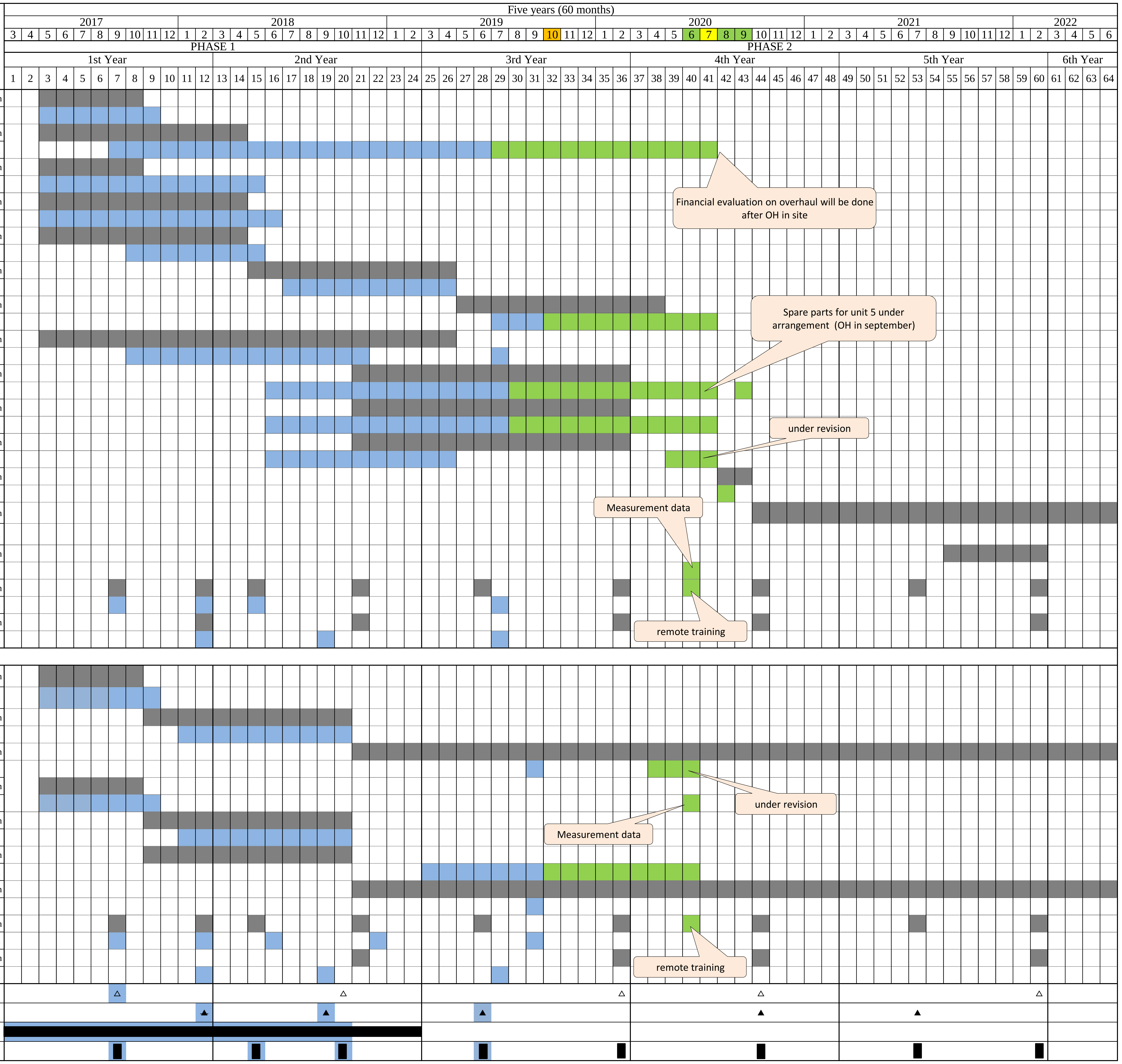
ATTACHMENT 5

Ver.4 July, 2020

Plan of Operation (PO)

Project Title: The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries
Project Term: March 2017 - June 2022 (Phase 1: March 2017 – February 2019 , Phase 2: March 2019 – June 2022)
Country: Kiribati
Target Area: Tarawa
Target Group: Related engineers and other technical staffs in the target area (MISE and PUB)

Output 1 Activities		**Product**	**Organizations in Charge**	
【Appropriate O&M System for DG】				
1-1.	Operational conditions of the existing DGs are reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose.	TNA Report, OVI	PUB, JICA Experts	Plan Act
1-2.	Asset management plan of DG is prepared including financial evaluation on overhaul.	PUB, JICA Experts	PUB, JICA Experts	Plan Act
1-3.	Specific fuel consumption of pilot DG units is measured.	Measurement of Specific fuel consumption	PUB, JICA Experts	Plan Act
1-4.	Improvement plan for the operation of pilot DG units is prepared.	Improvement plan	PUB, JICA Experts	Plan Act
1-5.	Existing spare parts and maintenance tools of pilot DG units are confirmed.	List of spare parts and maintenance tools	PUB, JICA Experts	Plan Act
1-6.	Improvement plan for the operation of pilot DG units is implemented.	Improvement Implementation Report	PUB, JICA Experts	Plan Act
1-7.	The result of implementation of the improvement plan is evaluated, and improvement plan is updated.	Improvement Evaluation Report	PUB, JICA Experts	Plan Act
1-8.	The concept of Economic Dispatch Control (EDC) is shared among operators and applied, if possible.	EDC software, manual, EDC sheet	PUB, JICA Experts	Plan Act
1-9.	Necessary spare parts and maintenance tools for the pilot DG units are prepared.	List of spare parts and maintenance tools prepared	PUB, JICA Experts	Plan Act
1-10.	Maintenance work schedule for the pilot DG units is prepared.	Maintenance work shedule	PUB, JICA Experts	Plan Act
1-11.	Check sheets and maintenance manuals for maintenance works for pilot DG units are prepared.	Check sheets and maintenance manulas	PUB, JICA Experts	Plan Act
1-12.	Maintenance works (daily/partial inspection/overhaul work) for pilot DG units are conducted in accordance with the maintenance schedule.	Maintenance record	PUB, JICA Experts	Plan Act
1-13.	The result of maintenance works is evaluated, and future maintenance work schedule together with budget (including sub-contract fee, cost for tools and equipment) is prepared.	Evaluation report and future schedule for maintenance	PUB, JICA Experts	Plan Act
1-14.	Specific fuel consumption of the pilot DG units is measured before and after implementation of the related project activities.	Measurement for specific consumption of the pilot DG	PUB, JICA Experts	Plan Act
1-15.	Related training programs for appropriate O&M system DGs are implemented periodically.	Training record, recommendations, reports, etc.	MISE, PUB, JICA Experts	Plan Act
1-16.	Knowledge on appropriate O&M of DGs is disseminated among stakeholders.	Seminar, workshop records	MISE, PUB, JICA Experts	Plan Act
Output 2 Activities				
2-1.	Current situation and future development plan of RE is reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose.	TNA Report, OVI	PUB, JICA Experts	Plan Act
2-2.	Planning manual for Hybrid Power Generation System is prepared	Planning manual for Hybrid Power Generation	PUB, JICA Experts	Plan Act
2-3.	Planning manual for Hybrid Power Generation System is reviewed and updated in the target area.	Updated Planning manual for Hybrid Power Generation	PUB, JICA Experts	Plan Act
2-4.	Operating conditions of the existing RE facilities are reviewed, including confirmation of objectively verifiable indicators for overall goal.	TNA Report, OVI	PUB, JICA Experts	Plan Act
2-5.	O&M manual for RE facilities is prepared.	O&M manual for RE facilities	PUB, JICA Experts	Plan Act
2-6.	Maintenance works are conducted according to O&M manual of RE facilities.	Maintenance Record	PUB, JICA Experts	Plan Act
2-7.	The result of maintenance works is evaluated, and future maintenance work schedule together with budget is prepared.	Evaluation report of maintenance work, and schedule	PUB, JICA Experts	Plan Act
2-8.	Training program for Hybrid Power Generation System including O&M of RE facilities is conducted.	Training record, recommendations, reports, etc.	MISE, PUB, JICA Experts	Plan Act
2-9.	Knowledge regarding Hybrid Power Generation System is disseminated among stakeholders.	Seminar, workshop records	MISE, PUB, JICA Experts	Plan Act
△: JCC				
▲: Training in Japan/Fiji				
JICA long term expert, stationed in Fiji				
JICA Consultant Team				



Kiribati Remote Training Report

Date	June 17th ,2020 / 13:00－16:00
Venue	Okinawa Enetech meeting room（ZOOM meeting）and PUB（Kiribati）：Control room & GM Tenikoria office
Participants	JICA Headquarter：Mr.Ogawa
	Expert team Okinawa Enetech：Kakefuku, Hokama, Hashimoto Observer: Director Shinzo、Fujita Smaeco：Miyagi Okinawa Electric Power：Nakachi、Shimabukuro Toyo Denki Control: Kakazu KDTECH：Watanabe
	PUC：GM Tenikoria Katauea, Buro Mikaere, Kirite Uriam, Tebakabu Tion, Tikoro Tanua, Rifene Ikaarau

First DG Remote Training（June）

Training details are shown in the below table

No.	Time	Training content	trainer
1	10:20～10:33	Overall description of the remote training schedule and contents	Kakefuku
2	10:33～11:00	Basic knowledge of DG (each utility system)	Miyagi
3	11:10～11:20	Daily inspection of DG’s, Pmax measurement, exhaust gas temperature verification and adjustment,(FO rack adjustment）	Kakefuku
4	11:20～11:25	Break time	
5	11:25～12:40	Description of electrical drawings (single line, three lines, sequence diagram)	Kakazu
6	12:40～12:50	Measuring method of fuel consumption rate	Kakefuku
7	12:50～13:00	Fuel consumption calculation exercise	Miyagi
8	13:00～13:10	Verifications and request for the next DG’s training	

■ Verification points, Q&A, others

・OVI (Objectively Verifiable Indicators) of the project has been already obtained from PUB（Ogawa）

→Tenikoria requested to send a fuel consumption rate recording sheet to Mr. Tebwatia.

・We will send again the list of proposed improvements in the power station (prepared during the last visit to Kiribati), so please feed back the progress of works of each items. (Kakefuku)

→OK. (Tenikoria)

・Since the JICA expert team wants to prepare the next training material, we request the operation data of May (each one hour data kW) of the power plant and PV facilities (DG+PV). (Kakefuku)

→OK. (Tenikoria)

・There was a problem with the CB1 circuit breaker last week (CT or VT ?) Abnormal color of the cable insulation and problems in the sync meter and AVR. Mr. Bauro will send the trouble report.
(Tenikoria)

→We will check the report and give you the possible cause of this issue. (Kakefuku)

・Please inform me if you need some special topics lectures for the next DG training. (Kakefuku)

→I will ask to the staff and inform you if any. (Tenikoria）

■Others ・Remarks on remote training

・It was the first time in make this remote training and took time (about 20 minutes) in connecting adjustments of Zoom. It would be good for the next training make the connection 10 minutes before the start.

・The communication with the core trainer's was not good, ZOOM image and sound was bad, so some time the training was difficult to do.
As the core trainer was using an old notebook, it seems to be difficult for them read the materials presented. It would be good to prepare a new computer and display.

End

KIRIBATI RE Training Report

Date	June 26th , 10:00－13:00
Venue	Okinawa Enetech meeting room（ZOOM meeting）and PUB（Kiribati）: Control room & GM Tenikoria office
Participants	JICA Headquarter : Mr.Ozaki JICA Fiji office : Eguchi
	Expert team Okinawa Enetech : Shimabuku, Gaja, Nakamura, Hashimoto Observer: Fujita Okinawa Electric Power : Shiohama, Taira Okinawa Kobori Denki: Ikehara KDTECH : Watanabe
	PUB : Bauro Mikaere, Tanua Tikoro,

First RE Remote Training（June）

- Training details are shown in the below table

No.	Time	Training content	trainer
1	10:00～10:15	Overall description of the remote training schedule and contents	Shimabuku
2	10:15～11:00	Basic knowledge of Hybrid power generation system (HPGS)technology	Shimabuku
3	11:00～11:25	Explanation of performance ratio	
4	11:25～11:33	Break time	
5	11:33～12:40	Basic knowledge for formulation, explanation and updating of the hybrid power generation planification manual	Taira
6	12:40～12:45	Break time	
7	12:45～13:00	Q&A regarding PV maintenance	Ikehara
8	13:00～13:10	Verifications and request for the next DG’s training	Shimabuku

■ Verifications points, Q&A, others

(a) Confirmation of educational contents, question and answer, etc.

（1）Basic knowledge of Hybrid power generation system (HPGS)technology

- Detailed explanation of CIS solar panels
- Difference between Mono and Poly- crystalline type panels
- No actual plan for implementation of WT in Tarawa
- Minimum output of diesel generator is 75% (?)

（2）Performance ratio measurement status

- Cables cutting in Hospital roof PV was verified by JICA expert team during the last visit.

（3）Basic knowledge for formulation, explanation and updating of the hybrid power generation planification manual

- PUB tolerance ratio for frequency is ±0.5Hz and 240V±5% ［V］ for voltage.
- PUB system voltage is 11kV.

(4) Q&A regarding PV maintenance

- No comments

(b) Others ・Remarks on remote training

- Next RE remote training will be hold in July 30th (thu)from 10:00～13:00。
- It was the second time for remote training and the connection was done smoothly.
- Since the prepared schedule required more time than expected, adjustments were made in time allocation. Lectures that could not be conducted will be conducted in the next training.
- On the other hand, giving priority to questioning and exchanging opinions during the lectures make the training fruitful.
- Mr. Teebwatia Takau, nominated in the JCC, has not participated, so I would like to ask for participation in the next training.

End

JICA Expert Team
2020/6/10

JICA Project for Introduction of Hybrid Power Generation System in the Pacific Island Countries
DG / RE Training Schedule (Plan for Kiribati)

Day/Date	Sun	Mon	Tue	Wed	Thu	Fri	Sat
June							
		6/1	6/2	6/3	6/4	6/5	6/6
DG							
RE							
	6/7	6/8	6/9	6/10	6/11	6/12	6/13
DG							
RE							
	6/14	6/15	6/16	6/17	6/18	6/19	6/20
DG				Kiribati (DG)			
RE							
	6/21	6/22	6/23	6/24	6/25	6/26	6/27
DG			Japanese Holiday				
RE					Kiribati (RE)		
	6/28	6/29	6/30				
DG							
RE							
July							
				7/1	7/2	7/3	7/4
DG							
RE							
	7/5	7/6	7/7	7/8	7/9	7/10	7/11
DG				Discussion w/KIRIBATI Manager PUB, MISE 14:00-15:00 (Japan 11:00-12:00)			
RE							
	7/12	7/13	7/14	7/15	7/16	7/17	7/18
DG							
RE							
	7/19	7/20	7/21	7/22	7/23	7/24	7/25
DG				Kiribati (DG)	Japanese Holiday	Japanese Holiday	
RE							
	7/26	7/27	7/28	7/29	7/30	7/31	
DG							
RE					Kiribati (RE)		
August							
							8/1
DG							
RE							
	8/2	8/3	8/4	8/5	8/6	8/7	8/8
DG							
RE							
	8/9	8/10	8/11	8/12	8/13	8/14	8/15
DG		Japanese Holiday					
RE							
	8/16	8/17	8/18	8/19	8/20	8/21	8/22
DG				Kiribati (DG)			
RE							
	8/23	8/24	8/25	8/26	8/27	8/28	8/29
DG							
RE				Kiribati (RE)			
	8/30	8/31					
DG							
RE							
September							
			9/1	9/2	9/3	9/4	9/5
DG				Okinawa Holiday			
RE							
	9/6	9/7	9/8	9/9	9/10	9/11	9/12
DG					Discussion w/KIRIBATI Manager PUB, MISE 14:00-15:00 (Japan 11:00-12:00)		
RE							
	9/13	9/14	9/15	9/16	9/17	9/18	9/19
DG							
RE							
	9/20	9/21	9/22	9/23	9/24	9/25	9/26
DG							
RE							

・Kiribati Local training time 13:00-16:00 (3h) (JST + 3h)
・Training time in Japan : 10:00-13:00

DEG Training Curriculum			Phase-1	Phase-2																																					Achievement rate
Subject		Contents	2017 / 2018	2019							2020												2021												2022						
				JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	
				North countries							🟩						🟩						🟩						🟩												
				South countries											🟩				🟩	🟦							🟩				🟩	🟦									
1. Basic Knowledge of DEG power generation	1	•Understanding of Diesel Generators type, structure, operation principle and characteristic.	🟩																																						100%
	2	•Diesel engine performance curve, efficiency during operation, heat balance diagram.	🟩																																						100%
	3	•Understanding of mechanical devices on Diesel power generation. Purpose, type, characteristics of each device.	🟩																																						100%
		1) Cylinder head, valves, rocker arm, pushing rod, springs	🟩																																						100%
		2) Piston, rings, connecting rod, pin	🟩																																						100%
		3) Cylinder liner	🟩																																						100%
		4) Crankshaft, camshaft, main bearings, fly wheel	🟩																																						100%
		5) Turbocharger	🟩																																						100%
		6) Governor	🟩																																						100%
		7) Intercooler (air, oil)	🟩																																						100%
		8) Pumps, radiators and others	🟩																																						100%
	4	•Understanding of electrical components on Diesel power generation. Purpose, type, characteristics etc. of each electrical panels, etc.	🟩																																						100%
		1) Generator & Exciter	🟩																																						100%
		2) Transformer	🟩																																						100%
		3) Circuit breaker	🟩																																						100%
		4) Control panel / alarms / CT, PT’s	🟩																																						100%
		5) Power center, AVR, AFC, Syncronous board	🟩																																						100%
		6) Electrical drawings, single line diagram	🟩																																						100%
		7) Device number / protection relays	🟩																																						100%
		8) Others electrical components	🟩																																						100%
	5	•Understanding of each utilities in diesel power plants	🟩																																						100%
		1) Fuel System	🟩																																						100%
		2) Lubricant oil system	🟩																																						100%
		3) Cooling water	🟩																																						100%
		4) Air system	🟩																																						100%
		5) Exhaust gas	🟩																																						100%
2. Operation of DEG’s	1	•Operation and control method of diesel power generation facilities (governor free, automatic control devices, etc.)	🟩																																						100%
	2	•Operating Procedure of Diesel Power Plant	🟩																																						100%
		1) Operation precautions	🟩																																						100%
		2) Patrol inspection	🟩																																						100%
	3	•Supply and Demand Management	🟩																																						100%
		1) Efficient operation	🟩																																						100%
		2) System frequency adjustment	🟩																																						100%
		3) Voltage management	🟩																																						100%
		4) Power reserve	🟩																																						100%
	4	•Diesel generator Economical load distribution operation	🟩																																						100%
		(EDC technology (basic knowledge · application))	🟩																																						100%
	5	•Power generation data sorting、analysis(Power generation amount, output、fuel consumption amount and rate, operation parameters of diesel engine operation)									🟩				🟩		🟩		🟩				🟩				🟩		🟩		🟩										
	6	•Diesel generation operation data record sheet																																							
	7	•Financial analysis of power plant operation	🟩																																						100%
	8	•Trouble Shooting									🟩				🟩		🟩		🟩				🟩				🟩		🟩		🟩										
3.Maintenance of DEG’s	1	•Safety work training	🟩																																						100%
	2	•Periodical inspection (Mechanical)	🟩																																						100%
		Types of inspections, contents, check sheet	🟩																																						100%
	3	•Periodical inspection (Electrical)	🟩																																						100%
		Types of inspections, contents, check sheet	🟩																																						100%
	4	•Overhaul of Diesel Generator and Auxiliary Equipment																																							
		1) Purpose & process	🟩																																						100%
		2) Washing & Inspection of parts (Dye penetrant test)	🟩																																						100%
		3) Engine maintenance standards													🟩		🟩		🟩				🟩				🟩														
		4) Assembly													🟩		🟩		🟩				🟩				🟩														
		5) Centering adjustment													🟩		🟩		🟩				🟩				🟩														
		6) Start-up and commissioning													🟩		🟩		🟩				🟩				🟩														
	5	•Drawing up of maintenance manual	🟩																																						100%
	6	•Verification, modification, addition of notes in the maintenance manual(electrical / mechanical)													🟩		🟩																								
	7	•Maintenance plan(spare parts verification, management, consumables, schedule, etc.)	🟩																																						100%
	8	•Handling of mechanical measurement equipment(OJT)		🟩	🟩	🟩	🟩	🟩	🟩	🟩																															
		1) Calipers, micrometers, dial gauge		🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩				🟩																										
		2) Noise meter		🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩				🟩																										
		3) Vibrometer		🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩				🟩																										
		4) Torque wrench		🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩				🟩																										
		5) Pmax device & Others		🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩				🟩																										
	9	•Handling of electrical measurement equipment(OJT)		🟩	🟩	🟩	🟩	🟩	🟩	🟩																															100%
		1) Electroscope		🟩	🟩	🟩	🟩	🟩	🟩	🟩																															100%
		2) Multi-meter		🟩	🟩	🟩	🟩	🟩	🟩	🟩																															100%
		3) Tester		🟩	🟩	🟩	🟩	🟩	🟩	🟩																															100%
		4) Digital Pressure Calibrator		🟩	🟩	🟩	🟩	🟩	🟩	🟩																															100%
		5) Instrumentation signal measurement / generator		🟩	🟩	🟩	🟩	🟩	🟩	🟩																															100%
		6) Ohm meter & Others		🟩	🟩	🟩	🟩	🟩	🟩	🟩																															100%
	10	•Maintenance works report writing, keeping and supervision																					🟩				🟩														
	11	•Disassembly & Inspection of each section of diesel generators, troubleshooting.(mechanical and electrical OJT)													🟩		🟩		🟩				🟩				🟩		🟩		🟩										
	12	•Planning of maintenance works																											🟩		🟩										
	13	•Maintenance works report writing																					🟩				🟩														
	14	•Improvements in power plant facilities													🟩		🟩		🟩				🟩				🟩		🟩		🟩										

RE Training Curriculum				Phase-1	Phase-2																																					Achievement rate
				2017 / 2018	2019							2020												2021												2022						
Subject		Contents			JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	
					North countries										■							■					■						■									
					South countries								■						■		▨				■						■			▨								
RE O&M	1. Formulation/Explanation / Update/of manual	(1)	Operation & Maintenance of System	■																																						100%
		(2)	patrol check and periodic inspection	■																																						100%
		(3)	Daily check	■									■		■																											100%
		(4)	Periodic Inspection	■									■		■																											100%
		(5)	Development of the check sheet										■		■																											
		(6)	Updating of maintenance manual according to the system condition of each country .(Joint work)										■		■				■			■			■		■				■		■										
			Verification of operational condition of the updated maintenabce manual, comments.(Follow up from Project team)																■			■			■		■				■		■										
			Periodic monitoring of the operational condition of the manual.(Joint work)										■		■				■			■			■		■				■		■										
	2. Operation practice of the measuring equipment	(1)	String tracer	■									■		■				■			■			■		■				■		■										100%
		(2)	Cell line checker	■									■		■				■			■			■		■				■		■										100%
		(3)	Insulation resistance tester										■		■				■			■			■		■				■		■										
		(4)	Infrared camera																			■			■																	
	3. Trouble shooting	(1)	Confirmation method of disconnection between the module										■																													
		(2)	Influence of the shadow										■																													
		(3)	Introduction for trouble example ①(Tuval)										■																													
	4. Future O&M Work plan (draw it up with a budget)	(1)	Confirmation of existing plan												■				■																							
			1) Actual organization chart												■				■																							
			2) Actual budget for annual maintenance												■				■																							
			3) Actual content of works												■				■																							
		(2)	Future planning																			■			■																	
			1) Future donor's support contents																			■			■																	
			2) Future strenghthen of the organization																			■			■																	
			3) Future budget for maintenance																			■			■																	
			4) Planning of work																			■			■																	
		(3)	Finalization of the future planning with the counter part																								■				■		■										
RE Integration	1. Formulation/Explanation/ Update/ of manual of Hybrid generation plan	(1)	Variability of RE(Solar & Wind)generation system	■																																						100%
			1)Power system basis and power quality	■																																						100%
		(2)	Impact on the grid operation by integrating RE generation systems	■																																						100%
			1)Frequency fluctuation	■																																						100%
			2)Voltage Flctuation	■																																						100%
			3)Excesss Energy	■																																						100%
		(3)	Countermeasures for the mitigation of RE impact on the grid	■																																						100%
			1)Grid Code	■																																						100%
			2)Frequency fluctuation(Algenraic method,other simulation software)	■																																						100%
			3)Voltage Fluctuation	■																																						100%
			4)Excess of energy (HOMER software)	■																																						100%
		(4)	Planning methodology for the Roadmap of RE integration																																							
			1)Planning Methodology overview																																							
			2)Inputs and assumption																																							
			3)Consideration according to the system capacity.(reliability, service quality)																																							
			4)Roadmap for small-grid to integrate RE generation system																																							
			5)RE integration road map for large scale grid.																																							
		(5)	（1）Update of the manual according to the condition of the country, working with the counterpart.										■		■				■			■			■		■				■		■										
			（2）Follow up of the updated manual, implementation condition, by the project team																■			■			■		■				■		■										
			（3）Monitaring in the use of the manual toghether with the CP										■		■				■			■			■		■				■		■										
	2. System Simulation	(1)	Overview	■									■																													
		(2)	Model case① (Power system simulation in Hateruma island)																			■			■																	100%
	3. Grid Connection of RE And Operation	(1)	Grid code (Interconnection requirement)												■				■																							
		(2)	Grid interconnection procedures												■				■																							
		(3)	Introduction for Operation and Output control												■				■																							
	4. Examples of Improvement in Okinawa for dissemination of RE	(1)	Miyako island Mega Solar Demonstration Reseach	■																																						100%
		(2)	Overview of the MG set Demonstration Research in Hateruma island	■															■			■									■		■										100%
		(3)	Abu Mega Solar Demonstration Reseach																			■			■																	
		(4)	Ogimi Wind Power Demonstration Reseach																			■			■																	
		(5)	Case study ①(Hybrid system in Yonaguni island)																			■			■																	
	5. Use of Battery Storage in Power systems	(1)	Overview										■						■																							
		(2)	Overview of Batterie's output and capacity																			■			■						■		■										
	6. PV system plan and design	(1)	Study for number of panels in series and parallel (10kW PV system)										■																													
		(2)	Design of frame and array												■				■																							
		(3)	Estimation of yearly PV power generation												■				■																							
		(4)	Study of System Composition																			■			■																	
	7. Performance ratio	(1)	Overview										■						■			■			■		■				■		■										
		(2)	Inspection and Evaluation of Monitaring results																■			■			■		■				■		■										
	8. HOMER	(1)	Overview	■									■																													100%
		(2)	Practice ① (Input of demand data)	■									■																													100%
		(3)	Practice ② (Analysis of long-term fluctuation)										■		■				■																							
		(4)	Practice ③ (Calculation of the facilities capacity for PV, Wind turbine, Battery storage)												■				■																							
		(5)	Data gathering and Modeling																			■			■		■				■		■										

July 1, 2020

JICA Consultant team

JICA Project for Introduction of Hybrid Power Generation System in the Pacific Island Countries

2nd (July) DG Remote Training Time Schedule

Time	Training Contents	Duration	Trainer	Items	Remark
13:00～14:10	1.Explanation of Remote training contents	10min	Mr. Kakefuku	Training process chart Time schedule	
	2.How to use measuring instruments (calipers, micrometer, dial gauge)	30min	Mr. K. Miyag Mr. Oshiro	How to Use Measuring Instruments How to read a Vernier Caliper (Video) How to read a Micrometer (Video)	
	3.Practice in the use of electrical measuring instruments (RTD, TC, pressure gauge)	30min	Mr. Oshiro Mr. K. Miyagi	Maintenance of diesel generators (Electrical side)	
14:10～14:20	Break time	10min			
14:20～14:50	4. Explanation of daily check sheet (daily, weekly, monthly)	30min	Mr. M. Miyagi		
14:50～15:20	5. Explanation of actual PUB power plant operation	30min	Mr. Nakachi Mr. Shimabukuro		
15:20～15:30	Break time	10min			
15:30～16:00	Specific fuel consumption measurement status (June data)	30min	Mr. Kakefuku		
	Revision of O&M Manual		Mr. Kakefuku		
	Confirm preparation status of OH		Mr. Kakefuku		
	Power plant improvement status		Mr. Kakefuku		
	Request for power plant operation data (June data)		Mr. Nakachi Mr. Shimabukuro		
JICA Experts Team members	Okinawa Enetech: Mr. Kakefuku, Mr. Hokama Sumaeco: Mr. M. Miyagi Okinawa Electric Power: Mr. Nakachi, Mr. Shimabukuro Okiden kigyo: Mr. K. Miyagi, Mr. Oshiro				

* During the training, time allocation will be prioritized for questions and discussion.

* If there is any training content that could not be covered within the set time, we will consider transferring it to later training sessions.

July 1st, 2020

JICA Project for Introduction of Hybrid Power Generation System in the Pacific Island Countries

2nd (June 2020) RE Remote Training Time Schedule (draft)

Time	Training content	duration	Trainer	Material used	Remarks
13:00-13:10	1. RE Remote Training Orientation	10 min	Shimabuku		
13:10-14:10	(RE Integration Plan) 3. Basic knowledge for formulating and updating the hybrid power generation planning manual ・Frequency fluctuation (algebraic method, detailed simulation) ・TBD	60 min	Shiohama Taira	(PowerPoint text documents)	
14:10-14:20	Break	10 min			
14:20-15:20	(RE O&M) 3. Basics of formulating and updating manual ・ Explanation of facility system configuration, O&M ・ Patrol inspection and periodic inspection ・ Daily inspection, periodic inspection ・ Inspection check sheet formulation and recording (method, frequency, etc.) * Measurement data analysis and evaluation method (String Tracer) * Inspection report preparation/storage method	60 min	Nakamura Ikehara Yonashiro	Excerpts from past training texts (REO&M) (PowerPoint text) ・ Create I-V curves using String Tracer data (Excel file)	*Verification of operating conditions
	(RE O&M) 4. Basics of formulating and updating manual 2 ・Lecture review quiz			Problems and answers/explanation (PowerPoint)	Q&A
15:20-15:30	Break	10 min			
15:30-16:00	(RE common field) 5. Performance ratio ・Overview and measurement method summary ・Current status check, evaluation/verification	20 min	Shimabuku	Performance ratio-related data	Interactive
	6. RE Remote Training Closing ・Questions, exchange views, etc.	10 min	Shimabuku		
Attendees	Okinawa Enetech: Shimabuku, Nakamura, Gaja Okinawa Electric Power Company: Shiohama, Taira Okinawa Kobori Electric: Ikehara, Yonashiro				

* During the training, time allocation will be prioritized for questions and discussion.

* If there is any training content that could not be covered within the set time, we will consider transferring it to later training sessions.

6.2.3 Minutes of the 2nd Meeting with Managers

2nd Minutes of Discussion with Managers (Kiribati)	
Date	October 2, 2020 11:30-12:15
Venue	Okinawa Enetech Conference Room (via Zoom) PUB: Adelaide Office (James), Head Office Meeting Room (Tenikoria)
Attendees	JICA Headquarters: Mr. Ogawa
	Okinawa Enetech: Mr. Kakefuku, Mr. Hokama, Mr. Nakamura, Mr. Gaja SMAECO: Mr. Miyagi KD Tech: Mr. Watanabe
	PUB：Chief Executive Officer James Young, Power Engineering Manager Tenikoria Katauea
Materials	・1. Agenda(Kiribati)_20201002 ・2. PO_HPGS(Kiribati)ver5.1 ・3.【Kiribati】Summary_of_Remote_Training__20200929 ・【Attachment3-1】Remote_training_schedule_(Results)Kiribati_20200928 ・【Attachment3-2】Remote_training_participant_list(Kilribati)_20200928 ・【Attachment3-3】Meeting_minutes_with_managers_(Kiribati)_20200716 ・【Attachment3-4】DG_Remote_Training_2nd_Report_Kiribati ・【Attachment3-4】RE_Remote_Training_2nd_Report_Kiribati ・【Attachment3-5】DG_Remote_Training_3rd_Report_Kiribati ・4. DG_RE_Remote_Training_Schedule_(draft)_Kiribati_20200929

Minutes

1. Greetings (11:30-11:40)

・The JICA expert team's role is to support the implementation of project activities. Please be aware that PUB and MISE are the performers of the activities, and we ask that you take the initiative in doing so.
(Ogawa)

- I have only been with PUB for about two weeks, so there may be some things that I am not aware of. I want to learn more about the project. We ask for your continued support. (James)

2. Explanation of Plan of Operation (PO) (11:40-11:50)

- Evaluation and update of improvement plan (Activity 1-7) is currently underway. It will be evaluated on our next trip.
- For the maintenance schedule (Activity 1-10), please prepare an OH schedule and share it with us. (Kakefuku)
- DG and RE maintenance activities (Activities 1-11, 2-6) are being implemented based on the manual. We would like to conduct the evaluation (Activities 1-13, 2-7) on the next trip. (Kakefuku)
- For the specific fuel consumption (Activities 1-14), I understand that a new flow meter is being procured. I want you to install it and take measurements as soon as you get it. (Kakefuku)
- Regarding training (Activities 1-15, 2-8), remote training was conducted 3 times each for DG and RE beginning in June. It was mainly a review of past training. Remote training will continue after October. (Kakefuku)
- Regarding information dissemination (Activities 1-16, 2-9), we plan to hold a seminar

in Pohnpei after the travel restrictions are lifted. (Kakefuku)

- The hybrid planning manual (Activity 2-3) is currently being revised. (Kakefuku)

3. Report of remote training (11:50-12:00)
   - If it is difficult for subjects to participate on the scheduled training date, the training schedule can be changed if you let us know in advance. (Kakefuku)
   - If there are any subjects that you would like us to cover in future training sessions, please request it. (Kakefuku)

4. Confirmation items (12:00-12:10)

FY 2020 JCC Meeting (Remote)

- The next JCC meeting will be held using the Zoom meeting system. If any subjects arise that should be discussed in the JCC by March 2021, it will be held in 2020 (JFY), but if not, we would like to hold it in 2021 (JFY). What do you think? (Kakefuku, Ogawa)

  → I agree. (Tenikoria)

- PUB is also supported by other donors such as ADB and New Zealand. I would like to reconfirm the JICA project through the JCC meeting.

  (James)

2nd Regional Training

- The 2nd Regional Training is scheduled for around May or June 2021. If we still can't fly at that time, we will conduct the training remotely. (Kakefuku)

Asset management

- First of all, we would like to calculate the power generation cost with HOMER. (Kakefuku)

  → I have already performed a trial calculation with HOMER, and the results show that 50% each of RE and DG is optimal. (Tenikoria)

  → I would like to analyze and study it, so please share that data with us. (Kakefuku)

  → OK. (Tenikoria)

Future remote training schedule

- Future remote training is planned on 10/14 (DG), 11/4 (RE), 2021/1/13 (DG), and 2021/2/3 (RE). (Kakefuku)
- The discussion with managers is planned for 12/2 and 3/10/2021. We will report the results of the training. (Kakefuku)

5. Closing remarks (12:10-13:10) Ogawa, James

End

October 2, 2020
JICA Expert team

Zoom Meeting Agenda ・ Kiribati

1. Opening Remarks by JICA Expert Mr. Ogawa Tadayuki
2. Explanation and confirmation of the Plan of Operation (PO)
3. Summary of remote training
4. Confirmation topics
    - 4.1 Progress of power plant improvement plan
    - 4.2 Overhaul schedule
    - 4.3 Holding of FY 2020 JCC Meeting (remote)
    - 4.4 Holding of the 2nd Regional Training
    - 4.5 Impact of COVID-19
5. Closing remarks

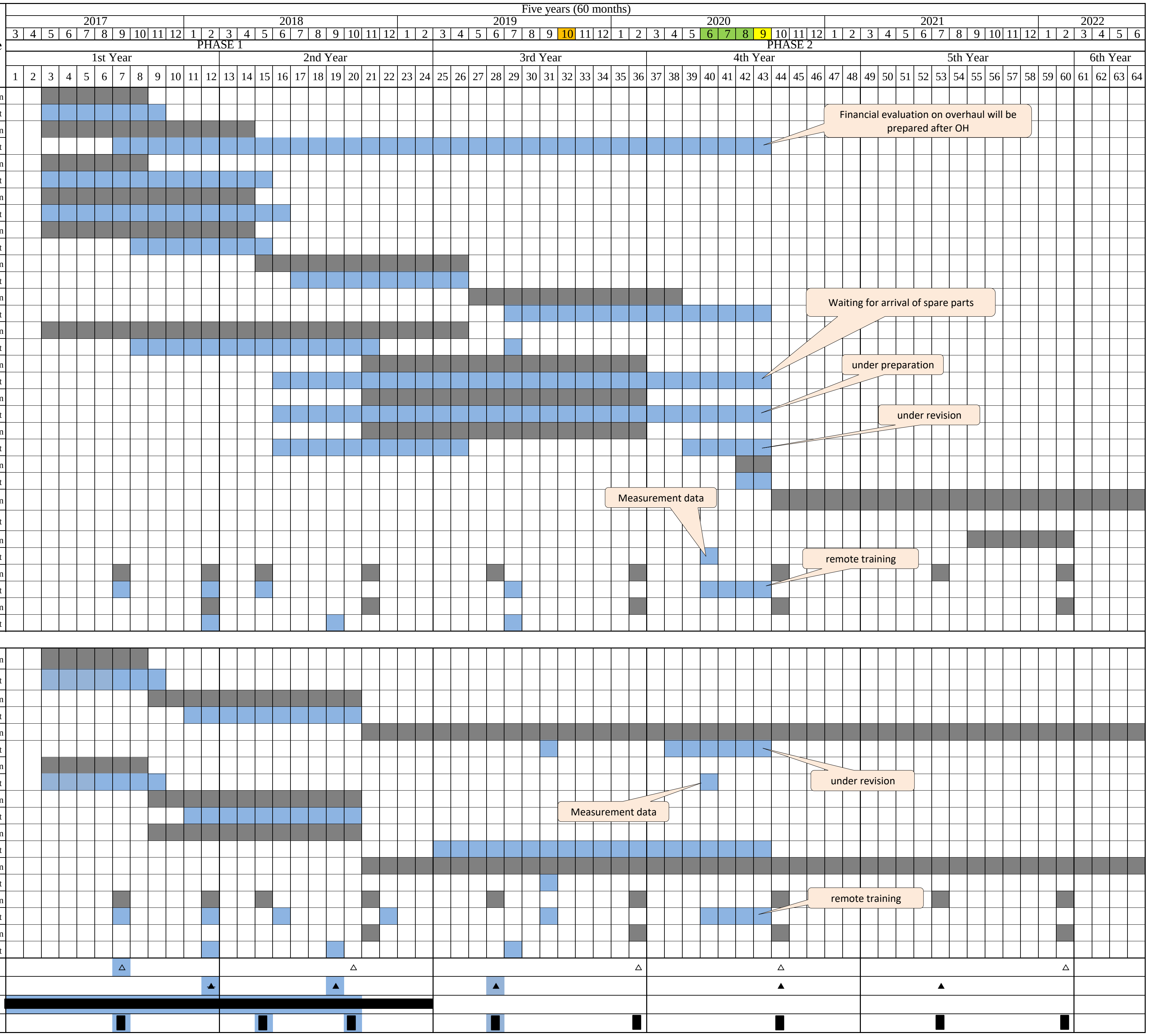
ATTACHMENT 5

Ver.5.1 July, 2020

Plan of Operation (PO)

Project Title: The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries
Project Term: March 2017 - June 2022 (Phase 1: March 2017 – February 2019 , Phase 2: March 2019 – June 2022)
Country: Kiribati
Target Area: Tarawa
Target Group: Related engineers and other technical staffs in the target area (MISE and PUB)

Output 1 Activities **【Appropriate O&M System for DG】**		**Product**	**Organizations in Charge**	
1-1.	Operational conditions of the existing DGs are reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose.	TNA Report, OVI	PUB, JICA Experts	Plan Act
1-2.	Asset management plan of DG is prepared including financial evaluation on overhaul.	PUB, JICA Experts	PUB, JICA Experts	Plan Act
1-3.	Specific fuel consumption of pilot DG units is measured.	Measurement of Specific fuel consumption	PUB, JICA Experts	Plan Act
1-4.	Improvement plan for the operation of pilot DG units is prepared.	Improvement plan	PUB, JICA Experts	Plan Act
1-5.	Existing spare parts and maintenance tools of pilot DG units are confirmed.	List of spare parts and maintenance tools	PUB, JICA Experts	Plan Act
1-6.	Improvement plan for the operation of pilot DG units is implemented.	Improvement Implementation Report	PUB, JICA Experts	Plan Act
1-7.	The result of implementation of the improvement plan is evaluated, and improvement plan is updated.	Improvement Evaluation Report	PUB, JICA Experts	Plan Act
1-8.	The concept of Economic Dispatch Control (EDC) is shared among operators and applied, if possible.	EDC software, manual, EDC sheet	PUB, JICA Experts	Plan Act
1-9.	Necessary spare parts and maintenance tools for the pilot DG units are prepared.	List of spare parts and maintenance tools prepared	PUB, JICA Experts	Plan Act
1-10.	Maintenance work schedule for the pilot DG units is prepared.	Maintenance work shedule	PUB, JICA Experts	Plan Act
1-11.	Check sheets and maintenance manuals for maintenance works for pilot DG units are prepared.	Check sheets and maintenance manulas	PUB, JICA Experts	Plan Act
1-12.	Maintenance works (daily/partial inspection/overhaul work) for pilot DG units are conducted in accordance with the maintenance schedule.	Maintenance record	PUB, JICA Experts	Plan Act
1-13.	The result of maintenance works is evaluated, and future maintenance work schedule together with budget (including sub-contract fee, cost for tools and equipment) is prepared.	Evaluation report and future schedule for maintenance	PUB, JICA Experts	Plan Act
1-14.	Specific fuel consumption of the pilot DG units is measured before and after implementation of the related project activities.	Measurement for specific consumption of the pilot DG	PUB, JICA Experts	Plan Act
1-15.	Related training programs for appropriate O&M system DGs are implemented periodically.	Training record, recommendations, reports, etc.	MISE, PUB, JICA Experts	Plan Act
1-16.	Knowledge on appropriate O&M of DGs is disseminated among stakeholders.	Seminar, workshop records	MISE, PUB, JICA Experts	Plan Act
Output 2 Activities				
2-1.	Current situation and future development plan of RE is reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose.	TNA Report, OVI	PUB, JICA Experts	Plan Act
2-2.	Planning manual for Hybrid Power Generation System is prepared	Planning manual for Hybrid Power Generation	PUB, JICA Experts	Plan Act
2-3.	Planning manual for Hybrid Power Generation System is reviewed and updated in the target area.	Updated Planning manual for Hybrid Power Generation	PUB, JICA Experts	Plan Act
2-4.	Operating conditions of the existing RE facilities are reviewed, including confirmation of objectively verifiable indicators for overall goal.	TNA Report, OVI	PUB, JICA Experts	Plan Act
2-5.	O&M manual for RE facilities is prepared.	O&M manual for RE facilities	PUB, JICA Experts	Plan Act
2-6.	Maintenance works are conducted according to O&M manual of RE facilities.	Maintenance Record	PUB, JICA Experts	Plan Act
2-7.	The result of maintenance works is evaluated, and future maintenance work schedule together with budget is prepared.	Evaluation report of maintenance work, and schedule	PUB, JICA Experts	Plan Act
2-8.	Training program for Hybrid Power Generation System including O&M of RE facilities is conducted.	Training record, recommendations, reports, etc.	MISE, PUB, JICA Experts	Plan Act
2-9.	Knowledge regarding Hybrid Power Generation System is disseminated among stakeholders.	Seminar, workshop records	MISE, PUB, JICA Experts	Plan Act
△: JCC				
▲: Training in Japan/Fiji				
JICA long term expert, stationed in Fiji				
JICA Consultant Team				



JICA Expert Team

Summary of Remote Training (Kiribati)

1. Training schedule (results)

Remote training was divided into DG training and RE training, and each was conducted three times (for details, see Attachment 1).

2. Participating organizations

Zoom was used to connect the Japanese side with the target countries.

Japan	Target Countries						
	Tuvalu	Kiribati	YAP	Chuuk	Pohnpei	Kosrae	Marshall
JICA Expert Team	TEC MTET TMTI	PUB MISE	YSPSC	CPUC	PUB	KUA	MEC KAJUR NEO

3． Participants

The number of participants was as follows (mainly core trainers) (see Appendix ② for details of participants).

① 1st Remote Training Session (DG and RE)
DG: 6 people RE: 2 people

② 2nd Remote Training Session (DG and RE)
DG: 6 people RE: 9 people

③ 3rd Remote Training Session (DG and RE)
DG: 4 people RE: 6 people(Additional:6 people)

4. Training content (topics)

The 1st to 3rd remote training sessions were conducted with a focus on reviewing the content of the training conducted in FY 2019.

1st Remote Training Session	
DG Training	RE Training
(1) Training schedule (2) Basic knowledge of DG (each system) (3) DG daily inspection (Pmax adjustment, setting adjustment, FO rack adjustment) (4) How to read electrical drawings (single line, three-line, sequence	(1) Training schedule (2) Basic technology of hybrid power generation system (HPGS) (3) Performance ratio measurement status (4) Basic knowledge for formulating and updating the hybrid power generation

diagrams) (5) Specific fuel consumption calculation exercise	planning manual

2nd Remote Training Session	
DG Training	RE Training
(1) How to use measuring instruments (Vernier calipers, micrometer, dial gauge) (2) How to use electrical measuring instruments (RTD, TC, pressure gauge) (3) Power plant operation (4) Confirmation of power plant improvement status	(1) Frequency fluctuation (system constant, algebraic method) (2) Basics of formulating and updating RE O&M manual ・ Explanation of facility system configuration and O&M ・ Patrol inspection and periodic inspection ・ Inspection check sheet formulation and recording (method, frequency, etc.) ・ Review questions and answers (3) Performance ratio ・ Overview and summary of measurement method ・ Confirmation, evaluation, and verification of the current situation

3rd Remote Training Session	
DG Training	RE Training
(1) Revision of O&M Manual (2) DG maintenance (mechanical) (3) Fuel tank inspection (4) Specific fuel consumption measurement status (5) Power plant improvement items (6) OH status (7) Power plant operation data	(1) Revision of Manual (2) Q&A on frequency fluctuation (system constant, algebraic method) (3) Q&A related to RE O&M (4) Performance ratio (5) PV facility inspection

5. Benefits of Remote Training

- Participation is possible regardless of location.
- Since there is no need to be on-site, travel expenses will be reduced.
- With on-site training, we can only meet with each country about twice a year, but remote training, we can conduct one training session per month (more frequent communication).

6. Challenges of Remote Training

- It is difficult to grasp the level of understanding of all participants.

 * With on-site training, we can grasp the understanding of each core trainer by observing his/her reaction

- It is difficult to have a one-on-one dialogue with each core trainer.
- It is difficult to provide detailed support through remote training.
- It requires getting acquainted with operating equipment such as PCs.
- While it is possible to remotely explain the handling of measuring instruments, etc. However, since we are not showing them how to operate the existing equipment on-site, it is unclear whether they can operate the instruments with remote training. ("Listening" and "doing" are different.)
- While in the on-site training, a comprehension test was conducted each in session, it is difficult to conduct a test for each individual remotely.
- If connectivity is poor, the audio and video will be interrupted.
- Training time is limited to 3 hours due to the time difference between Japan and the target countries.

7. Requests to target countries

- We request management to encourage core trainers to participate interactively. If a core trainer cannot join, please let us know in advance. In particular, the following core trainers have a low attendance rate.
  - Mr.Thomas Taoba(MISE)
  - Mr.Teebwatia Takau(PUB)
  - Mr.Beria Oromita(MISE)
  - Mr.Lokea ltienang(MISE)
- Request participants to actively comment and ask questions.
- Request participants to take initiative in revising the manual.

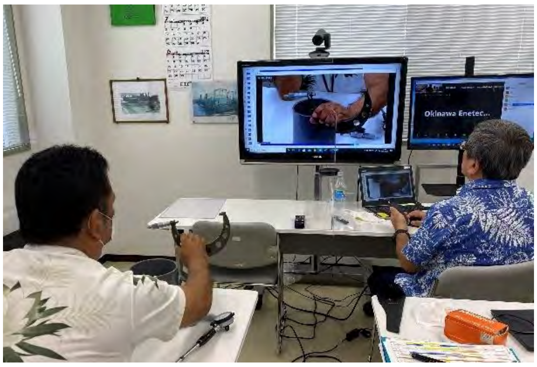
8. Impressions

- Since the training was often delayed due to participants did not gathering at scheduled time, we request participants to be on time.

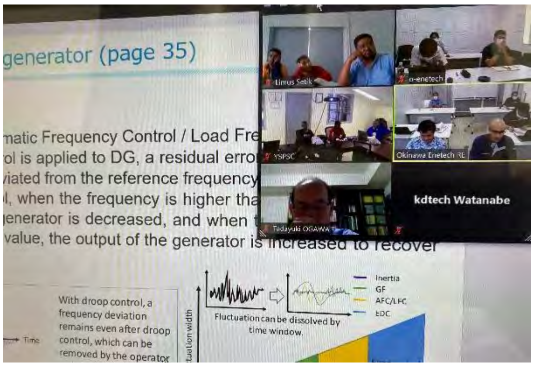
- Since some core trainers were not able to participate due to work circumstances, please let us know in advance if they will be absent.
- 60% of the remote training thus far was a review of the lectures given in the past, but we will cover new topics in future training sessions. In these sessions, we will ask questions and take other measures to ensure that the instructor does not give a one-way lecture. In addition, regarding texts, we will consider methods that make it easy for participants to understand the content by utilizing more photos and videos.

