3) Installation of Power Distribution Transformers

With consideration given to the demand factor and the diversity factor, along with a long-term forecast of maximum electricity demand forecast, power distribution transformers and pole transformers should be installed in each state as follows:

Table 4.14 Transformer Capacity in the Four Non Electrified States

State	Maximum electricity demand (KW)	Capacity of power distribution transformers (KVA)	Capacity of pole transformers (KVA)
Melekeok	200	Kokusai 1 x 750 KVA	10 x 25 KVA
Ngcesar	230		12 x 25
Ngeremiengui	230	Asahi 1 x 300	12 x 25
Ngatpang	50	Ibboban 3 x 25	3 x 25
Total	710	1,125	925

4) Transmission and Distribution Lines

Lines will be installed along the existing roads. The lines will be overhead in order to ensure compatibility with existing lines. In the electric poles located between Nekken and Kokusai, space to install one 34.5 KV power transmission circuit will be installed for future use. The assembly method and height of the electric poles should be determined with consideration given to this one circuit to be installed in the future. Furthermore, a load switch will be installed to major sections along the lines to make section switch possible to switch off the section during maintenance operations and accidents.

5) Implementation of Plan

The electrification plan targeting the four States on Babelthaup Island is subdivided into activities of two levels of priority.

Priority 2 : activities are the construction of 34.5 KV and 13.8 KV power transmission and distribution lines.

Priority 3 : activities are the provision of materials and equipment for the construction of the power distribution lines.

The "provision of equipment" described in section 4.3.4. is a priority 3 element. The 13.8 KV distribution lines mainly comprise short distance and direct lines,

and are included in the project. As knowledge and experience in the construction of 13.8 KV distribution lines are already possessed by the Government of Palau, it will only be necessary to provide equipment. On the other hand, Japan's provision of equipment and involvement in implementation is a priority 2 element.

4.3.3 Equipment Plan

Based on the facility plan (Section 4.3.2), equipment selection has been planned in consideration of functions, reliability, ease of maintenance, low running costs and ease of obtaining spare parts.

It is intended to include sufficient spare parts and consumables for two years of operations and maintenance of machines and equipment. Although many of these parts are small, damage to or shortage of these parts may make it difficult to maintain the equipment and to continue operations. The spare parts inventory must therefore be carefully prepared to avoid such a situation.

Major equipment and brief specifications are:

	Item	Quantity	Type and specifications
(1)	Malakal Substation Facilities		
1)	Main transformer	1	Oil filled, self cooled, equipped with on-load tap changer 10 MVA, 34.56 KV/13.8 KV
2)	Unit transformer	2	Oil filled, self cooled, 3.5 MVA 4.16 KV/13.8 KV
3)	Circuit breaker	1	Gas (SF6) type, 36 KV, 600 A, 12.5 KA
4)	Disconnecting switch	1	36 KV, 600 A, 12.5 KA
5)	Lightning arrestor	1	30 KV, 10,000 A
6)	Lightning arrestor	2	12 KV, 10,000 A
7)	Switchgear	1	Outdoor, self-supporting 13.8 KV
8)	Outdoor illumination	6	Fluorescent lamp 40 W x 2
9)	Grounding conductor	About 750 m	hard drawn stranded copper conductor, 100 mm^2

Item		Quantity	Type and specifications
(2)	Power transmission and distribution facilities in Koror district		
1)	Overhead transmission wire	About 79,820 m	AAC 150 mm^2 for 34.5 KV
2)	Overhead distribution wire	About 62,210 m	AC 38 mm^2
3)	Overhead neutral wire		
4)	Electric pole	288	13 m concrete poles
		202	16 m concrete poles
	(for guy wire)	10	12 m concrete poles
5)	Pole mounted section switch	1	Vacuum type 34.5 KV, 600 A
		9	Vacuum type 13.8 KV, 400 A
6)	Fault section indicator	2	
7)	Fault detection relay	9	
8)	Cable	About 730 m	33 KV CVT 100 mm^2
		About 1460 m	15 KV CVT 100 mm^2
9)	Steel Conduits	About 1650 m	galvanized steel pipe 150 A
(3)	Power transmission and distribution facilities on Babelthaup Island		
1)	Overhead transmission wire	About 159,400 m	AAC 150 mm^2 for 34.5 KV
2)	Overhead distribution wire	About 88,790 m	AC 38 mm^2
3)	Overhead neutral wire		
4)	Electric pole	619	13 m concrete poles

	Item	Quantity	Type and specifications
		175	16 m concrete poles
	(for substations)	12	12 m concrete poles
	(for support line)	40	12 m concrete poles
5)	Pole mounted load switch	6	Air type 34.5 KV, 600A
6)	Transformer	1	Three phase, oil filled, self cooled 750 kVA 13.8 KV/34.5 KV
		1	Three phase, oil filled, self cooled 300 kVA 13.8 KV/34.5 KV
		3	Single phase, oil filled, self cooled 25 kVA 34.5 KV/7.97 KV

(4) Power distribution facilities on Babelthaup Island (provision of equipment only)

1)	Overhead transmission wire	38,640 m	AC 38 mm^2
2)	Overhead neutral wire		
3)	Electric pole	106	13 m concrete poles

(5) Spare parts (for facilities at Malakal Substation)

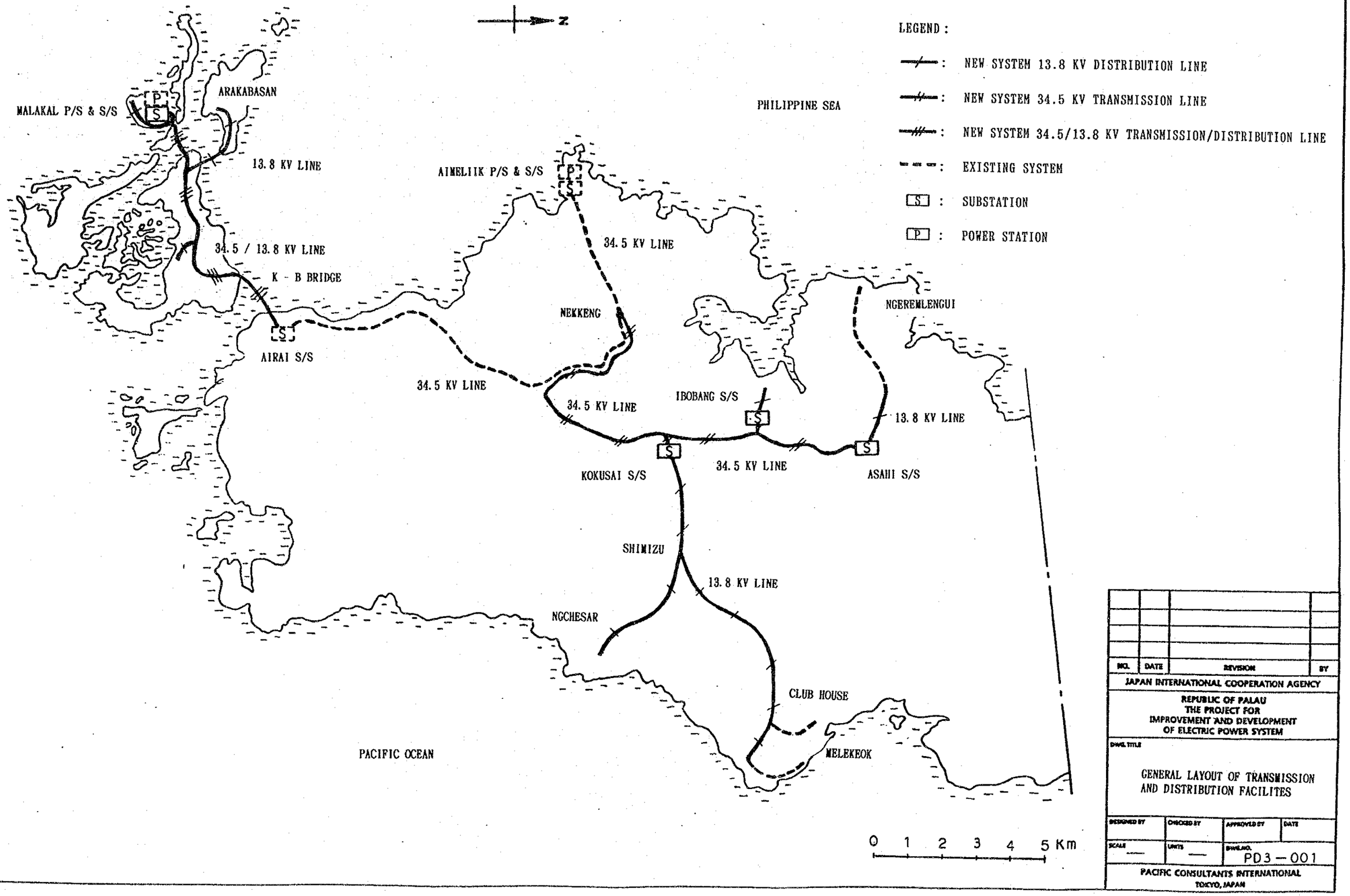
1)	Bushing for transformer	1	34.5 KV (200 A)
2)	Bushing for transformer	1	13.8 KV (600 A)
3)	Buchholtz relay	1	for transformer
4)	Buchholtz relay	1	for on-load tap changer
5)	Oil level gage	1	for transformer
6)	Oil level gage	1	for on-load tap changer
7)	Dial thermometer	1	
8)	Bursting plate	1	for transformer
9)	Bursting plate	1	for on-load tap changer
10)	Current transformer for bushing	1	
11)	On-load oil purification filter	500	
12)	Silica gel	60 kg	
13)	Lighting fixture	1	
14)	Lamp	20	

15)	Circuit breaker draw-out unit	1	
16)	Circuit breaker	1	
17)	Switch	1	for control panel
18)	Protection relay	1	for control panel
19)	Auxiliary relay	1	for control panel

4.3.4 Basic Design Drawing

Basic design drawings for the power transmission and distribution facilities are as follows.

No.	Drawing Title	Drawing No.
1	General Layout of Transmission and Distribution Facilities	PD3-001
2	Single Line Diagram for Malakal Substation	PD3-011
3	Single Line Diagram for Power Improvement Plan in Koror Area	PD3-012
4	Single Line Diagram for Electrification Plan in Babelthaup Island	PD3-013
5	Route Plan for Transmission and Distribution Lines	PD3-021
6	Plot Plan of Malakal Substation	PD3-101
7	Equipment Layout of Malakal Substation	PD3-102
8	Typical Pole Arrangement	PD3-201
9	Cabling Plan for K-B Bridge	PD3-301



NO.	DATE	REVISION	BY

JAPAN INTERNATIONAL COOPERATION AGENCY

REPUBLIC OF PALAU
THE PROJECT FOR
IMPROVEMENT AND DEVELOPMENT
OF ELECTRIC POWER SYSTEM

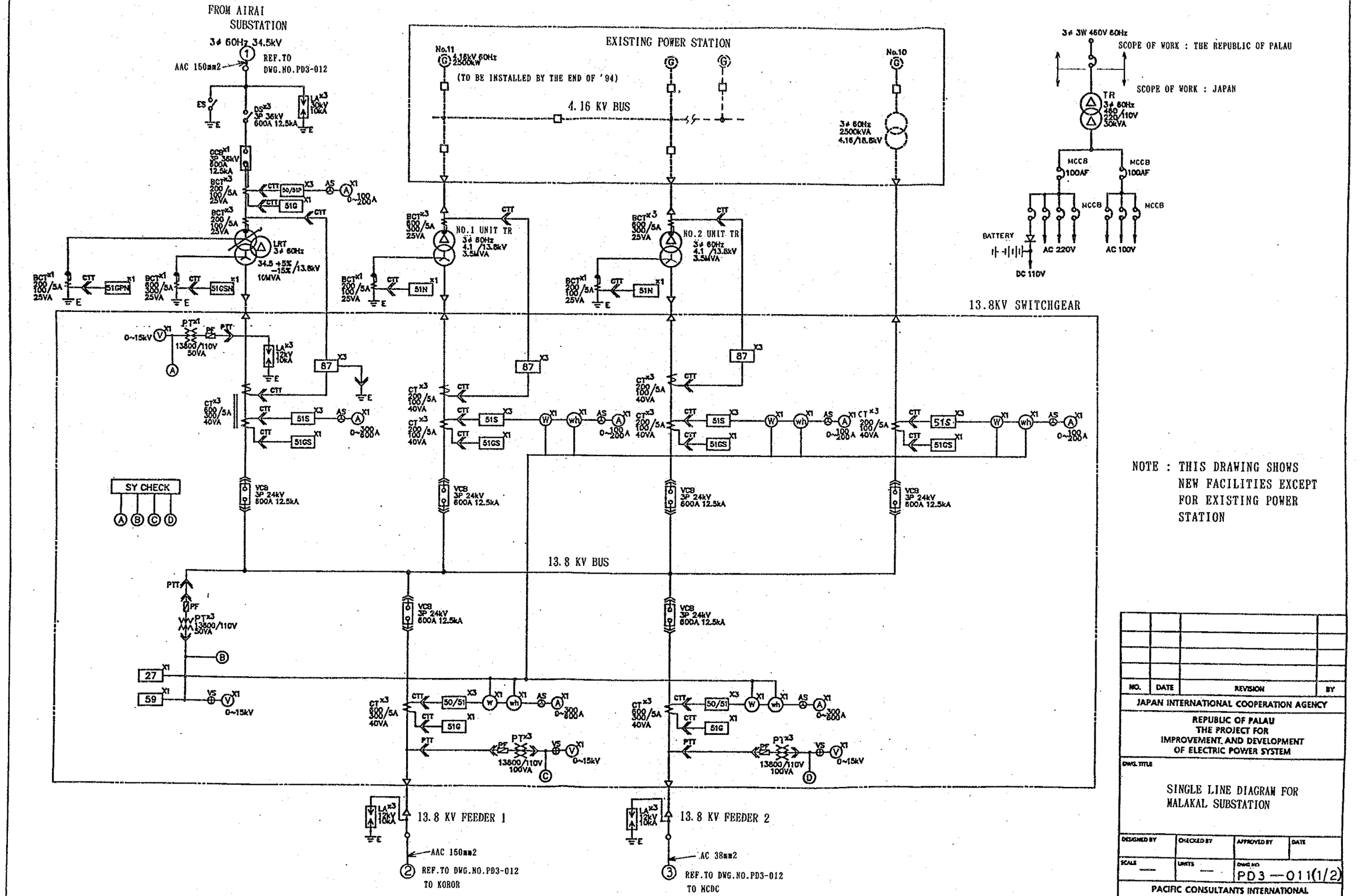
DWG. TITLE

GENERAL LAYOUT OF TRANSMISSION AND DISTRIBUTION FACILITES

DESIGNED BY	CHECKED BY	APPROVED BY	DATE

SCALE	UNITS	DWG.NO.
——	——	PD3 — 001

PACIFIC CONSULTANTS INTERNATIONAL
TOKYO, JAPAN



NOTE : THIS DRAWING SHOWS NEW FACILITIES EXCEPT FOR EXISTING POWER STATION

NO.	DATE	REVISION	BY

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OF ELECTRIC POWER SYSTEM

DWG. TITLE

SINGLE LINE DIAGRAM FOR
MALAKAL SUBSTATION

DESIGNED BY	CHECKED BY	APPROVED BY	DATE

SCALE	UNITS	DWG NO.
———	———	PD3 — 011(1/2)

