PALAU PUBLIC UTILITIES CORPORATION
THE REPUBLIC OF PALAU

PREPARATORY SURVEY
ON
THE PROJECT FOR
ENHANCING POWER GENERATION CAPACITY
IN THE URBAN AREA
IN THE REPUBLIC OF PALAU

FINAL REPORT

APRIL 2012

JAPAN INTERNATIONAL COOPERATION AGENCY
（JICA）
YACHIYO ENGINEERING CO., LTD.

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PREFACE

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey on the project for Enhancing Power Generation Capacity in the Urban Area in the Republic of Palau and entrusted the survey to Yachiyo Engineering Co., Ltd.

The survey team held a series of discussions with the officials concerned of the Government of Palau, and conducted field investigations. As a result of further studies in Japan, the present report was finalized.

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

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Palau for their close cooperation extended to the survey team.

April 2012

Kyoko KUWAJIMA
Director General,
Industrial Development and Public Policy Department
Japan International Cooperation Agency

Summary

Summary

① Overview of the Country

The republic of Palau (hereinafter referred to as "Palau") is an island country situated 3,000km apart from Japan in the south direction; it has a total land area of approximately 488 km^2 and a population of some 20,500 (2010, according to the Asian Development Bank) consisted of 340 islands scattered in 640km area from north to south. Out of many islands which consist of Palau, only nine are inhabited and about 70 % of population concentrates in Koror, the former capital. The largest island in Palau is Babledaob which accounts for approximately 70 % of its total land area.

The economy of Palau largely depends on grant aid assistance provided by the United States under the Compact which continued for 15 years until 2009. With the aid of Compact, Palau has expanded its public sector and public servants account for more than half of Palau's working population as a result. Palau continues the negotiation to extend the Compact after 2010. In the aspect of industry, major industries in Palau are construction which depends on grants from the United States, Japan and Taiwan, importing and sales industries which deal with foods and consumables and tourism industry which utilizes its marine resources. Those industries heavily depend on foreign workers. Gross National Income per capita in Palau is $8,940 (2009, the World Bank).

② Background of the Project

The power demand (peak load) in the urban area of Palau (Koror and Babeldaob islands) recorded an average annual growth rate of 7.3% in the nine year period from 1997 to 2005 because of the stable population growth of 2% a year, increased power consumption per capita and development of tourism, etc.; however, the power supply facilities of the Koror-Babeldaob power system can no longer provide a stable power supply due to their deterioration and insufficient maintenance, and planned outages of eight hours a day were introduced for one and a half months following an equipment failure in August, 2006. In order to avert this kind of critical situation and stabilize power supply to the urban area, the Government of Palau made a request to the Government of Japan for compilation of a power supply master plan targeting the Koror-Babeldaob power system. In response, the Government of Japan consigned JICA to implement the Master Plan Study for Improvement of Power Supply from December 2007 to July 2008, compile a long-term power development plan up to 2025 and conduct pre-F/S examination of priority projects.

The Government of Palau was aiming to conduct power development based on the above Master Plan, however, due to spiraling international prices of crude oil and the worldwide recession that ensued the Lehman shock, the demand for power in Palau has stagnated and development hasn't been conducted as planned. In addition, since output has declined due to deterioration of existing diesel generating equipment and damage caused by accidents, the current generating output potential is only 15.57 MW with respect to the maximum power demand of 12~13 MW in 2008, meaning that there isn't enough reserve capacity. Since Palau's main industry of tourism has been prosperous in recent years due to

increasing numbers of visitors, the demand for power is certain to grow in future, and it has become urgently necessary to improve the power supply situation in the urban area.

Against this background, the Government of Palau made a request to the Government of Japan for Grant Aid for the additional installation of diesel generators with total output of 10 MW in Aimeliik Power Station, which was compiled as a priority project in the Master Plan. In response, the Government of Japan consigned JICA to implement the preliminary survey in October 2010, and since this confirmed the validity of the requested contents, it was decided to implement the Preparatory Survey pertaining to implementation as a grant aid undertaking.

③ Outline of the study findings and Project contents

In response to the request, JICA dispatched the Study Team to Palau from October 19 to November 15, 2011 (first field survey) and from December 21 to 28, 2011 (supplemental field survey) in order to reconfirm the contents of the request and discuss the contents for implementation with related agencies on the Palauan side (responsible government agency: Ministry of Public Infrastructure, Industries and Commerce (MPIIC), and implementing agency: PPUC), survey the Project sites and gather related materials and data.

On returning to Japan, the Study Team examined the necessity, social and economic impacts and validity of the Project based on the field survey materials and compiled the findings into the draft preparatory study report. Furthermore, JICA dispatched the Study Team to Palau for the second field survey (outline explanations) from March 23 to April 2, 2012 in order to explain and discuss the draft preparatory study report and reach a basic agreement with the Palauan counterparts.

The grant portion of the Project compiled based on the survey findings targets the procurement and installation of two of 5MW diesel generators and the construction of a power house. The following table shows the components of the grant aid Project.

Components of the Grant Aid Project

	Plan Contents	Quantity
Procurement and installation	1. Diesel engine generators	
	1.1 Diesel engines	2 sets
	1.2 Synchronous generators	2 sets
	1.3 Common Beds	2 sets
	2. Mechanical auxiliary equipment for diesel engine generator	
	2.1 Fuel oil system	1 set for each generator
	2.2 Lube oil system	1 set for each generator
	2.3 Cooling water system	1 set for each generator
	2.4 Compressed air system	1 set for each generator
	2.5 Intake air and exhaust gas system	1 set for each generator
	2.6 Sludge treatment system	1 set
	2.7 Pipes and cables	1 set for each generator
	3. Electrical auxiliary equipment for diesel engine generator	1 set for each generator
	4. 13.8 kV switchgear panels	1 set
Procurement	1. Maintenance tools	1 set
	2. Spare parts	1 set
	3. Emergency spare parts	1 set
Construction	1. Powerhouse for diesel engine generators (total floor area: approximately1,169 m^2)	1 set
	2. Switch room of 13.8kV switchgear panels (total floor area: approximately 90 m^2)	1 set

④ Project implementation schedule and cost estimation

In the event where the Project is implemented based on the Japan's Grant Aid scheme, the total cost of the Project will be (confidential). The contents and costs to be borne by the Palauan side will primarily be partial demolition of the existing powerhouse at Aimeliik (approximately 45 million yen) and construction of fences and gates (approximately 2 million yen). The implementation schedule for the Project including the detailed design will be approximately 24 months.

⑤ Project Evaluation

[Relevance]

As is indicated below, since the Project will contribute to the realization of Palau's development plans and energy policy and impart benefits to the general public, it is deemed to have high relevance as an aid undertaking.

(1) Benefiting population

As a result of Project implementation, approximately 18,500 residents living in the Palau urban area will receive stable and high quality supply of electricity. The total number of power consumers in the target area is approximately 6,020, comprising approximately 4,540 general households, 900 commercial facilities and 580 government and public facilities.

(2) Urgency

The frequent unscheduled and planned power interruptions caused by troubles in generating facilities in Palau are causing deterioration of the living environment, adversely affecting public services and greatly harming the tourism sector. Therefore, there is an urgent need to remedy such issues through implementation of the Project.

(3) Contribution to stable operation of public and social welfare facilities

Frequent power interruptions in Palau are hindering the stable operation of water supply and sewerage facilities, making it necessary to take emergency countermeasures such as installing emergency generators in purification plants every time a major blackout occurs.

Implementation of the Project will enable stable and high quality power supply to be provided to public welfare facilities and thereby make it possible to realize the stable operation and vitalization of facilities.

(4) Operation and Maintenance Capacity

The PPUC routinely conducts the operation and maintenance of diesel oil-fired medium velocity diesel generators and has ample experience in operating and maintaining such equipment. Therefore, as the implementing agency, the PPUC possesses ample technical capacity to operate and maintain the generating equipment to be procured and installed in the Project, and there should be no major problems when it comes to implementing the Project.

(5) Project Contributing to National Development Plans in Palau

In the Medium Term Development Strategy (MTDS) of Palau, the "ample securing of PPUC profits and power generation, transmission and distribution capacity" in the power sector is raised as a priority policy in the realm of infrastructure.

According to the Energy Sector Strategic Action Plan (ESSAP) that was compiled in October 2009, upgrading of the PPUC's deteriorated base load generators is raised as a priority project, and it is proposed that four 5 MW generators be newly installed.

Since the Project aims to bolster generating capacity and thereby stabilize power supply and improve the quality of power in the urban area of Palau, it will contribute to the realization of the abovementioned development plans and energy policy of the Government of Palau.

(6) Environmental and Social Impacts

Examination was carried out based on environmental legislation in Palau and the JICA environmental and social consideration guidelines. As a result, it was found that although there will be some minor impacts in terms of air pollution, noise and vibration, they will not exceed national or international standards, and conversely the Project can improve the current situation. Concerning other items too, it should be possible to avert and/or mitigate impacts through taking countermeasures.

To sum up the above points, the Project will not impart any major impacts in terms of environment and society.

(7) Japan's Grant Aid Scheme

The main equipment for the Project will be procured in Japan, and the work is scheduled to finish within the E/N time limit. Therefore, since the Project contents and schedule are feasible and reasonable for implementation within the scope of the grant aid scheme, it should be possible to implement without any major difficulty.

[Effectiveness]

The following effects are anticipated as a result of Project implementation.

(1) Quantitative effects

Output Indicator	Current Value (2011)	Planned Value (2015)
Days of restricted power supply	42 days/year*[1]	0 days/year
Reserve supply capacity*[2]	0MW	10.54MW

[Note] *1: In the estimated value for 2011, only the days of restricted power supply due to generating equipment trouble are counted.

*2: Equipment capacity – Peak demand

(2) Qualitative effects (Project overall)

(i) Provision of stable power supply will contribute to economic development, industrial promotion

(ii) Reduction in power rationing will contribute to improvement of the lives of citizens.

(iii) Enabling planned shut down for periodical maintenance of generating facilities will facilitate effective and efficient operation of generators

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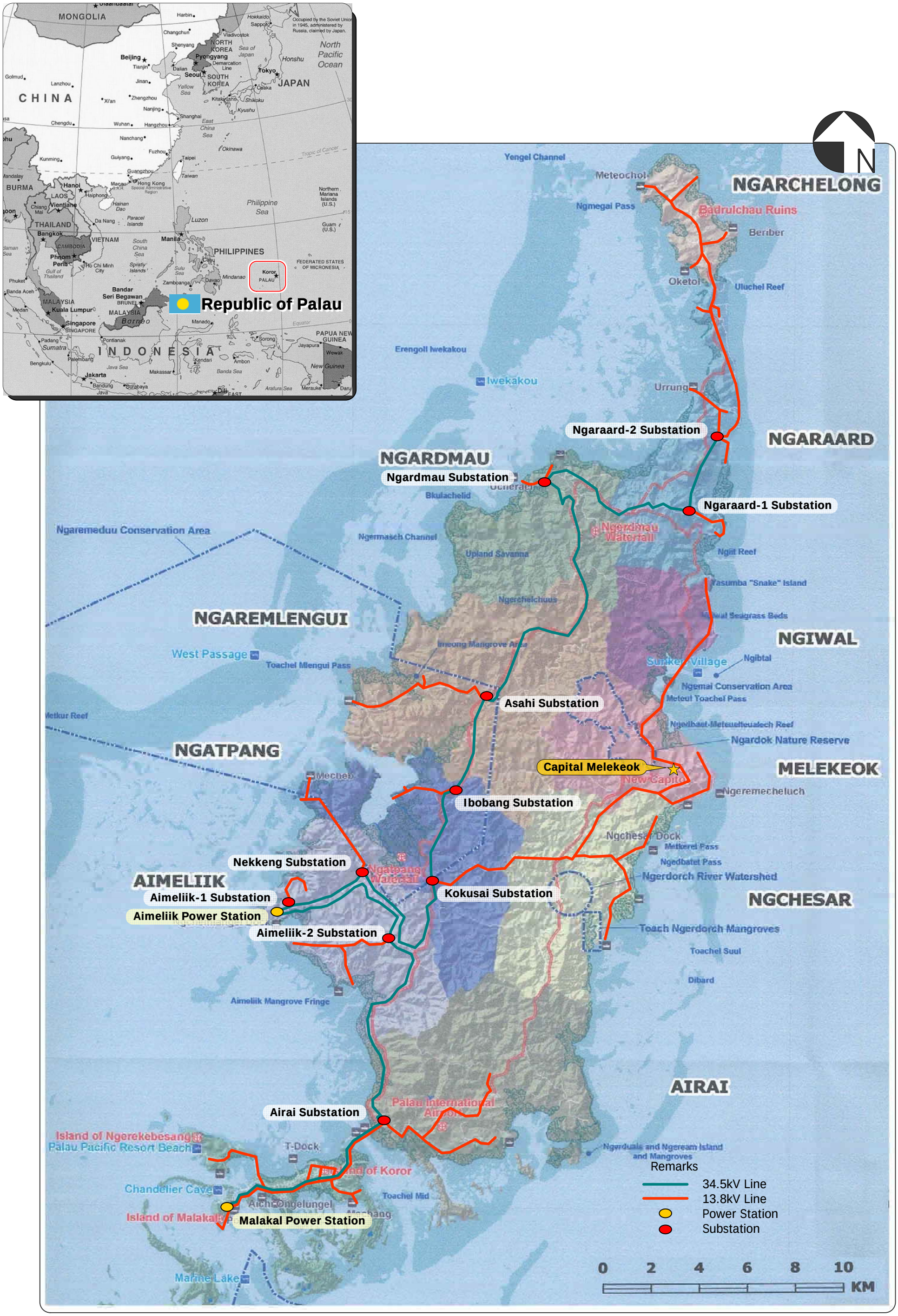

Transmission and Distribution Systems on Koror and Babeldaob Island

Perspective Drawing of new Aimeliik Power Station

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ABBREVIATIONS

ADB	Asian Development Bank
ASTM	American Society for Testing and Materials
CEO	Chief Executive Officer
CPI	Consumer Price Index
DAC	Development Assistance Committee
E/N	Exchange of Notes
EA	Environmental Assessment
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EQPB	Palau Environmental Quality Protection Board
ESSAP	Energy Sector Strategic Action Plan
F/S	Feasibility Study
G/A	Grant Agreement
GDP	Gross Domestic Product
IEC	International Electrotechnical Commission
IMF	International Monetary Fund
ISO	International Organization for Standards
JCS	Japanese Electrical Wire and Cable Maker's Association Standards
JEC	Japanese Electrotechnical Committee
JEM	Standards of Japan Electrical Manufacturer's Association
JICA	Japan International Cooperation Agency
JIS	Japanese Industrial Standards
MPIIC	Ministry of Public Infrastructure, Industry and Commerce
MRD	Ministry of Resource and Development
MTDS	Medium Term Development Strategy
NEP	National Energy Policy
O & M	Operation and Maintenance
OJT	On the Job Training
PNMDP	Palau 2020 National Master Development Plan
PPUC	Palau Public Utilities Corporation
UNGASS	United Nations General Assembly Special Session on HIV and AIDS 2008 Country Progress Report
VAT	Value Added Tax
WB	World Bank

CHAPTER 1 BACKGROUND OF THE PROJECT

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The Republic of Palau (hereinafter referred to as "Palau") is located in the Pacific approximately 3,200 km south of Japan and is an island country consisting of some 340 islands with a total area and population of 488 km^2 and 20,500 (2010 ADB's Statistics) respectively. Political and economic activities in Palau are centred on Babeldaob Island where the capital of Melekeok is located and on Koror Island as some 93% of the total population live on these islands (2005 National Census). The power demand (peak load) on these islands recorded an average annual growth rate of 7.3% in the nine year period from 1997 to 2005 because of the stable population growth of 2% a year, increased power consumption per capita and development of tourism, etc.; however, the power supply facilities of the Koror-Babeldaob power system can no longer provide a stable power supply due to their deterioration and insufficient maintenance, and planned outages of eight hours a day were introduced for one and a half months following an equipment failure in August, 2006. In order to avert this kind of critical situation and stabilize power supply to the urban area, the Government of Palau made a request to the Government of Japan for compilation of a power supply master plan targeting the Koror-Babeldaob power system. In response, the Government of Japan consigned JICA to implement the Master Plan Study for Improvement of Power Supply from December 2007 to July 2008, compile a long-term power development plan up to 2025 and conduct pre-F/S examination of priority projects.

The Government of Palau was aiming to conduct power development based on the above Master Plan such as introducing second hand two of 5 MW diesel generators by its own finance, however, due to spiralling international prices of crude oil and the worldwide recession that ensued the Lehman shock, the demand for power in Palau has stagnated and development hasn't been conducted as planned. In addition, since output has declined due to deterioration of existing diesel generating equipment and damage caused by accidents, the current generating output potential is only 15.57 MW with respect to the maximum power demand of 12~13 MW in 2008, meaning that there isn't enough reserve capacity. Since Palau's main industry of tourism has been prosperous in recent years due to increasing numbers of visitors, the demand for power is certain to grow in future, and it has become urgently necessary to improve the power supply situation in the urban area.

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1-1 Environmental and Social Considerations

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1-1-1-1 Project Components

The project components are listed below.

- Installation of 5 MW diesel oil fired medium speed diesel generators x 2 units
- Construction of a new power house in the existing Aimeliik Power Station

1-1-1-2 Environmental and Social Condition of the Site

(1) Physical Condition

The Project site is located at the Aimeliik Power Station Aimeliik State, approximately 15 km from Melekeok, the capital city in the island of Babeldaob, and 10 km north from the center of Koror city in the island of Koror.

The site is at the southern part of the existing plant. The area is currently paved with concrete and a part of the construction area is occupied with the existing plant. There is no rare and endangered species identified during the field surveys..

(2) Biological Condition

Since the land has been currently occupied by a part of the existing plant or paved with concrete, there is no fauna and flora exists at the site.

Lake Ngardok Nature Reserve, which is designated as a wetland of international importance under the term of the Ramsar Convention, is located on the eastern side of Babeldaob (14km from the project site).

(3) Economic, Social and Cultural Conditions

Since the land has been currently occupied by a part of the existing plant or paved with concrete, there are no economic and social activities at the site.

(4) Soil Type

The Project site is covered with concrete.

(5) Development of the Project Site

The land has served as a power plant over 20 years. After installation of 2 units of 5 MW diesel fuelled generators under this Japan's Grant Aid Project, the existing four (4) units of generators will served as back-up or standby generators for preparation of any emergency situation or corresponding to the increase demand of electricity in the future. However, these four (4) existing generators have

been operated more than 20 years and the power house has been deteriorated, the PPUC has a plan to replace/rehabilitate the existing power plant.

(6) Access to the Site

The main access to the site is from the unpaved road bounding for Koror City. However, the maximum load of bridges laid along the road is 10 tons, the heavy equipment including generators and construction materials/equipment will be accessed from the jetty located at the south of the Project site after sea transportation.

(7) Adjacent Areas

The characteristics of the adjacent areas are summarized in Table 1-1-1-1.

Table 1-1-1-1 Characteristics of the Adjacent Areas

Item		Feature
North Side	:	The Project site is adjacent to the existing power plant. Beyond the plant and the transformers, a forest area extends. There are a few households exist in the north and northeast side from the Project site.
East Side	:	A considerably steep cliff extends in the eastern side toward the sea. The slope of the cliff, terrestrial forest extends for approximately 20 or 30 m. The coastal line is covered with mangrove forest (See Figure 1-1-1-1).
South Side	:	A considerably steep cliff extends in the southern side toward the sea. The slope of the cliff, terrestrial forest extends for approximately 15 m. The coastal line is covered with mangrove forest (See Figure 1-1-1-1).
West Side	:	Eight (8) diesel fuel tanks belonging to the PPUC exist on the western side of the Project site. Beyond the tank yard, grassland extends. No household is observed in this area.
Economic and Social Conditions	:	A few house scatters on the northern and north-eastern side of the Project site. There is no major industries at these residential areas,
Cultural Characteristics	:	No historical monument is observed around the Project site. The nearest historical monument is an ancient mound of Ouballang Er Ngerkelalk Ngerbuns El Bad which locates approximately 1 km north-eastern side from the Project site.

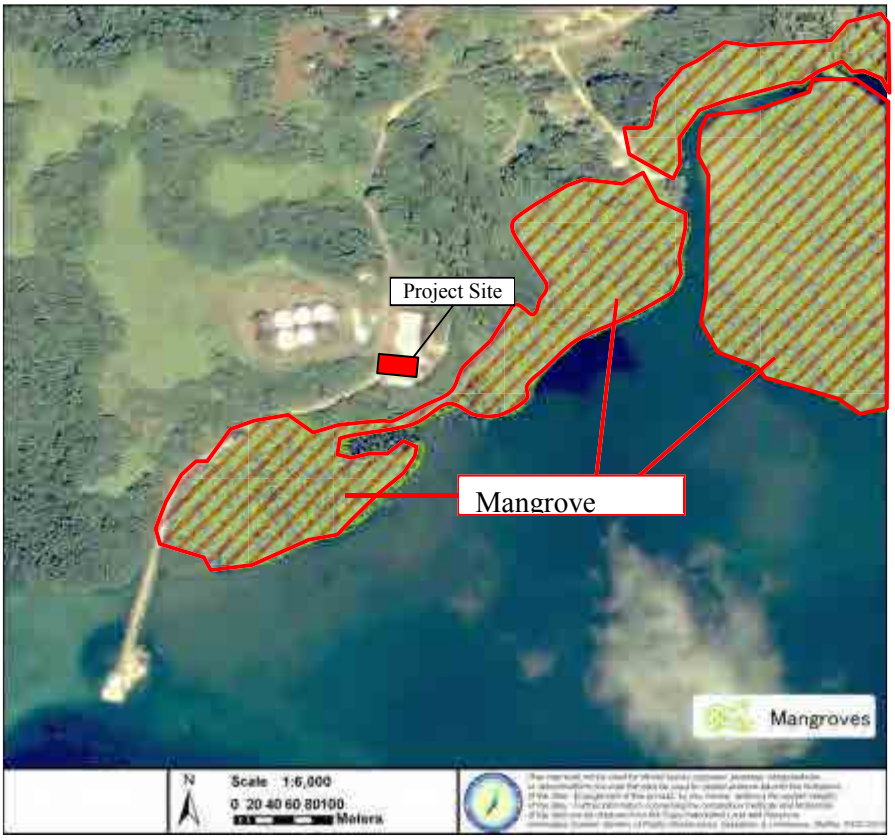


Figure 1-1-1-1 Mangrove Forest Area near the Project Site

1-1-1-3 Laws and Regulations Relating to the Environmental and Social Consideration

(1) Organisations

1) Palau Environmental Quality Protection Board (EQPB)

In accordance with the PNC Title 24, Environmental Quality Protection Act, Environmental Quality Protection Board (EQPB) was established as an environmental board. The EQPB is authorized to grant environmental licenses to any enterprises who intend to conduct projects and to instruct to prepare Environmental Assessments and Environmental Impact Statements (if necessary) upon the degree of the impacts of projects.

2) Palau Public Utilities Corporation (PPUC)

There is no specific section dealing with environmental studies in the PPUC. However, there are some engineers appointed to be assigned by the General Manager for environmental studies and application of environmental licenses dedicatedly for the Project.

3) Others (NGO etc)

By interviewing EQPB and PPUC, no NGOs were identified to be relating to the Project.

(2) Legal Framework

1) Environmental Quality Protection Act

The law prescribes the projects which require environmental permits as "governmental projects and formulation of bills which have significant impacts on the surrounding environment". The project applies the condition as it is (1) located within the nationally/state-owned land and (2) funded by national/state budget. The EQPB deliberates applications, issue environmental permits and give guidance to undergo Environmental Assessments (at Initial Environmental Examination level) or Environmental Impact Statement (at Environmental Impact Assessment level).

2) Air Pollution Control Regulations_Palau

Environmental standards for NO_X and SO_X are prescribed in the law. It is also stated that Stationary Source of Air Pollution is required to obtain permits.

3) Guide to Environmental Impact Assessment

When either Environmental Assessment or Environmental Impact Statement is required, the report is to be executed in accordance with the Guide to Environmental Impact Assessment (2000, EQPB).

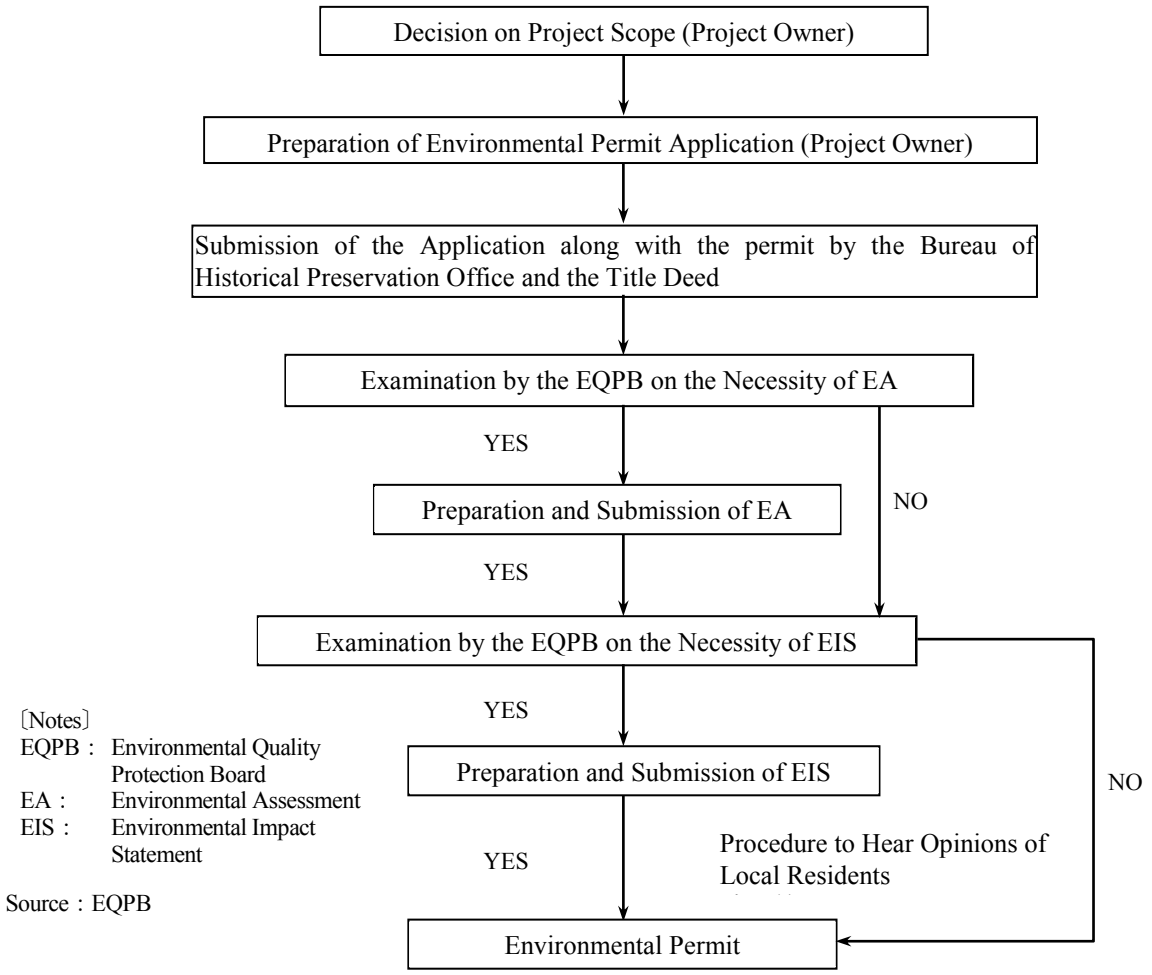


Figure 1-1-1-2 Flowchart for Environmental Permit

4) Consistency with the JICA's Environmental and Social Consideration Guidelines

Since the project is relatively small and a large scale involuntary resettlement is not foreseen, JICA's environmental category B is applied. The legal framework of Palau does not require examination of alternative project option based on the concept of Strategic Environmental Assessment (SEA). Other processes, such as hearing opinions of local residents, are consistent with the JICA's guidelines (April 2004).

Because the environmental standards are set only for air quality in Palau, for other items the internationally adopted standards are applied in this Project.