Remote Training

Explanation using equipment parts



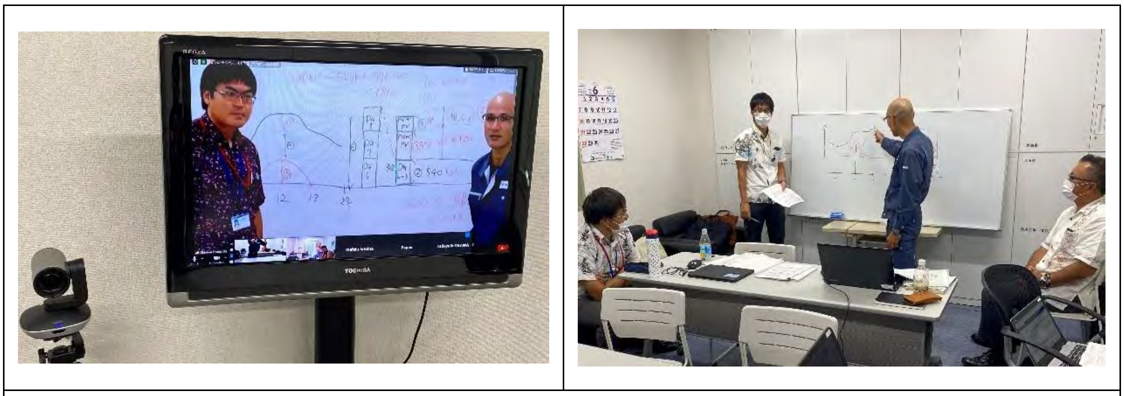
Measuring instrument demonstration



Training participants

Discussion

Communication through interpreter



Exercise using whiteboard (Zoom image is left image)

End

Attachment①

Remote trainingschedule (Results)

① 1st Remote training：June 17, 2020 –July 1, 2020

●:conducting date

Training	Date	Tubvalu	Kiribati	Micronesia				Marshall
				Yap	Chuuk	Pohnpei	Kosrae	
DG	6/17		●					
	6/18	●						
	6/22			●	●			
	6/24					●	●	
DG・RE	6/25		●(RE)					●(DG)
RE	6/26	●						
	6/29			●	●			
	7/1					●	●	●

② 2nd Remote training：July 21, 2020 –August 6, 2020

●: conducting date

Training	Date	Tubvalu	Kiribati	Micronesia				Marshall
				Yap	Chuuk	Pohnpei	Kosrae	
DG	7/21	●						
	7/22		●					
	7/27			●	●			
	7/28						●	
DG・RE	7/29	●(RE)						●(DG)
	7/30		●(RE)			●(DG)		
RE	8/3			●	●			
	8/5					●		
	8/6						●	●

Attachment①

③ 3rd Remote training : August 19, 2020 –September 28, 2020

●: conducting date

Training	Date	Tubvalu	Kiribati	Micronesia				Marshall
				Yap	Chuuk	Pohnpei	Kosrae	
DG	8/19		●					
	8/20	●						
	8/24			●	●			
	8/25					●	●	
	9/23							●
RE	8/26		●					
	8/27	●						
	8/31			●	●			
	9/3							●
	9/4		● (additional)					
	9/7			● (additional)	● (additional)			
	9/24					●	●	
	9/28	● (additional)						

Remote training attendance record

Kiribati

						Remote trainings						
						1st		2nd		3rd		
		Name	Organization	DG or RE	Country	6/17 DG	6/25 RE	7/22 DG	7/30 RE	8/19 DG	8/26 RE	9/4 RE(Additional)
1	Core trainers	Kirite Uriam	PUB	DG	Kiribati	○				○		
2		Tebakabu Tion	PUB	DG	Kiribati	○		○				
3		Thomas Taoaba	MISE	RE	Kiribati				○			
4		Teebwatia Takau	PUB	RE	Kiribati			○				
5		Bauro Mikaere	PUB	RE	Kiribati	○	○	○	○	○	○	○
6		Beria Oromita	MISE	RE	Kiribati							
7		Lokea Itienang	MISE	RE	Kiribati							
8		Tikoro Kirite (Ms.)	PUB	RE	Kiribati	○	○	○		○	○	○
9	Observers	Ritene Ikaarau	PUB		Kiribati	○			○	○	○	
10		Taibuwa Tabutoa	PUB		Kiribati			○				
11		Tebike Aree	PUB		Kiribati			○	○		○	○
12		Teariki Toani	PUB		Kiribati			○	○		○	○
13		Amota T	PUB		Kiribati			○				
14		Tamton Itirerei Tiitau	PUB		Kiribati				○		○	
15		Baraniko Bakaie	PUB		Kiribati				○			○
16		Thompson Teananga	PUB		Kiribati				○			
17		Tororo Tiwein	PUB		Kiribati							○

<table>
<tr><th colspan="2">Minutes of Discussion with Managers (Kiribati)</th></tr>
<tr><td>Date</td><td>Thursday, July 16, 2020 11:00-14:00</td></tr>
<tr><td>Venue</td><td>Okinawa Enetech Conference Room (via Zoom)
PUB (Kiribati) and MISE (Kiribati) personnel PCs</td></tr>
<tr><td rowspan="3">Attendees</td><td>JICA Headquarters: Mr. Ogawa, JICA Fiji Office: Mr. Eguchi</td></tr>
<tr><td>Okinawa Enetech: Mr. Kakefuku, Mr. Shimabuku, Mr. Hokama (rec), Mr. Nakamura, Mr. Gaja, Mr. Hashimoto
Observers: Mr. Fujita, Mr. Uezu
Okinawa Electric Power Company: Mr. Kuniba, Mr. Shimabukuro, Mr. Shiohama
SMAECO: Mr. Masaru Miyagi
KDTech: Mr. Watanabe</td></tr>
<tr><td>PUB: GM Tenikoria Katauea
MESE: Tiaon Aukitino, Tebateki Thomas Taoaba</td></tr>
<tr><td>Materials</td><td>・0. Agenda
・1. PO HPGS(Kiribati)
・2. DG Remote Training Report Kiribati
・3. RE Remote Training Report Kiribati
・4. Remote Trainig Schedule for Kiribati
・5. Training Curriculum (DG&RE)
・6. DG Remote Training Time Schedule
・7. RE Remote Training Time Schedule</td></tr>
</table>

Minutes

1. Greetings (11:15～11:20) Mr. Ogawa, Mr. Eguchi, Mr. Watanabe

2. Plan of Operation (PO) (11:20～11:45)

- Please share PUB DG's OH schedule (Kakefuku)
  → OH is scheduled in the following order in July: DG#3 ⇒DG#1 ⇒DG#5. (Mr. Tenikoria)
- What is the status of the airport PV? (Kakefuku)
  →The replacement of the fiber optic cable has not been completed yet. (Mr. Tenikoria)
- What are your plans for Kiribati's future power system plan (10-20 years) (Mr. Ogawa)
  → A ZOOM meeting between Kakefuku and Mr. Tenikoria will be held to confirm the contents. (Kakefuku)
- What is the status of revisions to the O&M manual and daily check sheet. (Kakefuku)
  → They are currently being revised according to the conditions in Kiribati. (Mr. Tenikoria)
  → We want to confirm this in the training session next week. (Kakefuku)
- How about Power generation cost (Mr. Tiaon)
  → As for asset management, I submitted it to the Secretary Ms. MIKA before, but I will send it to Mr. Tiaon again although the maintenance cost is not included. (Kakefuku)

3. Remote Training Report (11:45～12:10)

- Because several participant used only one PC during the training, I think that is very difficult for them see the slides clearly, so could you please prepare a projector and other equipment. (Kakefuku)

- Why the connectivity was poor during DG training, but good during RE training. (Mr. Ogawa)
  →There are times when connectivity is poor due to the provider service. (Mr. Tenikoria)
- We would like all core trainers to participate in the next RE training session. (Mr. Ogawa)
  → OK (Mr. Tenikoria)
- Tell us about the advantages and disadvantages of online training. (Mr. Eguchi)
  → There are times when the Internet connection is poor. (Mr. Tenikoria)
  → How about the use of Pocket WiFi. (Kakefuku)
  → It is a provider service issue so there will be no difference. (Mr. Tenikoria)
- In the next training session, we plan to use videos, etc. to improve the quality of the training, but I would like to hear your thoughts.
  → Because it is difficult to prepare equipment for online training, would JICA be able to provide support? (Mr. Tiaon)
  → Could MISE members join the training with Mr. Tenikoria at the Bikenibeu Power Plant? (Mr. Ogawa)
  →Need confirmation from Thomas and others. (Mr. Tiaon)
  → What kind of equipment do you need? (Mr. Eguchi)
  → We would like a room equipped with cameras, speakers, microphones, etc. if possible. (Mr. Tiaon)
  → Is such equipment available in Kiribati? (Mr. Eguchi)
  → We will check. (Mr. Tiaon)
  → Would it be okay for them to come to the JICA Kiribati Office for training? (Ogawa)
  → The conference room is only big enough for 5 or 6 people. I will check with the JICA Kiribati Office. (Mr. Eguchi)

4. Next remote training session content (12:10～12:15)
   - This schedule overlaps with DG's OH schedule. (Mr. Tenikoria)
     → Please attend the training (3h) as much as possible. (Kakefuku)

5. Other (12:15～12:25)
   - Currently, we are conducting remote training since we cannot travel due to COVID-19, but we would like to improve the content of the remote training in the future, but if you have any suggestions or requests, please let us know so we can incorporate them in the training. (Kakefuku)
   - We would like more training on HOMER. (Mr. Tion)

End

2nd DG Training Report (Kiribati)	
Date	July 22, 2020 10:20-13:05
Venue	Okinawa Enetech Conference Room (via Zoom) PUB (Kiribati): Control Room and Generation Manager Office
Attendees	JICA Headquarters: Mr. Ogawa
	Okinawa Enetech: Mr. Kakefuku, Mr. Hokama (record keeper), Mr. Hashimoto Observer: Mr. Fujita SMAECO: Mr. Masaru Miyagi Okinawa Electric Power Company: Mr. Nakachi Okiden Kigyo: Mr. Ken Miyagi, Mr. Oshiro
	PUB: GM Tenikoria Katauea (Mechanical) Tebwatia Takau, Tabawa Tabutoa, Amota T, Tebakabu Tion, (Electrical) Bauro Mikaere, Tikoro Kirite, Tebike Aree (Apprentice) Teariki, Tom
Training Materials	・1-1. Remote training schedule for Kiribati ・1-2. DG Remote Training Time schedule ・2. How to Use Measuring Instruments ・3-1. Thermocouple inspection ・3-2. Pressure gauge inspection ・3-3. Resistance temperature detector (RTD) inspection ・4-1. Kiribati-Graph Creation ・4-2. Inspection of Bikenibeu Power station Operation_2020.7.20 ・5 5. Improvement Plan Progress report (Kiribati-July2020)

2nd Remote Training (July)

Training details are shown in the following table.

Order	Time	Educational content	Instructor
1	10:20-10:25	Explanation of remote training	Kakefuku
2	10:25-10:55	How to use measuring instruments (Vernier calipers, micrometer, dial gauge)	Ken Miyagi
3	10:55-11:20	How to use electrical measuring instruments (RTD, TC, pressure gauge)	Oshiro
4	11:20-11:25	Break	
5	11:40-12:10	Power plant operation	Nakachi
6	12:10-12:30	Break	
	12:30-12:50	Confirmation of power plant improvement status	Kakefuku
7	12:50-13:00	Other	Kakefuku

■ Confirmation items

Do you carry out inspections using electrical measurement instruments that we provided you with? (Oshiro)

→ Yes. (Bauro)

・Can the glycerin-filled pressure gauge be calibrated? (Bauro)

→ No, but I think it can be used as a reference. (Oshiro)

- The RTD for cylinder No.4 exhaust gas temperature of Unit 4 was broken during our last trip. Did you replace it? (Oshiro)
  → No. (Bauro)
- In operation of the power plant (May data), why is Unit 5 stopped when the load is 3,000 kW or less? (Nakachi)
  → Units 1 and 5 are stopped when the load is low. (Tenikoria)
- Unit 5 is more efficient (lower specific fuel consumption), so it is more economical not to stop it. (Nakachi)
  → OK. (Tenikoria)
- Please use the Excel sheet for specific fuel consumption, performance ratio, Pmax, and exhaust temperature. (Kakefuku)
  → OK. (Bauro)
- Regarding the opening of the Cummins Package type generator door proposed for power plant improvement, the temperature will rise when the generator is operated with the door closed, so the door is left open. We are also considering improving the lubricating oil system. (Tenikoria)
  →If there are no problems such as dust intrusion or noise, you can leave it open as it is, but please check for the cause of the temperature rise in the instruction manual. I will see if we can give you advice on our next trip. (Kakefuku)
- Can the existing fuel flow meters used for Units 3 to 5 be used for the Cummins generator? (Tenikoria)
  → The metric system is used for Units 3 to 5, and imperial system is used for Cummins, so you may need an adapter for installation. (Kakefuku)

In the next training session, I would like to confirm the revision of the O&M manual. We will upload the data to the ONE DRIVE cloud server, so please check the content and revise it according to the standards used in Kiribati. (Kakefuku)
→ OK (Tenikoria)

- Please let us know if you have any requests for remote training. (Kakefuku)
  → Fuel consumption and performance ratio will be sent by Mr. Tebwatia. (Tenikoria)

■ Other thoughts on remote training

- As with the first session, Mr. Tenikoria connected using his PC and the core trainers connected with one PC, but it took about 20 minutes to connect to ZOOM. We must continue to request that they connect to ZOOM 10 minutes before the start of the training session.
- Connectivity was good, and the equipment (PC, microphone, speakers, etc.) connected to ZOOM had improved since the first session.
- In addition to the core trainers, new staff members also took part.

- We felt that the participants were motivated to study because they prepared the measuring instruments (calibrator, etc.) that we provided before.

＜Okinawa Electric Power Company＞

- I felt that it would be better to have more discussions to come to a mutual understanding. This is a one-sided communication during the explanation, so I would like to make it more fulfilling by asking questions and hearing the participants views during the explanation.
- Kiribati is already preparing graphs based on the operation data and to confirm operation, so I gave a rough explanation of on how to prepare graphs, and informed them that various insights can be attained based on how the graphs are arranged. In the future, I hope that operating data will be better understood by viewing it in multiple ways.

＜Okiden Kigyo＞

- I think the use of a measuring instruments was easy to understand with the English video used for the explanation of how to use them.

We will proactively incorporate materials such as videos in the future.

＜SMAECO＞

- It sometimes took time to connect to the Internet. Especially in Tuvalu, Kiribati, and Kosrae, we lost 20 or more minutes. There are various causes such as connection issues and not being accustomed to procedures for connecting to ZOOM, so we need to determine the situation in each country and address them.
  We requested the trainees to connect 10 minutes prior to the start of the next session, so we will decide what measures to take based on the response.
- Some participated in the training on a PC screen. Since it is difficult for many people to see on the PC screen, a projector or a large monitor should be prepared (or provided by JICA).
- In Kiribati, etc., the equipment provided is used for inspection, and they are proactive in the training, so we feel the project if fruitful.
- During the online training, there were few responses to the questions from the JICA team, and only certain trainees responded to them, so we feel that we need to improve motivation for the training.
- In the caliper and micrometer training, video was incorporated from the latter half, so we believe it was good that the content was easy to understand.

End

2nd RE Training Report (Kiribati)

Date	July 30, 2020 10:00-12:55
Venue	Okinawa Enetech Conference Room (via Zoom) PUB: Head Office
Attendees	JICA Headquarters: Mr. Ogawa
	Okinawa Enetech: Mr. Shimabuku, Mr. Nakamura, Mr. Uezu, Mr. Gaja Observer: Mr. Fujita Okinawa Electric Power Company: Mr. Shiohama, Mr. Taira Observer: Mr. Kuniba Okinawa Kobori Electric: Mr. Ikehara KD Tech: Mr. Watanabe
	PUB : Bauro Mikaere, Ritene IKaarau, Tebike Aare, Teariki Toani, Tamton Itinrerei Tiitau, Baraniko Bakaie, Thompson Teananga MISE: Thomas Taoaba (Joined at 12:35 No mic; Used chat)
Training Materials	・1-1_Remote_trainig_schedule_for_Kiribati_20200625 ・1-2_RE_remote_training_time_schedule_200722v1 ・2-1_Operation_and_maintenance_of_renewable_energy_facilities_200727v2 ・2-2._I-V_curve_graph_for_kiribati(5strings)_190913r0 ・2-3.PUB_record_sheet_20190912r0 ・2-4_Tuvalu_Report_200306 ・3-1_Remote_Training_RE_O&M_Comprehension_ Test_(Practice_Questions)_200728v2 ・4_ Basic_knowledge_for_formulating_and_updating_the_hybrid _powergeneration_planning_manual_v6(2) _202007 ・5_Perfomance_Ratio_Calculation_Sheet_Kiribati_20200707

2nd Remote Training (July)

Schedule

	Time	Educational content	Instructor
1	10:00-10:05	Greetings	Ogawa
2	10:05-10:10	Remote Training Orientation	Shimabuku
3	10:10-10:45	Basics of formulating and updating manual 1 ・ Explanation of facility system configuration, O&M ・ Patrol inspection, daily inspection, and periodic inspection ・ Inspection check sheet formulation and recording (method, frequency, etc.)	Nakamura
4	10:45-11:10	Basics of formulating and updating manual 2 Review questions and answers	Ikehara
5	11:10-11:30	Break	
6	11:30-12:10	Basic knowledge for formulating and updating the hybrid power generation planning manual ・Frequency fluctuation (system constant, algebraic	Taira

		method)	
7	12:10 PM-12:20	Break	
8	12:20-12:35	Performance ratio ・Overview and summary of measurement method ・Confirmation, evaluation, and verification of the current situation	Shimabuku
9	12:35-12:55	O&M manual revision ・Requested revision of Chapter 1	Shimabuku

■ Q&A on each training topic

Basics of formulating and updating RE O&M manual

・Have you set the PV inspection frequency? (Nakamura)

→ Yes. Although we have to consider other work at times, it is carried out almost every month in general. (Bauro)

・Has a person been put in charge of inspection? Or do you have a team? (Nakamura)

→ We have a team. (Bauro)

・Are you using the inspection sheet that we prepared with you during the training last year? (Nakamura)

→ We used it once. (Bauro)

→ Please correct the parts that are difficult to use and continue to use it. (Nakamura)

・Are the inspection reports stored in a specific file so that other staff can check it? (Nakamura)

→ Yes. (Bauro)

Basics of formulating and updating manual 2 (Review questions and answers)

・Is there a standard value for insulation resistance in Kiribati? (Ikehara)

→ The standard is 0.5 MΩ. (Bauro)

→ The insulation resistance tester will be provided on the next trip. In the next inspection and subsequent inspections, make a pass/fail judgment based on the set standard (0.5 MΩ). (Ikehara)

→ OK. (Bauro)

Basic knowledge for formulating and updating the hybrid power generation planning manual

・Does Kiribati use the LFC function which automatically controls the power generation output according to the frequency? (Taira)

→ We use AFC. (Bauro)

・Have you ever heard or used the value of System Constant in Kiribati? (Taira)

→ No. (Bauro)

→ By using the system constant, you can estimate how much the frequency will change with respect to output fluctuations. (Taira)

・I believe the frequency deviation allowed in Kiribati is ±0.5 Hz. Is that correct? (Taira)

→ Yes. (Bauro)

→ Based on this value, we will introduce a method of estimating the amount of RE fluctuations statistically and then calculating the PV penetration threshold (rated capacity). (Taira)

・Have you recorded the frequency data? (Taira)

→ No. (Bauro)

→ You already a recording device, so please check it first. (Taira)

→ OK. (Bauro)

・Are you using the Hybrid Wizard system in Kiribati? (Shimabuku)

→ Yes. (Bauro)

→ Can you confirm the PV output fluctuation and frequency fluctuation data with that system? (Shimabuku)

→I don't know. I will check SCADA. (Bauro)

Performance ratio

・Performance ratio is one of the important indicators of the project. The JICA expert team previously provided an Excel file that displays the calculation results when you enter the required values.

Fill in the yellow parts of in the "PEC Fund PV Performance Ratio" sheet of this Excel file (PV power generation amount and average solar radiation amount) to calculate the monthly performance ratio. Alternatively, if you already have a data sheet that you are using, you can continue to use it. (Shimabuku)

→ I have calculated using the sheet provided. (Bauro)

→ Please continue to use the sheet to calculate your performance ratio. Furthermore, I would like you to share the results with the JICA expert team on a regular basis. For the time being, enter the data for July as we will use it for the next training session. (Shimabuku)

→ OK. (Bauro)

・Are there any problems with the operational status of the 400 kW PV facility? (Shimabuku)

→ The power generation amount has slightly dropped. (Bauro)

→ If it's a slight decrease, it's nothing to be concerned about, but if the performance ratio drops significantly, something may be wrong, so keep an eye on it. (Shimabuku)

・What is the status of the 500 KW PV facility in Bonriki? (Shimabuku)

→ It's good. (Bauro)

・According to the information from Mr. Tenikoria during our last trip, there is a plan to expand PV integration on Christmas Island. Do you know the current status? (Shimabuku)

→ No. (Bauro)

・I heard that DG's OH is scheduled for September this year. Is that correct? (Shimabuku)

→ Yes. (Bauro)

・Please revise the O&M manual provided in February 2019. First of all, revise Chapter 1 by August 19 so that it includes Kiribati standards. The manual data will be shared by storing it on a cloud server (OneDrive). (Shimabuku)

→ OK. For Chapter 1, I think Mr. Thomas of MISE should be in charge of the revision. (Thomas, Bauro)

- One license each for the Homer software has been provided to PUB and MISE through the project. Do you know where Homer is now? (Shimabuku)
  → The PC on which Homer was installed has been formatted, so the Homer data has been lost. (Thomas)
  → The JICA expert team will coordinate with Thomas to confirm procedures for reinstallation. (Shimabuku)

- The next remote training session will be held August 26, 2020 (Wed) 13:00-16:00 (Kiribati time).
  (Shimabuku)

■ Other thoughts on remote training

- Since there was some time left for the training session, we used the time to check the local operation status. In the future, we will make provisions so that we can respond flexibly, taking into account that the scheduled time may shift.

＜Okinawa Electric Power Company＞

- The content of this lecture was to introduce the basic knowledge for calculating the RE interconnection threshold. The content is catered for those who are involved in system operations and RE integration planning. However, most of the participants are in charge of RE O&M, and the lecture was not directly related to their work, we felt content was a little difficult for the trainees.
- Due to the reasons mentioned above, it seemed that the content was even more difficult for the participants than the previous session, and we felt that there were not as many interactive questions as the previous session. Although it included a review of the content of the lectures given in the past trips, we felt the need to give lectures repeatedly to deepen the trainees' understanding little by little.
- In some cases, there were no clear answer to questions such as target frequency values, presence/absence of AFC, and the presence/absence of frequency and RE output fluctuation data. As we proceed, we hope that the participants will take the initiative in collecting such information as necessary in preparing the customized manuals.
- This was the second remote training session, we were able to perform smoothly including preparation and lecture facilitation, but we got the impression that it will take more time than face-to-face lectures. As an instructor, I would like to improve the method of conducting remote training by incorporating short problems and exercises so that the remote training will be fruitful within a limited time.

<Okinawa Kobori Electric>

- I gave a 40-minute lecture on an insulation resistance tester, but I felt that there was no problem in terms of knowledge as they answered all the questions correctly. However, since it was a remote lecture, it was not like the practical training we normally perform, so it felt like it was not enough.

End

JICA Consulting Team
Date of revision 09-Sep-20
09-Jun-20

Fiji
Kiribati
Tuvalu
Micronesia
RMI

JICA Project for Introduction of Hybrid Power Generation System in the Pacific Island Countries

DG/RE Training Schedule (draft)

Day/Date	Sun	Mon	Tue	Wed	Thu	Fri	Sat
Jun							
		6/1	6/2	6/3	6/4	6/5	6/6
DG		Schedule coordination w/each country	Schedule coordination w/each country	Schedule coordination w/each country	Schedule coordination w/each country	Schedule coordination w/each country	
RE							
	6/7	6/8	6/9	6/10	6/11	6/12	6/13
DG		Schedule coordination w/each country	Schedule coordination w/each country	Schedule coordination w/each country	Schedule coordination w/each country	Schedule coordination w/each country	
RE							
	6/14	6/15	6/16	6/17	6/18	6/19	6/20
DG				Kiribati(DG) 13:00～16:00(JST10:00～13:00)			
RE							
	6/21	6/22	6/23	6/24	6/25	6/26	6/27
DG			Holidays		Kiribati (DG) 13:00～16:00 (JST10:00～13:00)		
RE							
	6/28	6/29	6/30				
DG							
RE							
Jul							
				7/1	7/2	7/3	7/4
DG							
RE							
	7/5	7/6	7/7	7/8	7/9	7/10	7/11
DG							
RE							
	7/12	7/13	7/14	7/15	7/16	7/17	7/18
DG					Discussion w/managers of Kiribati PUB, MISE 14:00～15:00(JST11:00～12:00)		
RE							
	7/19	7/20	7/21	7/22	7/23	7/24	7/25
DG				Kiribati(DG) 13:00～16:00(JST10:00～13:00)	Japanese Holiday	Japanese Holiday	
RE							
	7/26	7/27	7/28	7/29	7/30	7/31	
DG					Kiribati(RE) 13:00～16:00(JST10:00～13:00)		
RE							
Aug							
							8/1
DG							
RE							
	8/2	8/3	8/4	8/5	8/6	8/7	8/8
DG			Kosrae Holiday				
RE							
	8/9	8/10	8/11	8/12	8/13	8/14	8/15
DG		Japanese Holiday					
RE							
	8/16	8/17	8/18	8/19	8/20	8/21	8/22
DG				Kiribati(DG) 13:00～16:00(JST10:00～13:00)			
RE							
	8/23	8/24	8/25	8/26	8/27	8/28	8/29
DG				Kiribati(DG) 13:00～16:00(JST10:00～13:00)			
RE							
	8/30	8/31					
DG							
RE							
Sep							
			9/1	9/2	9/3	9/4	9/5
DG				Okinawa Holiday		Supplementary lecture：Kiribati(RE) 14:00～15:00(JST11:00～12:00)	
RE							
	9/6	9/7	9/8	9/9	9/10	9/11	9/12
DG		Fiji Holiday					
RE							
	9/13	9/14	9/15	9/16	9/17	9/18	9/19
DG							
RE							
	9/20	9/21	9/22	9/23	9/24	9/25	9/26
DG							
RE							
	9/27	9/28	9/29	9/30			
DG							
RE							
Oct							
					10/1	10/2	10/3
DG						Discussion w/managers of Kiribati PUB,MISE 14:00～15:00(JST11:00～12:00)	
RE							
	10/4	10/5	10/6	10/7	10/8	10/9	10/10
DG							
RE							

	10/11	10/12	10/13	10/14	10/15	10/16	10/17
DG				Kiribati（DG） 13:00～16:00（JST10:00～13:00）			
RE							
	10/18	10/19	10/20	10/21	10/22	10/23	10/24
DG							
RE							
	10/25	10/26	10/27	10/28	10/29	10/30	10/31
DG							
RE							
	Nov						
	11/1	11/2	11/3	11/4	11/5	11/6	11/7
DG		Fiji holiday 予言者誕生祭	FSM Holiday インディペンスデイ	Kiribati（RE） 13:00～16:00（JST10:00～13:00）			
RE							
	11/8	11/9	11/10	11/11	11/12	11/13	11/14
DG							
RE							
	11/15	11/16	11/17	11/18	11/19	11/20	11/21
DG		Fiji Holiday ディーワーリー					
RE							
	11/22	11/23	11/24	11/25	11/26	11/27	11/28
DG							
RE							
	11/29	11/30					
DG							
RE							
	Dec						
			12/1	12/2	12/3	12/4	12/5
DG				Discussion w/managers of Kiribati PUB, MISE 14:00～15:00(JST11:00～12:00)		Marshall Holiday ゴスペルデイ	
RE							
	12/6	12/7	12/8	12/9	12/10	12/11	12/12
DG						Kiribati Holiday 人権と平和の日	
RE							
	12/13	12/14	12/15	12/16	12/17	12/18	12/19
DG							
RE							
	12/20	12/21	12/22	12/23	12/24	12/25	12/26
DG					Christmas Eve	Christmas	
RE							
	12/27	12/28	12/29	12/30	12/31		
DG			Year-end holiday	Year-end holiday	New year's Eve		
RE							
	Jan						
						1/1	1/2
DG						New year	
RE							
	1/3	1/4	1/5	1/6	1/7	1/8	1/9
DG							
RE							
	1/10	1/11	1/12	1/13	1/14	1/15	1/16
DG		成人の日 Japanese Holiday		Kiribati（DG） 13:00～16:00（JST10:00～13:00）			
RE							
	1/17	1/18	1/19	1/20	1/21	1/22	1/23
DG							
RE							
	1/24	1/25	1/26	1/27	1/28	1/29	1/30
DG							
RE							
	1/31						
DG							
RE							
	Feb						
		2/1	2/2	2/3	2/4	2/5	2/6
DG				Kiribati（RE） 13:00～16:00（JST10:00～13:00）			
RE							
	2/7	2/8	2/9	2/10	2/11	2/12	2/13
DG					建国記念日 Japanese Holiday		
RE							
	2/14	2/15	2/16	2/17	2/18	2/19	2/20
DG							
RE							

	2/21	2/22	2/23	2/24	2/25	2/26	2/27
DG			天皇誕生日 Japanese Holiday				
RE							
	2/28						
DG							
RE							
	Mar						
		3/1	3/2	3/3	3/4	3/5	3/6
DG				Discussion w/managers of Kiribati PUB, MISE 14:00～15:00(JST11:00～12:00)			
RE							
	3/7	3/8	3/9	3/10	3/11	3/12	3/13
DG							
RE							
	3/14	3/15	3/16	3/17	3/18	3/19	3/20
DG							
RE							
	3/21	3/22	3/23	3/24	3/25	3/26	3/27
DG							
RE							
	3/28	3/29	3/30	3/31			
DG							
RE							

・Local training time 13:00-16:00 (3h)
・Japan training time
12:00 to 15:00 (JST + 1h) Yap, Chuuk
11:00-14:00 (JST + 2h) Pohnpei, Kosrae
10:00-13:00 (JST + 3h) Fiji, Tuvalu, Kiribati, RMI

6.2.4 Minutes of the 3rd Meeting with Managers

3rd Minutes of the Periodical Counterpart Meeting (Kiribati)

Date, Time	25th February, 2021, 11:05-12:30 (Japan Standard Time)
Attendance	PUB: Mr. James Young, Chief Executive Officer, PUB Mr. Tenikoria Katauea, Power Engineering Manager, PUB
	JICAHQ: Mr. Tadayuki Ogawa, Chief Advisor JICA Fiji: Ms. Yukari Ono, Resident Representative Mr. Kazunobu Suzuki, Deputy Resident Representative Mr. Yuma Eguchi, Assistant Resident Representative Ms. Seema Chand, Program Officer
	Okinawa Enetech: Mr. Luis Kakefuku, Team Leader Mr. Masanori Shimabuku, Team Subleader Mr. Hideyasu Hokama Mr. Hirokazu Nakamura, Mr. Tsukasa Gaja, Interpreter Mr. Gaku Hashimoto, Coordinator Okinawa Electric Power Company: Mr. Yusuke Kuniba Smaeco: Mr. Masaru Miyagi KDTECH: Mr. Takahisa Watanabe, Coordinator
Documents	-Agenda -PROJECT_MONITIRING_SHEET_Kiribati_rev2 -PDM HPGS (Kiribati) ver.3 -PO HPGS(Kiribati) ver5 -Training_Schedule_for_Kiribati_(Plan)_Ver2

Contents

1. Opening Remarks by James, Chief Executive Officer, PUB(11:05~11:10)

- Mr. James expressed appreciation for the project which supports capacity building of PUB's staff members.
- Kiribati has a plan to upgrade both of renewable energy and diesel generation.

2. Explanation of the Project Monitoring sheet, Project Design Matrix (PDM), and Plan of Operation (PO) (11:10~11:55)

- (1-9) Is there any progress on procurement of additiona parts for OH? (Ogawa)
  →Procument office, Ministry of Finance, has evaluated tenders' documents and now it is under the process of confirmation of supplier. It is not sure when this process finish. After supplier is identified, it will take about 7 month to complete procurement. Then, OH works can be started at earliest in November. (Tenikoria)
  →Considering that the project will end in June 2022, OH should start early. JICA expert team will support OH work at site or online. (Ogawa)
- (1-16) Depending the situation, we will consider how to conduct a seminar, online or on site. (Ogawa)
- It is desirable that PUC could keep updating and utilizing O&M manual, for planning new PV system. (Ogawa)

- (Project Purpose Indicator 1) There is almost no change on specific fuel consumption so far. We hope the figure is improved at the end of the project.(Ogawa)
- (Project Purpose Indicator 2) Why the figure of performance ratio dropped rapidly?(Ogawa)
  →AC sytem had a problem and it took several manth to fix it. Mr. Tenikoria will share the latest data(Tenikoria)
- (Project Purpose Indicator 3) Through the project, manuals are developed and the planning program "HOMER" is introduced. Please apply these tools to additional PV and battery system and share the result. (Ogawa)
- PUB is requesting 2 DGs for Japan's Grant Aid for the Economic and Social Development Programme. For the procurement, JICS will shotly contact with Mr. Tenikoria. (Ogawa)
- At the same time, is PUC requesting Newzealand for additional DGs? (Ogawa)
  →unit 1 and 2 will be replaced.(James)
  →JICA expert team is now investigating for additional DGs. Mr. Kakefuku will share the results. (Ogawa)
- About disposal of DGs, we need to follow proper procedures in the guidelines of the government of Japan. Embassy of Japan in Fiji will contact with PUB. (Ogawa)
- When PUB decommission unit 3 and unit 5, is it possible to reuse and rebuilt for unit 1?(Tenikoria)
  →We may be able to adjust the output of DGs.(Ogawa)
- Unit 2 and 6 will be replaced by new units. (Tenikoria)
- Under the activity "1-2" to establish an asset management plan, JICA expert team is going to propose capacity and units for new DGs.(Ogawa)
- Although there is a delay on the activity about asset management plan, it will be completed with sartiscaftory quality shortly.(Ogawa)

3. Progress and future plan of remote training, 2nd Regional Training (11:55~12:00)
- JICA expert team will share plan of future remote tranings.(Kakefuku)
- The 2nd regional training is scheduled in August to Setember, 2021. If it is still difficult to visit Fiji, it will be held remotely. (Kakefuku)

4. Other: 2020-2030 Power generation Configuration Study Report. (12:00~12:25)
- How confident can we be about the average and peak load?. There are 1,000 customers not connected and PUB will installoptical fiber cables in the next year. We are not sure about accumulated demand. (James)
- To estimate the peak load, usually take the average for the three days with the highest demand in the year and add 5% to the average. (Kakefuku)
- What happens if OTEC project does not progress? (James)
  →Please refer to the case study 4.(Kakefuku)
- After this study is completed, JICA expert team will share the HOMER the simulation data with PUB so that PUB can calculate.(Ogawa, Kakefuku)

5. Closing remarks by Ms.Yukari Ono. (12:25~12:30)
- Resident Representative, JICA Fiji Office Ms. Ono conveyed her appreciation to PUB and JICA expert team for the meeting.

- It was glad that project activities has been proceeded through on-line basis, despite the travel restrictions due to the COVID-19.
- OH training is very important to be completed in the next Japanese fiscal year to meet the project goal..
- JICA Fiji hopes to work together even in remotely for the sutaible energy and efficient operation of diesel energy.
- Ms. Ono's assignment in JICA Fiji will be finished at the end of February. New Resident Representative, Ms. Amaike, has just arrived in Suva.

(End)

February 25, 2021
JICA Expert team

Agenda for Counterpart Meeting (Kiribati)

1. Opening Remarks by Mr.James Young, Chief Executive Officer, PUB

2. Explanation of the Project Monitoring Sheet, Project Design Matrix (PDM) and Plan of Operation (PO)

3. Progress and future plan of remote training, 2nd Regional Training.

4. Other
   ・2020～2030 Power generation Configuration Study report.

5. Closing remarks by Ms. Yukari Ono, Resident Representative of JICA Fiji Office

Attachments:
・PROJECT MONITORING SHEET for Kiribati
・PDM and PO for the Project in Kiribati
・Kiribati Training Schedule 2021 (Plan)

ATTACHMENT 3

To RR of JICA Fiji Office

PROJECT MONITORING SHEET

Project Title: The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries
Version of the Sheet: Ver.4 (Nov. 2019 – Dec. 2020)
Project Term: March 2017 －June 2022
Country: Kiribati

Name: Ms. Saitofi Mika
Title: Project Director
Name: Mr. Tadayuki OGAWA
Title: Chief Advisor
Submission Date: th January, 2021

I. Summary

1 Progress

1-1 Progress of Inputs

(1) Japanese side

1) Since March 2019, Chief Advisor has been based in Japan and assists JICA expert team & Kiribati counterparts to continuously upgrade skills and knowledge mainly through on-line support.
2) Due to the spread of COVID-19, JICA expert team has been working for on-line remote trainings since June 2020. In total four (4) remote sessions were held for O&M of Diesel Engine Generator (DEG) and another four (4) sessions plus one (1) extended session were conducted for grid integration of RE and O&M of PV facilities.

(2) Kiribati side

In total 8 number of core trainers are registered under the Project, 5 from PUB and 3 from MISE staff. Facilities and equipment (e.g. training classrooms) for the trainings in Kiribati were provided by PUB. 4 core trainers from PUB and 1 from MISE participated in the 1st regional training in Fiji in 2019. For the on-line support sessions 52 trainers (cumulative total) joined by the end of December 2020.

1-2 Progress of Activities

ATTACHMENT 3

No.	Activity	Progress
Output 1: 1. Appropriate and economical system for O&M of Diesel Generators (DGs) is enhanced.		
1-1	Operational conditions of the existing DGs are reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose.	The result of discussions and analysis for future training needs was compiled as "Training Needs Assessment Report" and submitted to all members in November 2017.
1-2	Asset management plan of DG is reviewed including financial evaluation on overhaul.	Draft asset management plan was submitted to PUB in October, 2019. Optimum capacity additions for RE and retirement of DEG units are under consideration by JICA Expert.
1-3	Specific fuel consumption of pilot DG units is measured.	Specific fuel consumption was measured by PUB in May 2018 after installation of new flow meter. The figure is 0.273 L/kWh and confirmed as the baseline figure for project evaluation. According to June report, SFC values at 80% rated output was as show below.(2020)DG3: 0.277 L/kWh DG4: 0.263 L/kWh DG5: 0.276 L/kWh AVG: 0.272 L/kWh
1-4	Improvement plan for the operation of pilot DG units is prepared.	Improvement plan was prepared and shared with Kiribati side in the letter issued on 20th June 2018, after discussion and confirmation with PUB representatives.
1-5	Existing spare parts and maintenance tools of pilot DG units are confirmed.	Existing spare parts and maintenance tools were confirmed in May 2018.
1-6	Improvement plan for the operation of pilot DG units is implemented.	Improvement plan has been implemented by April 2019 under consultation with JICA Expert.
1-7	The result of implementation of the improvement plan is evaluated, and improvement plan is updated.	Updated improvement plan has been implemented since April 2019.
1-8	The concept of Economic Dispatch Control (EDC) is shared among operators and applied, if possible.	The basic concept of EDC has been explained by JICA Expert in May 2018.
1-9	Necessary spare parts and maintenance tools for the pilot DG units are prepared.	Kiribati side prepared spare parts and maintenance tools in accordance with the advice by JICA Expert by June 2019. Since Additional budget was secured in November 2020, the procedure for arrangement of additional parts is in progress.
1-10	Maintenance work schedule for the pilot DG units is prepared.	Draft maintenance work schedule is under preparation by JICA Expert. PUB is requested to share the schedule for overhaul works for pilot DG units.
1-11	Check sheets and maintenance manuals for maintenance works for pilot DG units are prepared.	Draft check sheets and maintenance manuals was provided by JICA Expert in the training of July 2019.

		The manual revision has started in June 2020, updating the contents according to Kiribati standards.
1-12	Maintenance works (daily/partial inspection/overhaul work) for pilot DG units are conducted in accordance with the maintenance schedule.	Preparation for on-line support for overhaul works is on-going. It is necessary the signing of a minutes to confirm the support contents and area of responsibility of each parts.
1-13	The result of maintenance works is evaluated, and future maintenance work schedule together with budget (including sub-contract fee, cost for tools and equipment) is prepared.	Yet to be commenced
1-14	Specific fuel consumption of the pilot DG units is measured before and after implementation of the related project activities.	Yet to be commenced
1-15	Related training programs for appropriate O&M system for DGs are implemented periodically.	In total four (4) remote sessions were provided in 2020 with 23 cumulative total participants.
1-16	Knowledge on appropriate O&M of DGs is disseminated among stakeholders	1st Seminar was held in Kiribati in July 2019.
Output 2: Methodology for appropriate planning and O&M of renewable energy (RE) is established.		
2-1	Current situation and future development plan of RE is reviewed, including confirmation of objectively verifiable indicators for overall goal.	Same as activity 1-1
2-2	Planning manual for Hybrid Power Generation System is prepared.	Draft planning manual was prepared by JICA Expert and shared with Kiribati side for further update in February 2019. The manual revision has started in June 2020, updating the contents according to Kiribati standards.
2-3	Planning manual for Hybrid Power Generation System is reviewed and updated in the target area.	Kiribati side is requested to keep reviewing and updating the manual under consultation with JICA Expert.
2-4	Operating conditions of the existing RE facilities are reviewed, including confirmation of objectively verifiable indicators for overall goal.	Same as activity 1-1 Objectively verifiable indicators for overall goal was confirmed at the 1st JCC meeting in 2017.
2-5	O&M manual for RE facilities is prepared.	Draft O&M manual was prepared by JICA Expert and shared with Kiribati side for further update in February 2019.
2-6	Maintenance works are conducted according to O&M manual of RE facilities.	Kiribati side is requested to keep reviewing and updating the manual under consultation with JICA Expert.
2-7	The result of maintenance works is evaluated, and future maintenance work schedule together with budget is prepared.	Yet to be commenced
2-8	Training program for Hybrid Power Generation System including O&M of RE facilities is conducted.	In total four (4) remote sessions were provided in 2020 with 29 cumulative participants .
2-9	Knowledge regarding Hybrid Power	1st Seminar was held in Kiribati in July

	Generation System is disseminated among stakeholders.	2019.

(Remarks) Yellow-highlighted activities have already been completed.

1-3 Achievement of Output

(1) Output 1

Technical advice for the improvement of O&M of DGs has been provided by JICA Experts based on the initial survey of current conditions conducted in 2017. Also, classroom lecture & hands-on trainings have been provided to ensure appropriate and economical O&M of DGs with draft manuals and check sheets. In addition, counterpart training has been conducted with site visits and hands-on trainings to learn the necessary O&M of DGs in Japan. Since June 2020, on-line support by JICA Experts has been carried out to monitor the progress of related activities. This on-line support includes periodical meetings with counterparts and managers in addition to a series of training sessions.

Unfortunately, major faults of Unit 4 stator coil have been observed in 2018 and 2019. Therefore, further contribution from Kiribati side (e.g. periodical cleaning of alternators) should be expected to implement the improved O&M of DGs based on the learnings from the advice and trainings by JICA Experts. In addition, Kiribati side is encouraged to work for updating and revising related manuals under the on-line support by JICA Experts.

(Indicator 1-1) Adequacy on the use of the work schedule, check sheets and manual for the maintenance work for the pilot DG units

(Achievement) Draft check sheets and maintenance manuals are undergoing revision according to Kiribati standards. Draft maintenance work schedule is under preparation to be finalized once the Kiribati side determine the actual work period.

(Indicator 1-2)Number of training participants who are conducting operation and maintenance of DG based on the learnings from the training program (target: 2)

(Achievement) Two core counterparts are expected to continue working for the operation and maintenance of DG based on the learnings from the training program.

(2) Output 2

Technical advice for the appropriate planning and O&M of RE has been provided by JICA Experts based on the initial survey of current conditions conducted in 2017. Also, classroom lecture & hands-on trainings have been provided to ensure appropriate planning and O&M of RE with draft manuals and check sheets. In addition, counterpart training has been conducted with site visits and hands-on trainings to learn the methodology of planning and O&M of RE in Japan. Since June 2020, on-line support by JICA Experts has been carried out to monitor the progress of related activities. This on-line support includes periodical meetings with counterparts and managers in addition to a series of training sessions.

"Planning manual for Hybrid Power Generation System" and "O&M manual for RE facilities" shall be utilized and updated in accordance with the current O&M practices by MISE and PUB. Also, the results of O&M works for all solar PV systems shall be recorded and shared with JICA Expert Team. Therefore, further contribution from Kiribati side should be expected to implement the improved planning and O&M of RE based on the learnings from the advice and trainings by JICA Experts.

(Indicator 2-1) Number of training participants who have been certified under the Project for the planning method of the Hybrid Power Generation System (target: 1)
(Achievement) Three core counterparts have been working for the related activities of panning Hybrid Power Generation System.
(Indicator 2-2) Number of training participants who are conducting O&M of RE facilities based on the learnings from the training program (target: 2)
(Achievement) Three core counterparts are expected to continue working for the operation and maintenance of RE based on the learnings from the training program.
(Indicator 2-3) Preparation of related manuals for Hybrid Power Generation System
(Achievement) Draft planning manual together with O&M manual was prepared by JICA Expert and Kiribati side is currently working for further update in accordance with Kiribati standards.
(Indicator 2-4)Adequacy of the use of the related manuals for Hybrid Power Generation System
(Achievement) Already draft O&M manual with related check sheets are utilized for the operation and maintenance of existing solar PV systems.

1-4 Achievement of the Project Purpose

(Indicator 1) Improvement of specific fuel consumption of pilot DG units

The baseline figure for the specific fuel consumption is 0.273 L/kWh, while the measurement in 2020 resulted in the figure of 0.272 L/kWh. It is expected that those figures will be further improved after the planned overhaul works.

(Indicator 2) Improvement of performance ratio for RE power generation systems

The baseline figure for the performance ratio for PEC PV is 75%, while the measurement in 2020 up to June shows an average of 60.13 %~~.~~ Further analysis and additional measures will be needed to improve the performance ratio.

(Indicator 3) Proper application of planning and O&M method of HPGS

Planning manual and simulation tool (HOMER) have been utilized for the introduction of additional solar PV and battery system under the financial assistance by ADB.

1-5 Changes of Risks and Actions for Mitigation

N/A

1-6 Progress of Actions undertaken by JICA

N/A

1-7 Progress of Actions undertaken by the Parties

N/A

1-8 Progress of Environmental and Social Considerations (if applicable)

N/A

1-9 Progress of Considerations on Gender/ Peace Building/ Poverty Reduction (if applicable)

One female technician from PUB is working for the operation and maintenance of PV system and another one (no set as a core trainer in the JCC meeting) is working for maintenance of DG's.

1-10 Other remarkable/ considerable issues related/ affect to the Project (such as other JICA's projects, activities of counterparts, other donors, private sectors, NGOs, etc.)

Embassy of Japan in Fiji will procure generators and related equipment for Bikenibeu P/S under Japan's Grant Aid for the Economic and Social Development Programme.

2 Delay of Work Schedule and/or Problems (if any)

2-1 Detail

Originally the second regional training was scheduled in 2020, but it has been postponed to 2021 due to the extended COVID-19 pandemic. It may further influence quality of activities at site (e.g. hands-on trainings) in case on-line support cannot supplement those activities.

The delay was observed in implementation of activity 1-2 (Asset management plan of DG is prepared including financial evaluation on overhaul.).

2-2 Cause

The delay was caused mainly because it took long time to confirm the current financial structure of PUB. However, the delay is not critical in implementation of the project as it will not delay smooth implementation of successive activities.

2-3 Action to be taken

2-4 Roles of Responsible Persons/ Organization (JICA, the Parties, etc.)

3 Modification of the Project Implementation Plan

3-1 Plan of Operation

3-2 Other modifications on detailed implementation plan

4 Preparation of Government of Kiribati toward after completion of the Project

Government of Kiribati and PUB will be further requested to utilize and update the related manuals and tools for the planning and O&M of Hybrid Power Generation System. Also, those core trainers who have participated in the training in Kiribati and Fiji need to continue on the OJT for other staff inside the organization (MISE, PUB) to share the necessary skills and knowledge for the introduction of Hybrid Power Generation System.

II. **Project Monitoring Sheet I & II as Attached**

(Project Design Matrix and Plan of Operation)

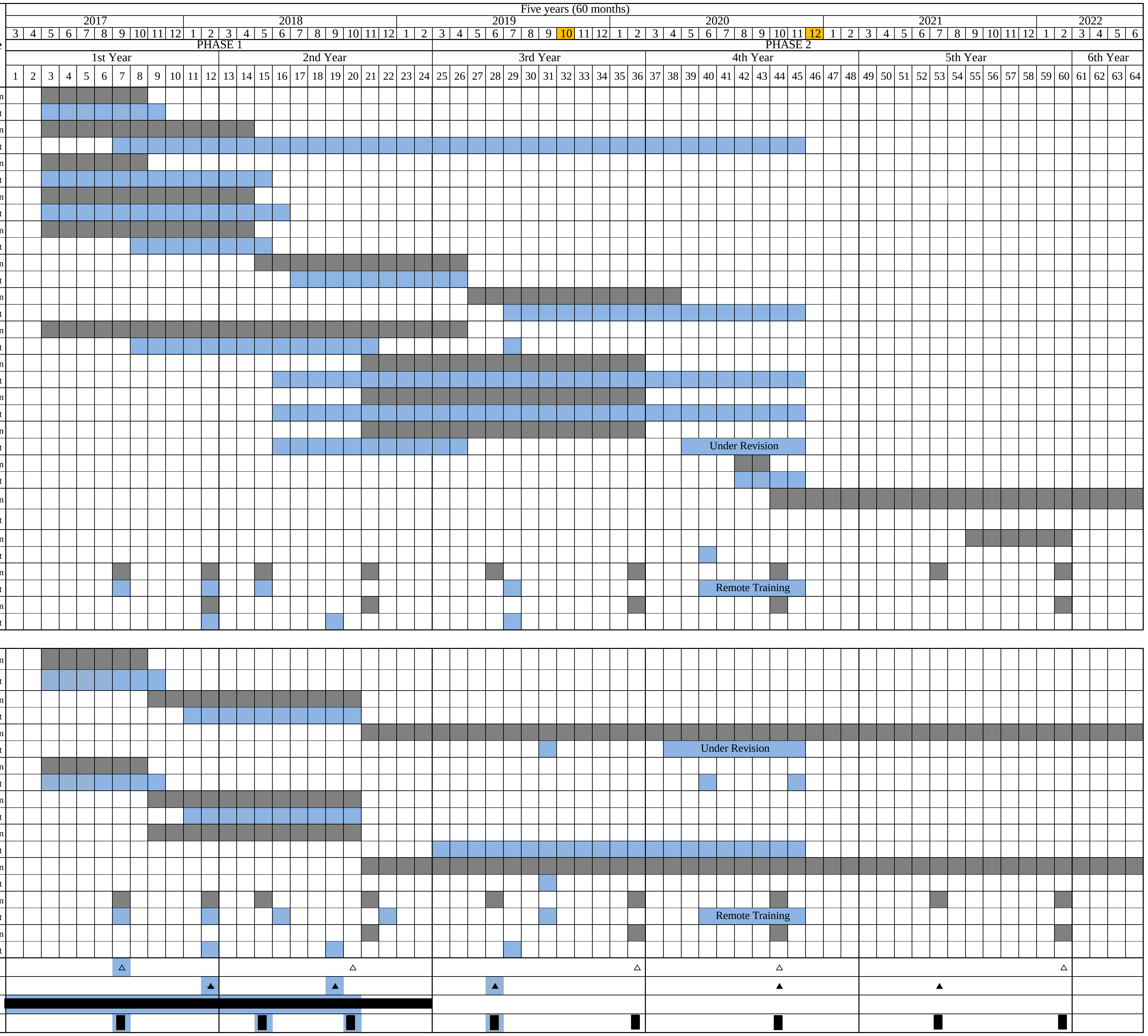
ATTACHMENT 5

Ver.5 December, 2020

Plan of Operation (PO)

Project Title: The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries
Project Term: March 2017 - June 2022 (Phase 1: March 2017 – February 2019 , Phase 2: March 2019 – June 2022)
Country: Kiribati
Target Area: Tarawa
Target Group: Related engineers and other technical staffs in the target area (MISE and PUB)

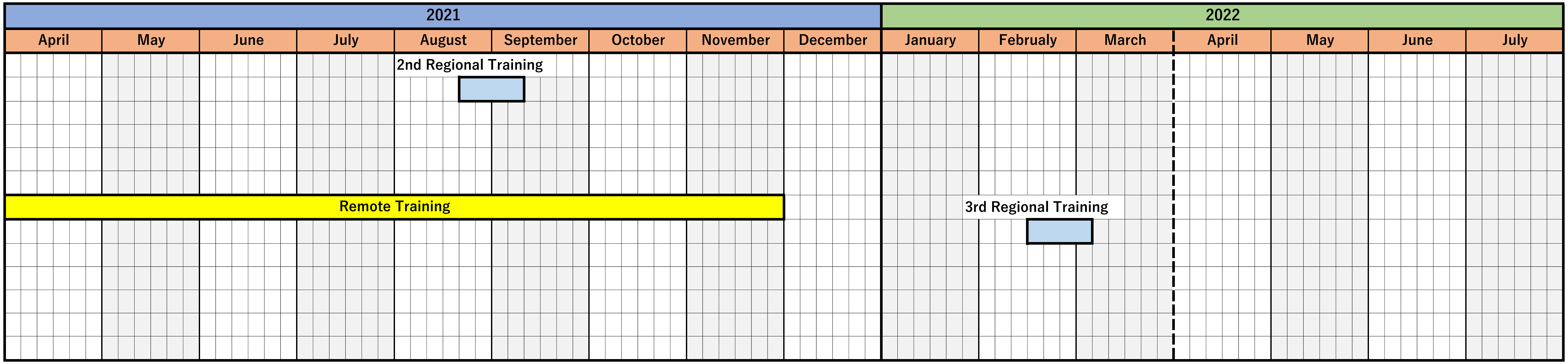
		Product	Organizations in Charge	
Output 1 Activities【Appropriate O&M System for DG】				
1-1.	Operational conditions of the existing DGs are reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose.	TNA Report, OVI	PUB, JICA Experts	Plan Act
1-2.	Asset management plan of DG is prepared including financial evaluation on overhaul.	PUB, JICA Experts	PUB, JICA Experts	Plan Act
1-3.	Specific fuel consumption of pilot DG units is measured.	Measurement of Specific fuel consumption	PUB, JICA Experts	Plan Act
1-4.	Improvement plan for the operation of pilot DG units is prepared.	Improvement plan	PUB, JICA Experts	Plan Act
1-5.	Existing spare parts and maintenance tools of pilot DG units are confirmed.	List of spare parts and maintenance tools	PUB, JICA Experts	Plan Act
1-6.	Improvement plan for the operation of pilot DG units is implemented.	Improvement Implementation Report	PUB, JICA Experts	Plan Act
1-7.	The result of implementation of the improvement plan is evaluated, and improvement plan is updated.	Improvement Evaluation Report	PUB, JICA Experts	Plan Act
1-8.	The concept of Economic Dispatch Control (EDC) is shared among operators and applied, if possible.	EDC software, manual, EDC sheet	PUB, JICA Experts	Plan Act
1-9.	Necessary spare parts and maintenance tools for the pilot DG units are prepared.	List of spare parts and maintenance tools prepared	PUB, JICA Experts	Plan Act
1-10.	Maintenance work schedule for the pilot DG units is prepared.	Maintenance work shedule	PUB, JICA Experts	Plan Act
1-11.	Check sheets and maintenance manuals for maintenance works for pilot DG units are prepared.	Check sheets and maintenance manulas	PUB, JICA Experts	Plan Act
1-12.	Maintenance works (daily/partial inspection/overhaul work) for pilot DG units are conducted in accordance with the maintenance schedule.	Maintenance record	PUB, JICA Experts	Plan Act
1-13.	The result of maintenance works is evaluated, and future maintenance work schedule together with budget (including sub-contract fee, cost for tools and equipment) is prepared.	Evaluation report and future schedule for maintenance	PUB, JICA Experts	Plan Act
1-14.	Specific fuel consumption of the pilot DG units is measured before and after implementation of the related project activities.	Measurement for specific consumption of the pilot DG	PUB, JICA Experts	Plan Act
1-15.	Related training programs for appropriate O&M system DGs are implemented periodically.	Training record, recommendations, reports, etc.	MISE, PUB, JICA Experts	Plan Act
1-16.	Knowledge on appropriate O&M of DGs is disseminated among stakeholders.	Seminar, workshop records	MISE, PUB, JICA Experts	Plan Act
Output 2 Activities 【 Appropriate planning and O&M of renewable energy (RE)】				
2-1.	Current situation and future development plan of RE is reviewed, including confirmation of objectively verifiable indicators for overall goal and project purpose.	TNA Report, OVI	PUB, JICA Experts	Plan Act
2-2.	Planning manual for Hybrid Power Generation System is prepared	Planning manual for Hybrid Power Generation	PUB, JICA Experts	Plan Act
2-3.	Planning manual for Hybrid Power Generation System is reviewed and updated in the target area.	Updated Planning manual for Hybrid Power Generation	PUB, JICA Experts	Plan Act
2-4.	Operating conditions of the existing RE facilities are reviewed, including confirmation of objectively verifiable indicators for overall goal.	TNA Report, OVI	PUB, JICA Experts	Plan Act
2-5.	O&M manual for RE facilities is prepared.	O&M manual for RE facilities	PUB, JICA Experts	Plan Act
2-6.	Maintenance works are conducted according to O&M manual of RE facilities.	Maintenance Record	PUB, JICA Experts	Plan Act
2-7.	The result of maintenance works is evaluated, and future maintenance work schedule together with budget is prepared.	Evaluation report of maintenance work, and schedule	PUB, JICA Experts	Plan Act
2-8.	Training program for Hybrid Power Generation System including O&M of RE facilities is conducted.	Training record, recommendations, reports, etc.	MISE, PUB, JICA Experts	Plan Act
2-9.	Knowledge regarding Hybrid Power Generation System is disseminated among stakeholders.	Seminar, workshop records	MISE, PUB, JICA Experts	Plan Act
△: JCC				
▲: Training in Japan/Fiji				
JICA long term expert, stationed in Fiji				
JICA Consultant Team				



JICA Expart Team

January 29th 2021

Training Schedule for Kiribati (Plan)



6.2.5 Minutes of the 4th Meeting with Managers

4th Minutes of the Periodical Counterpart Meeting (Kiribati)	
Date, Time	9th September, 2021, 10:15-11:15 (Japan Standard Time)
Attendance	PUB: Mr. James Young, Chief Executive Officer : Mr. Tenikoria Katauea, Power Engineering Manager MISE: Mr. Thomas Taoaba, Renewable Energy Planner
	JICAHQ: Mr. Tadayuki Ogawa, Chief Advisor JICA Kiribati Field Office: Ms. Floreen Tikau
	Okinawa Enetech: Mr. Luis Kakefuku, Team Leader Mr. Masanori Shimabuku, Team Subleader Mr. Hideyasu Hokama Mr. Hirokazu Nakamura, Mr. Tsukasa Gaja, Interpreter Mr. Gaku Hashimoto, Coordinator KDTECH: Mr. Takahisa Watanabe, Coordinator
Documents	-01-Agenda(Kiribati)_20210909_rev1 -02-Kiribati_Capacity_Assesment_Report (2020)rev2 -03-Training Program rev1 -Kiribati Unit #3 alternator ver1

Contents

1. Opening Remarks

- We would like to discuss the JCC meeting, the 2nd Regional Training, and the issue of the #3 unit in this meeting. (Ogawa)

2. Capacity Assessment in 2020-2021

DG

- The JICA expert team has provided 6 remote DG O&M remote trainings sessions and 2 DG Manual Revision training sessions. The result of the summary tests showed that Mr. Teebwatia and Mr. Tebakabu achieved about 74.5% of the training objectives. The JICA expert team advised DG counterparts to participate actively in the revision of the DG O&M manual in order to increase the knowledge and skill which will result in the efficient operation and maintenance of the entire power plant. (Kakefuku)

RE

- The JICA expert team has provided 6 remote RE integration and O&M training sessions and 2 RE Manual Revision training sessions. (Kakefuku)
- For RE integration, the result of the summary tests showed that Mr. Bauro and Ms. Mary achieved about 77% of the training objectives. However, the JICA expert team could not evaluate Mr. Thomas with the summary test as he did not submit it. (Kakefuku)
- For RE O&M, Ms. Mary achieved about 76.3% of the training objectives for RE O&M. Mr.