PACIFIC CONSULTANTS INTERNATIONAL
TOKYO, JAPAN

LEGEND

- EXISTING GENERATOR
- THREE PHASE TRANSFORMER (DELTA-DELTA)
- THREE PHASE TRANSFORMER (DELTA-STAR)
- TRANSFORMER WITH ON LOAD TAP CHANGER
- LIGHTNING ARRESTOR
- VACUUM CIRCUIT BREAKER
- GAS CIRCUIT BREAKER
- MOLDED CASE CIRCUIT BREAKER
- POWER FUSE
- DISCONNECTING SWITCH
- EARTHING SWITCH
- CURRENT TRANSFORMER
- CURRENT TRANSFORMER (BUSHING TYPE)
- POTENTIAL TRANSFORMER
- RECTIFIER
- BATTERY
- CHANGE-OVER SWITCH FOR AMMETER
- CHANGE-OVER SWITCH FOR VOLTMETER
- AMMETER
- VOLTMETER
- WATTMETER
- WATT-HOUR METER
- 87 RATIO DIFFERENTIAL RELAY
- 51G OVERCURRENT GROUND RELAY
- 51GPN OVERCURRENT GROUND RELAY AT PRIMARY SIDE NEUTRAL CIRCUIT
- 51GS OVERCURRENT GROUND RELAY AT SECONDARY SIDE
- 51S OVERCURRENT RELAY AT SECONDARY SIDE
- 50/51 OVERCURRENT RELAY WITH SHORT CIRCUIT PROTECTION
- 50/51P OVERCURRENT RELAY WITH SHORT CIRCUIT PROTECTION AT PRIMARY SIDE
- 27 UNDERVOLTAGE RELAY
- 59 OVERVOLTAGE RELAY

NO.	DATE	REVISION	BY

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REPUBLIC OF PALAU
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OF ELECTRIC POWER SYSTEM

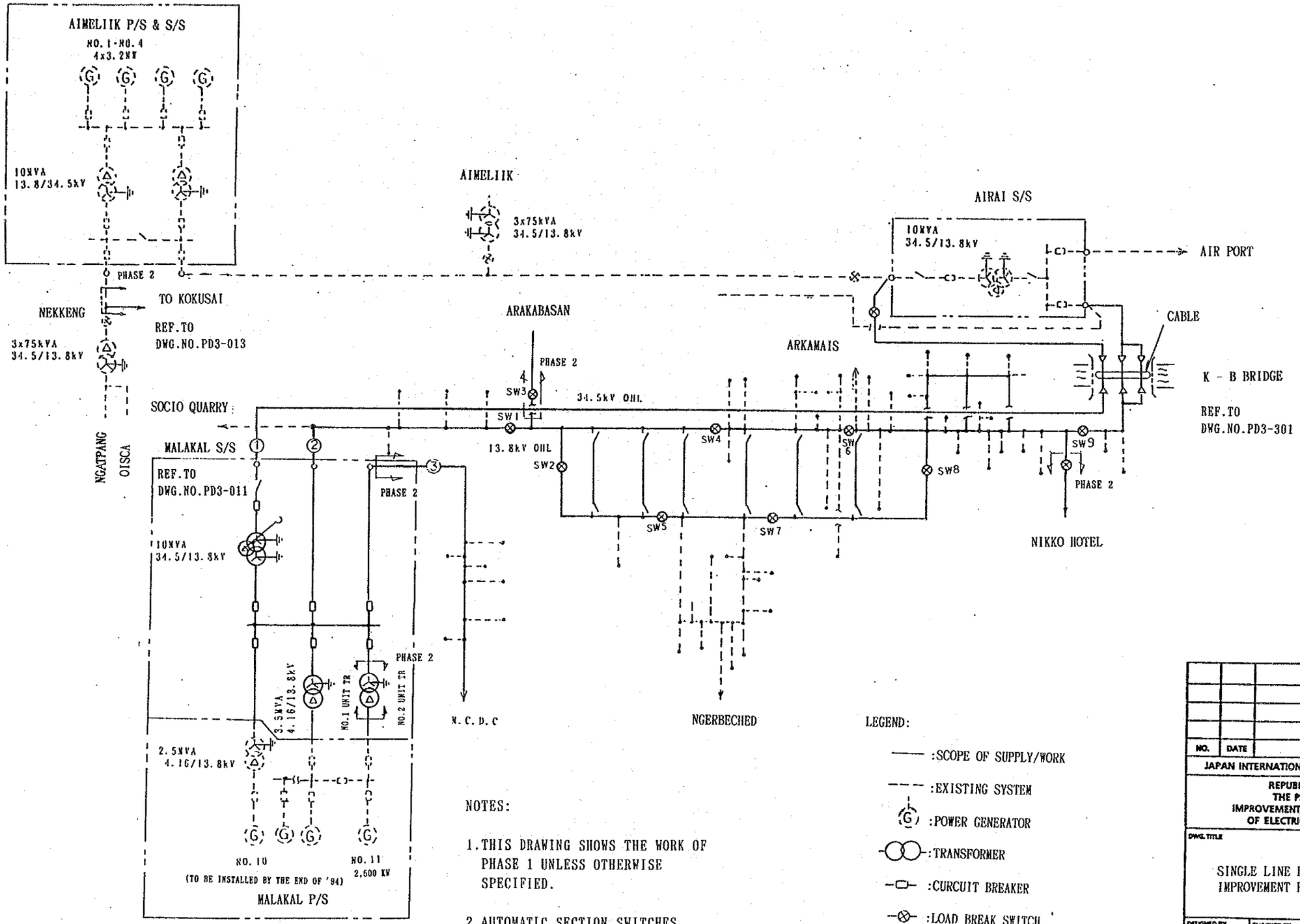
DWG. TITLE

SINGLE LINE DIAGRAM FOR
MALAKAL SUBSTATION (LEGEND)

DESIGNED BY	CHECKED BY	APPROVED BY	DATE

SCALE	UNITS	DWG. NO.
—	—	PD3-011(2/2)

PACIFIC CONSULTANTS INTERNATIONAL
TOKYO, JAPAN



NOTES:

1. THIS DRAWING SHOWS THE WORK OF PHASE 1 UNLESS OTHERWISE SPECIFIED.
2. AUTOMATIC SECTION SWITCHES AND NO.2 UNIT TR SHALL BE PROVIDED IN PHASE 2.

LEGEND:

- ——— :SCOPE OF SUPPLY/WORK
- - - - :EXISTING SYSTEM
- (G) :POWER GENERATOR
- ◯◯ :TRANSFORMER
- —□— :CURCUIT BREAKER
- —⊗— :LOAD BREAK SWITCH
  (SW1~SW9 : Q'TY 9,AUTOMATIC SECTION SWITCHES)
- —╲— :CUT OUT SWITCH

NO.	DATE	REVISION	BY

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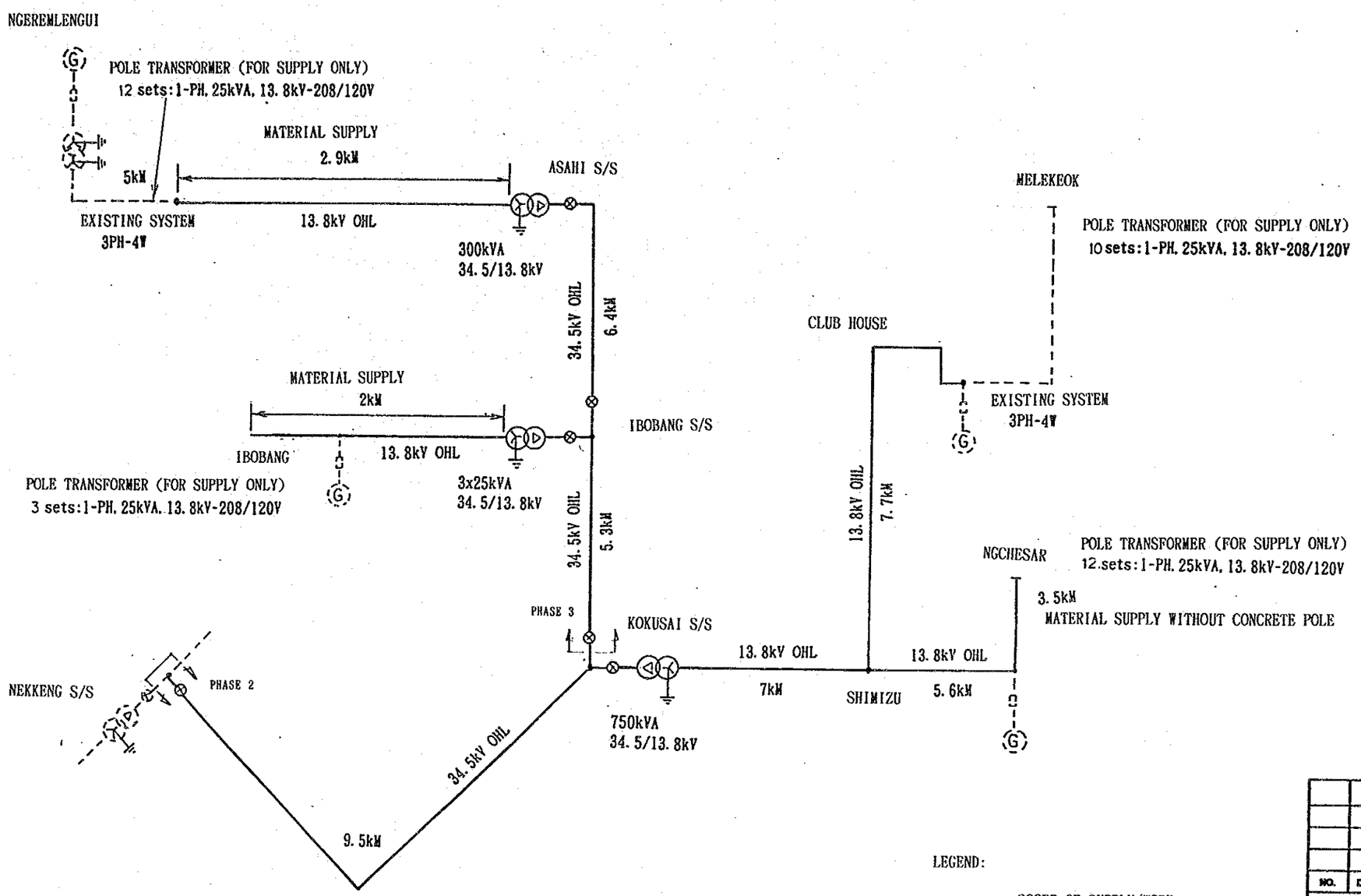
OF ELECTRIC POWER SYSTEM

DWG. TITLE

SINGLE LINE DIAGRAM FOR POWER IMPROVEMENT PLAN IN KOROR AREA

DESIGNED BY	CHECKED BY	APPROVED BY	DATE
SCALE ——	UNITS —	DWG.NO. PD3—012	

PACIFIC CONSULTANTS INTERNATIONAL
TOKYO, JAPAN



NOTE;

VALUES SUCH AS '9.5 KM 'SHOWN ADJACENT TO THE TRANSMISSION/DISTRIBUTION LINES ARE APPROXIMATE LINE LENGTH.

LEGEND:

- ——— :SCOPE OF SUPPLY/WORK
- - - - :EXISTING SYSTEM
- (G) :POWER GENERATOR
- :TRANSFORMER
- :CURCUIT BREAKER
- :LOAD BREAK SWITCH
- :CUT OUT SWITCH

NO.	DATE	REVISION	BY

JAPAN INTERNATIONAL COOPERATION AGENCY

REPUBLIC OF PALAU
THE PROJECT FOR
IMPROVEMENT AND DEVELOPMENT
OF ELECTRIC POWER SYSTEM

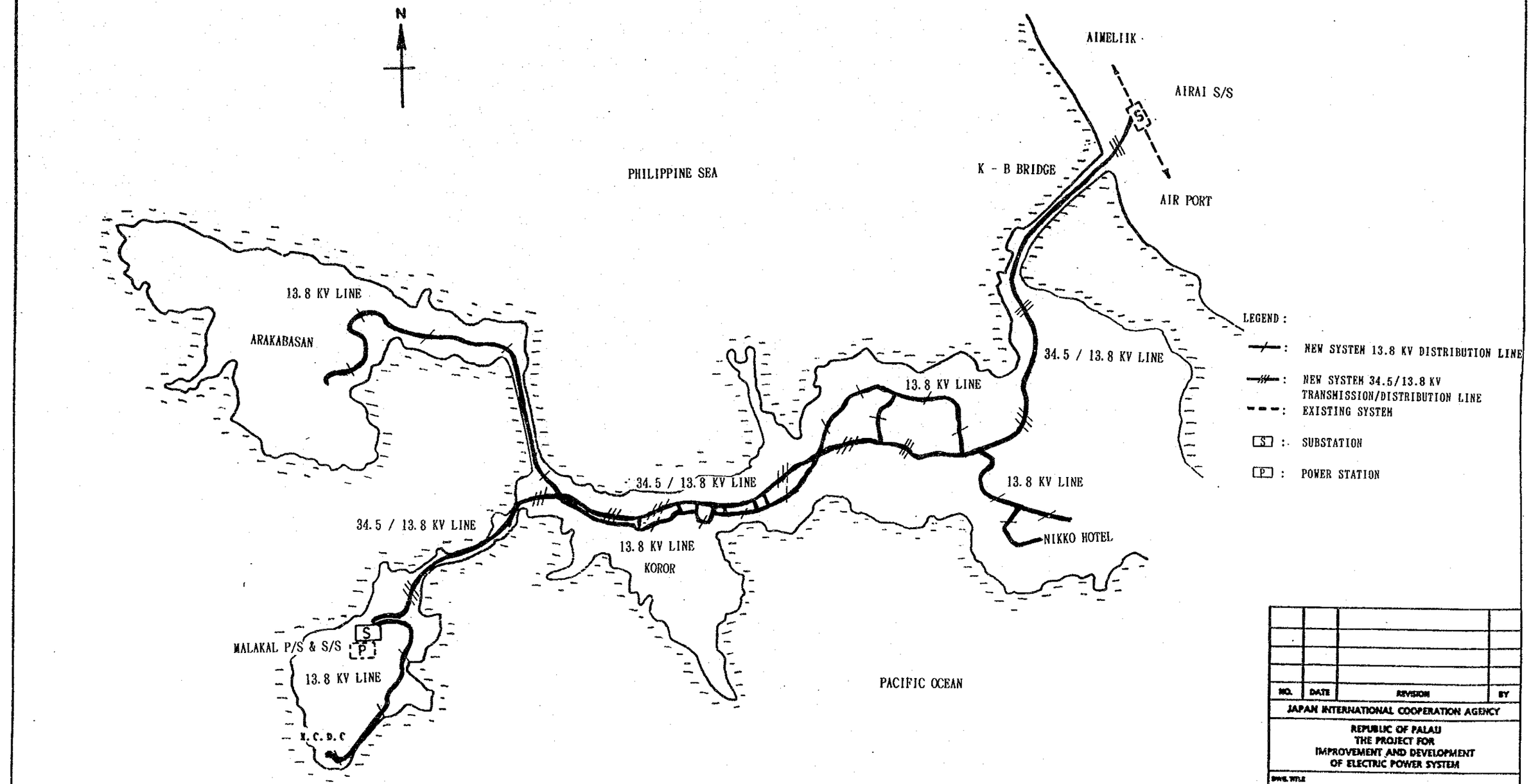
DWG. TITLE

SINGLE LINE DIAGRAM FOR ELECTRIFICATION PLAN IN BABELTHUAP ISLAND

DESIGNED BY	CHECKED BY	APPROVED BY	DATE

SCALE	UNITS	DWG.NO.
—	—	PD3 — 013

PACIFIC CONSULTANTS INTERNATIONAL
TOKYO, JAPAN



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JAPAN INTERNATIONAL COOPERATION AGENCY