5) Required Environmental Licenses

Through a couple of discussions with the EQPB, the PPUC was instructed to prepare applications for environmental permits for Earthmoving, Hazardous Waste Management and Stationary Source of Air Pollution.

Therefore, the PPUC submitted the application forms and EA to the EQPB at the end of November 2011. The examination of the application was completed and the permits were issued in the middle of

February 2012. (permit number 027-12). The permits are to be valid for three years.

1-1-1-4 Alternative of the Proposed Action

Alternative project option including zero option (without Project) is examined for the location of the Project site.

It is understood that although environmental aspect is advantageous, the stable electricity supply cannot be achieved by the zero option. Therefore, the proposed action is the most optimum option of the Project among alternatives.

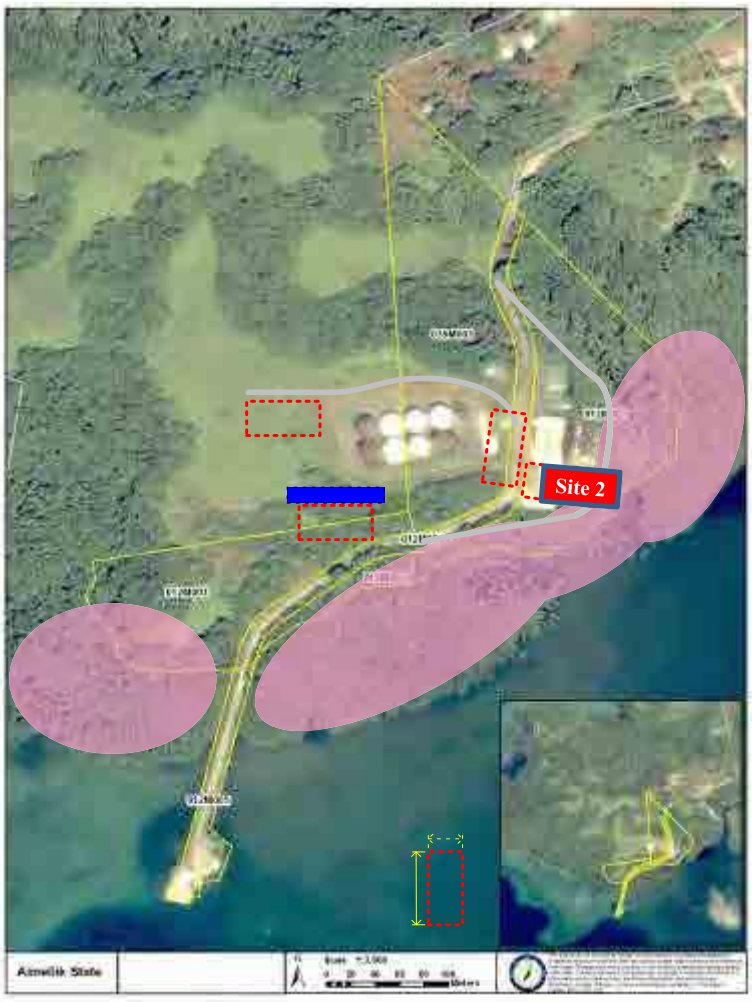


Figure 1-1-1-3 Candidate Alternative Sites

Table 1-1-1-2 Comparison of Alternative Actions

Item	Site 2 (Project Case)	Site 1	Site 3	Zero Option
Case Description	New power house at southern side of the existing power house	New power house at north-eastern side of the existing fuel tanks	New power house at western side of the existing fuel tanks	(Without Project)
Generators / Capacity	5 MW x 2 generators (10 MW)	5 MW x 2 generators (10 MW)	5 MW x 2 generators (10 MW)	0 MW
Technical Aspects (Palauan Side's Works)	Due to the impact of the fire accident, the existing facility must be demolished or rehabilitated. Yet, PPUC is confident to conduct works.	Due to topographic feature, a large scale soil filling and retention walls are required. Additionally, relocation of road, fence and a shed for employees is required.	The site is relatively flat slope. Soil Cut/Filling works are required.	N/A
(Evaluation)	C	C	B	-
Technical Aspects (Construction)	No restriction for construction works.	Construction works will be limited due to availability of spaces.	No restriction for construction works.	N/A
(Evaluation)	A	C	A	-
Environmental Aspects	Impact of soil erosion on mangrove forests is anticipated. Impact of noise from the new power house on the nearest households will be decreased, but slightly larger than Site 3.	Relocation works of the existing road may directly impact on the mangrove trees. Impact of noise from the new power house on the nearest households will be decreased, but largest among 3 cases.	The site is grassland and the impact on the natural environment is lowest among the 3 cases. Impact of noise from the new power house on the nearest households will be decreased.	Due to the fire incident occurred at the Aimeliik Power Plant on the 5th November 2011, the existing facilities are not in operation and therefore no impact is caused. Before the fire incident occurred, there had been complaints on the environmental pollution such as air and noise.
(Evaluation)	B	C	B	A
Social Impacts	The land belongs to the PPUC and no land acquisition is required.	The land belongs to the PPUC and no land acquisition is required.	The land belongs to the Government of Palau and land right transfer is required.	After the fire incident, electricity supply is unstable in Koror and Babeldaob. Impacts on social and economical aspects are significant.
(Evaluation)	A	A	C	D
Operational Aspects	The site is adjacent to the existing power house that is advantageous in respect to operation and maintenance.	Relatively close to the existing power house though the distance is a little far in comparison with Site 2.	The distance to the existing power house is approximately 200 m, but not significantly impact on O&M.	Risk for mechanical troubles would increase for the Malakal Power Plant and facility renewal becomes difficult to be carried out as planned.
(Evaluation)	A	B	B	D
Future Expansion	By demolishment or change of the existing power house, future expansion is available.	By demolishment or change of the existing power house, future expansion is available.	Purchase of the private surrounding land is required for the future expansion.	N/A
(Evaluation)	A	B	C	-
Total Evaluation	In compare with Site 3, technical and environmental aspects are not superior. Yet, there is advantage in the respects of O&M and future expansion.	This case is not recommended since technical and environmental factors are inferior.	Though technical and environmental aspects are advantageous, rational O&M and future expansion are not expected.	Though environmental aspect is advantageous, the stable electricity supply of the Koror-Babeldaob power system cannot be achieved. This option is not commendable.
(Evaluation)	A	C	B	D

A: Significant advantage, B: Advantage, C: Disadvantage, D: Significant disadvantage

1-1-1-5 Scoping

Considering the nature, capacity and characteristics of the planning facilities and site conditions, a scoping was conducted by the Team in accordance to the JICA's Guidelines for Environmental and Social Considerations (April 2004).

The result of the survey found the Project activities including construction and operation of the facilities will not significantly impact on society and environment such as involuntary resettlement, large scale vegetation clearing, etc. However, some minor impacts are expected. The following table summarizes social and environmental items which may receive minor impacts due to the Project activities.

Table 1-1-1-3 Result of the Scoping

Item	No.	Parameter	Evaluation		Evaluation / Reason
			Construction	Operation	
Pollution	1	Air Pollution	C-	C-	**Construction :** Due to operation of construction machine, partial air pollution is forecasted. **Operation :** Operation of the power plant may cause deterioration of air quality. However, considering the size of the facility (5 MW x 2), the degree of the deterioration is limited.
	2	Water Pollution	C-	C-	**Construction:** Due to excavation at the project site, some turbid water may be generated. However, it is planned appropriate turbid water treatment system will be installed. **Operation:** Cooling water circulates the power generation system. However, this water runs in a closed system. Besides, a minor amount of lubricant containing water will be generated.
	3	Waste Materials	C-	C-	**Construction:** No operation for replacement of the existing transformer, etc. is expected. However, a special attention for appropriate treatment of waste materials should be paid. **Operation:** A minor amount of sludge and ashes will be generated.
	4	Soil Contamination	D	D	The project will not trigger soil contamination.
	5	Noise / Vibration	C-	C-	**Construction:** Increase number of vehicle and construction vehicle may cause noise and vibration. **Operation:** Noise generated from the power generator is expected.
	6	Subsidence	D	D	No project components cause subsidence.
	7	Odour	D	D	No project components cause odour.
	8	Sediments	D	D	No project components cause deterioration on sediments.
Natural Environment	9	Protected Area	D	D	The Project site is not reserved as protected or conservation area.

Item	No.	Parameter	Evaluation		Evaluation / Reason
			Construction	Operation	
	10	Ecosystem	C-	D	**Construction:** Construction work may generate turbid water. The impact on the mangrove forests along the eastern and southern coastal area is anticipated. **Operation:** The project components will not impact on local ecosystem.
	11	Hydrology	D	D	The Project activity will not impact on hydrology.
	12	Geology	D	D	Large scale excavation is not planned. Therefore, no project component impact on geological condition.
Social Environment	13	Resettlement	D	D	The land is owned by the PPUC and no resident inhabits at the site.
	14	Poverty	D	C+	**Construction:** Construction activity will not impact on poverty **Operation:** Stable electricity supply will contribute to expansion of social services and capacity of capital market. Therefore, it gives positive effect.
	15	Minority Race	D	D	No minority race inhabits near the project site.
	16	Employment	C+	C+	**Construction:** Construction works may lead to employment of local residents. **Operation:** Stable electricity supply will improve social services and expansion of market. Therefore, it gives positive effect.
	17	Land Use	D	D	No project components impact on the current land use of the project site.
	18	Water Right	D	D	No project components impact on water right.
	19	Existing Social Infrastructure	C-	D	**Construction:** Transportation of construction materials and generators may influence on the movement of local residents. **Operation:** Stable electricity supply will improve the existing social infrastructure.
	20	Society / Capital Market	D	D	No project components impact on Society / Capital Market.
	21	Unbalance of Benefit	D	D	The Project activity will not influence on unbalance of benefit.
	22	Interests in the Region	D	D	The Project activity will not influence on interests in the region
	23	Heritage	D	D	No heritage exists at the project site.
	24	Landscape	D	C-	Construction of the new power facility may cause the view from prospect points nearby the site.
	25	Gender	D	D	Project component will not effect on gender issue.
	26	Right of Children	D	D	Project component will not effect on right of children.
	27	HIV / AIDS	C-	D	Construction works increase the number of workers. Therefore, this may increase HIV/AIDS.
Social Environment	28	Labour Environment	C-	D	**Construction:** Complying with the Palauan Labour regulation is required. **Operation:** Operation of the facility will not cause adverse effect on labours.

Item	No.	Parameter	Evaluation		Evaluation / Reason
			Construction	Operation	
Others	29	Accident	C-	C-	**Construction:** Construction works may cause accidents. **Operation:** Measurement against accident is required for avoiding accidents.
	30	Climate Change	D	C-	Considering the size of the power station, the project will not significantly impact on the climate change.

A± : Significant Impact is expected
B± : Some Impact is expected
C± : Minor Impact is expected
D : No Impact is expected

The items and parameters are set in accordance with the JICA's Guidelines for Environmental and Social Considerations (April 2004).

1-1-1-6 Terms of Reference (TOR) on the Further Study

The Team prepared Terms of References (TOR) for further analysis of the impacts predicted in the scoping and preparation of mitigation measures as shown in

Table 1-1-1-4 Terms of References for Environmental Study

No	Item	Evaluation	Survey Contents	Methodology
1	Air Pollution	Cons: C- Oper: C-	• Understanding present air quality • Ambient air quality standard • Impact of the project activity on the air pollution	• Field survey at and near the site • Interview with local residents • Analysis based on the previous studies
2	Water Pollution	Cons: C- Oper: C-	• Impact of turbid water during construction	• Field survey at and near the site • Analysis of the existing measurement methods and design
3	Waste Materials	Cons: C- Oper: C-	• Treatment methods of construction waste materials and soils • Treatment methods of generated wastes from the facility	• Interview with relevant organization • Study on the similar facility cases
5	Noise and Vibration	Cons: C- Oper: C-	• Detection of present noise level • Environmental standards • Impact of the Project activity on noise and vibration	• Field survey at and near the site • Interview with local residents • Concept and design study • Calculation of the future noise level
10	Ecosystem	Cons: C-	• Understanding the site and surrounding natural environment • Impact of construction works on the existing ecosystem	• Field survey at and near the site • Study on similar cases • Analysis of measurements and design
18	Existing infrastructure	Cons: C-	• Impact of the Project activity	• Study on similar cases • Preparation of countermeasure
24	Landscape	Oper: C-	• Change of the scenery from view points	• Study on similar cases • Photo montage method
27	HIV/AIDS	Cons: C-	• Present level of infection disease and governmental policy	• Study on similar cases • Interview with relevant organization
28	Labour Environment	Cons: C-	• Measure for protection of labour environment	• Literature survey • Study on similar cases
29	Accident	Cons: C- Oper: C-	• Accident cases	• Literature survey • Study on similar cases
30	Climate Change	Oper: C-	• Impact of greenhouse gases generated from the facility	• Literature survey • Estimation of CO_2 emission

Cons: During construction, Oper: During operation

1-1-2 Analysis of Impact

The following section will discuss on the predicted impacts caused by the implementation of the Project and their evaluation.

1-1-2-1 Air Quality

(1) Previous Surveys

There has been no air quality surveys conducted at the Aimeliik Power Plant or nearby areas.

(2) Environmental Standards

The following table shows the standard to be adopted in this Project. The standards set by the World Bank (Pollution Prevention and Abatement Handbook, 1998) or Japan (Air Pollution Prevention Act) were adopted for those items that the environmental standards are not set in the Republic of Palau.

Table 1-1-2-1 Standards for Air Quality

Item	Palau	International*	Japan**	This Project
NOx (Average per year)	0.05 ppm			0.05 ppm
SOx (Average per year)	0.02 ppm			0.02 ppm
Emission standard for NOx	NOT EXIST	O_2 13% conversion < 2,000mg/Nm^3 or < 1,200ppm	O_2 13% conversion < 950ppm	O_2 13% conversion < 950ppm

* World Bank, 1998, Pollution Prevention and Abatement Handbook

** Air Pollution Prevention Act in Japan

(3) Construction Phases

Construction vehicles and equipment will be operated during the construction phase. However, such heavy equipment as the 2 units of 5MW generators and other heavy materials is planned to be transported by sea transportation and delivered to the site via the jetty. Therefore, the significant impacts caused by transportation of construction materials are not forecasted.

The following mitigation measures will be applied for the construction works.

- Precise construction planning for avoiding operation of a number of vehicles and construction machine simultaneously
- Encouragement of idling reduction to the workers
- Introduction of low emission type of construction machines if applicable
- Sprinkling water on the ground if large scale dust scattering is anticipated

By adopting mitigation measures listed above, the impact of air pollution during the construction phase is forecasted to be not significant.

(4) Operation Phase

The design condition of generators in this Project is as follows;

a) NOx emission standard : Less than 950 ppm (at the time of 13% of residual oxygen density)
b) SOx emission standard : Less than 125 ppm (at the time of 0.5% of sulfur content in fuel oil)
c) Oil content emission standard : Less than 50 ppm
d) Dust emission standard : Less than 100 mg/Nm^3

The JICA Study Team referred the result of air pollution analysis conducted in the previous study "The Master Plan Study for the Upgrading of Electric Power Supply in the Republic of Palau". This previous study concluded that the maximum concentration of air pollution generated from six (6) units of 5MW HFO-fuel generators would be 0.01565ppm for NOx and 0.01618ppm for SOx which are still within the air quality standard designated in the Chapter 2401-71 Air Pollution Control Act (NOx: 0.05 ppm and SOx: 0.02 ppm).

It is forecasted that the impact on air quality is further mitigated in comparison with the result in the master plan study due to the following reasons;

- Whereas the master plan study calculated the air quality based on the assumption of operation of seven (7) units of generators, this Project adopts two (2) generators only,
- The design height of the chimney in this Project is 20m, however, the height of the chimney will be raised as much as architectural and structural design condition allows, and
- Whereas the master plan study calculated the air quality based on the assumption of the fuel using HFO, this Project employs diesel oil which contains far lower sulphur.

Additionally, regular inspection of the facilities and thorough O&M will be conducted. Therefore, the impact of the air pollution during the operation phase is sufficiently small and can be neglected. It is also assumed operation of the new generators instead of the present generators will improve the air quality of the surrounding area.

1-1-2-2 Water Pollution

(1) Construction Phase

Construction works may cause generation of turbid water and deteriorate the water quality at the sea. Therefore, the following measures shall be adopted.

- Any earthmoving works shall be refrained during rainy season or if heavy rain is forecasted.
- Silt fence will be adopted at the boundary of the Project site prior to civil works for prevention of any soil erosion and turbid water.

- Sedimentation basin shall be equipped at the site prior to civil works for prevention of any high turbid water discharged onto the mangrove forest areas.
- Any excavation works on the slope in the south and east, where mangrove forest exists along the coastal line, shall be refrained for avoiding any unnecessary soil erosion.

By adopting mitigation measures listed above, the impact of water pollution during the construction phase is forecasted to be not significant.

(2) Operation Phase

Despite the fact that the generators installed in the Project require cooling water, a closed circulation system will be adopted. Additionally, the following two stage treatment system will be installed for any drainage containing lubricating oil and waste oil before discharge into the environment.

- Waste oil treatment system equipped at the power house
- Oil separator at the power plant prior to discharge into the environment.

By adopting mitigation measures listed above, the impact of water pollution during the operation phase is forecasted to be not significant.

1-1-2-3 Waste Materials

(1) Construction Phase

Rubbles from the demolishment works of the existing power plant and excavated soil will be generated. The waste construction materials will be treated as follows;

- The rubbles will be segregated at the site and entrust contractors certified by the EQPB /the State Government for their treatment.
- The excavated soil will be utilized as a back-filling soil during the construction works.
- In case if there are remaining soil generated, further utilization of the soil within the territory of the PUCC shall be examined
- The remaining shall be delivered to the final disposal site designated by the EQPB /the State Government.

By adopting the mitigation measures listed above, the impact of waste materials during the operation phase is forecasted to be not significant.

(2) Operation Phase

A small amount of sludge may be generated from the waste oil treatment system and the oil separator. Such sludge will be combusted with an incinerator installed in the power house. Therefore, no significant amount of waste will be generated during the operation phase.

1-1-2-4 Noise and Vibration

(1) Previous Surveys and Present Conditions

There has no previous survey for noise and vibration level conducted at and nearby the Project site. The Team conducted a field measurement on noise at various locations as shown in Table 1-1-2-2. Since there is no environmental standard for noise in the Republic of Palau, The standards set by the World Bank (Pollution Prevention and Abatement Handbook, 1998) or Japan (Environmental Protection Act) were adopted as shown in Table 1-1-2-3.

The Team identified the current (before the fire incident) noise level exceeds these standards. The Team made further observation of the situation and understood the main sources of the noise are the fans set on the side and radiators placed on the backyard of the existing power house whereas the impact of the generators is comparatively minor. The Team further implemented an interview with local residents. The local residents have complaints on noise generated from the power station although the degree of the complaints is lower than air pollution.

Table 1-1-2-2 Results of Noise Level Detection (before the fire incident)

Survey Location	Noise Level	Survey Location	Noise Level
1. 1m away from the generators	92.1 dB(A)	6. Northern boundary of the Site	83.3 dB(A)
2. Inside the existing power house	91.9 dB(A)	7. Eastern boundary of the Site	84.4 dB(A)
3. Outside the existing power house	70.7 dB(A)	8. Center of the existing road	69.2 dB(A)
4. 1m away from the radiators	92.0 dB(A)	9. Private house in east	55.4dB(A)～56.9dB(A)
5. Eastern boundary of the Site	72.5 dB(A)	10. Private house in north	55.5 dB(A)

Table 1-1-2-3 Environmental Standards for Noise

Item	Palau	World Bank*	Japan**	This Project
Noise Level at residential Area	Not Exist	Day time: < 55dB Night time: <45 dB	Day time: < 55dB Night time: <45 dB	Day time: < 55dB Night time: <45 dB

* World Bank, 1998, Pollution Prevention and Abatement Handbook

** Environmental Protection Act in Japan

It is anticipated noise may be generated during the construction due to operation of heavy machine and construction works. The following measures shall be adopted for mitigation of the impact.

- Low-noise type of machines shall be employed if applicable
- Temporary enclosure of the site (approximately 3m) shall be adopted during the construction works
- Instructing the contractors to examine low noise/vibration construction methods
- Encouragement of idling reduction to the workers

By adopting the mitigation measures listed above, the impact of noise during the construction phase is forecasted to be not significant.

(3) Operation Phase

Noise level during the operation of the new generators and facility was calculated based on the following method.

(a) Noise Level at the Sources

The noise level was set as follows in accordance with the record at similar facilities and survey result by the Team.

Table 1-1-2-4 Noise Level at the Sources

Equipment	No.	Noise Level	Remarks
Diesel Engine Generator	2	96 dB(A)	1m beside the equipment
Radiators	4	81 dB(A)	Ditto

(b) Attenuation

The attenuation was calculated based on the following formula;

$$\Delta L = L_1 - L_2 = 20 \log (r_2/r_1) \qquad (2.1)$$

L_2 (Noise level at the target point) can be calculated from the following formula when L_1, r_1 and r_2 are known.

$L_2 = L_1 - \Delta L$

where

ΔL: attenuation of noise

L_1: Noise level at r_1 m away from the source (r_1=1m)

L_2: Noise level at the point of r_2

(c) Attenuation of Noise by Wall

Attenuation of noise by wall can be calculated from the following formula;

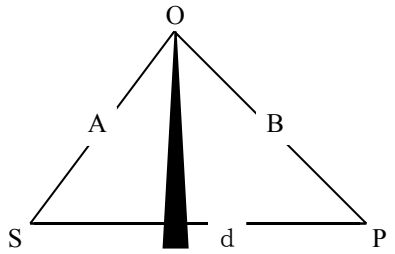
$$\delta = A + B - d$$

$$N = \delta f / 170$$

$$R = 10 \log N + 13 \qquad (3.1)$$

where;

S : Position of the Source
O : Upper point of wall
P : Position of the target point
A : Distance between S and O (m)
B : Distance between O and P (m)
d : Distance between S and P (m)
f : Frequency of noise (Hz)
R : Attenuation of noise level (dB)



(d) Synthesize

Each noise level can be synthesized based on the following calculation

$$Lp = 10 \log (10^{L1/10} + 10^{L2/10} + 10^{L3/10} \cdots + 10^{Lx/10}) \qquad (4.1)$$

where;

Lp: Synthesized noise level
Li: Each noise level (i=1,2,3・・・・x)

(e) Noise Prediction

[Step 1] Each noise level generated from diesel generators and radiators, respectively, were calculated from the formula (2.1) and (3.1)

[Step 2] Synthesized noise level was calculated based on the formula (4.1). The noise level at the target point is the overall noise level, which is synthesis of noise levels of each frequency and noise levels per each equipment.

(f) Excess Attenuation

It is widely known that forests and trees absorb noise level. Therefore, the attenuation of the noise by the forest was estimated. The value was adopted from the difference between the calculated noise level and the detected noise level during the field survey at the nearest houses. It was estimated the attenuation by the forest amounts to 4 dB.

(g) Condition for Projection

The future noise level was projected in the assumption that the existing power generators in Aimeliik Power Station will not be activated.

(h) Result of Noise Prediction

The noise levels at the nearest two (2) houses were calculated based on the above formulae. Table 1-1-2－5 shows the result of the predicted noise level, the standard set by the World Bank and the

present (before the fire incident) noise level. The result shows the predicted noise level at the nearest houses will be approximately 38.7 to 39.3 dB which is lower than the standard and the present (before the fire incident) noise level.

Therefore, it is evaluated that the noise level of operation of the new facility will not significantly impact on the surrounding environment. As a mitigation measure, the following will be adopted;

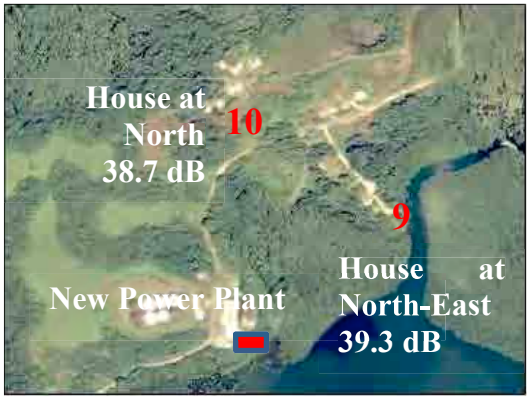
- Maintenance of the generators and other equipment will be conducted regularly for avoiding cause of unexpected noise.

By adopting the mitigation measure stated above, the impact of noise during the operation phase is forecasted to be not significant.

Table 1-1-2-5 Result of Noise Prediction

Unit: dB (A)

Result (Calculated Noise Level)		World Bank's Standard		Present (before the fire incident) Noise Level	
9 House at North-East	10 House at North	Day Time	Night Time	9 House at North-East	10 House at North
39.3	38.7	55	45	56.0	55.4



1-1-2-5 Ecosystem

Although there is no rare and endangered species identified during the field survey, a potential impact of eroded soil onto the mangrove forests located along the coastal line in the east and south of the Project site is anticipated. Therefore, the following measures shall be adopted.

- Any earthmoving works shall be refrained during rainy season or if heavy rain is forecasted.
- Silt wall shall be adopted at the boundary of the Project site prior to civil works.
- Sedimentation basin shall be equipped at the site
- Any excavation works on the slope in the south and east shall be refrained for avoiding any unnecessary soil erosion.

By adopting the mitigation measures listed above, the impact on the ecosystem is forecasted to be not significant.

1-1-2-6 Existing Social Infrastructure

The road running through the power plant has been occasionally used by public for approaching to the jetty. The road will be temporary closed upon the time the heavy equipment and generators are delivered to the site. The following measure will be adopted;

- The temporary closure of the road shall be informed to public using the road at least 2 weeks prior to the closure by standing the notice board, etc.

1-1-2-7 Landscape

The nearest historical monument is an ancient mound of Ouballang Er Ngerkelalk Ngerbuns El Bad which locates approximately 1 km north-eastern side from the Project site. It is anticipated the scenery from the ancient mound, a view point, may be altered. The JICA Study Team examined the impact of the construction of the new power house by photo montage method and evaluated the impact is not significant. As a mitigation measures;

- The colour of the power house shall be carefully selected (for matching to the surrounding environment)
- Trees nearby the plant shall be avoided to be cut

Figure 1-1-2-1 Future View of the Aimeliik Power Plant

1-1-2-8 HIV/AIDS

A considerable number of labours will participate in the construction work and infection of HIV/AIDS may be potentially considered.

According to the UNGASS 2008 Country Progress Report prepared by the Ministry of Health/HIV

section of the Republic of Palau, and submitted to the United Nations General Assembly Special Session on HIV and AIDS, the number HIV positive/infected number of patient in 2008 was only seven (7) in the whole country. The Government of the Republic of Palau has had a strong policy particularly since 2006 against HIV/AIDS. As a measure;

- The PPUC will strongly encourage the contractors to conduct HIV/AIDS education during the construction period in accordance to the governmental policy.

1-1-2-9 Labour Environment

The PPUC will strongly encourage the contractors to comply with relevant labour laws, regulations and acts for protecting the labour environment including prohibition of employment of children in the construction works.

1-1-2-10 Accident

(1) Construction Phase

According to the PPUC, no major accidents have been recorded in previous construction works of similar facilities. Under this Project, the PPUC will strongly encourage the contractors to take necessary safety measures for avoiding accidents during the construction phase including;

- Appointing safety officer or person in charge for safety of construction works
- Assigning workers for vehicle navigation if necessary
- Encouraging to hold periodic safety meeting and safety/hygiene education to temporary workers if required
- Preparation of construction plan with consideration of safety aspects
- Periodic inspection of construction machinery and vehicle

(2) Operation Phase

A fire incident occurred at the existing power house in the Aimeliik Power Plant on the 5th November 2011. The site has been inspected by the police and the Ministry of Justice under strong presidency by the President.

Due to the incident, PPUC has started thorough safety education and training for the staff involved in operation and maintenance. In addition, the PPUC is currently elaborating a new plan for safety measure, daily inspection and the act in an emergency by all members of the organization under safety officer's initiative. The JICA Study Team evaluated that the safety during the operation phase, such as accident avoidance and safety control, will be secured by the revised safety measures. Additional safety measure will be taken thoroughly by the guidance of the JICA senior volunteer staff or a specialist and the installation guidance of the engineer.