Beria and Mr. Lokea of MISE never participated in the training, so the JICA expert team could not evaluate their achievement for the training. (Kakefuku)

- The core counterparts are expected to share their knowledge and skills to others so that capacity building activities will continue even after the completion of the project. Although there have been some delay in progress due to the pandemic, we are supporting the activities remotely. In order for us to assist you in meeting your requirements or needs, please provide the latest information you have on site. (Kakefuku)

Core Trainers

- Mr. Lokea is no longer in the energy unit. Mr. Beria has been busy recently in the outer islands. MISE is planning to assign a replacement for Mr. Lokea. (Thomas)
  →Even if the period of the project is extended, it will end in June 2023. So, the time is limited. It may not be a good idea to invite a new counterpart at this moment. If somebody is seriously willing to study, then we will accept. Please discuss this internally within MISE. (Ogawa)

3. Project extension

- We are going to propose extending the project period for one year. Due to the pandemic, the JICA expert team could not visit Kiribati and other countries. Although the JICA expert team has continued the training remotely, they could not provide hands-on training, so some of the content was suspended. We would like to extend the period of the project to be able to do the hands-on training when the border opens. At the JCC meeting, it will be officially agreed on by the concerned parties. And the R&D (Record of Discussion) will be revised and signed by the governments of Kiribati and Japan. (Ogawa)
  →It is a great proposal from PUB's prospective. (James)

4. Project schedule and content 2021-2023

Schedule

- We hope to be able to travel to Kiribati after April 2022. We will continue online training and regional training as well. "03-Training_schedule_rev1" shows the tentative schedule. (Kakefuku)

Additional training content

- For RE, we are considering to add new content such as system stabilization study, overview of grid code, and follow up on the revision of the Energy Masterplan.

(Kakefuku)

→Is the Energy Master Plan different from the asset management plan? (James)

→Yes. It is different. In 2017 or 2018, PPA together with USP and some other parties provided a long-term energy supply plan to Kiribati. (Ogawa)

→Besides these, PUB is planning to prepare a 10-year road map, based on the asset management plan. (James)

→Is PUB doing this in consultation with an international organization? (Ogawa)

→No. we are trying to do it by ourself. (James)

→This is great. We are happy to assist you in this work. (Ogawa)

- Kiribati is now developing a new Energy Act. (James)
- For DG, the JICA expert team will support upgrading the manual and improving the existing DGs and power plant facilities. Other additional content will be considered upon request from PUB. (Kakefuku)
- For RE, the JICA expert team is considering to add new content such as system stabilization study, overview of grid code, and follow up in the revision of the Energy Masterplan. (Kakefuku)

5. Others

JCC

- JCC is scheduled for October 29, 1-3 PM, Kiribati time. (Kakefuku)
- Please confirm the attendance of Mr. Arobati, Deputy Secretary, so that he can sign on the minutes on behalf of MISE. (Ogawa)

  →Noted. (Thomas)

OH

- PUB is planning to conduct OH in January 2022. (James)
- The necessary spare parts will be delivered to PUB in December 2021. Although the issue of reserve margin is not solved yet, PUB thinks it would be too risky to wait anymore. (James)

Request for upcoming training content

- Training on project management would be helpful for PUB. (James)
- Let me discuss this internally within MISE about and get back to the JICA expert team. (Thomas)

#3Gen Temperature sensor failure

- The JICA expert team confirmed that the temperature of the monitoring control panel (control room) could not be monitored at the last training on site. Possible causes of this issue are malfunction of the resistance temperature detector (RTD), transducer, and meter in the monitoring control panel. (Kakefuku)

→There are three RTDs. Two of them were running during operation while the other did not react. One of the RTDs seems to be out of order. (Tenikoria)

→Please check if there is a spare and replace it. (Kakefuku)

→Yes. We are going to clean up the stater coil and check the inventory for a spare. (Tenikoria)

- The JICA expert team provided on-site training in 2019 on how to measure exhaust gas temperature of each cylinder using RTDs. Also, the JICA expert team conducted insulation resistance measurement for #4 in 2019 and the result was good at that time. The PUB staff are skilled at performing these inspections. It is good to maintain spare devices. In future training, we will explain how to read electrical drawings. (Kakefuku)

6. Closing remarks by Mr. James

- Mr. James expressed gratitude to the JICA expert team for continuous support. (James)
- In the report of the DG failure, there is a table which indicates to install a new stater from Japan, as one of the options. Please note that JICS is procuring a whole new generator, not only a stater. (Ogawa)
- We have been very conservative because of the experience of unplanned outages in 2019, which affected many households. (James)

  →Please share the latest situation so that the JICA expert team will be able to provide advice in a timely manner. (Ogawa)

(End)

September 9, 2021
JICA Expert team

Agenda for Counterpart Meeting (Kiribati)

1. Opening Remarks by JICA Expert Mr. Ogawa Tadayuki

2. Capacity Assessment in 2020-2021

3. About project extension

4. Project schedule and contents 2021-2023

5. Other
   - JCC meeting schedule
   - Overhaul schedule
   - Request for upcoming training content
   - #3Gen Temperature sensor failure

6. Closing remarks by Mr.James Young, Chief Executive Officer, PUB

Attachments:
- Capacity Assessment in 2020-2021
- Project schedule

August, 2021
JICA Expert Team

The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries
FY 2020 Training Evaluation
(KIRIBATI)

1. Executive Summary

In order to achieve the objectives of the Project for Introduction of Hybrid Power Generation System in Pacific Island Countries, two main outputs "1. Enhancement of an appropriate and economical system for O&M of Diesel Generators (DG's)," and "2. Establishment of a methodology for appropriate planning and O&M of Renewable Energy (RE)" are required.

Since the JICA expert team could not conduct the necessary activities for these two outputs on site due to the Covid-19 pandemic, 12 online training sessions (6 for output 1 and 6 for output 2), 2 meetings to facilitate manual revision and other technical support through email correspondence was provided.

Following the training on DG O&M and RE integration and PV facility O&M provided on site in 2019, the following online training was provided from June 2020 to June 2021.

2. Training Contents

2.1 Enhancement of appropriate and economical system for O&M of Diesel Generators (DG's)

The first 2 online training sessions were a review of the lectures previously provided on site by the JICA expert team. From the third training session, new topics on the maintenance of DG's and auxiliary devices such as fuel storage tanks, turbocharger, heat exchangers were covered.

For overhaul works, videos on the maintenance of generators, circuit breakers, cylinder heads, pistons, main bearing, fuel injection valve, etc. were shown.

For operation of the power plant, lectures on operation analysis, planning the addition of DG's according to the power reserve, specific fuel consumption, improvement plan, preparation for periodic inspection, and blackout restoration procedures were conducted.

Also, the expert team assigned the main counterparts' homework such as monthly measurement of SFC, maximum explosion pressure (Pmax), vibration, preparation of OH schedule, and revision of the maintenance manual according to PUB standards.

As a result of the June 2020～June 2021 training, it appears that the core trainers Mr. Tebwatia, Takau and Mr. Tebakabu Tion were able to achieve about 74.5% of the training objectives based on the summary tests conducted in June 2021, the evaluation of the generation manager and also findings from the expert team members.

The team of experts advises to PUB DG counterparts to participate actively in the revision of the DG's O&M manual in order to increase the knowledge and skill which will result in an efficient operation and maintenance of the entire power plant.

Training No./ Date		DG' s O&M On-line Training contents
1	6/18/20	1. Basic knowledge of DG (each utility system) 2. Daily inspection of DG's, Pmax measurement, exhaust gas temperature verification and FO rack adjustment. 3. Description of electrical drawings (Single line, three lines, sequence diagram). 4. Fuel consumption calculation exercise.
2	7/29/20	1. Use of measuring instruments for mechanic side (Vernier calipers, micrometer, dial gauge). 2. Use of measuring instruments for electrical side (RTD, TC, pressure gauge) 3. Power plant operation. 4. Power plant improvement progress. 5. Revision of DG's O&M manual.
3	9/23/20	1. Safety 2. Basic knowledge of DG's. 3. DG maintenance. DK26 Daihatsu engine Cylinder head, starting valve maintenance video. 4. Periodic mechanical inspection. 5. Power plant improvement progress. 6. Fuel tank inspection. 7. Specific fuel consumption measurement.
4	10/21/20	1. Revision of the O&M manual 2. DG maintenance. DK26 Daihatsu engine. Fuel oil injection nozzle, pump, Piston and connecting rod, Main bearing maintenance video. 3. Turbocharger maintenance video. 4. Periodic mechanical inspection. 5. Power plant improvement progress.
5	1/27/21	1. Daily inspection. 2. Generator inspection. 3. Preparation of a Remote Island Power Plant Periodic Inspection Plant. 4. Power plant improvement progress. 5. Specific fuel consumption measurement.
6	5/26/21	1. Circuit breaker inspection. 2. Nondestructive Testing (Penetrant Testing, Magnetic Particle Testing). 3. Blackout restoration procedure. 4. Heat exchanger. 5. Power plant improvement progress. 6. Specific fuel consumption measurement.
7	7/16/21	1st DG O&M Revision Training
8		2nd DG O&M Revision Training

2.2 Establishment of the methodology for appropriate planning and O&M of Renewable Energy (RE)

As well as the training for the DG's O&M, on-line training was given in replacement of hands-on training in site. Following the review of past lectures, the contents of the training were as follow:

- RE integration

  Review of past lectures, explanation of the effort in Okinawa to disseminate RE, Grid interconnection and operation (grid code, flow of grid interconnection, output control, etc.), output and frequency fluctuation mitigation control (ΔP & Δf control)

- RE (PV's facilities) Integration and Operation and maintenance

  Regarding to operation, training focused to verify the actual operating status of PV facilities, such as overview and summary of measurement method of performance ratio, confirmation and evaluation of the current situation, PV power generation cost were done.

And for maintenance topics, lectures of configuration of PV systems, patrol inspection, daily and periodic inspections, update of inspection check sheet, future maintenance system, schedule and budget were done.

Other main component of the RE training was focused in basic knowledge for formulation explanation and updating of the Hybrid power generation integration, O&M manual.

As a result of the training, it appears that the core trainers for RE integration Mr. Bauro, Ms. Rui were able to achieve about 77% of the training objectives. For Mr. Thomas of MISE, the JICA expert team could not evaluate the achievement of the training objectives due he has not submitted the summary tests conducted in June 2021.

For RE O&M only Ms. Rui achieved the objective of the training with about 76.3%, Mr. Beria and Mr. Lokea of MISE never participate in the 5 trainings held, so the JICA expert team could not evaluate their achievement of the training.

PV facilities are subject to the performance ratio indicator, so JICA expert team request the sharing of performance ratio measurements of PV facilities to monitor and give advises as is necessary.

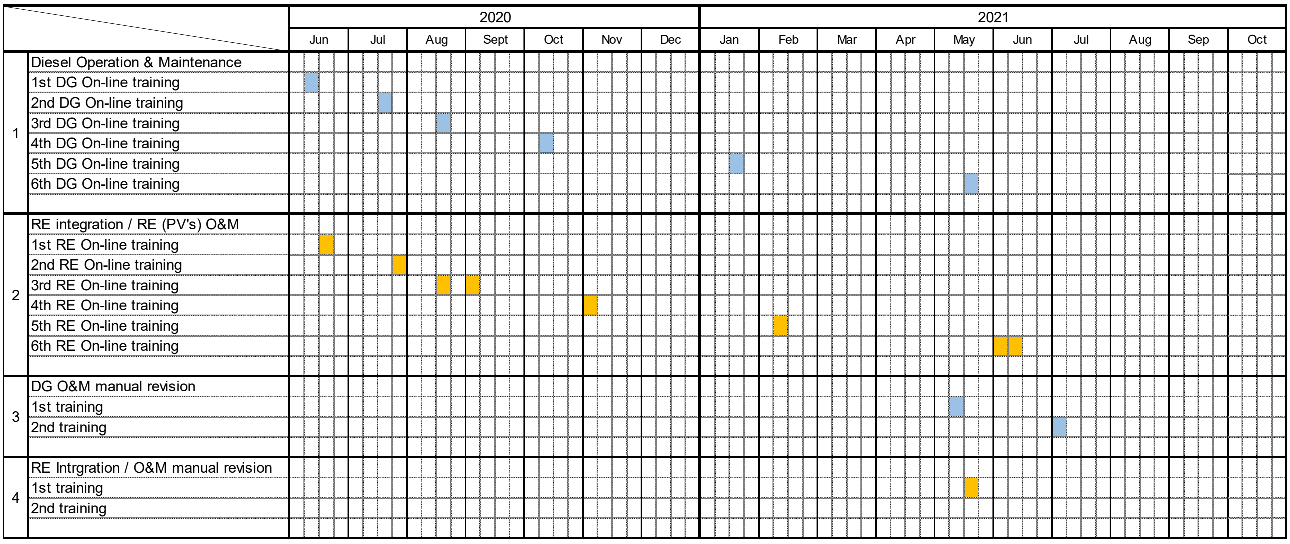
Also, the expert's team advises to RE counterparts to participate actively in the revision of the RE integration, O&M manual in order to increase the knowledge and skill which will result in an efficient operation and maintenance of all facilities in Kiribati.

Training No. / Date		Training contents
1	7/1/20	1. Basic knowledge of Hybrid power generation system (HPGS)technology 2. Explanation of performance ratio 3. Basic knowledge for formulation, explanation and updating of the hybrid power generation planification manual 4. Q&A regarding PV maintenance
2	8/6/20	1. Basics of formulating and updating manual 1 ・ Explanation of facility system configuration, O&M ・ Patrol inspection, daily inspection, and periodic inspection ・ Inspection check sheet formulation and recording (method, frequency, etc.) 2. Basic knowledge for formulating and updating the hybrid power generation planning manual ・ Frequency fluctuation (system constant, algebraic method) 3. Performance ratio. ・ Overview and summary of measurement method ・ Confirmation, evaluation, and verification of the current situation 4. O&M manual revision. Requested revision of Chapter 1
3	9/3/20	1. Basic knowledge for formulating and updating the hybrid power generation planning manual ・ Review questions 2. Basics of formulating and updating RE O&M manual ・ Review questions 3. PV facility inspection ・ Power generation cost exercise 4. Performance ratio.
4	11/11/20	1. RE O&M manual revision (Chapter 1) 2. Performance ratio 3. RE grid interconnection and operation (system stabilization method) ・ Output fluctuation mitigation control (ΔP control)

		・ Frequency fluctuation mitigation control (ΔF control) 4. Example of efforts in Okinawa to disseminate RE ・ Yonaguni Hybrid System 5. Explanation of Plan of Operation (PO) 6. Future maintenance system and budget
5	2/18/21	1. Performance ratio ・ How to acquire solar radiation data (using NASA site) 2. Discussion on manual revision 3. Grid interconnection and operation of RE ・ Grid code (interconnection requirement) ・ Flow of grid interconnection ・ Operation (output control) *Case study 4. Future Maintenance System and Budget ・ Maintenance system ・ Maintenance budget ・ Assistance from other donors
6	6/11/21	1. Example of efforts in Okinawa to disseminate RE ・ Abu mega solar facility ・ Ogimi wind power facility (Proof research facility) ・ Control of power fluctuation (ΔP &Δ f control) 2. Future maintenance system and budget 3. Future maintenance schedule plan
7	5/24/21	1st DG O&M Revision Training
8	7/27/21	2nd DG O&M Revision Training

3. Training schedule

The Introduction of Hybrid Power Generation System in Pacific Island Countries / Kiribati / On-Line Remote Training Schedule (2020～2021)



		2020							2021									
		Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
1	Diesel Operation & Maintenance																	
	1st DG On-line training	🟦																
	2nd DG On-line training		🟦															
	3rd DG On-line training			🟦														
	4th DG On-line training					🟦												
	5th DG On-line training								🟦									
	6th DG On-line training												🟦					
2	RE integration / RE (PV's) O&M																	
	1st RE On-line training	🟧																
	2nd RE On-line training		🟧															
	3rd RE On-line training			🟧	🟧													
	4th RE On-line training						🟧											
	5th RE On-line training									🟧								
	6th RE On-line training													🟧🟧				
3	DG O&M manual revision																	
	1st training												🟦					
	2nd training														🟦			
4	RE Intrgration / O&M manual revision																	
	1st training												🟧					
	2nd training																	

3. Core Trainers

No.	Core Trainer Name	Position	Comments
1) Operation and Maintenance of Diesel Engine Generators			
1	Teebwatia Takau	Generation Engineer	
2	Tebakabu Tion	Lead Hand Mechanical	
2) Plan for introduction of hybrid power generation systems			
1	Bauro Mikaere	Instrumentation & PV supervisor	

2	Mary Rui	Solar engineer	
3	Thomas Taoaba	RE Planner	MISE
3) Operation and Maintenance of Renewable Energy generation system			
1	Mary Rui	Solar engineer	
2	Beria Oromita	Energy technician	MISE
3	Lokea Itienang	Energy technician	MISE

4. FY 2020 TEC & MTET counterparts training evaluation

Training contents	
1. DG	・Review of 2020's training ・Handling of mechanical and electrical measuring equipment ・Inspection, troubleshooting of each part of diesel generator ・Update of power plant maintenance manual. *CP have the capacity to perform disassembly inspection, verification of spare parts condition and measurement of operation parameters (Pmax, fuel consumption rate, etc.)
2. RE integration	・Review of 2020‘s training ・Renewable energy grid interconnection and operation method. ・Examples of initiatives in Okinawa related to the spreading of renewable energy. ・Use of storage battery in power system. ・PV system design. ・Data measurement related to performance ratio calculation. ・Update of hybrid power generation planning manual. *CP will acquire more detailed knowledge regarding to Hybrid power generation.
3. RE O&M	・Review of 2020‘s training ・Operation and maintenance of PV system. ・Inspection check sheet revision and use. ・Practice in the use of measurement equipment (string tracer, cell line checker, insulation resistance meter) ・Revision of PV system O&M manual. *CP will have the capacity to perform maintenance planning, inspection, and prepare, manage, and analyze work reports.

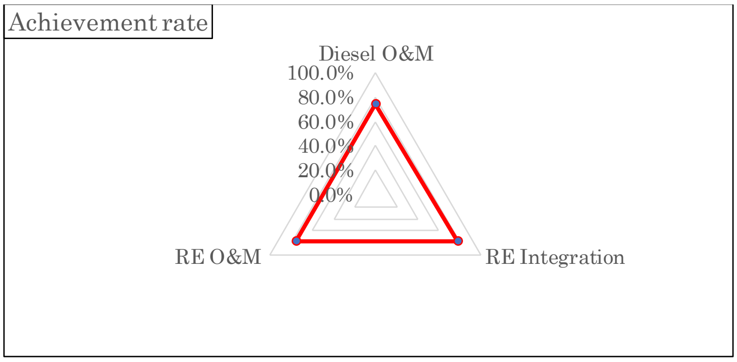
Results

The training evaluation of the core counterparts was carried out by taken a consideration the result of the summary test, evaluation of the manager, attendance ratio and also, findings from the expert team members. The result for each task is shown in below tables.

Summary

Diesel O&M

Name	Test points	Achievement
Tebwatia Takau	9.30	76.0%
Tebakabu Tion	7.30	73.0%
Average	8.30	74.5%

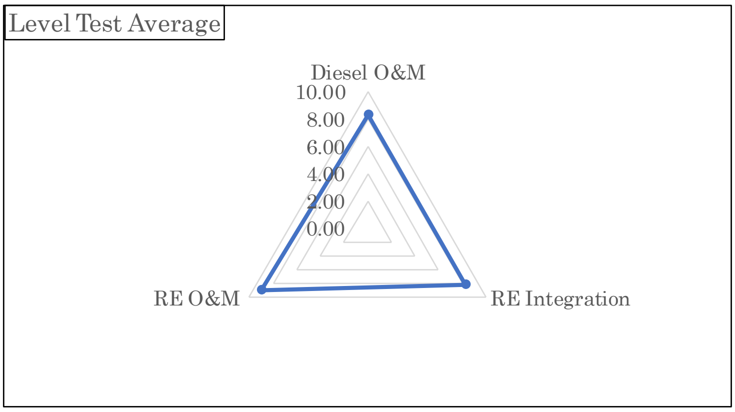


RE Integration

Name	Test points	Achivement
Mary Rui (PUB)	9.0	76.3%
Bauro Mikaere (PUB)	7.5	77.7%
Thomas Taoaba (MISE)	-	-
Average	8.3	77.0%

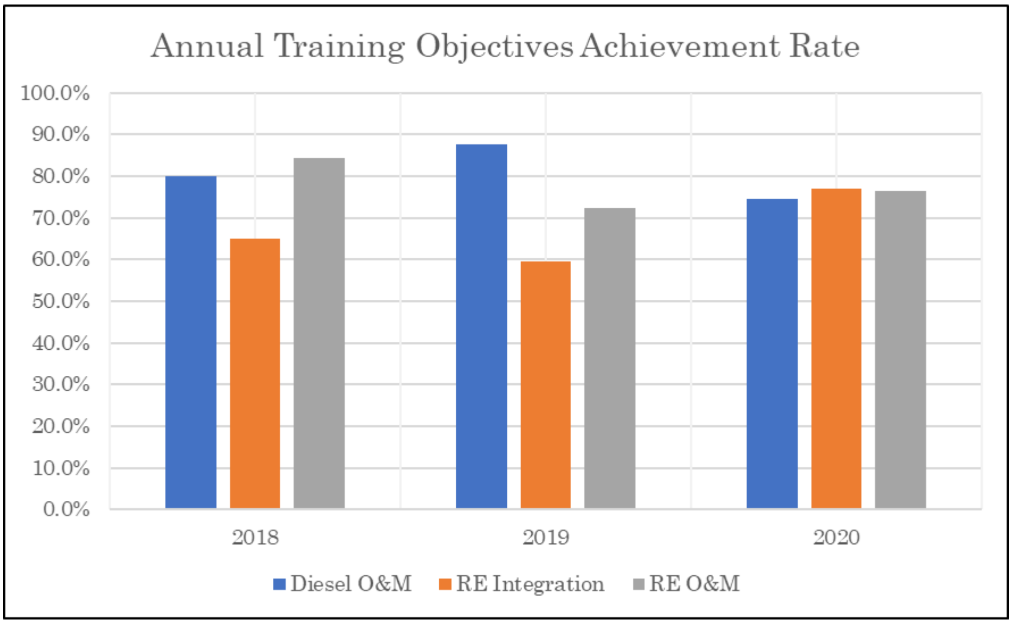
RE O&M

Name	Test points	Achivement
Mary Rui (PUB)	9	76.3%
Beria Oromita (MISE)	-	-
Lokea Itienang (MISE)	-	-
Average	9.00	76.3%



TEC average	Test points	Achivement
Diesel O&M	8.30	74.5%
RE Integration	8.3	77.0%
RE O&M	9.00	76.3%

PUB average	2018	2019	2020
Diesel O&M	80.0%	87.7%	74.5%
RE Integration	65.0%	59.5%	77.0%
RE O&M	84.4%	72.5%	76.3%



The project for introduction of Hybrid Power Generation System in Pacific Countries / Training Program

DEG Training Curriculum （DEGトレーニングのカリキュラム）				Phase-1	Phase-3																																							
				2017 / 2018	2020												2021												2022												2023					
Subject			Contents		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
1. Basic Knowledge of DEG power generation		1	・Understanding of Diesel Generators type, structure, operation principle and characteristic.	🟩																															Extension of the project											
		2	・Diesel engine performance curve, efficiency during operation, heat balance diagram.	🟩																																										
		3	・Understanding of mechanical devices on Diesel power generation. Purpose, type, characteristics of each device. 1) Cylinder head, valves, rocker arm, pushing rod, springs 2) Piston, rings, connecting rod, pin 3) Cylinder liner 4) Crankshaft, camshaft, main bearings, fly wheel 5) Turbocharger 6) Governor 7) Intercooler (air, oil) 8) Pumps, radiators and others	🟩																																										
		4	・Understanding of electrical components on Diesel power generation. Purpose, type, characteristics etc. of each electrical panels, etc. 1) Generator & Exciter 2) Transformer 3) Circuit breaker 4) Control panel / alarms / CT, PT's 5) Power center, AVR, AFC, Syncronous board 6) Electrical drawings, single line diagram 7) Device number / protection relays 8) Others electrical components	🟩																																										
		5	・Understanding of each utilities in diesel power plants 1) Fuel System 2) Lubricant oil system 3) Cooling water 4) Air system 5) Exhaust gas	🟩						🟨																																				
2. Operation of DEG's		1	・Operation and control method of diesel power generation facilities (governor free, automatic control devices, etc.)	🟩								🟨		🟨																																
		2	・Operating Procedure of Diesel Power Plant 1) Operation precautions 2) Patrol inspection	🟩																																										
		3	・Supply and Demand Management 1) Efficient operation 2) System frequency adjustment 3) Voltage management 4) Power reserve	🟩																																										
		4	・Diesel generator Economical load distribution operation (EDC technology (basic knowledge・application))	🟩						🟨																																				
		5	・Power generation data sorting, analysis（Power generation amount, output, fuel consumption amount and rate, operation parameters of diesel engine operation）		🟩							🟨		🟨							🟩		🟩		🟩																					
		6	・Diesel generation operation data record sheet									🟨		🟨																																
		7	・Financial analysis of power plant operation	🟩																																										
		8	・Trouble Shooting		🟩									🟨	🟨	🟨					🟩		🟩		🟩																					
3.Maintenance of DEG's		1	・Safety work training	🟩																																									
		2	・Periodical inspection (Mechanical) Types of inspections, contents, check sheet	🟩						🟨																																				
		3	・Periodical inspection (Electrical) Types of inspections, contents, check sheet	🟩						🟨																																				
		4	・Overhaul of Diesel Generator and Auxiliary Equipment 1) Purpose & process 2) Washing & Inspection of parts (Dye penetrant test) 3) Engine maintenance standards 4) Assembly 5) Centering adjustment 6) Start-up and commissioning	🟩						🟨	🟨	🟨	🟨	🟨							🟨																									
		5	・Drawing up of maintenance manual	🟩						🟨	🟨	🟨	🟨	🟨																																
		6	・Verification, modification, addition of notes in the maintenance manual(electrical / mechanical)							🟨	🟨	🟨	🟨	🟨																																
		7	・Maintenance plan（spare parts verification, management, consumables, schedule, etc.）	🟩																																										
		8	・Handling of mechanical measurement equipment（OJT） 1) Calipers, micrometers, dial gauge 2) Noise meter 3) Vibrometer 4) Torque wrench 5) Pmax device & Others	🟩	🟩				🟨		🟨																																			
		9	・Handling of electrical measurement equipment（OJT） 1) Electroscope 2) Multi-meter 3) Tester 4) Digital Pressure Calibrator 5) Instrumentation signal measurement / generator 6) Ohm meter & Others	🟩							🟨																																			
	On site	10	・Disassembly & Inspection of each section of diesel generators, troubleshooting.（mechanical and electrical OJT ）						🟨												🟨		🟨		🟨								🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
	On site	11	・Maintenance works report writing, keeping and supervision ・Planning of maintenance works ・Maintenance works report writing ・Improvements in power plant facilities						🟨	🟨	🟨	🟨	🟨	🟨							🟨		🟨		🟨								🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
4. Additional Training Topics	On line / on site	12	・Upgrading manual of DG O&M																														🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
		13	・Request from PUB																														🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
		14	・Improvement in the existing DG's and the power plant facilities.																														🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
		15	・Review of past lectures																														🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
		16	・																																											
		17	・																																											

September 3rd, 2021
JICA Expert Team

The project for introduction of Hybrid Power Generation System in Pacific Countries / Training Program

RE Training Program					Implemented	2nd Phase																																									
						2020												2021												2022												2023年					
Subject			Contents			1月	2月	3月	4月	5月	6月	7月	8月	9月	10月	11月	12月	1月	2月	3月	4月	5月	6月	7月	8月	9月	10月	11月	12月	1月	2月	3月	4月	5月	6月	7月	8月	9月	10月	11月	12月	1月	2月	3月	4月	5月	6月
																																				Extension of the project											
RE O&M	**On site**	1. Formulation/Explanation / Update/of manual	(1)	Operation & Maintenance of System	🟨						🟧	🟧	🟧			🟧			🟧				🟧										🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧
			(2)	patrol check and periodic inspection	🟨						🟧	🟧	🟧			🟧			🟧				🟧										🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧
			(3)	Daily check	🟨						🟧	🟧	🟧			🟧			🟧				🟧										🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧
			(4)	Periodic Inspection	🟨						🟧	🟧	🟧			🟧			🟧				🟧										🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧
			(5)	Development of the check sheet	🟨																																										
	On Line		(6)	Updating of maintenance manual according to the system condition of each country .(Joint work)																													🟧	🟧	🟧												
				Verification of operational condition of the updated maintenabce manual, comments.(Follow up from Project team)																													🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧
				Periodic monitoring of the operational condition of the manual.(Joint work)																													🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧
	On line/ On site	2. Operation practice of the measuring equipment	(1)	String tracer	🟨						🟧	🟧	🟧						🟧																												
			(2)	Cell line checker	🟨						🟧	🟧	🟧																																		
			(3)	Insulation resistance tester	🟨						🟧	🟧	🟧																																		
			(4)	Infrared camera																													🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧						
	On site	3. Trouble shooting	(1)	Confirmation method of disconnection between the module	🟨																																										
			(2)	Influence of the shadow	🟨																																										
			(3)	Introduction for trouble example ①(Tuval)	🟨																																										
	On Line	4. Future O&M Work plan (draw it up with a budget)	(1)	Confirmation of existing plan												🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧																				
				1) Actual organization chart												🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧																				
				2) Actual budget for annual maintenance												🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧																				
				3) Actual content of works												🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧																				
			(2)	Future planning																								🟧	🟧	🟧	🟧	🟧															
				1) Future donor's support contents	🟨											🟧	🟧	🟧																											
				2) Future strenghthen of the organization	🟨														🟧	🟧	🟧	🟧	🟧																						
				3) Future budget for maintenance																						🟧																				
				4) Planning of work																								🟧	🟧	🟧	🟧	🟧															
			(3)	Finalization of the future planning with the counter part																										🟧	🟧	🟧															
RE Integration	**On line/ On site**	1. Formulation/Explanation/ Update/ of manual of Hybrid generation plan	(1)	Variability of RE(Solar & Wind)generation system	🟨						🟧	🟧	🟧																																		
				1)Power system basis and power quality	🟨						🟧	🟧	🟧																																		
	On line/ On site		(2)	Impact on the grid operation by integrating RE generation systems	🟨						🟧	🟧	🟧																																		
				1)Frequency fluctuation	🟨						🟧	🟧	🟧																																		
				2)Voltage Flctuation	🟨						🟧	🟧	🟧																																		
				3)Excesss Energy	🟨						🟧	🟧	🟧																																		
	On line/ On site		(3)	Countermeasures for the mitigation of RE impact on the grid	🟨																																										
				1)Grid Code	🟨														🟧																												
				2)Frequency fluctuation(Algenraic method,other simulation software)	🟨								🟧																																		
				3)Voltage Fluctuation	🟨																																										
				4)Excess of energy (HOMER software)	🟨																																										
	On Line		(4)	Planning methodology for the Roadmap of RE integration																																											
				1)Planning Methodology overview																																											
				2)Inputs and assumption																																											
				3)Consideration according to the system capacity.(reliability, service quality)																																											
				4)Roadmap for small-grid to integrate RE generation system																																											
				5)RE integration road map for large scale grid.																																											
	On Line		(5)	(1)Update of the manual according to the condition of the country, working with the counterpart,									🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧															
				(2)Follow up of the updated manual, implementation condition, by the project team																													🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧
				(3)Monitaring in the use of the manual toghether with the CP																													🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧
	On site	2. System Simulation	(1)	Overview	🟨																																										
			(2)	Model case① (Power system simulation in Hateruma island)																																											
	On Line	3. Grid Connection of RE And Operation	(1)	Grid code (Interconnection requirement)	🟨														🟧																												
			(2)	Grid interconnection procedures	🟨														🟧																												
			(3)	Introduction for Operation and Output control	🟨											🟧			🟧																												
	On site	4. Examples of Improvement in Okinawa for dissemination of RE	(1)	Miyako island Mega Solar Demonstration Reseach	🟨																																										
			(2)	Overview of the MG set Demonstration Research in Hateruma island	🟨														🟧																												
	On Line		(3)	Abu Mega Solar Demonstration Reseach	🟨																		🟧																								
			(4)	Ogimi Wind Power Demonstration Reseach	🟨																		🟧																								
			(5)	Case study ①(Hybrid system in Yonaguni island)	🟨											🟧																															
	On Line	5. Use of Battery Storage in Power systems	(1)	Overview																						🟧																					
			(2)	Overview of Batterie's output and capacity																						🟧																					
	On site	6. PV system plan and design	(1)	Study for number of panels in series and parallel (10kW PV system)	🟨																																										
			(2)	Design of frame and array	🟨																																										
			(3)	Estimation of yearly PV power generation	🟨																																										
			(4)	Study of System Composition	🟨																																										
	On line/ On site	7. Performance ratio	(1)	Overview	🟨						🟧	🟧	🟧			🟧			🟧				🟧			🟧																					
			(2)	Inspection and Evaluation of Monitaring results	🟨						🟧	🟧	🟧			🟧			🟧				🟧			🟧																					
	On line/ On site	8. HOMER	(1)	Overview	🟨																					🟧																					
			(2)	Practice ① (Input of demand data)	🟨																					🟧																					
			(3)	Practice ② (Analysis of long-term fluctuation)	🟨																																										
			(4)	Practice ③ (Calculation of the facilities capacity for PV, Wind turbine, Battery storage)																																											
			(5)	Data gathering and Modeling																																											
Additional Training Topics	**On line/ On site**	**9.System Stabilization Study**	(1)	**Samoa Grid stability study**																						🟧																					
			(2)	**Tuvalu System stabilization measure study**																												🟧															
			(3)	**Examples of 100% renewable energy system**																																											
	On line/ On site	**Overview of Grid code**	(1)	**Discussion in the need for support for grid code * Pompeii, Marshall, and Tuvalu have draft codes. "**																						🟧																					
			(2)	**Examination of support contents (country / state where support was requested)**																							🟧	🟧	🟧																		
			(3)	**Implementation support**																										🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧	🟧						
	Online/ On site	**Follow up in the revision of the Energy Master Plan**	(1)	**Master plan**																							🟧	🟧	🟧																		
			(2)	**Understanding the main points of the master plan**																										🟧	🟧	🟧															
			(3)	**Explanation of the main points of the master plan**																													🟧	🟧	🟧	🟧											
			(4)	**HOMER study review and update**																															🟧	🟧	🟧	🟧	🟧	🟧	🟧						

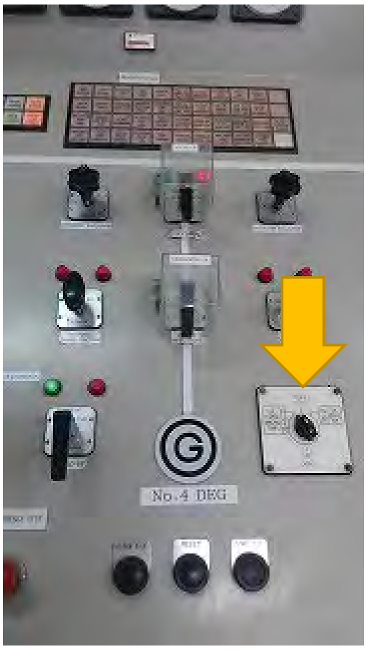
September 8th, 2021

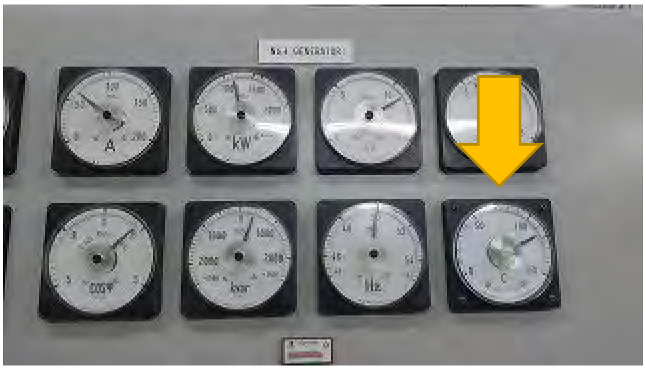
JICA Expert Team

Bikenibeu PS DG#3 Stator temperature detector malfunction

1.Actual condition:

Since the last training on site, we confirmed that the temperature of the monitoring control panel (control room) could not be monitored.





2. Possible causes of the issue

1. Resistance temperature detector (RTD)(sensor)

   But it is unlikely that there will be a problem with the three phases of the resistance temperature detector at the same time.

2. Transducer

   Aging of the transducer can show no proper function. PUB has similar issue in the meter board in the engine room. Some of the meters not show the real value due to malfunction of this electrical device.

3. Meter in the monitoring control panel. (above picture)

3.How to know which device is fault. (When the engine is stop)

3.1 For the RTD's, measure the resistance as we taught during on-site training.

a. Remove the A1B1 to A3B3 cables (RTD side) from the terminal block in the generator terminal box. (see picture-1and 2 / drwg 3)

b. Inspect the resistance of each RTD one by one. If the measurement is 0 means that the RTD is fault. According to the value of resistance (Ω) check the temperature with the PT100 conversion table and compare with the temperature of the stator measured externally with any thermometer.

3.2 For the transducer

Check if when you remove the cables from the terminal block in the generator terminal box, in the control room sound the alarm and the red lamp of heavy fault stator temperature turns on. If yes, means that the transducer is good. (Please report to the operator this activity)

Other way is use the calibrator provided by JICA and send a signal of XX℃ from the terminal box and check if this value is shown in the meter of the monitoring control panel. If there is a big difference with the signal value means that the transducer is fault.

3.2 For the meter in the monitoring control panel.

Replace for another that is working (eg. From the meter board in engine room) and check sending a signal by using the calibrator.

4. How to resolve this issue

4.1 In case of RTD's fault

According to the electrical drawings there are a spare for each phase RTD. Check inside of the terminal box, remove the actual connection and connect the spare. Check in the control room the indication of the meters (℃).

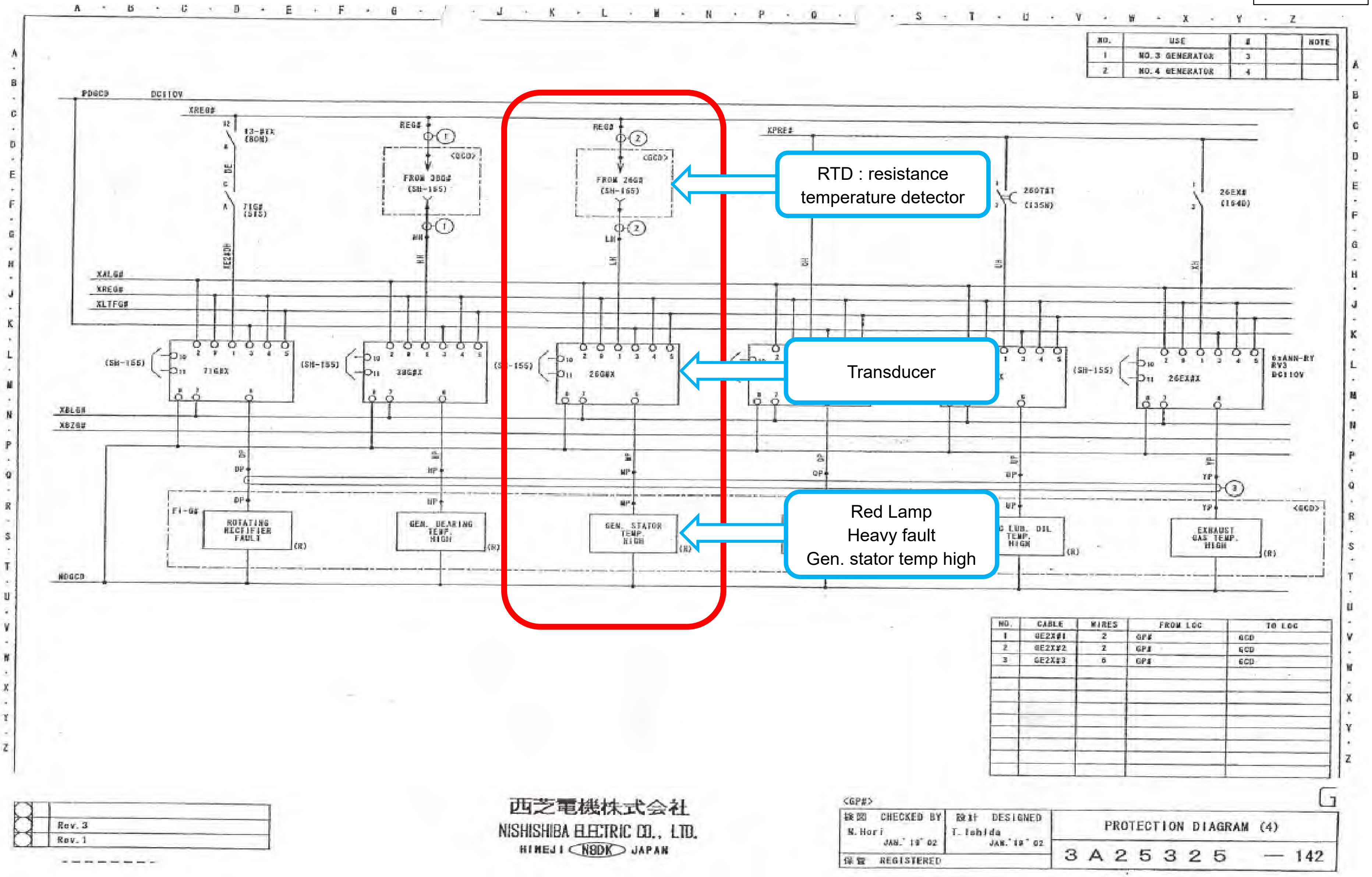
4.2 In case of transducer fault

Check the part number of the transducer and arrange the necessary amount and some spares.

4.3 In the case of meter fault.

Same as the transducer.