REPUBLIC OF PALAU
THE PROJECT FOR
IMPROVEMENT AND DEVELOPMENT
OF ELECTRIC POWER SYSTEM

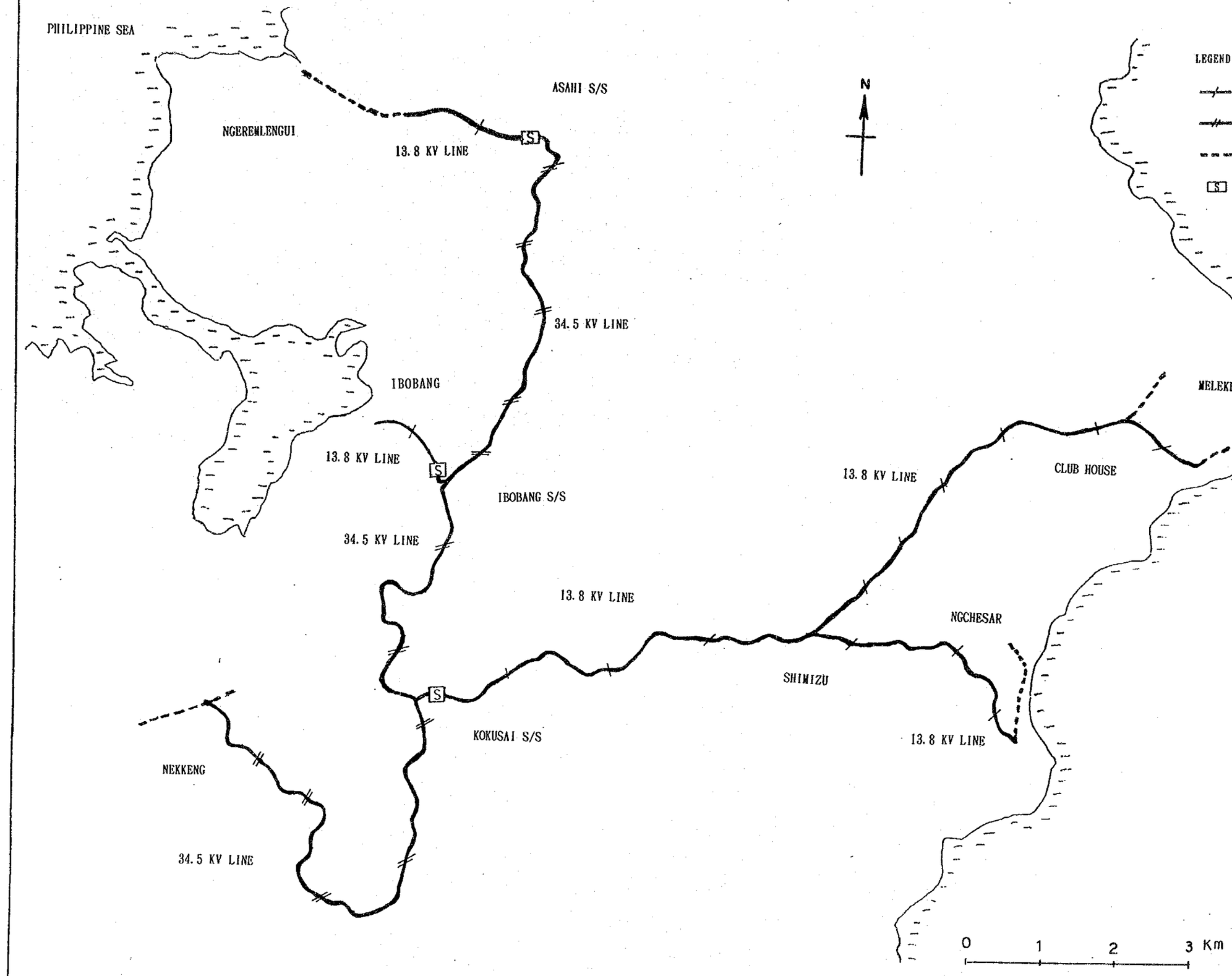
DWG. TITLE

ROUTE PLAN FOR TRANSMISSION
AND DISTRIBUTION LINES
(KOROR AREA)

DESIGNED BY	CHECKED BY	APPROVED BY	DATE

SCALE	UNITS	DWG.NO.
—	—	PD3-021(1/2)

PACIFIC CONSULTANTS INTERNATIONAL
TOKYO, JAPAN



NO.	DATE	REVISION	BY

JAPAN INTERNATIONAL COOPERATION AGENCY

REPUBLIC OF PALAU
THE PROJECT FOR
IMPROVEMENT AND DEVELOPMENT
OF ELECTRIC POWER SYSTEM

DWG. TITLE

ROUTE PLAN FOR TRANSMISSION
AND DISTRIBUTION LINES
(BABELTHUAP ISLAND)

DESIGNED BY	CHECKED BY	APPROVED BY	DATE

SCALE	UNITS	DWG.NO.
——	——	PD3—021(2/2)

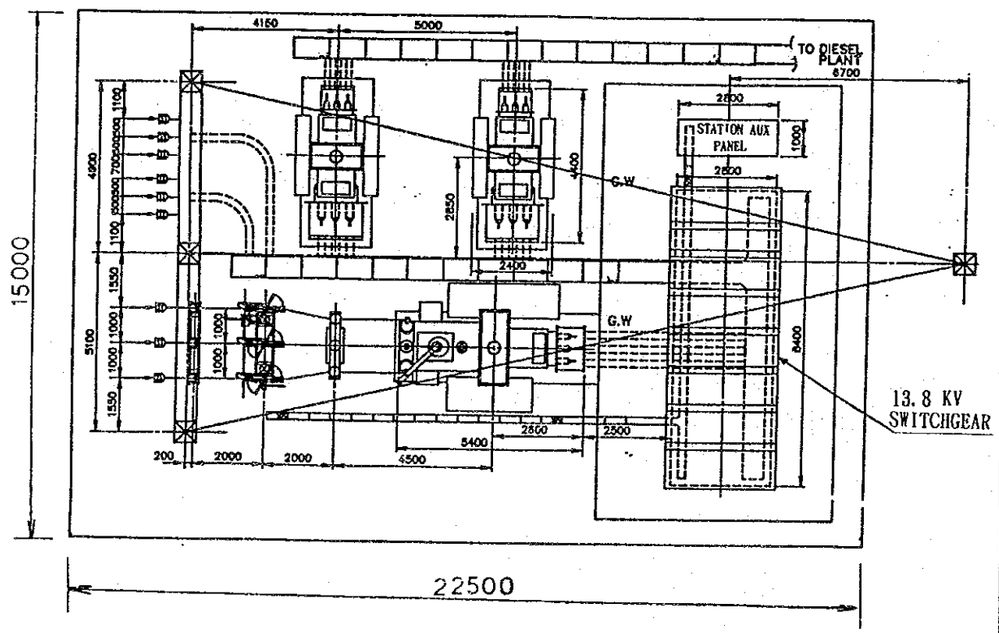
PACIFIC CONSULTANTS INTERNATIONAL
TOKYO, JAPAN

ENTRANCE

EXISTING ROAD

EXISTING MALAKAL POWER STATION

NEW MALAKAL SUBSTATION



EXISTING MALAKAL SUBSTATION

NOTE : NEW MALAKAL SUBSTATION WILL BE LOCATED AS CLOSE TO EXISTING MALAKAL POWER STATION AS POSSIBLE.

0 5 10 15m

NO.	DATE	REVISION	BY

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REPUBLIC OF PALAU
THE PROJECT FOR
IMPROVEMENT AND DEVELOPMENT
OF ELECTRIC POWER SYSTEM

DWG. TITLE

PLOT PLAN OF MALAKAL SUBSTATION

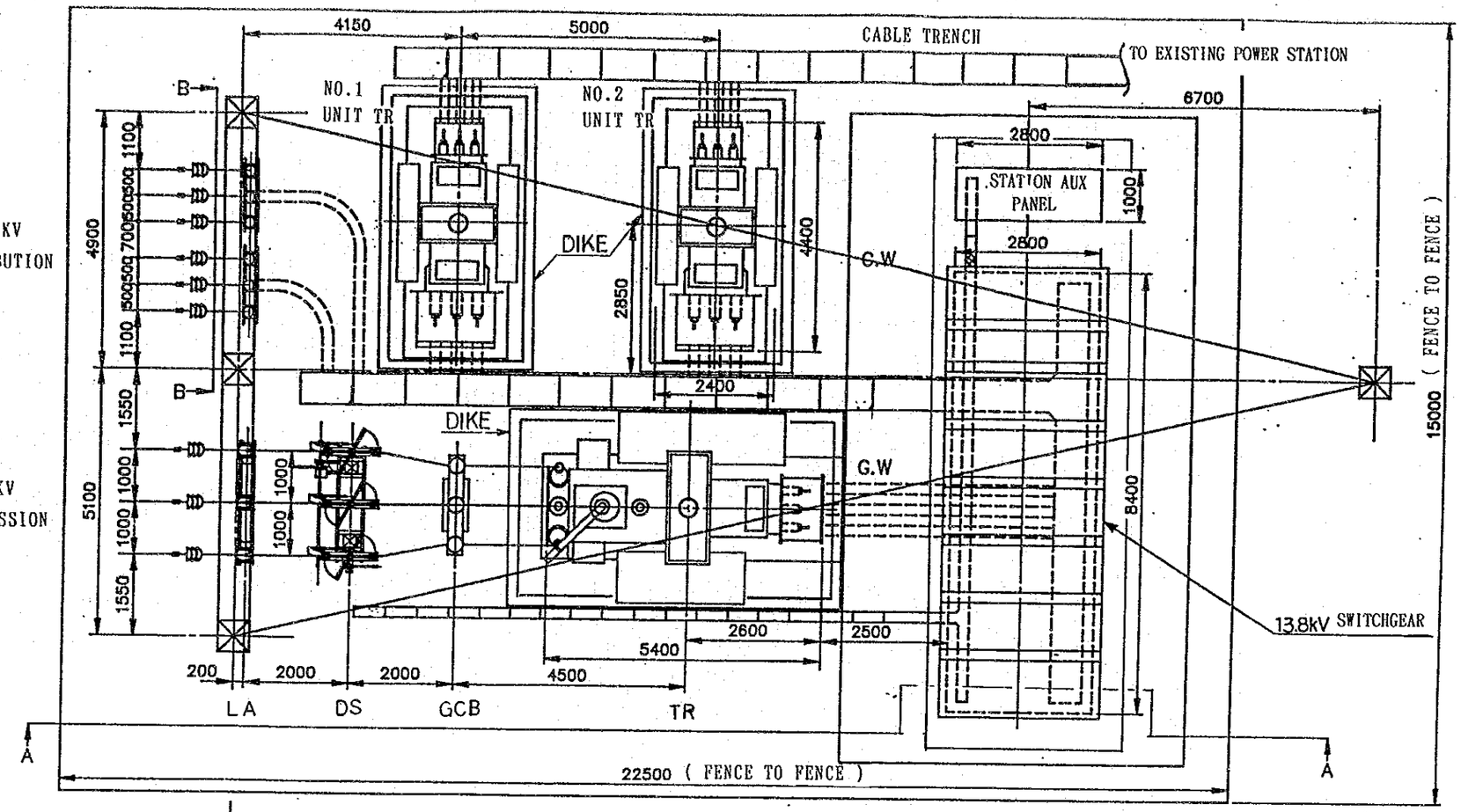
DESIGNED BY	CHECKED BY	APPROVED BY	DATE

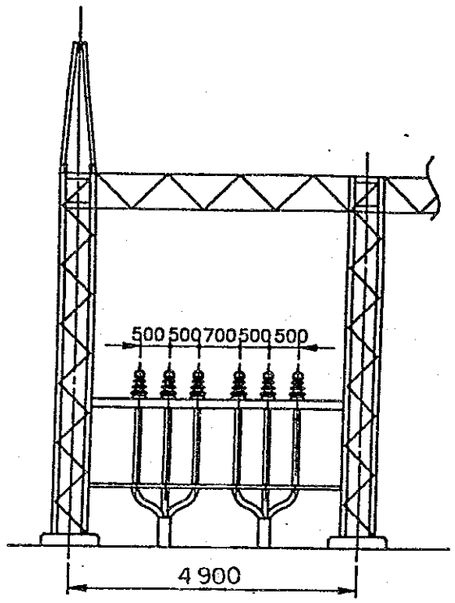
SCALE	UNITS	DWG.NO.
—	MM	PD3-101

PACIFIC CONSULTANTS INTERNATIONAL
TOKYO, JAPAN

13.8 KV DISTRIBUTION LINES

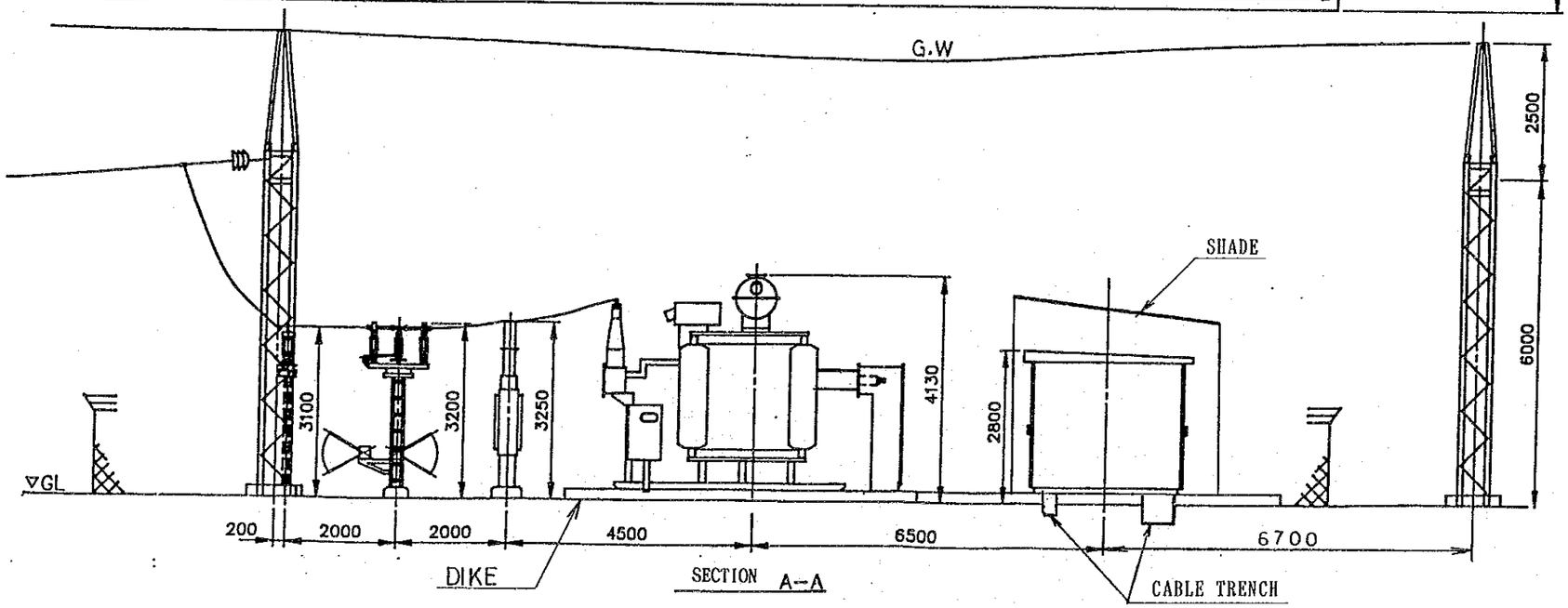
34.5 KV TRANSMISSION LINE





SECTION B–B

LIGHTNING ARRESTOR
NOT SHOWN FOR CLARITY



SECTION A–A

NO.	DATE	REVISION	BY

JAPAN INTERNATIONAL COOPERATION AGENCY

REPUBLIC OF PALAU
THE PROJECT FOR
IMPROVEMENT AND DEVELOPMENT
OF ELECTRIC POWER SYSTEM

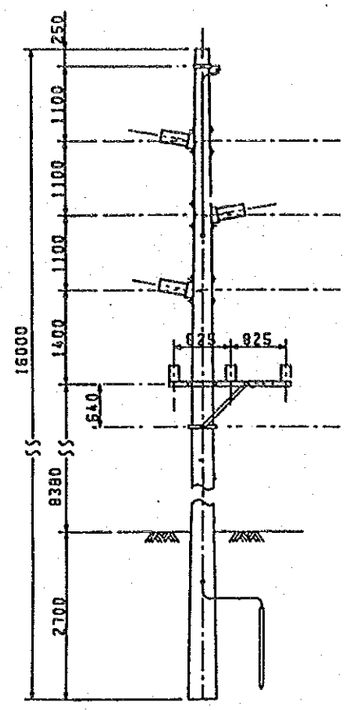
DWG. TITLE

EQUIPMENT LAYOUT OF
MALAKAL SUBSTATION

DESIGNED BY	CHECKED BY	APPROVED BY	DATE

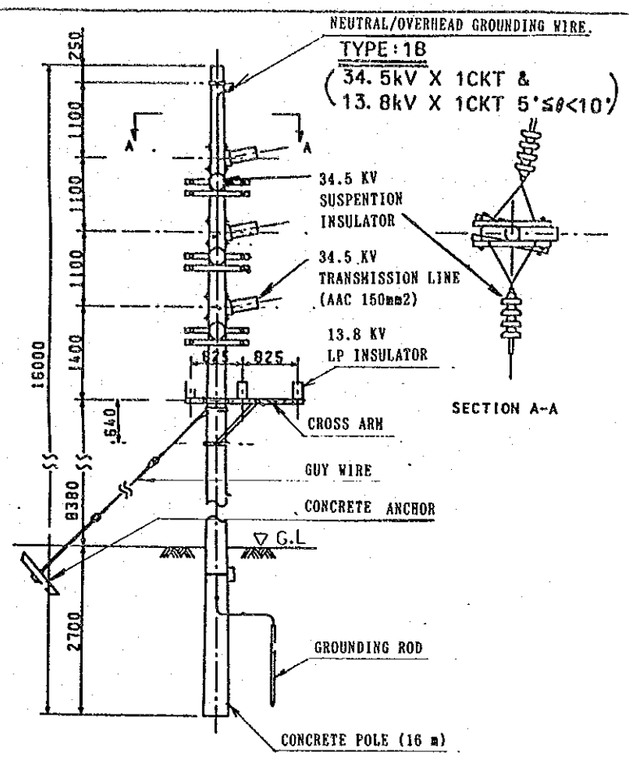
SCALE	UNITS	DWG.NO.
1/100	MM	PD3—102

PACIFIC CONSULTANTS INTERNATIONAL
TOKYO, JAPAN



TYPE : 1A

(34. 5kV X 1CKT &
13. 8kV X 1CKT 0°≤θ<5°)