1-1-2-11 Climate Change

An increase of greenhouse gas emission is anticipated due to operation of the new power plant. Based on the formula in the report "the final report for project for formulation in electricity and energy sector as a measure against climate change" (2008, Japan Bank for International Cooperation (JBIC)), the amount of carbon dioxide emitted from the generators will amount to 44,134 t-CO_2 per year, which is approximately 29% increase from the "without Project" case (i.e. power generation by the existing generators). However, considering the amount, it is concluded the impact on the climate change is very much limited.

Table 1-1-2-6 Greenhouse Gas Emission

Item	Power Generation	CO_2 Emission	Thermal Efficiency	% of increase from "Without Project" Case
This Project (5 MW x 2 units)	72,000 kW/h	44,134 t-CO_2	43.5%	28.7%
Without Project Case	45,000 kW/h	34,282 t-CO_2	35.0%	

As countermeasures against climate change, the following will be taken;

- Challenge to reduce load on air conditioners through securing insulation, securing airtight of the power house and architectural design for shelter against sunlight.
- Conduct periodical maintenance for maintaining load of equipment

1-1-3 Evaluation of the Impact

Table 1-1-3-1 summarises the evaluation of the impact forecasted on the course of the Project.

Table 1-1-3-1 Evaluation of the Impact

Item	No	Parameter	Scoping		Evaluation		Evaluation / Reason
			Const	Oper	Const	Oper	
Pollution	1	Air Pollution	C-	C-	C-	C-	Although minor impact may remain, impact can be eased by mitigation measures during the construction. The impact of operation of the facility is limited.
	2	Water Pollution	C-	C-	C-	C-	The impact can be minimized with mitigation measures including setting of silt fence and sedimentation basin during construction phase and oil treatment system and oil separator during operation.
	3	Waste Materials	C-	C-	C-	C-	Reuse of soil and waste materials will mitigate the impact during the construction. The waste generated during operation will be appropriately treated.
	4	Soil Contamination	D	D	N/A	N/A	-
	5	Noise / Vibration	C-	C-	C-	C-	Noise during the construction can be mitigated by applying mitigation measures. The noise level during operation phase is below the present (before the fire incident) level and the

Item	No	Parameter	Scoping		Evaluation		Evaluation / Reason
			Const	Oper	Const	Oper	
							environmental standards.
	6	Subsidence	D	D	N/A	N/A	-
	7	Odour	D	D	N/A	N/A	-
	8	Sediments	D	D	N/A	N/A	-
Natural Environment	9	Protected Area	D	D	N/A	N/A	-
	10	Ecosystem	C-	D	C-	D	The impact can be minimized with mitigation measures including setting of silt fence and sedimentation basin during construction phase
	11	Hydrology	D	D	N/A	N/A	-
	12	Geology	D	D	N/A	N/A	-
	13	Resettlement	D	D	N/A	N/A	-
	14	Poverty	D	C+	N/A	C+	-
	15	Minority Race	D	D	N/A	N/A	-
	16	Employment	C+	C+	C+	C+	-
	17	Land Use	D	D	N/A	N/A	-
	18	Water Right	D	D	N/A	N/A	-
	19	Existing Social Infrastructure	C-	D	C-	N/A	Provision of notice/information to public will mitigate the impact.
	20	Society / Capital Market	D	D	N/A	N/A	-
	21	Unbalance of Benefit	D	D	N/A	N/A	-
	22	Interests in the Region	D	D	N/A	N/A	-
	23	Heritage	D	D	N/A	N/A	-
	24	Landscape	D	C-	N/A	D	The facility will not impact on the landscape.
	25	Gender	D	D	N/A	N/A	-
	26	Right of Children	D	D	N/A	N/A	-
	27	HIV / AIDS	C-	D	C-	N/A	Appropriate hygiene and HIV/AIDS education by the contractors will mitigate the impact.
Natural Environment	28	Labour Environment	C-	D	C-	N/A	PPUC will encourage compliance of relevant laws, regulations and acts to the contractors.
Others	29	Accident	C-	C-	C-	C-	PPUC will encourage compliance of safety regulations to the contractors. PPUC has started thorough safety education and training for the staff involved in operation and maintenance. In addition, the PPUC is currently elaborating a new plan for safety measure, daily inspection and the act in an emergency by all members of the organization under safety officer's initiative. The JICA Study Team evaluated that the safety during the operation phase, such as accident avoidance and safety control, will be secured by the revised safety measures. Additional safety measure will be taken thoroughly by the guidance of the JICA senior volunteer staff or a specialist and the installation guidance of engineers.

Item	No	Parameter	Scoping		Evaluation		Evaluation / Reason
			Const	Oper	Const	Oper	
	30	Climate Change	D	C-	N/A	C-	Although an increase of CO_2 is forecasted, the impact is minor and will not cause climate change in consideration of the scale of the facility and emission amount.

A± : Significant Impact is expected
B± : Some Impact is expected
C± : Minor Impact is expected
D : No Impact is expected

1-1-4 Mitigation Measures for the Project

Based on the discussion, the mitigation measures required for implementation of the Project are as in the followings.

Table 1-1-4-1 Mitigation Measures for the Project

No.	Item	Phase	Potential Impact	Mitigation Measures	Organization
1	Air Pollutin	Const	Operation of Construction Vehicle / Machine	• Precise construction planning for avoiding • Encouragement of idling reduction to the workers • Introduction of low emission type of construction machines if applicable • Sprinkling water on the ground if large scale dust scattering is anticipated	Contractors
		Oper	Operation of Facility	• Conducting inspection of the facilities and thorough O&M.	PPUC / Consultant
2	Water Pollution	Const	Discharge of Turbid Water	• Any earthmoving works shall be refrained during rainy season or if heavy rain is forecasted. • Silt fence will be adopted at the boundary of the Project site prior to civil works for prevention of any soil erosion and turbid water. • Sedimentation basin shall be equipped at the site prior to civil works for prevention of any high turbid water discharged onto the mangrove forest areas. • Any excavation works on the slope in the south and east, where mangrove forest exists along the coastal line, shall be refrained for avoiding any unnecessary soil erosion.	Contractors
		Oper	Treatment of lubricant contaminated water	• Applying the closed system for cooling water • Waste oil treatment system equipped at the power house • Oil separator at the power plant prior to discharge into the environment.	PPUC
3	Waste Materials	Const	Treatment of Construction Waste Materials	• The rubbles will be segregated at the site and entrust contractors certified by the EQPB/the State Government for their treatment. • The excavated soil will be utilized as a back-filling soil during the construction works. • In case if there are remaining soil generated, further utilization of the soil within the territory of the PPUC shall be examined • The remaining shall be delivered to the final disposal site designated by the EQPB.	Contractor

No.	Item	Phase	Potential Impact	Mitigation Measures	Organization
		Oper	Treatment of Sludge	• Appropriate treatment of sludge by the incinerator set at the new plant	PPUC
5	Noise and Vibration	Const	Operation of Construction Vehicle / Machine	• Low-noise type of machines shall be employed if applicable • Temporary enclosure of the site (approximately 3m) shall be adopted during the construction works • Instructing the contractors to examine low noise/vibration construction methods • Encouragement of idling reduction to the workers	Contractor
		Oper	Operation of Facility	• Regular maintenance of all machine and generators	PPUC
10	Eco system	Const	Discharge of Turbid Water	• Any earthmoving works shall be refrained during rainy season or if heavy rain is forecasted. • Silt fence will be adopted at the boundary of the Project site prior to civil works for prevention of any soil erosion and turbid water. • Sedimentation basin shall be equipped at the site prior to civil works for prevention of any high turbid water discharged onto the mangrove forest areas. • Any excavation works on the slope in the south and east, where mangrove forest exists along the coastal line, shall be refrained for avoiding any unnecessary soil erosion.	Contractor
19	Existing Infrastructure	Const	Impact on resident's move	• Provision of road closure information at least 2 weeks before the closure	Contractor
24	Landscape	Oper	Appearance of the Facility	• The colour of the power house shall be carefully selected (for matching to the surrounding environment) • Trees nearby the plant shall be avoided to be cut	PPUC
27	HIV/AIDS	Const	Increase number of workers	• Encouragement of Hygiene, HIV and AIDS education for workers	Contractor
28	Labour Environment	Const	Consideration for labor environment	• Compliance with the relevant laws, regulations and acts.	Contractor
29	Accident	Const	Accidents during construction works	• Appointing safety officer or person in charge for safety of construction works • Assigning workers for vehicle navigation if necessary • Encouraging to hold periodic safety meeting and safety/hygiene education to temporary workers if required • Preparation of construction plan with consideration of safety aspects • Periodic inspection of construction machinery and vehicle	Contractor
		Oper	Accident during operation	• Thorough safety education and training for the operation and maintenance staff. • Elaborate a new plan for safety measure, daily inspection and the act in an emergency by all members of the organization under safety officer's initiative. • Additional safety measure will be taken thoroughly by the guidance of the JICA senior volunteer staff or a specialist and installation guidance of the engineer.	PPUC

No.	Item	Phase	Potential Impact	Mitigation Measures	Organization
30	Climate Change	Oper	Increase in Greenhouse gas emission	• Challenge to reduce load on air conditioners through securing insulation, securing airtight of the power house and architectural design for shelter against sunlight. • Conduct periodical maintenance for maintaining load of equipment	PPUC

Const: Construction Phase, Oper: Operation Phase

1-1-5 Monitoring Programmes

The monitoring programme was prepared for those items which require mitigation measures for minimizing the impact based on the PPUC's capacity for environmental monitoring including technical and financial aspects as well as practical availability of resources.

[Construction Phase]

Item	Method	Frequency	Organization
Air Pollution	• Visual inspection of dust	Occasionally	PPUC Contractor
Water Pollution	• Visual inspection of turbid water	Weekly	PPUC Contractor
Waste Materials	• Understanding of the amount of waste materials	Monthly	Contractor
Noise and Vibration	• Complaints from residents	Occasionally	PPUC Contractor
Ecosystem	• Visual inspection of turbid water flowing to Mangrove forest	Weekly	PPUC Contractor
Existing Infrastructure	• Record in progress reports	Monthly	PPUC Contractor
HIV/AIDS			
Labour Environment			
Accident			

[Operation Phase]

Item	Method	Frequency	Organization
Air Pollution	• Interview with residents	6 months after operation	PPUC
Water Pollution	• Visual inspection of surface oil	Weekly	PPUC
Waste Materials	• Record of operation of the incinerator	Monthly	PPUC
Noise and Vibration	• Interview with residents	6 months after operation	PPUC
Accident	• Safety Meeting and Inspection in accordance with PPUC's Safety Manual	Occasionally	PPUC

1-1-6 Stakeholder Meetings

Although stakeholder Meeting is neither required for Category B Project nor requested by the EQPB, the PUCC and the Team visited residents to explain the Project and to interview their complaints about the environmental condition. It was carried out before the fire incident occurred.

The main complaints are listed below. The majority is about air pollution and there are expectations

for improvement by the Project.

- Although the noise continues 24hours, it is not too bothering when you are used to it. (40s, man)
- Never been aware of odour. The house is under reconstruction to mitigate the noise. (40s, woman)
- Depending on the wind direction, the smoke from the existing power plants gets into house and furniture, home appliances and laundries get sooty. (40s woman etc.)
- As well as the smoke emission, smell of the smoke is expected to be improved. (40s woman)
- Been aware that the existing power plant is deteriorating. Expectation is high for installation of the new plant by JICA to improve the air quality and noise problem. (50s woman)
- Noise and air pollution are allowable to certain extent as it is by own choice to be living close to the power plant. Yet it is desirable to see any sort of improvement by the project. (40s couple)

1-2 Land Acquisition and Involuntary Resettlement

The Project site locates within the boundary of Cadastral Lot No. 012 M 03 situated in Ngchemiangel, Aimeliik State. The current land owner of the Project site is the PPUC.

The land was transferred from the Elilai Clan and Telbong Lineage to the Republic of Palau on the date of 24th day of September, 2004 and this deed of transfer was filed as the Document No. 04 2023 in the Clerk of Court. The Republic of Palau transferred the ownership of the land to the PPUC on the date of 1st of September, 2005 and this deed of transfer was filed as the Document No. 05 1724 in the Clerk of Court. Since no resident inhabits at the Project site, land acquisition and involuntary resettlement will not occur for this Project.

CHAPTER 2 CONTENTS OF THE PROJECT

Chapter 2 Contents of the Project

2-1 Basic Concenpt of the Project

2-1-1 Project Targets

In the Medium Term Development Strategy (MTDS) of Palau, the "ample securing of PPUC profits and power generation, transmission and distribution capacity" in the power sector is raised as a priority policy in the realm of infrastructure.

According to the Energy Sector Strategic Action Plan (ESSAP) that was compiled in October 2009, upgrading of the PPUC's deteriorated base load generators is raised as a priority project, and it is proposed that four 5 MW generators be newly installed.

In these circumstances, the Project aims to bolster and install power supply facilities, which are essential infrastructure for ensuring the stable operation of social and public facilities and improving the living standard of local residents while maintaining political and economic activities in the urban area of Palau.

2-1-2 Project Outline

In order to achieve the above objectives, the Project aims to construct a stable power supply setup through building base load operation generating facilities (two generators of 5 MW output each) in the urban area and environs, and thereby contribute to the vitalization of socioeconomic activities in the urban area and stabilization of citizen life.

The Project entails the procurement of equipment and construction of a generation building necessary for the additional installation of two 5 MW diesel generators at Aimeliik Power Station, which carries the burden of supplying power to the urban region.

2-2 Outline Design of the Japanese Assistance

2-2-1 Design Policy

2-2-1-1 Basic Concept

The Project intends to procure and install base load operation generating facilities (two generators of 5 MW output each) with the aim of boosting power supply capacity in the urban area of Palau. The power demand for the coming 10 years (2011~2020) in the Project area will be projected and the preconditions for the Project plan will be verified. Incidentally, the target year of the Project shall be one year following the start of the service.

2-2-1-2 Concept regarding Natural Conditions

(1) Temperature and Humidity

Palau has a marine tropical climate and the temperature remains almost constant at 27°C to 28°C all year round. Mean annual humidity is 82%. As the engines and generators to be procured in the Project will be installed indoors, it will not be necessary to take any special measures regarding outside temperature, however, concerning design of engine combustion air and engine room ventilation, care will be taken to secure equipment functions through making the design temperature 40°C, the electricity room temperature 35°C and the outdoor equipment temperature 40°C.

(2) Seismic Conditions

Earthquakes are extremely rare in Palau, however, in consideration of damage during the transportation of equipment, horizontal seismic coefficient of 0.1G, which is commonly adopted as design criteria in Japan, will be adopted.

2-2-1-3 Concept regarding Social and Economic Conditions

Palau has no religious customs that have a large impact on the construction schedule such as Ramadan in Islamic countries. However, when starting the power plant construction works, it will be necessary to inform the local citizens and improve their understanding in advance.

2-2-1-4 Concept regarding Construction Situation

The key industries of Palau, i.e. construction, commerce and tourism, have relied heavily on assistance from Japan, the United States and Taiwan, etc. and on overseas workers primarily from the neighboring Philippines. Accordingly, it is difficult to secure engineers of higher standard than simple laborers possessing only limited technical skill. Since infrastructure conditions are good and there is a good network of roads between islands as typified by the Japan-Palau Friendship Bridge (new Koror-Babeldaob Bridge) which was constructed under Japan's grant aid and enables overland transport from Malakal Port, the environment for executing works in the Project is favorable.

2-2-1-5 Concept regarding Utilization of Local Contractors and Local Equipment and Materials

(1) Utilization of Local Contractors

Local contractors will be utilized mainly for the provision of construction works materials and labor in the generating equipment installation works and facilities construction works. Moreover, it will be necessary to dispatch engineers from Japan in order to conduct quality control, schedule control, safety control, testing and adjustment.

(2) Utilization of Local Equipment and Materials

The aggregate, cement and reinforcing bars, etc. used in foundation works can be procured in Palau, however, since architectural reinforcing bars, finishing, equipment materials, generating equipment piping, cables and other materials for mechanical and electrical works cannot be procured in Palau, procurement from Japan and third countries will be examined.

(3) Procurement of third country products

When procuring equipment and materials from third countries, ample consideration will be given to price, quality, delivery schedule, availability of spare parts after equipment goes into service, post-sales service and compatibility with existing equipment.

All power generating equipment in Palau consists of imported items with many products coming from Europe. Therefore, ample consideration will be given to procuring circuit breakers and other equipment for the Project generating equipment from third countries. However, concerning power generating equipment, in view of the operating performance, quality and durability of equipment procured in previous grant aid, as well as the post-sales service setup of makers and acquisition of operation and maintenance technology for equipment made in Japan, the Palauan side has an avid desire for Japanese products to be adopted. Considering that the power generating equipment in Malakal power station that was procured in the previous grant aid has been operating stably for a long time, the wishes of the Palauan side are deemed to be appropriate.

(4) Concerning architecture

Since Palau has foreign-affiliated general contractors and electrical works companies, it is relatively easy to procure ordinary laborers, transport vehicles, construction works machinery and so on. Accordingly, it will be relatively simple to secure the local labor required for constructing the generator building and implementing the civil engineering foundation works in the Project.

On the other hand, high-level engineers will be required in order to perform installation of the Project generating equipment and construction of the steel frame structure generator building, which will be relatively tall and large, and since it is difficult to find such personnel in Palau, it will be necessary to dispatch engineers from Japan in order to conduct quality control, offer technical guidance and manage the works schedule.

2-2-1-6 Concept regarding Operation and Maintenance Capacity of the Implementing Agency

As with the existing equipment, PPUC will implement the maintenance of equipment after it goes into service. Since the PPUC operates numerous medium-speed diesel generators of the type scheduled for

introduction in the Project and has so far acquired around 25 years of experience, it is deemed to possess practical operation and maintenance capacity.

However, because hardly any staff members have received specialist education in machinery and electricity, they lack systematic and theoretical knowledge of preventive maintenance including routine inspections, etc. Accordingly, the Japanese engineers will conduct short but intensive classroom courses geared to training the operation and maintenance staff in the basic theory of generating equipment from the mechanical and electrical aspects during the Project works period. Moreover, effort will be made to enhance the effective and efficient operation of facilities through proposing the preventive maintenance setup after facilities go into service.

2-2-1-7 Concept regarding Setting of Facilities and Equipment Grades

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

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

The generating equipment to be procured in the Project will have sufficient capacity to complement base load operation regarding the power demand of Palau in 2015 (one year after going into service), and the equipment composition will be such that efficient and economical operation and maintenance can be conducted.

(2) Concept regarding the setting of grades

Specifications of the component equipment in the power generation system to be installed in the Project shall be decided in conformance with the technical level of the PPUC, which will be responsible for operation and maintenance following completion of the Project.

(3) Concept regarding architecture

In order to conduct technically and economically appropriate design, standard equipment items that conform to international standards such as ASTM will be adopted as far as possible, compatibility will be sought through selecting only a few model types, and only the base minimum specifications and qualities will be adopted.

2-2-1-8 Concept regarding Construction Method, Procurement Method and Works Schedule

Since the Project will be implemented based on Japan's grant aid scheme, it will be necessary to finish the procurement and installation within 24 months after that grant agreement (G/A). Moreover, in order to finish on time and realize the anticipated effects, it will be necessary to coordinate the works on the Japanese side with the works on the Palauan side and compile the implementation schedule while giving consideration to inland transportation routes, transportation methods, lead times and procedures, etc.

Equipment procured in Japan and other third countries will primarily be transported to Palau by sea. In the case where equipment is transported overland from Malakal Port to Aimeliik Power Station, road conditions are relatively good through Koror and up to the peripheral road on Babeldaob Island (approximately 20 km), however, the access road from this point to the power station (approximately 8 km) is almost totally unpaved ; moreover, there is a bridge over a medium-size river (weight limit: 10 ton) that may not have the strength to permit transportation of heavy steel frame materials, etc. It is anticipated that heavy materials, like the generators, will first be towed by barge from Malakal Port to the fuel landing jetty at Aimeliik Power Station, and from there be towed to the site by trailer.

The power station building is a relatively tall steel frame structure, and since skilled technology will be needed in construction, it will be necessary to dispatch engineers from Japan or a third country to conduct technical guidance and schedule management to ensure that the required quality control and schedule management are conducted.

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

2-2-2-1 Preconditions

(1) Power demand forecast

Based on the econometric approach, the power demand forecast up to fiscal 2020 was carried out upon conducting regression analysis and seeking a forecasting formula in which the power demand (kWh) was assumed to be the explained variable and the real GDP, mean power tariff and power demand in the previous year were assumed to be the explanatory variables (X). The data on past power demand and so on used in the regression analysis was taken from the 11-year period from fiscal 2001 to 2011. Concerning the future real GDP growth rate, the IMF forecast from 2012 to 2015 (3%/year) was adopted, while the Study Team assumed a figure of 2% per year from 2016 to 2020 based on theTeam's own forecast.

Table 2-2-2-1 Real GDP Growth Rate used in the Power Demand Forecast

Fiscal Year	2012	2013	2014	2015	2016	2017	2018	2019	2020
Real GDP growth rate	3%/year				2%/year				

[Source] International Monetary Fund (April 2010) "Article-IV Consultation Staff Report" (from 2012 to 2015)
JICA Study Team's own estimate (from 2016 to 2020)

Concerning electricity tariffs, it was assumed that the revised tariffs of May 2012 will be upheld until fiscal 2020 and tariffs were converted into actual prices based on the consumer price index.

The following expression is used when converting annual power demand of consumers (kWh) to peak load at the generating end (kW). Concerning the load factor and distribution loss (technical loss + non-technical loss), the actual figures for fiscal 2011 indicated in Table 2-2-2.2 and Table 2-2-2.3 were adopted.

$$Peak\ load\ (kW, generating\ end) = \frac{Power\ demand\ (kWh) + Distribution\ loss\ (kWh)}{8{,}760 \text{ x } Load\ factor\ (\%)}$$

Table 2-2-2-2 Load Factor Performance in the Koror-Badeldaob System

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Load factor (%)	78.61	73.25	75.00	76.30	78.45	72.08	74.05	71.23	57.14	77.29	74.07

[Source] PPUC

Table 2-2-2-3 Distribution Loss Performance in the Koror-Badeldaob System

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Distribution loss (%)	24.61	22.50	19.23	22.69	18.85	15.89	18.18	17.93	11.93	18.64	18.05

[Source] PPUC

The results of power forecast based on the above methods and conditions are indicated in Figure 2-2-2.1, Figure 2-2-2.2 and Table 2-2-2.4.

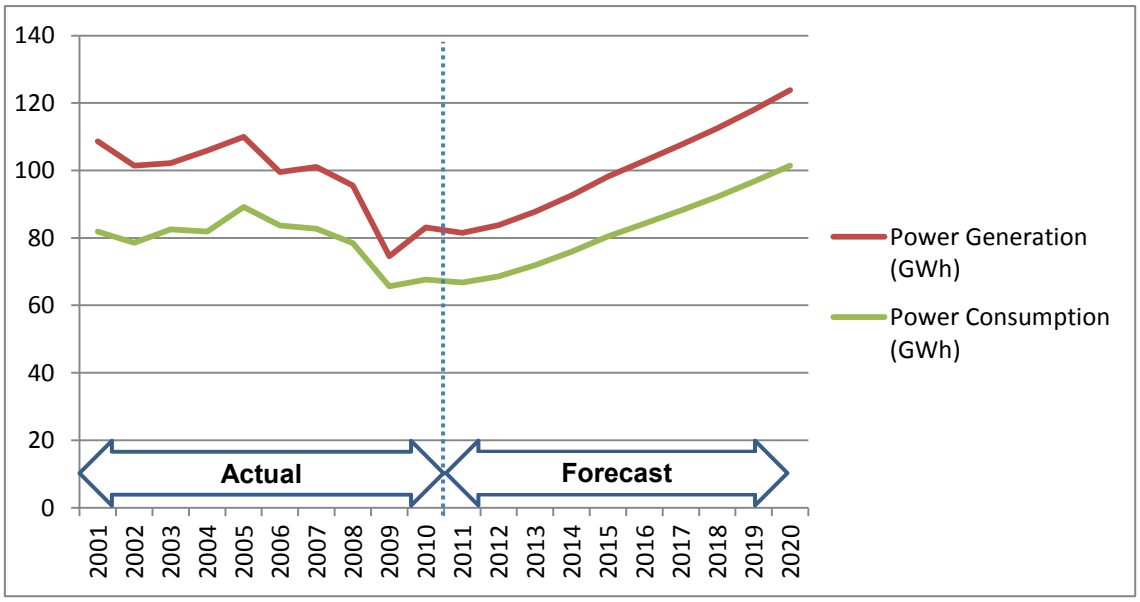


Figure 2-2-2-1 Results of Power Demand Forecast (Power Demand and Generated Electric Power)

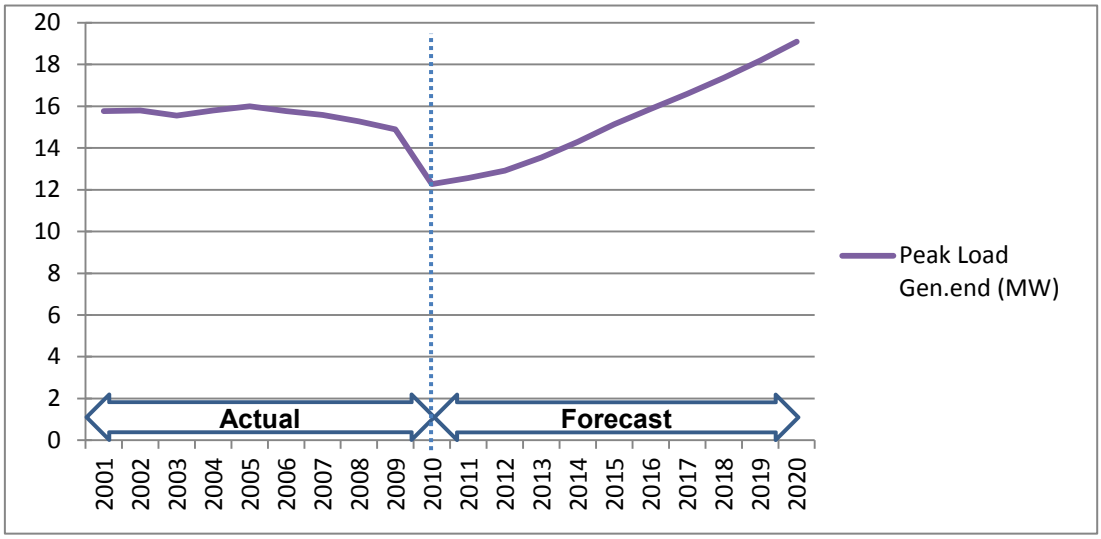


Figure 2-2-2-2 Results of Power Demand Forecast (Peak load at the Generating End)

Table 2-2-2-4 Results of Power Demand Forecast

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020
Power demand (GWh)	68.6	71.9	75.9	80.4	84.3	88.1	92.2	96.6	101.5
Power at the generating end (GWh)	83.7	87.8	92.6	98.2	102.9	107.6	112.5	117.9	123.8
Peak load at the generating end (MW)	12.9	13.5	14.3	15.1	15.9	16.6	17.4	18.2	19.1
Distribution loss (%)	18%	18%	18%	18%	18%	18%	18%	18%	18%
Load factor (%)	74%	74%	74%	74%	74%	74%	74%	74%	74%

(2) Unit Capacity of New Generating Equipment

In cases where generating equipment drops off the network due to accidents and so on, the frequency declines because the balance between power demand and supply is upset. The following formula is used to express this relationship:

$$\Delta F = -\frac{1}{K} \times \frac{\Delta P}{P} \times 100$$

Where,

ΔF: Grid frequency fluctuation (Hz)

ΔP: Output or load of the generator concerned (MW)

P: Total load of grid (MW)

K: Grid constant (KG + KL) (%MW/0.1Hz)

KG: Frequency characteristics of the generator (%MW/0.1Hz)

KL: Frequency characteristics of the network (%MW/0.1Hz)

The unit capacity in cases of newly connecting generating equipment to power systems needs to be enough to ensure that the system frequency doesn't exceed the scope of the operating limit even if the unit in question stops operation due to a sudden accident. In Palau, the operating limit value of the system frequency is determined as follows:

Malakal Feeder : 58.2 Hz
Meyuns Feeder : 57.2 Hz
Airport Feeder : 58.0 Hz
Airai Feeder : 57.6 Hz

When the Niigata Unit No. 15 at Malakal Power Station tripped during 3.9MW operation on September 6, 2011, the system frequency dropped from 59.97Hz to 56.97Hz (Δ3Hz). In view of these conditions, the system constant of the Koror-Badeldaob power system can be sought as follows:

[Conditions during unit tripping]

ΔF : Fall in system frequency (Hz) = 59.97-56.97 = 3.00Hz
ΔP : Load of dropped generator (MW) = 3.90MW
P : Overall system load (MW) = 10.275MW

[Calculation of system constant]

$$3.00\text{Hz} = -\frac{1}{K} \times \frac{3.90MW}{10.275MW} \times 100$$

K = 12.652 %MW/Hz or K = 1.265 %MW/0.1Hz

In the case where the permissible value for system frequency drop is assumed to be Δ2.8 Hz (60Hz-57.2 Hz (at Meyuns Feeder)), the maximum unit capacity at which system frequency can be sustained within the permissible range even when a unit trips can be calculated from the above system constant (K) as shown in Table 2-2-2.5.