Drwg-1



RTD : resistance temperature detector

Transducer

Red Lamp
Heavy fault
Gen. stator temp high

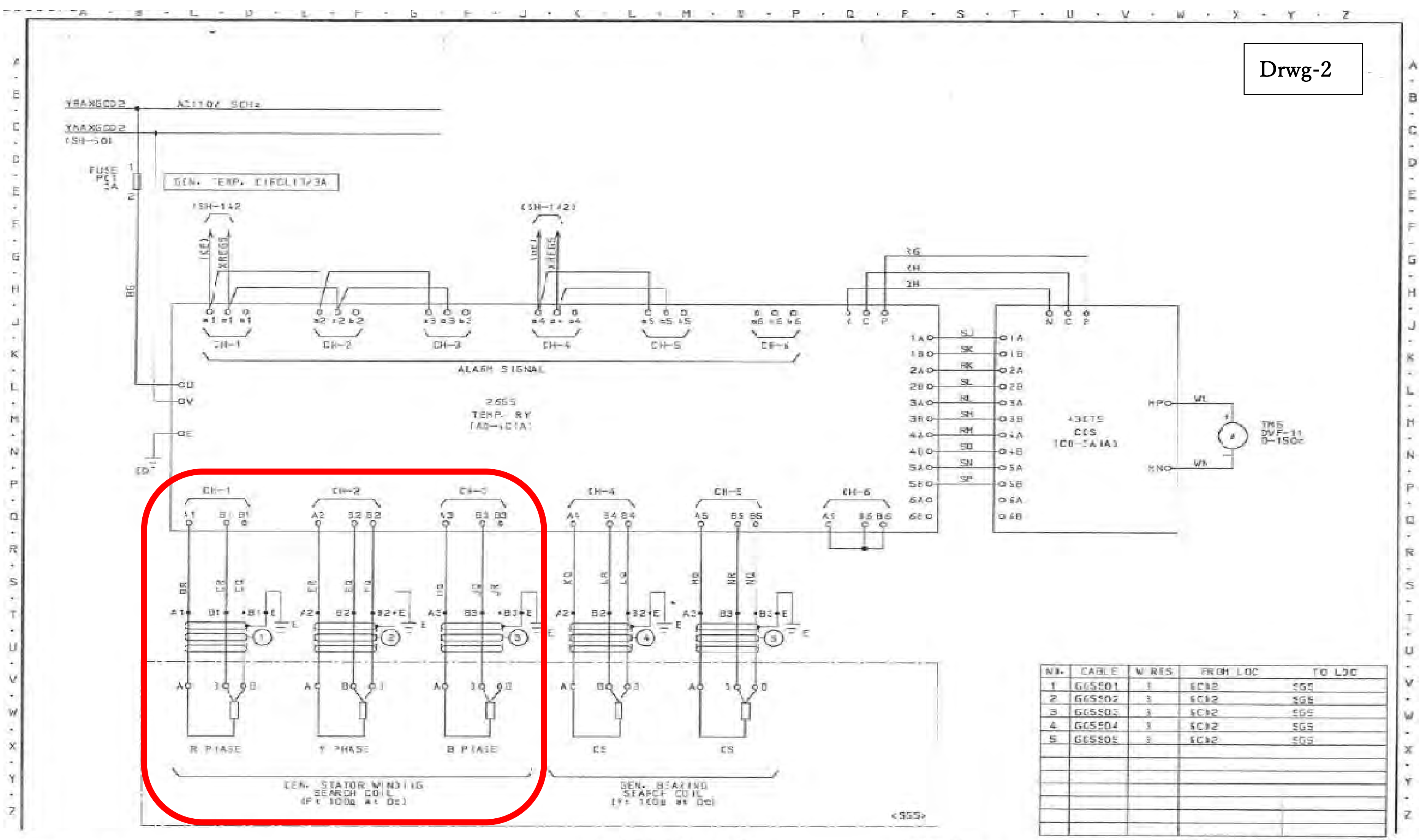
NO.	USE	#		NOTE
1	NO. 3 GENERATOR	3		
2	NO. 4 GENERATOR	4		

NO.	CABLE	WIRES	FROM LOC	TO LOC
1	GE2X#1	2	GP#	GCD
2	GE2X#2	2	GP#	GCD
3	GE2X#3	6	GP#	GCD

西芝電機株式会社
NISHISHIBA ELECTRIC CO., LTD.
HIMEJI NSDK JAPAN

<GP#>
検図 CHECKED BY N. Hori JAN.'19'02
設計 DESIGNED T. Ishida JAN.'19'02
保管 REGISTERED
PROTECTION DIAGRAM (4)
3 A 2 5 3 2 5 — 142

Drwg-2



NO.	CABLE	WIRES	FROM LOC	TO LOC
1	GCS501	3	GCD2	SGS
2	GCS502	3	GCD2	SGS
3	GCS503	3	GCD2	SGS
4	GCS504	3	GCD2	SGS
5	GCS505	3	GCD2	SGS

Rev. 4
Rev. 11
Rev. 5

西芝電機株式会社
NISHISHIBA ELECTRIC CO., LTD.
HIMEJI NSDK JAPAN

<GCD2>
GEN. WINDING & BEARING TEMP. G

検図 CHECKED BY
J.Ito
FEB 4 '05

設計 DESIGNED BY
Feb. 1, '05

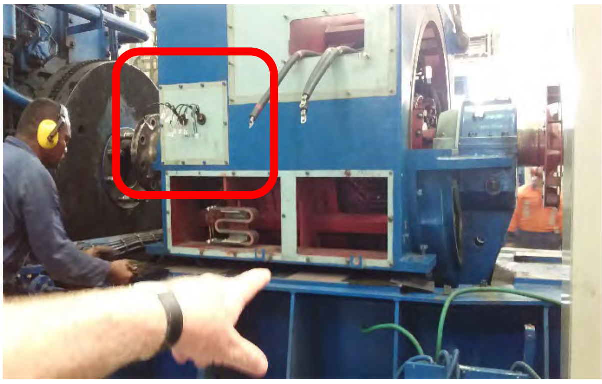
登録 REGISTERED

MEASURING CIRCUIT
FOR GENERATOR TEMP. (2)

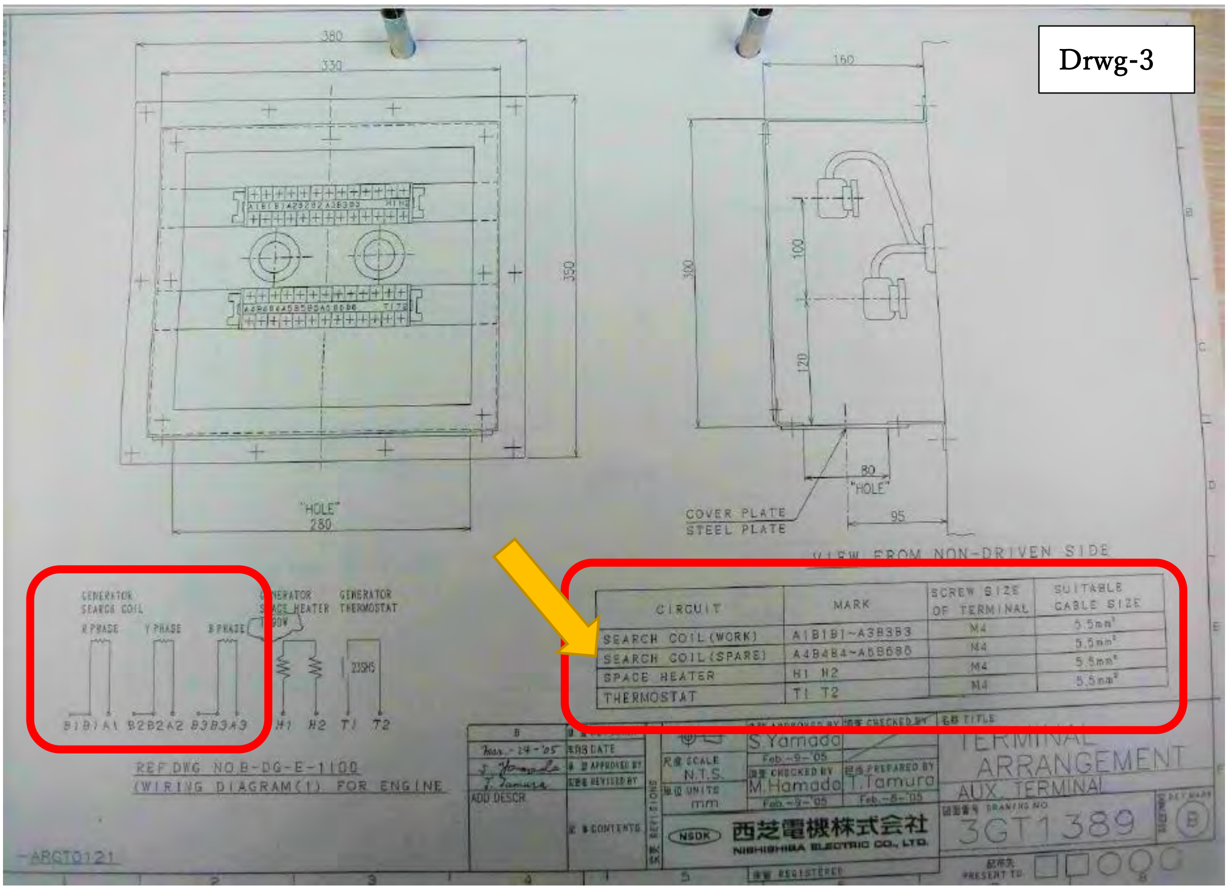
3Y20073 -165

Pic-1

Pic-2



Drwg-3



CIRCUIT	MARK	SCREW SIZE OF TERMINAL	SUITABLE CABLE SIZE
SEARCH COIL (WORK)	A1B1B1~A3B3B3	M4	5.5mm²
SEARCH COIL (SPARE)	A4B4B4~A6B6B6	M4	5.5mm²
SPACE HEATER	H1 H2	M4	5.5mm²
THERMOSTAT	T1 T2	M4	5.5mm²

6.2.6　2nd Seminar Report

Meeting Memo of 2nd Seminar in Kiribati
～About the results of the five-year project～
(On-line)

Date, Time	June 20, 2023 13:00-15:40 (Kiribati time), 10:00-12:40 (Japan Time)
Attendance	Ministry of Infrastructure and Sustainable Energy (MISE): Mr. Jimmy Nuake, Director Mr. Rimeta Tabwere, Urban Energy Planner Mr. Teweiariki Tebuka, Rural Energy Planner Mr. Thompson Burentarawa, Energy Supervisor Public Utilities Board (PUB): Mr. James Young, Chief Executive Officer Ms. Mary Rui, PV & Instrumentation engineer, Mr. Teebwatia Taakau, Power generation engineer,
	JICA Headquarters: Mr. Naohiro Ojima Mr. Tadayuki Ogawa, Chief Advisor JICA Kiribati Field Office: Mr. Nobuaki Matsui, Project Formulation Advisor
	JICA Expert Team: Mr. Luis Kakefuku, Team Leader Mr. Masanori Shimabuku, Team Subleader Mr. Hideyasu Hokama Mr. Hirokazu Nakamura Mr. Takahisa Watanabe MS. Ayako Yoshida
Documents	① Project Summary by Mr. Ogawa ② Capacity Assessment Report by Mr. Luis ③ Kiribati National Energy Road map by Mr. Rimeta ④ 「Experience, knowledge, and expertise in maintenance and management of diesel power plants gained through the project」 by Mr. Teebwatia ⑤ Maintenance of a solar PV system」 by Ms. Mary Rui ⑥ Current status of PUB by Mr. James Young

Content

1. Opening Remarks by: Director, MISE, Mr. Jimmy Nuake

Mr. Jimmy Nuake expressed his appreciation towards to JICA, JICA Expert team and

PUB for the opportunity to be part of this seminar. He explained responsibilities of the Energy department at MISE and the project aims followed by introducing today's seminar's program and expected to hear from Kiribati team the result, lesson learned and improvement came through the project.

2. Project Summary by JICA Chief Advisor, Mr. Tadayuki Ogawa

Mr. Ogawa thanked today's participation and expressed his biggest appreciation for long term contribution to the project towards to MISE and PUB. He summarized the activities of the project from the JICA's viewpoint which highlighted the challenges, the strategy, the concept and the ultimate goal of the project. Especially, he expected that the project outputs such as manuals would be fully utilized in the long term in the future. In addition, he highlighted achievement done throughout the project period and mentioned that the biggest achievement was the overhaul works had been done by PUB without external supervisors. He also mentioned the concept of the region wide training based in Fiji and fully supported this concept to continuously keep on the training within the region. New concept which is called "Green Tower Island Programme" was also introduced. Under this new concept, JICA is going to launce the next phase of the technical cooperation project by the end of this year or early next year. (Please refer to the attached document for more detail.)

3. Capacity Assessment report（JICA Expert Team leader Mr. Luis Kakefuku）

Mr. Luis explained the Capacity Assessment report for the period of July 2022 to April 2023 which included the Executive Summary, Training Contents, the training schedules, the attendance records and the result of the trainers' evaluation. More details can be found the attached documents.

Mr. James congratulated Ms. Mary, Mr. Teebwatia and the others for their efforts in the trainings, and thanked the training team through very tough period of COVID. He also commented that some of trainings are less relevant to MISE than PUB in the sense that PUB run the diesel generators and also commented about Ministry of Line and Phoenix islands which is more near Hawaii and they actually do run the diesel generators and the Grid. They were not dispatched in this programme. PUB is happy to try and transfer the knowledge to the Ministry of Line and Phoenix islands.

Mr. Ogawa responded that the project was aware of this issue of the Phoenix islands in the north part of the country. He heard that the operation in those islands may be transferred to mandate of PUB in the future but is still handled by the Ministry. Therefore, he hoped that the knowledge and skills could be transferred from PUB in the

Phoenix islands. He also offered any assistance to transfer the knowledge.

4. Keynote speech

① 「National Energy Roadmap」 by MISE, Urban Energy Planner, Mr. Rimeta Tabwere

Mr. Rimeta presented "National Energy Roadmap 2017-2025". Challenges were picked up from the roadmap which included "supply" "demand" "need for change" and "modernization" for three locations, south Tarawa, Kiritimati and the outer islands. He also showed their solutions which were "optimize and reduce current fossil fuel use", "expand the efficient use of indigenous renewable energy resources" and "introduce new technologies to the Kiribati energy sector". (More details can be also found the attached documents.)

Mr. Ogawa questioned how changed the roadmap which Mr. Rimeta explained.

Mr. James commented that the document was the still the same, but the demand increases has been well beyond what was when the plan was originally projected. However, it's probably due to be updated because things have changed.

Mr. Ogawa asked about "new technology" which Mr. Rimeta mentioned in his slide.

Mr. Rimeta explained that it was still under discussion with the Government of Korea.

② 「Experience, knowledge, and expertise in maintenance and management of diesel power plants gained through the project」 by PUB, Power generation engineer, Mr. Teebwatia Takau

Mr. Teebwaita presented what PUB learned from the project. Main points were that PUB gained the general knowledge on Diesel engines such as safety precaution, operation and purpose of several engine parts, importance of preventive maintenance and specific fuel consumption test. In addition, he mentioned the overhaul on Daihatsu engine in Okinawa which was the greatest achievement. He also mentioned that they learned troubleshooting skills which included "adjustment of exhaust gas temperatures and combustion pressure". Advices on record sheets for engine parts measurement and alternative fix to lack of spares were very helpful. They also learned maintenance tips learned through regional trainings. Suggestions to improve were to include specialized training on turbocharger, hands on trade skills such as welding, drilling and machining, and lube oil analysis. He also asked to provide support on spare part procurement on Japanese made parts. Support to provide another power station with bigger engines was also suggested. (More details can be also found the attached documents.)

Mr. James added on procurement issue which was when the part was not made from Daihatsu and wondered if the project could provide support on this issue.

Mr. Ogawa recommended to exchange the information with Tuvalu to find out the possible sources of the spare parts which are not Daihatsu made since they had also tried to find out some alternatives for those spare parts. He also agreed on to contact the project to communicate on this issue.

Mr. James also commented that PUB procured substandard parts through Chinese suppliers, but recently corrected to genuine ones which gave much longer and better longevity with the operation, so PUB will continue to do so.

Mr. Ogawa exampled that EFL also usually bid the possible suppliers but the only the genuine parts they would buy.

③ 「Maintenance of a solar PV system」 by PUB, Solar PV engineer Ms. Mary Rui

Ms. Mary presented the current activities based on what have learned from the project in detailed. She showed types of inspection for solar plant maintenance along with PUB's inspection schedule with the checklist and visual inspection & measurement record sheet. Measurement standard and measurement equipment and tools for O&M of PV plant were also presented. Measurement required for O&M of solar PV plant maintenance which included "Insulation resistance of PV system", "Insulation resistance of PV arrays", "Measurement of the short circuit current Isc of the PV array", "IR Thermal imaging", "Cell Line checker" and "String Tracer" were explained in the presentation as well. She also summarized measures against abnormal conditions. (More details can be also found the attached documents.)

Mr. Ogawa encouraged to continue sharing skills and knowledge which had been acquired throughout the project and keep instruments in good conditions. For the measurement standard of the Insulation resistance of PV system, he advised PUB to check the system voltage for the PEC system so that PUB would find out the figures would be the same standard.

Mr. Nakamura also recommended to check the profile as well instead of just judging from the figures of VOC and etc. He also reminded to choose only "magnetic field mode", not necessary to choose "electric mode" for that appliance.

④ 「Current status of PUB」 by PUB, Chief Executive Officer Mr. James Young

Unfortunately, Mr. James got a call from the Minister in the middle of explanation on the front slide and left the meeting. He showed two logos which meant that the board would create a subsidiary company to specifically focus on water supply. (His presentation is attached.)

5. Closing remarks（JICA Kiribati Field Office, Mr. Nobuaki Matsui）

Mr. Matsui thanked all participants and presentations which were done today. He mentioned that the instability of the power supply in Tarawa well maintained by huge effort from the PUB people. He unfortunate that the overhaul for the number 5 could not be done during this project period, but gladly that JICA would continue the next phase and support Kiribati through remotely. He also hoped that participants such as Mr. Teebwaita and Ms. Mary could share their knowledge and skill to other staff. In addition, he also hoped that continuous support to provide training opportunities in the next phase and possibly to dispatch volunteers to MISE or PUB in the future so that they work together with the project. He also stated that the good relationship among PUB, MISE and the project team which was good achievement and hoped that we could work together and contribute to the stabilization and development in the energy sector in the future.

(End)

THE PROJECT FOR INTRODUCTION OF HYBRID POWER GENERATION SYSTEM IN PACIFIC ISLAND COUNTRIES

2nd Seminar in Kiribati

～About the results of the five-year project～

Tuesday, June 20th 2023 / 13:00 – 15:40

Venue： Zoom meeting

【Program】

13:00 ～ 13:05　Opening Remarks　(Director, MISE, Mr. Jimmy Nuake)
13:05 ～ 14:00
①　Project Summary (JICA Chief Advisor, Mr. Tadayuki Ogawa)
②　Capacity Assessment report（JICA Expert Team leader Mr. Luis Kakefuku）

14:00 ～ 15:30　Keynote speech
①　「National Energy Roadmap」
（MISE, Urban Energy Planner, Mr. Rimeta Tabwere）

②　「Experience, knowledge, and expertise in maintenance and management of diesel power plants gained through the project」
（PUB, Power generation engineer Mr. Teebwatia Takau）

③　「Maintenance of a Solar PV system」
(PUB, Solar PV engineer Ms. Mary Rui）

④　「Current status of PUB」
(PUB, Chief Executive Officer Mr. James Young）

15:30 ～ 15:40　Closing remarks（JICA Kiribati Field Office, Mr. Nobuaki Matsui）

Participant list

No.	Organization	Position	Name
1	Ministry of Infrastructure and Sustainable Energy	Director	Mr. Jimmy Nuake
2	Ministry of Infrastructure and Sustainable Energy	Urban Energy Planner	Mr. Rimeta Tabwere
3	Ministry of Infrastructure and Sustainable Energy	Rural Energy Planner	Mr. Teweiariki Tebuka
4	Ministry of Infrastructure and Sustainable Energy	Energy Supervisor	Mr. Thompson Burentarawa
5	Public Utilities Board	Chief Executive Officer	Mr. James Young
6	Public Utilities Board	Power generation engineer	Mr. Teebwatia Taakau
7	Public Utilities Board	PV & Instrumentation engineer	Ms. Mary Rui
8	JICA Kiribati Field Office	Project Formulation Advisor	Mr. Nobuaki Matsui
9	JICA	Chief Advisor	Mr. Tadayuki Ogawa
10	JICA	JICA Expert	Mr. Luis Kakefuku
11	JICA	JICA Expert	Mr. Masanori Shimabuku
12	JICA	JICA Expert	Mr. Hirokazu Nakamura
13	JICA	JICA Expert	Mr. Hideyasu Hokama
14	JICA	JICA Expert	Mr. Takahisa Watanabe
15	JICA	JICA Expert	Ms. Ayako Yoshida

Public Utilities Board

Strategic Revision & Update

KIRIBATI WATER AUTHORITY

Objectives for the Planning Period

Implementation of a financial recovery plan	
A	Determine the value of pub generation, transmission and distribution assets, prepare impairment model and assets management procedures
B	Implement systems and financial management processes for effective financial reporting and internal controls, aligned to international standards
Governance, policy and procedural restoration	
C	Influence a clear and unambiguous legislative environment and strengthen PUB's governance protocols.
D	Strengthened governance and management of basic utilities through business process and system improvements to aid decision making and support efficiencies
E	Improved confidence and competence of utilities workforce to deliver and manage reliable, safe, and affordable electricity and water services meeting customer expectations.
Improved Reliability for Power Generation/Distribution/Retail	
F	Stabilizing the current power supply
G	Provide for future power demand by maximizing renewable energy penetration into the Power Grid
H	Improved practice of routine maintenance to ensure more dependable energy supply with fewer outages.
Project and asset management upgrades for water	
I	PUB to rapidly improve the safety and reliability of its current water supply
J	Help ensure the South Tarawa Water Supply Project meets the needs of the community.
Project and asset management upgrades for sewerage	
K	Significant Upgrade to the Sewerage systems

Improved Reliability for Power Generation/Distribution/Retail

Preventative Maintenance Planning & Capital Works	
A	Develop fully funded maintenance programme
STREP 1	
B	7.5 MW of PM/13.5MwHrs of BESS
C	Tariff modelling to ensure adequate revenue generation
STREP 2	
F	4 MWac FPV in Betio, and 3 MWac ground mounted PV at Bonriki plus a 33 kV ring including upgrades at RMU 63 (Betio), RMU 39 (Bonriki) and RMU 27 (Bikinibeu), with a 33 kV lines between these RMUs. BESS 10 MWh
G	Provide for future power demand by maximizing renewable energy penetration into the Power Grid
H	Improved practice of routine maintenance to ensure more dependable energy supply with fewer outages.
STREP 3	
I	Additional 5MWac in Betio + 5 MWh Batteries

Key Points

Demand forecast is difficult to project

High Growth rates are certain

33KVA Grid upgrade is critical

Reliability of Diesel Generators is an issue

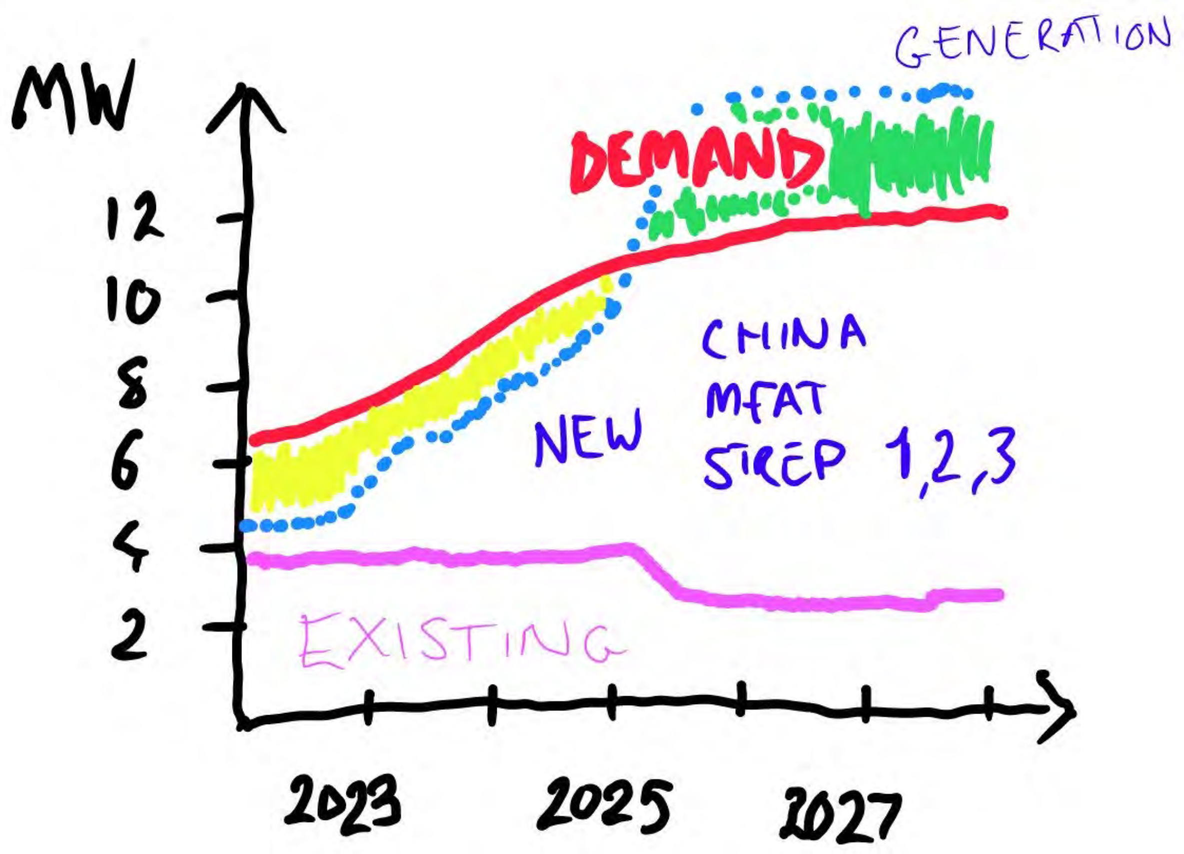
Remaining shortfall in generation capacity to 2025

Long term: require ongoing operation of diesel generators

Skills learnt, developed and the support of JICA/Okinawa has been critical to ensuring PUB is able to continue our operations

Programme to date has built capacity and confidence in the team

PUB looks forward to an ongoing relationship with JICA and the Okinawa Teams



Maintenance of a Solar PV System.

Experience, knowledge, and expertise in renewable energy (Solar pv) maintenance gained through the project

Content

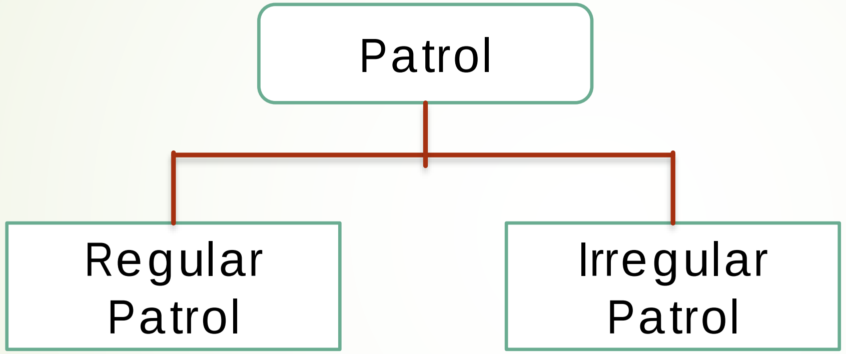
Introduction

- Just like any power plant, a solar plant in operation also requires maintenance. As the solar power plant starts aging, the need to implement operations and maintenance becomes more and more important to keep the plant in operable condition.
- As the solar plant starts aging, the need to implement operations and maintenance becomes more and more important.
- Two Main activities required for Solar plant maintenance

1. Patrol
2. Inspection

Type of Inspection for solar plant maintenance

Patrol is a record of the facilities in operation is kept in order to determine whether conditions are good or not.



Patrol

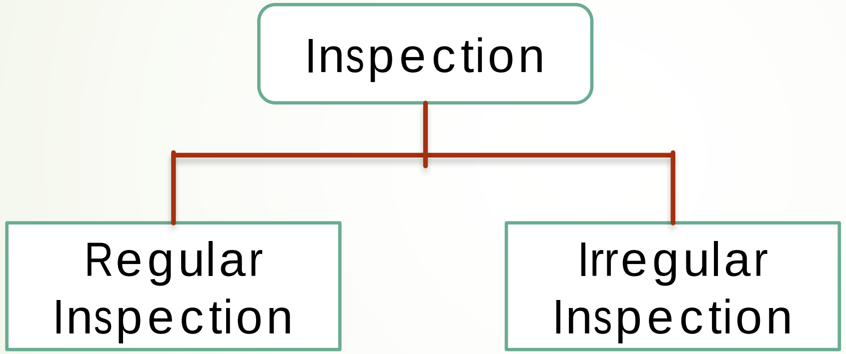
Regular Patrol

Irregular Patrol

Type	Contents	Frequency
Regular Patrol	During operation, check the condition of all equipment to find defect	Daily (PEC), once a week (Other solar plant)
Irregular Patrol	After heavy rainfall, operator should check the equipment	Emergency case

Type of Inspection for solar plant maintenance

Inspection – The system is stopped, components are replaced and measurements taken to judge whether conditions are good or not.


Inspection

Regular Inspection

Irregular Inspection

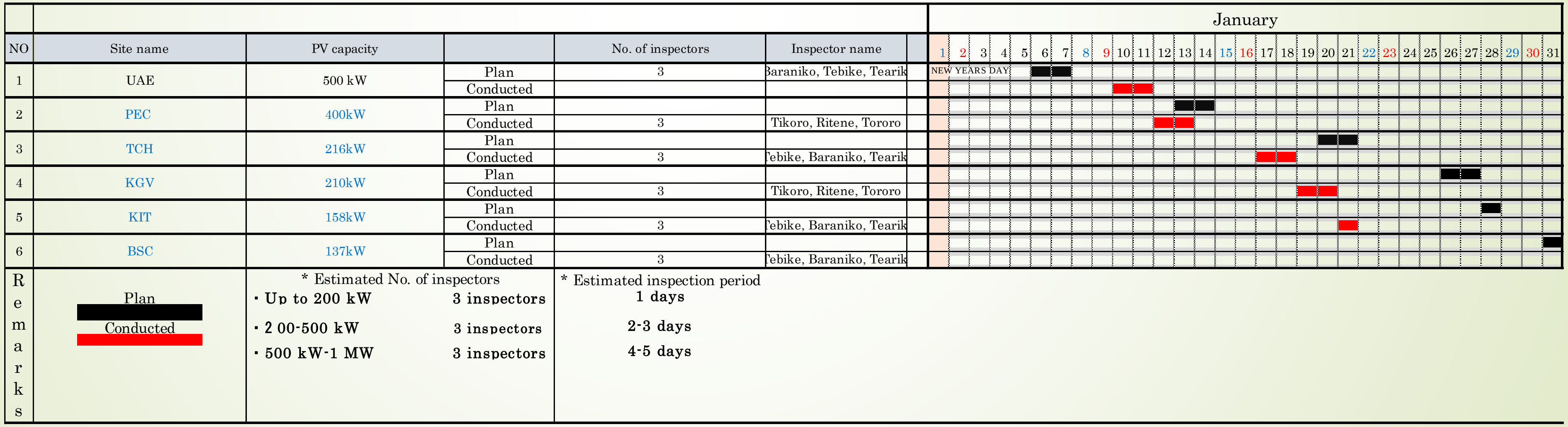
Type	Contents	Frequency
Regular Inspection	Regularly check equipment condition	Every month
Irregular Inspection	If there is a fault or abnormal condition, inspection of each equipment is necessary	When necessary

Inspection Schedule

[Annual Work Schedule]

PV System Maintenance

PUB



							January																													
NO	Site name	PV capacity		No. of inspectors	Inspector name		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1	UAE	500 kW	Plan	3	Baraniko, Tebike, Tearik		NEW YEARS DAY					■	■																								
			Conducted												🟥	🟥																				
2	PEC	400kW	Plan															■	■																	
			Conducted	3	Tikoro, Ritene, Tororo													🟥	🟥																		
3	TCH	216kW	Plan																							■	■										
			Conducted	3	Tebike, Baraniko, Tearik																		🟥	🟥													
4	KGV	210kW	Plan																													■	■				
			Conducted	3	Tikoro, Ritene, Tororo																				🟥	🟥											
5	KIT	158kW	Plan																															■			
			Conducted	3	Tebike, Baraniko, Tearik																						🟥										
6	BSC	137kW	Plan																																		■
			Conducted	3	Tebike, Baraniko, Tearik																																	

Remarks

Plan ■

Conducted 🟥

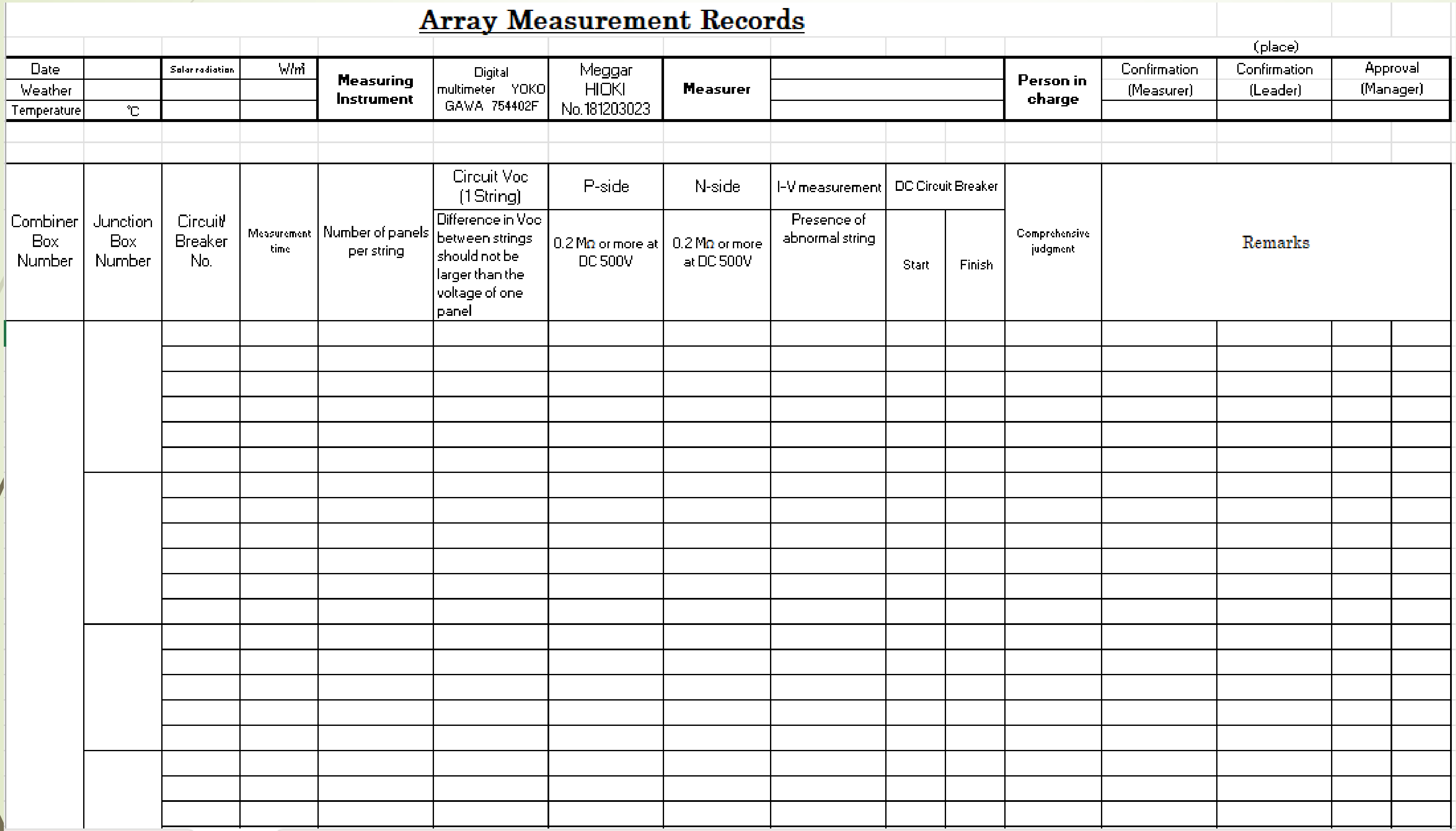
* Estimated No. of inspectors
- Up to 200 kW 3 inspectors
- 2 00-500 kW 3 inspectors
- 500 kW-1 MW 3 inspectors

* Estimated inspection period
1 days
2-3 days
4-5 days

Visual inspection, Measurement and Inspection record

Patrol Checklist	Date:	/	/	/	/	/	/	/
	Inspector:							
Items	**Check Point**							
General conditions at the yard								
Time								
Weather								
Temperature	(°C)							
Relative humidity (present)	(%)							
PV array 1								
Surface of the main body	Damage, Dust, Abnormal noise, Abnormal smell, Installation condition							
External Wiring (plus grounding wires)	Damage, Looseness							
Gantry	Rust, Corrosion, Damages,							
Foundations	Damage, Slant							
Ground, surroundings	New shading sources							
DC/Junction Box								
General condition	Corrosion, moisture, overheating.							
external wiring	Damage, Looseness							
PCS/Inverters								
General condition	abnormal noise, odor during operation							
	Invasion of Water							
	Dust, Security condition							
Operation of Ventilation	Fan function, V port filter clogging							
Others（TR、RMUetc)								
Device breakage	Significant damage to equipment							
Terminal	Contamination around the terminal due to dust and oil attachement							
Device	Significant damage to equipment							
Equipment	Deformation of insulation/ terminal part due to overheating							
Wiring damage	heat generation, breakage and flaws							
Terminal block, Internal equipment	Screw looseness							
Structure and Foundation	breakage of distortion, damage, cracks							
	looseness in the fixing bolt etc. of the outer box and it is surely mounted							
	deformation, scratches, dirt, rust, corrosion and breakage							

Visual inspection and Measurement record



Array Measurement Records

(place)

Date		Solar radiation	W/㎡	**Measuring Instrument**	Digital multimeter YOKOGAWA 754402F	Meggar HIOKI No.181203023	**Measurer**		**Person in charge**	Confirmation (Measurer)	Confirmation (Leader)	Approval (Manager)
Weather												
Temperature	℃											

Combiner Box Number	Junction Box Number	Circuit Breaker No.	Measurement time	Number of panels per string	Circuit Voc (1 String)	P-side	N-side	I-V measurement	DC Circuit Breaker		Comprehensive judgment	Remarks			
					Difference in Voc between strings should not be larger than the voltage of one panel	0.2 MΩ or more at DC 500V	0.2 MΩ or more at DC 500V	Presence of abnormal string	Start	Finish					

Measurement Standard

The criteria for judgment for measurement shall be follows below set values.

Measured Value Item	Judgment criteria	Note
1.Insulation resistance ［MΩ］ ［V］	≥ 0.2 ［MΩ］	As Refer to the Japanese standard. This applies for PEC solar plant.
1. Insulation resistance ［MΩ］ ［V］	≥ 1 ［MΩ］	Applies for UAE and World Bank Solar Plants Voc of world Bank SP is much closer to Voc of UAE= 768 Vdc, and for this value, it shall have a 1 MΩ as a minimum value of insulation resistance (UAE plant manual)
2.Open circuit voltage ［V］ (1 String) **Circuit Voc (1 String)**	Difference in Voc between strings should not be larger than the voltage of one panel	
3.I-V Curve (a)	P≈5kW, Voc = 768Vdc and Isc= 8.63	UAE (20 modules in series)
I-V Curve (b.1)	P≈6.72 kW, Voc = 938.4 Vdc, Isc = 9.50A	World Bank (24 modules in series)
IV Curve (b.2)	P≈6.44kW, Voc = 899.3 Vdc, Isc= 9.50A	World Bank (23 modules in series)
IV Curve (c)	P≈3.675kW, Voc = 559.5 Vdc, Isc = 8.62A	PEC (15 modules in series)

Measuring Equipment and required tools

Instrument name	Purpose
1. Digital multi meter	General measurement to know circuit condition
1. Insulation Resistance Tester (Megger)	Measurement to verify insulation condition of the circuit from PV panels to the switching board
1. I-V Curve tracer	Verification of the condition of strings
1. Line tracer	Verification of the condition of panels
1. Infrared camera	Verification of the condition of panels

Items	Specifications
1. Screwdriver (+ and -)	Screwdriver (+ and -)
1. Cutting nipper	Cutting nipper
1. Cutting Plier	Cutting Plier
1. Hammer	Hammer
1. Socket wrench	Socket wrench
1. Paint	Paint
1. Anti-corrosive paint	Anti-corrosive paint
1. Tool cabinet with door	Tool cabinet with door

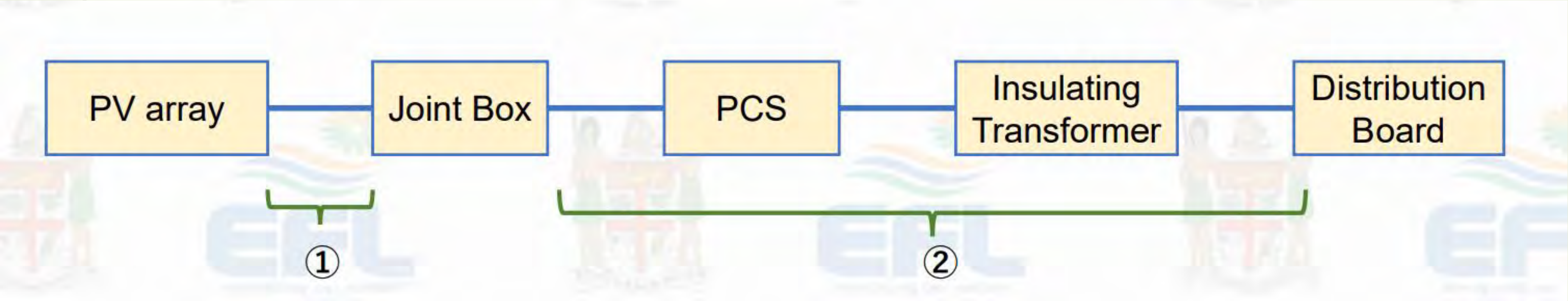
Measurement required for solar Plant Maintenance

1. Insulation resistance of PV system
2. Insulation resistance of PV arrays
3. Measurement of the short circuit current Isc of the PV array
4. Open Circuit voltage of the PV array
5. IR Thermal imaging
6. Cell Line checker
7. String tracer

Insulation resistance of PV system

Resistance measurement is normally divided into 2 sections:

1. PV array to primary side of the junction box
2. From junction box to distribution board (Typically not measured for periodic inspections)

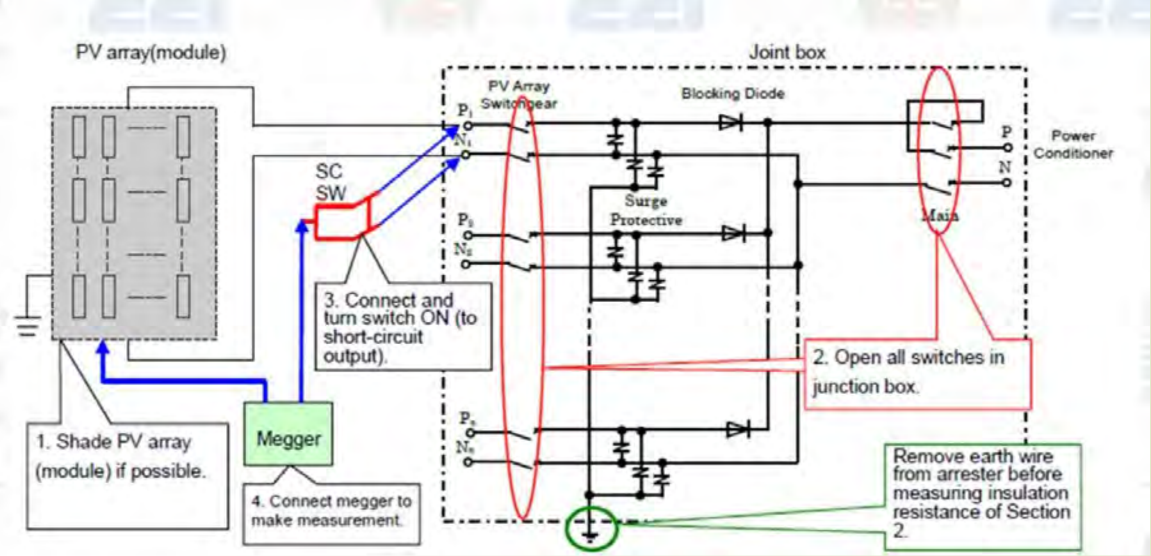


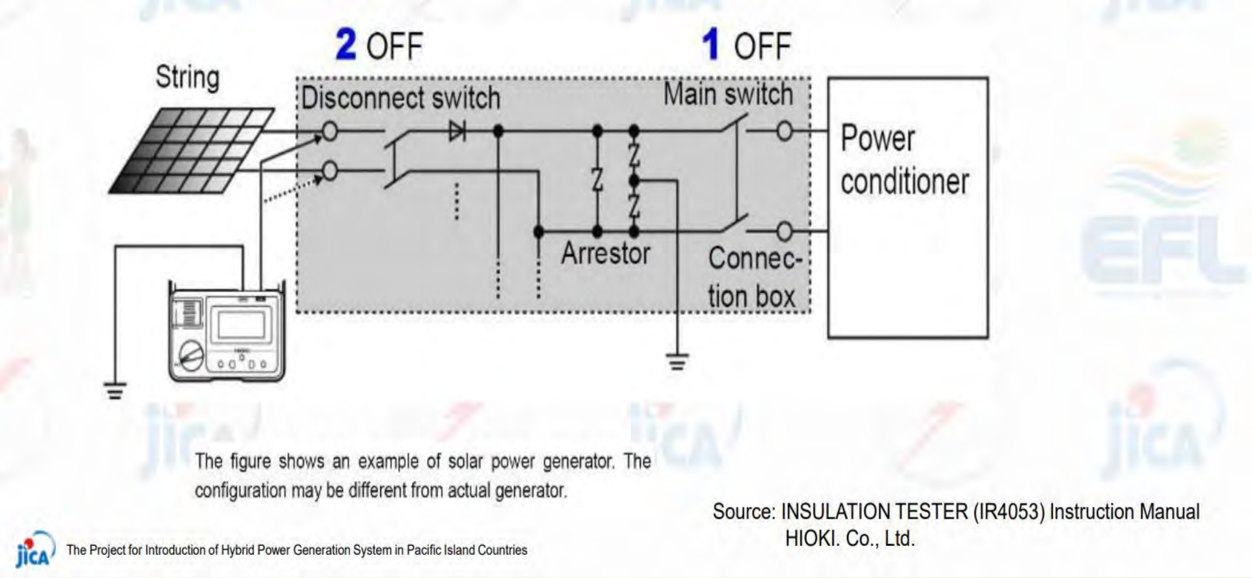
These measurements are taken to inspect the condition of cable insulation, so be sure to isolate any electronic devices connected to them to avoid potential damage unless instructed otherwise.

Insulation resistance of PV arrays

The two methods to test the insulation resistance of PV panels:

- ➢ Short the positive and negative electrodes of the PV string before measuring the insulation resistance between the shorting point and earth (Standard method)
- ➢ Measure the insulation resistance between the positive electrode and earth and negative electrode and earth separately without short-circuiting (Safer method used with the insulation tester provided through this project





The figure shows an example of solar power generator. The configuration may be different from actual generator.

Source: INSULATION TESTER (IR4053) Instruction Manual HIOKI. Co., Ltd.

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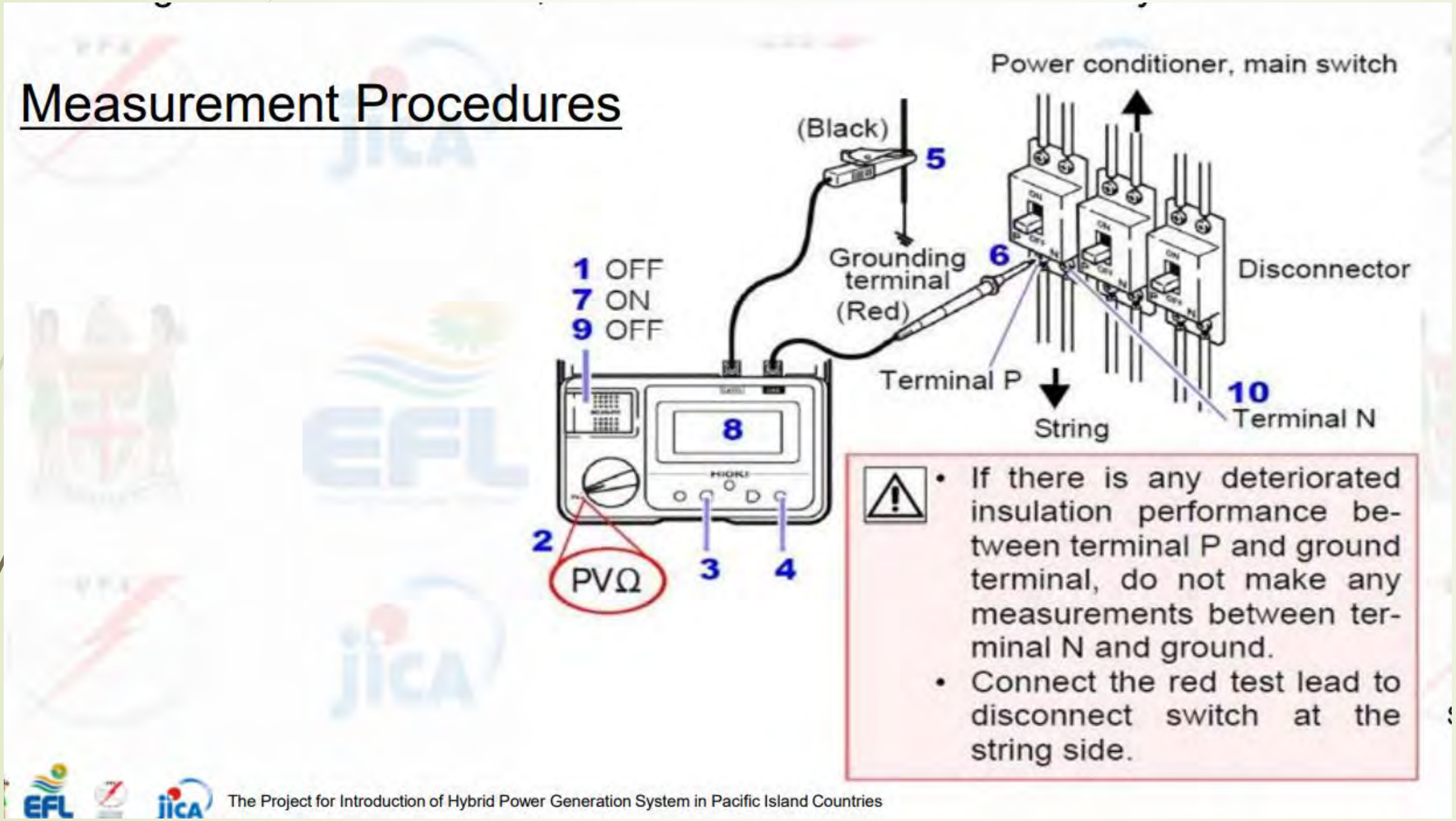
Procedure to carry out method 2



Measurement Procedures

- If there is any deteriorated insulation performance between terminal P and ground terminal, do not make any measurements between terminal N and ground.
- Connect the red test lead to disconnect switch at the string side.

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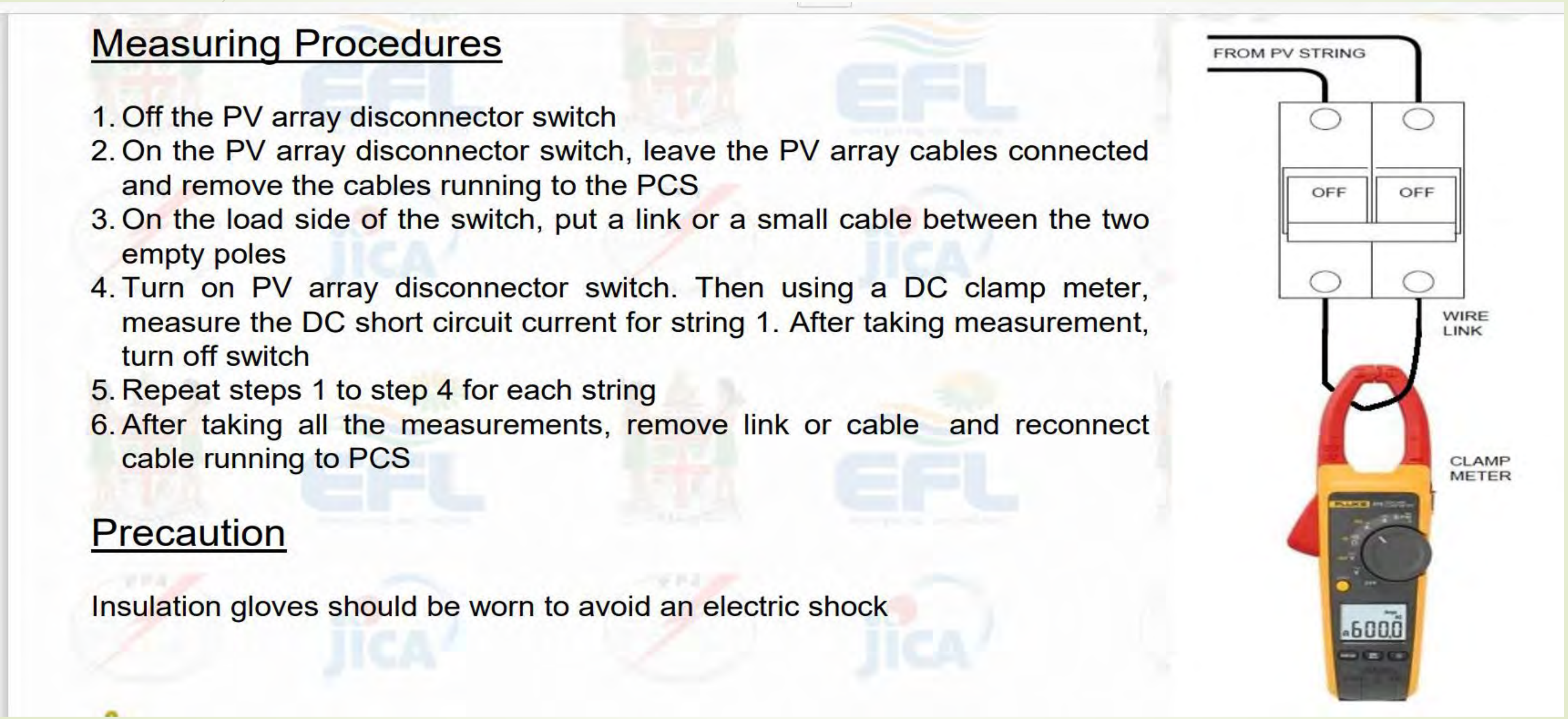
❖ INSULATION TESTER (IR4053)

Measurement of the short circuit current Isc of the PV array



Measuring Procedures

1. Off the PV array disconnector switch
2. On the PV array disconnector switch, leave the PV array cables connected and remove the cables running to the PCS
3. On the load side of the switch, put a link or a small cable between the two empty poles
4. Turn on PV array disconnector switch. Then using a DC clamp meter, measure the DC short circuit current for string 1. After taking measurement, turn off switch
5. Repeat steps 1 to step 4 for each string
6. After taking all the measurements, remove link or cable and reconnect cable running to PCS

Precaution

Insulation gloves should be worn to avoid an electric shock

IR Thermal imaging

- Thermo-diagnostic camera is used to detect defects called “Hotspots” These “hotspots” indicate a recombination of electrons which can create holes in the solar cells
- A significant amount of energy is released during this process and radiates into space as heat. These problem areas can heat to very high temperatures – in fact, the difference between a good cell and a defective one can be greater than 50℃
- Hot-spots are clearly visible in thermal images because they have a remarkable strong color contrast to the other solar cells and the surrounding environment.