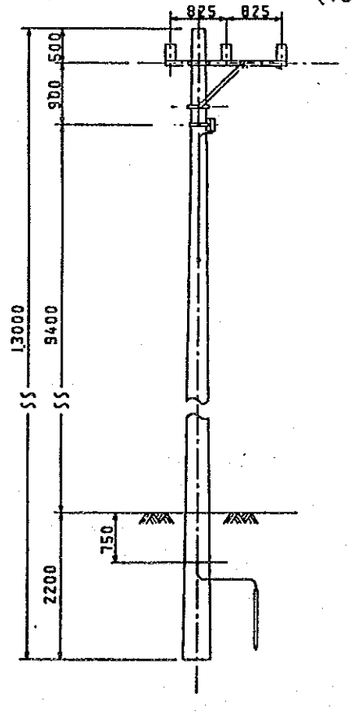


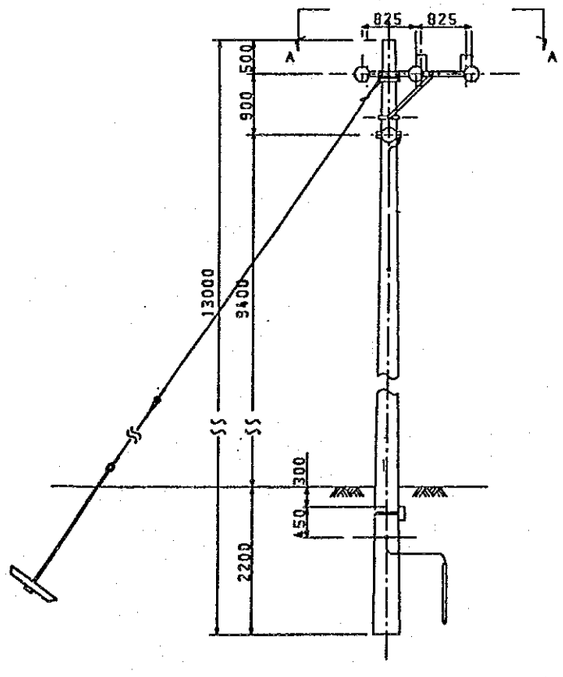
TYPE : 1B

(34. 5kV X 1CKT &
13. 8kV X 1CKT 5°≤θ<10°)

TYPE : 2A (21A)

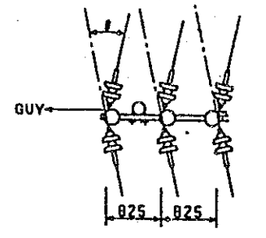
(13. 8kV×1CKT 0°≤θ<5°)





TYPE : 2D (21D)

(13. 8kV X 1CKT 20°≤θ<35°)



SECTION A-A

NO.	DATE	REVISION	BY

JAPAN INTERNATIONAL COOPERATION AGENCY

REPUBLIC OF PALAU
THE PROJECT FOR
IMPROVEMENT AND DEVELOPMENT
OF ELECTRIC POWER SYSTEM

DWG. TITLE

TYPICAL POLE ARRANGEMENT

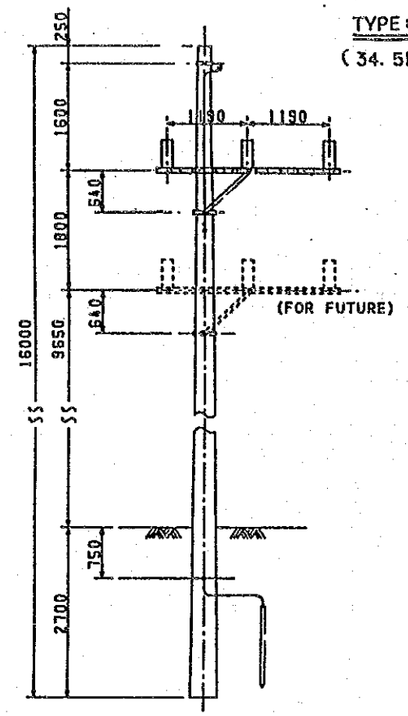
DESIGNED BY	CHECKED BY	APPROVED BY	DATE

SCALE	UNITS	DWG.NO.
—	MM	PD3—201(1/2)

PACIFIC CONSULTANTS INTERNATIONAL
TOKYO, JAPAN

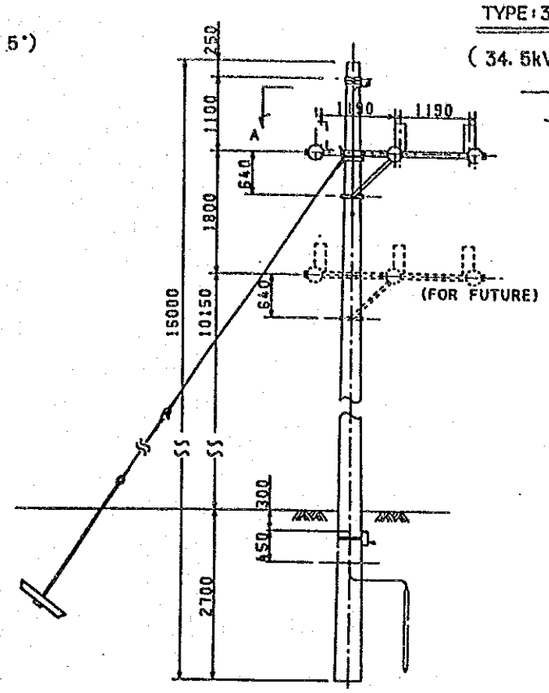
TYPE : 3A

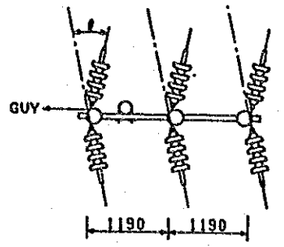
(34. 5kV X 1CKT 0°≦θ< 5°)



TYPE : 3D

(34. 5kV X 1CKT 20°≦θ<35°)

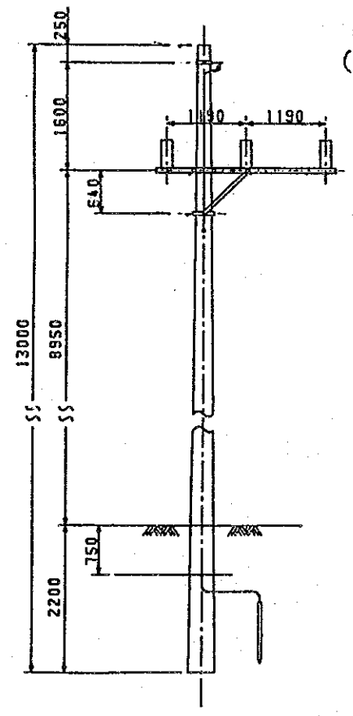




SECTION A-A

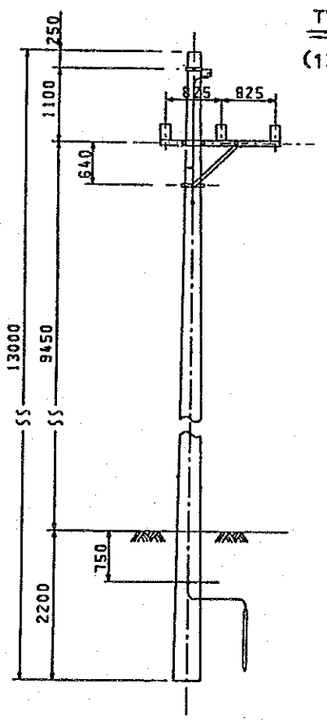
TYPE : 4A

(34. 5kVX1CKT 0°≦θ<5°)



TYPE : 5A

(13. 8kVX1CKT 0°≦θ<5°)



NO.	DATE	REVISION	BY

JAPAN INTERNATIONAL COOPERATION AGENCY

REPUBLIC OF PALAU
THE PROJECT FOR
IMPROVEMENT AND DEVELOPMENT
OF ELECTRIC POWER SYSTEM

DWG. TITLE

TYPICAL POLE ARRANGEMENT

DESIGNED BY	CHECKED BY	APPROVED BY	DATE

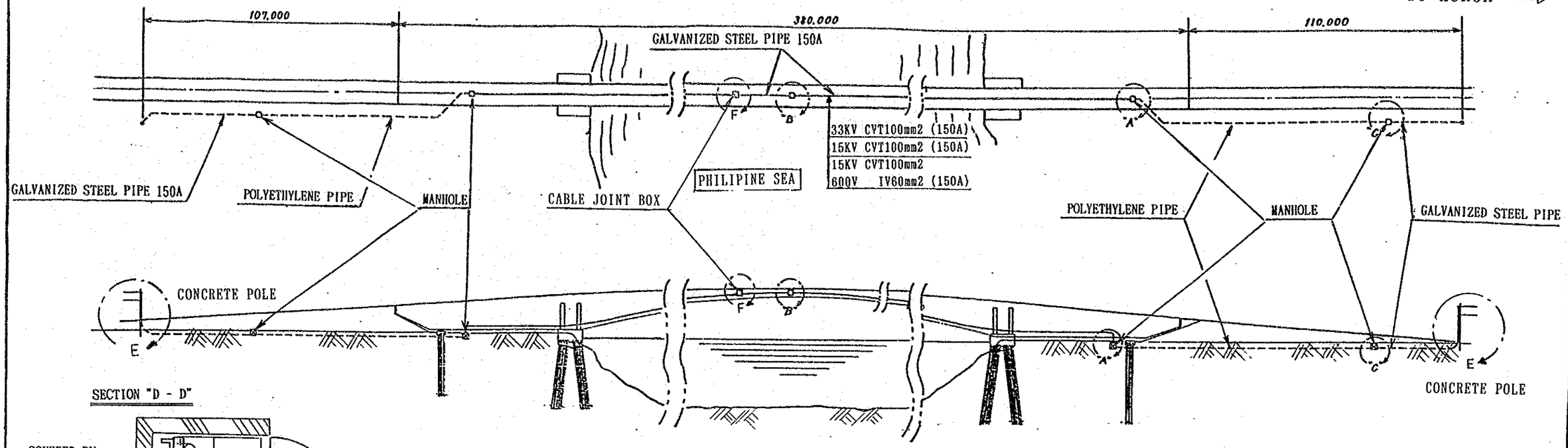
SCALE	UNITS	DWG.NO.
—	MM	PD3 −201(2/2)

PACIFIC CONSULTANTS INTERNATIONAL
TOKYO, JAPAN

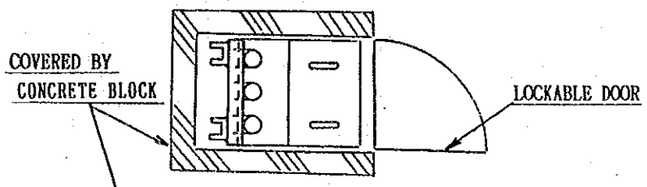
TO AIRAI

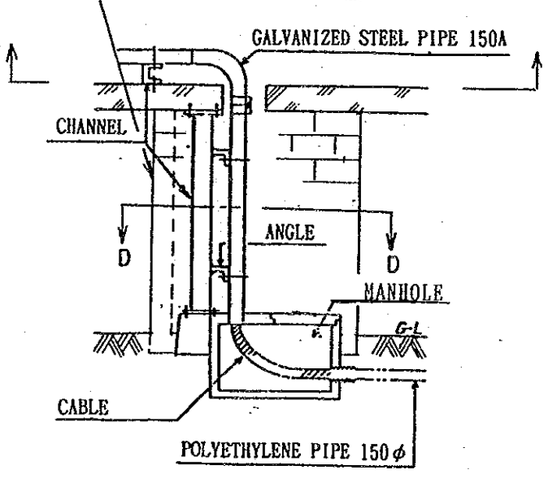
K-B BRIDGE

TO KOROR

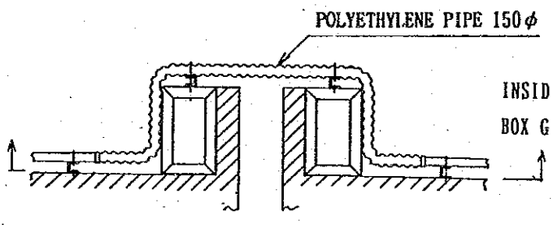


SECTION "D - D"

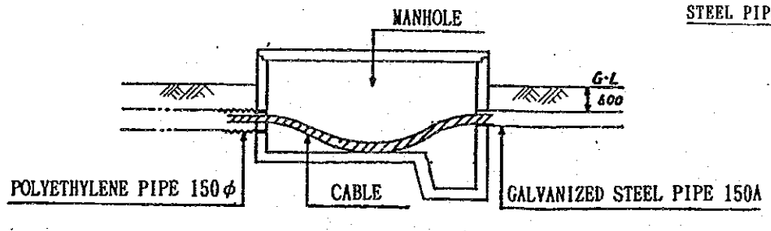




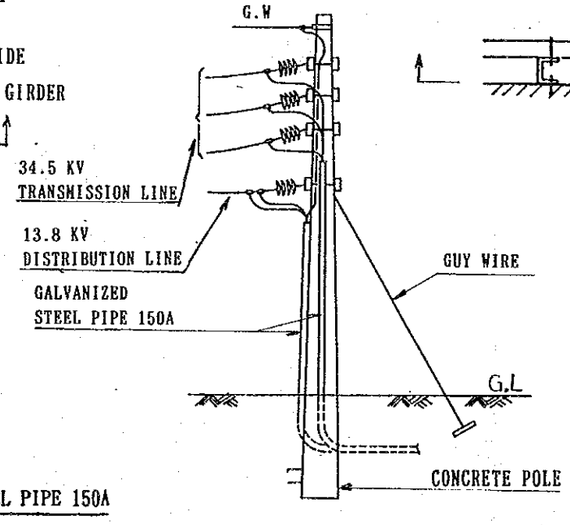
DETAIL " A "



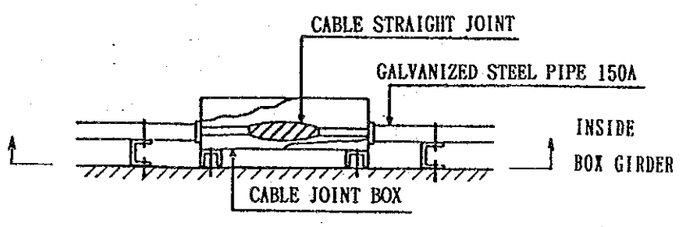
DETAIL " B "