Table 2-2-2-5 Maximum Unit Capacity at which System Frequency can be Sustained at the Permissible Level

System Load (MW)	Maximum Unit Capacity (MW)	Ratio concerning System Load	Special Remarks
7.00	2.48	35.4%	Nighttime load in fiscal 2011
8.00	2.83		
9.00	3.19		
10.00	3.54		
11.00	3.90		
12.00	4.25		
12.57	4.45		Maximum power in fiscal 2011
13.00	4.60		
14.00	4.96		
14.29	5.06		Maximum power in fiscal 2014
15.00	5.31		
16.00	5.67		
17.00	6.02		
18.00	6.38		
19.00	6.73		
20.00	7.08		

According to the above findings, in the Project completion year of fiscal 2014, there should be no problem when the unit capacity is 5 MW. Moreover, since generators with unit capacity of 5

MW have already been introduced to Malakal Power Station, units with similar capacity will also be introduced in the Project in consideration of operating compatibility and convenience.

(3) Plan for decommissioning of existing generating equipment

Based on the current state of generating units, the decommissioning schedule for existing equipment is planned as follows.

Table 2-2-2-6 Plan for Decommissioning of Existing Generating Equipment

Generating equipment name	Commissioned year	Rated output	Available output*	Decommissioning year
Malakal Power Station				
(1) Wartsila-1	1998	2.00 MW	1.00 MW	2014
(2) Wartsila-2	1998	2.00 MW	0 MW	Decommissioned
(3) Wartsila-3	1998	2.00 MW	0 MW	Decommissioned
(4) Mitsubishi-12	1998	3.40 MW	2.38 MW	2021 or after
(5) Mitsubishi-13	1998	3.40 MW	2.72 MW	2021 or after
(6) Caterpillar-1 (High Speed)	2006	1.88 MW	0 MW	2014
(7) Caterpillar-2 (High Speed)	2006	1.88 MW	1.50 MW	2014
Aimeliik Power Station				
(1) Pielstick-2	1986	3.27 MW	0 MW	2012
(2) Pielstick-3	1986	3.27 MW	0 MW	2012
(3) Pielstick-4	1986	3.27 MW	0 MW	2012
(4) Pielstick-5	1986	3.27 MW	0 MW	2012

[Remarks]*: As of the end of March 2012

(4) Reserve supply capacity

In consideration of the drop in output that arises as a result of stoppages due to periodic overhauls and stoppages caused by sudden accidents, reserve capacity equivalent to the combined total of the largest and second largest generators will be secured. In the Project, reserve capacity equivalent to two 5 MW units will be needed.

(5) Power demand and supply balance

Table 2-2-2.7 shows the power demand and supply balance compiled based on the above conditions (1) ~ (4).

Table 2-2-2-7 Power Demand and Supply Balance in the Koror-Babeldaob System

	Installed	Capacity	Forecast (Fiscal Year)									
	Year	(MW)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1. Peak Demand (MW)			**12.57**	**12.92**	**13.54**	**14.29**	**15.14**	**15.87**	**16.59**	**17.36**	**18.19**	**19.10**
Growth Rate (%)				2.79%	4.81%	5.55%	5.97%	4.78%	4.57%	4.63%	4.79%	4.99%
2. Generating Capacity (MW)			**12.50**	**13.98**	**20.57**	**25.82**	**25.69**	**30.56**	**30.41**	**30.25**	**30.10**	**29.95**
2.1 Malakal P/S			**6.50**	**11.98**	**18.58**	**13.84**	**13.77**	**13.70**	**13.63**	**13.56**	**13.49**	**13.43**
(1) Wartsila-1	1998	2.00	(1.00)	(1.70)	1.69	Retire						
(2) Wartsila-2	1998	2.00	Retire									
(3) Wartsila-3	1998	2.00	Retire									
(4) Mitsubishi-12	1998	3.40	2.30	2.29	2.28	2.27	2.25	2.24	2.23	2.22	2.21	2.20
(5) Mitsubishi-13	1998	3.40	2.70	2.69	2.67	2.66	2.65	2.63	2.62	2.61	2.59	2.58
(6) Caterpillar-1 (High Speed)	2006	1.88	(1.50)	(1.50)	1.49	Retire						
(7) Caterpillar-2 (High Speed)	2006	1.88	1.50	(1.50)	1.49	Retire						
(8) Niigata-14	2011	5.00	(5.00)	3.50	3.48	3.47	3.45	3.43	3.41	3.40	3.38	3.36
(9) Niigata-15	2011	5.00	(5.00)	3.50	3.48	3.47	3.45	3.43	3.41	3.40	3.38	3.36
(10) Mitsubishi-16 (High Speed)	2012	0.50		(0.50)	0.50	0.50	0.49	0.49	0.49	0.49	0.48	0.48
(11) Mitsubishi-17 (High Speed)	2012	0.50		(0.50)	0.50	0.50	0.49	0.49	0.49	0.49	0.48	0.48
(12) Mitsubishi-18 (High Speed)	2012	0.50		(0.50)	0.50	0.50	0.49	0.49	0.49	0.49	0.48	0.48
(13) Mitsubishi-19 (High Speed)	2012	0.50		(0.50)	0.50	0.50	0.49	0.49	0.49	0.49	0.48	0.48
2.2 Aimeliik P/S			**6.00**	**2.00**	**1.99**	**11.98**	**11.92**	**16.86**	**16.78**	**16.69**	**16.61**	**16.53**
(1) Pielstick-2	1986	3.27	2.00	Retire								
(2) Pielstick-3	1986	3.27	(2.00)	Retire								
(3) Pielstick-4	1986	3.27	2.00	Retire								
(4) Pielstick-5	1986	3.27	2.00	Retire								
(5) Caterpillar-1 (High Speed)	2012	2.00		2.00	1.99	1.98	1.97	1.96	1.95	1.94	1.93	1.92
(5) New DG-1 (Japan's Grant)	2014	5.00				5.00	4.98	4.95	4.93	4.90	4.88	4.85
(6) New DG-2 (Japan's Grant)	2014	5.00				5.00	4.98	4.95	4.93	4.90	4.88	4.85
(7) New DG-3 (PPUC)	2016	5.00						5.00	4.98	4.95	4.93	4.90
3. Power Balance(MW) (2.－1.)			**(0.07)**	**1.06**	**7.03**	**11.52**	**10.54**	**14.69**	**13.81**	**12.89**	**11.91**	**10.85**
4. Capacity of the largest generator (MW)			2.70	3.50	3.48	5.00	4.98	5.00	4.98	4.95	4.93	4.90
5. Firm capacity (MW) (2.－4.)			9.80	10.48	17.09	20.82	20.71	25.56	25.43	25.30	25.18	25.05
6. Reserve margin (MW) (5.－1.)			**(2.77)**	**(2.44)**	**3.55**	**6.52**	**5.57**	**9.69**	**8.84**	**7.94**	**6.99**	**5.95**
7. Capacity of second largest Generator (MW)			2.30	3.50	3.48	5.00	4.98	4.95	4.93	4.90	4.88	4.85
8. Safe reserve margin (MW) (6.－7.)			**(5.07)**	**(5.94)**	**0.07**	**1.52**	**0.59**	**4.74**	**3.91**	**3.04**	**2.11**	**1.10**

Source: Forecasted by JICA Study Team

Remarks: Decreasing factor for each engine is supposed to be 0.5 % per annum.

2-2-2-2 Overall Plan

(1) Design Criteria

Upon examining the scale and specifications of the Project according to the above conditions, the following design criteria have been adopted.

1) Generating facilities construction site, location and altitude

Inside the existing Aimeliik Power Station, altitude 14 m

2) Climatic Conditions

Table 2-2-2-8 Climatic Conditions

Region		Aimeliik State
Altitude		Less than 1,000m
Ambient Temperature	Maximum	40℃
	Minimum	10℃
	Mean	30℃
Maximum Humidity		85%
Max. Wind Velocity		40 m/sec.
Rainfall		4,100 mm/year
Seismic Force		Horizontal 0.1G
Soil Bearing Capacity		10 ton/m^2
Salt Deposit Density		0.5 mg/cm^2
Annual thunderstorm days (IKL)		37 days

3) Applicable Codes / Standards and Units

With regard to the Project design, relevant international standards such as IEC, ISO and Japanese standards are applied to the major functions of equipment and facilities in conformity with the existing electrical equipment and facilities in Palau. For the system of units, the International System of Units (SI) is applied.

- International Standardization Organization (ISO): Applied to performance evaluation of industrial products in general
- Japanese Industrial Standard (JIS): Applied to industrial products in general
- International Electro-technical Commission (IEC): Applied to major functions of electrical products in general
- Japanese Electro-technical Commission (JEC): Applied to electrical products in general
- Standards for Japan Electrical Manufacturer's Association (JEM): Same as above
- Japanese Electrical Wire and Cable Maker's Association (JCS): Applied to electric

wire and cables

- Relevant Technical Standards on Electrical Installation: Applied to electrical work in general

4) Basic Electrical Design Conditions

Basic conditions for designing the electrical equipment and materials shall be as follows.

Table 2-2-2-9 Basic Electrical Design Conditions

Item	High Voltage	Low Voltage			DC
		(Generating equipment power)	(Control and lighting)	(Air conditioning and ventilation)	
Nominal voltage	13.8 kV	440/250 V	240/120 V	208/120 V	110 V
Maximum voltage	14.5 kV	462/267 V	252/126 V	218/126 V	116 V
Wiring System	3 phase 3 wire	3 phase 4 wire	1 phase 3 wire	3 phase 4 wire	2 wire
Frequency	60 Hz				-
Grounding method	Resistance grounding	Direct grounding	-	Direct grounding	-

5) Lightning impulse withstand voltage (LIWV)

The electrical equipment shall withstand the following level of lightning impulse withstand voltage (LIWV), which is applied to the existing equipment, in order to keep consistency between the equipment.

13.8 kV system: LIWV 110 kV

6) Environmental protection criteria

When constructing new power generating facilities, since no related environmental standards are established in Palau, Japanese criteria and the following standards in consideration of local conditions in Palau will be established as design criteria:

Table 2-2-2-10 Environmental protection criteria

Items	design criteria
1. NOx discharge criteria	No more than 950 ppm (when residual oxygen concentration is 13%)
2. SOx discharge criteria	No more than 125 ppm (when fuel sulfur content is 0.5%)
3. Oil discharge standard	No more than 50 ppm
4. Particulate matter discharge criteria	No more than 100 mg/Nm^3
5. Noise standard	No more than 110dB(A) when only the target generating equipment is operating (1 m from the machine side)
6. Vibration criteria	No more than 65 dB at the site perimeter when only the target generating equipment is operating

(2) Facilities Layout Plan

The equipment of the Project shall be provided in the new powerhouse or switch room separated constructed from the powerhouse.

Location of the equipment of the Project shall be designed in consideration of simple operation and maintenance. The diesel engine generators and their mechanical auxiliary equipment shall be located in the new powerhouse. Their auxiliary electrical equipment shall be located in the electrical room of the powerhouse. The air blowers shall be located in the blower room of the powerhouse and the sludge treatment equipment and radiators shall be located outside. The 13.8 kV switchgear panels for connection to the existing 13.8 kV power system shall be located in the new switch room.

The fuel (diesel oil) for the engines shall be supplied from the existing diesel oil storage tanks.

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

Table 2-2-2.11 shows an outline of the basic plan of the Project based on the basic design concept, design criteria and facilities layout plan described previously (see 2-2-1-1).

Table 2-2-2-11 Outline of the Basic Plan

	Plan Contents	Quantity
Procurement and installation	1. Diesel engine generators	
	1.1 Diesel engines	2 sets
	1.2 Synchronous generators	2 sets
	1.3 Common Beds	2 sets
	2. Mechanical auxiliary equipment for diesel engine generator	
	2.1 Fuel oil system	1 set for each generator
	2.2 Lube oil system	1 set for each generator
	2.3 Cooling water system	1 set for each generator
	2.4 Compressed air system	1 set for each generator
	2.5 Intake air and exhaust gas system	1 set for each generator
	2.6 Sludge treatment system	1 set
	2.7 Pipes and cables	1 set for each generator
	3. Electrical auxiliary equipment for diesel engine generator	1 set for each generator
	4. 13.8 kV switchgear panels	1 set
Procurement	1. Maintenance tools	1 set
	2. Spare parts	1 set
	3. Emergency spare parts	1 set
Construction	1. Powerhouse for diesel engine generators (total floor area: approximately1,169 m^2)	1 set
	2.Switch room of 13.8kV switchgear panels (total floor area: approximately 90 m^2)	1 set

(1) Basic requirements for the equipment of the Project

① Selection of driving equipment for generator

Diesel engine shall be applied as driving equipment of synchronous generators of the Project in consideration of consistency with the existing equipment, experience of operation and maintenance of the Palauan side and urgency of the Project.

② Verification of engine output and generator capacity

Output of the diesel engine generators of the Project shall be with total capacity of 10 MW and able to operate continuously for base load (at least 8,000 hours throughout the year).

The following rough guides shall be followed:

- Engine output

$$Pe \geqq \frac{P}{\eta} \fallingdotseq 5{,}200 \text{ kWm}$$

Pe : Engine output
P : Generating end output (5,000 kW)
η : Generator efficiency (assumed to be 96%)

- Generator capacity

$$P_G = \frac{P}{Pf} = 6{,}250 \text{ kVA}$$

P_G : Generator capacity (kVA)
P : Generating end output (5,000 kW)
Pf : Generator power factor 0.8

For the economical operation and maintenance a medium-speed unit with engine speed of 720 rpm or less shall be applied in the Project. In addition, Generally speaking, such medium-speed generators have enough experiences of continuous operation for power supply. Concerning these conditions, medium-speed diesel engines shall be applied in the Project.

③ Selection of fuel oil

At Aimeliik Power Station, diesel oil is applied for fuel of the existing diesel engine generators. From the viewpoint of storage capacity, diesel oil shall also be applied for fuel of the new generators.

④ Selection of lubricating oil

Lube oil of SAE-40 is applied to the existing diesel engine generators. The diesel engine generators of the Project shall be of medium-speed type and their revolution speed shall not be over 720 rpm. Lube oil of SAE-40 shall also be applied to them in consideration of availability and characteristic of diesel engine.

⑤ Application of cooling water

City water is applied for cooling of the existing diesel engine generators (cooling tower system is applied to two existing engines, and radiator system is applied to others). City water shall also be applied for the generators of the Project for cooling purpose and a water softener shall be provided as same as the diesel engine generators provided at Malakal Power Station in the previous project under the Japanese grant aid project.

⑥ Basic requirements for mechanical auxiliary equipment

a) Fuel oil system

Aimeliik Power Station currently has eight (8) fuel storage tanks (of which six are currently being used) with capacity of 740,000 cubic gallons (2,800 m^3) and one intermediate storage tank with capacity of 50,000 cubic gallons (190 m^3). Fuel is transferred from the main storage tanks to the intermediate storage tank before being supplied to the four existing generators. These existing fuel tanks will be used in order to supply fuel to the generating equipment provided in the Project.

To the diesel engine generators of the Project, fuel will be transferred to small fuel service tanks of the new generator engines by piping connected to the existing intermediate storage tank (see Basic Design Drawing M08).

Fuel will be supplied to the engines from the fuel service tank by transfer pump. Basic design drawing M02 shows the fuel oil system drawing.

Capacity of Fuel Oil Service Tank

The fuel oil service tank will have enough capacity to keep the generating equipment running for approximately four hours. Capacity is calculated as follows:

$$Vs = V \times 5{,}000\ kW \times 4\ hours \times 2\ units \fallingdotseq 9.88\ m^3$$

Where,

Vs : Capacity of the fuel oil service tank
V : Fuel consumption (210 g / kWh) per unit of generating equipment (rated output 5,000 kW)
However, the specific gravity of diesel fuel is assumed to be 0.85.

Considering dead volume of 15%, the capacity of the service tank shall be 12 m^3.

b) Lube oil system

Lube oil shall be filled to the sump tanks of the diesel engine generators of the Project by fuel oil transfer pump from drum cans. (See DWG No. M-03)

c) Cooling water system

City water will be supplied through the valve at the end of branch line from the existing

city water system provided by the Palauan side for the Project. A water softener shall be provided in order to improve hardness before being used as cooling water. The radiator method shall be applied for the cooling system. The water treated by the softener shall also be supplied to the lube oil purifiers.

(See DWG No. M-04)

d) Compressed air system

One lot (total two sets) of air compressor for start-up purposes of diesel engines shall be provided for each diesel engine of the Project. The compressed air systems of the No. 6 and No. 7 engines shall be connected for each other by common pipes so that the units can be mutually used in case of emergency. (See DWG No. M-05)

Due to high humidity in the project site, an automatic drain valve shall be provided to the compressed air tank. The piping on the secondary side of the tank shall be divided into high and low pressure systems. Air driers shall be attached to the low pressure system. The low pressure system shall be applied for the control system of auxiliary equipment and utility purpose.

e) Intake air and exhaust gas system

Air for combustion of diesel engines shall be supplied into the powerhouse of the Project through intake ducts. Air shall be compressed and supplied to the engines through turbochargers mounted on them. The exhaust gas from the engines shall be conducted outside through silencers. (See DWG No. M-06)

Air intake blowers shall be provided in the blower room in the second floor of the powerhouse for air supply to the generators and preventing temperature rise inside the powerhouse.

f) Sludge treatment system

Due to lack of enough capacity of the existing equipment for additional sludge treatment for the diesel engine generators of the Project, sludge treatment system shall be provided separately. (See DWG No. M-07)

g) Piping systems

The following relevant piping systems shall be provided for the diesel engine generators. The type of fluids and flow directions shall be indicated by colors on them.

- Fuel oil pipes
- Lubricating oil pipes
- Cooling water pipes
- Compressed air pipes
- Waste oil pipes
- Wastewater pipes

⑦ Electrical equipment plan

The generating voltage of the diesel engine generators of the Project shall be of 13.8 kV in accordance with the existing generators in Aimeliik Power Station to connect them to the 13.8 kV system directly without a transformer. Unit-type power supply method shall be applied to the auxiliary equipment of the Project. Basically, each equipment shall be provided for each generator. However, some equipment, i.e.; the blowers, fuel transfer pumps, common low voltage power panels, shall be shared in accordance with their applications.

To connect the equipment of the Project to the existing 13.8 kV power system, the new 13.8 kV Bus bar including 13.8 kV switchgears shall be provided in the new switch room constructed apart from the new powerhouse under the Project.

The electrical equipment of the Project shall be as follows.

(a) Electrical equipment for generating equipment in the new electrical room

a) Local control panels

Local control panels which enable to start, stop and control engines, monitor conditions of generator, and raise alarms in case of faults shall be provided next to the diesel engine generators.

b) 13.8 kV generator circuit breaker panels

13.8 kV generator circuit breaker panels shall be provided in the electrical room in the new powerhouse. They shall be actuated in accordance with signals from the automatic synchronizing panel.

c) Generator protective relay panels

The generator protective relay panels shall be provided in the electrical room.

d) Disconnect switch panel and resister panel for neutral grounding of generators

A disconnect switch panel and resister panel for neutral grounding of generators shall be provided in the electrical room. Two disconnect switches shall be provided for each generator in the disconnect switch panel. As the generators shall operate with the neutral grounding at one point, mechanical interlock shall be provided for these two disconnect switches.

e) Supervisory and control panel, and automatic synchronizing panel

A supervisory and control panel, and automatic synchronizing panel shall be provided in the electrical room in order to enable centralized control and supervisory of the generators and electrical equipment in the new switch room apart from the new powerhouse. Static type relays shall be adopted.

Control devices for exciter in brushless and thyristor type shall be provided in the automatic synchronizing panel. This control system shall be in coordination with synchronous closing operation. As these panels include static instruments, air conditioning equipment shall be provided for the new electrical room and switch room.

f) Station service transformer

Two oil-immersed station service transformers (13.8/0.440-0.250 kV) shall be provided outdoors as power sources for the auxiliary equipment of the generators and building equipment of the Project. Each transformer shall have capacity of not less than 630 kVA to supply enough power to the equipment of the Project.

g) Low voltage power panels (main power panel, common power panel and unit power panels)

Low voltage power panels to supply power to auxiliary equipment of generators and low voltage distribution panels in the electrical and switch rooms shall be provided in the electrical room. The low voltage power panels shall be equipped with the necessary operation and measurement instruments, and annunciation equipment. Double-sided type shall be applied in order to use the limited area of the electrical room effectively.

h) DC power supply device

DC power supply device (batteries, battery charger and DC distribution panel) shall be provided in the electrical room for power supply to electrical equipment in case of black-out. Voltage level shall be of 110 V and batteries shall have enough capacity to operate the electrical equipment for 12 hours under black-out.

i) Low voltage distribution panels (building services and lighting panels)

Low voltage distribution panels including mould-type transformers shall be provided in the electrical room for the building services and lighting.

j) Generator for black-out start

A package-type diesel engine generator shall be provided to supply enough power to the minimum auxiliary equipment required for start-up of one diesel generator even in the case of black-out.

(b) 13.8 kV electrical equipment in the new switch room

13.8 kV electrical equipment and low voltage electrical equipment in the new switch room constructed apart from the new powerhouse shall be provided in order to connect the diesel engine generators of the Project to the existing 13.8 kV power system.

a) 13.8 kV switchgear panels

13.8 kV electrical equipment shall be composed of total nine (9) sets of 13.8 kV switchgear panels, i.e.; two panels to connect the generators of the Project to the 13.8 kV Bus bar, two panels to connect the existing generators to the 13.8 kV Bus bar, two panels

to connect the 13.8 kV Bus bat to the existing 13.8 kV power system, two panels for station service transformers and a panel for bus connection. The panels to connect the generators of the Project shall be equipped with synchronous closing function in coordination with the automatic synchronizing panel in the powerhouse. These panels shall be equipped with multi-type measuring instruments and static protective relay. In addition, these functions shall be able to control and monitor from the supervisory and control panel in the powerhouse.

b) Low voltage distribution panels (building service and lighting panels)

Low voltage distribution panels including mould-type transformers shall be provided in the switch room for the building services and lighting. Power for the panels shall be supplied from Common Power Panel in the powerhouse.

c) DC power supply device

DC power supply device (batteries, battery charger and DC distribution panel) shall be provided in the switch room for power supply to the 13.8 kV switchgear panels in case of black-out. Voltage level shall be of 110 V and batteries shall have enough capacity to operate the electrical equipment for 12 hours under black-out.

(c) Common electrical equipment

a) Grounding measures

The following grounding measures shall be carried out by connection to the common ground network of the existing powerhouse:

- Grounding for detection of ground fault
- Grounding to prevent accidental electrocution from metal objects and electrical equipment
- Grounding to protect equipment and facilities from lightning impulse voltage

b) Cables

Power cables of the above mentioned equipment shall be laid in the cable trenches provided in the powerhouse, switch room, and outdoors. To preserve the maintainability of the cables, similar cable supports to the existing ones shall be provided.

(2) Basic Specifications of Main Equipment

Based on the above mentioned design policy, design criteria, and design conditions, the specifications of the equipment of the Project shall be compiled as shown below.

Table 2-2-2-12 Basic Specifications of Main Power Generating Equipment

No.	Main Instruments	Quantity	Rough Specifications
1.	Diesel engine generator		
1.1	Diesel engine	2 sets	Operation: Continuous (base load operation) Rated output: 5,000 kWe or more Revolution speed: Not more than720 rpm Engine type: 4 stroke cycle, trunk piston, turbo-charged, water-cooled, V-type diesel engine Cooling method: Radiator method Fuel: Diesel oil
1.2	Generator	2 sets	Operation: Continuous Rated output: 5,000 kWe or more Frequency: 60 Hz Phases: 3 Rated voltage: 13.8 kV Revolution speed: Same as for engine Power factor: 0.8 (delayed) Winding connection method: Y connection, neutral wire shall be drawn Insulation class: F
1.3	Common bed	2 sets	Material: Steel Accessory: lubricating oil sump tank (capacity 7 m^3) self-contained type Vibration prevention device: Spring or rubber
2.	Mechanical auxiliary equipment for diesel engine generator		
2.1	Fuel oil system		
	(1) Fuel oil transfer pump	2 sets	Gear pump motor-driven with filter, 4 m^3/h, 3 phase 440 V
	(2) Fuel oil service tank	1 set	Self-standing type made of steel, 12 m^3 or more
	(3) Fuel oil circulating pump	2 sets	Gear pump motor-driven, 3 phase 440 V
	(4) Fuel oil primary filter	2 sets	Multiple basket type
	(5) Fuel oil secondary filter	2 sets	Basket or cartridge type, It shall be equipped with automatic back-wash function
	(6) Fuel oil flow meter	2 sets	Accuracy ±0.5% F.S., It shall be equipped with a filter
	(7) Fuel oil pressure regulating valve	2 sets	Self-actuated type
	(8) Fuel oil drain tank	1 set	Self-standing type made of steel, 0.2 m^3 or more
	(9) Fuel oil drain pump	1 set	Gear pump motor-driven with filter, 0.5 m^3/h or more, 3 phase 440 V
2.2	Lube oil system		
	(1) Lube oil transfer pump	1 set	Gear pump motor-driven with filter, 1 m^3/h or more, 3 phase 440 V
	(2) Lube oil priming pump	2 sets	Gear pump motor-driven with filter, 20 m^3/h or more, 3 phase 440 V
	(3) Lube oil purifier unit	3 sets	Centrifugal type, includes automatic discharger
	(4) Lube oil cooler	2 sets	Water-cooled plate or fin tube type, includes automatic temperature adjustment valve
	(5) Lube oil main filter	2 sets	Bucket type, It shall be equipped with automatic back-wash function
	(6) Lube oil indication filter	2 sets	Basket or cartridge type
	(7) Lube oil pressure regulating valve	2 sets	Self-actuated type
	(8) Sludge tank	1 set	Self-standing type made of steel, 0.5 m^3 or more
	(9) Sludge pump	1 set	Includes motor, centrifugal type and filter, 0.5 m^3/h or more, 3 phase 440 V
2.3	Cooling water system		
	(1) Water supply pump	2 sets	Centrifugal pump motor-driven with filter, 2 m^3/h or more, 3 phase 440 V
	(2) Treated water pump	2 sets	Centrifugal pump motor-driven with filter, 2 m^3/h or more, 3 phase 440 V
	(3) Water treatment unit (Softener)	1 set	Ion exchange resin type

No.	Main Instruments	Quantity	Rough Specifications
	(4) Treated water tank	1 set	Self-standing type made of steel, 2 m^3 or more
	(5) High temperature water circulating pump (HT)	2 sets	Centrifugal pump motor-driven with filter, 3 phase 440 V
	(6) Low temperature water circulating pump (LT)	2 sets	Centrifugal pump motor-driven with filter, 3 phase 440 V
	(7) High temperature water expansion tank (HT)	2 sets	Self-standing type made of steel, 0.25 m^3 or more
	(8) Low temperature water expansion tank (LT)	2 sets	Self-standing type made of steel, 0.25 m^3 or more
	(9) Cooling water temperature adjustment valve	2 sets	Self-actuated type
	(10) Radiator	2 sets	2-layer (HT/LT), vertical flow fan, copper cooling tubes, 3 phase 440 V
2.4	Compressed air system		
	(1) Air compressor	2 sets	Approx. from 2.5 to 3MPa, 3 phase 440 V
	(2) Air receiver	2 sets	Enough capacity to start engine 3 times at least and not less than 0.8 m^3, it shall be equipped with automatic drainage valve
	(3) Air drier	2 sets	Dehumidifying dryer type
	(4) Air ressure reducing valve	2 sets	Self-actuated type
2.5	Air intake and exhaust gas system		
	(1) Air cooler	2 sets	Fin tube water-cooled type
	(2) Air intake filter	2 sets	Oil bath outdoor type
	(3) Air intake expansion joint	2 sets	Bellows made of SUS
	(4) Air intake duct	2 sets	It shall be made of SS
	(5) Air intake silencer	2 sets	Not more than 110 dB at 1 m , horizontal type
	(6) Exhaust gas expansion joint	4 sets	Bellows made of SUS
	(7) Exhaust gas duct	2 sets	It shall be made of SS
	(8) Exhaust gas silencer	2 sets	Not more than 110 dB at 1 m, it shall be equipped with exhaust tube
	(9) Tail pipe	2 sets	It shall be made SS and height of 14 m
	(10) Oil mist detector	2 sets	It shall be located in clank case
	(11) Air intake blower	1 lot	Horizontal axial flow type
	(12) Indoor suction filter	1 lot	5 m/s or less, 100 Pa or less
	(13) Duct for air intake blower	1 lot	It shall be made of steel
2.6	Sludge treatment system		
	(1) Oily water separator tank	1 set	Gravity type, 2 m^3 or more, it shall be equipped with oil level gauge
	(2) Oily water pump	1 set	Centrifugal pump motor-driven with filter, 1 m^3/h or more, 3 phase 440 V
	(3) Oily water separation unit	1 set	Residual oil contents 50 ppm or less, 1 m^3/h or more, 3 phase 440 V
	(4) Waste oil pump	1 set	Centrifugal pump motor-driven with filter, 0.5 m^3/h or more, 3 phase 440 V
	(5) Waste oil tank	1 set	Self-standing type made of steel, 2 m^3 or more
	(6) Incinerator	1 set	Auxiliary waste oil burner, 0.05 m^3/h or more, auxiliary fuel tank, with control panel
2.7	Cables and piping		
	(1) Pipes, valves	1 lot	Fuel oil pipes, lubricating oil pipes, compressed air pipes, cooling water pipes, miscellaneous air pipes
	(2) cable, trays	1 lot	13.8 kV cable, 13.8 kV cable terminal materials, low voltage power line power, control power line
3.	Electrical auxiliary equipment for diesel engine generator		
3.1	Supervisory and control panel	2 sets	Indoor self-standing type, it shall be equipped with AVR, control button of circuit breakers, measuring equipment, alarm, and etc.