IR Thermal imaging

Common Solar Panel Faults

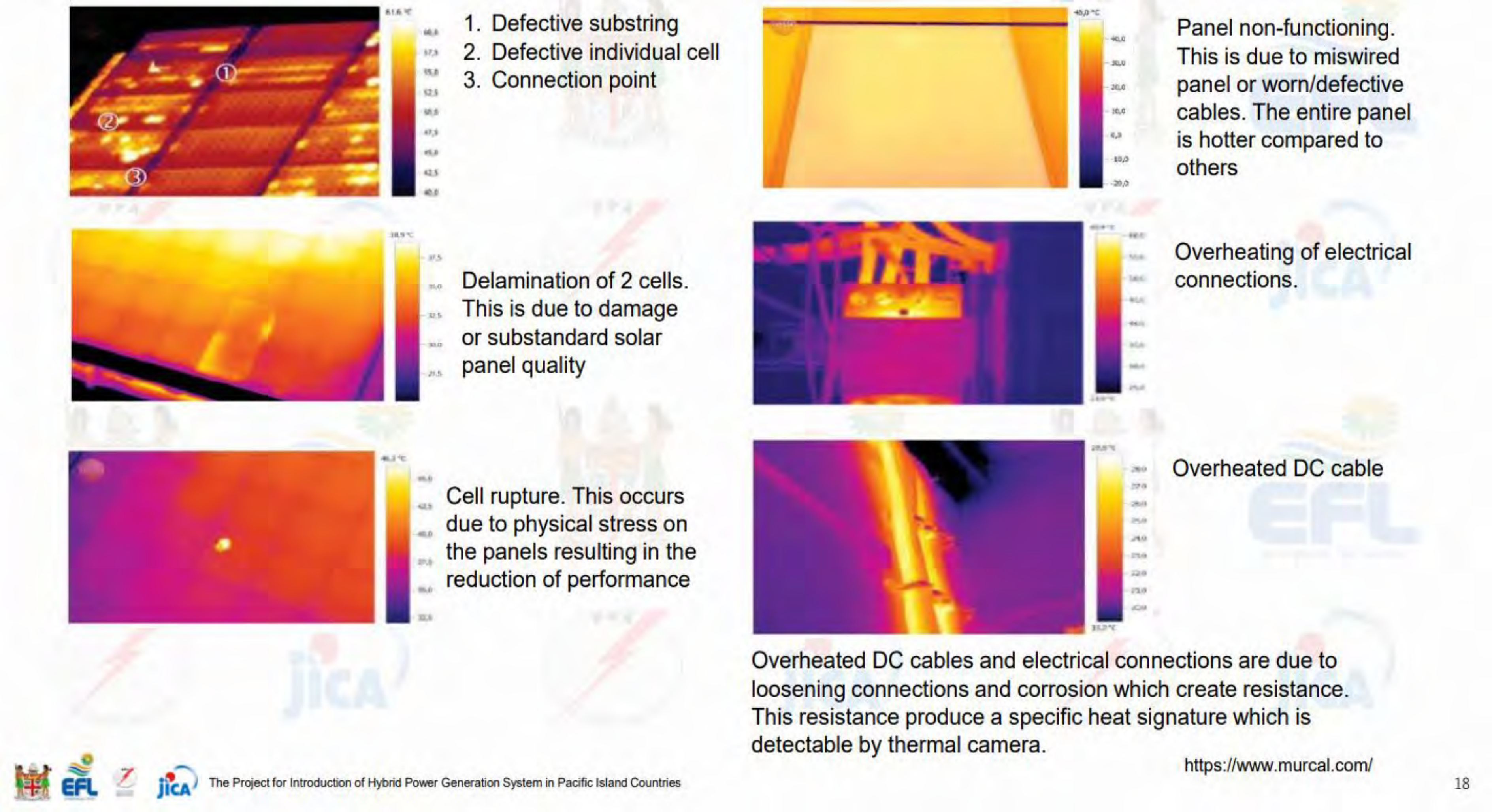
- ➢ Thermal imaging cameras can show several problems. such as defects in cells, temporary shadowing (dirt, pollution, humidity, bird droppings), defective bypass diode, or faulty interconnections.

Main faults

- ✓ Defect bypass diodes
- ✓ Short circuit and falling connections
- ✓ Penetration of moisture and dirt
- ✓ Cracked cells or glass cracks
- ✓ Mismatched panels with different capabilities
- ✓ Loose contacts and wiring faults

❖ Damp or wet conditions will also adversely affect results because water will cause false anomalies in a thermal image. Cloudy and windy conditions are also to be avoided if possible.

Image samples of common defects



1. Defective substring
2. Defective individual cell
3. Connection point

Panel non-functioning. This is due to miswired panel or worn/defective cables. The entire panel is hotter compared to others

Delamination of 2 cells. This is due to damage or substandard solar panel quality

Overheating of electrical connections.

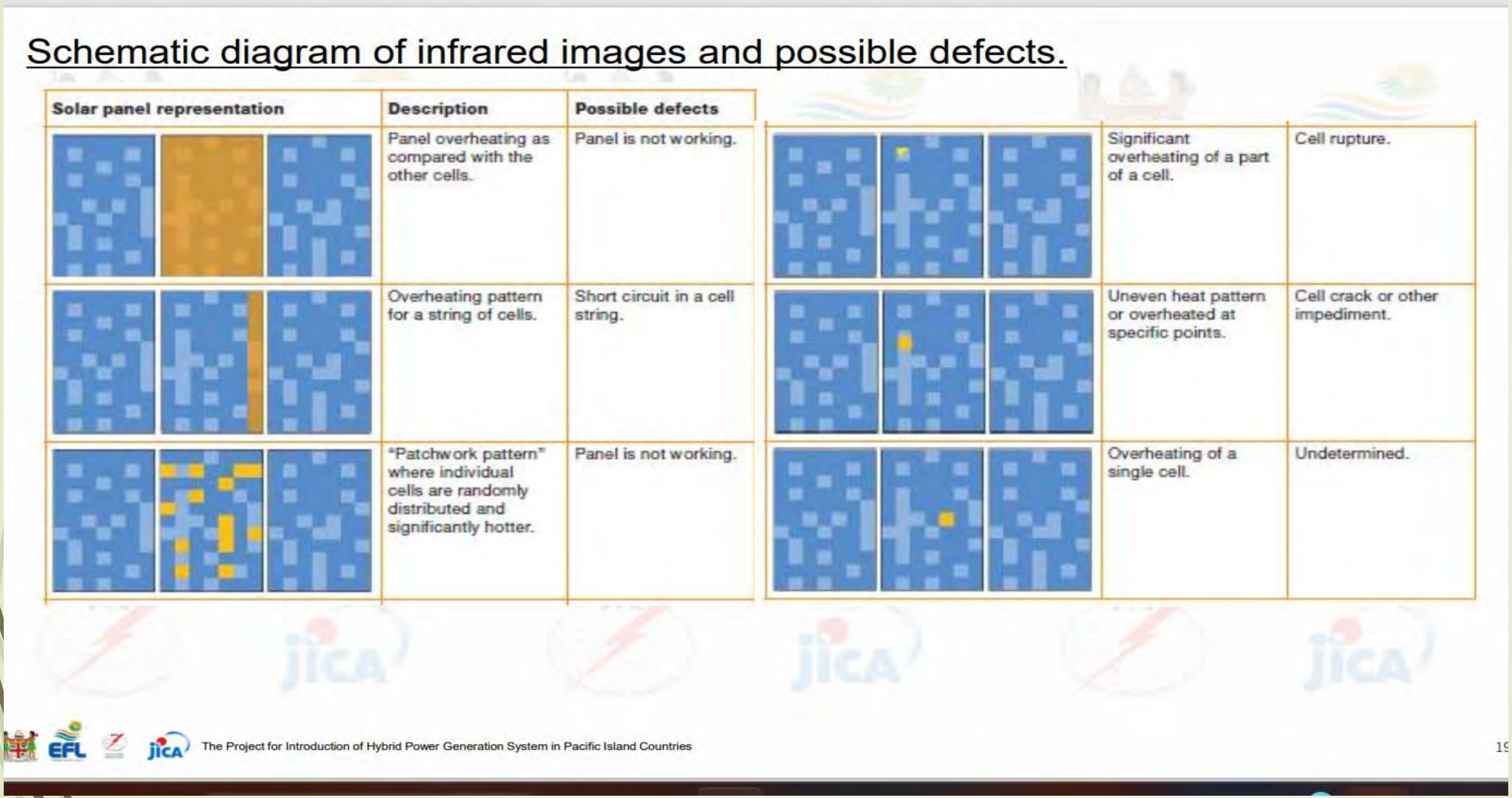
Cell rupture. This occurs due to physical stress on the panels resulting in the reduction of performance

Overheated DC cable

Overheated DC cables and electrical connections are due to loosening connections and corrosion which create resistance. This resistance produce a specific heat signature which is detectable by thermal camera.

https://www.murcal.com/

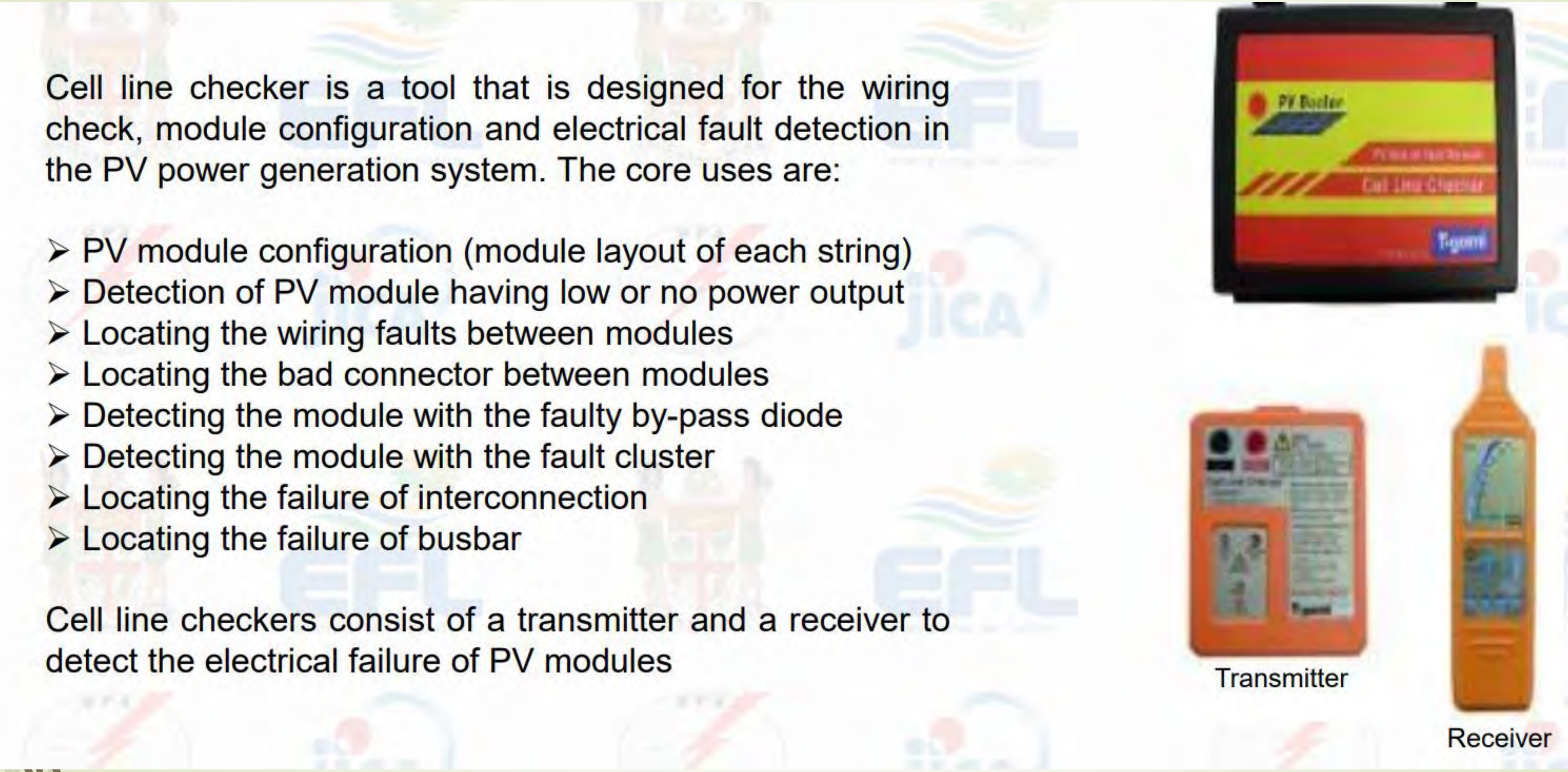
Schematic diagram of infrared images and possible defect



Schematic diagram of infrared images and possible defects.

Solar panel representation	Description	Possible defects
	Panel overheating as compared with the other cells.	Panel is not working.
	Overheating pattern for a string of cells.	Short circuit in a cell string.
	"Patchwork pattern" where individual cells are randomly distributed and significantly hotter.	Panel is not working.
	Significant overheating of a part of a cell.	Cell rupture.
	Uneven heat pattern or overheated at specific points.	Cell crack or other impediment.
	Overheating of a single cell.	Undetermined.

Cell Line checker



Cell line checker is a tool that is designed for the wiring check, module configuration and electrical fault detection in the PV power generation system. The core uses are:

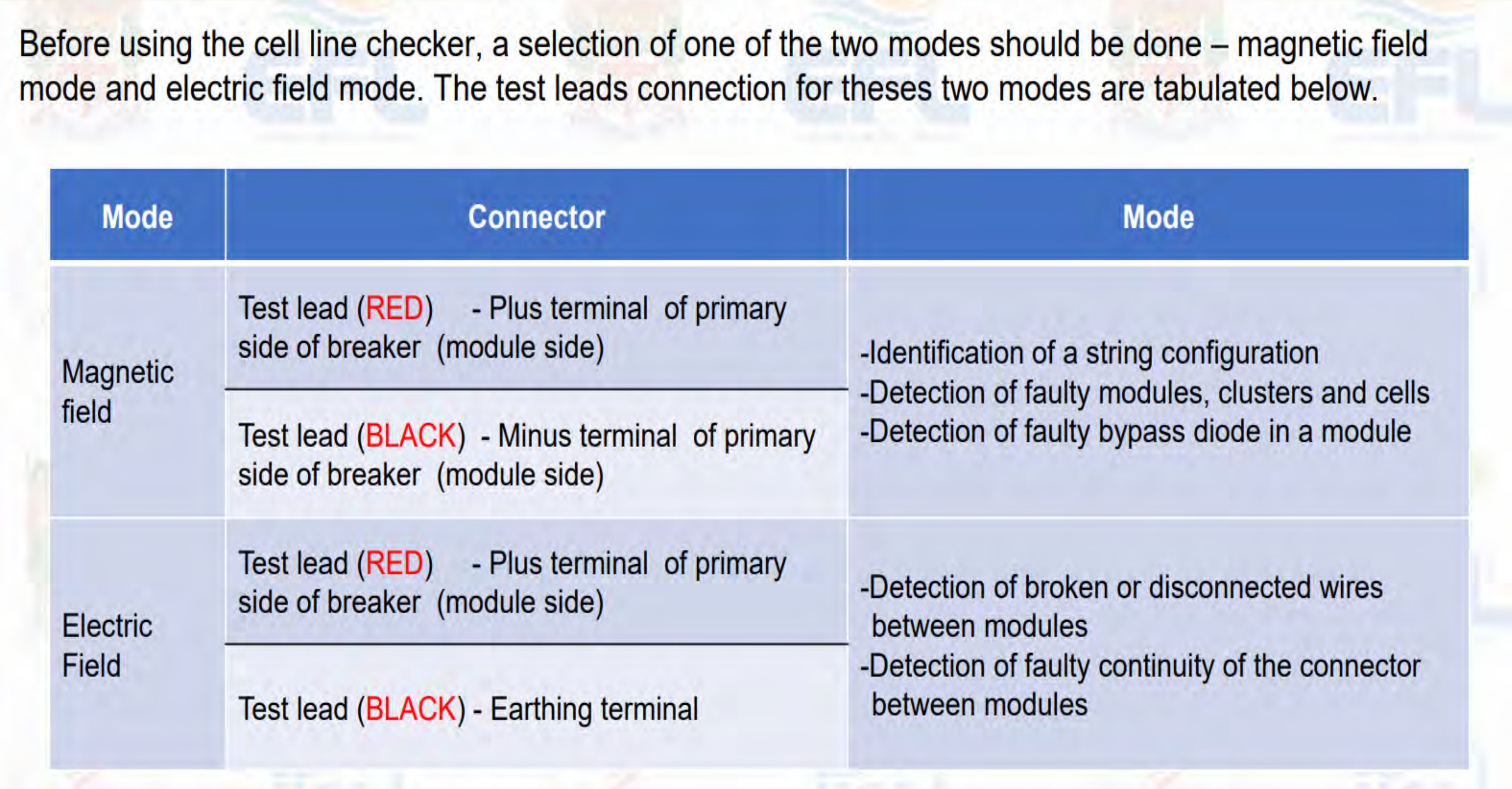
- ➢ PV module configuration (module layout of each string)
- ➢ Detection of PV module having low or no power output
- ➢ Locating the wiring faults between modules
- ➢ Locating the bad connector between modules
- ➢ Detecting the module with the faulty by-pass diode
- ➢ Detecting the module with the fault cluster
- ➢ Locating the failure of interconnection
- ➢ Locating the failure of busbar

Cell line checkers consist of a transmitter and a receiver to detect the electrical failure of PV modules

Transmitter

Receiver

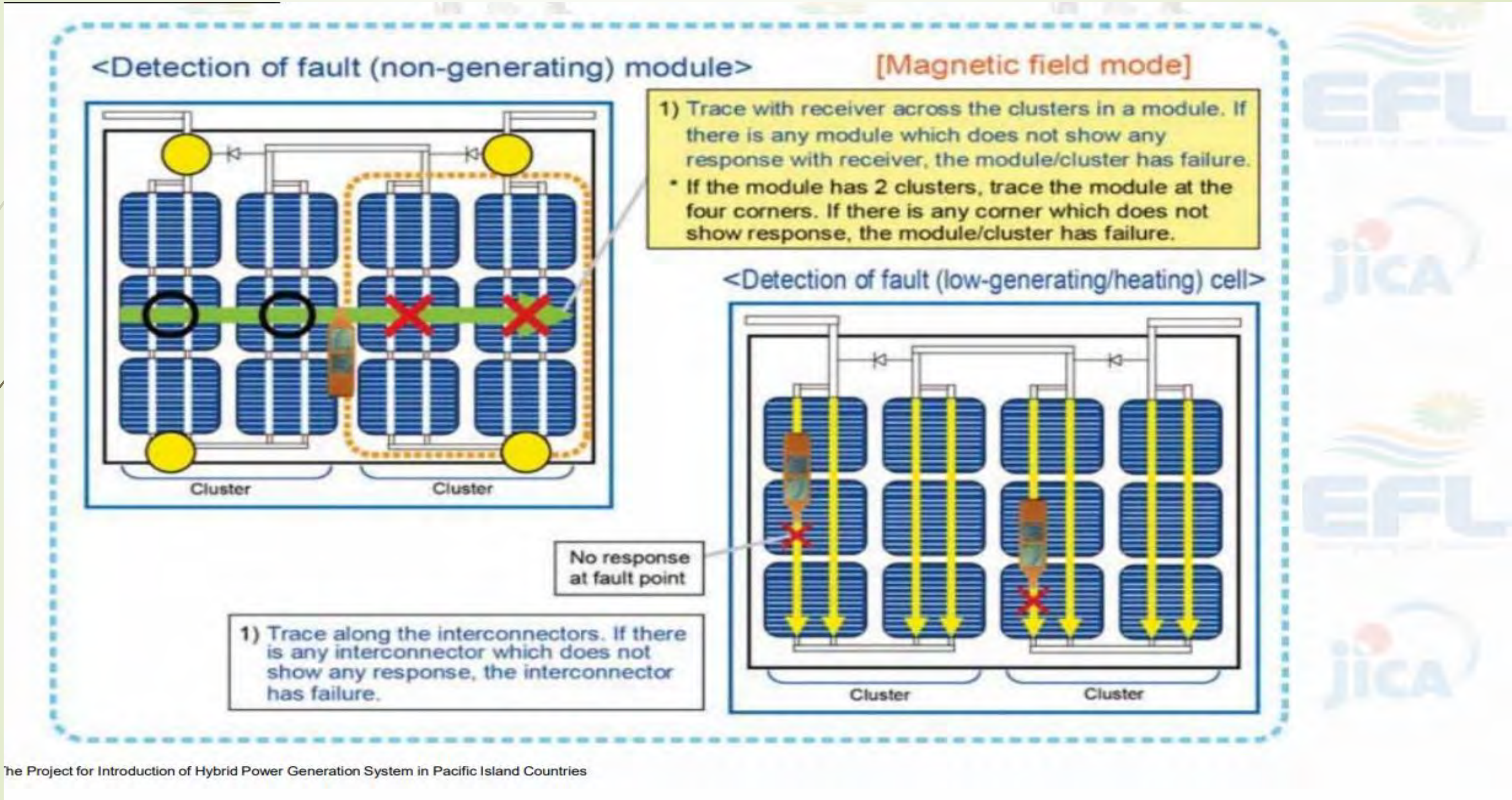
Basic Usage of a Cell Line Checker



Before using the cell line checker, a selection of one of the two modes should be done – magnetic field mode and electric field mode. The test leads connection for theses two modes are tabulated below.

Mode	Connector	Mode
Magnetic field	Test lead (RED) - Plus terminal of primary side of breaker (module side)	-Identification of a string configuration -Detection of faulty modules, clusters and cells -Detection of faulty bypass diode in a module
	Test lead (BLACK) - Minus terminal of primary side of breaker (module side)	
Electric Field	Test lead (RED) - Plus terminal of primary side of breaker (module side)	-Detection of broken or disconnected wires between modules -Detection of faulty continuity of the connector between modules
	Test lead (BLACK) - Earthing terminal	

Examples of Detection



<Detection of fault (non-generating) module>

[Magnetic field mode]

1) Trace with receiver across the clusters in a module. If there is any module which does not show any response with receiver, the module/cluster has failure.

- If the module has 2 clusters, trace the module at the four corners. If there is any corner which does not show response, the module/cluster has failure.

<Detection of fault (low-generating/heating) cell>

No response at fault point

1) Trace along the interconnectors. If there is any interconnector which does not show any response, the interconnector has failure.

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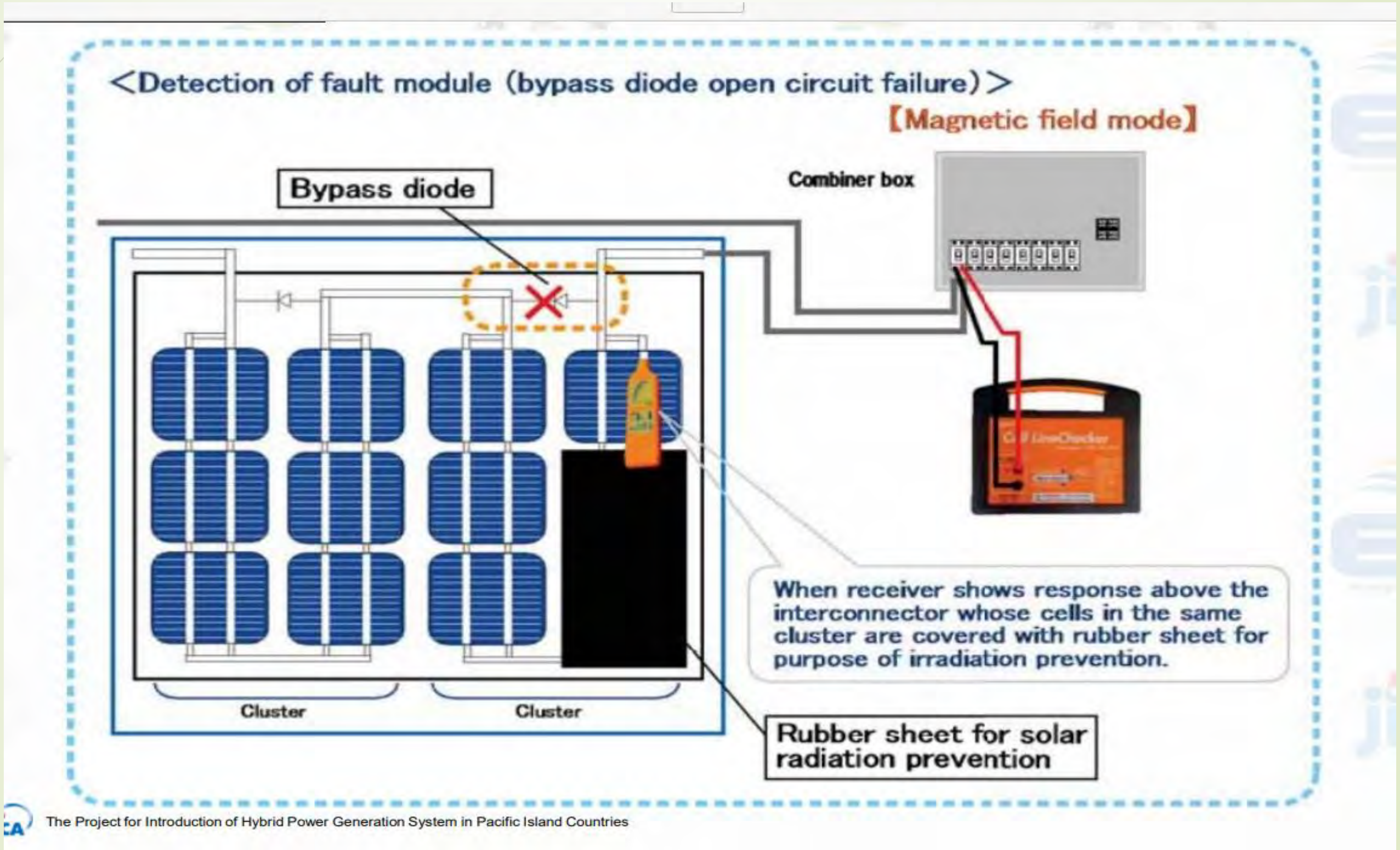
Examples of Detection



<Detection of fault module (bypass diode open circuit failure)>

【Magnetic field mode】

When receiver shows response above the interconnector whose cells in the same cluster are covered with rubber sheet for purpose of irradiation prevention.

Rubber sheet for solar radiation prevention

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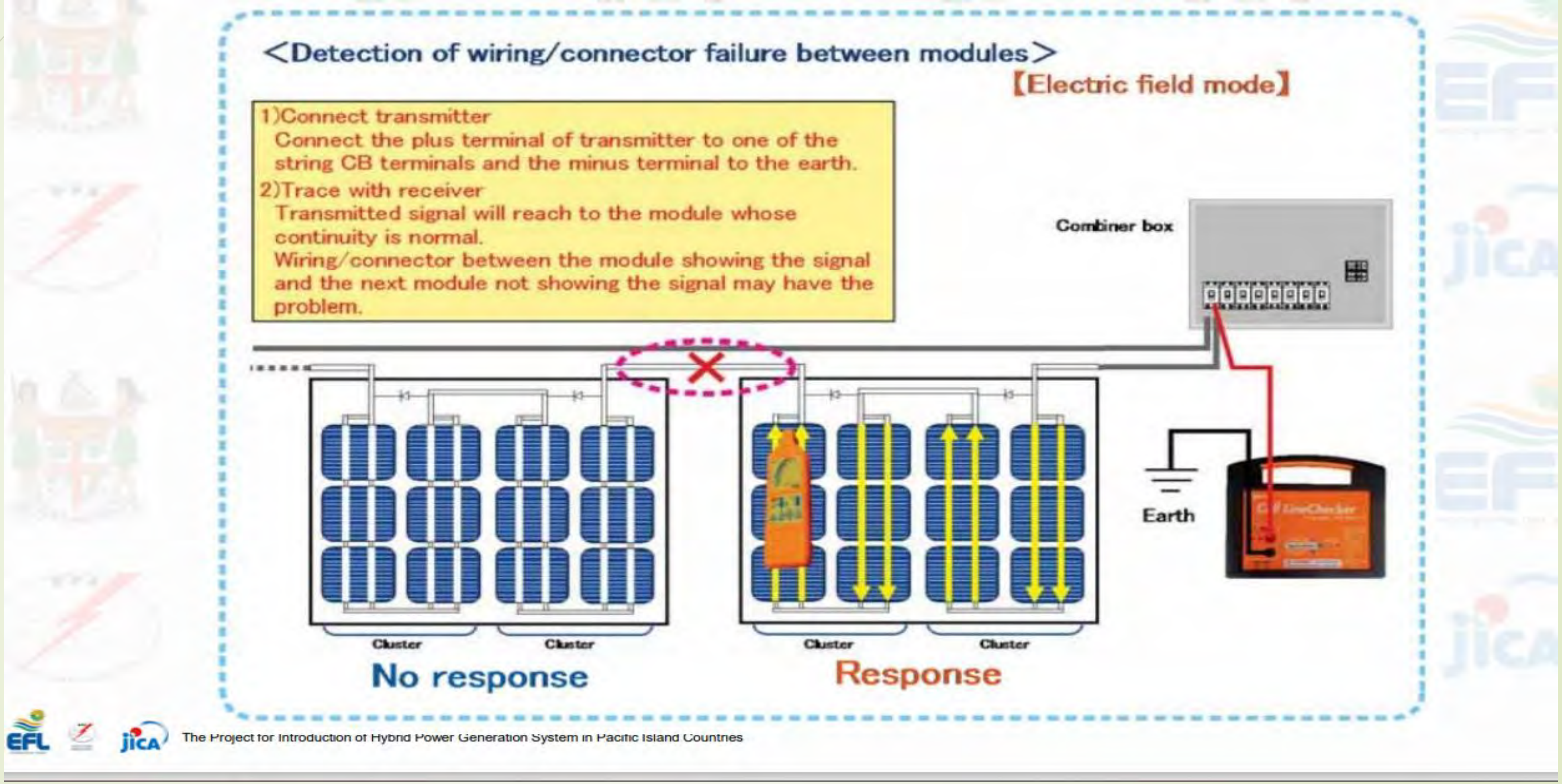
Example of Detection



＜Detection of wiring/connector failure between modules＞

【Electric field mode】

1)Connect transmitter
Connect the plus terminal of transmitter to one of the string CB terminals and the minus terminal to the earth.

2)Trace with receiver
Transmitted signal will reach to the module whose continuity is normal.
Wiring/connector between the module showing the signal and the next module not showing the signal may have the problem.

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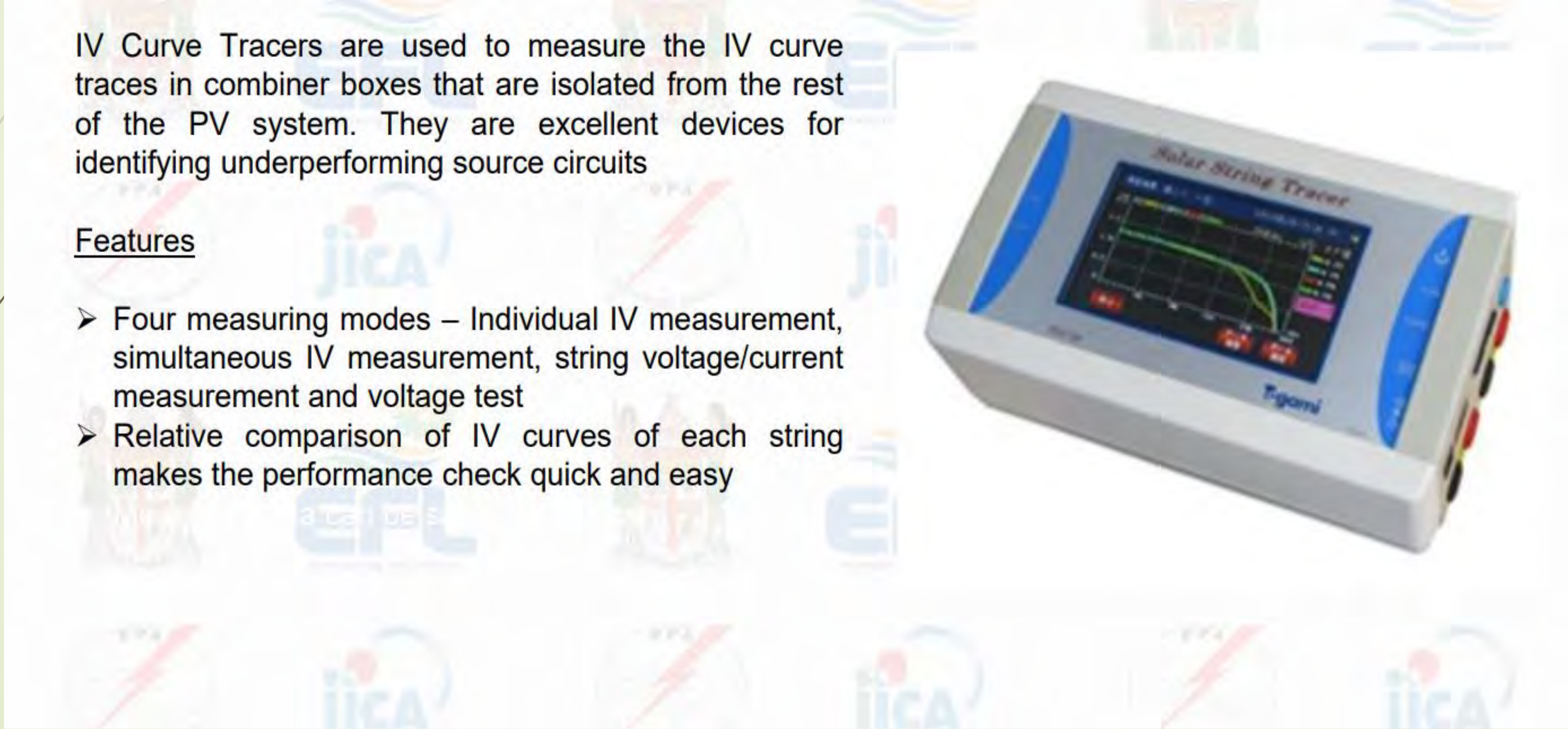
String Tracer

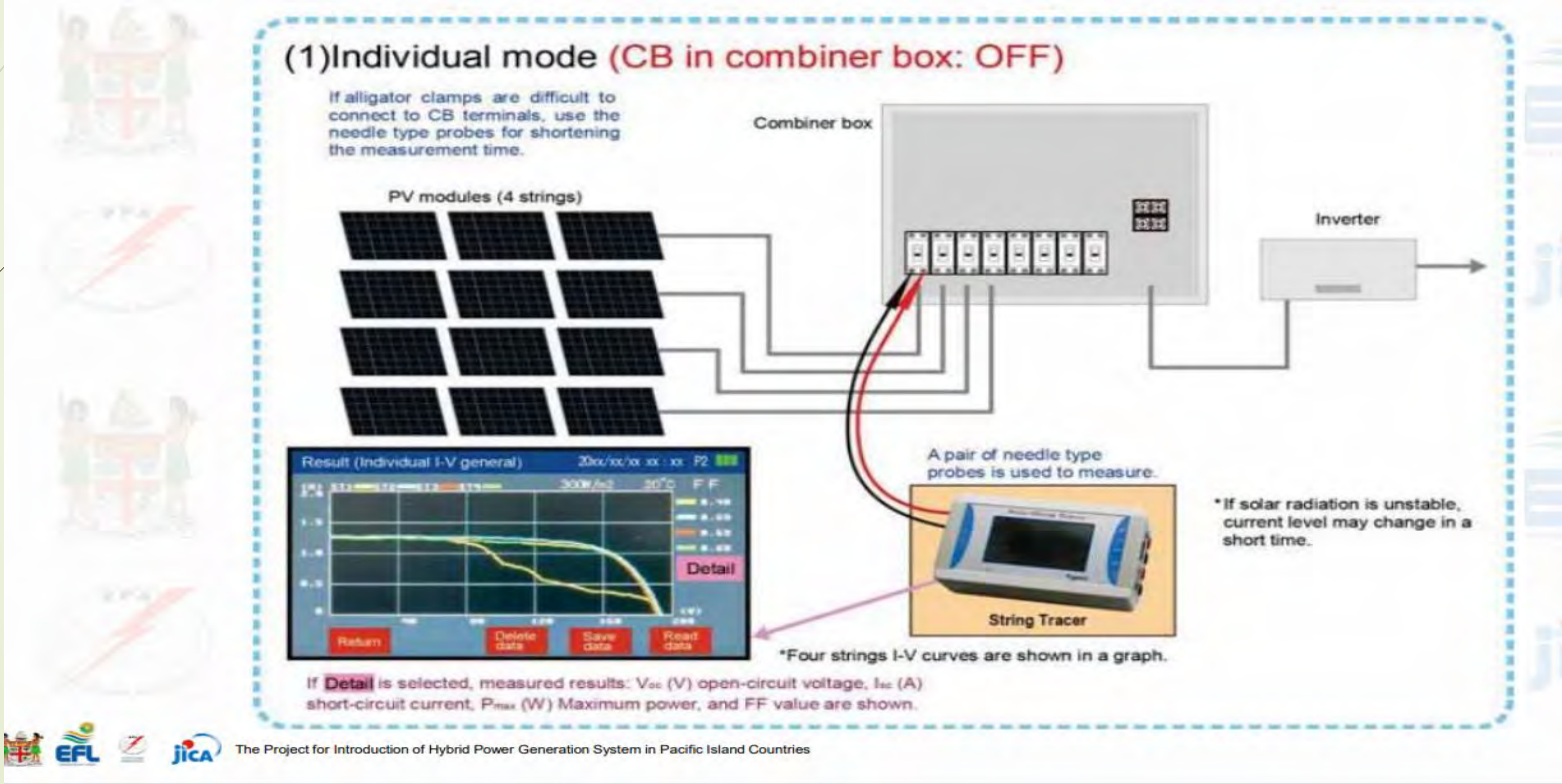


IV Curve Tracers are used to measure the IV curve traces in combiner boxes that are isolated from the rest of the PV system. They are excellent devices for identifying underperforming source circuits

<u>Features</u>

- ➢ Four measuring modes – Individual IV measurement, simultaneous IV measurement, string voltage/current measurement and voltage test
- ➢ Relative comparison of IV curves of each string makes the performance check quick and easy

Individual mode



(1)Individual mode (CB in combiner box: OFF)

If alligator clamps are difficult to connect to CB terminals, use the needle type probes for shortening the measurement time.

A pair of needle type probes is used to measure.

*If solar radiation is unstable, current level may change in a short time.

*Four strings I-V curves are shown in a graph.

If **Detail** is selected, measured results: V_{oc} (V) open-circuit voltage, I_{sc} (A) short-circuit current, P_{max} (W) Maximum power, and FF value are shown.

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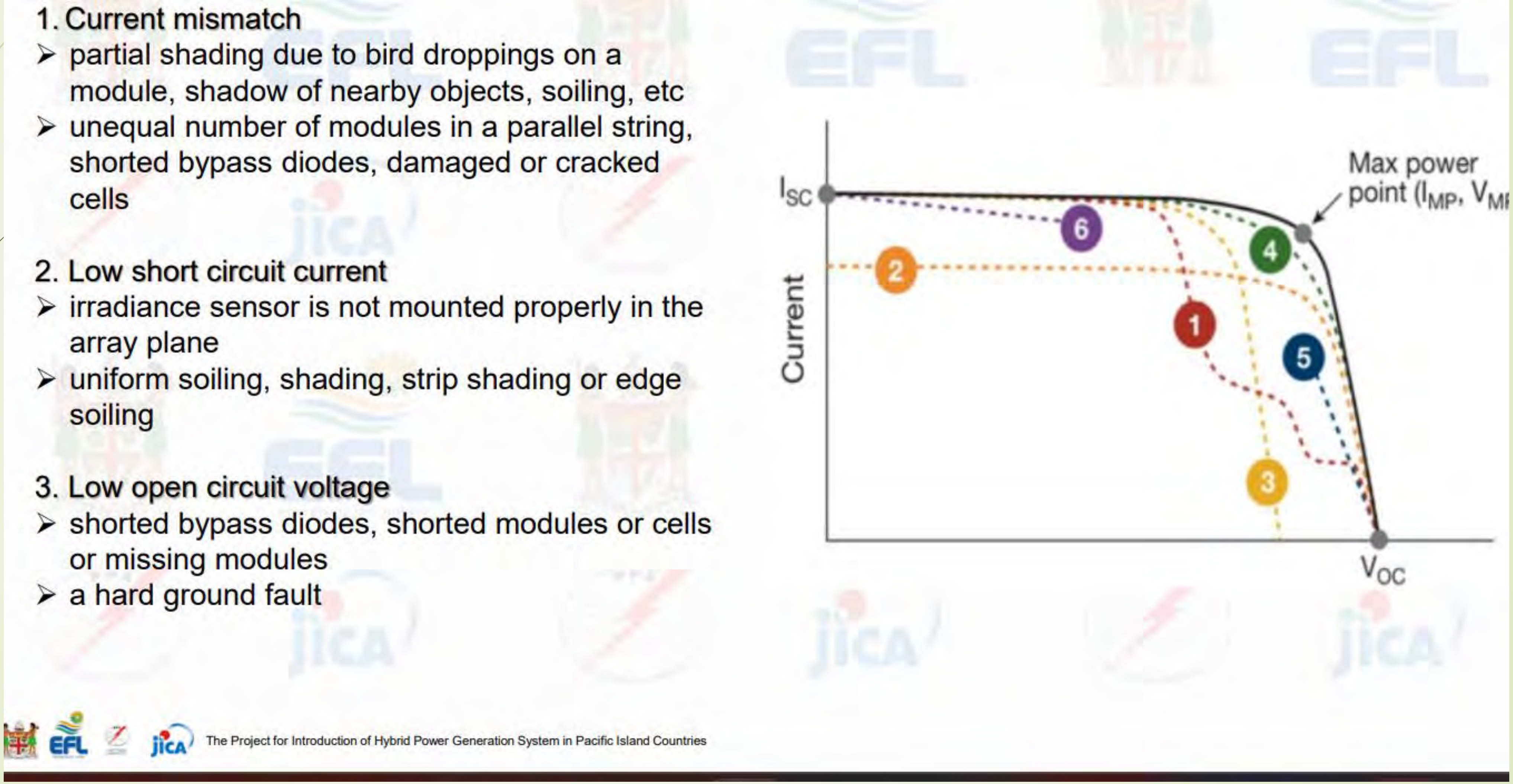
Interpretation of The IV Curve Shape



1. Current mismatch

- ➢ partial shading due to bird droppings on a module, shadow of nearby objects, soiling, etc
- ➢ unequal number of modules in a parallel string, shorted bypass diodes, damaged or cracked cells

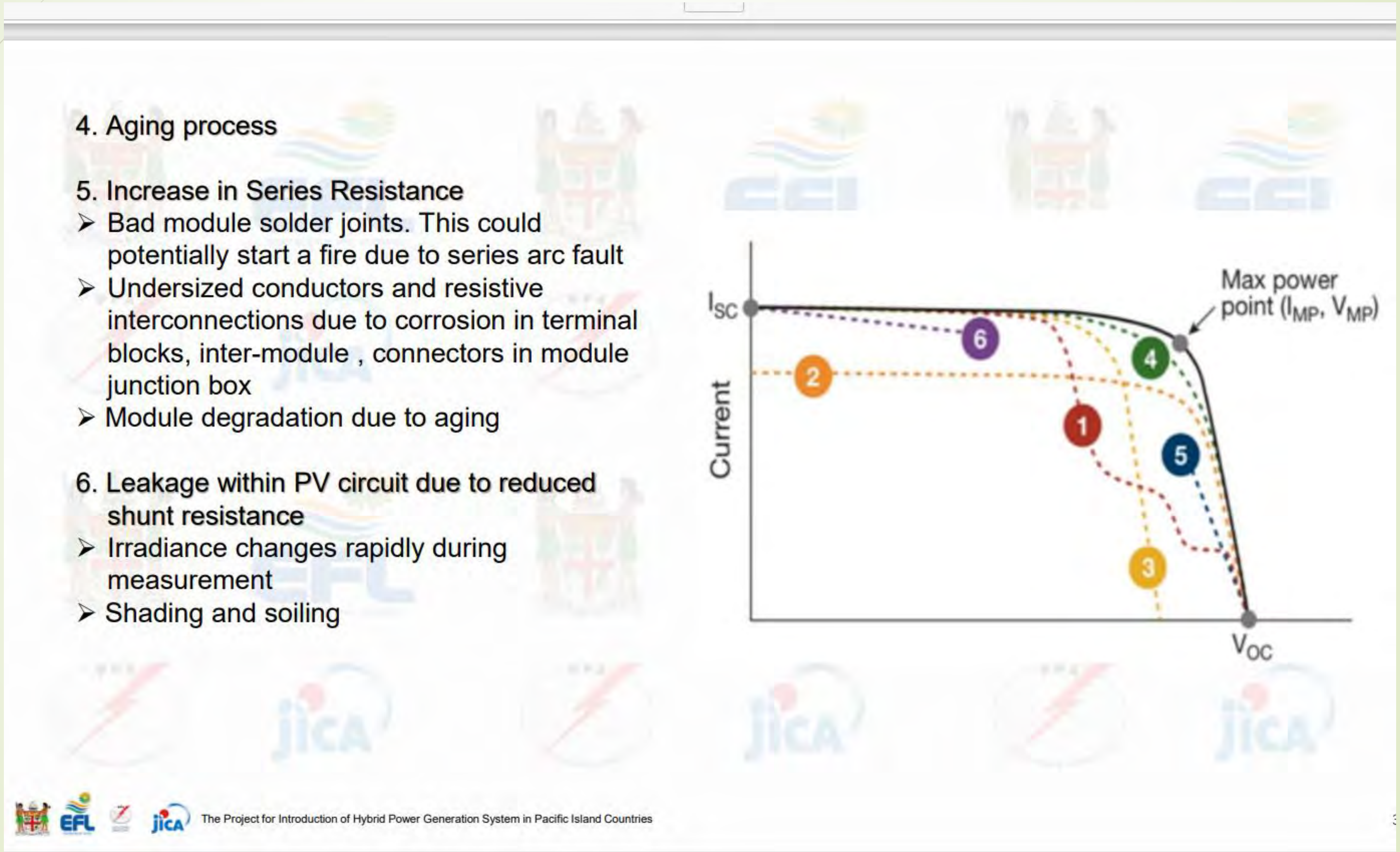
2. Low short circuit current

- ➢ irradiance sensor is not mounted properly in the array plane
- ➢ uniform soiling, shading, strip shading or edge soiling

3. Low open circuit voltage

- ➢ shorted bypass diodes, shorted modules or cells or missing modules
- ➢ a hard ground fault

Interpretation of the IV Curve Shape

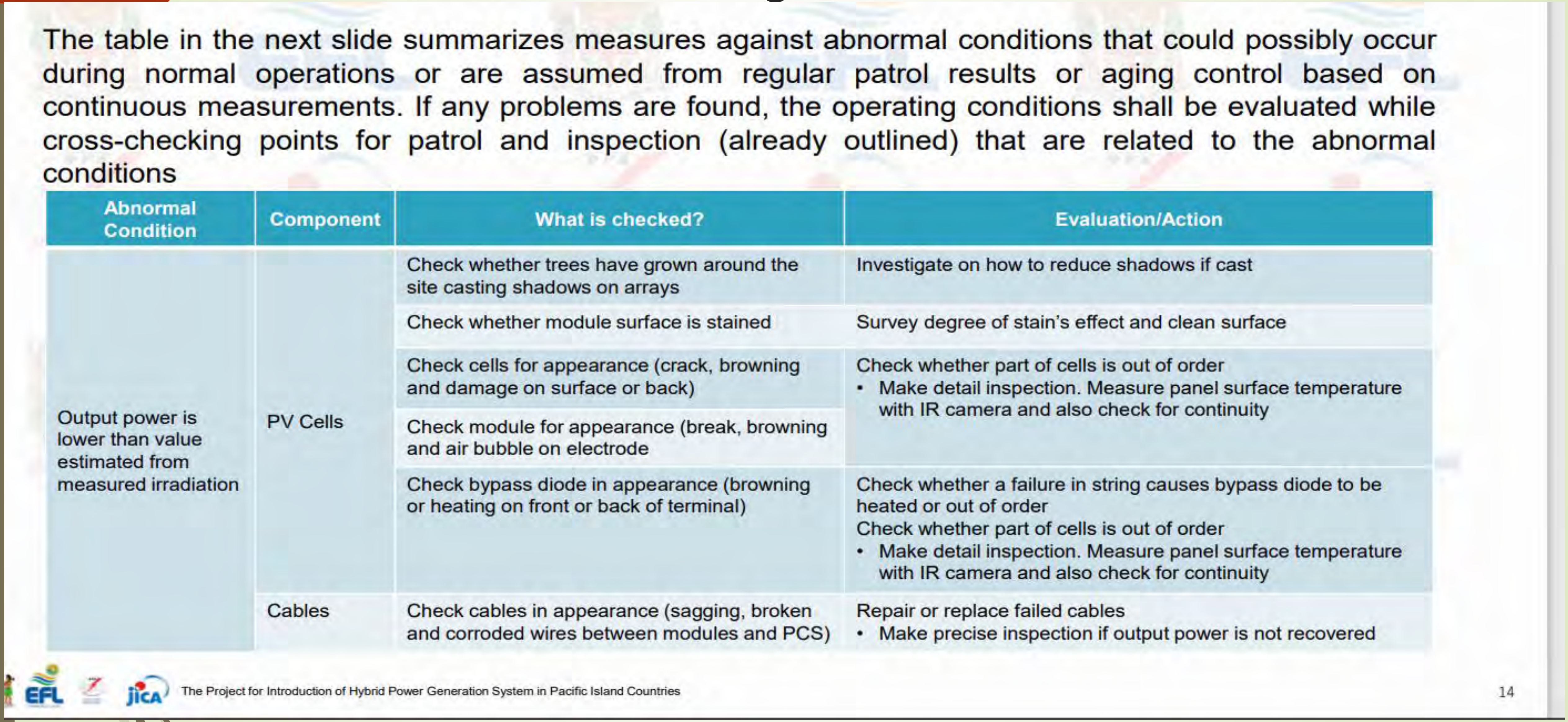


4. Aging process

5. Increase in Series Resistance
- ➢ Bad module solder joints. This could potentially start a fire due to series arc fault
- ➢ Undersized conductors and resistive interconnections due to corrosion in terminal blocks, inter-module , connectors in module junction box
- ➢ Module degradation due to aging

6. Leakage within PV circuit due to reduced shunt resistance
- ➢ Irradiance changes rapidly during measurement
- ➢ Shading and soiling

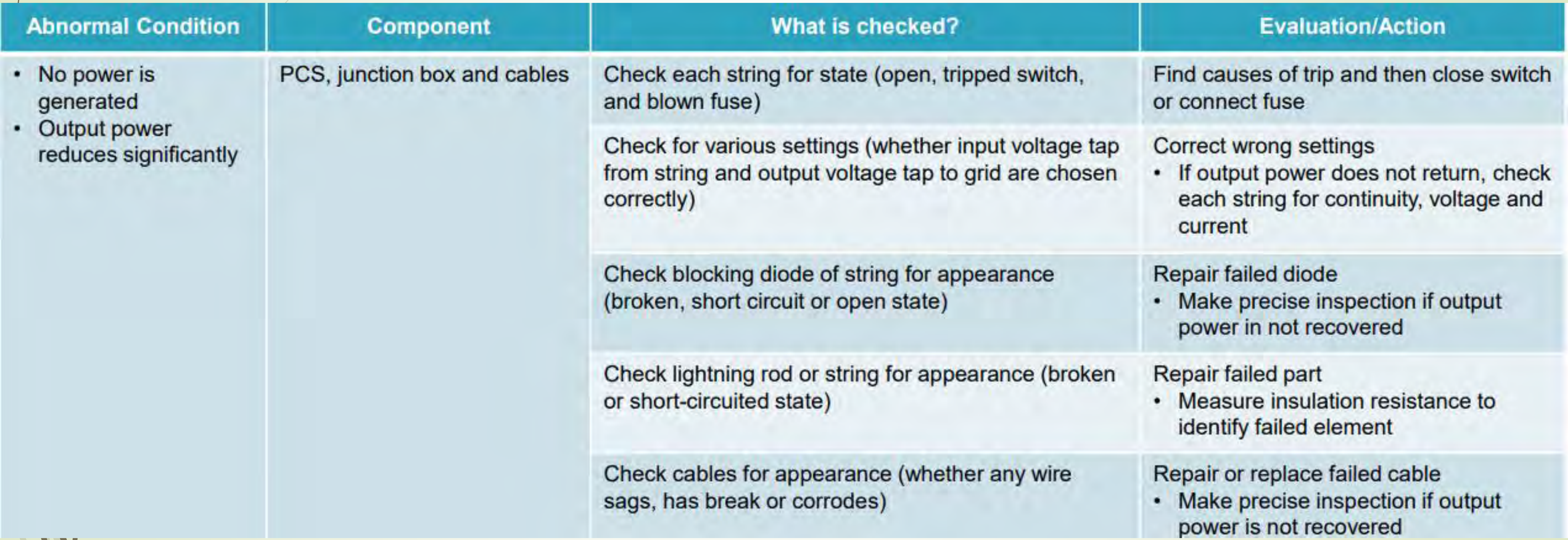
Troubleshooting



The table in the next slide summarizes measures against abnormal conditions that could possibly occur during normal operations or are assumed from regular patrol results or aging control based on continuous measurements. If any problems are found, the operating conditions shall be evaluated while cross-checking points for patrol and inspection (already outlined) that are related to the abnormal conditions

Abnormal Condition	Component	What is checked?	Evaluation/Action
Output power is lower than value estimated from measured irradiation	PV Cells	Check whether trees have grown around the site casting shadows on arrays	Investigate on how to reduce shadows if cast
		Check whether module surface is stained	Survey degree of stain's effect and clean surface
		Check cells for appearance (crack, browning and damage on surface or back)	Check whether part of cells is out of order • Make detail inspection. Measure panel surface temperature with IR camera and also check for continuity
		Check module for appearance (break, browning and air bubble on electrode	
		Check bypass diode in appearance (browning or heating on front or back of terminal)	Check whether a failure in string causes bypass diode to be heated or out of order Check whether part of cells is out of order • Make detail inspection. Measure panel surface temperature with IR camera and also check for continuity
	Cables	Check cables in appearance (sagging, broken and corroded wires between modules and PCS)	Repair or replace failed cables • Make precise inspection if output power is not recovered

Troubleshooting



Abnormal Condition	Component	What is checked?	Evaluation/Action
• No power is generated • Output power reduces significantly	PCS, junction box and cables	Check each string for state (open, tripped switch, and blown fuse)	Find causes of trip and then close switch or connect fuse
		Check for various settings (whether input voltage tap from string and output voltage tap to grid are chosen correctly)	Correct wrong settings • If output power does not return, check each string for continuity, voltage and current
		Check blocking diode of string for appearance (broken, short circuit or open state)	Repair failed diode • Make precise inspection if output power in not recovered
		Check lightning rod or string for appearance (broken or short-circuited state)	Repair failed part • Measure insulation resistance to identify failed element
		Check cables for appearance (whether any wire sags, has break or corrodes)	Repair or replace failed cable • Make precise inspection if output power is not recovered

JICA Technical Cooperation Project for Introduction of Hybrid Power Generation System in Pacific Island Countries

13 June 2023

JICA Experts Team

To: Whom it concern.