DETAIL " C "



DETAIL " E "



DETAIL " F "

NO.	DATE	REVISION	BY

JAPAN INTERNATIONAL COOPERATION AGENCY

REPUBLIC OF PALAU
THE PROJECT FOR
IMPROVEMENT AND DEVELOPMENT
OF ELECTRIC POWER SYSTEM

DWG. TITLE

CABLING PLAN FOR K-B BRIDGE

DESIGNED BY	CHECKED BY	APPROVED BY	DATE

SCALE	UNITS	DWG.NO.
—	MM	PD3—301

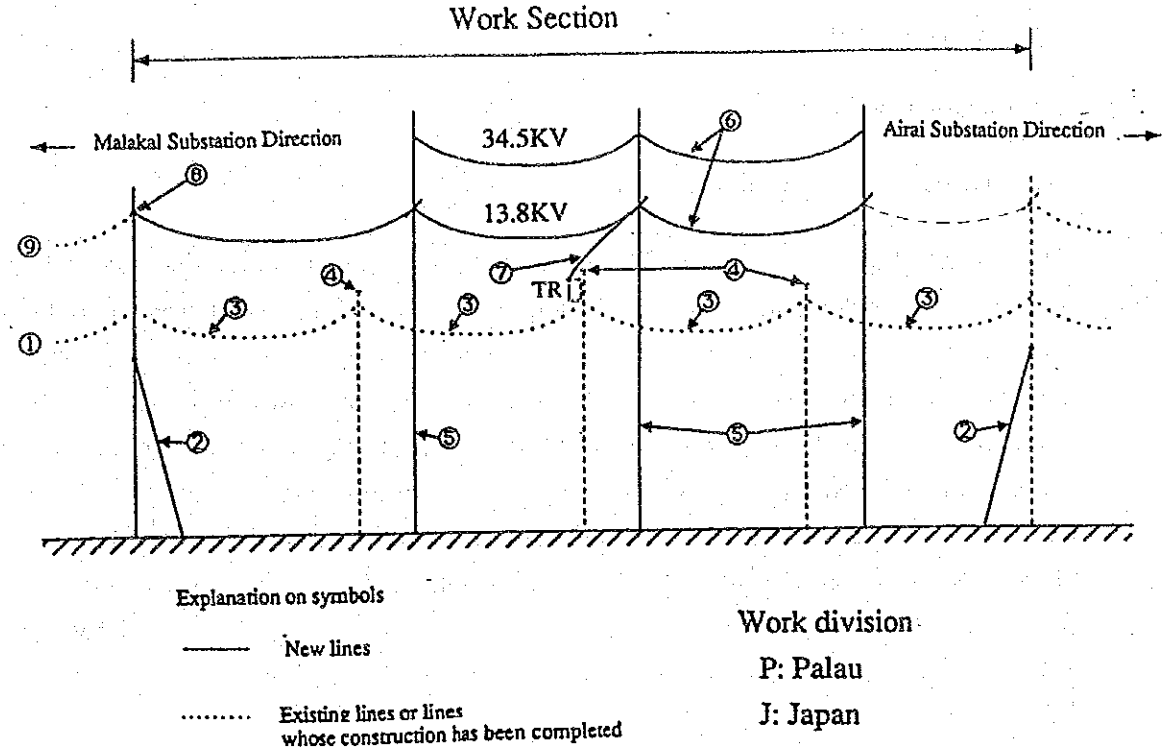
PACIFIC CONSULTANTS INTERNATIONAL
TOKYO, JAPAN

4.4 Implementation Plan

4.4.1 Construction Condition

(1) Power Distribution Lines in Koror State

The removal of existing lines and the construction of power distribution lines under this project will be implemented concurrently with the improvement and enhancement of the power distribution network in order to minimize the scope and duration of power blackouts. As a compromise between the desire to minimize power blackouts and the requirements for securing maximum construction time, the duration of power blackouts for each line will be set as a maximum eight hours during the day. It is necessary to pay careful attention in order to ensure human safety during systematic power blackouts and the reconnection of electricity. Discussions with the Government of Palau during implementation will enable adjustment of operating details. Figure 4.4 shows an example of the sequence of construction work and the work section.



No.	Activities	Work division
(1)	Open feeder ciruit breaker at Malkal Substation	P
(2)	Install guy wire to enhance existing electric poles	J
(3)	Cut existing electric wires	P
(4)	Cut and remove the upper part of existing electric pole	P
(5)	Erect new electric poles	J
(6)	Install new electric wires	J
(7)	Connect the primary side of pole transformer	P (J:materials)
(8)	Connect existing electric wires and new electric wires	J
(9)	Close feeder circuit breaker at Malakal Substation	P

Figure 4.4 Examples of Sequence of Construction for Power Distribution Line

(2) Transport of Materials and Equipment

Transport of materials and equipment from Japan to Palau will utilize existing shipping opportunities. Currently ocean liners travel between Palau and Japan two to three times a month.

(3) Weather Provisions

As rainfall and humidity are high, it will be necessary to pay careful attention to the establishment of a temporary tent for the protection of excavated parts, procurement and storage of cement and the pouring of concrete. Rain also loosens the foundations of both major and access roads, and may effect the progress of the transport of materials and equipment and of construction work. It is therefore vital for the Government of Palau to accurately plan and implement construction, maintenance and control of roads.

(4) Safety Measures for Existing Facilities

As the construction site will be located next to the existing substation and power transmission and distribution lines, adequate safety measures should be taken to ensure that the work will not cause any problems in the operation of existing facilities.

(5) Human Safety during Systematic Power Blackout and Reconnection

In constructing power transmission and distribution lines, it is necessary to systematically shut down power along existing lines, section by section, and subsequently connect electricity to the new lines. In order to eliminate accidents from electric shocks, the procedures for implementing power blackouts and reconnecting electricity, as well as other safety matters, must be thoroughly understood by all parties concerned. Measures such as safety education, safety meetings, and installation and use of safety tools should be taken.

(6) Consultation with State Governments and Residents

During construction works it will be necessary to approach or enter the land and properties of State Governments' and residents'. The Government of Palau must give explanations to and consult with the State Governments and residents to ensure there will be no access problems during construction work.

4.4.2 Implementation Method

This project is carried out within the framework of Grant Aid provided by the Government of Japan. After this project is approved by the governments of both countries and an exchange note (E/N) is concluded, this project will be formally implemented. A Japanese corporate consultant will then be selected by the Government of Palau, and the contract concerning the control of implementation as well as implementation design will be exchanged between these two parties, subject to approval by the Government of Japan. Facilities and equipment design will then begin. After completing the design plan a construction contract will also be exchanged between the Government of Palau and a Japanese company selected through bidding. The contract will come into effect after approval has been given by the Government of Japan.

The Japanese contractor will supervise overall operations, with Japanese electricians becoming involved in works that require high skills such as cable terminations. Supplementary and general operations will be conducted by locals and foreigners (chiefly Filipinos) under the supervision of the contractor.

4.4.3 Construction and Supervisory Plan

(1) Implementation Design

Based on the basic design, implementation design and bidding documents should be prepared. After the conclusion of the contract with the consultant, a survey of the project area should be conducted to confirm the routes of the power transmission and distribution lines, and the location of electricity poles to be installed.

(2) Bidding

The consultant must assist the Government of Palau in sending out invitations for bidding, establishing the qualifications of bidders, issuing bid documents, examining bids and so forth. In doing so, the consultant must promote the conclusion of a contract for the work between the Government of Palau and the Japanese contractor.

(3) Supervision of Implementation

After the conclusion of the contract, the consultant will assist the Government of Palau in implementing the project quickly. In doing so, the consultant will carry out contractor document approvals and inspect materials and equipment to be procured. The consultant must also attend the inspections carried out before the commencement of construction works, as well as witnessing factory test of materials and equipment. The

consultant must also give instructions to and supervise the contractor concerning construction works, installation, commissioning, final inspection before the hand-over, and so forth. The consultant will carry out progress control, quality control and cost control, and must complete responsibilities within the period set out in the exchange note.

4.4.4 Procurement Plan

(1) Basic Policies

Materials and equipment that can be procured in Palau are cement, gravel, reinforcing bars, wood, plywood, nails and general use steel pipe. Palau places orders with countries such as the United States for materials required for electrical work, even for low voltage electrical work. Therefore, such materials will take time to be delivered. Materials and equipment that cannot be procured locally will, in principal, be procured from Japan.

Among machines used for constructing power transmission and distribution lines and machines used for installation of equipment, cranes, concrete mixers, dump trucks and backhoes can be procured locally. Other machines should be brought from Japan.

(2) Procurement of Materials and Equipment

1) Materials and Equipment Procured Locally

Cement, gravel, reinforcing bars, wood, plywood, nails, general use steel pipe, gasoline, compact work vehicles, hand tools, and other consumable materials and equipment.

2) Materials and Equipment Procured from Japan

Facilities for power transmission and distribution lines: electric poles, electric wires, cables, insulators, metal fittings for assembly, automatic section switches.

Facilities for substations: transformers, circuit breakers, disconnecting switches, lightning arrestors, switchgears, control panels, direct current power source devices, cables, earthing conductors, lights and fences.

Machines for construction work: above-ground work vehicles, vehicles for setting up poles, general and special tools.

3) Materials and Equipment Procured from Other Countries

Through local surveys and consequent analysis conducted in Japan, we examined the possibility of procuring materials and equipment in other countries. However, for the following reasons, this will not occur:

- The materials and equipment used in this project can all be procured in Japan and there are several suppliers of these materials and equipment
- The Government of Palau has strong faith in Japanese products
- The U.S. mainland and Guam are other possible source sites, however, procurement from these places under this project is difficult. Procurement of equipment for substations from the U.S. mainland is conceivable but products supplied from the U.S. will not be compatible with equipment delivered under the fiscal 1984/85 Japanese Grant Aid project, and the delivery of parts raises some concern. Procurement of concrete poles from Guam is possible, but Guam produces only hexagonal electric poles, that are not compatible with existing round electric poles.

4.4.5 Implementation Schedule

The targeted areas in this project are spread over a wide region: Koror State in the south and Babelthaup Island in the north. In addition, the types and quantities of equipment to be provided are large. The manufacturing period for this equipment is long: it takes at least six months to manufacture a 10 MVA transformer. The hours spent on operations will be restricted in order to minimize the duration of power blackouts while constructing a distribution network in Koror State. Careful attention shall also be paid to possible decrease in productivity due to bad weather conditions expected in the rainy season between May and September. The implementation will therefore be planned in three stages. Figure 4.5 shows the implementation time schedule.

Stage 1

(1) Improvement and enhancement of power transmission and distribution lines in Koror State (Part 1, excluding branch lines, one 3.5 MVA transformer and automatic section switches)

Months required for detail design and bidding	:	4.5 months
Months required for construction	:	9.5 months

Stage 2

(1) Improvement and enhancement of power transmission and distribution lines in Koror State (Part 2, branch lines, one 3.5 MVA transformer and automatic section switches)

(2) Construction of 34.5 KV and 13.8 KV power transmission and distribution lines in the two eastern States on Babelthaup Island (including provision of materials and equipment for constructing power distribution lines)

Months required for contract	:	2.0 months
Months required for construction	:	10.5 months

Stage 3

(1) Construction of 34.5 KV and 13.8 KV transmission and distribution lines in the two western States on Babelthaup Islands (including provision of materials and equipment for constructing power distribution lines)

Months required for contract	:	2.0 months
Months required for construction	:	8.5 months

A specific division by stage of the works included in the Project is as shown in the drawings PD3-012 and PD3-013 under Section 4.3.4 Basic Design Drawing. As automatic section switches are installed at the Stage 2, due consideration will be taken into the design and installation of power distribution lines for the Stage 1 so that the switches will be easily and safely installed.

In addition, disconnecting switches will be installed on the distribution lines at the Stage 1 to enable branch circuits for MCDC, Arakabesan and Nikko to be connected at the Stage 2 with a minimum time of power outage at the time of connection.

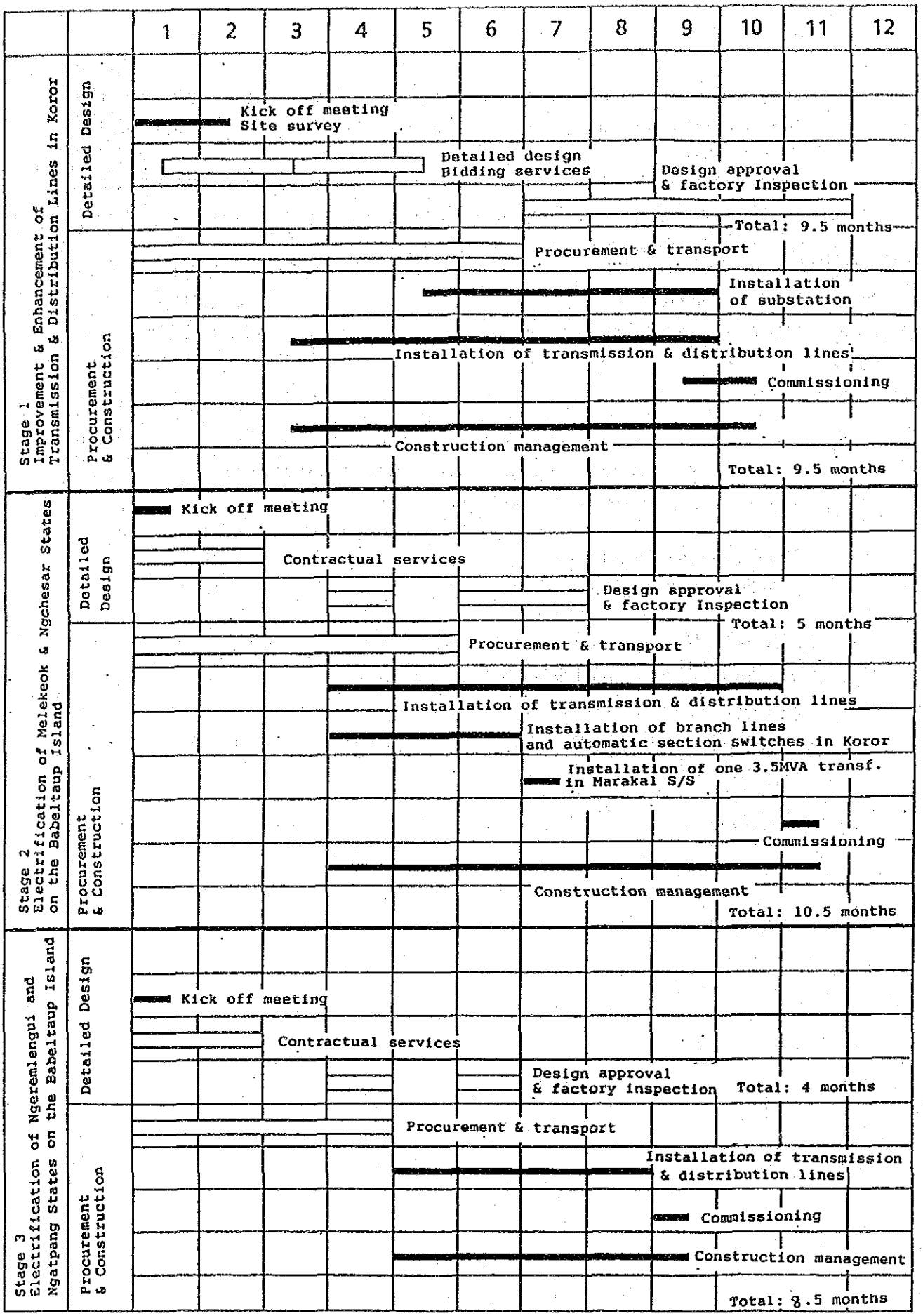


Figure 4.5 Implementation Time Schedule

4.4.6 Scope of Work

Under the framework of Grant Aid system, the division of responsibility is as follows:

(1) Works for which Japan is responsible include the following three items (described in the outline of Facilities and Equipment Section 4.3.4):

1) Improvement and enhancement of power transmission and distribution lines

2) Construction of 34.5 KV power transmission and 13.8 KV distribution lines to the four States on Babelthaup Island

3) Provision of materials and equipment for the construction of power distribution lines on Babelthaup Island

(2) The works for which Palau will be responsible are stated in Annex III of Minutes of Discussions (Attachment 4), exchanged on August 16, 1993. In addition, the following items are confirmed as the responsibility of the Government of Palau:

1) Provision of site for the storage of materials and equipment for the construction works

2) Acquisition of site for the construction of power transmission and distribution lines

3) Construction of access roads for the power transmission and distribution lines

4) Cutting of trees, elimination of obstacles and so forth, that will impede survey of required land, construction of power transmission and distribution lines.