No.	Main Instruments	Quantity	Rough Specifications
3.2	Generator protective relay panel	2 sets	Indoor self-standing type, it shall be equipped with engine start/stop button, recorder, alarm, and etc.
3.3	Automatic synchronizing panel	1 set	Indoor self-standing type, it shall be equipped with synchronizer, and etc.
3.4	13.8 kV generator circuit breaker panel	2 sets	Indoor metal enclosed cubicle, circuit breaker withdraw type (VCB or SF6), 13.8 kV or more, 630 A or more, 25 kA (1 s) or more
3.5	Station service transformer	2 sets	Outdoor oil-immersed self-cooling type, 13.8 kV/0.44-0.25 kV, Dyn11, 630 kVA or more
3.6	Disconnect switch panel for neutral grounding of generator	1 set	Indoor metal enclosed cubicle, it shall be equipped with two sets of disconnect switches, $13.8/\sqrt{3}$ kV or more, 200 A or more
3.7	Resister panel for neutral grounding of generator	1 set	Indoor metal enclosed cubicle, $13.8/\sqrt{3}$ kV, 200A, 40 ohm, 10 sec. or more
3.8	DC power supply device	1 set	Indoor self-standing type, fully sealed lead storage battery, 110 V, battery capacity shall bear 12 hours of power interruption, charger, DC distribution panel (DC 110 V)
3.9	Supervisory and control panel for 13.8 kV equipment	1 set	Indoor metal enclosed cubicle. It shall be able to monitor and control 13.8 kV equipment
3.10	Main power panel (Low voltage)	1 set	Indoor metal enclosed cubicle, 0.44/0.25 kV, 3 phase 4 wire, ACB, mold case circuit breaker (MCCB)
3.11	Common power panel (Low voltage)	1 set	Indoor self-standing type, two-sides type, 0.44/0.25 kV, 3 phase 4 wire, mold case circuit breaker (MCCB)
3.12	Unit power panel (Low voltage)	2 sets	Indoor self-standing type, two-sides type, 0.44/0.25 kV, 3 phase 4 wire, mold case circuit breaker (MCCB)
3.13	Building service panel (Low voltage)	1 set	Indoor self-standing type, dry transformer, it shall be equipped with MCCB (208/120 V, 3 phase 4 wire)
3.14	Lighting panel (Low voltage)	1 set	Indoor self-standing type, dry transformer, it shall be equipped with MCCB (240/120 V, 1 phase 3 wire)
3.15	Local control panel	2 sets	Indoor self-standing type, it shall be equipped with engine start/stop button, and etc.
3.16	Generator for black-out start	1 set	Diesel engine, continuous operation, 60 Hz, 3 phase 4 wire, 0.44/0.25 kV
4.	13.8 kV electrical equipment		
4.1	13.8 kV switchgear panel for the new generator	2 sets	Indoor metal enclosed cubicle, circuit breaker withdraw type (VCB or SF6), 13.8 kV or more, 630 A or more, 25 kA (1 s) or more
4.2	13.8 kV switchgear panel for connection to the existing 13.8 kV power system	2 sets	Indoor metal enclosed cubicle, circuit breaker withdraw type (VCB or SF6), 13.8 kV or more, 630 A or more, 25 kA (1 s) or more
4.3	13.8 kV switchgear panel for the existing generator	2 sets	Indoor metal enclosed cubicle, circuit breaker withdraw type (VCB or SF6), 13.8 kV or more, 630 A or more, 25 kA (1 s) or more
4.4	13.8 kV switchgear panel for station service transformer	2 sets	Indoor metal enclosed cubicle, circuit breaker withdraw type (VCB or SF6), 13.8 kV or more, 630 A or more, 25 kA (1 s) or more
4.5	13.8 kV switchgear panel for bus tie	1 set	Indoor metal enclosed cubicle, circuit breaker withdraw type (VCB or SF6), 13.8 kV or more, 1250 A or more, 25 kA (1 s) or more
4.6	Building service panel (Low voltage)	1 set	Indoor self-standing type, dry transformer, low voltage distribution panel (208/120 V, 3 phase 4 wire, mold case circuit breaker)
4.7	Lighting panel (Low voltage)	1 set	Indoor self-standing type, dry transformer, low voltage distribution panel (240/120 V, 1 phase 3 wire, mold case circuit breaker)
4.8	DC power supply device	1 set	Indoor self-standing type, fully sealed lead storage battery, 110 V battery capacity (during power interruption: 12 hours), charger, DC distribution panel (DC 110 V)

2-2-3 Outline Design Drawings

Drawing No.	Drawing Title
G-01	Transmission and Distribution Systems on Koror and Babeldaob Island
G-02	General Layout at the Project Site
AA-03	NEW POWERHOUSE PLAN-1
AA-04	NEW POWERHOUSE FLOOR PLAN-2
AA-05	NEW POWERHOUSE ROOF PLAN
AA-06	NEW POWERHOUSE ELEVATION-1
AA-07	NEW POWERHOUSE ELEVATION-2
AA-08	NEW POWERHOUSE SECTION
AA-17	NEW SWITCH HOUSE PLAN, ELEVATIONS
M-01	SYMBOL LIST
M-02	FUEL OIL FLOW DIAGRAM
M-03	LUBRICATING OIL FLOW DIAGRAM
M-04	COOLING WATER FLOW DIAGRAM
M-05	COMPRESSED AIR FLOW DIAGRAM
M-06	INTAKE AIR AND EXHAUST GAS FLOW DIAGRAM
M-07	SLUDGE TREATMENT FLOW DIAGRAM
E-01	SINGLE LINE DIAGRAM
E-02	SINGLE LINE DIAGRAM GENERATOR CIRCUIT
E-03	SINGLE LINE DIAGRAM MAIN LV PANEL
E-04	SINGLE LINE DIAGRAM NEW 13.8kV STATION SWITCHBOARD

Remarks: See Appendix-5 for each drawing

2-2-4 Implementation and Procurement Plan

2-2-4-1 Implementation and Procurement Policy

The Project will be implemented based on the Government of Japan's Grant Aid scheme. According to this, the Project will receive approval by the Government of Japan, the Exchange of Notes (E/N) will be signed by the two countries' governments, and the Grant Agreement (G/A) will be concluded by JICA (Japan International Cooperation Agency) and the Government of Palau before the Project progresses to the implementation stage. The following paragraphs describe the basic items and points requiring particular consideration in the event where the Project is implemented.

(1) Project Implementing Agency

The implementing agency for the Project is the Palau Public Utilities Corporation (PPUC). The implementing department in PPUC will need to execute the Project works and undertake the operation and maintenance of the supplied equipment following completion. Moreover, in order to smoothly advance the Project, the PPUC will need to liaise and communicate closely with the Japanese consultant and contractor and to appoint staff in charge of the Project in order to smoothly advance the Project.

The appointed PPUC Project staff member will need to fully explain and secure understanding for the contents of the Project to employees of the PPUC, related agencies and residents of the target area with a view to eliciting cooperation for Project implementation.

(2) Consultant

In order to implement the equipment and materials procurement and installation works and facilities construction works, the Japanese Consultant will conclude a Design Supervision Contract with the PPUC and conduct the implementation design and supervision work for the procurement and installation works in the Project. Moreover, the Consultant will prepare the tender documents and act for the Project implementing agency, the PPUC in conducting the tender work.

(3) Contractor

In accordance with the framework of Japan's Grant Aid scheme, the Japanese contractor that has been selected by the Palauan side in general open tender will implement the equipment and materials procurement and installation works and facilities construction works of the Project. Following completion of the Project, since it will be necessary to continue supplying spare parts and conducting post-installation service to resolve breakdowns and so on, it will be necessary to conduct thorough liaison and coordination after the handover of equipment and materials.

(4) Need for Dispatch of Engineers

Since the Project entails the procurement and installation of two diesel generating units with capacity of 5 MW, and the work will need to be conducted by multiple teams, it will be necessary to coordinate the work between each team. Moreover, as the works will largely be conducted simultaneously, it will be essential to dispatch Japanese engineers and technicians who can conduct consistent management and guidance on schedule, quality, progress and safety throughout the works.

2-2-4-2 Important Points in Implementation / Procurement

(1) Important Points in Equipment and Materials Procurement

1) Concerning the country of equipment and materials procurement

Since Palau depends on imports for major items of equipment such as motors, synchronous generators and switchgear, etc. and such items cannot be procured locally, it will be necessary to procure equipment from Japan or third countries. Moreover, since it depends on imports for wiring and piping materials and so on too and these items are also not available locally, they will be procured from Japan or a third country.

2) Safety measures

The Project target site has relatively few problems in terms of law and order, however, it will be necessary to display ample care for preventing theft of equipment and securing the safety of works personnel. Accordingly, not only is it essential that the Palauan side take safety measures,

but also the Japanese side will need to take steps such as erecting fences (as temporary works) and assigning guards around equipment and materials storage areas and so on.

3) Tax Exemptions

In order to receive exemptions of customs charges and tariffs on the Project equipment, the contractor will need to submit an application form for the customs clearance and tax exemption measures with a copy of the bill of lading appended with other necessary documentation to the Bureau of Revenue, Customs and Taxation of the Ministry of Finance via the Procurement Officer of the PPUC. At the same time, it will need to submit copies of the application and documentation to the Bureau of International Trade and Technical Assistance of the Ministry of State. Through doing so, it will be possible to receive exemptions of 3% on tariffs, however, it has been confirmed that this is not an advance rebate system but rather a total exemption scheme.

Incidentally, Palau has no system for paying value added tax (VAT) and the like on products.

4) Transportation

Equipment carried to Palau by sea is usually landed and undergoes customs clearance at the country's only international port of Malakal (two berths). Since unloading work here is carried out by the private firm Belau Transfer & Terminal Company, tariffs are exempted, however, it will be necessary to pay handling charges as part of the marine transportation costs of the Project.

Concerning heavy objects such as engines and so on, concerning internal transportation from Malakal International Port to the Project target site of Aimeliik Power Station, as there is a bridge (close to Aimeliik) that only has a maximum load of 10 tons on the route to the power station, marine transportation will be conducted. Therefore, heavy objects such as the engines, etc. will first be transferred to barge at Malakal Port and then towed to the fuel landing jetty at Aimeliik Power Station for unloading.

Moreover, because Malakal International Port has no crane equipment capable of lifting engines (50 tons or more), the operator will separately need to secure a barge equipped with crane, and traveling crane, etc. for lifting and transferring the equipment. Concerning the securing of lifting equipment, since diesel generating equipment of similar scale to that intended for procurement in the Project was unloaded at Malakal International Port in February 2011, there should not be any problems.

Furthermore, the equipment and materials transported from Japan will be packed in such a way that it can withstand the long sea voyage, landing at port, inland transportation to the Project site and storage.

2-2-4-3 Scope of Works, Procurement and Construction

According to the Grant Aid Scheme for General Project, Table 2-2-4.1 shows the detailed scope of works on the Japanese and Palauan sides.

Table 2-2-4-1 Scope of Works on the Japanese and Palauan Sides

No.	Item	Scope of Work		Remarks
		Japan	Palau	
*1	(1) Securing of the Project site		○	Securing of generator building, circuit breaker equipment building and station service transformer site
	(2) Removal of existing buildings and equipment from the Project site (including foundations and buried objects), ground leveling, site preparation, weeding and removal of obstructions		○	This includes transfer of auxiliary equipment for the pre-existing generating equipment inside the Project site.
*2	Installation of fences and gates			
	(1) Temporary fences and gates	○		
	(2) Permanent fences and gates		○	
*3	Road works			
	(1) Inside the Project site	○		
	(2) Access road to the Project site		○	
*4	Incidental equipment works			
	(1) Electrical works			
	a) Power line extension works		N/A	Not applicable because a station service transformer will be installed
	b) Indoor wiring works	○		
	(2) Water supply works			
	a) Pipe extension and connection works		○	
	b) Piping works on the secondary side of connection points	○		
	(3) Drainage works			
	a) Outside the site		○	
	b) Inside the site	○		
*5	Handling of transport and customs clearance procedures and taxes			
	(1) Responsibility for ocean transport (air transport) of products related to procured equipment to the recipient country (Palau)	○		
	(2) Tax burden and customs clearance procedures at the port of unloading in Palau		○	
	(3) Transportation of procured equipment, etc. from the port of unloading to the inland site in Palau	○		Carrying-in site: Temporary storage are inside Aimeliik Power Station
	(4) Exemption or bearing of domestic value added tax on procured construction materials and equipment in Palau		○	
*6	Necessary steps for acquiring the following authorizations: - Permission necessary for installation works - Permission for entry to restricted areas		○	Acquire before Project implementation according to necessity
*7	Appropriate operation and maintenance of facilities and equipment		○	This includes purchase of exchange parts
*8	Bearing of costs not included in the grant aid		○	

No.	Item	Scope of Work		Remarks
		Japan	Palau	
*9	Payment of the following commissions based on the banking agreement:			
	(1) A/P (Authorization to Pay) commission fee		○	Around 10,000 yen
	(2) Payment commission fee		○	Around 0.1% of the total project cost
*10	Securing and implementation of the environmental and social consideration budget necessary for Project implementation		○	
11	Securing of site for the temporary equipment and materials storage area		○	Site: Approx. 40 m x 40 m
12	Securing of parking area during the works period		○	
13	Works offices	○		For the Japanese consultant and local contractor
14	Appropriate storage and safety management of equipment and materials in the temporary equipment and materials storage area	○		
15	Transfer of underground cables and pipes and securing of authorizations (power, telephone, waterworks, sewage, etc.)		○	According to necessity
16	Acquisition of authorization for road traversal works		○	
17	Provision of a dump site for residual soil and works wastewater		○	
18	Manufacture and procurement of equipment and materials	○		Equipment and materials to be procured in the Project
19	Equipment installation works, adjustment and testing	○		The Palauan side will lend the maintenance tools included in the procured equipment and materials to the contractor on the Japanese side for installation works.
20	Temporary power interruption during the works period		○	
21	Final connections to existing equipment			
	(1) Final connection to the power grid		○	
	(2) Final connection to the existing fuel oil system		○	
	(3) Final connection to the existing city water line		○	This includes connection points and connection valves inside the Project site.
22	Procurement of materials necessary for conducting the above final connections	○		
23	Operational guidance on initial operation and maintenance of procured equipment and materials	○		
24	Securing of safety of Project personnel on the Project site		○	According to necessity
25	Response to and compensation for consumers, etc. at times of power interruptions, etc. during the works		○	According to necessity
26	Notification to consumers of planned power interruptions during the works		○	

Source: JICA Study Team

○: Indicates the scope of responsibility regarding each item. Numbers indicate the items stated in the M/D.

2-2-4-4 Consultant Supervision

Based on the scheme of the Government of Japan's Grant Aid, the Consultant will organize a consistent project team to smoothly conduct the implementation design and construction supervision work according to the principles of the outline design. The Consultant will permanently assign at least one engineer to the Project site during the construction supervision stage in order to conduct schedule control, quality control, performance control and safety control. Furthermore, an expert in Japan will attend plant inspections and pre-shipping inspections of equipment and materials manufactured in Japan as needed with a view to ensuring that no troubles occur following delivery of materials and equipment to Palau.

(1) Basic Concept of Execution Supervision

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

The important points to consider in Consultant supervision are described below.

1) Schedule control

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

① Confirmation of works performance (manufacture of equipment and materials in plant and performance of power distribution works on site)
② Confirmation of equipment and materials delivery (power generation equipment and materials)
③ Confirmation of temporary installation works and construction machinery preparations
④ Confirmation of yield and actual numbers of engineers, skilled workers and laborers, etc.

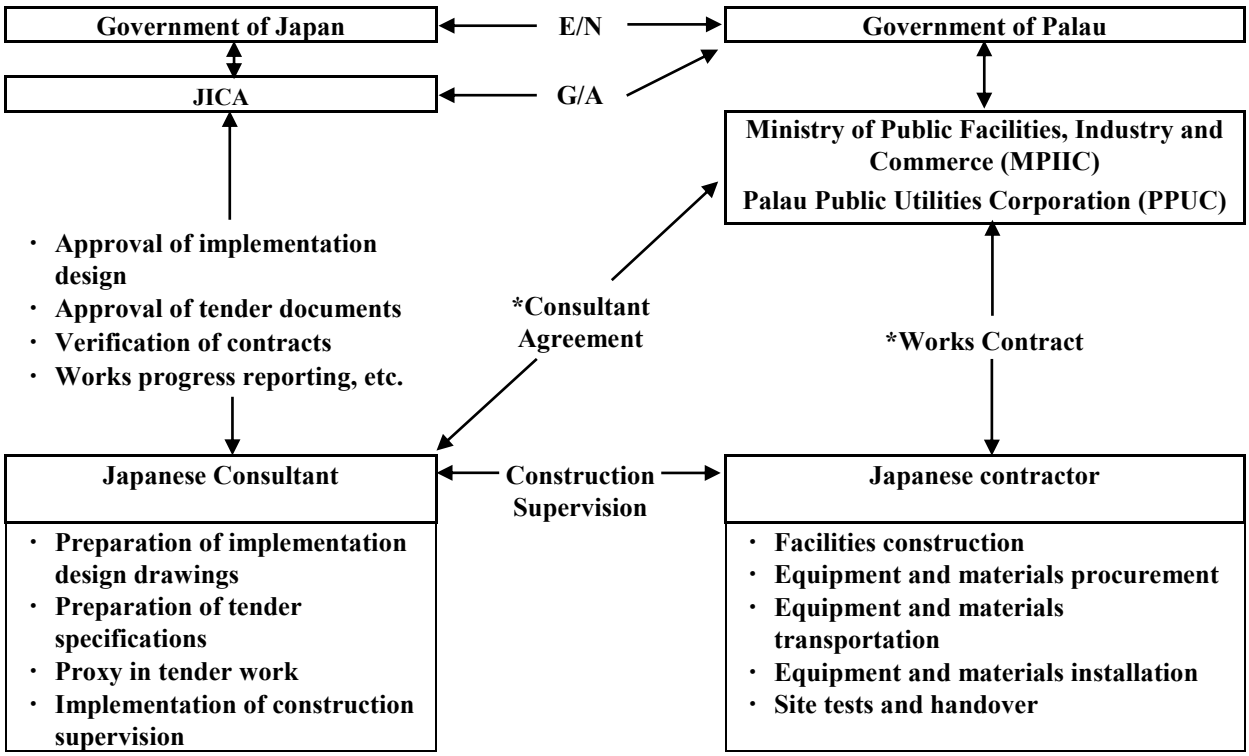
2) Safety control

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

① Establishment of safety control regulations and appointment of manager
② Prevention of accidents through implementation of periodic inspections of construction machinery
③ Planning of the works vehicles and construction machinery operating routes and thorough enforcement of slow driving
④ Encouragement of laborers to utilize welfare measures and vacations

(2) Overall Relationships concerning Project Implementation

Figure 2-2-4.1 shows the mutual relationships between Project parties including the construction supervision.



＊Note: The Consultant Agreement and Works Contract require verification by JICA.

Figure 2-2-4-1 Project Implementation Relationships

(3) Works supervisor

When implementing the facilities construction works and equipment installation works based on the works contract, the contractor will bind a contract with and employ a local subcontractor. Therefore, since the contractor will need to ensure that the subcontractor complies with the works schedule, quality, performance and safety measures prescribed in the contract, it will dispatch an engineer who has experience of similar projects in overseas countries to provide guidance and advice on the site.

2-2-4-5 Quality Control Plan

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

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

2-2-4-6 Procurement Plan

Because the equipment and materials and the construction materials targeted for procurement in the Project are not manufactured in Palau, they will be procured from Japan or third countries. Some of the construction materials that can be procured locally (cement, rocks, sand, etc.) are available in Palau and will be procured locally.

Possible sources of the power generating equipment are Japan and European countries that belong to DAC. There are a number of companies in Europe that manufacture generating equipment that satisfies the required specifications of the Project, however, there is a high possibility that such companies cannot meet the delivery schedule required in the Project and do not possess the necessary post-sales service setup.

Meanwhile, the Japanese made diesel generating units (Unit 12 and Unit 13, 3.4 MW each) that were procured and provided in Malakal Power Station in the previous grant aid project have continually contributed to power supply in Palau for the past 10 years or more. In view of the operating performance, quality and durability of equipment procured in previous grant aid, as well as the post-sales service setup of makers and acquisition of operation and maintenance technology for this equipment, the Palauan side has an avid desire for Japanese products to be adopted

In consideration of the above points, Japanese made diesel generating units will be adopted in the Project.

Out of the generating equipment, concerning radiators and lubricating oil purifiers, since even Japanese generator makers incorporate European and American products in their systems, DAC member countries will be adopted as procurement destinations in the Project, too.

Table 2-2-4-2 Procurement Sources of the equipment and materials of the Project

Equipment and materials	Source		
	Palau	Japan	Third country (see the note)
(Oil related)			
① Fuel oil, cooling water	○	―	―
② Lubricating oil	○	―	―
(Building materials)			
① Sand, gravel	○	―	―
② Cement	○	―	―
③ Ready-mixed concrete	○	―	―
④ Steel	―	○	○
⑤ Steel beams	―	○	○
⑥ Building equipment, finishing materials	―	○	○
(Construction machinery / Transportation vehicles)			
① General construction machinery	○	―	―
(Diesel generating equipment)			
① Diesel engine, synchronous generator	―	○	―
② Mechanical auxiliary equipment for diesel engine generator	―	○	○
③ Piping and accessories	―	○	○
④ Electrical auxiliary equipment for diesel engine generator	―	○	○
⑤ 13.8 kV switchgear panels for connection to the existing 13.8 kV power system	―	○	○
⑥ Cables and accessories	―	○	○
⑦ Spare parts and maintenance tools	―	○	○

Note: Third countries will be DAC countries.

*1 Special construction machinery and transportation vehicles will be procured from neighboring countries.

2-2-4-7 Operational Guidance Plan

The diesel generating equipment targeted in the Project is relatively large-scale with a unit output of 5 MW. Moreover, since failures are occurring frequently in existing equipment, a plan of OJT during the works and testing period will be proposed to ensure smooth operation following installation.

(1) OJT plan during the installation works and trial operation period

Operation and maintenance techniques for the equipment and materials to be procured in the Project will be transferred to the Palauan counterparts during the installation works and trial operation period.

The specifications and grades of the generating equipment to be procured in the Project will be selected in consideration of the current technical level of the PPUC which operates and maintains the existing equipment. Moreover, the PPUC has a certain degree of experience with the operation and maintenance of Japanese diesel engine generating equipment in the previous grant aid project. However, because the generating system to be procured in the Project contains

new technology that appeared after equipment in the previous project was introduced, operating and maintenance OJT will be implemented by instructors from the manufacturer during the installation works and trial operation period.

Moreover, in order to minimize environmental impacts, thorough guidance on oil treatment will be conducted; training on how to operate the measuring instruments that are essential for maintenance work will be implemented, and the effective operation of supplied equipment will be secured.

(2) Plan contents

1) OJT implementation period and location

- Classroom lectures: Roughly 1 week (implemented during the works period in Palau)
- OJT: Roughly 3 weeks (implemented during the works period in Palau)

2) Instructors

The installation, trial operation and adjustment engineers dispatched from the manufacturer of the generating equipment supplied by the Japanese contractor will act as the instructors.

3) Trainees

The PPUC operation and maintenance personnel who will be directly involved in the operation and maintenance of the generating equipment after it goes into operation will be the trainees who receive the following OJT. Accordingly, the PPUC (the implementing agency on the Palauan side) shall appoint the specific trainees by the start of the generating equipment installation works.

-	General engineer:	1
-	Operation personnel:	Electrical engineer: 1
		Mechanical engineer: 1
		Electrical technicians: 2
		Mechanical technicians: 2
		Subtotal: 6
-	Maintenance personnel:	Electrical engineer: 1
		Mechanical engineer: 1
		Electrical technicians: 2
		Mechanical technicians: 3
		Subtotal: 7
		Total: 13

4) Training contents

Classroom lectures

Using the operation and maintenance, the following basic education focusing on the generating

equipment will be conducted:

- Characteristics and structure, etc. of the generating equipment
- Basics of operation and maintenance (schedule control, basic thinking on preventive maintenance, equipment functions, basic accident and failure countermeasures, control of spare parts and tools, control of drawings and documents)
- Control methods in the waste oil processing equipment system, etc.

OJT

The contractor on the Japanese side will conduct OJT covering the following items and contents during the equipment installation and trial operation period.

- Cylinder head opening and maintenance methods
- Fuel valve disassembly and maintenance methods
- Air intake and exhaust valve grinder finishing
- Piston disassembly and maintenance methods
- Crank pin bearings opening and inspection methods
- Motor driven pump maintenance methods
- Intake air filter and filter unit maintenance methods
- Waste oil processing equipment maintenance methods
- Starting and stopping methods
- Emergency stopping method in the event of failure
- Monitoring and visual inspection methods
- Piping equipment and cable maintenance methods
- Electrical equipment maintenance methods

2-2-4-8 Implementation Schedule

Following the granting of approval for Project implementation by the Government of Japan, the Exchange of Notes (E/N) will be conducted and the Project will be commenced based on Japan's grant aid scheme. The Project is broadly composed of the following three stages: ① Implementation design, ② Selection of contractors (preparation of tender documents, announcement of tender, implementation of tender, evaluation of tender, contracting), and ③ Procurement and installation of equipment and materials. Figure 2-2-4.2 shows the implementation schedule.