Invitation to the 2nd Online Seminar for the Introduction of Hybrid Power Generation System (HPGS) in PICs (Kiribati)

Thank you very much for your kindly cooperation to proceed on the Project.

The JICA Experts team is organizing a seminar aimed at sharing the activities carried out within the framework of the Project of introduction of Hybrid Power Generation System in Pacific Countries.

In the seminar, JICA, main counterparts of Kiribati will give presentations regarding to the activities done, results, and learnings, improvements gained through the project.

On this occasion, I am very pleased to invite you all to attend this seminar as below .

Date : June 20 (Tuesday)
Hour: 13:00 to 16:00 (Kiribati time)
Connection: Zoom link
Https://us02web.zoom.us/j/82458391972
ID: 824 5839 1972
Passcode: seminar

Waiting for your kind participation,
Yours sincerely,

Luis Kakefuku
JICA Expert Team Leader

Attachment 】: Seminar Program

Public Utilities Board

Introduction of Hybrid Power Generation System (HPGS) in PICs (Kiribati)

Experience, knowledge, and expertise in maintenance and management of diesel power plants gained through the project

Contents

General knowledge on Diesel engines

- Introduction to Diesel engines
  - History and background – delivered through lectures.
  - Design – JICA enetech has helped us understand different designs
- Safety precaution – The most priority of all. “Life cannot be replaced”
- Operation and purpose of several engine parts
  - Basic flow diagrams – fuel, lube oil and cooling water lines
  - Operation of Governor – internal components and function
- Importance of preventive maintenance
- Specific fuel consumption test
  - Purpose
  - How to do it the right way

Overhaul on Daihatsu engines

- Attending on-site Daihatsu overhaul in Kumejima
- Preparation of Overhaul schedule
- Preparation of tools and spare parts
- Use of special tools – Bore gauges and micrometers
- Observe useful techniques:
  - Extraction of stuck liner – Use of hydraulic jack to snap up the liner
  - Load dumping test on the engine governor - to test for governor response to load changes
  - Installation of valve seats using dry ice
  - Crack test using colour check

Troubleshooting & advice

- Adjustment of exhaust gas temperatures
- Adjustment of combustion pressure
- Advice on:
  - Record sheets for engine parts measurements – simplified
  - Alternative fix to lack of spares – use of double old exhaust gaskets

Tips learned through regional trainings

- Site visits
  - Observe different types and sizes of diesel generators – pros and cons
- Learn through experience from other regional members
  - Maintenance tips
  - Incidents – cracked main bearings due to overhaul overdue
  - Safety
- Economic load dispatch
  - To ensure power stations operate efficiently
  - To be adopted after PUB get more generating sets
- Use of electrical and mechanical tools
- Knowledge and experience exchange

Suggestions

- Include
  - Specialized training on turbocharger
  - Hands-on trade skills – welding, drilling, machining
  - Lube oil analysis
- Provide support on spare part procurement – especially on Japanese made parts
- Provide another power station with bigger engines
  - Preferably medium and low speeds

Conclusion

- Continuous support and technical advice through email
- Special thanks to JICA, Mr Ogawa, Enetech engineering team, regional trainers from FIJI, fellow colleagues from other pacific islands and all people involved throughout this successful project

7 Capacity Assessment

7.1 2018-2019

August 2019
JICA Expert Team

The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries
July 2018 to June 2019 / Training Evaluation
(Kiribati)

1. Executive Summary

To achieve the project purpose for Kiribati in the project of the introduction of the Hybrid Power Generation System, two main outputs [1. Enhancement of an appropriate and economical system for O&M of Diesel Generators (DGs) and 2. Establishment of a methodology for appropriate planning and O&M of Renewable Energy (RE)] are required.

As activities for these two outputs, training on basic knowledge of DG's and RE was provided in the period July 2018 to June 2019

2. Trainer List

No.	**JCC Meeting**		**Core Trainer Name**	**Position**	**Comments**
	JCC1	**JCC2**			
1) Operation and Maintenance of Diesel Engine Generators					
1	●	●	Kirite Uriam	Lead Hand Mechanical, PUB	
2		●	Tebakabu Tion	Lead Hand Mechanical, PUB	
2) Plan for introduction of hybrid power generation systems					
1	●	●	Thomas Taoaba	Renewable Energy Planner	MISE
2	●	●	Teebwatia Takau	Generation Engineer, PUB	
3		●	Bauro Mikaere	Instrumentation & PV supervisor	
3) Operation and Maintenance of Renewable Energy generation system					
1	●		Ubaitoi Teurakai	Energy Technician	MISE
2	●		Bauro Mikaere	Instrumentation & PV supervisor	
3		●	Beria Oromita	Energy Technician	MISE
4		●	Lokea Itienang	Energy Technician	MISE
5		●	Tikoro Kirite	PV and instrumentation electrician	

3. Results

The training evaluation result for each task is shown in below tables. The Achievement evaluation of the trainers is the result of the discussion and judgment between the Experts Team members based in the average result of the level tests done in Fiji, second the active participation demonstrated during the training and third in the speed in knowledge acquisition during the practical training.

● **DEG Training (Kiribati)**	**Project Counterparts (Core trainers)**		**Other training participants**													
Name	Kirite Uriam (PUB)	Tebakabu Tion (PUB)	Taibuwa Tabutoa (PUB)	Nawaia Ataake (PUB)	Tebwatia Takau (PUB)	Bauro Mikaere (PUB)	Tikoro Tanua (PUB)	Akan Taati (PUB)	Amota T. (PUB)	Tabanou Betiota (PUB)	Takenteiti Tonana (PUB)	Tebike Aree (PUB)	Baiteke Henry (PUB)	Natanaera Ataia (PUB)	Ritene Ikaarau (PUB)	Kwairenga Korodea (PUB)
(1) Operation & Maintenance of DG	Mechanical		Mechanical		Mechanical	Electrical	Electrical	Mechanical	Mechanical	Mechanical	Mechanical	Electrical	Mechanical	Mechanical	Electrical	Electrical
Operation of DG																
1) Can start-up/stop engines	2	3														
2) Can control DG according to the grid load	2	2														
3) Can trouble shoot the plant in case of faults	2	2														
4) Can Black start procedures	2	3														
5) Can check parameters of the DG in operation (temperature, pressure, voltage, frequency, etc.)	2	3														
6) Can measure and calculate specific fuel consumption	2	2														
7) Can explain the concept of Economic Dispatch Control (EDC)	2	2														
8) Can manage operation (running hours, selection of DG, numbers of units, maintenance schedule, etc.)	2	2														
9) Any other specific ability to be mentioned																
Average	2.0	2.4														
Maintenance of DG																
1) Can plan maintenance schedule (spare parts, staff, arrangements, etc.)	2	3														
2) Can plan maintenance of equipment of the power house (overhead crane, boiler, incinerator, etc.)	2	3														
3) Can plan and coordinate daily, weekly, monthly maintenance works	2	3														
4) Can supervise periodical maintenance works(daily, weekly, monthly)	2	3														
5) Can trouble shoot the plant in case of faults	2	3														
6) Can manage the planning for overhaul works	2	2														
7) Can supervise overhaul works (use of special tools, measurement equipment, etc.)	2	2														
8) Any other specific ability to be mentioned																
Average	2.00	2.71														
Training of Operation and maintenance of DG (24/May～31/May/2018)																
Attendance days	3	4	5	–	5	5	5	5	5	4	2	5	5	2		
Mechanical Check Test	4	6	5	–	7	–	–	7	3	4	7	–	4	4		
Electrical Check Test	–	–	–	–	–	6	4	–	–	–	–	6	–	–		
Average	4	6	5	–	7	6	4	7	3	4	7	6	4	4		
Disel Power Generation Facility Overhaul Training in Kumejima (27/Sep～22/Oct/2018)																
1st Check Test	–	–	–	–	9	8	–	–	–	–	–	–	–	–		
2nd Check Test	–	–	–	–	10	10	–	–	–	–	–	–	–	–		
Average	–	–	–	–	9.5	9	–	–	–	–	–	–	–	–		
Training of Operation and maintenance of DG (07/Dec～13/Dec/2018)																
Attendance days	4	–	5	5	5	5	5	–	–	–	–	5	–	–	5	5
Mechanical Check Test	–	–	4	3	8	–	–	–	–	–	–	–	–	–	–	–
Electrical Check Test	–	–	–	–	–	9	9	–	–	–	–	0	–	–	5	3
Average	–	–	4	3	8	9	9	–	–	–	–	–	–	–	5	3
Evaluation results (Max 10)	4	6	4.5	3	8.2	8	6.5	7	3	4	7	6	4	4	5	3
Remarks, (JICA Expert team opinion) 3 : Well Done 2: Achieved 1 : One further step 0 : unachieved	1/ Experienced in maintenance. Need basic theorical traininng	1/ Experienced in maintenance. Need basic theorical traininng	1/ good participation in the traininng.	1/ good participation in the traininng.	2/ Good knowledge in DG's mechanical area.Need training in management.	2/ Good knowledge in DG's electrical area.Need training in management.	1/ good participation in the traininng. Fast acquisition of knowledges.	2/ good participation in the traininng.	1/ good participation in the traininng.	1/ good participation in the traininng.	2/ over average knowledge in maintenance.	1 /Need more training.	1 /Need more training.	1 /Need more training.	1 /Need more training.	1 /Need more training.

O&M for Diesel Engine Generators / YEAR GOAL ACHIEVEMENT Sheet /Kiribati(2018)

	Project Counterparts (Core trainers)		**Other training participants**		
Name	Kirite Uriam	Tebakabu Tion	Tebwatia Takau	Bauro Mikaere	Tikoro Tanua
General Evaluation	2	2	3	3	2

【Score Standard】3P：Well Done / 2P: Achieved / １P：One further step / ０P：unachieved

FY2018 (Basic knowledge learning)					
・Understanding of Diesel Generators type, structure, operation principle and characteristic.	2	2	2	2	1
・Understanding of mechanical devices on Diesel power generation. Purpose, type, characteristics etc. of each device.	2	1	2	2	1
・Understanding of electrical components on Diesel power generation. Purpose, type, characteristics etc. of each electrical panels, etc.	1	1	2	2	2
・Diesel engine performance curve, efficiency during operation, heat balance diagram, etc.	1	1	2	2	1
・Operation and control method of diesel power generation facilities (governor free, automatic control devices, etc.)	1	1	1	2	1
・Diesel generator Economical load distribution operation (EDC technology (basic knowledge・application))	1	1	1	1	1
・Operation supervisory monitoring method	1	1	1	2	1
・Proper maintenance of the diesel generation facility・(Electrical and Mechanical) Maintenance method (disassembly inspection item, cycle etc)	2	2	2	2	2
・Inspection after disassembly inspection	2	2	2	2	2
・Safety work training	2	2	2	2	2
***CP acquire the basic knowledge of DG power generation facility. (Composition, operation and maintenance)**	2	2	2	2	1
points	17	16	19	21	15
Full mark	22	22	22	22	22
score	77%	73%	86%	95%	68%

● **RE Training (Kiribati)**	**Project Counterparts (Core trainers)Nov.2018**						**Other training participants**	
Name	Thomas Taoaba (MISE)	Teebwatia Takau (PUB)	Bauro Mikaere (PUB)	Beria Oromita (MISE)	Lokea Itienang (MISE)	Tikoro Tanua (PUB)	Ubaitoi Teurakai (MISE)	Baraniho Bahaie (PUB)
Item	RE Planner	Mechanical	Electrical	Energy technician	Energy technician	Electrical	Energy technician	
(2) Planning, Operation & Maintenance of RE generation system								
Grid integration of RE								
1) Knowledge of the issues in RE integration (frequency, voltage etc.)	2	2	2	2	2		2	
2) Can explain the difference of short-term and long-term output fluctuation of RE and their effect on grid operation	2	2	2	2	2		2	
3) Can calculate the maximum capacity of RE for grid-interconnection, in consideration of the effect of frequency fluctuation (short term fluctuation)	2	2	2	2	2		2	
4) Can calculate the maximum capacity of RE for grid-interconnection, in consideration the effect of demand fluctuation (long term fluctuation) without battery storage system	2	2	2	2	2		2	
5) Can derive the optimum capacity of RE, in consideration of the total generation cost	2	2	2	2	2		2	
6) Can plan solar home systems, and mega solar facilities	1	2	1	2	2		3	
7) Knowledge of kind of solar panels, batteries, inverters, etc.(characteristics and frequent uses)	2	2	2	2	3		3	
8) Knowledge of RE grid interconnection guideline	2	2	2	2	3		2	
9) Any other specific ability to be mentioned								
Personal Average	1.9	2.0	1.9			#DIV/0!		
Operation & Maintenance of RE (PV)								
1) Can establish maintenance schedule and checklist	3	2	3	2	3		2	
2) Can conduct periodical maintenance works	3	2	3	2	3		2	
3) Can conduct troubleshooting in case of faults	2	2	3	2	3		2	
4) Can use measuring instruments for maintenance works	2	2	3	2	3		2	
5) Any other specific ability to be mentioned								
Average	2.5	2.0	3.0	2.0	3.0		2.0	
Training of Operation and maintenance of RE (19/Jun～25/Jun/2018)	RE Planner	Mechanical	Electrical	Energy technician	Energy technician	Electrical		
Attendance days	4	4	4	4	4	4	—	
RE Check Test	2	—	5	1	3	—	—	
Average	2	—	5	1	3	—	—	—
Training of Operation and maintenance of RE (22/Oct～26/Oct/2018)	RE Planner			Energy technician		Electrical		Electrical
Attendance days	4	—	—	4	—	4	—	2
RE Check Test	7	—	—	5	—	4	—	1
Average	7	—	—	5	—	4	—	1
Evaluation results (Max 10)	4.5	—	5	3	3	4	—	1
Remarks, (JICA Expert team opinion) 3: Well Done 2: Achieved 1 : One further step 0: unachieved	1/ Need more theorical knowledge on RE.	1/ Need more theorical knowledge on RE.	2/ Good knowledge on RE	1/Good acquisition of knowledge in maintenance. Need more theorical training	1/Good acquisition of knowledge in maintenance. Need more theorical training	1/Good acquisition of knowledge in maintenance. Need more theorical training	1/Good acquisition of knowledge in maintenance. Need more theorical training	1/Good acquisition of knowledge in maintenance. Need more theorical training

Grid Integration of RE Generation Systems / Year Goal Achievement Level Sheet / Kiribati(2018)

	Project Counterparts (Core trainers)			Other training participants		
Name	Thomas Taoaba	Tebwatia Takau	Bauro Mikaere	Tenikoria Katauea	Beria Oromita	Lokea Itienang
Comprehensive Evaluation	1	1	1	2	1	1

【Scoring Standard 】 3P：Well Done / 2P: Achieved / １P：Nearly achieved / ０P：Much room for impovement

FY 2018 (Acquisition of Basic Knowledge)						
・Impact on the power quality caused by implementation of RE.	2	2	2	2	1	1
・Basic knowledge of allowable amount of RE. (algebraic method, HOMER software)	1	1	1	2	1	1
・Basic knowledge of Hybrid systems	2	2	2	2	1	1
***CP will acquire the basic knowledge of Hybrid power generation.**	1	1	1	2	1	1
Points	6	6	6	8	4	4
Full mark	8	8	8	8	8	8
Score	75%	75%	75%	100%	50%	50%

RE Operation and Maintenance Training /Goal Achievement Level Sheet / Kiribati(2018)

	Project Counterparts (Core trainers)			Other training participants		
Name	Beria Oromita	Lokea Itienang	Tikoro Tanua	Bauro Mikaere	Thomas Taoaba	Tebike Asee
Comprehensive Evaluation	2	2	2	2	2	2

【Scoring Standard 】 3P：Well Done / 2P: Achieved / １P：Nearly achieved / ０P：Much room for impovement

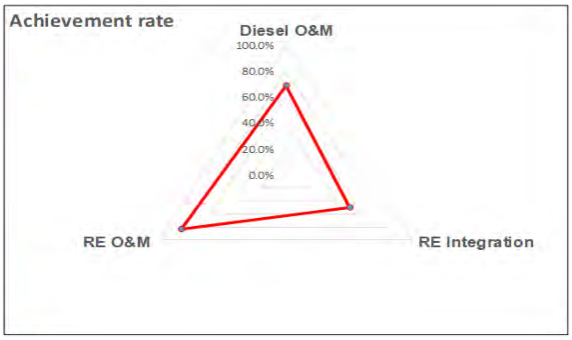
FY 2018 (Acquisition of Basic Knowledge)						
・Understanding of the types, structure, operation principle and characteristic of the solar cell.	2	2	2	2	2	1
・Role of peripheral equipment of solar power facilities (connection box, PCS, distribution board, etc.)	2	2	2	2	2	1
・How to process and utilize photovoltaic power generation measurement system (solar radiation intensity, total output power etc.)	1	1	1	2	2	1
・Plan and installation method of solar array (practical exercise)	1	1	1	2	2	1
・Summary from Plan to implementation of solar power system.	1	1	1	2	2	1
・Economic study.	0	0	0	2	2	0
・Appropriate maintenance of solar power generation system. Maintenance method (inspection item, cycle etc).	2	2	2	2	2	2
・Inspection after installation (IV checker, open circuit voltage, insulation resistance measurement, etc.)	2	2	2	2	2	2
・Training on working safely	2	2	2	2	2	2
***CP will acquire the basic knowledge of solar power generation facilities. (Composition, operation and maintenance)**	2	2	2	2	2	1
Points	15	15	15	20	20	12
Full mark	18	18	18	18	20	18
Score	83%	83%	83%	90%	100%	67%

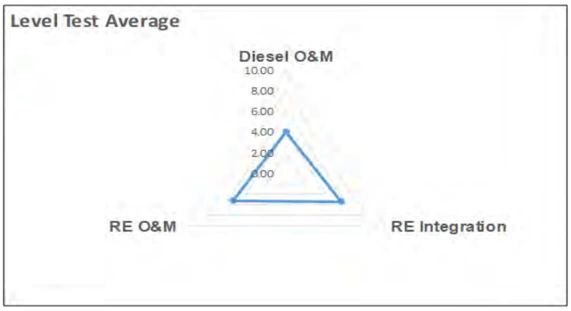
Diesel O&M		
Name	Test points	Achievement
Mika Kalele	4.83	68.2%
William Teipauli	2.00	68.2%
Tito Saosaoa	5.17	68.2%
Teafa Tautu		68.2%
Average	4.00	68.2%

RE Integration		
Name	Test points	Achievement
Fatoga Talama	4.0	75.0%
Polu Tanei	7.0	62.5%
Nielu Meisake	-	62.5%
Taaku Esikielu	-	0.0%
Average	5.50	50.0%

RE O&M		
Name	Test points	Achievement
Teafa Tautu	6.0	88.9%
Tito Saosaoa	4.0	72.2%
Fatoga Talama	4.0	77.8%
Polu Tanei	7.0	94.4%
Average	5.25	83.3%

TEC average	Test points	Achievement
Diesel O&M	4.00	68.2%
RE Integration	5.5	50.0%
RE O&M	5.25	83.3%


Achievement rate


Level Test Average

End

7.2 2019-2020

May 2020
JICA Expert Team

The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries
July 2019 to June 2020 / Training Evaluation
(Kiribati)

1. Executive Summary

In order to achieve the purpose of "Introduction of hybrid power generation systems in Pic's" project, two main outputs "1. Enhancement of appropriate and economical system for O&M of Diesel Generators (DG's)," and "2. Establishment of the methodology for appropriate planning and O&M of Renewable Energy (RE)" are required.

As activities for these two outputs, following the training on basic knowledge of DG's and RE provided in FY 2018, the following training was provided in FY 2019.

- **Enhancement of appropriate and economical system for O&M of Diesel Generators (DG's)**

Training focused mainly in hands-on training such us measuring of fuel consumption rate, maximum explosion pressure (Pmax), vibration etc., also inspection of circuit breaker, measurement of the current and insulation resistance of auxiliary equipment to verify the operating state of the DG facility was conducted.

In the training for performing OH, training on using various measuring instruments provided by the JICA expert team was conducted. Necessary verification of spare parts (dimension), meters (pressure, temperature) in boards, conditions of circuit breakers, etc. and record of the measurement results using the necessary sheets was performed.

As a result of the training, it appears that the core trainers (Mr. Uriam and Mr. Tion) were able to achieve about 80% of the training objectives based on the tests conducted on-site and the findings from the expert team members.

The team of experts advises to PUB to regularly use the measuring instruments in order to increase the skill of the staff, which will result in an efficient operation and maintenance of the entire power plant.

- **Establishment of the methodology for appropriate planning and O&M of Renewable Energy (RE)**

Training focused on hands-on training was conducted to verify the actual operating status of PV facilities, training such as IV curve measurement and verification of strings connections using equipment provided by the JICA expert team, also update of inspection check sheet and manual of O&M was conducted.

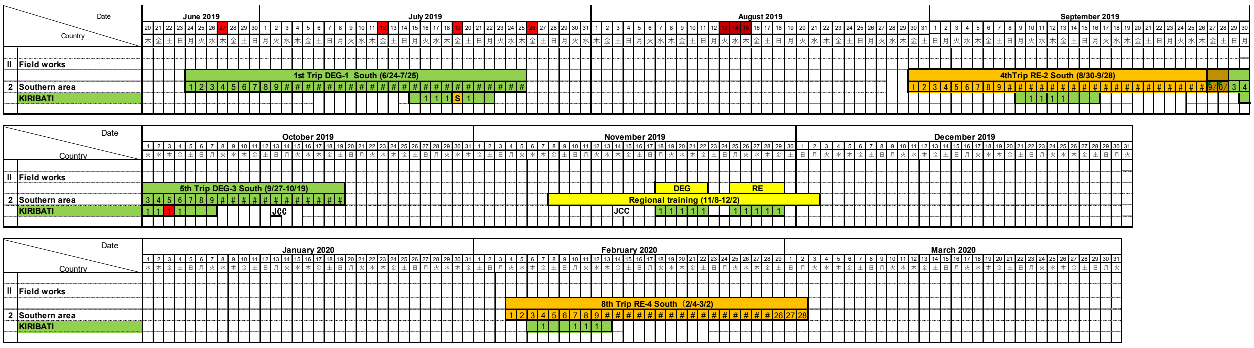
As a result of the training, it appears that the core trainers for RE were able to achieve about 72% of the training objectives in RE O&M based on the tests conducted on-site and the findings from the team members.

The expert team confirm that core trainer Mr. Bauro working on RE is the key person in conducting O&M of PV facilities. In the quarterly report received from Generation Manager Mr. Tenikoria, the expert team confirm that PV facilities are inspected following knowledge acquired in the training. We recommend PUB continuing to conduct periodic inspections using the updated inspection check sheets.

The training in how to calculate the maximum amount of RE interconnectable into the system using HOMER software, has yet to be achieved, so expert team will continue providing training in this area in the future.

Additionally, the expert team is planning to monitor the performance ratio value of PV facilities and also conduct training focusing on troubleshooting and cases study of integration of renewable energy in Okinawa.

2.Training schedule



3. Core Trainers (Set in JCC meeting)

No.	JCC Meeting			Core Trainer Name	Position	Comments
	JCC1	JCC2	JCC3			
1) Operation and Maintenance of Diesel Engine Generators						
1	●	●	●	Kirite Uriam	Lead Hand Mechanical, PUB	
2		●	●	Tebakabu Tion	Lead Hand Mechanical, PUB	
2) Plan for introduction of hybrid power generation systems						
1	●	●	●	Thomas Taoaba	Renewable Energy Planner	MISE
2	●	●	●	Teebwatia Takau	Generation Engineer, PUB	
3		●	●	Bauro Mikaere	Instrumentation & PV supervisor	
3) Operation and Maintenance of Renewable Energy generation system						
1	●			Ubaitoi Teurakai	Energy Technician	MISE
2	●			Bauro Mikaere	Instrumentation & PV supervisor	
3		●	●	Beria Oromita	Energy Technician	MISE
4		●	●	Lokea Itienang	Energy Technician	MISE
5		●	●	Tikoro Kirite	PV and instrumentation electrician	

4. FY 2019 PUB & MISE counterparts training evaluation

Training contents	
1. DG	*CP have the capacity to perform disassembly inspection, verification of spare parts condition and measurement of operation parameters (Pmax, fuel consumption rate, etc.) Writing of inspection record sheets.
2. RE integration	*CP will acquire more detailed knowledge regarding to Hybrid power generation.
3. RE O&M	*CP will have the capacity to perform implementation plan, operation training in-house, maintenance planning, inspection, and prepare, manage, and analyze work reports.

Results

The training evaluation result for each task is shown in below tables.

The Achievement evaluation of the trainers is the result of the discussion and judgment between the Experts Team members based first in the average result of the level tests done in Tarawa and Fiji regional training, second the active participation demonstrated during the training and third in the speed in knowledge acquisition during the practical training.

Diesel O&M

Name	Test points	Achievement
Kirite Uriam	7.00	81.3%
Tebakabu Tion	7.25	81.3%
Tebwatia Takau	10.00	100.0%
Bauro Mikaere	9.00	100.0%
Taibuwa Tabutoa	7.00	76.5%
Tikoro Tanua	8.33	87.5%
Average	8.10	87.7%

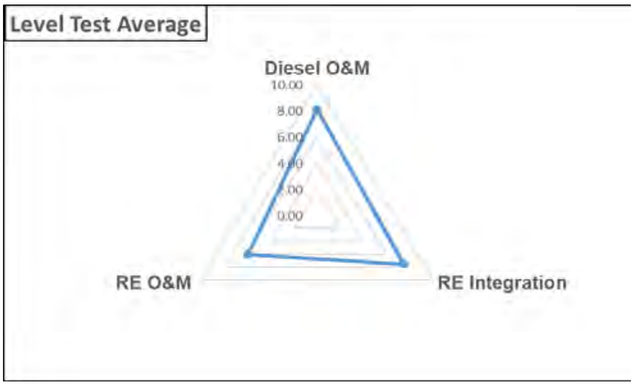
RE Integration

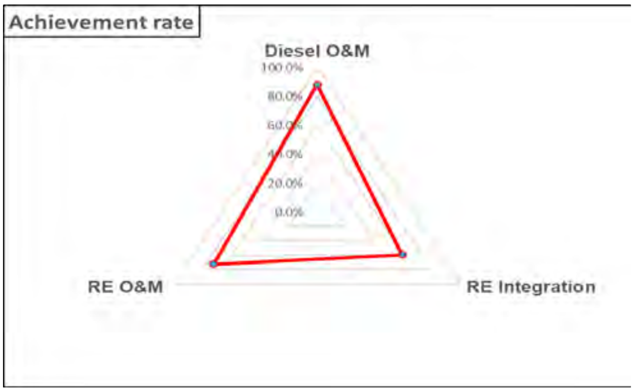
Name	Test points	Achievement
Thomas Taoaba	-	50.0%
Teebwatia Takau	-	57.1%
Bauro Mikaere	7.5	71.4%
Average	7.5	59.5%

RE O&M

Name	Test Points	Achievement
Beria Oromita	-	-
Lokea Itienang	-	-
Tikoro Tanua	-	75.0%
Tebike Asee	6	70.0%
Average	6.00	72.5%

PUB / MISE average	Test Points	Achievement
Diesel O&M	8.10	87.7%
RE Integration	7.5	59.5%
RE O&M	6.00	72.5%





● **DG Training (Kiribati)**	**Project Counterparts (Core trainers)**		**Other training participants**									
Name / Skill	Kirite Uriam (PUB)	Tebakabu Tion (PUB)	Taibuwa Tabutoa (PUB)	Tebwatia Takau (PUB)	Bauro Mikaere (PUB)	Tikoro Tanua (PUB)	Amota T. (PUB)	Takenteiti Tonana (PUB)	Tebike Asee (PUB)	Taerea Tekakoro (PUB)	Natanaera Ataia (PUB)	Ritene Ikaarau (PUB)
	Mechanical	Mechanical	Mechanical	Generation Engineer	Instrument & PV supervisor	PV & instrument electrician	Mechanical	Mechanical	Electrician	Mechanical	Mechanical	Electrician
(1) Operation & Maintenance of DG												
Operation of DG												
1) Can start-up/stop engines	2	3										
2) Can control DG according to the grid load	2	2										
3) Can trouble shoot the plant in case of faults	2	2										
4) Can Black start procedures	2	3										
5) Can check parameters of the DG in operation (temperature, pressure, voltage, frequency, etc.)	2	3										
6) Can measure and calculate specific fuel consumption	2	2										
7) Can explain the concept of Economic Dispatch Control (EDC)	2	2										
8) Can manage operation (running hours, selection of DG, numbers of units, maintenance schedule, etc.)	2	2										
9) Any other specific ability to be mentioned												
Average	2.0	2.4										
Maintenance of DG												
1) Can plan maintenance schedule (spare parts, staff, arrangements, etc.)	2	3										
2) Can plan maintenance of equipment of the power house (overhead crane, boiler, incinerator, etc.)	2	3										
3) Can plan and coordinate daily, weekly, monthly maintenance works	2	3										
4) Can supervise periodical maintenance works(daily, weekly, monthly)	2	3										
5) Can trouble shoot the plant in case of faults	2	3										
6) Can manage the planning for overhaul works	2	2										
7) Can supervise overhaul works (use of special tools, measurement equipment, etc.)	2	2										
8) Any other specific ability to be mentioned												
Average	2.00	2.71										
Training of Operation and maintenance of DG (July 16 ～July 20, 2019)												
Attendance days (max 4 days)	4	-	4	4	4	4	-	-	2	4	1	4
Mechanical level Test	7	0	6	10	-	-	0	0	-	6	7	-
Electrical level Test	-	0	-	-	9	8	0	0	5	-	-	5
Average	7	0	6	10	9	8	0	0	5	6	7	5
Training of Operation and maintenance of DG (October 1 ～October 4, 2019)												
Attendance days (max 4 days)	2	1	2	3	4	4	1	2	4	4	2	4
Mechanical level Test	7	7	8	10	-	-	3	6	-	6	3	-
Electrical level Test	-	-	-	-	9	9		-	4	-	-	5
Average	7	7	8	10	9	9	3	6	4	6	3	5
Regional Training of DG in FIJI (November 18 ～November 22, 2019)												
Attendance days (max 5 days)	-	5	-	-	-	5	-	-	-	-	-	-
Level Test	0	7.5	0	0	0	8	0	0	0	0	0	0
Average	0	7.5	0	0	0	8	0	0	0	0	0	0
Evaluation results (Max 10)	7	7.25	7	10	9	8.33	3	6	4.5	6	5	5
Remarks, (JICA Expert team opinion) 3 : Well Done 2: Achieved 1 : One further step 0 : unachieved	2/ Experienced in maintenance. Need basic theorical traininng	2/ Experienced in maintenance. Need basic theorical traininng	2/ good participation in the traininng. Fast acquisition of knowledges.	3/ Good knowledge in DG's mechanical area.Need training in management.	3/ Good knowledge in DG's electrical area.Need training in management.	2/ good participation in the traininng. Fast acquisition of knowledges.	1 /Need more training.	2/ over average knowledge in maintenance.	1 /Need more training.	1 /Need more training.	1 /Need more training.	1 /Need more training.

※Total evaluation is made if the trainer has participate in more than 2 (two) training.

● **RE Integration Training (Kiribati)**	**Core trainers**			**Other training participants**				
Name / Skill	Thomas Taoaba (MISE)	Teebwatia Takau (PUB)	Bauro Mikaere (PUB)	Tikoro Tanua (PUB)	Tebike Asee (PUB)			
	RE Planner	Generation Engineer	Instrument & PV supervisor	PV & instrument electrician	PV technician	Electrician	Electrician	-
(2) Planning, Operation & Maintenance of RE generation system								
Grid integration of RE								
1) Knowledge of the issues in RE integration (frequency, voltage etc.)	2	2	2					
2) Can explain the difference of short-term and long-term output fluctuation of RE and their effect on grid operation	2	2	2					
3) Can calculate the maximum capacity of RE for grid-interconnection, in consideration of the effect of frequency fluctuation (short term fluctuation)	2	2	2					
4) Can calculate the maximum capacity of RE for grid-interconnection, in consideration the effect of demand fluctuation (long term fluctuation) without battery storage system	2	2	2					
5) Can derive the optimum capacity of RE, in consideration of the total generation cost	2	2	2					
6) Can plan solar home systems, and mega solar facilities	1	2	1					
7) Knowledge of kind of solar panels, batteries, inverters, etc.(characteristics and frequent uses)	2	2	2					
8) Knowledge of RE grid interconnection guideline	2	2	2					
9) Any other specific ability to be mentioned								
Personal Average	1.9	2.0	1.9					
Operation & Maintenance of RE (PV)								
1) Can establish maintenance schedule and checklist	3	2	3	2				
2) Can conduct periodical maintenance works	3	2	3	2				
3) Can conduct troubleshooting in case of faults	2	2	3	2				
4) Can use measuring instruments for maintenance works	2	2	3	2				
5) Any other specific ability to be mentioned								
Average	2.5	2.0	3.0	2.0				
Training of Operation and maintenance of RE (September 10 ～ September 13, 2019)								
Attendance days (max 4 days)	-	4	4	-	-			
RE Check Test	0	10	9	-	-			
Average	0	10	9	−	-			
Training of Operation and maintenance of RE (February 7～ February 12, 2020)	コロナウイルスによる渡航負荷能							
Attendance days (max 4 days)	-	-	-	-	-	-	-	-
RE Check Test	-	-	-	-	-	-	-	-
Average	-	-	-	-	−	−	−	−
Regional Training of DG in FIJI (November 25 ～November 29, 2019)								
Attendance days (max 5 days)	-	-	5	-	-	−	−	−
Level Test	-	-	6	-	−	−	−	−
Average	-		6	-	−	—	—	—
Evaluation results (Max 10)	-	-	7.5	—	-	−	−	−
Remarks, (JICA Expert team opinion) 3: Well Done 2: Achieved 1: One further step 0: unachieved	1/ Need more participation in the training.	1/ Need more participation in the training.	2/ Good knowledge on RE					

● **RE O&M Training (Kiribati)**	**Core trainers**						**Other training participants**				
Name / Skill	Thomas Taoaba (MISE)	Teebwatia Takau (PUB)	Bauro Mikaere (PUB)	Beria Oromita (MISE)	Lokea Itienang (MISE)	Tikoro Tanua (PUB)	Ubaitoi Teurakai (MISE)	Tebike Asee (PUB)	Ritene Ikaarau	Baraniho Bahaie	Tororo Tiwin
	RE Planner	Generation Engineer	Instrument & PV supervisor	Energy technician	Energy technician	PV & instrument electrician	Energy technician	PV technician	Electrician	Electrician	-
(2) Planning, Operation & Maintenance of RE generation system											
Grid integration of RE											
1) Knowledge of the issues in RE integration (frequency, voltage etc.)	2	2	2	2	2		2				
2) Can explain the difference of short-term and long-term output fluctuation of RE and their effect on grid operation	2	2	2	2	2		2				
3) Can calculate the maximum capacity of RE for grid-interconnection, in consideration of the effect of frequency fluctuation (short term fluctuation)	2	2	2	2	2		2				
4) Can calculate the maximum capacity of RE for grid-interconnection, in consideration the effect of demand fluctuation (long term fluctuation) without battery storage system	2	2	2	2	2		2				
5) Can derive the optimum capacity of RE, in consideration of the total generation cost	2	2	2	2	2		2				
6) Can plan solar home systems, and mega solar facilities	1	2	1	2	2		3				
7) Knowledge of kind of solar panels, batteries, inverters, etc.(characteristics and frequent uses)	2	2	2	2	3		3				
8) Knowledge of RE grid interconnection guideline	2	2	2	2	3		2				
9) Any other specific ability to be mentioned											
Personal Average	1.9	2.0	1.9	2.0	2.3	#DIV/0!		#DIV/0!		#DIV/0!	
Operation & Maintenance of RE (PV)											
1) Can establish maintenance schedule and checklist	3	2	3	2	3		2				
2) Can conduct periodical maintenance works	3	2	3	2	3		2				
3) Can conduct troubleshooting in case of faults	2	2	3	2	3		2				
4) Can use measuring instruments for maintenance works	2	2	3	2	3		2				
5) Any other specific ability to be mentioned											
Average	2.5	2.0	3.0	2.0	3.0	#DIV/0!	2.0	#DIV/0!			
Training of Operation and maintenance of RE (September 10 ～ September 13, 2019)											
Attendance days (max 4 days)	-	4	4	-	-	3	-	3	3	3	3
RE Check Test	0	10	9	0	0	9	0	3	6	1	6
Average	0	10	9	0	0	9	0	3	6	1	6
Training of Operation and maintenance of RE (February 7～ February 12, 2020)	コロナウイルスによる渡航負荷能										
Attendance days (max 4 days)	-	-	-	-	-	-	-	-	-	-	-
RE Check Test	-	-	-	-	-	-	-	-	-	-	-
Average	-	-	-	-	-	-	-	–	–	–	–
Regional Training of DG in FIJI (November 25 ～November 29, 2019)											
Attendance days (max 5 days)	-	-	5	-	-	-	-	5	–	–	–
Level Test	-	-	6	-	-	-	-	9	–	–	–
Average	-		6			-	-	9	—	—	—
Evaluation results (Max 10)	-	-	7.5	-	-	-	—	6	–	–	–
Remarks, (JICA Expert team opinion) 3: Well Done 2: Achieved 1 : One further step 0: unachieved	1/ Need more participation in the training.	1/ Need more participation in the training.	2/ Good knowledge on RE	1/ Need more participation in the training.	1/ Need more participation in the training.	1/Good acquisition of RE knowledge Need more theorical Knowledge		2/Good acquisition of RE knowledge Need more theorical Knowledge			

※Total evaluation is made if the trainer has participate in more than 2 (two) training.

O&M for Diesel Engine Generators / YEAR GOAL ACHIEVEMENT Sheet /Kiribati(2019)

	Core trainers		Other training participants			
Name	Kirite Uriam	Tebakabu Tion	Tebwatia Takau	Bauro Mikaere	Taibuwa Tabuto	Tikoro Tanua
General Evaluation (2019)	2	2	3	3		2

【Score Standard 】3P：Well Done / 2P: Achieved / １P：One further step / ０P：unachieved

FY2018 (Basic knowledge learning)						
・Understanding of Diesel Generators type, structure, operation principle and characteristic.	2	2	2	2	-	1
・Understanding of mechanical devices on Diesel power generation. Purpose, type, characteristics etc. of each device.	2	1	2	2	-	1
・Understanding of electrical components on Diesel power generation. Purpose, type, characteristics etc. of each electrical panels, etc.	1	1	2	2	-	2
・Diesel engine performance curve, efficiency during operation, heat balance diagram, etc.	1	1	2	2	-	1
・Operation and control method of diesel power generation facilities (governor free, automatic control devices, etc.)	1	1	1	2	-	1
・Diesel generator Economical load distribution operation (EDC technology (basic knowledge・application))	1	1	1	1	-	1
・Operation supervisory monitoring method	1	1	1	2	-	1
・Proper maintenance of the diesel generation facility・(Electrical and Mechanical) Maintenance method (disassembly inspection item, cycle etc)	2	2	2	2	-	2
・Inspection after disassembly inspection	2	2	2	2	-	2
・Safety work training	2	2	2	2	-	2
***CP acquire the basic knowledge of DG power generation facility. (Composition, operation and maintenance)**	2	2	2	2	-	1
points	17	16	19	21	-	15
Full mark	22	22	22	22	-	22
score	77%	73%	86%	95%	-	68%

FY2019 (Use of inspection tools (OJT・Teoubleshooting)）						
・Review of 2018 training, comprehension test, complementary training.	2	2	2	2	2	2
・Calculation of fuel consumption rate, measurement of operation parameters of diesel engine, etc.	1	1	2	2	1	1
・Inspection of each section of diesel generators, troubleshooting.（mechanical and electrical OJT）	2	2	2	2	2	2
・Handling of mechanical measuring equipment（OJT)	2	2	2	-	2	-
・Handling of electrical measuring equipment（OJT)	-	-	-	2	-	2
・Verification, modification, addition of notes in the maintenance manual(electrical / mechanical)	1	1	2	2	1	1
・Mechanical and electrical fault case introduction	2	2	2	2	2	2
・Maintenance works report writing, keeping and supervision	1	1	2	2	1	2
***CP have the capacity to perform disassembly inspection, verification of spare parts condition and mesurement of operation parameters(Pmax, fuel consumption rate, etc.) Writing of inspection record sheets.**	2	2	2	2	2	2
points	13	13	16	16	13	14
Full mark	16	16	16	16	17	16
score	81%	81%	100%	100%	76%	88%

Grid Integration of RE Generation Systems / Year Goal Achievement Level Sheet / Kiribati(2019)

	Core trainers			Other training participants		
Name	Thomas Taoaba	Tebwatia Takau	Bauro Mikaere	Tenikoria Katauea	Beria Oromita	Lokea Itienang
General Evaluation (2019)	1	1	2			

【Scoring Standard 】3P：Well Done / 2P: Achieved / １P：Nearly achieved / ０P：Much room for impovement

FY 2018 (Acquisition of Basic Knowledge)						
・Impact on the power quality caused by implementation of RE.	2	2	2	2	1	1
・Basic knowledge of allowable amount of RE. (algebraic method, HOMER software)	1	1	1	2	1	1
・Basic knowledge of Hybrid systems	2	2	2	2	1	1
***CP will acquire the basic knowledge of Hybrid power generation.**	1	1	1	2	1	1
Points	6	6	6	8	4	4
Full mark	8	8	8	8	8	8
Score	75%	75%	75%	100%	50%	50%

Fiscal 2019 (Understanding of implementation plan of Hybrid system)						
・Review of 2018 training, comprehension test, supplemental training.	-	2	2			
・ Understanding of the permissible amount of renewable energy connected into the system. (algebraic method)	1	1	1			
・Control of Hybrid power generation system.（DG low load operation/PV output)	2	1	1			
・System simulation overview.	1	1	1			
・Outline and practice of HOMER software	1	1	1			
・Outline of performance ratio	1	1	2			
***CP will acquire more detailed knowlwdge regarding to Hybrid power generation.**	1	1	2			
Points	7	8	10	0	0	0
Full mark	14	14	14	14	14	14
Score	50%	57%	71%	0%	0%	0%

RE Operation and Maintenance Training /Goal Achievement Level Sheet / Kiribati(2019)

	Core trainers						Other training participants		
Name	Thomas Taoaba	Teebwatia Takau	Bauro Mikaere	Beria Oromita	Lokea Itienang	Tikoro Tanua	Tebike Asee		
General Evaluation (2019)	-	1	2	-	-	2	2		
【Scoring Standard 】3P：Well Done / 2P: Achieved / １P：Nearly achieved / ０P：Much room for impovement									
FY 2018 (Acquisition of Basic Knowledge)									
・Understanding of the types, structure, operation principle and characteristic of the solar cell.	2	2	2	2	2	2	1		
・Role of peripheral equipment of solar power facilities (connection box, PCS, distribution board, etc.)	2	2	2	2	2	2	1		
・How to process and utilize photovoltaic power generation measurement system (solar radiation intensity, total output power etc.)	2	2	2	1	1	1	1		
・Plan and installation method of solar array (practical exercise)	2	1	2	1	1	1	1		
・Summary from Plan to implementation of solar power system.	2	1	2	1	1	1	1		
・Economic study.	2	1	2	0	0	0	0		
・Appropriate maintenance of solar power generation system. Maintenance method (inspection item, cycle etc).	2	1	2	2	2	2	2		
・Inspection after installation (IV checker, open circuit voltage, insulation resistance measurement, etc.)	2	1	2	2	2	2	2		
・Training on working safely	2	2	2	2	2	2	2		
***CP will acquire the basic knowledge of solar power generation facilities. (Composition, operation and maintenance)**	2	2	2	2	2	2	1		
Points	20	15	20	15	15	15	12	0	0
Full mark	20	20	20	20	20	20	20	20	20
Score	100%	75%	100%	75%	75%	75%	60%	0%	0%
Fiscal 2019 (Understanding of implementation plan and operation method)									
・Review of 2018 training, comprehension test, supplemental training.	-	2	2	-	-	2	2		
・Preparation of the maintenance check sheet	-	1	2	-	-	2	1		
・Implementation and compilation of facility inspections using check sheets	-	1	2	-	-	2	2		
・ Measurement equipment operation practice (string tracer, cell line checker, insulation resistance meter)	-	1	2	-	-	2	2		
・Troubleshooting (breakage between modules, influence of shadow, etc.)	-	1	2	-	-	2	2		
・Fault case introduction.	-	1	2	-	-	2	2		
・Verification, modification, addition of content, etc. of the maintenance and operation manual.	-	1	2	-	-	1	1		
・Preparation of reports on operation and maintenance work as well as their storage and management.	-	1	2	-	-	1	1		
***CP will have the capacity to perform implementation plan, operation training in-house, maintenance planning, inspection, and prepare, manage, and analyze work reports.**	-	1	2	-	-	1	1		
Points	0	10	18	0	0	15	14	0	0
Full mark	20	20	20	20	20	20	20	20	20
Score	-	50%	90%	-	-	75%	70%	0%	0%

End

7.3　2020-2021

June, 2021
JICA Expert Team

The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries
July 2020 to June 2021 / Training Evaluation
(Kiribati)

1. Executive Summary

In order to achieve the objectives of the Project for Introduction of Hybrid Power Generation System in Pacific Island Countries, two main outputs "1. Enhancement of an appropriate and economical system for O&M of Diesel Generators (DG's)," and "2. Establishment of a methodology for appropriate planning and O&M of Renewable Energy (RE)" are required.

Since the JICA expert team could not conduct the necessary activities for these two outputs on site due to the Covid-19 pandemic, 12 online training sessions (6 for output 1 and 6 for output 2), 2 meetings to facilitate manual revision and other technical support through email correspondence was provided.

Following the training on DG O&M and RE integration and PV facility O&M provided on site in 2019, the following online training was provided from June 2020 to June 2021.

2. Training Contents

2.1 Enhancement of appropriate and economical system for O&M of Diesel Generators (DG's)

The first 2 online training sessions were a review of the lectures previously provided on site by the JICA expert team. From the third training session, new topics on the maintenance of DG's and auxiliary devices such as fuel storage tanks, turbocharger, heat exchangers were covered.

For overhaul works, videos on the maintenance of generators, circuit breakers, cylinder heads, pistons, main bearing, fuel injection valve, etc. were shown.

For operation of the power plant, lectures on operation analysis, planning the addition of DG's according to the power reserve, specific fuel consumption, improvement plan, preparation for periodic inspection, and blackout restoration procedures were conducted.

Also, the expert team assigned the main counterparts' homework such as monthly measurement of SFC, maximum explosion pressure (Pmax), vibration, preparation of OH schedule, and revision of the maintenance manual according to PUB standards.

As a result of the June 2020～June 2021 training, it appears that the core trainers Mr. Tebwatia, Takau and Mr. Tebakabu Tion were able to achieve about 74.5% of the training objectives based on the summary tests conducted in June 2021, the evaluation of the generation manager and also findings from the expert team members.

The team of experts advises to PUB DG counterparts to participate actively in the revision of the DG's O&M manual in order to increase the knowledge and skill which will result in an efficient operation and maintenance of the entire power plant.

Training No./ Date		**DG' s O&M On-line Training contents**
1	6/18/20	1. Basic knowledge of DG (each utility system) 2. Daily inspection of DG's, Pmax measurement, exhaust gas temperature verification and FO rack adjustment. 3. Description of electrical drawings (Single line, three lines, sequence diagram). 4. Fuel consumption calculation exercise.
2	7/29/20	1. Use of measuring instruments for mechanic side (Vernier calipers, micrometer, dial gauge). 2. Use of measuring instruments for electrical side (RTD, TC, pressure gauge) 3. Power plant operation. 4. Power plant improvement progress. 5. Revision of DG's O&M manual.
3	9/23/20	1. Safety 2. Basic knowledge of DG's. 3. DG maintenance. DK26 Daihatsu engine Cylinder head, starting valve maintenance video. 4. Periodic mechanical inspection. 5. Power plant improvement progress. 6. Fuel tank inspection. 7. Specific fuel consumption measurement.
4	10/21/20	1. Revision of the O&M manual 2. DG maintenance. DK26 Daihatsu engine. Fuel oil injection nozzle, pump, Piston and connecting rod, Main bearing maintenance video. 3. Turbocharger maintenance video. 4. Periodic mechanical inspection. 5. Power plant improvement progress.
5	1/27/21	1. Daily inspection. 2. Generator inspection. 3. Preparation of a Remote Island Power Plant Periodic Inspection Plant. 4. Power plant improvement progress. 5. Specific fuel consumption measurement.
6	5/26/21	1. Circuit breaker inspection. 2. Nondestructive Testing (Penetrant Testing, Magnetic Particle Testing). 3. Blackout restoration procedure. 4. Heat exchanger. 5. Power plant improvement progress. 6. Specific fuel consumption measurement.
7	7/16/21	1st DG O&M Revision Training
8		2nd DG O&M Revision Training

2.2 Establishment of the methodology for appropriate planning and O&M of Renewable Energy (RE)

As well as the training for the DG's O&M, on-line training was given in replacement of hands-on training in site. Following the review of past lectures, the contents of the training were as follow:

- RE integration

Review of past lectures, explanation of the effort in Okinawa to disseminate RE, Grid interconnection and operation (grid code, flow of grid interconnection, output control, etc.), output and frequency fluctuation mitigation control (ΔP & Δf control)

- RE (PV's facilities) Operation and maintenance

Regarding to operation, training focused to verify the actual operating status of PV facilities, such as overview and summary of measurement method of performance ratio, confirmation and evaluation of the current situation, PV power generation cost were done.

For maintenance topics, lectures of configuration of PV systems, patrol inspection, daily and periodic inspections, update of inspection check sheet, future maintenance system, schedule and budget were done.

Other main component of the RE training was focused in basic knowledge for formulation explanation and updating of the Hybrid power generation integration, O&M manual.

As a result of the training, it appears that the core trainers for RE integration Mr. Bauro Mikaere, Ms. Mary Rui were able to achieve about 77% of the training objectives. For Mr. Thomas Taoaba of MISE, the JICA expert team could not evaluate the achievement of the training objectives due he has not submitted the summary tests conducted in June 2021.

For RE O&M only Ms. Mary Rui achieved the objective of the training with about 76.3%, Mr. Beria Oromita and Mr. Lokea Itienang of MISE never participate in the 6 trainings held, so the JICA expert team could not evaluate their achievement of the training.