The removal of existing facilities that will become superfluous after the improvement and enhancement of power transmission and distribution facilities, such as Malakal Substation and power distribution lines in Koror State will also be the responsibility of Palau.

CHAPTER 5 PROJECT EVALUATION AND CONCLUSION

CHAPTER 5 PROJECT EVALUATION AND CONCLUSION

This project aims at providing a reliable supply of electricity through improvement and enhancement of power transmission and distribution facilities in the core area of Palau, as well as implementing electrification plan in the four non electrified States on Babelthaup Island. When this project is completed the following effects can be expected.

(1) With the improvement and enhancement of power transmission and distribution facilities in Koror State, the incidence of power blackouts caused by breakdowns in equipment, disconnections and line-to-ground faults will be minimized, voltage fluctuations and drops will also be kept at a minimum, and the quality of power distribution will therefore be improved. The automatic detection and isolation of fault points will limit the area of power blackouts, rather than the current situation in which a localized failure may cause power blackouts throughout Koror State. Palau's objective of economic independence will be assisted by improvement in the availability and reliability of its electricity supply. Stability and improvement in the life of residents will also result from this project.

(2) Although the population on Babelthaup Island that will benefit from the project is small, access to electricity will improve the basic standard of living for local residents. This project will also facilitate the implementation of development projects leading to economic and social development of the Island and increased employment opportunities, and will promote decentralization of the population. As variations in living standards between regions decrease, the foundation for sound development as an entire nation will be formed.

(3) By upgrading Koror State's transformers and distribution lines to a higher capacity, electricity losses will decrease resulting in savings on the fuel expenses of power generation. This will also significantly reduce the repair and maintenance effort devoted to maintaining and controlling antiquated power transmission and distribution facilities. This will improve the balance of accounts of the electricity business carried out by the Bureau of Public Works, which finds itself in a financially difficult situation. This project will also facilitate a smooth and rapid shift to the establishment of a Public Utilities Corporation.

The project will improve the living environment for residents and contribute to the establishment of infrastructure and economic development. Therefore it is considered appropriate to implement this project with Grant Aid. In addition, Palau's

administrative, organizational and personnel resources appear to be adequate for managing the facilities in the long term.

In order to ensure maximum success of this project and to carry out maintenance and control over a long period it will be preferable to undertake the following measures.

1) In order to maintain the power transmission and distribution systems so that they function properly, daily inspection and maintenance should be carried out without fail, in accordance with the maintenance criteria sheet, maintenance procedures sheet and checklist. In particular, visual inspection of lines and trimming of trees that may come into contact with distribution wires should be implemented regularly.

2) The Bureau of Public Works, which will be responsible for the operation, maintenance and control of facilities after the completion of this project, should strive to secure its financial resources. Electricity charges are a sole income source that should be reviewed in order to establish an appropriate rate. The Bureau should also aim for 100 % collection of charges. However, to implement these measures, the Bureau must have an accurate understanding on the cost of power generation, transmission and distribution and should endeavaor for full installation and checking of watt-hour meters. Cutting electricity supply to non-payers should be one of the measures to be taken.

3) Basic data concerning operation and maintenance of facilities should be collected and recorded to establish a data base. Planning and documentation based on the latest information should facilitate maintenance and control operations. This data should also be used in planning preventive maintenance.

4) The design strength of electric poles does not anticipate the attachment of other objects such as telephone and cable TV lines, and therefore their attachment to electric poles should be avoided. Furthermore, service wire installation must be based on the public design standards. Mechanical or electrical damage should not be inflicted upon transformers and switches through poor design or implementation.

ATTACHMENTS

Attachment 1

Member List of Study Team

Basic Design Study Team

Name	Responsibilities	Organization
Hidenao Watanabe	Team Leader	Grant Aid Division, Economic Cooperation Bureau of Ministry of Foreign Affairs
Yuko Obuchi	Project Leader	Pacific Consultants International
Hiroshi Kadowaki	Power Transmission and Distribution Planning	Pacific Consultants International
Takashi Kasai	Power Transmission and Distribution Facilities	Pacific Consultants International

Study Team to Explain the Draft Final Report

Name	Responsibilities	Organization
Hidenao Watanabe	Team Leader	Grant Aid Division, Economic Cooperation Bureau of Ministry of Foreign Affairs
Yuko Obuchi	Project Leader	Pacific Consultants International
Takashi Kasai	Power Transmission and Distribution Facilities	Pacific Consultants International

Attachment 2

Survey Schedule

Basic Design Study Team

Itinerary

Date (Day of Week)	Site	Activities
August 9 Mon.	Transfer (Tokyo ~ Guam)	Visit Consul General in Agana for discussions
August 10 Tues.	Transfer (Guam ~ Palau)	Explain the contents of inception report to the Minister of Natural Resources and Development and National Planner and obtain approval from them. At the same time, listen to the outline of the current situation concerning existing power plants and transmission and distribution network.
August 11 Wed.	Palau (Koror and Babelthaup Islands)	Site survey
August 12 Thurs.	Palau (Koror)	Visit to President Kuniwo Nakamura of Palau. Listen to the Minister of Resources and Development about outline of national development project after the conclusion of COMPACT, its effects on this project, the contents of electricity business and administration, and maintenance and control plans.
August 13 Fri.	Palau (Koror)	Present the draft of "Minutes of Discussions" to the Minister of Resources and Development and National Planner, explain about the contents and receive their approval.
August 14 Sat.	Palau (Koror, Peleliu Islands)	Inspect present status of Japanese Grant Aid project
August 15 Sun.	Palau (Koror)	Sort out materials and examine more detailed survey schedule
August 16 Mon.	Palau (Koror)	Exchange "Minutes of Discussions" with the Minister of Resources and Development and National Planner

Date (Day of Week)	Site	Activities
		Survey facilities of large electricity consumers in Koror
August 17 Tues.	Palau (Koror)	Discuss within the team contents of basic design study and schedule in more detail. Consult with the Minister of Resources and Development and National Planner. Mr. Watanabe, team leader, returns to Japan.
August 18 Wed.	Palau (Koror)	Collect materials and information from the Bureau of Public Works. Consult with the Minister of Resources and Development and National Planner on more detailed scope of project and sections where the power distribution network, is planned to be installed.
August 19 Thurs.	Palau (Babelthaup Island)	Survey planned power transmission routes in two non electrified state of Ngeremiengui and Ngatpang. Survey on existing Aimeliik Power Plant and Airai Substation.
August 20 Fri.	Palau (Babelthaup Island)	Survey on planned power transmission routes on two non-electrified states of Melekeok and Ngcnesar. Survey on existing Malakal Power Plant.
August 21 Sat.	Palau (Koror)	Sort out and analyze results of detailed survey. Survey on facilities of large consumers in Koror.
August 22 Sun.	Palau (Koror)	Mr. Kadowaki, returns to Japan. Carry out detailed survey on existing power distribution lines in Koror (north).
August 23 Mon.	Palau (Koror)	Carry out detailed survey on existing power distribution lines in Koror (south). Consult with the Minister of Resources and Development and National Planner, obtain their confirmation and collect additional materials. Survey materials and equipment locally procured.

Date (Day of Week)	Site	Activities
August 24 Tues.	Palau (Koror)	Sort out and analyze materials, plans and other matters. Survey fields related to construction (materials and equipment locally procured, labor-management relations, laws and regulations, level of implementation capabilities, etc.)
August 25 Thurs.	Palau (Koror)	Confirm and discuss with the Minister of Resources and Development and National Planner the contents of electricity business and the administration, maintenance and control plan. Survey fields related to construction (materials and equipment locally procured, labor-management relation, laws and regulations, etc.)
August 26 Thurs.	Palau (Koror)	Confirm and consult with the Minister of Resources and Development and National Planner about the scope of works for which Palau will be responsible and systems to be provided by Palau for the project.
August 27 Fri.	Palau (Koror)	Sort out and analyze materials acquired. Examine and confirm scope of basic design and design conditions. Survey fields related to construction (local businesses, implementation capabilities level, etc.)
August 28 Sat.	Palau (Koror)	Sort out and analyze materials acquired. Examine and confirm scope of basic design and design conditions.
August 29 Sun.	Palau (Koror)	Plan operation contents and examine and prepare optimum project draft
August 30 Mon.	Palau (Koror)	Consult with the Minister of Resources and Development and National Planner on detailed scope of basic design and design conditions.

Date (Day of Week)	Site	Activities
August 31 Tues.	Palau (Koror)	Prepare minutes of meetings concerning determination of detailed scope of basic design and design conditions with the Minister of Resources and Development and National Planner.
September 1 Wed.	Transfer (Palau ~ Guam)	Mr. Obuchi and Mr. Kasai leave Palau. After arriving in Guam, visit the Consul General in Agana to report on the results.
September 2 Thurs.	Transfer (Guam ~ Tokyo)	Mr. Obuchi and Mr. Kasai return to Japan.

Survey Team to Explain the Draft Final Report

Itinerary

Date (Day of Week)	Site	Contents
November 9 Tues.	Transfer (Tokyo ~ Guam)	Visit the Consul General in Agana to explain about the outline of draft final report.
November 10 Wed.	Transfer (Guam ~ Koror)	Visit the Minister of Resources and Development and National Planner to explain about the contents of the draft final report.
November 11 Thurs.	Koror	Visit the Bureau of Public Works to explain about the method of cable installation inside of the K-B Bridge and about the design details of new Malakal Substation.
November 12 Fri.	Koror	Question and answer about the draft final report, followed by the signing and exchange of "Minutes of Discussions".
November 13 Sat.	Koror	Internal meeting and preparation of the report.
November 14 Sun.	Koror	Internal meeting and sort out documents.
November 15 Mon.	Angaur	Survey on the Angaur Port which was damaged by a typhoon.
November 16 Tues.	Transfer (Koror ~ Guam)	Collect information on the result of national referendum on the Compact from National Planner.
November 17 Wed.	Transfer (Guam ~ Tokyo)	Visit the Consul General in Agaya to report on the result of the "Minutes of Discussions".

Attachment 3

Member List of Concerned Parties in the Recipient Country

President House

President Kunio Nakamura

Mr. Victorio Uherbelau / Presidential Assistant

Office of Planning and Statistics

Mr.Koichi L.Wong / National Planner

Ministry of Resources and Development

Mr. Marcelino Melairei / Minister of Resources and Development

Mr. J. S. Swords / Distri bution Consultant, Bureau of Public Works

Mr. Hideo Rdialul / Manager, Bureau of Public Works

Ministry of Commerce and Trade

Mr. George Ngirarsaol / Minister, Ministry of Commerce and Trade

Bureau of Foreign Affairs

Mr. Steven Kanai / Director, Bureau of Foreign Affairs

Melekeok State Government

Mr. Lazarus Kodep / Governor

Mr. Ubal Tellei / Speaker, State Legislature

Mr. Daniel Miner / Legislator, Second Chief R & D Chairman

Ngeremlengui State Government

Mr. John Skebong / Governor

Ngchesar State Government

Mr. Moses Uludong / Governor

Ngatpang State Government

Mr. Ngirboketreng Merep / Governor

Palao Pacific Resort

Miss. Keiko Kon / Director of Sales

Pacific Islands Development Corporation

Mr. Michiaki Takahashi / Manager

Palau Sea & Air Trans Company

Mr. Polycarp Basilius / Chairman

Overseas Fishery Cooperation Foundation (OFCF)

Mr.Katsumi Kira / Fisheries Expert, Rural Fishery Community Development Project

Mr. Ryo Nishii / Fishery Expert, Rural Fishery Community Development Project

Attachment 4

Minutes of Discussions

MINUTES OF DISCUSSIONS

OF

BASIC DESIGN STUDY ON THE PROJECT FOR
IMPROVEMENT AND DEVELOPMENT
OF POWER SYSTEM

IN

THE REPUBLIC OF PALAU

In response to a request from the Government of the Republic of Palau, the Government of Japan decided to conduct a Basic Design Study on the Project for Improvement and Development of Electric Power System in the Republic of Palau (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent to the Republic of Palau a study team, which is headed by Mr. Hidenao Watanabe, Officer, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs and is scheduled to stay in the country from August 10 to September 1, 1993.

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

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

Koror, August 16, 1993

Mr. Hidenao Watanabe
Leader
Basic Design Study Team, JICA

Mr. Marceline Melairei
Minister
Ministry of Resources and Development
Government of the Republic of Palau

WITNESS

Koichi L Wong

Mr. Koichi L. Wong
Office of Planning and Statistics
Government of the Republic of Palau

ATTACHMENT

1. Objective

The objective of the Project is to improve and develop transmission and distribution system in the Republic of Palau, thus contributing to the improvement of the system stability and reliability and to the electrification of the non electrified four (4) states in Babelthaup Island.

2. Project Area

The site of the Project is in Koror and Babelthaup Islands as shown in ANNEX I. II & III.

3. Executing Agency

The Office of Planning and Statistics of the Government of the Republic of Palau is responsible for the coordination of the Project.
The Ministry of Resources and Development takes responsibility for the administration and implementation of the Project and the management of the facilities and equipment provided under the Project.

4. Items Requested by the Government of the Republic of Palau

The contents of the Project finally requested by the Government of the Republic of Palau are listed in ANNEX II.

However, the final components of the Project may differ from those presented in ANNEX II, if it found necessary after further studies in Japan.

5. Japan's Grant Aid System and Undertakings of the Government of the Republic of Palau.

(1) The Government of the Republic of Palau has understood the system of Japan's Grant Aid as explained by the Team.

(2) The Government of the Republic of Palau will take the necessary measures, described in Annex-III, for smooth implementation of the Project on condition that the Grant Aid Assistance by the Government of Japan is extended to the Project.