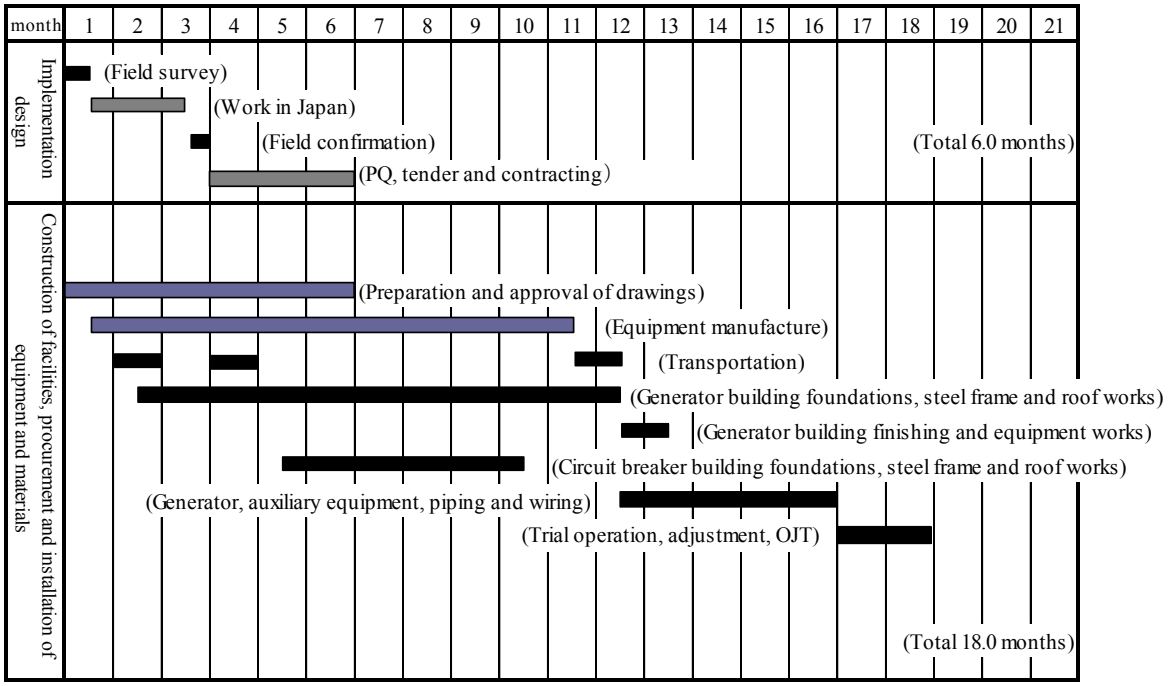


Figure 2-2-4-2 Project Implementation Schedule

2-3 Obligations of the Recipient Country

When it comes to implementing the Project, in addition to the scope of works on the Palauan side indicated in 2-2-4-3 Scope of Works, Procurement and Construction, items to be implemented or borne by the Palauan side are as follows

- To provide information and data necessary for the Project.
- To appoint specialist engineers and technicians for the transfer of Project operation and maintenance technology and to attend equipment and materials quality inspections on site.

2-4 Project Operation Plan

2-4-1 Basic Concept

Maintenance will be most important for the power generating equipment in the Project. In order to secure a stable supply of power, it will be essential to perform operation and maintenance (O&M) and preserve the equipment environment.

In order to maintain the performance and functions of the generating equipment and conduct sustained power supply, it is desirable to implement appropriate preventive maintenance and regular maintenance geared to enhancing the reliability, safety and efficiency of equipment.

Figure 2-4-1.1 shows the basic thinking regarding the maintenance of equipment.

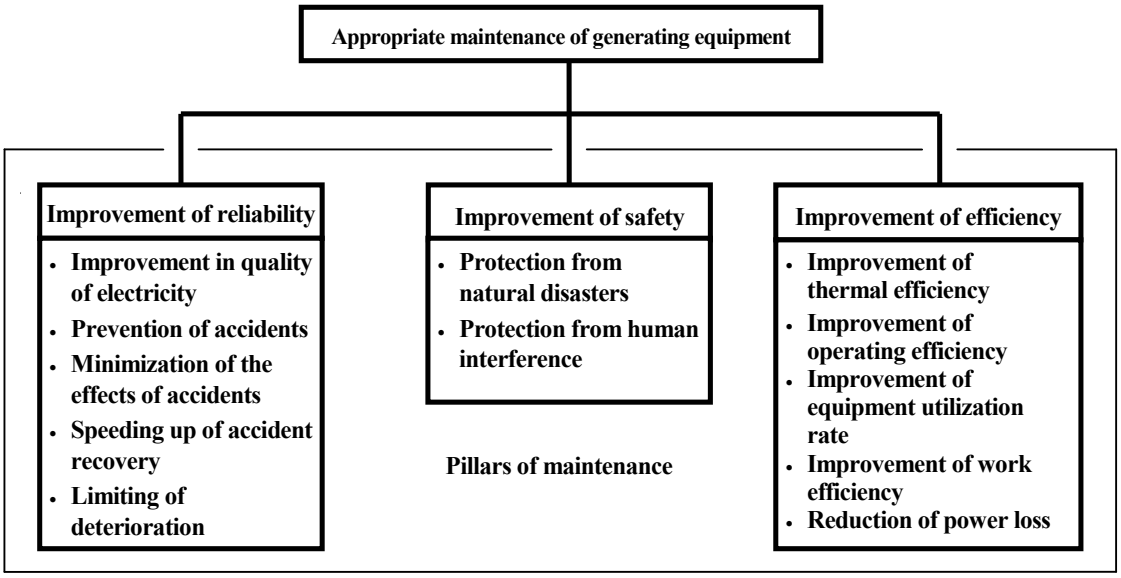


Figure 2-4-1-1 Basic Thinking on Maintenance of Generating Equipment

In the Project, bearing in mind the above points, it will be necessary for the Palauan side to implement operation and maintenance following completion of the Project in accordance with the O&M technology that was transferred by the expert engineers dispatched by the Japanese contractor during the works and the operation and maintenance manual, while always bearing in mind the basic items indicated above.

2-4-2 Periodic Inspection Items

(1) Generating equipment

The Project counterparts in Palau will need to compile an operation and maintenance plan for the generating equipment based on the standard periodic inspection items shown in Table 2-4-2.1 and the operation and maintenance manual submitted by the equipment manufacturer, as well as prepare an economical operation plan that corresponds to demand.

Table 2-4-2-1 Periodic Inspection Items in Standard Generating Equipment

	Inspection Category	Main Work Items
Diesel Engine	Routine (daily) inspections	- Fuel oil level, lubricating oil sump tank oil level - Confirmation of jacket water level - Confirmation of pressure in start air tank - Exterior appearance inspection of each part
	1,000 hour inspection	- Confirmation of tightening of nuts and bolts - Cleaning of fuel and lubricating oil filters
	2,500~3,000 hour inspection	- Confirmation of operating state and oil leaks, etc. in air intake and exhaust valves, starting valves, fuel valves, fuel pumps, pistons, and liners, etc., and analysis of oil in the lubricating oil sump tank

	Inspection Category	Main Work Items
	7,500~8,000 hour inspection	- Confirmation of operating state and oil leaks, etc. in pistons and cylinder liners and replacement of gaskets - Replacement of piston rings, hydraulic rings and O-rings - Cylinder head disassembly and replacement of gaskets and O-rings - Inspection of air intake and exhaust valves and replacement of exhaust valve O-rings - Inspection of fuel injection valves and replacement of nozzles - Inspection of crank pin bearings and replacement where necessary - Disassembly and inspection of supercharger and replacement of bearings, etc. - Analysis of oil in the lubricating oil sump tank and replacement of lubricating oil where necessary
	16,000 hour inspection	- Above inspections every 7,500~8,000 hours - Inspection of main bearings and replacement where necessary - Inspection of exhaust valve rotator and replacement where necessary - Disassembly inspection of lubricating oil pump attached to engine and replacement where necessary
Generator	Routine (every day during operation) inspection	- Visual inspection and confirmation of strange noise and temperature in each part
	Monthly inspection	- Existence of strange vibrations - Confirmation of lubricating oil flow conditions and oil leakage around bearings - Necessary cleaning of each part
	Annual inspection	- Insulation resistance measurement and inspection of lead wires and terminals - Visual inspection of space heater and other accessories - Visual inspection and cleaning where necessary of bearings

Incidentally, the rough number of days required for each standard periodic inspection is as follows:

- 2,500~3,000 hour inspection : 7~8 days per inspection
- 7,500~8,000 hour inspection :15~18 days per inspection
- 16,000 hour inspection : 20~25 days per inspection

(2) Electrical equipment

The standard periodic inspection items for electrical equipment to be procured and installed in the Project are as indicated in Table 2-4-2.2. As is indicated in this, inspections can be categorized into the following three types:

- Patrol inspections in which abnormal heating or noises, etc. are inspected everyday based on the five senses;
- Ordinary inspections in which inspections are conducted on energized sections that cannot be inspected in routine patrols, for example, heating and torque of bolts, etc., surface dirt on insulated objects, and so on, and
- Detailed inspections on functions of interlocking mechanisms between instruments and for maintaining precision of measuring instruments.

Ordinary inspections are normally conducted once every one or two years, while detailed inspections are conducted around once every four years. Moreover, it is desirable to replace parts such as fuses, meters and relays, etc. fitted inside circuit breaker panels and distribution panels, etc. when they are found to have deteriorated performance, deteriorated insulation performance or altered characteristics in ordinary inspections and detailed inspection upon confirming the characteristics and frequency of use of parts.

Table 2-4-2-2 Periodic Inspection Items in Standard Electrical Equipment

Inspection Item	Inspection Contents (Method)	Patrol Inspection	Ordinary Inspection	Detailed Inspection
Equipment exterior	Display conditions of switching indicators, switching display lamps	○	○	
	Abnormal noise and odor	○	○	
	Heating discoloration of terminals	○	○	
	Cracking, damage and staining of bushing and porcelain tubes	○	○	
	Rust on installation booths and frames, etc.	○	○	
	Abnormal temperature (thermometer)	○	○	
	Bushing terminals torque (mechanical check)	○	○	
Operating device and control panel	Display conditions on measuring instruments	○	○	○
	Indications on operation counters		○	○
	Condensation, rust and dirt inside operating boxes and panels		○	○
	Lubrication and cleaning conditions		○	○
	Wiring terminals torque	○	○	○
	Confirmation of switching display status		○	○
	Air and oil leaks		○	○
	Pressure check before and after operation (air pressure, etc.)		○	○
	Operation check of operation meters		○	○
	Rust, deformation and damage of springs (repair)	○	○	○
	Abnormality of pins at tightening parts		○	○
	Inspection (repair) of auxiliary switches and relays		○	○
	Inspection of DC control power source	○		
Measurement and testing	Measurement of insulation resistance		○	○
	Measurement of contact resistance			○
	Heater disconnections		○	○
	Operation test of relays		○	○

2-4-3 Spare Parts Purchasing Plan

The spare parts for generating equipment comprise standard accessory parts are replaced according to operating time and replacement parts that are urgently needed in the event of breakdowns. Therefore, the Palauan side will need to purchase these parts corresponding to the cycle of periodic inspections.

In the Project, it is planned to procure the minimum necessary spare parts for the first full-scale inspection implemented after 16,000 hours of operation (approximately after two years) and for the periodic inspections up to that point. The major items are the periodic inspection items shown in Table 2-4-3.1. Therefore, it will be necessary for the Palauan side to budget for the purchase of standard accessory parts up to roughly two years ahead (approximately 3% of the generating and electrical equipment costs) and the purchase of the necessary emergency replacement parts.

Table 2-4-3-1 Emergency Spare Parts of the Project

Equipment Component No.	Item	Quantity
1.	Diesel engine generator	
1.1	Diesel engine	
	(1) Fully equipped cylinder cover (including each valve)	1 lot
	(2) Fully equipped pistons	1 lot
	(3) Fully equipped cylinder liner (including fire ring and O-ring)	1 lot
	(4) Fully equipped fuel injection pump discharge valve (number of cylinders)	1 lot
	(5) Fully equipped fuel injection pump	1 lot
2.	Diesel engine generator auxiliary unit (mechanical)	
2.1	Fuel supply equipment	
	(3) Fully equipped fuel oil circulating pump	1 set
	(9) Fully equipped fuel oil drain pump	1 set
2.2	Lubricating oil equipment	
	(2) Fully equipped lube oil priming pump	1 set
	(9) Fully equipped sludge pump	1 set
2.3	Cooling water equipment	
	(5) Fully equipped high temperature water circulating pump (HT)	1 set
	(6) Fully equipped low temperature water circulating pump (LT)	1 set
2.6	Waste oil processing equipment	
	(2) Fully equipped oily water pump	1 set
	(4) Fully equipped waste oil pump	1 set

Table 2-4-3-2 Spare parts of the Project

Equipment Component No.	Item	Quantity
1.	Diesel engine generator	
1.1	Diesel engine	
	(1) O-rings for cylinder cover (3 sets x number of cylinders)	1 lot
	(2) Packing for cylinder cover (3 sets x number of cylinders)	1 lot
	(3) Packing for cylinder cover (exhaust pipe) (3 sets x number of cylinders)	1 lot
	(4) Packing for cylinder cover (suction pipe) (3 sets x number of cylinders)	1 lot
	(5) Roto cap for R intake valve (1 set x number of cylinders)	1 lot
	(6) Valve shaft for intake valve (1 set x number of cylinders)	1 lot

Equipment Component No.	Item	Quantity
	(7) Sleeve for intake valve (1 set x number of cylinders)	1 lot
	(8) Seat for intake valve (1 set x number of cylinders)	1 lot
	(9) O-ring for intake valve (2 sets x number of cylinders)	1 lot
	(10) Valve shaft for exhaust valve (1 set x number of cylinders)	1 lot
	(11) Sleeve for exhaust valve (1 set x number of cylinders)	1 lot
	(12) Seat for exhaust valve (1 set x number of cylinders)	1 lot
	(13) O-ring for exhaust valve (2 sets x number of cylinders)	1 lot
	(14) Roto cap for exhaust valve (1 set x number of cylinders)	1 lot
	(15) Nozzle cap for fuel injection valve (3 sets x number of cylinders)	1 lot
	(16) O-ring for fuel injection valve (3 sets x number of cylinders)	1 lot
	(17) Piston ring (2 sets x number of cylinders)	1 lot
	(18) Oil ring for piston (2 sets x number of cylinders)	1 lot
	(19) Piston pin bearings (2 sets x number of cylinders)	1 lot
	(20) Crown bolt for piston (1 set x number of cylinders)	1 lot
	(21) O-ring for piston (2 sets x number of cylinders)	1 lot
	(22) Crank pin bearings for connecting bar (2 sets x number of cylinders)	1 lot
	(23) Tightening bolt for connecting bar (1 set x number of cylinders)	1 lot
	(24) Main bearings (2 sets x number of cylinders)	1 lot
	(25) Thrust bearings	1 lot
	(26) Plunger sleeve for fuel injection valve (2 sets x number of cylinders)	1 lot
	(27) Deflector for fuel injection pump (2 sets x number of cylinders)	1 lot
	(28) O-ring for fuel injection pump (3 sets x number of cylinders)	1 lot
	(29) Bearings for supercharger	1 lot
	(30) Thrust bearings for supercharger	1 lot
	(31) Packing for air coolers	1 lot
	(32) Packing for starting valve (2 sets x number of cylinders)	1 lot
	(33) Packing for cylinder safety valve (2 sets x number of cylinders)	1 lot
	(34) Indicator valve (1 set x number of cylinders)	1 lot
	(35) Intake expansion pipe (1 set x number of cylinders)	1 lot
	(36) Exhaust expansion pipe (1 set x number of cylinders)	1 lot
	(37) Fuel injection pipe (2 sets x number of cylinders)	1 lot
2.	Mechanical auxiliary equipment for diesel engine generator	
2.1	Fuel oil system	
	(1) Fuel oil transfer pump	
	Shaft seal packing	1 set
	O-rings, gaskets	1 lot
	Measuring instruments (pressure gages, etc.)	1 lot
	(2) Fuel oil service tank	
	Measuring instruments (Level switches, etc.)	1 lot
	(3) Fuel oil circulating pump	
	Shaft seal packing	1 set
	O-rings, gaskets	1 lot
	Measuring instruments (pressure gages, etc.)	1 lot
	(4) Fuel oil primary filter	
	Filter Elements	1 set
	Measuring instruments (pressure gages, pressure switches, etc.)	1 set
	(5) Fuel oil secondary filter	
	Filter Elements	1 set
	Measuring instruments (pressure gages, pressure switches, etc.)	1 lot
	(6) Fuel oil flow meter	
	(7) Fuel oil drain tank	

Equipment Component No.	Item	Quantity
	Measuring instruments (Level switches, etc.)	1 lot
	(8) Fuel oil drain pump	
	Shaft seal packing	1 set
	O-rings, gaskets	1 lot
	Measuring instruments (pressure gages, etc.)	1 lot
2.2	Lube oil system	
	(1) Lube oil transfer pump	
	Shaft seal packing	1 set
	O-rings, gaskets	1 lot
	Measuring instruments (pressure gages, etc.)	1 lot
	(2) Lube oil priming pump	
	Shaft seal packing	1 set
	O-rings, gaskets	1 lot
	Measuring instruments (pressure gages, etc.)	1 lot
	(3) Lube oil purifier unit	
	Mechanical seal for lubricating oil purifier pump	1 lot
	Shaft seal packing for lubricating oil purifier pump	1 set
	O-ring for lubricating oil purifier	1 set
	Ring for lubricating oil purifier	1 set
	Clamping for lubricating oil purifier	1 set
	Valve plug for lubricating oil purifier	1 set
	Maintenance tool for lubricating oil purifier	1 lot
	Measuring instruments (pressure gages, thermometers, pressure switches, temperature switches, etc.)	1 set
	(4) Lube oil cooler	
	Measuring instruments (pressure gages, thermometers, pressure switches, temperature switches, etc.)	1 lot
	(5) Lube oil main filter	
	Filter Elements	1 set
	Measuring instruments (pressure gages, pressure switches, etc.)	1 lot
	(6) Lube oil indication filter	
	Filter Elements	1 set
	Measuring instruments (pressure gages, pressure switches, etc.)	1 lot
	(8) Sludge tank	
	Measuring instruments (Level switches, etc.)	1 lot
	(9) Sludge pump	
	Shaft seal packing	1 set
	O-rings, gaskets	1 lot
	Measuring instruments (pressure gages, etc.)	1 lot
2.3	Cooling water system	
	(1) Water supply pump	
	Shaft seal packing	1 set
	O-rings, gaskets	1 lot
	Measuring instruments (pressure gages, etc.)	1 lot
	(2) Treated water pump	
	Shaft seal packing	1 set
	O-rings, gaskets	1 lot
	Measuring instruments (pressure gages, etc.)	1 lot
	(3) Water treatment unit (Softener)	
	Consumables	1 lot

Equipment Component No.	Item	Quantity
	Measuring instruments	1 lot
	(4) Treated water tank	
	Measuring instruments (Level switches, etc.)	1 lot
	(5) High temperature water circulating pump (HT)	
	Shaft seal packing	1 set
	O-rings, gaskets	1 lot
	Measuring instruments (pressure gages, etc.)	1 lot
	(6) Low temperature water circulating pump (LT)	
	Shaft seal packing	1 set
	O-rings, gaskets	1 lot
	Measuring instruments (pressure gages, etc.)	1 lot
	(7) High temperature water expansion tank (HT)	
	Measuring instruments (pressure gages, thermometers, pressure switches, temperature switches, etc.)	1 lot
	(8) Low temperature water expansion tank (LT)	
	Measuring instruments (Level switches, etc.)	1 lot
	(10) Radiator	
	Measuring instruments	1 lot
2.4	Compressed air system	
	(1) Air compressor	
	Shaft seal packing	1 set
	O-rings, gaskets	1 lot
	Measuring instruments (pressure gages, etc.)	1 lot
	(2) Air receiver	
	Measuring instruments (pressure gages, pressure switches, , etc.)	1 lot
	(3) Air drier	
	Measuring instruments	1 lot
2.5	Air intake and exhaust gas system	
	(2) Air intake filter	
	Filter Elements	1 set
2.6	Sludge treatment system	
	(1) Oily water separator tank	
	Measuring instruments (Level switches, etc.)	1 lot
	(2) Oily water pump	
	Shaft seal packing	1 set
	O-rings, gaskets	1 lot
	Measuring instruments (pressure gages, etc.)	1 lot
	(3) Oily water separation unit	
	Measuring instruments (pressure gages, thermometers, pressure switches, temperature switches, etc.)	1 lot
	(4) Waste oil pump	
	Shaft seal packing	1 set
	O-rings, gaskets	1 lot
	Measuring instruments (pressure gages, etc.)	1 lot
	(5) Waste oil tank	
	Measuring instruments (Level switches, etc.)	1 lot
	(6) Incinerator	
	Measuring instruments (pressure gages, thermometers, pressure switches, temperature switches, etc.)	1 lot
3.	Electrical auxiliary equipment for diesel engine generator	

Equipment Component No.	Item	Quantity
3.1	Supervisory and control panel	
	Auxiliary relays	1 lot
	MCCBs	1 lot
	Control circuit fuses	1 lot
	Display lamps (excluding LED)	1 lot
	Fluorescent lamps in panel and glow lamps	1 lot
3.2	Generator protective relay panel	
	Auxiliary relays	1 lot
	MCCBs	1 lot
	Control circuit fuses	1 lot
	Display lamps (excluding LED)	1 lot
	Fluorescent lamps in panel and glow lamps	1 lot
3.3	Automatic synchronizing panel	
	Auxiliary relays	1 lot
	MCCBs	1 lot
	Control circuit fuses	1 lot
	Display lamps (excluding LED)	1 lot
	Fluorescent lamps in panel and glow lamps	1 lot
3.4	13.8 kV generator circuit breaker panel	
	Auxiliary relays	1 lot
	MCCBs	1 lot
	Control circuit fuses	1 lot
	Display lamps (excluding LED)	1 lot
	Fluorescent lamps in panel and glow lamps	1 lot
3.6	Disconnect switch panel for neutral grounding of generator	
	Contactor for disconnect switches	1 lot
	Display lamps (excluding LED)	1 lot
	Fluorescent lamps in panel and glow lamps	1 lot
3.7	Resister panel for neutral grounding of generator	
	Display lamp (excluding LED)	1 lot
	Fluorescent lamps in panel and glow lamps	1 lot
3.8	DC power supply device	
	Auxiliary relays	1 lot
	MCCBs	1 lot
	Control circuit fuses	1 lot
	Display lamps (excluding LED)	1 lot
	Fluorescent lamps in panel and glow lamps	1 lot
3.9	Supervisory and control panel for 13.8 kV equipment	
	Auxiliary relays	1 lot
	MCCBs	1 lot
	Control circuit fuses	1 lot
	Display lamps (excluding LED)	1 lot
	Fluorescent lamps in panel and glow lamps	1 lot
3.10	Main power panel (Low voltage)	
	Auxiliary relays	1 lot
	MCCBs	1 lot
	Control circuit fuses	1 lot
	Display lamps (excluding LED)	1 lot
	Fluorescent lamps in panel and glow lamps	1 lot
3.11	Common power panel (Low voltage)	

Equipment Component No.	Item	Quantity
	Auxiliary relays	1 lot
	ACBs, MCCBs	1 lot
	Thermal relays	1 lot
	Fuses for VT	1 lot
	Control circuit fuses	1 lot
	Display lamps (excluding LED)	1 lot
	Fluorescent lamps in panel and glow lamps	1 lot
3.12	Unit power panel (Low voltage)	
	Auxiliary relays	1 lot
	MCCBs	1 lot
	Thermal relays	1 lot
	Fuses for VT	1 lot
	Control circuit fuses	1 lot
	Display lamps (excluding LED)	1 lot
	Fluorescent lamps in panel and glow lamps	1 lot
3.13	Building service panel (Low voltage)	
	Auxiliary relays	1 lot
	MCCBs	1 lot
	Thermal relays	1 lot
	Fuses for VT	1 lot
	Control circuit fuses	1 lot
	Display lamps (excluding LED)	1 lot
	Fluorescent lamps in panel and glow lamps	1 lot
3.14	Lighting panel (Low voltage)	
	Auxiliary relays	1 lot
	MCCBs	1 lot
	Thermal relays	1 lot
	Fuses for VT	1 lot
	Control circuit fuses	1 lot
	Display lamps (excluding LED)	1 lot
	Fluorescent lamps in panel and glow lamps	1 lot
3.15	Local control panel	
	Auxiliary relays	1 lot
	MCCBs	1 lot
	Thermal relays	1 lot
	Fuses for VT	1 lot
	Control circuit fuses	1 lot
	Display lamps (excluding LED)	1 lot
	Fluorescent lamps in panel and glow lamps	1 lot
3.16	Generator for black-out start	
	Control circuit fuse	1 lot
	Display lamp	1 lot
4.	13.8 kV electrical equipment	
4.1	13.8 kV switchgear panel for the new generator	
	Auxiliary relays	1 lot
	MCCBs	1 lot
	Control circuit fuses	1 lot
	Display lamps (excluding LED)	1 lot
	Fluorescent lamps in panel and glow lamps	1 lot
4.2	13.8 kV switchgear panel for connection to the existing 13.8 kV power system	

Equipment Component No.	Item	Quantity
	Auxiliary relays	1 lot
	MCCBs	1 lot
	Control circuit fuses	1 lot
	Display lamps (excluding LED)	1 lot
	Fluorescent lamps in panel and glow lamps	1 lot
4.3	13.8 kV switchgear panel for the existing generator	
	Auxiliary relays	1 lot
	MCCBs	1 lot
	Control circuit fuses	1 lot
	Display lamps (excluding LED)	1 lot
	Fluorescent lamps in panel and glow lamps	1 lot
4.4	13.8 kV switchgear panel for station service transformer	
	Auxiliary relays	1 lot
	MCCBs	1 lot
	Control circuit fuses	1 lot
	Display lamps (excluding LED)	1 lot
	Fluorescent lamps in panel and glow lamps	1 lot
4.5	13.8 kV switchgear panel for bus tie	
	Auxiliary relays	1 set
	MCCBs	1 set
	Control circuit fuses	1 set
	Display lamps (excluding LED)	1 set
	Fluorescent lamps in panel and glow lamps	1 set
4.6	Building service panel (Low voltage)	
	Auxiliary relays	1 lot
	MCCBs	1 lot
	Thermal relays	1 lot
	Fuses for VT	1 lot
	Control circuit fuses	1 lot
	Display lamps (excluding LED)	1 lot
	Fluorescent lamps in panel and glow lamps	1 lot
4.7	Lighting panel (Low voltage)	
	Auxiliary relays	1 lot
	MCCBs	1 lot
	Thermal relays	1 lot
	Fuses for VT	1 lot
	Control circuit fuses	1 lot
	Display lamps (excluding LED)	1 lot
	Fluorescent lamps in panel and glow lamps	1 lot
4.8	DC power supply device	
	Auxiliary relays	1 lot
	MCCBs	1 lot
	Control circuit fuses	1 lot
	Display lamps (excluding LED)	1 lot
	Fluorescent lamps in panel and glow lamps	1 lot

Table 2-4-3-3 Maintenance Tools to be Procured in the Project

Equipment Component No.	Item	Quantity
5.	Maintenance tools for power generation	
5.1	Tools for mechanical installations	
	(1) Standard engine maintenance tools	1 lot
	(2) Special engine maintenance tools	1 lot
	(3) Intake and exhaust valve grinding machine	1 set
	(4) Intake and exhaust valve seat grinding machine	1 set
	(5) Lubricating oil control instruments	1 set
	(6) Cooling water control instruments	1 set
	(7) Tool box	1 set
	(8) Measuring instruments (Calipers)	1 set
	(9) Measuring instruments (Micrometer)	1 set
	(10) Hand pallet (1.5 t with stopper)	2 sets
	(11) Ladder (Aluminum, 2 sections)	1 set
	(12) 1.0 t chain block	1 set
	(13) 2.5 t chain block	1 set
	(14) Wire Ropes (6 mm × 5 m, 8 mm × 5 m, 10 mm × 6 m, 14mm mm × 6 m)	1 lot
5.2	Tools for electrical installations	
	(1) AC clamp meter (with noise filter)	1 set
	(2) Digital multi tester (Digital type)	1 set
	(3) Insulation Tester (1,000 V / 2,000 Ω)	1 set
	(4) Insulation Tester (500 V / 1 ,000 Ω)	1 set
	(5) High-voltage earth resistance meter	1 set
	(6) Low-voltage earth resistance meter	1 set
	(7) Phase rotation meter	1 set
	(8) Basic grounding resistance meter	1 set
	(9) DC high voltage tester	1 set

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

In the case of the actual implementation of the Project under the grant aid scheme of the Government of Japan, The Palauan side is expected to pay the costs of its undertakings as listed below.