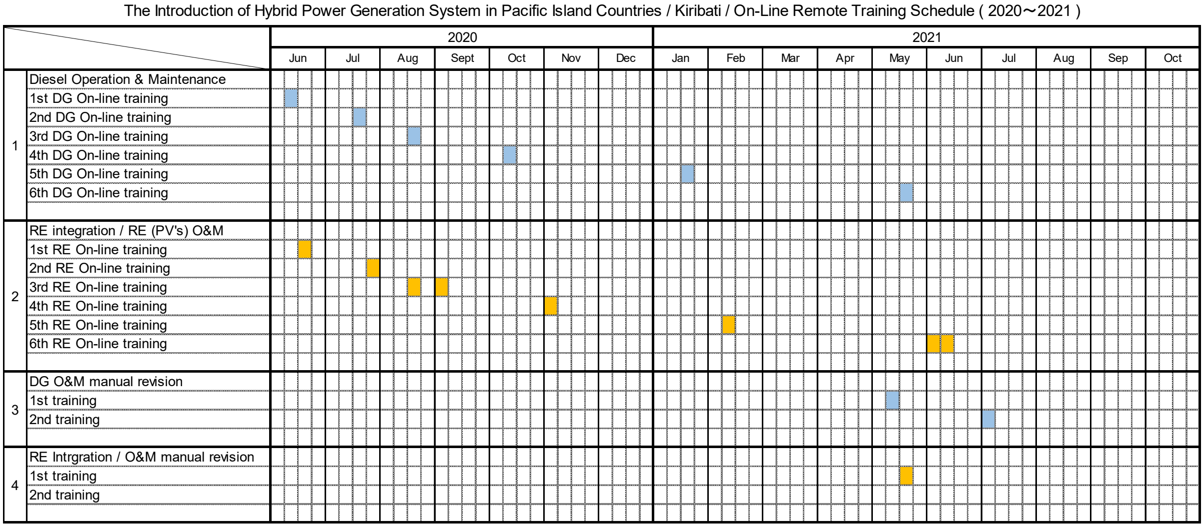
PV facilities are subject to the performance ratio indicator, so JICA expert team request the sharing of performance ratio measurements of PV facilities to monitor and give advises as is necessary.

Also, the expert's team advises to RE counterparts to participate actively in the revision of the RE integration, O&M manual in order to increase the knowledge and skill which will result in an efficient operation and maintenance of all facilities in Kiribati.

Training No. / Date		Training contents
1	7/1/20	1. Basic knowledge of Hybrid power generation system (HPGS)technology 2. Explanation of performance ratio 3. Basic knowledge for formulation, explanation and updating of the hybrid power generation planification manual 4. Q&A regarding PV maintenance
2	8/6/20	1. Basics of formulating and updating manual 1 ・ Explanation of facility system configuration, O&M ・ Patrol inspection, daily inspection, and periodic inspection ・ Inspection check sheet formulation and recording (method, frequency, etc.) 2. Basic knowledge for formulating and updating the hybrid power generation planning manual ・ Frequency fluctuation (system constant, algebraic method) 3. Performance ratio. ・ Overview and summary of measurement method ・ Confirmation, evaluation, and verification of the current situation 4. O&M manual revision. Requested revision of Chapter 1
3	9/3/20	1. Basic knowledge for formulating and updating the hybrid power generation planning manual 2. Basics of formulating and updating RE O&M manual 3. PV facility inspection ・ Power generation cost exercise 4. Performance ratio.
4	11/11/20	1. RE O&M manual revision (Chapter 1)

		2. Performance ratio 3. RE grid interconnection and operation (system stabilization method) ・ Output fluctuation mitigation control (ΔP control) ・ Frequency fluctuation mitigation control (ΔF control) 4. Example of efforts in Okinawa to disseminate RE ・ Yonaguni Hybrid System 5. Explanation of Plan of Operation (PO) 6. Future maintenance system and budget
5	2/18/21	1. Performance ratio ・ How to acquire solar radiation data (using NASA site) 2. Discussion on manual revision 3. Grid interconnection and operation of RE ・ Grid code (interconnection requirement) ・ Flow of grid interconnection ・ Operation (output control) *Case study 4. Future Maintenance System and Budget ・ Maintenance system ・ Maintenance budget ・ Assistance from other donors
6	6/11/21	1. Example of efforts in Okinawa to disseminate RE ・ Abu mega solar facility ・ Ogimi wind power facility (Proof research facility) ・ Control of power fluctuation (ΔP＆Δ f control) 2. Future maintenance system and budget 3. Future maintenance schedule plan
7	5/24/21	1st DG O&M Revision Training
8	7/27/21	2nd DG O&M Revision Training

3. Training schedule



The Introduction of Hybrid Power Generation System in Pacific Island Countries / Kiribati / On-Line Remote Training Schedule (2020～2021)

		2020							2021									
		Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
1	Diesel Operation & Maintenance																	
	1st DG On-line training	🟦																
	2nd DG On-line training		🟦															
	3rd DG On-line training			🟦														
	4th DG On-line training					🟦												
	5th DG On-line training								🟦									
	6th DG On-line training												🟦					
2	RE integration / RE (PV's) O&M																	
	1st RE On-line training	🟨																
	2nd RE On-line training		🟨															
	3rd RE On-line training			🟨	🟨													
	4th RE On-line training						🟨											
	5th RE On-line training									🟨								
	6th RE On-line training													🟨🟨				
3	DG O&M manual revision																	
	1st training												🟦					
	2nd training														🟦			
4	RE Intrgration / O&M manual revision																	
	1st training												🟨					
	2nd training																	

4. Core Trainers

	Core Trainer Name	Position	Comments
1) Operation and Maintenance of Diesel Engine Generators			
1	Teebwatia Takau	Generation Engineer	
2	Tebakabu Tion	Lead Hand Mechanical	
2) Plan for introduction of hybrid power generation systems			

1	Bauro Mikaere	Instrumentation & PV supervisor	
2	Mary Rui	Solar engineer	
3	Thomas Taoaba	RE Planner	MISE
3) Operation and Maintenance of Renewable Energy generation system			
1	Mary Rui	Solar engineer	
2	Beria Oromita	Energy technician	MISE
3	Lokea Itienang	Energy technician	MISE

4. FY 2020 PUB & MISE counterparts training evaluation

Training contents	
1. DG	・Review of 2020's training ・Handling of mechanical and electrical measuring equipment ・Inspection, troubleshooting of each part of diesel generator ・Update of power plant maintenance manual. *CP have the capacity to perform disassembly inspection, verification of spare parts condition and measurement of operation parameters (Pmax, fuel consumption rate, etc.)
2. RE integration	・Review of 2020's training ・Renewable energy grid interconnection and operation method. ・Examples of initiatives in Okinawa related to the spreading of renewable energy. ・Use of storage battery in power system. ・PV system design. ・Data measurement related to performance ratio calculation. ・Update of hybrid power generation planning manual. *CP will acquire more detailed knowledge regarding to Hybrid power generation.
3. RE O&M	・Review of 2020's training ・Operation and maintenance of PV system. ・Inspection check sheet revision and use. ・Practice in the use of measurement equipment (string tracer, cell line checker, insulation resistance meter) ・Revision of PV system O&M manual. *CP will have the capacity to perform maintenance planning, inspection, and prepare, manage, and analyze work reports.

Results

The training evaluation of the core counterparts was carried out by taken a consideration the result of the summary test, evaluation of the manager, attendance ratio and also, findings from the expert team members. The result for each task is shown in below tables.

June 2020 ～June 2021 / DG Core trainer evaluation result sheet

● **DG O&M Training (KIRIBATI / PUB)**	**Project Counterparts (Core trainers)**				
Name Skill	Teebwatia Takau	Tebakabu Tion			
	Generation Engineer	Lead Hand Mechanical			
Ⅰ.Attitude to training (max.25 points =10)					
1. Remote training participation (5 times)	1	2			
2. JICA Expert team (Attitude during the web training)	6	6			
3. Manager evaluation	9.2	8.4			
subtotal	16.2	16.4			
evaluation	6.5	6.6			
Ⅱ.Test (max.20 points=10)					
4. 2020 Summary test	9.3	7.3			
Ⅲ.Target skill (Plan)	**(Results)**				
・Review of 2019's training, comprehension test, complementary training.	Included in the 2020 summary test				
・Disassembly inspection, troubleshooting of each part of diesel generator. Continuation of training on electrical and mechanical OJT	Not carried out in site. It was done by remote training via videos.				
・Handling of mechanical measuring equipment （OJT）	Not carried out in site. It was done by remote training via videos.				
・Handling of electrical measuring equipment （OJT）	Not carried out in site. It was done by remote training via videos.				
・Trouble shooting	Remote trainings				
・Update of power plant maintenance manual.	In process yet				
・Verification, modification, addition of notes in the maintenance manual(electrical / mechanical)	In process				
・Improvements in power station	In process				
Evaluation from JICA Expert Team	7.00	6.00			
General evaluation	**2.28**	**2.19**			
Remarks, (JICA Expert team opinion) 3:Well Done 2: Achieved 1:One further step 0:unachieved	Need more attendance to the remote trainings ※1,	Need more attendance and active participation in the remote trainings ※1			

Comments
※1 Possibility of no attendance to the training due to works priority.
※2 No presentation of answer to the summary test. (Others reason)
※Total evaluation is made if the trainer has participate in more than 2 (two) trainings and presented the test

June 2020 ～June 2021 / RE Integration Core trainer evaluation result sheet

● **RE Integration Training (KIRIBATI / PUB / MISE)**	**Project Counterparts (Core trainers)**				
Name Skill	Mary Rui (PUB)	Bauro Mikaere (PUB)	Thomas Taoaba (MISE)		
	Solar engineer	Instrumentation & PV supervisor	RE Planner		
Ⅰ.Attitude to training (max.25 points=10)			aoaba		
1. Remote training participation (5 times)	2	5	2		
2. JICA Expert team (Attitude during the web training)	7	7	6		
3. Manager evaluation	8.2	9.8	N/A		
subtotal	17.2	21.8	8		
evaluation	6.9	8.7	4.0		
Ⅱ.Test					
4. 2020 Summary test	9.0	7.5	N/A		
Ⅲ.Target skill (Plan)	**(Results)**				
・Review of 2019 training, comprehension test, supplemental training.	Included in the 2020 summary test				
・Practice using HOMER software.	In process				
・Update of hybrid power generation planning manual.	In process				
・Renewable energy introduction roadmap planning method(1).	In process				
・Renewable energy grid interconnection and operation method(1).	In process				
・Examples of initiatives in Okinawa related to the spreading of renewable energy(1).	Done in on-line training				
・Use of storage battery in power system(1).	Done in on-line training				
・PV system design(1).	Next year				
・Data measurement related to performance ratio calculation	Done in on-line training				
Evaluation from JICA Expert Team	7.00	7.00	6.00		
General evaluation	**2.29**	**2.33**	**-**		
Remarks, (JICA Expert team opinion) 3: Well Done 2: Achieved 1: One further step 0: unachieved	New core trainer with active response to JICA team request.	Good attendance to the training ※2	Need more attendance and actively participation to the training		

Comments
※1 Possibility of no attendance to the training due to works priority.
※2 No presentation of answer to the summary test. (Others reason)
※Total evaluation is made if the trainer has participate in more than 2 (two) trainings and presented the test

June 2020 ～June 2021 / RE O&M Core trainer evaluation result sheet

● RE O&M Training (KIRIBATI / PUB / MISE)	Project Counterparts (Core trainers)				
Name Skill	Mary Rui (PUB)	Beria Oromita (MISE)	Lokea Itienang (MISE)		
	Solar engineer	Energy technician	Energy technician		
Ⅰ.Attitude to training (max.25 points=10)					
1. Remote training participation (5 times)	2	0	0		
2. JICA Expert team (Attitude during the web training)	7	0	0		
3. Manager evaluation	8.2	N/A	N/A		
subtotal	17.2	0	0		
evaluation	6.9	0.0	0.0		
Ⅱ.Test					
5. 2020 Summary test	9.0	N/A	N/A		
Ⅲ.Target skill (Plan)	**(Results)**				
・Review of 2019 training, comprehension test, supplemental training.	Included in the 2020 summary test				
・Operation and maintenance of PV system.	Done in on-line training				
・Revision of PV system operation manual.	In prosess				
・Analysis of PV equipment operation efficiency improvement (current situation, economic efficiency, planning (understand master plan)	Done in on-line training / Verification of performance ratio measurement values.				
・Check sheet revision	Done in on-line training				
・Operation and maintenance of existing PV system (use of check sheet)	Done in on-line training / Verification of check sheets.				
・Measurement equipment operation practice (string tracer, cell line checker, insulation resistance meter)	Done in on-line training / Verification of performance ratio measurement values.				
Evaluation from JICA Expert Team	7.00	0.00	0.00		
General evaluation	**2.29**	-	-		
Remarks, (JICA Expert team opinion) 3: Well Done 2: Achieved 1: One further step 0: unachieved	New core trainer with active response to JICA team request.	Verify the participation in the project, ※1,※2	Verify the participation in the project, ※1,※2		

Comments
※1 Possibility of no attendance to the training due to works priority.
※2 No presentation of answer to the test. (Others reason)
※Total evaluation is made if the trainer has participate in more than 2 (two) trainings and presented the test

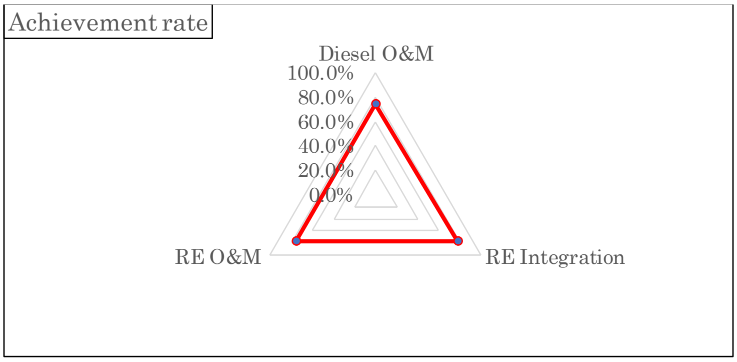
Summary

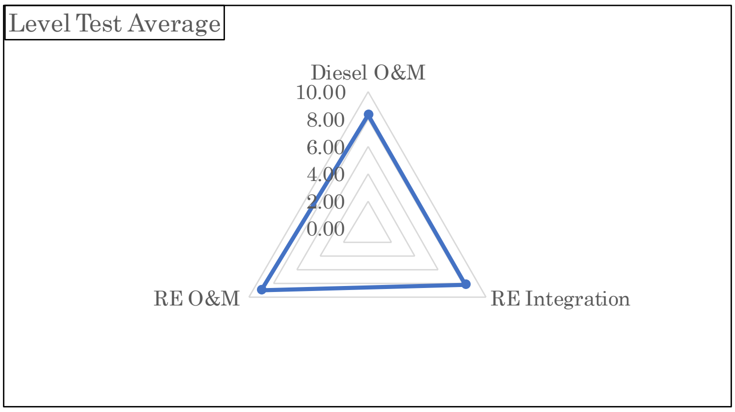
Diesel O&M		
Name	Test points	Achievement
Tebwatia Takau	9.30	76.0%
Tebakabu Tion	7.30	73.0%
Average	8.30	74.5%

RE Integration		
Name	Test points	Achivement
Mary Rui (PUB)	9.0	76.3%
Bauro Mikaere (PUB)	7.5	77.7%
Thomas Taoaba (MISE)	-	-
Average	8.3	77.0%

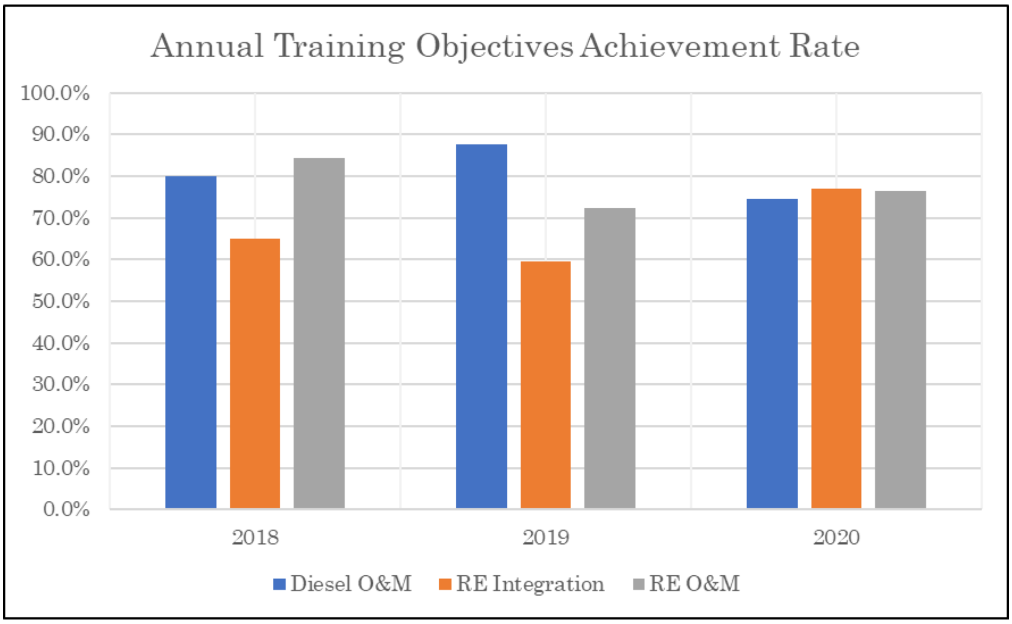
RE O&M		
Name	Test points	Achivement
Mary Rui (PUB)	9	76.3%
Beria Oromita (MISE)	-	-
Lokea Itienang (MISE)	-	-
Average	9.00	76.3%

TEC average	Test points	Achivement
Diesel O&M	8.30	74.5%
RE Integration	8.3	77.0%
RE O&M	9.00	76.3%





PUB average	2018	2019	2020
Diesel O&M	80.0%	87.7%	74.5%
RE Integration	65.0%	59.5%	77.0%
RE O&M	84.4%	72.5%	76.3%



End

7.4　2021-2022

November 2022
JICA Expert Team

The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries
July 2021 to June 2022 / Training Evaluation
(Kiribati)

1. Executive Summary

To achieve the project purpose for Kiribati in the project of the introduction of Hybrid Power Generation System, two main outputs [1. Enhancement of an appropriate and economical system for O&M of Diesel Generators (DGs) and 2. Establishment of a methodology for appropriate planning and O&M of Renewable Energy (RE)] are required.

From July 2021 through June 2022, as a result of the current COVID-19 pandemic, the JICA Expert Team was unable to conduct on site the necessary activities for these two outputs, so four online training sessions (two for DG and two for RE outputs), four meetings to support the manuals revision, fifteen support meetings during the unit #3 overhaul and also others technical advice to resolve issues in the power plant was provided. Additionally, in November 2021, PUB and MISE counterparts have participated in the 2nd Regional Online Training for DG and RE delivered by Fijian trainers.

2. Training Contents

2.1 Enhancement of an appropriate and economical System for O&M of Diesel Generators (DG)

Since the JICA Expert Team was not able to travel to Kiribati to conduct face-to-face hand-on training, via online training focusing mainly on improving knowledge of diesel engines, monitoring of fuel consumption, lectures on troubleshooting, and reviewing diesel engine O&M manuals were conducted. The contents of the trainings are detailed in the below table.

The result of the training in the period July 2021 to June 2022, shown that Mr. Teebwatia Taakau was able to achieve about 86% of the training objectives based on the rate of attendance to the online trainings, the test carried out after the 2nd Regional Online Training and the evaluations by his manager and the JICA Expert Team. Unfortunately, Mr. Tion Tebakabu and Mr. Kirite Uriam were not assessed because they did not attend the regional training due to their work priority, but they were replaced several times by Mr. Bauro Mikaere and Ms. Mary Rui who perform electrical maintenance work in the DG.

An important training during this period was the conducting of the unit #3 OH by PUB staff with online technical assistance of the JICA Expert Team. The assistance was based in three weekly online meetings, where works performed by PUB staff was verified by using daily works reports sent by email. The JICA Expert Team gave some advice according to the maintenance procedures carried out at Okinawa Electric Power.

The JICA Expert Team believes that this event has greatly helped PUB maintenance staff to increase their self-confidence in performing OH work without the assistance of foreign supervisors.

Another important activity in this period was the revision of the O&M manual. PUB core trainers have made good progress in this area with only 2 of the 5 chapters remain to be reviewed. The Expert Team advises DG counterparts to actively participate in the revision of the DGs O&M manual in order to improve knowledges and skills that will result in efficient operation and maintenance of the entire power plant.

Training No./ Date		**DG O&M Online Training contents**
1	7/7/21	1. DG Maintenance Manual Revision
2	1/9/21	1. Kiribati DG Manual updating schedule 20210802 rev1 2. Governor Fundamentals ver1 3. Heat Balance rev 03 4. Basics of Relays 5. Basics of Sequence Control 6. Kiribati Improvement Plan Report 7. Others (SFC, OH)
3	14/11/21 ～ 24/11/21	2nd Online Regional Training for Operation and Maintenance of DGs.
4	23/5/22	1. OH (Turbocharger) 2. Troubleshooting case study 3. Revision of O&M Manual 4. Specific fuel consumption 5. Power plant improvement plan

2.2 Establishment of a methodology for appropriate planning and O&M of Renewable Energy (RE)

As well as training for the DG O&M, online training was delivered instead of on-site face-to-face trainings. For the task of RE Integration, following the review of previous lectures, the contents of the online training were mainly focused on explaining the effort made in Okinawa to disseminate RE, increase knowledge in Grid interconnection and operation (grid code, flow of grid interconnection, output control, and others related topics).

For the task of RE (PV facilities) Operation and Maintenance, the online training was focused to verify the actual operating status of PV facilities, such as overview and summary of measurement method of performance ratio, confirmation and evaluation of the current situation.

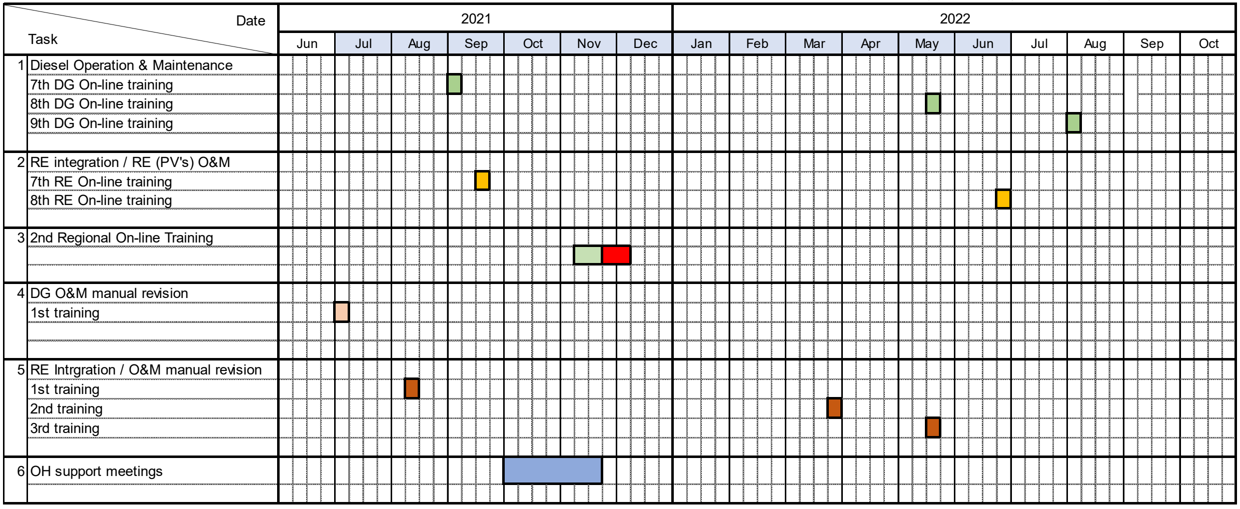
Another main component of the RE training was the updating of the Hybrid power generation system integration, O&M manual according to the local standard and conditions, discussions and explanations were conducted actively between PUB staff and JICA Expert Team.

The result of the overall training, shown that Ms. Mary Rui was able to achieve a very high score of 85.2% of the training objectives based on the summary test conducted after the 2nd Online Regional Training, the manager and JICA Expert Team evaluation and the attendance rate of online trainings. Unfortunately, the JICA Expert Team could not evaluate the achievement rate of Mr. Bauro Mikaele and Mrs. Tikoro Uriam from PUB and Mr. Simon Reiher, Mr. Beria Oromita and Mr. Burennata Teinamotuna from MISE for their low attendance rate to the trainings.

Training No. / Date		RE Online Training contents
1	18/8/21	1. 2nd RE Manual Revision Meeting
2	15/9/21	1. RE Manual Revision Training 2. Performance ratio 3. Discussion on facility inspection ・PV inspection records ・Advice and discussion on inspection work ・Review of PV inspection methods 4. Future maintenance system for O&M ・Establishment of maintenance system and personnel plan
3	29/11/21 ～ 09/12/21	1. 2nd Online Regional Training for Integration of RE, Operation and Maintenance of PV facilities.
4	29/3/22	1. 3rd RE Manual Revision Meeting
5	19/5/22	2. 4th RE Manual Revision Meeting
6	28/6/22	1. Performance ratio 2. RE Integration Planning ・Lecture - Kurima Island Community Microgrid Development 3. RE Manual Revision (Chapter 1) 4. RE Manual Revision (Chapter 2)

3. July 2021 to June 2022 Training schedule

The Introduction of Hybrid Power Generation System in Pacific Island Countries / Kiribati / On-Line Remote Training Schedule (2021～2022)



4. Core Trainers

No.	Core Trainer Name	Position	Comments
1) Operation and Maintenance of Diesel Engine Generators			

1	Teebwatia Taakau	Generation Engineer	
2	Tebakabu Tion	Lead Hand, Mechanical	
3	Kirite Uriam	Lead Hand, Mechanical	
2) Plan for introduction of hybrid power generation systems			
1	Bauro Mikaere	Instrumentation & control engineer	
2	Mary Rui	Solar PV engineer	
3	Simon Reiher	Urban Energy Planner	MISE
3) Operation and Maintenance of Renewable Energy generation system			
1	Mary Rui	Solar PV engineer	
2	Tikoro Uriam	Solar PV technician	
3	Beria Oromita	Energy technician	MISE
4	Burennata Teinamotuna	Energy technician	MISE

DG Remote training attendance record

	Date Name / Org.		2021										2022		Attend. Rate %
			2nd	7th	2nd Online Regional Training								8th	9th	
			7/7	9/1	11/15	11/16	11/17	11/18	11/19	11/22	11/23	11/24	5/23	8/4	
Core trainers	Uriam Kirite	PUB		1										1	16.7%
	Tebakabu Tion	PUB													0.0%
	Teebw atia Taakau	PUB	1	1	1	1	1	1	1		1		1	1	83.3%
	Bauro Mikaere	PUB	1	1	1	1	1	1	1	1	1		1	1	91.7%
	Mary Rui	PUB			1	1	1	1	1	1	1	1			66.7%
	Teariki Toani	PUB												1	
	Ziemingka Karotu	PUB												1	
	Taerea Takakoro	PUB												1	
	Takenteiti Tonana	PUB												1	

🟩 Remote training

🟧 Manual Revision

RE Remote training attendance record

	Date Name / Org.		2021											2022			Attend. Rate %
			2nd	7th	2nd Online Regional Training									3rd	4rd	8th	
			8/18	9/15	11/29	11/30	12/1	12/2	12/3	12/6	12/7	12/8	12/9	3/29	5/19	6/28	
Core trainers	Bauro Mikaere	PUB				1		1		1	1						28.6%
	Mary Rui	PUB	1	1	1	1	1	1		1	1	1	1	1	1	1	92.9%
	Tikoro Kirite (Ms.)	PUB	1												1		14.3%
	Thomas Taoaba	MISE		1													7.1%
	Beria Oromita	MISE															0.0%
	Lokea Itienang	MISE															0.0%
Observers	Baraniko Bakaie	PUB	1	1													
	Ritene Ikaarau	PUB	1	1													
	Teariki Toani	PUB	1														
	Taerea Takakoro	PUB		1													

🟨 Remote training

🟧 Manual Revision

5. PUB & MISE core trainers training evaluation

The training contents for the 3 task is shown in below table.

Training contents	
1. DG	・Review of past trainings ・Basics on DGs operation and control system ・Auxiliary devices of diesel generators ・Inspection, troubleshooting of diesel generator ・Update of power plant maintenance manual. *CP have the capacity to perform disassembly inspection, verification of spare parts condition and measurement of operation parameters through the OH works (Pmax, fuel consumption rate, etc.)
2. RE integration	・Review of 2020 trainings ・Renewable energy grid interconnection and operation method. ・Examples of initiatives in Okinawa related to the spreading of renewable energy. ・Use of storage battery in power system. ・Grid code. ・Data measurement related to performance ratio calculation. ・Update of hybrid power generation planning manual. *CP will acquire more detailed knowledge regarding to the implementation of Hybrid power generation.
3. RE O&M	・Review of past trainings ・Operation and maintenance method of PV system. ・Inspection check sheet revision and use. ・Revision of PV system O&M manual. ・Establishment of maintenance system and personnel plan *CP will have the capacity to perform maintenance planning, inspection, and prepare, manage, and analyze work reports.

Results

Below training evaluation sheet shown the punctuation of each task core trainer according to the attendance rate to the online trainings, the summary test after the 2nd Regional Online training and the evaluations by managers and the JICA Expert Team.

The PUB overall evaluation result is shown in the summary.

July 2021 ～June 2022 / DG Core trainer evaluation sheet

● **DG O&M Training (KIRIBATI / PUB)**	**Project Counterparts (Core trainers)**				
Name Skill	Teebwatia Taakau	Tebakabu Tion	Kirite Uriam		
	Generation Engineer	Lead Hand Mechanical	Lead Hand Mechanical		
Ⅰ.Attitude to training (max. 31 points =10)					
1. Remote training participation (3 times)	1.0	0.0	1.0		
2.Participation in the 2nd Regional Training (8 days)	6.0	0.0	0.0		
3.JICA Expert team (willingness to learn)	9.0	-	6.0		
4. Manager evaluation	9.8	8.4	9.4		
subtotal	25.8	8.4	16.4		
evaluation	8.3	2.7	5.3		
Ⅱ.Test (max.20 points=10)					
4. 2021 Summary test	8.5	N/A	N/A		
Ⅲ.Target skill (Plan)	**(Results)**				
・Review of 2020's training, comprehension test, complementary training.	Included in the 2021 summary test				
・OH works / Disassembly inspection, troubleshooting of each part of diesel generator. Continuation of training on electrical and mechanical OJT	Not carried out in site. It was done by remote training via videos.				
・ Handling of mechanical measuring equipment （OJT)	Not carried out in site. It was done by remote training via videos.				
・ Handling of electrical measuring equipment （OJT)	Not carried out in site. It was done by remote training via videos.				
･Trouble shooting	Online trainings				
・ Update of power plant maintenance manual.	In process yet				
･Verification, modification, addition of notes in the maintenance manual(electrical / mechanical)	In process				
･Improvements in power station	In process				
Evaluation from JICA Expert Team	9.0	-	7.0		
General evaluation (max10)	**8.7**	**-**	**-**		
Comments ※1 No attendance to the training due to works priority. ※2 No presentation of answer to the summary test. (Others reason) ※Basically the general evaluation is made if the trainer has participated in the regional training and presented the test.	Need more attendance to the remote trainings ※1,	Need to confirm his participation in the project. ※1、 ※2	Need more attendance and active participation in the remote trainings ※1, ※2		

July 2021 ～June 2022 / RE Integration Core trainer evaluation sheet

● RE Integration Training (KIRIBATI / PUB / MISE)	Project Counterparts (Core trainers)				
Name Skill	Mary Rui (PUB)	Bauro Mikaere (PUB)	Simon Reiher (MISE)		
	Solar engineer	Instrumentation & PV supervisor	Urban Energy Planner		
Ⅰ.Attitude to training (max.34 points=10)					
1. Remote training participation (5 times)	5.0	0.0	0.0		
2.Participation in the 2nd Regional Training (9 days)	8.0	4.0	0.0		
3.JICA Expert team (willingness to learn)	8.0	7.0	0.0		
4. Manager evaluation	9.8	8.8	6.2		
subtotal	30.8	19.8	6.2		
evaluation	9.1	5.8	1.8		
Ⅱ.Test					
4. 2020 Summary test	9.5	N/A	N/A		
Ⅲ.Target skill (Plan)	**(Results)**				
・ Review of 2020's training, comprehension test, supplemental training.	Included in the 2021 summary test				
・Renewable energy grid interconnection and operation method.	In process				
・ Examples of initiatives in Okinawa related to the spreading of renewable energy.	On-line training				
・Use of storage battery in power system.	On-line training				
・Grid code.	On-line training				
・Data measurement related to performance ratio calculation.	In process				
・Update of hybrid power generation operation and maintenance manual	In process				
Evaluation from JICA Expert Team	7.00	7.00	0.00		
General evaluation	**8.52**	(6.4)	-		
Comments ※1 No attendance to the training due to works priority. ※2 No presentation of answer to the summary test. (Others reason) ※Basically the general evaluation is made if the trainer has participated in the regional training and presented the test.	Good willingness to learn,	Need adjust the time in the work to participate in the trainings※1 ※12	Need attendance and actively participation to the training※1 ※2		

July 2021 ～June 2022 / RE O&M Core trainer evaluation sheet

● **RE O&M Training (KIRIBATI / PUB / MISE)**	**Project Counterparts (Core trainers)**					
Name Skill	Mary Rui (PUB)	Tikoro Uriam (PUB)	Beria Oromita (MISE)	Burennata Teinamotuna (MISE)		
	Solar PV engineer	Solar PV Technician	Energy technician	Energy technician		
Ⅰ.Attitude to training (max.34 points=10)						
1. Remote training participation (5 times)	5.0	2.0	0.0	0.0		
2.Participation in the 2nd Regional Training (9 days)	8.0	0.0	0.0	0.0		
3.JICA Expert team (willingness to learn)	8.0	7.0	0.0	0.0		
4. Manager evaluation	9.8	9.00	9.60	4.60		
subtotal	30.8	18	9.6	4.6		
evaluation	9.1	5.3	2.8	1.4		
Ⅱ.Test						
5. 2021 Summary test	9.5	-	N/A	N/A		
Ⅲ.Target skill (Plan)	**(Results)**					
・Review of 2020's training, comprehension test, supplemental training.	Included in the 2021 summary test					
・Operation and maintenance of PV system.	Online training					
・Revision of PV systemO&M manual.	In prosess					
・Analysis of PV equipment operation efficiency improvement (current situation, economic efficiency, planning (understand master plan)	Online training / Verification of performance ratio measurement values.					
・Inspection check sheet revision and use.	Online training					
・Operation and maintenance of existing PV system (use of check sheet)	Online training / Verification of check sheets.					
・Establishment of maintenance system and personnel plan						
Evaluation from JICA Expert Team	7.00	7.00	-	-		
General evaluation	**8.5**	(6.1)	-	-		
Comments ※1 No attendance to the training due to works priority. ※2 No presentation of answer to the summary test. (Others reason) ※Basically the general evaluation is made if the trainer has participated in the regional training and presented the test.	Very good core trainer with active participation in trainings	Returned to work after 2 years of study	Verify the participation in the project, ※1,※2	Verify the participation in the project,※1, ※2		

➢ Summary

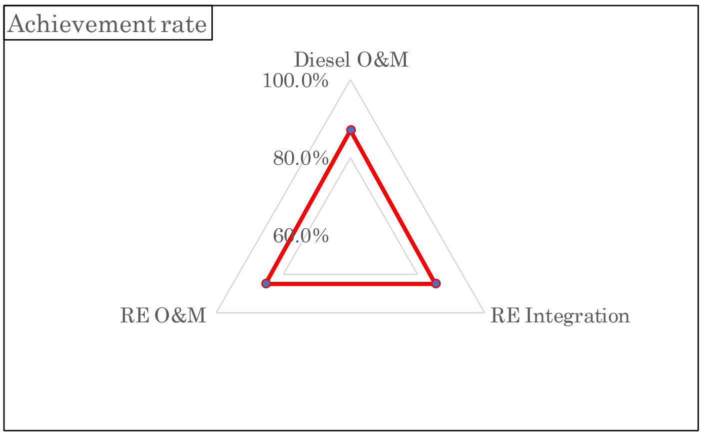
2021～2022 PUB counterparts training evaluation

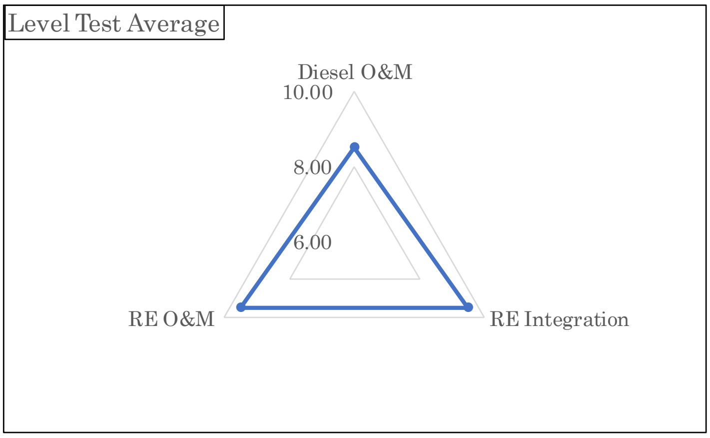
Diesel O&M		
Name	Test points	Achievement
Tebwatia Taakau	8.50	87.0%
Tebakabu Tion	-	-
Kirite Uriam	-	-
Average	8.50	87.0%

RE Integration		
Name	Test points	Achivement
Mary Rui (PUB)	9.5	85.2%
Bauro Mikaere (PUB)	-	-
Simon Reiher (MISE))	-	-
Average	9.5	85.2%

RE O&M		
Name	Test points	Achivement
Mary Rui (PUB)	9.5	85.2%
Tikoro Uriam	-	
Beria Oromita (MISE)	-	-
Burennata Teinamotuna (MISE)	-	-
Average	9.50	85.2%

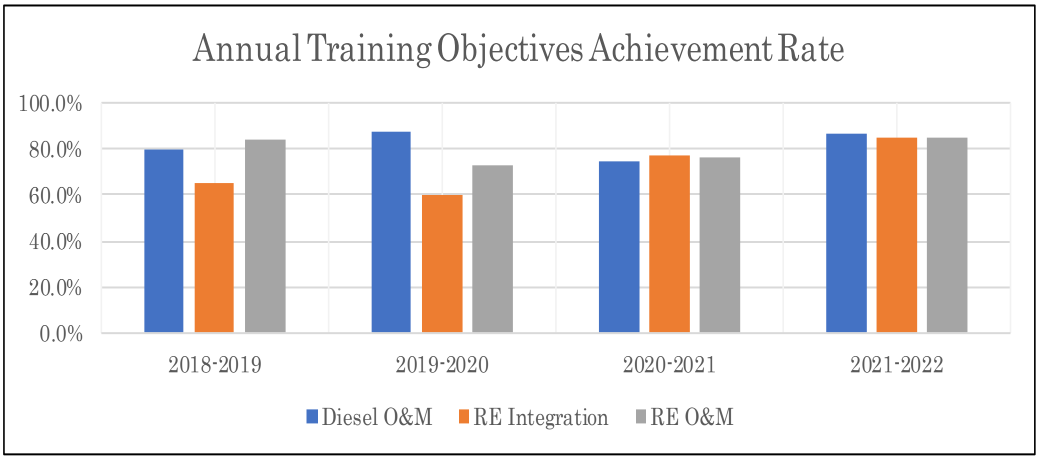
PUB average	Test points	Achivement
Diesel O&M	8.50	87.0%
RE Integration	9.5	85.2%
RE O&M	9.50	85.2%





Annual Training Objectives Achievement rate

PUB average	2018-2019	2019-2020	2020-2021	2021-2022
Diesel O&M	80.0%	87.7%	74.5%	87.0%
RE Integration	65.0%	59.5%	77.0%	85.2%
RE O&M	84.4%	72.5%	76.3%	85.2%



From above graph we can observe that

① DGs O&M Training

In the first phase of the project (2018 to 2019) a very good achievement rate was observed due to face-to-face training with closer communication between the JICA Expert Team and trainers. In 2020 the influence of covid-19 changed the teaching method to the online method which made a distancing between the JICA Expert Team and trainers which was getting clearer in 2022 where it was back to a high level of achievement rate of 87%.

The JICA Expert Team would like that in the remainder period of the project, the PUB core trainer could finish the DG O&M manual and also prepare future maintenance plan that must include the necessary budget. The JICA Expert Team will try to maintain close communication with PUB core trainers to complete above two tasks with the necessary technical assistance.

② RE Integration

In 2019 begins the influence of covid-19 which changes the teaching method to the online way that as same for DGs made a distancing between the JICA Expert Team and trainers. This distancing has decreased year over year due to active communication via online meetings. In addition, because this topic is more theoretical than practical, the online training enabled PUB trainers to achieve a very good level of performance of 80% over the period 2021-2022. In the remainder of the project, the JICA Expert Team expects the trainers to complete the revision of the manual on interconnection methods and operation of renewable energy grids, which is one of the main objectives of this task.

③ RE O&M

Due to the influence of COVID-19, the JICA Expert Team was not able to provide the hands-on training for the maintenance of PV facilities, despite of this, through the online trainings PUB core trainers achievement rate was 85.2%, around 9% more than the before period.

For the remainder of the project, the JICA team expects the completion of the O&M manual and the future maintenance plan, that are important material for the efficient operation of RE facilities.

End

7.5 2022-2023

June 2023
JICA Expert Team

The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries
July 2022 to April 2023 / Training Evaluation
(Kiribati)

1. Executive Summary

To achieve the project purpose for Kiribati in the project of the introduction of Hybrid Power Generation System, two main outputs [1. Enhancement of an appropriate and economical system for O&M of Diesel Generators (DGs) and 2. Establishment of a methodology for appropriate planning and O&M of Renewable Energy (RE)] are required.

As a result of the continuous COVID-19 pandemic since 2020 until October 2022, the JICA Expert Team was unable to conduct the necessary activities on site, so online training sessions have been provided. In October 2022, the expert team resumed the travel to Tarawa and conducted the 5th DG training on the site, while online training sessions have been also continued to support technical issues in the power plant and also to prepare the revision of the DG O&M and RE integration O&M manuals.

Additionally, in February 2023, the main counterparts of Kiribati have participated in the 3rd Regional Training for DG and RE, conducted by Fijian trainers in Lautoka training center, Fiji.

2. Training Contents

2.1 Enhancement of an appropriate and economical System for O&M of Diesel Generators (DG)

Training for DG O&M has been implemented in various forms depending on the situation, which includes 9th DG remote training and follow up (Aug 2022), 5th on site DG training (Oct, 2023), 3rd Online Follow up for Manual Revision (Nov, 2022), and 3rd Regional Training in Fiji (Feb, 2023). The contents of the trainings are detailed in the below table.

The result of the training in the period July 2022 to April 2023, shown that Mr. Teebwatia Taakau was able to achieve about 93.0% of the training objectives based on the rate of attendance to the online trainings, the test carried out after the 3rd Regional Training and the evaluations by his manager and the JICA Expert Team. Especially, Mr. Teebwatia scored 15 points out of 16 points in the test of the 3rd regional training, while Mr. Takenteiti Tonana scored 10 points.

Training No./ Date		DG O&M Training contents
1	4/Aug/2022	**9th DG remote training and follow up** ・Overview of the training ・Revision of O&M Manual] ・Specific fuel consumption measurement status ・Power plant improvement status

		・Confirm status of OH (Data update) ・Troubleshooting ・Other
2	4-8/Oct/2022	**5th DG On site training** ・Confirmation of current status of power plant ・Specific fuel consumption measurement ・Hands-on training in the use of measurement instruments ・Inspection of operation parameters (explosion pressure, exhaust gas temperature), adjustments in the engine. ・Maintenance of generator (Cleaning) ・Maintenance of circuit breaker ・Lectures in the use of electrical measurement instruments provided by the project.
3	15/Nov/2022	**3rd Follow up for Manual Revision (DG) (Online)** ・DG O&M Manual Revision
4	13-17/Feb/2023	**3rd Regional Training for DG O&M in Fiji** ・Safety / ・Preparation for OH / ・Operation of PS in EFL ・Measurement before starting OH / ・OH works ・Restoration / ・Commissioning / ・Measurement Instruments ・Documentation

2.2 Establishment of a methodology for appropriate planning and O&M of Renewable Energy (RE)

Two online trainings for manual revision support have been provided in August and December 2022. In addition, the 3rd Regional Training in Fiji has been implemented in February 2023.

The contents of the trainings are detailed in the below table.

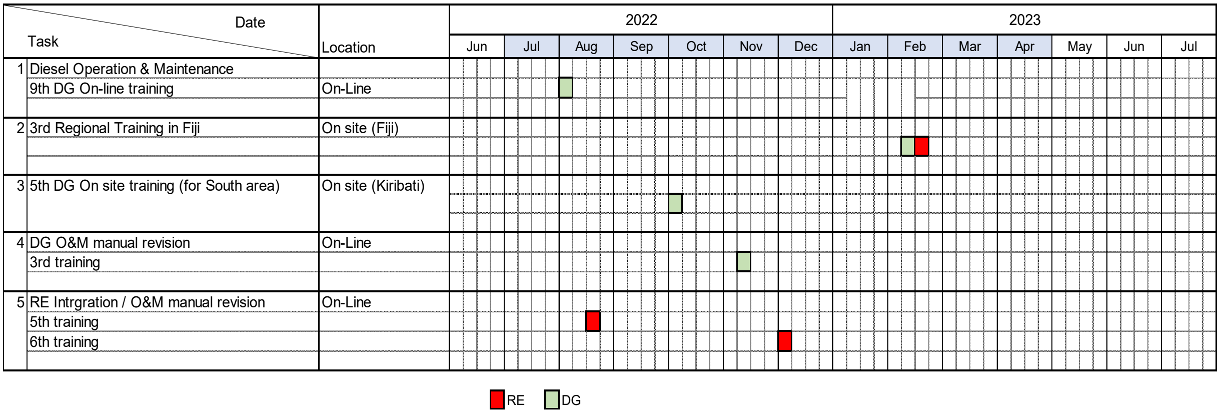
The result of the training in the period July 2022 to April 2023, shown that Ms. Mary Rui was able to achieve about 90% of the training objectives based on the rate of attendance to the online trainings, the test carried out after the 3rd Regional Training and the evaluations by his manager and the JICA Expert Team.

All of the three participants for the 3rd Regional Training got a score of 10 out of 12 at the evaluation test of the training.

Training No./ Date		**DG O&M Training contents**
1	23/Aug/2022	**5th Follow up for Manual Revision (RE) (Online)** ・RE integration / O&M Manual Revision
2	2/Dec/2022	**6th Follow up for Manual Revision (RE) (Online)** ・RE integration / O&M Manual Revision
3	20-24/Feb/2023	**3rd Regional Training for RE integration・PV O&M in Fiji** ・DOE presentation(Case study of LaKaRo PV project) ・RE integration & planning(RE development plan in Fiji, (PV and Hydro), Homer software, NCC experiences in RE integration or Grid operation, ・Operation and Maintenance of PV facilities (Measurement of I-V in Lautoka PV, Drawing up of I-V curve and explanation of the curve, Inspection, budget, SCADA system, etc.) ・Site visit (Inspection to Nadi Police Station PV facility / NCC)

3. July 2022 to April 2023 Training schedule

The Introduction of Hybrid Power Generation System in Pacific Island Countries / Kiribati / On-Line Remote Training Schedule (2022～2023)



	Task / Date	Location	2022							2023						
			Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
1	Diesel Operation & Maintenance															
	9th DG On-line training	On-Line			🟩											
2	3rd Regional Training in Fiji	On site (Fiji)														
											🟩🟥					
3	5th DG On site training (for South area)	On site (Kiribati)														
							🟩									
4	DG O&M manual revision	On-Line														
	3rd training							🟩								
5	RE Intrgration / O&M manual revision	On-Line														
	5th training				🟥											
	6th training								🟥							

🟥 RE 🟩 DG

4. Core Trainers

No.	Core Trainer Name	Position	Org/ Comments
1) Operation and Maintenance of Diesel Engine Generators			
1	Teebwatia Taakau	Generation Engineer	PUB
2	Tebakabu Tion	Lead Hand, Mechanical	PUB
3	Kirite Uriam	Lead Hand, Mechanical	PUB
2) Plan for introduction of hybrid power generation systems			
1	Bauro Mikaere	Instrumentation & control engineer	PUB
2	Mary Rui	Solar PV engineer	PUB
3	Thomas Taoaba	Rural Energy Planner	MISE (Excluded for this evaluation due to recent return)
4	Simon Reiher	Urban Energy Planner	MISE
3) Operation and Maintenance of Renewable Energy generation system			
1	Mary Rui	Solar PV engineer	PUB
2	Tikoro Uriam	Solar PV technician	PUB
3	Beria Oromita	Energy technician	MISE
4	Burennata Teinamotuna	Energy technician	MISE

DG training attendance record

Name / Org. / Date			2022			2023	Attend. Rate %
			9th On-Line	5th DG On site training (for South area) On site (Kiribati)	3rd Manual Revision On-Line	3rd Regional Training in Fiji	
			8/4	2022/10/04-08	11/15	2023/2/13-17	
Core trainers	Uriam Kirite	PUB	1	1			50.0%
	Tebakabu Tion	PUB					0.0%
	Teebwatia Taakau	PUB	1	1	1	1	100.0%
Observer	Takenteiti Tonana	PUB	1	1		1	75.0%

RE Integration , O&M training attendance record

Date Name / Org.			2022		2023	Attend. Rate %
			5th Manual Revision On-Line	6th Manual Revision On-Line	3rd Regional Training in Fiji	
			8/23	12/2	2023/2/20-24	
Core trainers	Mary Rui	PUB	1	1	1	100.0%
	Tikoro Uriam	PUB				0.0%
	Beria Oromita	MISE				0.0%
	Burennata Teunamotuna	MISE			1	33.3%
Observers	Bauro Mikaere	PUB				0.0%
	Tebike Aree	MISE			1	33.3%

5. PUB & MISE core trainers training evaluation

The training contents for the 3 task is shown in below table.

Training contents	
1. DG	・Review of 2021 trainings ・Disassembly inspection, troubleshooting of each part of diesel generator. (Continuation of training on electrical and mechanical OJT) ・Completion of the operation and maintenance manual of DG's power generation. (electrical / mechanical) ・Performing of comprehensive test of the regional training. * CP have the knowledge and skill necessary to train staff of the power station.
2. RE Integration	・Review of 2021 trainings ・Renewable energy grid interconnection and operation method. Grid code. ・Data measurement related to performance ratio calculation. ・Update of hybrid power generation planning manual. *CP will acquire more detailed knowledge regarding to the implementation of Hybrid power generation.
3. RE O&M	・Review of past trainings ・Operation and maintenance method of PV system. ・Inspection check sheet revision and use. ・Revision of PV system O&M manual. ・Establishment of the future maintenance system plan *CP will have the capacity to perform maintenance planning, inspection, and prepare, manage, and analyze work reports.

Results

Below training evaluation sheet shown the punctuation of each task core trainer according to the attendance rate to the online trainings, the summary test after the 3rd Regional training and the evaluations of managers and the JICA Expert Team.

The PUB overall evaluation result is shown in the summary.

July 2022 ～April 2023 / DG Core trainer evaluation sheet

● DG O&M Training (KIRIBATI / PUB)	Project Counterparts (Core trainers)				
Name Skill	Teebwatia Taakau	Tebakabu Tion	Kirite Uriam		
	Generation Engineer	Lead Hand Mechanical	Lead Hand Mechanical		
Ⅰ.Attitude to training (max. 30 points =10)					
1. training participation	10.0	0.0	5.0		
9th DG remote training	✓	absent	✓		
5th DG On-site training (4days)	✓	absent	✓		
3rd Manual Revision on line	✓	absent	absent		
3rd Regional Training (5 days)	✓	※	※		
2. JICA Expert team (willingness to learn)	9.0	-	9.0		
3. Manager evaluation	9.8	8.4	9.4		
subtotal	28.8	-	23.4		
evaluation	9.3	-	7.6		
Ⅱ.Test (max.16 points=10)					
7. 3rd Regional Training Summary test	9.4	※	※		
Ⅲ.Target skill (Plan)	**(Results)**				
・Review of 2021's training	Verifications during Hands-on training in October 2022,				
・Disassembly inspection, troubleshooting of each part of diesel generator. (Continuation of training on electrical and mechanical OJT)	Hands-on training in October 2022,				
・Completion of the operation and maintenance manual of DG's power generation. (electrical / mechanical)	Completed in December 2022 after 1 follow up meeting.				
・Performing of comprehensive test of the regional training.	Carried out in Fiji after DG O&M training.				
General evaluation from JICA Expert Team	9.0	-	7.0		
General evaluation (max10)	**9.3**	**-**	**-**		
Comments ※1 No attendance to the training due to works priority. ※Basically the general evaluation is made if the trainer has participated in the regional training and presented the test.	Very good participation to the activities of the project. Candidate for trainer	Poor participation due he is charge of Betio PS.	Good performance during the on site training in October 2022.		