6. Schedule of Study

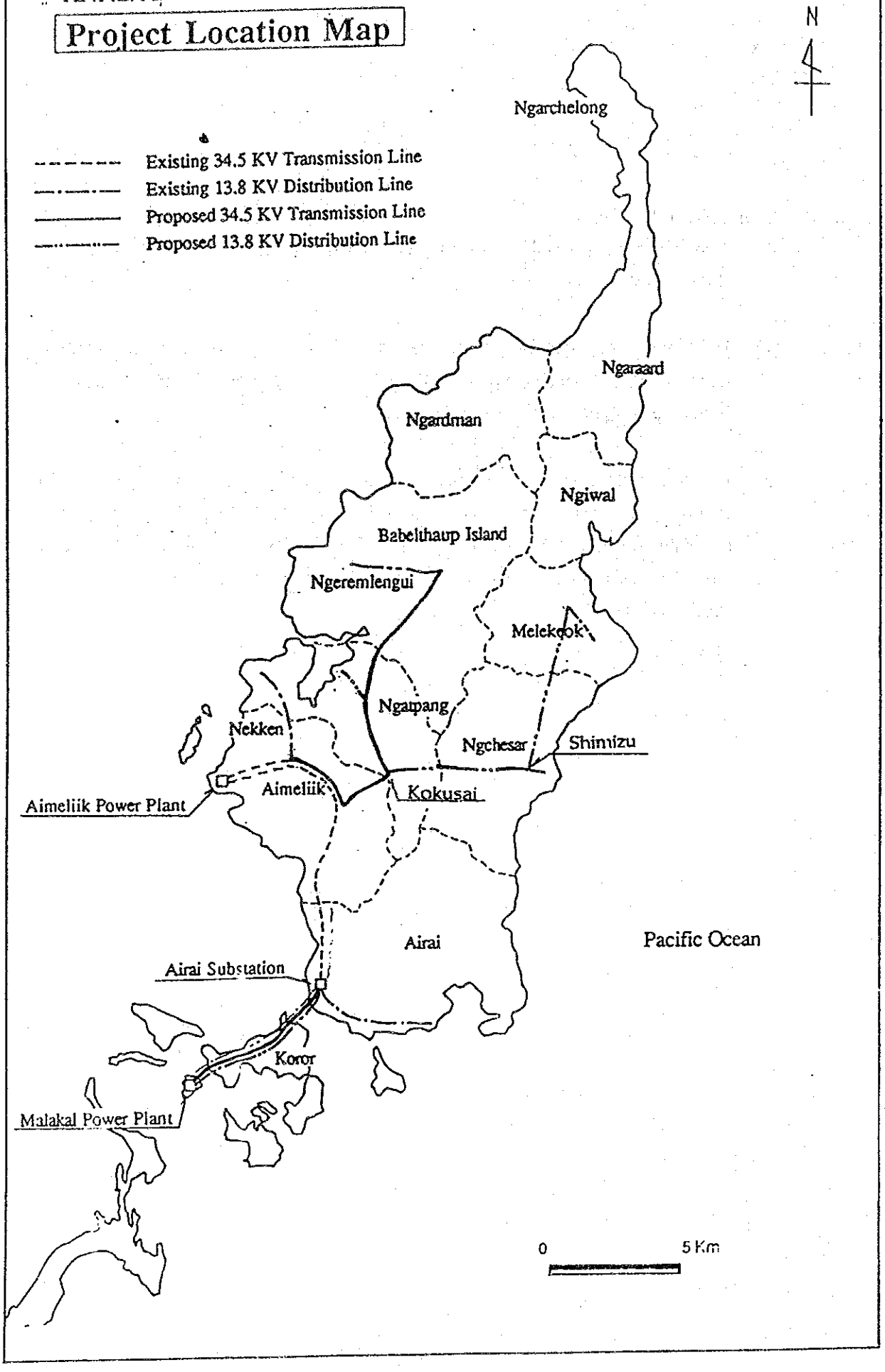
(1) The consultants will proceed to further studies in the Republic of Palau until September 1, 1993.

(2) JICA will prepare the draft final report in English and dispatch a mission in order to explain its contents at/around the middle of November 1993.

(3) In case that the contents of the draft final report is accepted in principle by government of the Republic of Palau side, JICA will complete the final report and send it to the Government of the Republic of Palau at/round the end of December 1993.

ANNEX I

Project Location Map



ANNEX II

The contents of the Project required by the Government of the Republic of Palau are as follows:

(1) Priority-1
Improvement of Power Transmission and Distribution System

1) Construction of a combined vertically aligned 34.5 KV and 13.8 KV circuits from Airai to Malakal in Koror along the existing transmission and distribution line.
2) Construction of 13.8 KV by-pass loops along the existing distribution line in Koror.
3) Construction of tie-in of existing laterals to the newly constructed 13.8 KV line.
4) Installation of 34.5 KV to 13.8 KV substation at Malakal in Koror and connection of Malakal power system to the transmission line.

(2) Priority-2
Construction of 34.5 KV and 13.8 KV transmission line to the nonelectrified four (4) states in Babelthaup Island.

1) Construction of 34.5 KV line from Nekken to Kokusai including installation of a substation for Ngchesar and Melekeok.

2) Construction of 34.5 KV line form Kokusai to Ngeremlengui including installation of a substation for Ibobang and a substation for Ngeremlengui.

3) Construction of 13.8 KV line from Kokusai to Melekeok and to Ngchesar.

(3) Priority-3
Provision of distribution line materials to non electrified states in Babelthaup

1) Provision of materials for the 13.8 KV distribution line from the relevant substation to the existing distribution line in Ngeremlengui.

2) Provision of materials for the 13.8 KV distribution line from the relevant substation to existing distribution lines in Melekeok and Ngchesar.
3) Provision of materials for the 13.8 KV distribution line from the relevant substation to the existing distribution line in Ibobang.

ANNEX III

Necessary measures to be taken by the Government of the Republic of Palau are as follows:

1. To secure the ownership and/or the right to use the Project site.
2. To clear, level and reclaim the Project site when needed, prior to the commencement of the Project.
3. To provide necessary permission, license and other authorizations for smooth implementation of the Project.
4. To construct wall and fences around the Project site.
5. To improve and complete the access road along the transmission and distribution line before the Project is implemented.
6. To provide facilities for drainage, telephone line and other incidental facilities.
7. To bear advising commission of the Authorization to Pay (A/P) and Payment commission to the Japanese foreign exchange bank for banking services based upon the Banking Arrangement (B/A).
8. To ensure prompt unloading, tax exemption, and custom clearance of the goods for the project at port of disembarkation in the Republic of Palau
9. To ensure prompt unloading and internal transportation of the goods purchased and/or imported under the Grand Aid for the Project.
10. To accord Japanese nationals whose services may be required in connection with the supply of the products and services under the verified contract such facilities as may be necessary for their entry into the Republic of Palau and stay therein for the performance of their work.
11. To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the Republic of Palau with respect to the supply of the projects and services under the verified contracts.
12. To maintain and use properly and effectively the facilities constructed and equipment under the verified contracts.
13. To bear all the expenses other than those to be borne by the Grant, necessary for construction of the facilities as well as for the transportation and installation of the equipment.
14. To coordinate and solve any matters related which may arise with third party and inhabitants living in the Project area during implementation of the Project.

15. To arrange prompt receiving, unloading, storing, erecting, testing and commissioning of the HV/LV distribution equipment supplied for the Project.
16. To avoid installation of any other cables and wires on the newly constructed transmission and distribution line poles.

Attachment 5

List of Materials Collected

1. Electrical power production for 1991 & 1992

2. Questionnaire (partly filled out)

3. Local climatological data 1991

4. Aimeliik power plant hourly load variations for July 1993 (low load month)

5. Aimeliik power plant hourly load variations for November 1992 (high load month)

6. Aimeliik power plant - operation cost 1986 - 1990

7. Aimeliik power plant - power generation bill 1986 - 1990

8. Aimeliik power plant - actual utility collection by years

9. Aimeliik power plant - statistics (Oct. 86 - July 92)

10. Aimeliik power plant - operations covering FY1985 - FY1992)

11. Official 1990 census population counts

12. Compact of free association appropriation - Republic of Palau

13. Unified national budget - appropriation request FY1993

14. Ngchesar state government budget for FY1993

15. Ngaremlengui state government budget for FY1993

16. Ngatpang state government budget for FY1993

17. Melekeok state government budget for FY1993

18. State operated power plants & private power plants

19. Present condition of generator units at Malakal power station

20. Utility system - electric / water consumption for Jan. 1992 to July 1993

21. Basic information of Ngchesar state

22. Electricity rate for Ibobang & Ngaremlengui states

23. Primary electrical(power distribution system improvements project - Malakal & Koror Islands (1986, engineering only, 28 sheets)

24. Plans for electrical system improvements (1979, as built, 21 sheets)

25. Construction plans for electrical system improvements phase II (1982,19sheets)

26. Final drawings for Babelthaup electrical power transmission line system (three files)

27. Operation and maintenance guide for Babelthaup electrical power transmission line system

28. Basic design study report for Babelthaup electrical power transmission line system

29. Tender documents for Babelthaup electrical power transmission line system

30. Contract for consultancy services for Babelthaup electrical power transmission line system

31. Project summary for Babelthaup electrical power transmission line system

32. Report on the transmission capability of the existing Koror system

31. TTPI Caroline islands, Palau district capital imp. prog. electricals, imp. phase II)

32. Power station monthly report (April 1992 - April 1993)

33. Organization chart for Bureau of Public Works

34. Wage Advisory Group report (Appendix A to C)

35. Typical prices of locally available building / construction materials

36. First national development plan 1987 - 1991

37. National accounts of Palau 1991 - 1992

38. Palau Visitors Authority report (visitors between1980 - 1990)

39. Soil survey of islands of Palau

40. Government equipment that can be used on power line project

41. Aimeliik power plant hourly load variations for an average day

42. R.O.P. power generation peak demand growth in kW (1986 -1992)

43. R.O.P. electric load demand growth in GWH (1987-1992)

44. Republic of Palau national power system July 1993

45. Koror-Aimeliik power system status August 1993

46. Senate Bill No.3-325, SD4, "a bill for an act." (regarding P.U.C.)

47. 1993 Telephone directory

48. Malakal substation electrical Plans (5 OF 17)

49. K-B bridge drawings (6 sheets)

Attachment 6

Country Data

ATTACHMENT 6 COUNTRY DATA

6.1 Location of Palau and Social and Economic Situations

(1) Location

The Republic of Palau comprises about 200 islands, including Koror, Malakal, Arakabesan and Babelthaup Island (the largest in Palau). These Islands belong to the West Caroline group of islands in the South Western Pacific. The distance between Kayangel Island located at the northern tip and four isolated islands (Southwestern Islands) located in the south is 640 km. Babelthaup Island (area of 397 km^2) is the largest in Palau and is second only to Guam in size in Micronesia. The country is located between 2° and 8° longitude north and between 131° and 135° latitude east. The total national area is 489 km^2 and the area of territorial sea is 630,000 km^2. The distance between Koror, the capital, and Tokyo is 3,200 km, and the distance between Koror and Guam is 1,300 km.

(2) Population

In accordance with the 1990 statistics, the population of Palau is 15,122, comprising 8139 men and 6983 women. 10,501 citizens, about 69 % of the total population, live in the Koror State. In the four States where electricity has yet to be supplied, live a total of 874 citizens (6 % of the total population) : 244 in Melekeok, 287 in Ngchesar, 281 in Ngeremlengui and 62 in Ngatpang. The total number of households is 2,885, with one household comprising an average of 5.01 family members.

12,575 citizens, about 83 % of the total population, are natives, and 98 % of them were born in Palau. Of the remaining 17 %, 10% are Filipinos and 2 % are other Micronesians. 1,858 natives were born in Palau and live in Guam, and 1,620 natives live in the Federated States of Micronesia, a total of 3,878 (23 % of the total population of 15,122, and 28 % of the total native population of 12,575).

(3) Major Industries

1) Agriculture, Forestry and Fishing

Agriculture basically provides for self-sufficiency, mainly comprising staple crops such as coconuts, taros, yams, bananas, breadfruit and fruit, produced on an individual or family unit level.

The sea surrounding the Republic of Palau is considered a treasure trove of marine resources with considerable potential, however, development is small. As at January 1990, Palau had fishing agreements with five overseas fishing organizations from Japan, the United States, Taiwan and other countries. The 1990 revenue from fishing agreement charges was $660,000. The total number of long-liners, round haul netters and so forth, to which operations permits have been given, is 487. In 1990 the Palau Fishing Federation Association (PFFA) purchased 370,000 pounds of snapper, rabbitfish, crabs, lobster and deep-sea fish, for a total cost of $300,000. About 40 % of the leaf fish catch was exported to destinations such as Guam and Saipan. The catch of fish in the outer seas, such as tuna, totalled 105,000 pounds, worth $66,000 in sales (not including the catch of private companies and individuals in Palau).

2) Tourist Industry

Improvements in visitor facilities is slow, however, the number of visitors to Palau has been increasing in recent years. The total number of visitors in 1990 was 32,846, an increase of over 240 % since 1986 (13,653 visitors). Most visitors are Japanese (40 %) and Americans (20 %). 80% of visitors list the purpose of their visit as sightseeing or business. Sightseeing resources are many, and include Rock Islands, natural scenery, tropical weather, traditional art, ruins of the age when Japan was the trusted governor, and war ruins. The Government has therefore established tourism related projects as a high priority in economic development. There are still many issues remaining to be solved such as insufficient accommodation facilities, delays in improving the infrastructure, and the attraction of foreign investment. The following tables indicate the number of visitors to Palau, the major countries from where they came, and the major hotels and their number of rooms. 70 % to 80 % of visitors come for the purpose of sightseeing, visitors travelling to Palau for business are only a small proportion of the total. Visits are also made to this country to find employment and for religious activities.

Table A6.1 Change in the Number of Visitors (1988–92)

	Number of Visitors	Sightseeing and Visitors	
1988	22,675	18,344	(81 %)
1989	26,005	21,433	(83 %)
1990	32,846	25,809	(78 %)
1991*	32,700	56,054	(80 %)
1992*	36,117	30,004	(83 %)

(Source : Palau Visitors Authority 1989-90 Annual Report)

* Figures for fiscal 1991 and 1992 are unofficial statistics

Table A6.2 Major Visitor Source Countries

	1990		1991*	
United States	6,440	(20 %)	6,411	(20 %)
Japan	13,512	(40 %)	14,529	(44 %)
Philippines	3,528	(11 %)	4,073	(13 %)
Others	9,666	(23 %)	67,687	(23 %)
Total	32,846		32,700	

(Source : Palau Visitors Authority 1989-90 Annual Report)

* Fiscal 1991 figures are unofficial statistics

Table A6.3 Number of Guest Rooms at Major Hotels

Palau Pacific Resort	100
Hotel Nikko Palau	51
Palau Hotel	38
New Koror Hotel	26
Marina Hotel	28
Malakal Central Hotel	18
West Plaza Hotel	22
Others	105
Total	388

(Source : Palau Visitors Authority 1989-90 Annual Report)

(4) Social and Economic Structure

As Palau is blessed with rich marine resources, the fishing industry is regarded as having high economic potential. The shipping of fresh fish such as tuna to Japan has just begun, but is showing major growth. The number of tourists visiting this beautiful

natural environment has also been increasing in recent years. Therefore, in promoting economic development, the country has selected the improvement of tourism facilities and infrastructure as the most important issues.

The production sector is also undeveloped and there are no significant industries. Government finances are supported by economic assistance from the United States, and government institutions are major employers. The economic foundations are different between the capital Koror and other regions such as Babelthaup Island and other isolated islands where the traditional lifestyle is maintained. In the urban areas, the economy is based on money, while in other regions self-sufficiency (in combination with a monetary economy) is the mainstay, creating major differences in the standard of living. In order to increase the rate of national self-sufficiency, it will be necessary to establish a production sector and move away from an economic structure which is excessively dependent on imports.

6.2 Natural Conditions

(1) Geology and Geography

Geologically Palau comprises two sections: a portion with a rock foundation made up of andesite and bassalt, like Koror and Babelthaup Islands, and another section based on limestone, as seen in Malakal. The southwestern part of Babelthaup Island is made up of a sedimentary layer over a 5–10 m thick volcanic layer. The power transmission and distribution lines in this Project will be constructed on this base. As Figure A6.1 shows, the planned sites will be classified into the following three regions in terms of geography and the spread of plants.

1) Seashore Area

The seashore area is flat and low-lying, mostly at sea level, and is covered by sedimentary layers, supporting a jungle of mangroves.

2) Stepped Plateau on the Seashore

The stepped plateau area is formed between the coastline and the inland plateau, supporting trees such as mahogany, teak and oak on a soil suited to agriculture.

3) Inland Steppe

This is a gently undulating plain covered by grass and trees. As the soil is strongly acid, it is not suitable for agriculture.