Estimated overall cost for the Palauan side: US$ 601,200 (= ¥47.89 million)

① Partial demolition work of the existing powerhouse, relocation of the relevant equipment, removal of obstacles and land leveling of the project site — US$ 560,000 (= ¥44.61 million)

② Construction of permanent fencing and gate at the new substations — US$ 20,000 (= ¥1.59 million)

- US$ 150 /m × 100m ＝ US$ 15,000
- US$ 2,500 /set × 2 sets ＝US$ 5,000

③ Branching work from the existing city water system and installation of a stop valve in the project site for the Project — US$ 1,000 (= ¥0.08 million)

④ Payment of bank commission based on banking — US$ 20,200 (= ¥1.61 million)

・A/P commission (US$ 200)
・Payment commission (US$ 20,000)

<Estimation Conditions>

①	Date of estimation	:	November, 2011
②	Foreign exchange rates	:	US$ 1 = ¥79.67 (TTS average from May, 2011 to Oct., 2011) 1 € = ¥112.79 (TTS average from May, 2011 to Oct., 2011)
③	Procurement and construction periods	:	The detailed design, equipment procurement and installation periods are as shown in the project implementation schedule.
④	Other	:	The Project will be implemented in accordance with the grant aid scheme of the Government of Japan

2-5-2 Operation and Maintenance Cost

Operation and maintenance cost for the equipment to be procured under the Project is estimated to be aound 3% of the initial procuremet cost, i.e. 33 million JPY. Currently, PPUC expenses approx. US$ 2 million for the maintenance of its power supply facilities. The maintenance expense will increase up to US$ 2.4 million after the completion of the Project.

Table 2-5-2-1 shows profit and loss projection of the generation equipment to be procured under the Project. As swhon in the table, operational balance after subtracting maintenance cost will be profitable if the equipment is operated at the utilization factor of 30% or more. Since operation mode of the equipment is supposed to be “Base Load” (utilization factor: 70% or more) in this Project, the operational profit will be US$ 2.36 million or more (operated at utilization factor of 70% or more). Therefore, PPUC will be able to bare the maintenance cost of the equipment to be procured under the Project.

Table 2-5-2-1 Profit and Loss Projection of the Equipment to be Procured under the Project

Items		Unit	Utilization Factor (%)					
			25	30	50	60	70	80
Ⅰ. Revenue								
1 Generation capacity ①		[kW]	10,000	10,000	10,000	10,000	10,000	10,000
2 Electricity generated ②		[kWh]	21,900,000	26,280,000	43,800,000	52,560,000	61,320,000	70,080,000
3 Station consumption ③	(②×0.05)	[kWh]	1,095,000	1,314,000	2,190,000	2,628,000	3,066,000	3,504,000
4 T&D losses ④	((②-③)×0.2)	[kWh]	4,161,000	4,993,200	8,322,000	9,986,400	11,650,800	13,315,200
5 Electricity sold ⑤	(②-③-④)	[kWh]	16,644,000	19,972,800	33,288,000	39,945,600	46,603,200	53,260,800
6 Average tariff ⑥		[US$/kWh]	0.41	0.41	0.41	0.41	0.41	0.41
Total revenue ⑦	(⑤×⑥)	[US$]	6,840,684	8,208,821	13,681,368	16,417,642	19,153,915	21,890,189
Ⅱ. Expenditure								
1 Fuel cost ⑧	(②×(2)×(4))	[US$]	5,031,231	6,037,477	10,062,461	12,074,953	14,087,446	16,099,938
2 Lubrication oil cost ⑨	(②×(3)×(5))	[US$]	121,764	146,117	243,528	292,234	340,939	389,645
3 Personnel cost ⑩	((6)×22)	[US$]	381,345	381,345	381,345	381,345	381,345	381,345
4 O&M cost ⑪	(8)×0.03	[US$]	414,209	414,209	414,209	414,209	414,209	414,209
5 Administration cost ⑫	((10)×22/130)	[US$]	135,080	135,080	135,080	135,080	135,080	135,080
6 Depreciation ⑬	(9)	[US$]	828,417	828,417	828,417	828,417	828,417	828,417
Total expenditure ⑭		[US$]	6,912,045	7,942,644	12,065,040	14,126,237	16,187,435	18,248,633
Ⅲ. Profit and/or loss		[US$]	-71,361	266,177	1,616,328	2,291,404	2,966,480	3,641,556
		JPY	-5,685,334	21,206,309	128,772,881	182,556,168	236,339,454	290,122,740

Preconditions

(1)	Average tariff	0.41	US$/kWh	2012 PPUC Proposed Tariff
(2)	Fuel cost	0.93	US$/ℓ	US$3.52/gal (Source: PPUC)
(3)	Lubrication oil cost	3.48	US$/ℓ	US$695/drum (Source: PPUC)
(4)	Unit fuel consumption	0.247	ℓ/kWh	210g/kWh, Specific gravity : 0.85
(5)	Unit lub-oil consumption	0.0016	ℓ/kWh	
(6)	Personnel cost	17,334	US$/person	FY2012 budget 2,253,400 US$/year is divided by total number of PPUC's staffs
(7)	Exchange rate	79.67	US$	Average TTS rate between May and October 2011
(8)	Equipment cost	1,100,000,000	2units	
		13,806,954	US$/2units	
(9)	Depreciation	828,417	US$/y	15years straight line depreciation, remaining book value: 10%
(10)	Administration cost	798,200	US$/y	Administration cost in FY2012 budget is prorated by the staff number of Aimeliik power station
(11)	T&D losses	20%		

CHAPTER 3 PROJECT EVALUATION

Chapter 3 Project Evaluation

3-1 Preconditions

Project implementation is conditional on the partial removal of the existing Aimeliik Power Station building, relocation of the facilities (diesel oil service tank, oil-water separation tank, piping, etc.) around the existing generator building, preparation of site and acquisition of the necessary environmental authorizations.

3-2 Necessary Inputs by the Recipient Country

In order to realize and sustain the effects of the Project, the issues that need to be tackled by the Palauan side are as follows.

① It will be necessary to appropriately conduct routine maintenance to ensure that the power generating equipment procured and installed by the Japanese side in the Project is utilized to the full.
② It will be necessary to implement the planned training of personnel assigned to the constructed power station and to take steps to ensure that operation of the station is commenced smoothly.
③ It will be necessary to purchase and replenish the necessary expendables and emergency spare parts necessary for conducting maintenance of the Project generating facilities and to certainly implement periodic maintenance.
④ It will be necessary to introduce and implement preventive maintenance in order to prevent major breakdowns such as crankshaft burning, etc.
⑤ It will be necessary to improve PPUC profits to ensure that the costs of maintaining generating equipment can be covered.

3-3 Important Assumptions

In order for the PPUC to meet the necessary inpus described above, revenue in electricity supply business shall be secured to cover necessary expenses. For this purpose, electricity tariff of the PPUC should be properly revised with public consent and electricity consumers should pay their electricity charges in a timely maner.

3-4 Project Evaluation

3-4-1 Relevance

As is indicated below, since the Project will contribute to the realization of Palau's development plans and energy policy and impart benefits to the general public, it is deemed to have high relevance as an aid undertaking.

(1) Benefiting population

As a result of Project implementation, approximately 18,500 residents living in the Palau urban area will receive stable and high quality supply of electricity. The total number of power consumers in the target area is approximately 6,020, comprising approximately 4,540 general households, 900 commercial facilities and 580 government and public facilities.

(2) Urgency

The frequent unscheduled and planned power interruptions caused by troubles in generating facilities in Palau are causing deterioration of the living environment, adversely affecting public services and greatly harming the tourism sector. Therefore, there is an urgent need to remedy such issues through implementation of the Project.

(3) Contribution to stable operation of public and social welfare facilities

Frequent power interruptions in Palau are hindering the stable operation of water supply and sewerage facilities, making it necessary to take emergency countermeasures such as installing emergency generators in purification plants every time a major blackout occurs.

Implementation of the Project will enable stable and high quality power supply to be provided to public welfare facilities and thereby make it possible to realize the stable operation and vitalization of facilities.

(4) Operation and Maintenance Capacity

The PPUC routinely conducts the operation and maintenance of diesel oil-fired medium speed diesel generators and has ample experience in operating and maintaining such equipment. Therefore, as the implementing agency, the PPUC possesses ample technical capacity to operate and maintain the generating equipment to be procured and installed in the Project, and there should be no major problems when it comes to implementing the Project. In addition, JICA has dispatched an expert for improving power system operation and is planning to dispatch senior volunteers who will transfer technology to maintain diesel engines. Such technical cooperation by JICA will contribute to improve PPUC's capacity to operate and maintain diesel generators.

(5) Project Contributing to National Development Plans in Palau

In the Medium Term Development Strategy (MTDS) of Palau, the "ample securing of PPUC profits and power generation, transmission and distribution capacity" in the power sector is raised as a priority policy in the realm of infrastructure.

According to the Energy Sector Strategic Action Plan (ESSAP) that was compiled in October 2009, upgrading of the PPUC's deteriorated base load generators is raised as a priority project, and it is proposed that four 5 MW generators be newly installed.

Since the Project aims to bolster generating capacity and thereby stabilize power supply and improve the quality of power in the urban area of Palau, it will contribute to the realization of the abovementioned development plans and energy policy of the Government of Palau.

(6) Environmental and Social Impacts

Examination was carried out based on environmental legislation in Palau and the JICA environmental and social consideration guidelines. As a result, it was found that although there will be some minor impacts in terms of air pollution, noise and vibration, they will not exceed national or international standards, and conversely the Project can improve the current situation. Concerning other items too, it should be possible to avert and/or mitigate impacts through taking countermeasures.

To sum up the above points, the Project will not impart any major impacts in terms of environment and society.

(7) Japan's Grant Aid Scheme

The main equipment for the Project will be procured in Japan, and the work is scheduled to finish within the E/N time limit. Therefore, since the Project contents and schedule are feasible and reasonable for implementation within the scope of the grant aid scheme, it should be possible to implement without any major difficulty.

3-4-2 Effectiveness

The following effects are anticipated as a result of Project implementation.

(1) Quantitative effects

Output Indicator	Current Value (2011)	Planned Value (2015)
Days of restricted power supply	42 days/year*[1]	0 day/year
Spare supply capacity*[2]	0MW	10.54MW

[Note] *1: In the estimated value for 2011, only the days of restricted power supply due to generating equipment trouble are counted.
*2: Equipment capacity – Maximum output

(2) Qualitative effects (Project overall)

Current Conditions and Problems	Project Measures (target works)	Project Effects and Improvements
1. In Palau, since there is no reserve capacity in generating equipment and it isn't possible to stop generators for overhaul, serious accidents occur frequently in generating facilities, thereby restricting	Construct a new power station.	Through securing reserve generating capacity, it will be possible to periodically stop and overhaul generating equipment, thereby preventing serious accidents from occurring. As a result, supply restrictions can be

Current Conditions and Problems	Project Measures (target works)	Project Effects and Improvements
the power supply.		averted.
2. In Palau, since there is no reserve capacity in generating equipment, generating capacity in the event of sudden accidents is insufficient and power supply has to be limited.	Construct a new power station.	Through securing reserve generating capacity, output decline caused by sudden accidents can be augmented by spare units, thereby enabling supply restrictions to be averted.
3. In Palau, unstable power supply adversely affects economic development, promotion of industry and the lives of citizens.	Construct a new power station.	Provision of stable power supply will contribute to economic development, industrial promotion and improvement of the lives of citizens.

Appendices

A- 1　Member List of the Study Team

A-1 Member of List of Study Team

【First Survey】

Name	Job Tittle	Occupation
Yoshikazu Wada	Team Leader	Japan International Cooperation Agency
Kyoji Fujii	Chief Consultant / Power Supply Planning	Yachiyo Engineering Co., Ltd.
Kazunari Nogami	Deputy Chief Consultant/Procurement and Installation Plan / Cost Estimation	Yachiyo Engineering Co., Ltd.
Noboru Matsumura	Power Generation Plant Planning 1	Yachiyo Engineering Co., Ltd.
Takashi Hara	Social and Environmental Considerations	Yachiyo Engineering Co., Ltd.
Shoichi Konishi	Civil and architecture	Yachiyo Engineering Co., Ltd.
Masayuki Tamai	Power Generation Plant Planning 2	Yachiyo Engineering Co., Ltd.
Lazunori Sadamori	Social and Environmental Considerations (Assistant)	Yachiyo Engineering Co., Ltd

【Supplemental Survey】

Name	Job Tittle	Occupation
Kyoji Fujii	Chief Consultant / Power Supply Planning	Yachiyo Engineering Co., Ltd.
Masayuki Tamai	Power Generation Plant Planning 2	Yachiyo Engineering Co., Ltd.
Tadashi Nio	Power Generation Plant Planning 3	Yachiyo Engineering Co., Ltd

【**Second Survey**】

Name	Job Tittle	Occupation
Hiroo Tanaka	Team Leader	Japan International Cooperation Agency
Naoto Furukawa	Planning Management	Japan International Cooperation Agency
Kyoji Fujii	Chief Consultant / Power Supply Planning	Yachiyo Engineering Co., Ltd.
Noboru Matsumura	Power Generation Plant Planning 1	Yachiyo Engineering Co., Ltd.
Takashi Hara	Social and Environmental Considerations	Yachiyo Engineering Co., Ltd.
Kazunori Sadamori	Social and Environmental Considerations (Assistant)	Yachiyo Engineering Co., Ltd.

A-２　Study Schedule

A-2 Study Schedule

First Field Survey

No.	Day	Date	Survey Items			Stay
			JICA Member	Consultant Member		
			Mr. Wada (Team Leader)	Mr. Fujii	Mr. Nogami, Mr. Matsumura, Mr. Konishi, Mr. Hara, Mr. Tamai and Mr. Sadamori	
1	19-Oct	Wed		Trip {Tokyo 11:05→Guam15:35 by CO162、Guam18:50→Koror 19:50 by CO157}		Koror
2	20-Oct	Thu		①09:00 Meeting with JICA ②11:00 Courtesy Call to PPUC		Koror
3	21-Oct	Fri		①Courtesy Call to MPIIC ②Field Survey on Aimeliik Power Plant		Koror
4	22-Oct	Sat		①Site Survey on Aimeliik Power Plant		Koror
5	23-Oct	Sun		①Internal Meeting		Koror
6	24-Oct	Mon		①Site Survey on Marakar Power Plant ②Survey for Initial Environmental Examination		Koror
7	25-Oct	Tue		①Preparation of Sub-Contract for Topographic and Geological Survey ②Survey for the Route of Transporation		Koror
8	26-Oct	Wed		①Topographic and Geological Survey ②Environmental and Social Consideration		Koror
9	27-Oct	Thu		①Power Supply & Demand Survey、②Study on Power Development、③Layout for the new Power Plant、④Environmental and Social Consideration		Koror
10	28-Oct	Fri		Ditto		Koror
11	29-Oct	Sat		①Internal Meeting		Koror
12	30-Oct	Sun	Trip {Tokyo11:00→Guam15:25 by UA827、Guam18:50→Koror 19:50 by CO157}	①Internal Meeting		Koror
13	31-Oct	Mon	①09:00 Meeting with JICA ②10:00 Courtesy Call to Japanese Embassy ③11:30 Courtesy Call to MOS、MPIIC ④13:30 Courtesy Call to PPUC ⑤14:00 Discussion with PPUC		①Identification of Issues for Power Generation and O&M、②Study on Financial Soundness、③Study on Electricity Distribution Expansion、④Study on Tariff and Tariff Collection、⑤Initial Environmental Examination	Koror
14	1-Nov	Tue	①Field Survey for Aimeliik Power Plant ②Meeting with Power Supply Section		Ditto	Koror
15	2-Nov	Wed	①Discussion on Site Slection and Project Components		①Basic Design of New Power Plant, ②Initial Environmental Examination、③Preparation of Technical Notes、④Preparation of Field Report	Koror
16	3-Nov	Thu	①Discussion on Minutes with PPUC		Ditto	Koror
17	4-Nov	Fri	①09:00 Discussion on Minutes with MPIIC、 PPUC ②14:00 Sign on the Minutes ③15:00 Report to JICA Palau ④16:00 Report to Japanese Embassy		Ditto	Koror
18	5-Nov	Sat	Trip {Koror 01:15→Guam05:30 by CO186、Guam07:00→Tokyo 09:30 by UA826}	①Preparation of Technical Notes、②Preparation of Field Report		Koror
19	6-Nov	Sun		Ditto		Koror
20	7-Nov	Mon		Submission of Technical Notes to PPUC and Discussion		Koror
21	8-Nov	Tue		Discussion on Technical Notes with PPUC		Koror
22	9-Nov	Wed		Ditto		Koror
23	10-Nov	Thu		Ditto		Koror
24	11-Nov	Fri		Sign on Technical Notes/Field Report with PPUC		Koror
25	12-Nov	Sat		Preparation of Field Report (Japanese)		Koror
26	13-Nov	Sun		Ditto		Koror
27	14-Nov	Mon		①Courtesy Call to MPIIC ②Courtesy Call to PPUC ③Courtesy Call to JICA Palau ④Report to Japanese Embassy		Koror
28	15-Nov	Tue		Trip {Koror 02:35→Guam 05:30 by CO158, Guam 07:00→Tokyo 09:30 by CO826}		-

［Remarks］

MPIIC : Ministry of Public Infrastructure, Industries and Commerce

MOS : Ministry of State

PPUC : Palau Public Utilities Corporation

JICA : Japan International Cooperation Agency

Supplemental Survey

No.	Date	Day	Contents of Field Survey		Stay at
			Consultant Members		
			Mr. Fujii	Mr. Tamai and Mr. Nio	
1	21-Dec	Wed	Trip {Tokyo 22:00→Guam 02:00+1 by CO1748C}		Guam
2	22-Dec	Thu	Trip {Guam19:55→Koror 20:55 by CO157}		Koror
3	23-Dec	Fri	①08:30 Meeting with JICA Palau Office ②10:00 - 12:00 Meeting with the Minister of MPIIC and PPUC (GM) on confirmation of reorganization of PPUC's management, future plan on damaged Aimeliik power station and the progress of evironmental application ③13:00 Equipment diagnosis at Aimelik Power Plant		ditto
4	24-Dec	Sat	①Equipment diagnosis at Aimelik Power Plant		ditto
5	25-Dec	Sun	①Preparation of evaluation report		ditto
6	26-Dec	Mon	①Equipment diagnosis at Aimelik Power Plant ②14:00 Explanation of evaluation report to JICA ③15:00 Explanation of evaluation report at Japanese Ambassador's Residence		ditto
7	27-Dec	Tue	①Explanation of evaluation report to PPUC & signing for M/D with PPUC		ditto
8	28-Dec	Wed	Trip {Koror 02:35→Guam 05:30 by CO158, Guam 07:00→Tokyo 09:30 by CO826}		

［Remarks］

MPIIC : Ministry of Public Infrastructure, Industries and Commerce
MOS : Ministry of State
PPUC : Palau Public Utilities Corporation
EOJ : Embassy of Japan
JICA : Japan International Cooperation Agency

Second Field Survey

No.	Date	Day	Survey Items			Stay
			JICA Member	Consultant Member		
			Mr. Tanaka (Team Leader) Mr. Furukawa (Planning Management)	Mr. Fujii	Mr. Matsumura, Mr. Hara and Mr. Sadamori	
1	23-Mar	Fri	Trip {Tokyo 11:00→Guam 15:25 by UA827、Guam 18:50→Koror 19:50 by UA193}			Koror
2	24-Mar	Sat	Field Survey on (i) Aimeliik Power Station and Malakal Power Station			Koror
3	25-Mar	Sun	Internal Discussion for Minutes of Discussions			Koror
4	26-Mar	Mon	(i) 09:00 Meeting with JICA, (ii) 10:00 Courtesy Call to MOS、MPIIC, Submission of DFR (iii) 11:30 Courtesy Call to PPUC, Submission of DFR, (iv)14:00 Discussion on the Minutes with PPUC			Koror
5	27-Mar	Tue	Discussion on Minutes with PPUC	(i) DFR Explanation, (ii) Site Condition Survey		Koror
6	28-Mar	Wed	(i) 09:00 Discussion on Minutes with MPIIC & PPUC (ii) 14:00 Sign on the Minutes (iii) 15:00 Report to JICA Palau (iv) 16:00 Report to EOJ		(i) DFR Explanation (ii) Field Survey (iii) Confirmation of Undertakings of the Recipient Country	Koror
7	29-Mar	Thu	Trip {Koror 02:10→Guam 05:10 by UA158、Guam 07:07→Tokyo 09:50 by UA826}	(i) Survey on Environmental Procedure (ii) Survey on Emergency Generator Procurement (iii) Survey on Electricity Supply and Demand Situation in Koror&Babeldaob		Koror
8	30-Mar	Fri		(i) Survey on Electricity Consumer (Water Supply and Sewerage) (ii) Survey on Electricity Consumer (School and Hospital)		Koror
9	31-Mar	Sat		(i) Survey on Electricity Consumer (Hotel) (ii)Survey on Electricity Consumer (Tourism)		Koror
10	1-Apr	Sun		*Ditto*		Koror
11	2-Apr	Mon		Trip {Koror 02:10→Guam 05:10 by UA158、Guam 07:07→Tokyo 09:50 by UA826}		-

［Remarks］

MPIIC : Ministry of Public Infrastructure, Industries and Commerce
MOS : Ministry of State
PPUC : Palau Public Utilities Corporation
JICA : Japan International Cooperation Agency
DFR : Draft Final Report

A-3 List of Parties Concerned In Recipient Country

A-3 List of Parties Concerned In Recipient Country

Name and Organization	Position
Ministry of Finance	
H.E. Kerai Mariur	Vice President/ Minister of Finance
Ministry of Public Infrastructure, Industries & Commerce (MPIIC)	
H.E. Jackson R. NGIRAINGAS	Minister
Stalin Pedro	Special Assistant to the Minister
William Hayes Moses	Bureau of Commercial Development
Ministry of States	
H.E. Victor M. YANO	Minister
Gustav N. Aitaro	Director, Bureau of International Trade and Technical Assistance
Palau Public Utilities Corporation (PPUC)	
Temmy Shmull	Chairman, Board of Directors
Clarence Masayosi	Vice Chairman, Board of Directors
Jennifer K. Gibbons	Secretary/Treasurer, Board of Directors
John Sugiyama	Member, Board of Directors
Kenneth Uyehara	CEO / General Manager
Brian Melairei	Former Chairman, Board of Directors
Rukebai K. Inabo	Former CEO / General Manager
Jacqueline Alexander	CFO
Lorenzo B. Mamis	Manager, Power Generation Division
Antipas Raymond	Superintendent, Aimeliik Power Plant
Jack Ngiraked	Superintendent, Malakal Power Plant
Tmetuchl Baules	Public Information Officer
Sofronio Pons Mahor	Civil Engineer
Tito Cabunagan	Electrical Engineer
Wridon Ngiralman	Safety Officer

Name and Organization	Position
Environmental Quality Protection Board (EQPB)	
Portia K. Franz	Executive Officer
Roxanne Simae Blesam	Compliance Specialist
Embassy of Japan, Palau	
Yoshiyuki Sadaoka	Ambassador of Japan
Takao Anzawa	Counsellor
Naoko Hayashi	Researcher/Advisor
Japan International Cooperation Agency (JICA) Palau Office	
Taiji Usui	Resident Representative
Naoki Takeuchi	Volunteer Coordinator
Japan International Cooperation Agency (JICA) Expert	
Hideo Oya	Advisor

A-４　Minutes of Discussions（M/D）

Minutes of Discussions
on
the Preparatory Survey on the Project
for
Enhancing Power Generation Capacity in the Urban Area
in
the Republic of Palau

In response to the request from the Government of the Republic of Palau, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), in consultation with the Government of Japan, decided to conduct a Preparatory Survey (hereinafter referred to as "the Survey") on the Project for Enhancing Power Generation Capacity in the Urban Area of Palau (hereinafter referred to as "the Project").

JICA sent to the Republic of Palau the Preparatory Survey Team (hereinafter referred to as "the Team"), headed by Mr. Yoshikazu WADA, Deputy Director for Electric Power Division, Natural Resources and Energy Group, Industrial Development and Public Policy Department, JICA. The Team is scheduled to stay in the country from October 19 to November 15, 2011.

The Team held discussions with the officials of concerned authorities in Palau (hereinafter referred to as "the Palauan side"). In the course of the discussions, both sides have confirmed the main items described in the sheets attached hereto.

Koror State, Palau, November 4, 2011

Mr. Yoshikazu WADA
Leader
Preparatory Survey Team
Electric Power Division
Industrial Development and
Public Policy Department
Japan International Cooperation Agency

H.E. Jackson R. NGIRAINGAS
Minister
Ministry of Public Infrastructure, Industries & Commerce
Republic of Palau

Mr. Brian MELAIREI
Chairman, Board of Directors
Palau Public Utilities Corporation
Republic of Palau

(witness)

H.E. Victor M. YANO
Minister
Ministry of State
Republic of Palau

ATTACHMENT

1. Objective of the Project

The objective of the Project is to enhance the continuous supply of electric power to the island of Koror and Babeldaob, the Republic of Palau.

2. Project Site

The Project site is located in Aimeliik State as shown in Annex-1. The location of the new power house is shown in Annex-2

3. Responsible and Implementing Organization

(1) The responsible ministry is the Ministry of Public Infrastructure, Industries & Commerce (MPIIC).
(2) The implementing organization is Palau Public Utilities Corporation (PPUC).
(3) The Organization Structure of MPIIC and PPUC are shown in Annex-3 and Annex-4, respectively.

4. Requested components from Palauan side

(1) Items originally requested by the Palauan Side are as follows;
  (a) Facilities of powerhouse for 2 sets of 5MW diesel engine generators of new Aimeliik Power Station
  (b) Installation of 5 MW medium speed diesel generators x 2 units
  (c) Provisions of soft components, such as administrative cost and contingency
  (d) Provision of engineering services for design and supervision
(2) Based on discussion and field survey, both parties confirmed requested components as follows;
  (a) Installation of 5 MW diesel oil fired medium speed diesel generators x 2 units
  (b) Construction of a new power house in the existing Aimeliik Power Station

5. Japan's Grant Aid Scheme

(1) JICA confirmed that the Palauan side has understood Japan's Grant Aid Scheme explained by the Team as described in Annex-5 and 6.
(2) The Palauan side will take the necessary measures, as described in Annex-6, for smooth implementation of the Project as prerequisites for the Japan's Grant Aid to be implemented.

6. Schedule of the 1st Field Survey

The Team will continue the Survey in Palau until November 15, 2011.

7. Environmental and Social Considerations

(1) The Team explained the outline of the JICA Guidelines for Environmental and Social Considerations (hereinafter referred to as "the JICA Guidelines").
(2) The Palauan side agreed to comply with the JICA Guidelines as well as Palauan laws and regulations, and to prepare Environmental Checklist and Monitoring Form by the end of November 2011 which are designated by JICA Guidelines for an outline design.
(3) The Palauan side will take necessary actions such as conducting an Initial Environmental Examination (IEE) based on Environmental Quality Protection Act of Palau and obtain environmental license and certificates.
(4) The Palauan side agreed to hold stakeholder meeting at least one time, based on the request by the Environmental Quality Protection Board of the Republic of Palau, with inviting representatives from district offices and communities in order to notice the Outline Design

1

of the Project. The representatives should include those who may be potentially affected by the implementation of the Project. Besides, the Palauan side will take necessary measures to mitigate environmental and social impacts in consideration of the public opinion.