July 2022 ～April 2023 / RE Integration Core trainer evaluation sheet

● **RE Integration Training (KIRIBATI / PUB / MISE)**	**Project Counterparts (Core trainers)**				
Name / Skill	Mary Rui (PUB)	Bauro Mikaere (PUB)	Simon Reiher (MISE)	Thomas Taoaba (MISE)	
	Solar engineer	Instrumentation & PV supervisor	Urban Energy Planner		
Ⅰ.Attitude to training (max.30 points=10)					
1. training participation	10	0	0		
5th Manual Revision (On-Line)	✓	absent	absent		
6th Manual Revision (On-Line)	✓	absent	absent		
3rd Regional Training (4 days)	✓	※	※		
2.JICA Expert team (willingness to learn)	9.0	9.0	-		
3. Manager evaluation	9.8	8.8	6.2		
subtotal	28.8	17.8	-		
evaluation	9.6	5.9	0.0		
Ⅱ.Test (max.12 points=10)					
6. 3rd Regional Training Summary test	8.3	※	※		
Ⅲ.Target skill (Plan)	**(Results)**				
・Review of 2021 trainings	During on-line trainings				
・Renewable energy grid interconnection and operation method. Grid code.	On-line training				
・Data measurement related to performance ratio calculation.	In every On-line trainings				
・Update of hybrid power generation planning manual.	Completed in March 2023				
Evaluation from JICA Expert Team	9.0	8.0	-		
General evaluation	**8.98**	(6.9)	-		
Comments ※1 No attendance to the training due to works priority. ※Basically the general evaluation is made if the trainer has participated in the regional training and presented the test.	Very good participation to the activities of the project. Candidate for trainer	Poor participation in trainings due to works priority.	No participation.	Recent return.	

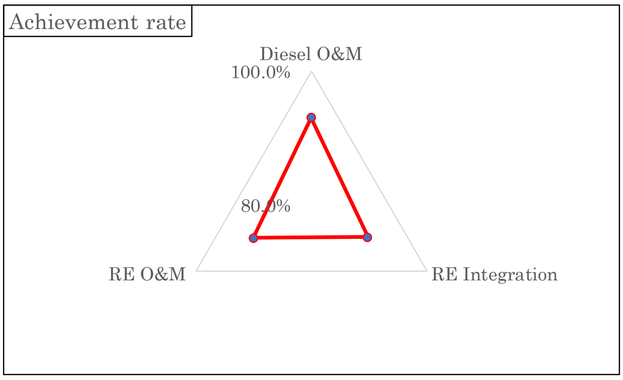
July 2022 ～April 2023 / RE O&M Core trainer evaluation sheet

● RE O&M Training (KIRIBATI / PUB / MISE)	Project Counterparts (Core trainers)					
Name	Mary Rui (PUB)	Tikoro Uriam (PUB)	Beria Oromita (MISE)	Burennata Teinamotuna (MISE)		
Skill	Solar PV engineer	Solar PV Technician	Energy technician	Energy technician		
Ⅰ.Attitude to training (max.30 points=10)						
1. training participation	10	0.0	0.0	3.4		
5th Manual Revision (On-Line)	✓	absent	absent	absent		
6th Manual Revision (On-Line)	✓	absent	absent	absent		
3rd Regional Training (4 days)	✓	※	※	1.0		
2.JICA Expert team (willingness to learn)	9.0	8.0	-	-		
3. Manager evaluation	9.8	9.00	9.60	4.60		
subtotal	28.8	17.0	9.6	8.0		
evaluation	9.6	5.7	3.2	2.7		
Ⅱ.Test (max.12 points=10)						
6. 3rd Regional Training Summary test	8.3	※	※	8.3		
Ⅲ.Target skill (Plan)	**(Results)**					
・Review of 2021 training	Verifications during Hands-on training in October 2022,					
・Operation and maintenance method of PV system.	Verifications during Hands-on training in October 2022,					
・Inspection check sheet revision and use.	In prosess					
・Revision of PV system O&M manual.	Completed in December 2022 after 2 follow up meeting.					
・Establishment of the future maintenance system plan	In preparation					
Evaluation from JICA Expert Team	9.00	8.00	-	-		
General evaluation	**9.0**	(6.8)	-	-		
Comments ※1 No attendance to the training due to works priority. ※Basically the general evaluation is made if the trainer has participated in the regional training and presented the test.	Very good core trainer with active participation in trainings	Returned to work after 2 years of study	Verify the participation in the project	Need more participation in the trainings.		

➢ Summary

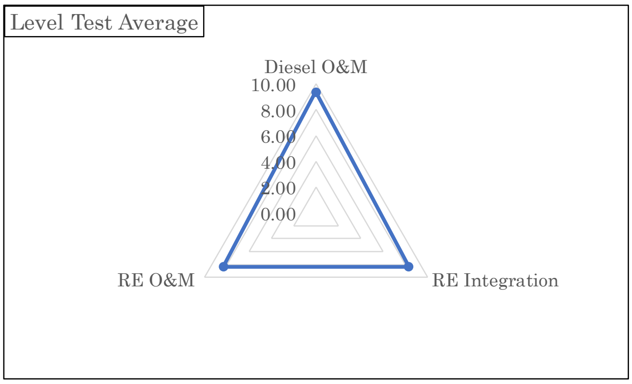
2022～2023 PUB counterparts training evaluation

Diesel O&M		
Name	Test points	Achievement
Tebwatia Taakau	9.40	93.0%
Tebakabu Tion	-	-
Kirite Uriam	-	-
Average	9.40	93.0%



RE Integration		
Name	Test points	Achivement
Mary Rui (PUB)	8.3	89.8%
Bauro Mikaere (PUB)	-	-
Simon Reiher (MISE))	-	-
Average	8.3	89.8%

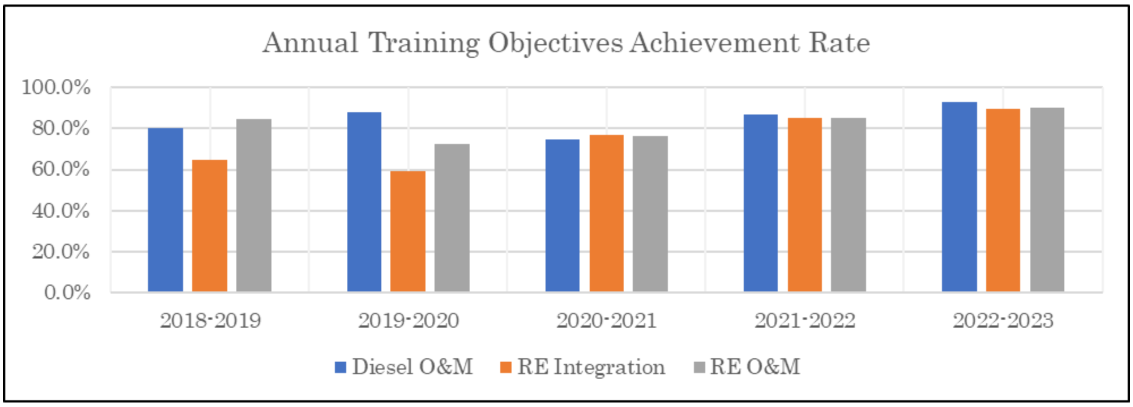
RE O&M		
Name	Test points	Achivement
Mary Rui (PUB)	8.3	90.0%
Tikoro Uriam	-	
Beria Oromita (MISE)	-	-
Burennata Teinamotuna (MISE)	8.3	-
Average	8.3	90.0%



PUB average	Test points	Achivement
Diesel O&M	9.40	93.0%
RE Integration	8.3	89.8%
RE O&M	8.30	90.0%

Annual Training Objectives Achievement rate

PUB average	2018-2019	2019-2020	2020-2021	2021-2022	2022-2023
Diesel O&M	80.0%	87.7%	74.5%	87.0%	93.0%
RE Integration	65.0%	59.5%	77.0%	85.2%	89.8%
RE O&M	84.4%	72.5%	76.3%	85.2%	90.0%



From above graph we can observe that

① DGs O&M Training

The result of the evaluation of the DG O&M training objectives for the last project period shows a very good result of 93%, but this is not the average of the three main DG core trainers, is the achievement of Mr. Teebwatia, who made a good effort to complete the task in this area.

The other two counterparts (Mr. Tion and Mr. Uriam) unfortunately could not participate in the trainings due to work priorities, but the JICA team of experts know that they have a great skill for practical maintenance work, they need only more training in the management of maintenance work, that is an area covered by Mr. Teebwatia.

The JICA Expert Team will try to maintain the necessary technical assistance for the trainers to complete the remaining task of the project which is the preparation of the future maintenance plan including the necessary budget.

② RE Integration and RE O&M

Same as DG O&M task, for RE Integration and RE O&M training objectives shows a very good result of 90% achieved by Ms. Mary Rui, she participated in online trainings, revised the manuals and she has participated in the regional training in Fiji last February. Other core trainers did not attend the trainings due to works priorities and other reasons.

The JICA Expert Team will continue to provide technical assistance to finalize the future maintenance plan for Tarawa's PV facilities, including the necessary budgets to maintain the efficient operation of RE facilities.

End

8 Provision of equipment

8.1 Equipment List

8.1 List of Equipment Provided (Kiribati)

No.	Equipment name	Quantity	Purpose/necessity	Remarks
DG-related procured equipment				
1	Fuel flow meter Nitto Seiko RC25CFFM2	4	Accurate specific fuel consumption measurement	
2	Digital Pressure Calibrator Baker Hughes DPI800S	1	Maintenance of DG instrumentation equipment	
3	Digital multimeter YOKOKAWA TY710	1	Maintenance of DG instrumentation equipment	
4	Digital thermometer TOKOKAWA TX1001	1	Maintenance of DG instrumentation equipment	
5	Instrumentation signal measurement / Generator YOKOKAWA CA150	1	Maintenance of DG instrumentation equipment	
6	Ohm meter YOKOKAWA MY600	1	Maintenance of DG instrumentation equipment	
7	Air compressor kit Baker Hughes PV211	1	Maintenance of DG instrumentation equipment	
8	Air hose 1 m × 2　1.5 m × 1	1	Maintenance of DG instrumentation equipment	
9	Various types of fittings (1/8, 1/4, 3/8, 1/2, 3/4, 1)	1	Maintenance of DG instrumentation equipment	
10	Battery HiTester HIOKI BT3554	1	Diagnosis of storage battery operating conditions	
11	Clamp on AC/DC HiTester HIOKI 3285	1	Diagnosis of storage battery operating conditions	
12	Radiation thermometer HIOKI FT3701	1	Diagnosis of storage battery operating conditions	
13	Battery hydrometer	1	Diagnosis of storage battery operating conditions	
14	Vibration measuring instrument TASCO TA415EB	1	Diagnosis of DG facility operating conditions	
15	Digital panel meter OON K3MA-J DC24V	6	Mitigation of DG facility deterioration/ Digital display	
16	DC input converter M-SYSTEM WVS-AAA-P DC110V	6	Mitigation of DG facility deterioration	

17	VILEDON air filter (W1.6m×30m×8mm) JAPAN VILENE COMPANY, LTD PS/150N	1	Mitigation of generator deterioration/ Intake filter	
18	INSULTEX Tape	1	Safety measure for generation facility/ Heat resistant tape to apply on exhaust pipe	
RE-related procured equipment				
19	Pyranometer & thermometer Togami Electric Mfg SPST-A-F2	1	Diagnosis of PV facility operating conditions	
20	String Tracer(I -V curve tracer) Togami Electric Mfg SPST-A2A-Y1	1	Diagnosis of PV facility operating conditions/ detect string issues	
21	Cell Line Checker Togami Electric Mfg SPLC-A-Y1	1	Diagnosis of PV facility operating conditions/ detect faulty PV modules	
22	HOMER PRO HOMER Software	2	Effective RE integration planning/ Simulation software	
23	Insulation Tester HIOKI IR4053-11	1	Diagnosis of PV facility operating conditions	
24	Thermographic Camera Fluke TiS55	1	Diagnosis of PV facility operating conditions/ temperature monitoring	
25	Digital Multimeter HIOKI DT4254	1	Diagnosis of PV facility operating conditions	
26	Mower Makita MEM428	1	PV facility maintenance	
27	High pressure washer KOSHIN JCE-1408UDX	1	PV facility maintenance/ Solar panel cleaning	

8.2 Handover

CERTIFICATE OF HANDOVER

To: Okinawa Enetech Co.,Inc
Re: The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries

This certificate of handover is to certify that the equipment in the attached list, which shall be utilized for the [The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries][1], have been handed over properly to [Public Utilities Board], as of below date.

Attached: List of Equipment
Item: Small size rotary flow meter
Model:RC25CFFM2
Quanity:4 units
Manufacturing company : NITTO SEIKO CO.,LTD.

(Signature)[2]
Mr.Tenikoria Kataueа
Power Engineering Manager
Public Utilities Board

Date 01/05/18

---

[1] 表記しているのは、供与機材の場合を想定。事業用物品（旧携行機材、旧調査用機材等）を物品管理細則第20 条に基づき譲与する場合は以下のとおり。

[2] 受領者（署名者）は、「当該相手国政府等の機関の長又はそれに準ずる者」でなければなりません。

CERTIFICATE OF HANDOVER

To: Okinawa Enetech Co.,Inc
Re: The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries

This certificate of handover is to certify that the equipment in the attached list, which shall be utilized for the [The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries], have been handed over properly to [Tuvalu Electricity Corporation], as of below date.

■Attached: List of Equipment

No.	Name of equipment	Model	Quantity	Manufacturing company
1	Pyranometer & thermometer	SPST-A-F2	1	Togami Electgric Mfg.Co.,Ltd
2	StringTracer(I -V curve tracer)	SPST-A2A-Y1	1	
3	Cell Line Checker (Fault module detector)	SPLC-A-Y1	1	

(Signature)
Mr. Tenikoria Kataueа
Power Engineering Manager
Public Utilities Bord

Date 21-06-18

CERTIFICATE OF HANDOVER

To: Okinawa Enetech Co., Inc.
Re: The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries

This certificate of handover is to certify that the software in the attached list, which shall be utilized for the [The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries][1], have been handed over properly to [Ministry of Infrastructure and Sustainable Energy], as of below date.

Attached: List of software
Item: HOMER Pro
Type: Standard permanent License
Quantity: 1 unit
Manufacturing company：HOMER Energy, USA

(Signature)[2]
Mr. Thomas Taoaba
Renewable Energy Planner
Ministry of Infrastructure and Sustainable Energy

Date 23/10/18.

---

[1] 表記しているのは、供与機材の場合を想定。事業用物品（旧携行機材、旧調査用機材等）を物品管理細則第20 条に基づき譲与する場合は以下のとおり。

[2] 受領者（署名者）は、「当該相手国政府等の機関の長又はそれに準ずる者」でなければなりません。

CERTIFICATE OF HANDOVER

To: Okinawa Enetech Co., Inc.
Re: The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries

This certificate of handover is to certify that the software in the attached list, which shall be utilized for the [The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries][1], have been handed over properly to [Public Utilities Board], as of below date.

Attached: List of software
Item: HOMER Pro
Type: Standard permanent License
Quantity: 1 unit
Manufacturing company：HOMER Energy, USA

(Signature)[2] ____________________
Mr. Tenikoria Katauea
Power Engineering Manager
Public Utilities Board

Date 24/10/18

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[1] 表記しているのは、供与機材の場合を想定。事業用物品（旧携行機材、旧調査用機材等）を物品管理細則第20 条に基づき譲与する場合は以下のとおり。

[2] 受領者（署名者）は、「当該相手国政府等の機関の長又はそれに準ずる者」でなければなりません。

CERTIFICATE OF HANDOVER

To: Okinawa Enetech Co., Inc
Re: The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries

This certificate of handover is to certify that the equipment in the attached list, which shall be utilized for the [The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries], have been handed over properly to [Public Utilities Board], as of below date.

■Attached: List of Equipment

No.	Name of equipment	Model	Quantity	Manufacturing company
1	Digital Pressure Calibrator (With calibration certificate)	DPI800S	1	GE Sensing & Inspection・Technologies
2	Digital multimeter (with calibration certificate)	TY 710	1	Yokogawa Test & Measurement Corporation
3	Digital thermometer (with calibration certificate)	TX1001	1	
4	Instrumentation signal measurement / generator (with calibration certificate)	CA 150	1	
5	Ohm meter (with calibration certificate)	240633 J	1	
6	Air compressor kit	PV 211	1	GE Sensing & Inspection・Technologies
7	Air hose 1 m×2, 1.5 m×1		1	
8	Various types of fittings (1/8, 1/4, 3/8, 1/2, 3/4, 1)		1	

(Signature)

Mr. Tenikoria Kataueа
Generation Manager
Public Utilities Board

Date 9/10/19

Returned Equipment list (October 17, 2019)

No.	Name of equipment	Model No.	Qty	Manufacturer	Comments
1	Digital multimeter Cost : USD 497(¥54,600)	TY710	1	横河計測㈱ Yokogawa Test & Measurement Corporation	 560g・W90 mm×L192 mm×H49 mm
2	Digital thermometer Cost : USD 280(¥30,800)	TX1001	1	横河計測㈱ Yokogawa Test & Measurement Corporation	 180g・W56 mm×L151 mm×H33 mm
3	Instrumentation signal measurement / generator Cost : USD 2,408(¥264,800)	CA150	1	横河計測㈱ Yokogawa Test & Measurement Corporation	 1,000g・W251 mm×L124 mm×H70 mm
4	Insulation Tester Cost : USD 394(¥43,300)	IR-4055-11	1	日置電機株式会社 HIOKI E.E. CORPORATION	 600g・W159 mm×L177 mm×H53 mm

RECEIVED.

Epeli Rokodrokaya
Training Officer Mechanical Generation
EFL Energy Fiji Limited

CERTIFICATE OF HANDOVER

To: JICA Fiji Office

Re: The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries

This certificate of handover is to certify that the equipment in the attached list, which shall be utilized for the [The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries], have been handed over properly to [PUBLIC UTILITIES BOARD (PUB)], as of below date.

■ Attached: List of Equipment

No.	Equipment name	Model	Qty.	Manufacturer
1	Battery HiTester	BT3554	1	HIOKI
2	Clamp on AC/DC HiTester	3285	1	
3	Radiation thermometer	FT3701	1	
4	Battery hydrometer	-	1	-
5	Vibration measuring instrument	TA415EB	1	TASCO
6	Digital panel meter	K3MA-J DC24V	6	OMRON
7	DC input converter	WVS-AAA-P DC110V	6	M-SYSTEM

(Signature)____________________

Mr. James Young
Chief Executive Officer
Public Utilities Board (PUB)
Kiribati

Date 6-10-22

Equipment List

No.	Name of equipment	Model	Qty	Manufacturer	Comments
1	BATTERY HiTESTER	BT3554	1	HIOKI	 960g・W199×H132×D60.6 ㎜
2	CLAMP ON AC/DC HiTESTER	3285	1	HIOKI	 540g・W62×H260×D39㎜
3	Radiation thermometer	FT3701	1	HIOKI	 256g・W48×H172×D119㎜
4	Battery hydrometer	-	1	-	 230g・W200×H78×D54㎜
5	Vibration measuring instrument	TA415EB	1	TASCO	 55g・W150×H22×D18㎜
6	Digital panel meter	K3MA-J DC24V	6	OMRON	 200g・W96×H48×D80㎜
7	DC input converter	WVS-AAA-P DC110V	6	M-SYSTEM	 400g・W50×H80×D136㎜

End

CERTIFICATE OF HANDOVER

To: JICA Fiji Office

Re: The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries

This certificate of handover is to certify that the equipment in the attached list, which shall be utilized for the [The Project for Introduction of Hybrid Power Generation System in Pacific Island Countries], have been handed over properly to [PUBLIC UTILITIES BOARD (PUB)], as of below date.

■ Attached: List of Equipment

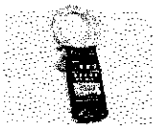
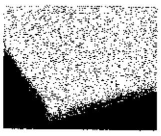
No.	Equipment name	Model	Qty.	Manufacturer
1	Battery HiTester	BT3554	1	HIOKI
2	Clamp on AC/DC HiTester	3285	1	
3	Radiation thermometer	FT3701	1	
4	Battery hydrometer	-	1	-
5	Vibration measuring instrument	TA415EB	1	TASCO
6	Digital panel meter	K3MA-J DC24V	6	OMRON
7	DC input converter	WVS-AAA-P DC110V	6	M-SYSTEM
8	VILEDON air filter (W1.6m×30m×8mm)	PS/150N	1	JAPAN VILENE COMPANY, LTD.
9	Thermographic Camera	TiS55	1	Fluke
10	Digital Multimeter	DT4254	1	HIOKI
11	Mower	MEM428	1	Makita
12	High pressure washer	JCE-1408UDX	1	KOSHIN
13	Insulation Tester	IR4053-11	1	HIOKI

(Signature) X

Mr. James Young
Chief Executive Officer
Public Utilities Board (PUB)
Kiribati

Date 27 / 01 / 2023

Equipment List

No.	Name of equipment	Model	Qty	Manufacturer	Comments
1	BATTERY HiTESTER	BT3554	1	HIOKI	 960g・W199×H132×D60.6 mm
2	CLAMP ON AC/DC HiTESTER	3285	1	HIOKI	 540g・W62×H260×D39mm
3	Radiation thermometer	FT3701	1	HIOKI	 256g・W48×H172×D119mm
4	Battery hydrometer	-	1	-	 230g・W200×H78×D54mm
5	Vibration measuring instrument	TA415EB	1	TASCO	 55g・W150×H22×D18mm
6	Digital panel meter	K3MA-J DC24V	6	OMRON	 200g・W96×H48×D80mm
7	DC input converter	WVS-AAA-P DC110V	6	M-SYSTEM	 400g・W50×H80×D136mm
8	VILEDON air filter (W1.6m×30m×8mm)	PS/150N	1	JAPAN VILENE COMPANY, LTD.	 8kg・W1600×H30×D30mm

9	Thermographic Camera	TiS55	1	Fluke	 2270g・W101×H267×D145㎜
10	Digital Multimeter	DT4254	1	HIOKI	 390g・W84×H52×D174㎜
11	Mower	MEM428	1	Makita	 5.2kg・W595×H1770×D370㎜
12	High pressure washer	JCE-1408UDX	1	KOSHIN	 31kg・W585×H775×D960㎜
13	Insulation Tester	IR4053-11	1	HIOKI	 2270g・W101×H267×D145㎜

End

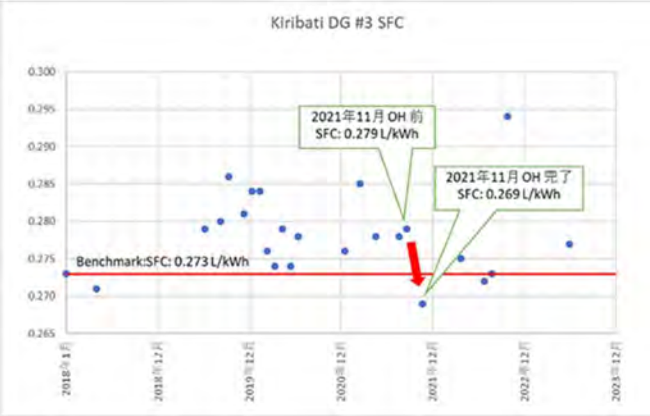
9 Fuel consumption rate, performance ratio value

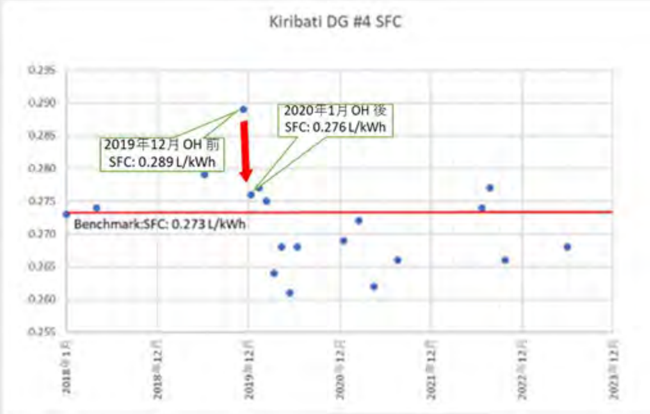
9.1 Fuel consumption rate

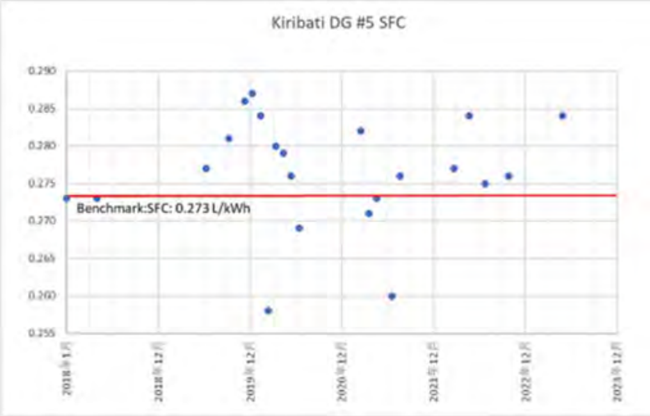
Kiribati Fuel Consumption Rate Record

The following table shows the output 1-3 "Fuel consumption rate of the pilot DG is measured" set in the PDM of Kiribati

DATE	Fuel Consumption rate [L/kWh]		
	Unit #3	Unit #4	Unit #5
2018/5/25	0.276	0.274	0.277
2019/7/16	0.280	0.280	0.281
2019/9/3	0.280	0.280	0.281
2019/10/4	0.286	—	0.281
2019/12/31	0.281	0.289	0.286
2020/1/31	0.284	0.276	0.287
2020/2/29	0.284	0.277	0.284
2020/3/31	0.276	0.275	0.258
2020/4/21	0.274	0.261	0.278
2020/4/30	0.282	0.266	0.282
2020/5/31	0.279	0.268	0.279
2020/6/30	0.274	0.261	0.276
2020/7/16	0.274	—	—
2020/7/17	—	—	0.276
2020/7/20	—	0.263	—
2020/7/31	0.283	0.272	0.263
2021/1/25	0.276	—	—
2021/1/29	—	0.269	—
2021/3/30	0.285	0.272	0.282
2021/4/2			0.271
2021/4/8	0.278	0.266	
2021/5/21	0.278	0.262	0.273
2021/9	**0.278**	—	—
2021/11	**0.269**	—	—
2022/1/4	0.275	—	—
2022/3/4		—	0.277
2022/7/1	0.272	—	0.275
2022/7/4	—	0.274	—
2022/8/19	—	—	—
2022/8/22	0.273	0.277	0.275
2022/10/4	0.294	0.266	0.276
2023/5/26	—	—	0.284
2023/6/28	—	0.268	—
2023/6/29	0.277	—	—







🟨DG ＃3 OH, showing fuel consumption rates before and after DG＃ 4 Top OH.

The results of the annual fuel consumption rate of the power plant during the project period are shown in the table below.

No	Description	Unit	2017	2018	2019	2020	2021	2022
1	Diesel Power Generation	kWh	24,006,273	26,245,091	26,554,070	28,532,009	29,225,827	28,269,856
2	Annual Total Fuel Consumption	Litres	6,494,435	7,154,536	7,437,873	7,852,069	7,787,986	7,876,079
3	**SFC**	**L/kWh**	**0.271**	**0.273**	**0.280**	**0.275**	**0.266**	**0.279**

Summary

Kiribati's DG units are regularly overhauled and inspected, so many data show fuel consumption rates better than the benchmark 0.273 L/kWh.

In November 2021, DG Unit 3 OH was performed, and an improvement in fuel consumption rate is observed. The fuel consumption rate improved from 0.278 L/kWh before the overhaul to 0.269 L/kWh after the overhaul, that result an improvement of 0.09 L/kWh.

For DG Unit 4, the burnout of the generator stator was repaired and restored in December 2019, and a Top overhaul was performed at the same time. The fuel consumption rate before and after the overhaul was 0.289 L/kWh to 0.276 L/kWh , an improvement of 0.013 L/kWh was observed.

As of June 2023, a periodical overhaul has not been performed for DG Unit 5, we can observe that the fuel consumption rate is seen to be above the baseline. Currently, a new DGs are being installed to ensure the reserve power needed at the time of overhaul, and the overhaul is scheduled to be implemented during the FY 2023.

The fuel consumption rate for the entire power plant during the project period averaged 0.274 L/kWh, and while there is an improvement in the fuel consumption rate starting in 2020 (Top OH of Unit 4), the fuel consumption rate value increases in 2022 (after OH of DG Unit 3). One possible reason is that the cylinder head of Unit 4 is experiencing cavitation, which may be limiting the unit's output and operating in a load band with a poor fuel consumption rate. However, the fuel consumption rate is expected to improve after the overhaul of DG Unit 5.

We would like to request that periodic inspections and overhauls continue to be performed to ensure economical and stable operation of the DG units.

End

9.2 Performance ratio value

Kiribati PV facility（PEC Fund PV）

Basic information

Facility name	PEC Fund PV(Bikenibeu)	Exterior photo	
Installation year	2015		
Capacity (kW)	400 kW		
Donor name	PEC Fund		
Facility manager	PUB		

Performance ratio (baseline:75%)

2020	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
	57.9	72.8	53.2	57.4	70	49.5	-	-	24.2	51.8	50.6	35	52.24
2021	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
	16.3	31.4	16.5	-	-	44.9	65	63.1	63.2	62.2	65.3	66.2	49.41
2022	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
	58	70.1	58.5	51.1	59.5	61.7	61.1	60.8	63.4	64.4	71.3	63.7	61.97
2023	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
	60.65	70.74	66.6	57.61	59.57	58.45	-	-	-	-	-	-	62.27

Note

Baseline Performance Ratio =75%

(Attached reference material)

1. Comparison chart of performance ratio values of the pilot facility (Baseline value, monthly measured value, annual average measured value)
2. Performance ratio measured value evaluation sheet （Kiribati）

Kiribati PV facility（UAE PV）

Excluded facilitiy of The Project

Basic information

Facility name	UAE PV(Bonriki PV(空港))	Exterior photo	
Installation year	2015		
Capacity (kW)	500 kW		
Donor name	（UAE、2015）		
Facility manager	PUB		

Performance ratio

2020	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
	88.3	83.9	60.4	82.4	79.8	76.1	77.9	73.2	77.3	78.8	79.1	78.6	77.98
2021	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
	69.5	60	68.7	69.2	-	47	50.4	77	76.8	75	80.2	81.4	68.65
2022	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
	-	-	-	55.7	65.9	70.1	71.8	56.9	66.1	78.3	92.1	84.5	71.27
2023	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
	80.20	61.73	53.48	60.11	63.67	67.26	-	-	-	-	-	-	64.41

Note

Excluded facilitiy of The Project

・Not Baseline Perfomance Ratio

Kiribati PV facility（TCH PV）

Excluded facilitiy of The Project

Basic information

Facility name	TCH PV(Tungaru Centeral Hospital)-Nawerewere	Exterior photo	
Installation year	2016/7		
Capacity (kW)	216.4 kW		
Donor name	WB fund		
Facility manager	PUB		

Performance ratio

2020	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
	73.6	72.1	73.9	76.3	74.9	76.1	77	68.5	69.5	69.4	69	67.3	72.3
2021	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
	64.1	65.9	66	65.4	72.3	63.4	70.9	67.6	67.5	64.6	65	64.9	66.47
2022	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
	65.2	0	66.9	-	-	47.7	45.8	55.8	54.8	54.9	60.6	54.1	50.58
2023	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
	66.68	57.38	60.73	58.66	61.76	60.1	-	-	-	-	-	-	60.89

Note

Excluded facilitiy of The Project

・Not Baseline Perfomance Ratio

Kiribati PV facility（KIT PV）

Excluded facilitiy of The Project

Basic information

Facility name	KIT PV（Kiribati Institute of Technology）-Betio	Exterior photo	
Installation year	2016/8		
Capacity (kW)	158.16 kW		
Donor name	（Australia、WB）		
Facility manager	PUB		

Performance ratio

2020	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
	72.5	77.2	77.1	79.3	77.6	74	72.6	-	57.4	70.7	72.3	15.6	67.85
2021	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
	55.9	62.9	73.3	55.6	13.9	-	38.2	-	-	-	62	72	54.23
2022	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
	61	67.1	-	-	-	35.2	35.1	-	50.4	67.2	74.2	-	55.74
2023	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
	66.4	64.4	62.4	-	-	-	-	-	-	-	-	-	64.4

Note

Excluded facilitiy of The Project

・Not Baseline Perfomance Ratio

Kiribati PV facility（KGV PV）

Excluded facilitiy of The Project

Basic information

Facility name	KGV PV（King George V & Elaine Bernacchi School）- Bikenibeu	Exterior photo	
Installation year	2016/9		
Capacity (kW)	217kW		
Donor name	（Australia、WB）		
Facility manager	PUB		

Performance ratio

2020	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
	76.8	73	62.7	65.3	65.6	67	67.7	59.3	65.3	71.5	68.8	62.7	67.14
2021	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
	53.8	69.3	69.8	65.7	72.2	66.9	70.8	70.3	71	66.5	68	69	67.78
2022	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
	68.6	-	67.3	51.1	57.7	52.9	70.6	68	66.2	58.4	72	68.8	63.78
2023	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
	65.81	57.51	67.35	61.38	65.47	60.6	-	-	-	-	-	-	63.02

Note

Excluded facilitiy of The Project

・Not Baseline Perfomance Ratio

Kiribati PV facility（BSC PV）

Excluded facilitiy of The Project

Basic information

Facility name	BSC PV(Betio Sports Complex)	Exterior photo	
Installation year	2016/8		
Capacity (kW)	137 kW		
Donor name	（Australia、WB）		
Facility manager	PUB		

Performance ratio

2020	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
	-	-	-	21	72.2	68.6	71.8	70.5	72.4	74.6	71.7	69.9	65.86
2021	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
	71	71.9	70.4	71.1	79.4	69.5	74.1	70.1	68.3	68	69.7	70.7	71.18
2022	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
	82.2	-	72.1	67.2	66.5	64.3	71.4	68.4	70.2	71.4	78	70.7	71.13
2023	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
	-	-	-	-	-	-	-	-	-	-	-	-	-

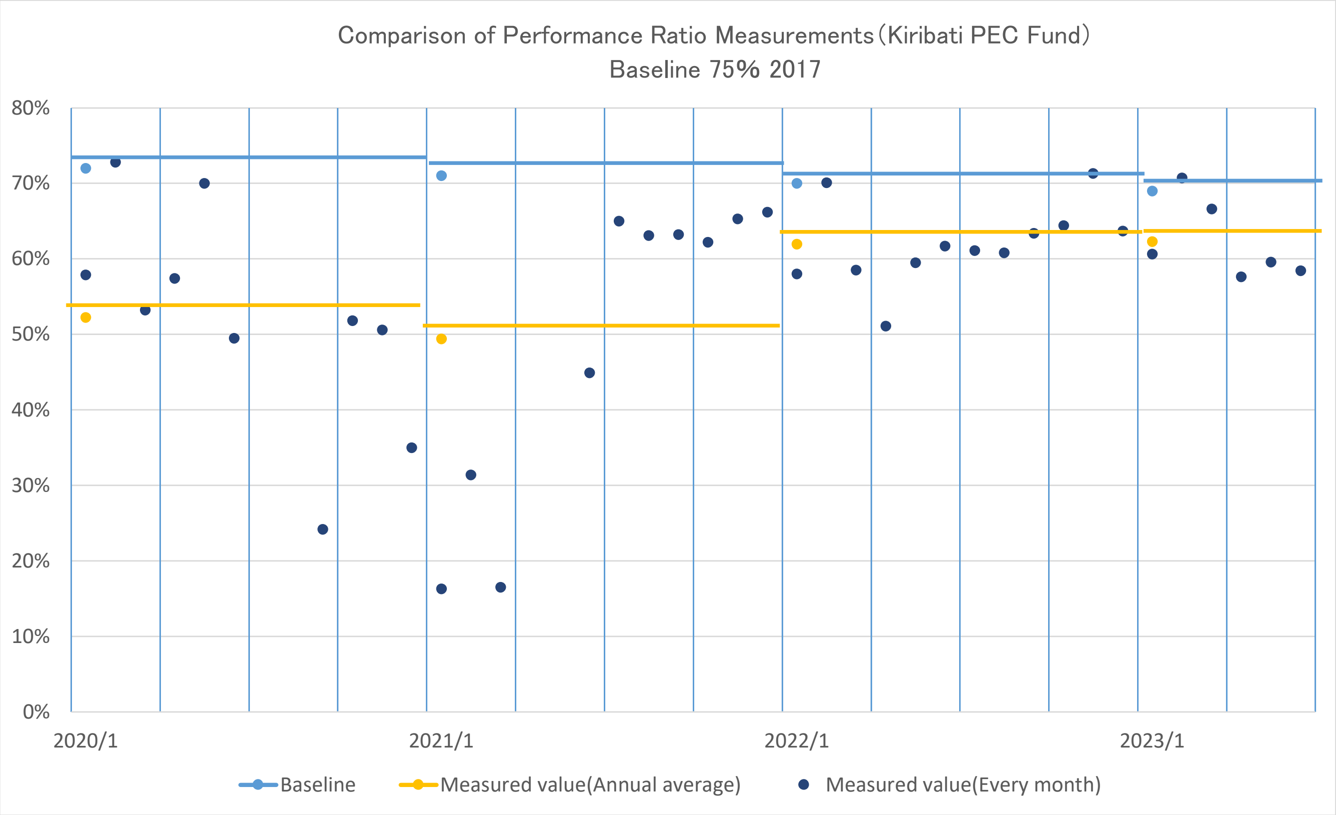
Note

Excluded facilitiy of The Project

・Not Baseline Perfomance Ratio

Comparison of Performance Ratio Measurements（Kiribati PEC Fund）

	Baseline	Measured value(Annual average)	Measured value(Every month)
2020/1	72%	52.2%	57.9%
2020/2			72.8%
2020/3			53.2%
2020/4			57.4%
2020/5			70.0%
2020/6			49.5%
2020/7			
2020/8			
2020/9			24.2%
2020/10			51.8%
2020/11			50.6%
2020/12			35.0%
2021/1	71%	49.4%	16.3%
2021/2			31.4%
2021/3			16.5%
2021/4			
2021/5			
2021/6			44.9%
2021/7			65.0%
2021/8			63.1%
2021/9			63.2%
2021/10			62.2%
2021/11			65.3%
2021/12			66.2%
2022/1	70%	62%	58.0%
2022/2			70.1%
2022/3			58.5%
2022/4			51.1%
2022/5			59.5%
2022/6			61.7%
2022/7			61.1%
2022/8			60.8%
2022/9			63.4%
2022/10			64.4%
2022/11			71.3%
2022/12			63.7%
2023/1	69%	62%	60.7%
2023/2			70.7%
2023/3			66.6%
2023/4			57.6%
2023/5			59.6%
2023/6			58.5%



※Expected loss of efficiency by 1%/Year is permitted.(6% degradation is permitted for 6 years of operation)

As of the end of June 2023

［JICA Project for Introduction of Hybrid Power Generation System in the Pacific Island Countries］
Performance ratio measured value evaluation sheet (Kiribati)

Country name	Evaluation of measured performance ratio value											
	Project pilot facility Baseline (2017)		2020		2021		2022		2023		Rationale for validity (permissible value)	Evaluation of measured values, reasons for low values, etc.
			Annual average measured value	Permissible value	Annual average measured value	Permissible value	Annual average measured value	Permissible value	Annual average measured value	Permissible value		
Kiribati	PEC Fund	75%	52.24%	72%	49.41%	71%	61.97%	70%	62.27%	69%	Expected loss of efficiency by 1%/Year is permitted. (6% degradation is permitted for 6 years of operation)	(Evaluation of measured values) ・Compared with the baseline value of 75%, annual average of measured values remained constantly low at 49%-62%. ・Significant variability was observed in the monthly measured values between 2020 and June 2021, and annual average values were approximately 50%. Significant decrease in measured values was also observed. ・Annual average values increased to be higher than 60% between June 2021 and 2023, and variability of the values was also reduced. ・ Although the measured value has been constantly lower than the baseline value since the beginning of the monitoring, it is on a recovery trend. The Expert team therefore would like that facility O&M be continued with monitoring of measured value and accumulating data. ・Although PR value greatly decreased in some months between 2020 and 2021, it is insufficient for concluding that the facility is malfunctioning or degrading. The decrease in the measured value may have been caused by external (ex. shading) or other factors. If similar values are obtained in future measurements, the value should be rechecked, and the facility should be inspected. (Reasons for the current low PR value, etc.) ・PR value has been constantly low since the beginning of the monitoring. ・Monthly values averaged at around 50%-60% from 2020 to 2022. ・PCS malfunction is dealt with a temporary fix each time it occurs. ・According to a recent interview with PUB (July 2023), the reason for PR value being below the baseline value is assumed to be the issue of tripping of DC breaker for No.3 PCS after heavy rain. Advice was therefore given to conduct inspection by taking measurements (insulation resistance, etc.) to identify the cause.

(Attached reference material)
1.Measured performance ratio value (January 2020 - June 2023 Monthly measured value of each facility)
2.Comparison chart of performance ratio values of the pilot facility (Baseline value, monthly measured value, annual average measured value)

10 Improvement Plan

Improvement plan works progress report sheet (Kiribati)

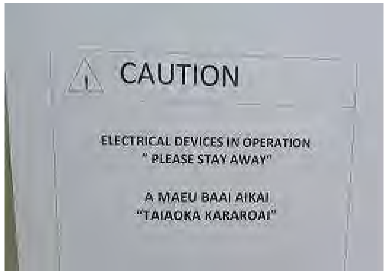
Phase		Phase1			Phase2												
No.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Location		On-site			On-site		Online										On-site
Year		2017	2018		2019		2020				2021			2022			
Confirmation Date		Sep. 21 South-1	May, 30 South-2	Dec. 12 South-3	July, 19 South-1	Oct. 4 South-2	Jun.17 1st	July, 22 2nd	Aug.19 3rd	Oct. 14 4th	Jan. 19 5th	May, 18 6th	Sep. 17 7th	May, 23 8th	Aug. 4 9th	Sep. 1 From PUB	Oct. 4 South-5
No.	Remarks																
Power station building																	
1	Ventilation system /Building air inlet suction aperture net is off.	○	add.	Not yet	Not yet	Not yet	Not yet	Not yet	Not yet	Not yet	-	Not yet	Not yet	**Completed**			Check
Electrical Devices																	
1	Engine control Panel No protection covers in the emergency stop of the units #3 and #5 Staff of the power plant can operate erroneously and stop the engine.			Add.	Not yet	Not yet	Not yet	Not yet	Not yet	Not yet		Not yet	Not yet	Not yet	Not yet	**Completed**	
2	The spare VCB in the electric room is not cured. Condition of the circuit breaker deteriorates due to dust and humidity.			Add.	Not yet	Not yet	Not yet	Not yet	Not yet	Not yet		**Completed**					
3	Protection relays panel We cannot know at a glance if the unit is in operations or not in the Protection relays panel.	○		Not yet	**Completed**												
4	The cover of the RTD in the unit #5 broken and it is no possible close. Liquid may enter and short circuit.(RTD of secondary cooling water inlet in the lubricating oil cooler)					Add.	Add.	Not yet	Not yet	Not yet		waiting for parts	waiting for parts	waiting for parts	waiting for parts	waiting for parts	Parts not ordered
5	Some meters in the engine control panel are defective. Mistake in the readings of engine operation parameters.			Add.	Not yet	Not yet	Not yet	Not yet	Not yet	Not yet		Not yet	Not yet	Not yet	Not yet	Not yet	**Completed**
Mechanical devices																	
1	Lubricating oil regulating valve Oil leaks in the lubricating oil regulating valve of the 3 units.	○		Not yet	完了	Not yet	Not yet	Not yet	Not yet	Not yet		**Completed**					
2	Cooling water regulating valve	○		Not yet	Not yet	Not yet	Not yet	Not yet	Not yet	Not yet		**Completed**					
3	Lubricating oil leaks Lubricating oil leaks in the flexible joint unit #3 and #4			Add.	仮復旧	Not yet	Not yet	Not yet	Not yet	Not yet			**Completed**				
4	Old thermometers. Replacement of old thermometers in all engines is recommended.			Add.	Not yet	Not yet	Not yet	Not yet	Not yet	Not yet		Not yet	Not yet	Not yet	Not yet	Not yet	Not yet
5	Pressure meters/ Some pressure meters in the engine control panel are defective			Add.	削除	Not yet	Not yet	Not yet	Not yet	Not yet		Not yet	Not yet	Not yet	Not yet	Not yet	Not yet
6	Safety valve Oil leaks in the safety valve.(Unit #3, #4 and #5)			Add.	**Completed**	Not yet	Not yet	Not yet	Not yet	Not yet		Not yet	Not yet	Not yet	Not yet	Not yet	**Completed**
7	Exhaust gas pipe heat insulation			Add.	Not yet	Not yet	Not yet	Not yet	Not yet	Not yet		Not yet	Not yet	Not yet	Not yet	Not yet	Not yet
8	Fuel Service tank Level meter fault			Add.	Not yet	Not yet	Not yet	Not yet	Not yet	Not yet		Not yet	Not yet	Not yet	Not yet	Not yet	Not yet
9	Supercharger lubricating oil piping oil leak (Unit 5)																**Completed**
10	Manometer / Replacements of the manometer in the CJC filter lubricant inlet side of the unit #3.																Not yet

Maintenance																	
1	Washing of generators of the units #3, #4 and #5			Add.	Not yet	Not yet	Not yet	Not yet	Not yet	Not yet	Not yet	Not yet	Not yet		**Completed**		
2	Weekly checks are carried out every week to clean the filters.																OK
3	The adjustable spanner is often used for daily disassembly and maintenance, but it is better to use a ring spanner because it does not lick the head of the bolt and it is easier to apply force.																Not yet
Operation																	
1	Introduce loudspeaker equipment in the power station.(safety)																Not yet
2	Introduce Rotary light patrol to notify the staff in case of faults. (sound and light・siren)																Not yet
3	Work clothes, safety shoes and earplugs are good used, but make it a habit to wear a helmet.																OK

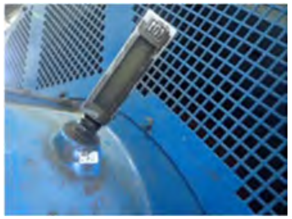
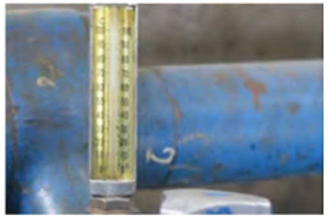
June 2023
JICA Expert Team

Improvement plan works progress report sheet (Kiribati)

Improvement Plan	Progress status	Completed
Power station building		
1. Ventilation system Engine room air suction aperture net is off. Small animal can cause damage to the blower fan. 	・Reason for not implementation: The blower fan filter was mounted in front of the fan instead of the whole wall. The reason for this is that we tried to save the filter material. This filter is washable so all we had to do is to switch the filters every week. ・Expected implementation schedule: 2022/5/23  	**OK**
Electrical Devices		
1.Engine control Panel No protection covers in the emergency stop of the units #3 and #5 Staff of the power plant can operate erroneously and stop the engine. Cure with acrylic cover.	・Reason for not implementation : No material in Tarawa ・Expected implementation schedule: Warning indication installed.(2022/9/1)	**OK**

	 	
2.Spare VCB The spare VCB in the electric room is not cured. Condition of the circuit breaker deteriorates due to dust and humidity. Cure the spare VCB with a vinyl sheet and install name tag (delivery date) indicating that is a spare item. 	・Reason for not implementation : ・Expected implementation schedule: done 2021/5/18 	**OK**
3. Protection relays panel We cannot know at a glance if the unit is in operations or not in the Protection relays panel. Risk: It is expected that the engine in operation will be stopped due to human error. Attach the indicator plate [In Operation] 	・Reason for not implementation : No material in Tarawa No proper warning or caution sign. ・Expected implementation schedule: done 2019/7/19  	**OK**

4. The cover of the RTD The cover of the RTD in the unit #5 broken and it is no possible close. Liquid may enter and short circuit.(RTD of secondary cooling water inlet in the lubricating oil cooler) 	・Reason for not implementation : new parts are necessary ・Expected implementation schedule: TBC	**Pending**
5.Engine control panel Some meters in the engine control panel are defective. (Check all units) Mistake in the readings of engine operation parameters. Replacement or calibration is recommended.   	・Reason for not implementation : Waiting for parts. Some of the units have recently defected. ・Expected implementation schedule: Unit #5 done 2022/10/4. Other units as soon as parts arrive. (#5 replaced with the support of JICA experts)  	**Completed**
Mechanical devices		
1.Lubricating oil regulating valve Oil leaks in the lubricating oil regulating valve of the 3 units. → Disassembly and maintenance of temperature control valve (Oil wiping is done regularly.)	・Reason for not implementation: Very hard to source the parts. ・Expected implementation schedule: Valve by passed 2021/5/18	**OK**

 	DG ＃5  DG ＃4  DG ＃3 	
2.Cooling water regulating valve DGs Cooling water regulating valve malfunction. Oil leaks are also increasing, so we recommend take early maintenance. → Disassembly and maintenance  	・Reason for not implementation: Very hard to source the parts. ・Expected implementation schedule: 2 completed in 2021/5/18, 1 in arrangement.   	**OK**
3.Lubricating oil leaks Lubricating oil leaks in the flexible joint unit #3 and #4 	・Reason for not implementation : ・Expected implementation schedule: done in 2021/9/17 	**OK**
4.Old thermometers Replacement of old thermometers in all engines is recommended.  	・Reason for not implementation: Waiting for genuine thermometers since the new thermometers break easily and give wrong readings. ・Expected implementation schedule: Some of them replaced. Need original parts.	**Pending**

5.Pressure meters Some pressure meters in the engine control panel are defective, so verifications must be done in the engine side. (Check all units)(cooling water, air inlet, fuel) Replacement is recommended. 	・Reason for not implementation: New parts did not fit the hose. Need to order genuine parts through DAIKAI. ・Expected implementation schedule: Arrangement of new meters to replace the bad ones. Material arrived, need installation during OH.	**Pending**
6.Safty valve Oil leaks in the safety valve.(Unit #3, #4 and #5) O Ring replacement is recommended due risk of sticking. 	・Reason for not implementation: ・Expected implementation schedule: Confirmed in 2022/10/4   	**OK**
7.Exhaust gas pipe heat insulation Due to exposition of the exhaust gas pipe, high temperature can affect sensors etc. around it, also is danger for maintenance staff. We recommend installing of insulation. 	・Reason for not implementation: Material not yet arrived. ・Expected implementation schedule: Material provided by JICA, need installation. 	**Pending**
8. Fuel Service tank Level meter fault Fault in the level meter of the fuel daily tank in the unit #3 and #4. Probably wires are cut off.	・Reason for not implementation: Need steel wire for replacement. Planning to change system.	**Pending**

	・Expected implementation schedule: July 2023	
9.Supercharger lubricating oil piping oil leak (Unit 5) 	・Reason for not implementation: Already fixed by welding the cracked oil mist pipe.	**OK**
	・Expected implementation schedule: done / confirmed in 2022/10/4	
10.Manometer Replacements of the manometer in the CJC filter lubricant inlet side of the unit #3. (Normal pressure must be 0.2 MPa, indication of 0.4 is shown) 	・Reason for not implementation: Waiting for parts	**Pending**
	・Expected implementation schedule: waiting for new manometers	
11.Unit #6 The high-speed engine (Cummins) is operated with the package open, but it sucks in outdoor dust and the air filter becomes dirty. Unless there is a special reason, the package should be closed at all times. 	・Reason for not implementation: This Cummins genset has a stator fault. The container top is corroded all around. It has not been operated for 6 months now.	**decommissioned**
	・Expected implementation schedule: The management will decide whether they`ll keep this engine or discard depending on the amount of work and cost for repair.	
Maintenance		
Washing of generators of the units #3, #4 and #5 ← Planned during august OH. #3 stator rewind was done in October 2021. #5 stator was cleaned on September 2021. #4 Stator was cleaned on March 2021.		OK
Weekly checks are carried out every week to clean the filters.		OK

In Okinawa, cleaning is not performed unless the pressure drops. (Sometimes not cleaning for 4,000 hours, However, in high-speed engine is replaced by the operating time.)	
The adjustable spanner is often used for daily disassembly and maintenance, but it is better to use a ring spanner because it does not lick the head of the bolt and it is easier to apply force.	Pending
Operation	
Introduce loudspeaker equipment in the power station.(safety) ← Not yet	Pending
Introduce Rotary light patrol to notify the staff in case of faults. (sound and light • siren) ← Not yet.	Pending
Work clothes, safety shoes and earplugs are good used, but make it a habit to wear a helmet.	OK
Good 1. Cleaning of each engine's fuel / lubricating oil is performed every Saturday. 2. Supercharger filters and engine oil wipes are also carefully implemented. 3. Work clothes, safety shoes and earplugs are good used, but make it a habit to wear a helmet.	-