MAP UNITS

SOILS ON BOTTOM LANDS

1 — Dechel-Mesei-Ngersuul: Very deep, very poorly drained, and somewhat poorly drained, level and nearly level soils; on valley and coastal bottom lands

2 — Ngerungor Variant-Ngerungor: Very deep, very poorly drained, level and nearly level soils; on bottom lands and in depressional areas

3 — Ilachetomel: Very deep, very poorly drained, level soils; in the intertidal zone adjacent to the shoreline

SOILS ON MARINE TERRACES

4 — Tebecheding-Ngatpang: Very deep, somewhat poorly drained and moderately well drained, nearly level to steep soils; on dissected terraces

SOILS ON VOLCANIC UPLANDS

5 — Aimeliik-Palau: Very deep, well drained, nearly level to very steep; on hills

6 — Babelthuap-Aimeliik-Ngardmau: Very deep, well drained, nearly level to very steep soils; on hills and ridges

7 — Ngardok-Babelthaup: Very deep, well drained, nearly level to very steep soils; on ridgetops and side slopes

8 — Ollei-Nekken-Rock outcrop: Shallow and moderately deep, well drained, strongly sloping to very steep soils, and Rock outcrop; on hills and ridgetops

SOILS ON LIMESTONE

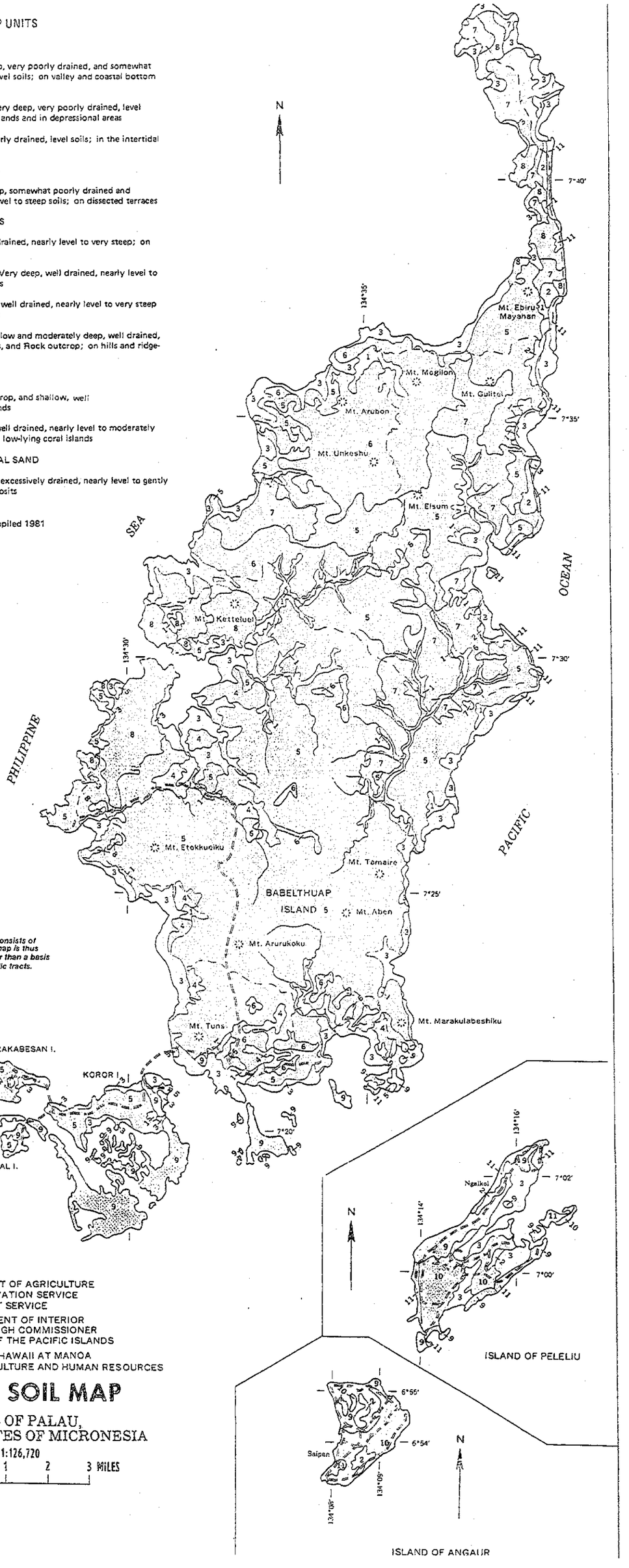
9 — Rock outcrop-Peleliu: Rock outcrop, and shallow, well drained, very steep soils; on uplands

10 — Peleliu-Rock outcrop: Shallow, well drained, nearly level to moderately steep soils, and Rock outcrop; on low-lying coral islands

SOILS THAT FORMED IN CORAL SAND

11 — Ngedebus: Very deep, somewhat excessively drained, nearly level to gently sloping soils; on raised beach deposits

Compiled 1981



Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FOREST SERVICE

U.S. DEPARTMENT OF INTERIOR
OFFICE OF THE HIGH COMMISSIONER
TRUST TERRITORY OF THE PACIFIC ISLANDS

UNIVERSITY OF HAWAII AT MANOA
COLLEGE OF TROPICAL AGRICULTURE AND HUMAN RESOURCES

GENERAL SOIL MAP

ISLANDS OF PALAU,
FEDERATED STATES OF MICRONESIA

SCALE 1:126,720

1 0 1 2 3 MILES

Figure A6.1 Geological and Geographical Chart

(2) Climate

1) Temperature and Rainfall

The weather reflects the country's oceanic tropical situation, with average annual temperatures of 27°C. Temperatures are almost uniform throughout the year. The average annual humidity is 82 %, creating high temperature and high humidity. The dry periods are normally between February and April and between October and December, with an average annual rainfall of 3,800 mm. The rainy season is between May and September.

2) Wind

Between December and April a northeasterly wind predominates, and between July and October a southwesterly wind blows. The wind speed is between 3 and 5 m/s throughout the year. In December, March or July, maximum wind speeds of 20–30 m/s are recorded. As the country is not located in the typhoon belt, the wind strength and speed is low, with barely any damage from typhoons.

3) Thunderstorms

Thunderstorms occur once or twice a month, excluding the dry seasons. There is no record of a thunderstorm causing problems to the electricity facilities.

4) Earthquakes

Although small earthquakes occur, their occurrence is minimal. There is no incident in the past where earthquakes have affected electricity facilities.

Table A6.4 shows the 1991 meteorological statistics.

6.3 Social Environment

(1) Conditions of improvement of infrastructure

The trunk road, which began to be constructed in the 1920s, serves as the key transport corridor. Furthermore, with funds provided by the United States after the conclusion of the Free Association Agreement, it is proposed to improve and expand 85 km of roads within 6 years. Telephones are common in households as a means of communications, but microwave is depended upon in depopulated regions and on isolated islands.

Since the 1960s the United States has been involved in the construction of the Malakal Power Plant and a power distribution network, and in the gradual improvement of electricity facilities. The Government of Palau constructed the Aimeliik Power Plant in 1985 to replace antiquated facilities. Furthermore, as a fiscal 1984–85 Grant Aid project, Japan constructed power transmission and distribution lines between Aimeliik and Airai. The country now has a system that quantitatively meets current electricity demand. However, the power distribution network in Koror continues to experience frequent fluctuations, and drops in voltage and power failures. The reliability of the power supply is low. In addition, most part of Babelthaup Island, where the potential for development is high, remains without an electricity supply.

Through grant aid provided by Japan for the Improvement of Water Supply System in the fiscal year 1990/1991, water and sewerage facilities were constructed in both Koror and Arai State, and these are contributing to the improvement of public health.

Table A6.4 Monthly Meteorological Statistics in 1991

Month	Average temperature (°C)	Relative humidity (%)	Rainfall (mm)	Wind speed (m/s)	Proportion of fair weather (%)
1	27.2	91	614	3.5	40
2	26.9	88	139	3.7	41
3	27.3	89	450	3.4	64
4	28.1	90	263	3.0	58
5	28.2	91	238	2.7	59
6	28.0	88	325	2.6	40
7	27.2	93	802	2.5	36
8	27.8	85	349	4.0	28
9	27.3	87	537	3.9	40
10	27.7	87	198	3.5	41
11	28.1	89	198	2.6	47
12	27.3	89	311	2.9	45
Annual average	27.6	89	4,424 throughout the year	3.2	45

(Source : United States Meteorological Statistics Center)

Note : The highest maximum temperature recorded was 35°C in June 1976. The maximum instantaneous wind speed was 37 m/s, recorded in November 1990.

(2) Education

Primary education is compulsory and extends 8 years from ages 6 to 14. Each state has one public primary school (three in Koror). Adding the two private schools, the total number of primary schools is 24. Secondary education runs under a four year system. In addition to the Palau public high school, there are five private schools. Between 1989 and 1990, there were 2,949 for primary school students and 1,055 secondary school students. The one higher educational institution is the Micronesia Occupational College (MOC), which is a branch of the College of Micronesia, and which is located in Koror. Students number about 400, and include students from the Federated States of Micronesia and the Republic of the Marshall Islands. Many students also study at other universities, including universities in Guam, Hawaii, and on the U.S. mainland. At present, these students are believed to number between 600 to 700. Furthermore, under scholarships provided by the Government of Japan, about three students each year study electronic engineering, tourism and other subjects at Japanese special schools.

6.4 Outline of Power Operations

(1) Outline

The Aimeliik Power Plant and the power transmission and distribution lines between Aimeliik and Airai which began operating between 1985 and 1986 constitute the core of the electricity system of Palau. However, the power distribution network in Koror State and facilities at Malakal Substation have not been maintained or controlled sufficiently for a long time owing to a lack of financial resources. The aging of facilities has advanced to the allowable limit, resulting in instability in the supply of electricity. Furthermore, although there has been a plan to supply electricity to Babelthaup Island for quite some time, steps to realize the plan have not been taken owing to a shortage in funds.

(2) Power transmission and distribution facilities in Koror State

Based on the operation records of Aimeliik Power Plant, the frequency of power blackouts and their duration by cause between May 1992 and April 1993 are as follows.

Table A6.5 Frequency and Duration of Power Blackouts by Cause

Cause	Frequency of trips and power blackouts		Duration of power blackout (minute)	
Malfunction in power transmission and distribution facilities	9	(31.2)	298	(19.3)
Contact with trees or falling trees	5	(17.2)	256	(16.6)
Errors by operators or maintenance staff	5	(17.2)	192	(12.5)
Planned blackouts	5	(17.2)	549	(35.6)
Unknown cause	5	(17.2)	247	(16.0)
Total	29	(100.0)	1,542	(100.0)

Note : Figures in brackets show proportions (percent)

Accidents resulting in line-to-ground faults and disconnections in power transmission and distribution lines caused by equipment malfunction at power transmission and distribution facilities as well as contact with trees or falling trees explain 48.4 % of the trips and 35.9% of power blackout duration. The proportion of accidents resulting from these causes is significant. As the reliability of facilities declines through the aging of power transmission and distribution facilities and poor design and installation, fluctuations and drops in voltage occur constantly, and frequent line-to-ground faults and power blackouts are experienced. These accidents not only affect the daily lives of citizens but also cause major problems for facilities which can be described as comprising the main social artery, including hospitals, communications facilities, aviation facilities and water and sewerage systems. All facilities such as hotels, restaurants and supermarkets, which handle frozen and chilled items, operate their own diesel generators in order to protect themselves from losses sustained through power blackouts. These facilities are forced to buy expensive fuels and diesel generators and pay maintenance costs. Furthermore, frequent power blackouts have shaken the trust in the Government's power system. It is believed that this has made it difficult for the Government to set appropriate electricity charges that meet the unit costs of power generation; in other words, increase the charges. Improving and enhancing power transmission and distribution facilities has become another urgent concern for the management of electricity operations.

(3) General Situation of Non Electrified Areas

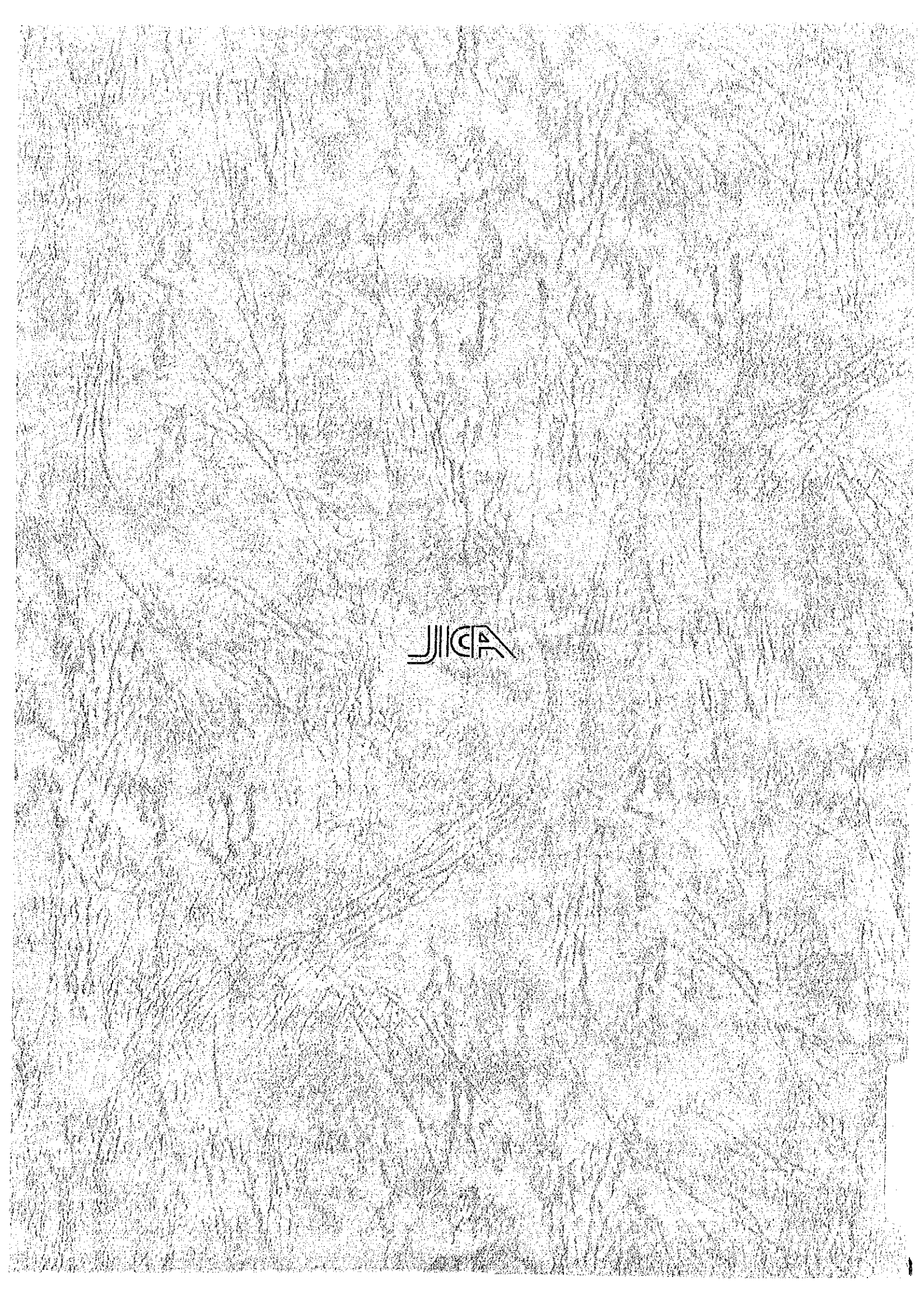
In non electrified areas on Babelthaup Island, emergency diesel generators are being operated about six to seven hours a day for the limited function of providing lighting at night. Table A6.6 compares amount of per capita electricity consumption in these areas with electrified areas, including Koror State. In non electrified areas, only about 16% of the electricity consumed in the Koror State can be used.

Table A6.6 Comparison in Electricity Consumption (1992)

	Electrified areas including Koror State	Non electrified areas on Babelthaup Island
Electricity consumed (KWH)	56,685,714	591,300
Population (1993 estimate)	13,000	874
Per capita electricity consumption (KWH/person)	4,360	677

Note : Average electricity demand in the four non electrified states on Babelthaup Island is 270 KW. Electricity consumption was calculated on the assumption that operations are carried out for six hours a day at this capacity.

As a result, residents in these non electrified areas are unable to install even the basic necessities of life, let alone access to the electric products that serve as a measure of civilized life style. The gap between these areas and urban districts such Koror is widening. For example, 46 % of Koror State is served with water and sewerage facilities, while only 4 %, or less than one tenth, of the four non electrified states enjoy the benefits of such facilities. Not only from the perspective of eliminating the gap between regions, but also in order to maintain a minimum standard of living in terms of culture and health, is the promotion of electricity supply to these areas believed to make a major contribution to regional development.


JICA