(5) The Palauan side agreed to secure lands necessary for implementation of the Project by the end of March, 2012. The land owned by the Government was confirmed by the Ministry of Public Infrastructure, Industries and Commerce with related documents.

(6) The Palauan side agreed to secure funding for and execution of the above environmental matters in a schedule as required for smooth execution of the Project.

8. Other Relevant Issues

(1) Status of the Survey

The Team explained that the purpose of the Survey is to collect necessary information and data for evaluating the relevancy, appropriateness and urgency of the Project, and to identify issues to be cleared for the implementation of the Project. The Team also explained the Japanese side was not expressing any commitments on the Project implementation at this stage.

(2) Urgency of the Project

The Palauan side emphasized that the Project should be implemented and completed urgently. The Team understood the urgency and will convey the needs to JICA headquarters.

(3) Selection of location of new power house

Both sides conducted screening procedures for selection of location for a new power house. In the first screening, 4 sites were considered and 2 sites were screened out mainly due to technical and environmental aspects. In the second screening, 2 sites were considered. One was a site which utilizes a part of the existing power house area and requires removal work and relocation work of existing facilities. The location is shown as Site-2 in Annex-2. The other was an open field within the Government land placed in the northern side of tank yard, Site-3 in Annex-2.

Japanese side examined the conditions of the both sites and recommended Site-3 as the Project site, due to less preparatory work required. On the other hand, the Palauan side expressed its willingness of selecting Site-2, from the aspect of fully utilization of existing assets and operational convenience..

Both parties agreed to clarify feasibility of necessary preparatory work by the Palauan side. For the clarification, the Palauan side agreed to submit a proposal including schedule, work items and budget estimate by November 9 for further discussion.

Both parties confirmed if a plan of preparatory work is not likely to be feasible in consideration of technical aspects, time constraints, and financial availability, both parties will choose a site in the open field which is Site-3.

(4) Progress of preparatory works for the Project

The Palauan side agreed to undertake preparatory works necessary for the Project, including land acquisition and rehabilitation of access road to Aimeliik power station, re-surfacing delivery road from the Compact road to the IPSECO port. The preparatory works shall be completed no later than six months from the conclusion of Grant Agreement (G/A).

(5) Budget for operation and maintenance

The Team expressed its concern about PPUC's financial situation including uncollected balance from government agencies. The Team also emphasized that it is essential for the Palauan side to constantly secure the necessary budget for operation and maintenance based on periodical overhaul and preventive maintenance program including major overhauls of equipment to be procured under the Project in order to ensure long-term stable power supply. The Palauan side has fully understood and explained the budget plan including on-going new tariff introduction procedures. Based on the new tariff structure PPUC's financial situation is projected to be improved. In addition, the Palauan side committed to secure budget allocation sufficient to maintain Project equipment.

(6) Action to be taken by the Government for financial sustainability of PPUC

The Team expressed that the governmental agencies should pay their uncollected balance against PPUC in order to enhance financial sustainability and soundness of PPUC. The Palauan side understood the importance and acknowledged to consider for allocating budget to the relevant government agencies for the purpose.

(7) Enhancement of structure for operation and maintenance

The Team emphasized that the establishment of an operation and maintenance structure with the allocation of enough number of qualified engineers and skilled technicians who will be in charge of operating and maintaining the new facilities is a crucial factor for implementation of the Project. The Palauan side understood its importance and agreed to formulate the operation and maintenance structure within PPUC and submit the plan to JICA by April 2012.

(8) Counterpart personnel

The Team requested the Palauan side that the necessary number of counterpart personnel shall be assigned to the Team and necessary arrangements with related organizations shall be made during the Survey in Palau. The Palauan side agreed to support the Team based on the request.

(9) Questionnaires

The Team requested the Palauan side that the answers to the questionnaires which the Team had already submitted to the Palauan side shall be given to the Team by November 4, 2011.

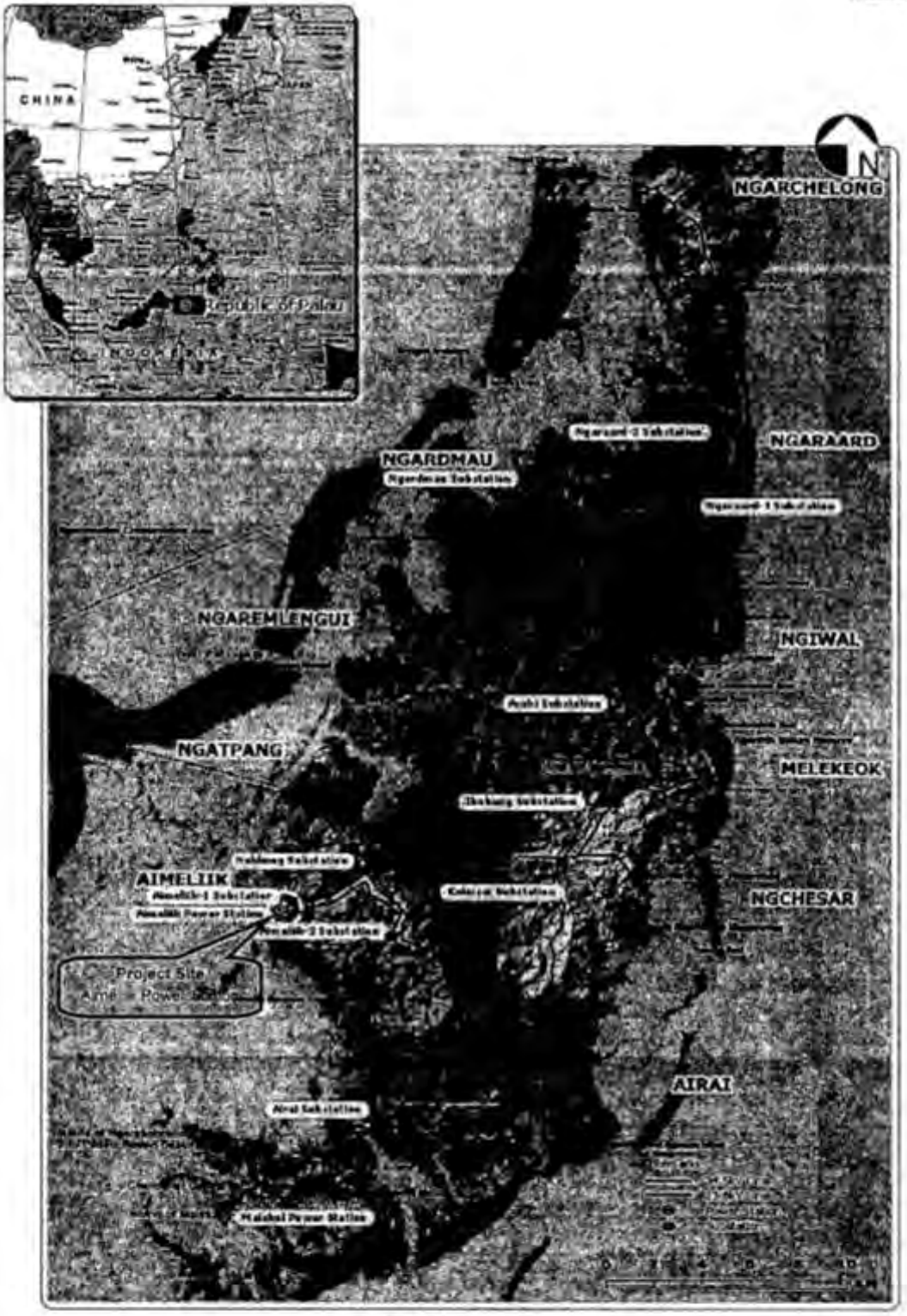
(10) Customs and tax exemption

The Palauan side understands that it shall be fully responsible on exemption of taxes, custom duties and any other levies imposed in the Republic of Palau, in case the Project is implemented.

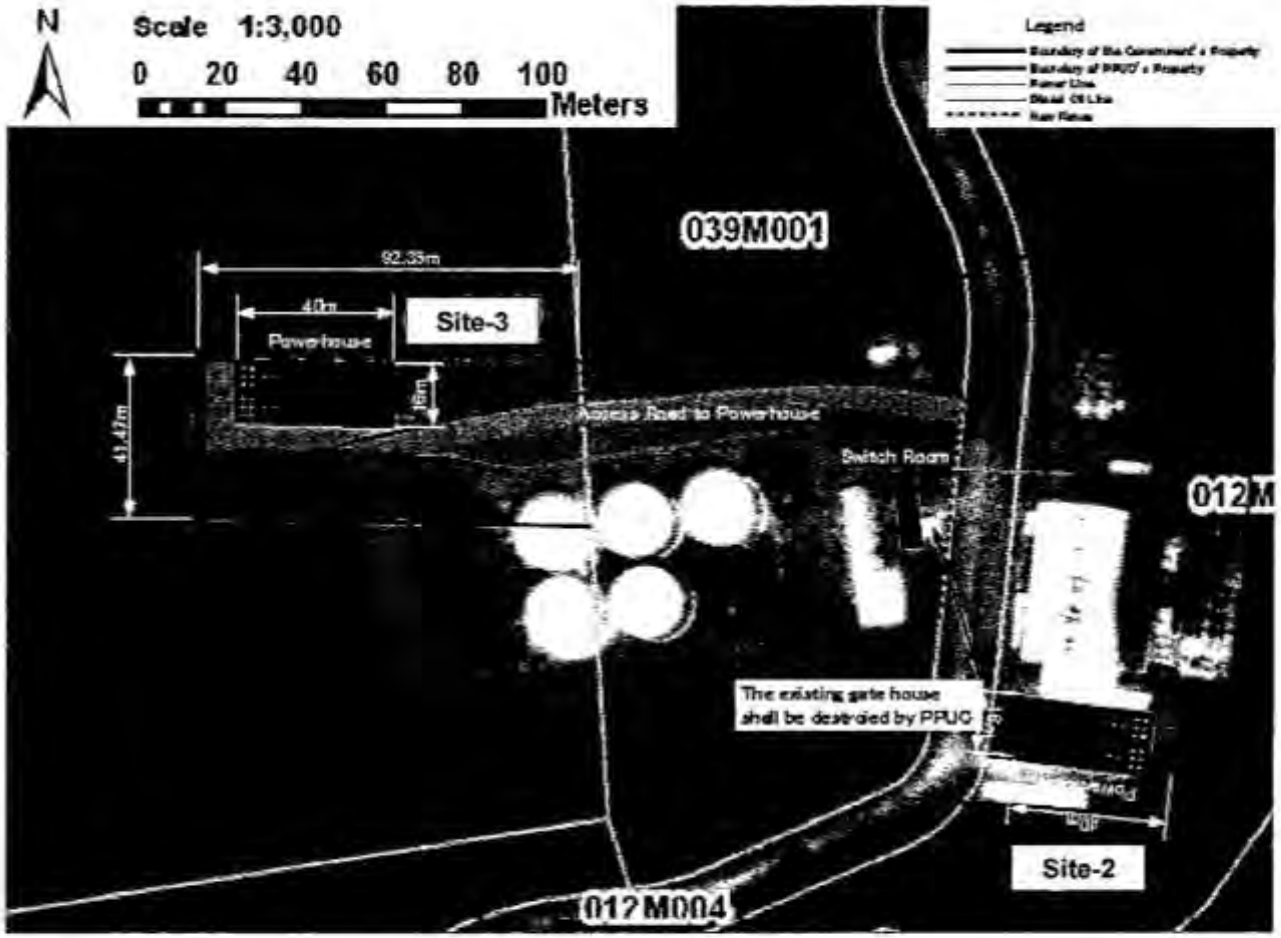
(End)

Annex-1 Project Site
Annex-2 Location of New Power House
Annex-3 Organization Chart of MPIIC
Annex-4 Organization Chart of PPUC
Annex-5 Japan's Grant Aid
Annex-6 Flow Chart of Japan's Grant Aid Procedures
Annex-7 Major Undertakings to be taken by Each Government

Annex-1

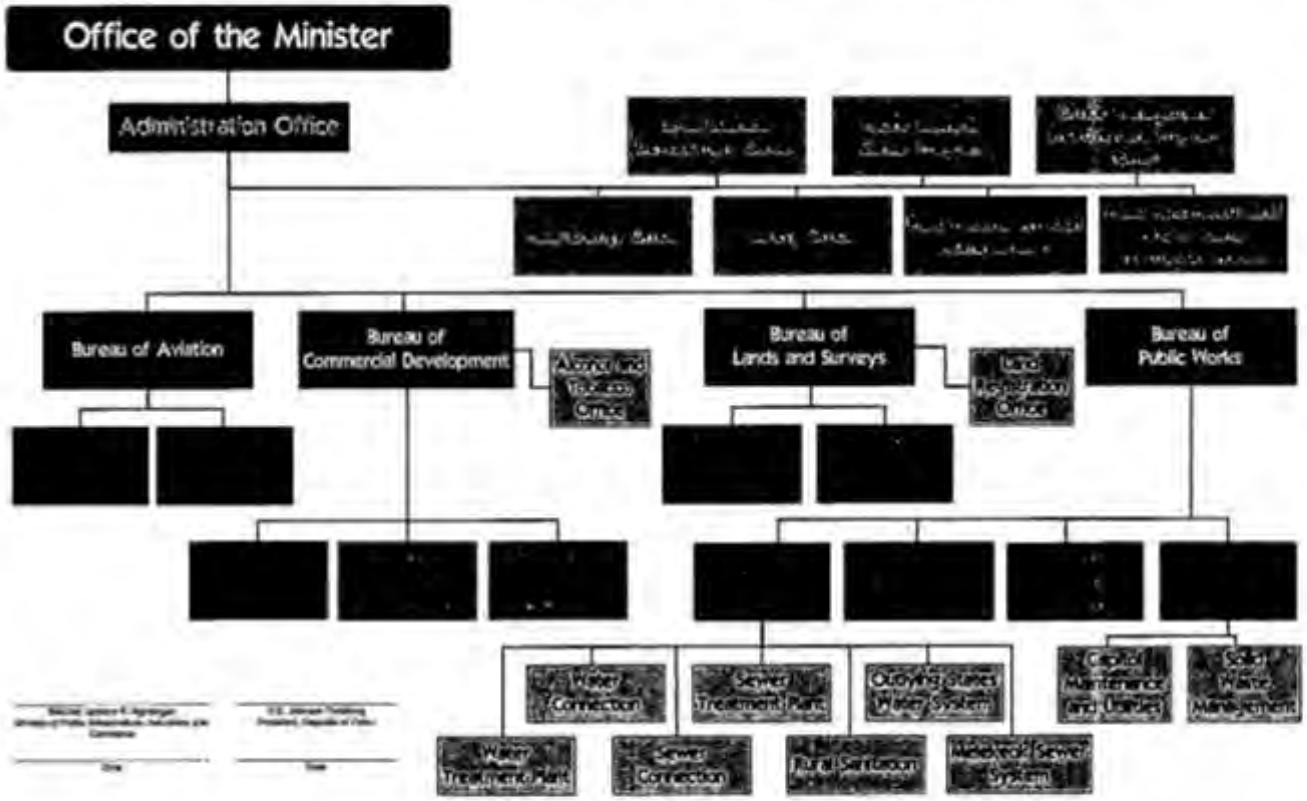


The Project Site

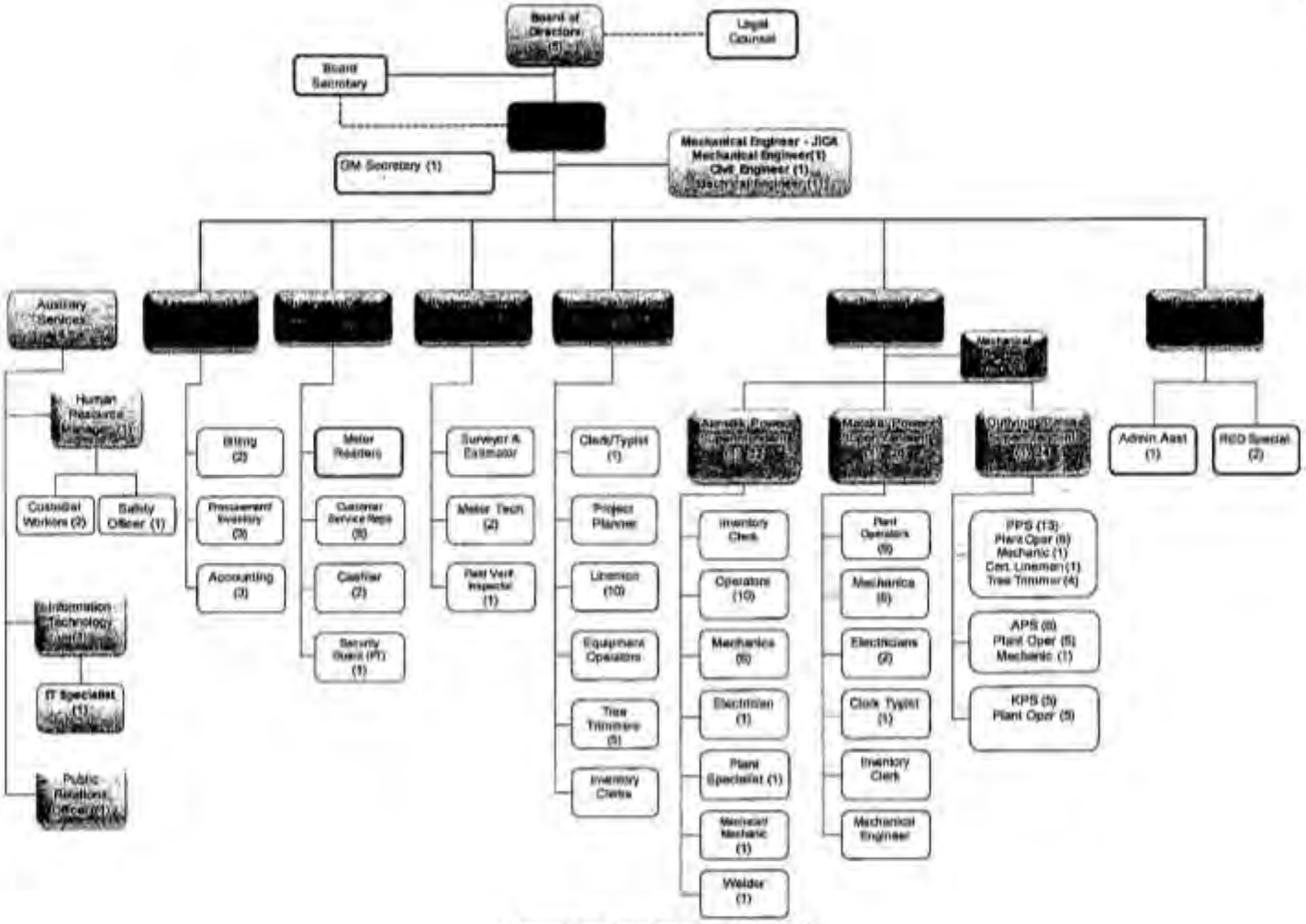


Location of New Power House

Ministry of Public Infrastructure, Industries, and Commerce



Organization Chart of MPIIC



Organization Chart of PPUC

Japan's Grant Aid

The Government of Japan (hereinafter referred to as "the GOJ") is implementing the organizational reforms to improve the quality of ODA operations, and as a part of this realignment, a new JICA law was entered into effect on October 1, 2008. Based on the law and the decision of the Government of Japan (hereinafter referred to as "the GOJ"), JICA has become the executing agency of the Grant Aid for General Projects, for Fisheries and for Cultural Cooperation, etc.

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

1. Grant Aid Procedures

The Japanese Grant Aid is conducted as follows-

・Preparatory Survey (hereinafter referred to as "the Survey")
- The Survey conducted by JICA

・Appraisal &Approval
- Appraisal by The GOJ and JICA, and Approval by the Japanese Cabinet

・Determination of Implementation
- The Notes exchanged between the GOJ and a recipient country

・Grant Agreement (hereinafter referred to as "the G/A")
- Agreement concluded between JICA and a recipient country

・Implementation
- Implementation of the Project on the basis of the G/A

2. Preparatory Survey

(1) Contents of the Survey

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

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

The contents of the original request by the recipient country are not necessarily approved in their initial form as the contents of the Grant Aid project. The Basic Design of the Project is confirmed considering the guidelines of the Japan's Grant Aid scheme.

JICA requests the Government of the recipient country to take whatever measures are necessary to ensure its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the Project. Therefore, the implementation of the Project

is confirmed by all relevant organizations of the recipient country through the Minutes of Discussions.

(2) Selection of Consultants

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

(3) Result of the Survey

The Report on the Survey is reviewed by JICA, and after the appropriateness of the Project is confirmed, JICA recommends the GOJ to appraise the implementation of the Project.

3. Japan's Grant Aid Scheme

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

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

(2) Selection of Consultants

The consultant firm(s) used for the Survey will be recommended by JICA to the recipient country to also work on the Project's implementation after the E/N and the G/A, in order to maintain technical consistency.

(3) Eligible source country

Under the Japanese Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. When JICA and the Government of the recipient country or its designated authority deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm are limited to "Japanese nationals".

(4) Necessity of "Verification"

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

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

In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as Annex-7.

(6) "Proper Use"

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

(7) "Export and Re-export"

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

(8) Banking Arrangements (B/A)

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

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

(9) Authorization to Pay (A/P)

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

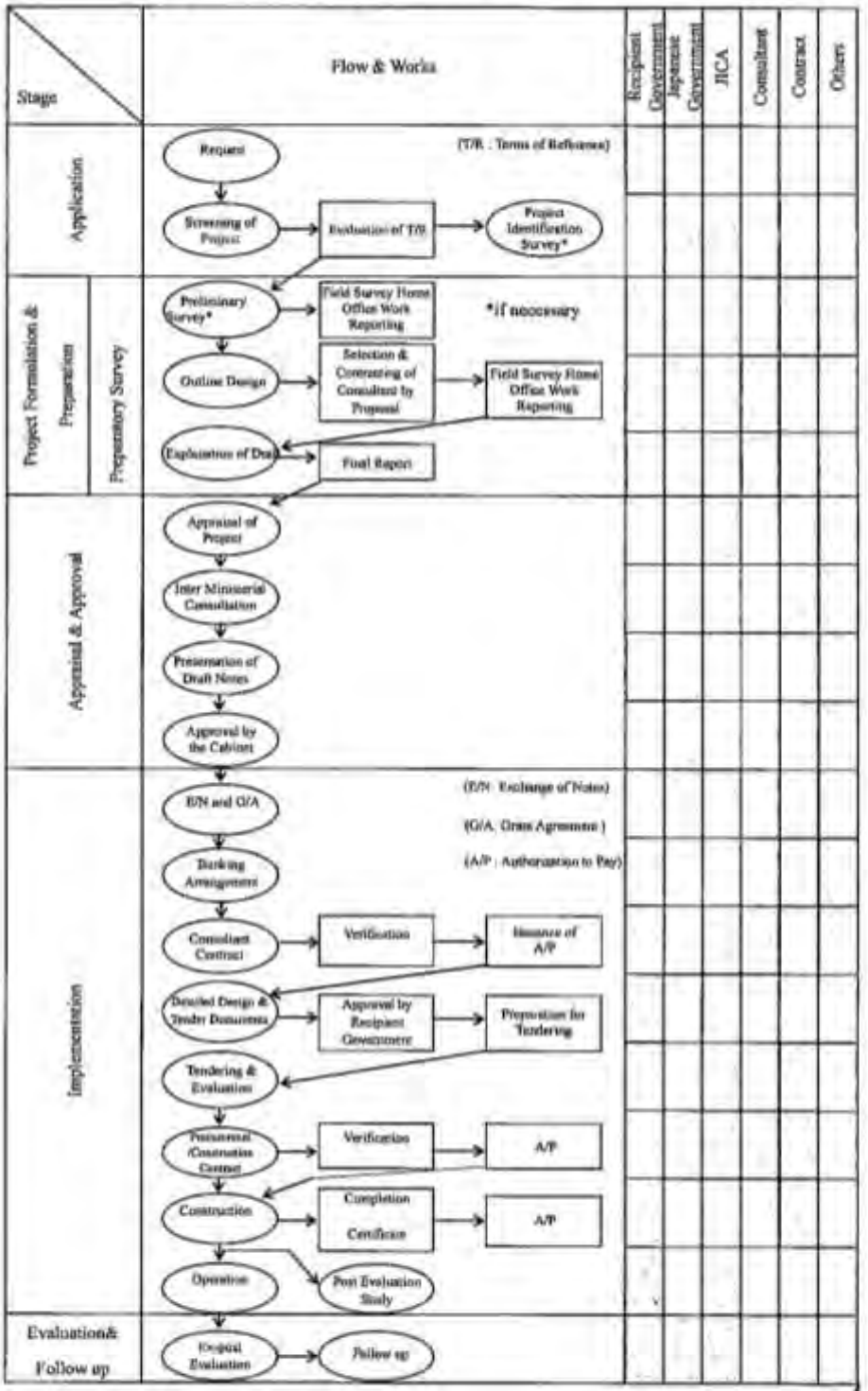
(10) Social and Environmental Considerations

A recipient country must ensure the social and environmental considerations for the Project and must follow the environmental regulation of the recipient country and JICA socio-environmental guideline.

(End)

Annex-6

Flow Chart of Japan's Grant Aid Procedures



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Annex-7

Major undertakings to be taken by each Government

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	to secure [a lot] /[lots] of land necessary for the implementation of the Project and to clear the [site]/[sites];		●
2	To construct the following facilities		
	1) The building	●	
	2) The gates and fences in and around the site		●
	3) The parking lot	●	
	4) The road within the site	●	
	5) The road outside the site		●
3	To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities necessary for the implementation of the Project outside the [site]/[sites]		
	1)Electricity		
	a. The distributing power line to the site		●
	b. The drop wiring and internal wiring within the site	●	
	c. The main circuit breaker and transformer	●	
	2) Water Supply		
	a. The city water distribution main to the site		●
	b. The supply system within the site (receiving and elevated tanks)	●	
	3) Drainage		
	a. The city drainage main (for storm sewer and others to the site)		●
	b. The drainage system (for toilet sewer, common waste, storm drainage and others) within the site	●	
	4) Gas Supply		
	a. The city gas main to the site		●
	b. The gas supply system within the site	●	
	5) Telephone System		
	a. The telephone trunk line to the main distribution frame/panel (MDF) of the building		●
	b. The MDF and the extension after the frame/panel	●	
	6) Furniture and Equipment		
	a. General furniture		●
	b. Project equipment	●	
4	To ensure prompt unloading and customs clearance of the products at ports of disembarkation in the recipient country and to assist internal transportation of the products		
	1) Marine (Air) transportation of the Products from Japan to the recipient country	●	
	2) Tax exemption and custom clearance of the Products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site	●	
5	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and the services [be exempted] / [be borne by the Authority without using the Grant]		●
6	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●
7	To ensure that [the Facilities and the products]/[the Facilities]/ [the products] be maintained and used properly and effectively for the implementation of the Project		●
8	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project		●
9	To bear the following commissions paid to the Japanese bank for banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
10	To give due environmental and social consideration in the implementation of the Project.		●

*1 B/A : Banking Arrangement, A/P : Authorization to pay) *2 If the environmental screening category is C, No. 10 is unnecessary

Minutes of Discussions
on
the Supplemental Field Survey on the Project
for
Enhancing Power Generation Capacity in the Urban Area
in
the Republic of Palau

In response to the request from the Government of the Republic of Palau, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), in consultation with the Government of Japan, decided to conduct a Supplemental Field Survey (hereinafter referred to as "the Survey") on the Project for Enhancing Power Generation Capacity in the Urban Area of Palau (hereinafter referred to as "the Project").

JICA sent to the Republic of Palau the Preparatory Survey Team (hereinafter referred to as "the Team"), headed by Mr. Kyoji FUJII, Chief Consultant, Yachiyo Engineering Co., Ltd. The Team is scheduled to stay in the country from December 22 to December 28, 2011.

The Team held discussions with the officials of concerned authorities in Palau (hereinafter referred to as "the Palauan side"). In the course of the discussions, both sides have confirmed the main items described in the sheets attached hereto.

Koror State, Palau, December 27, 2011

Mr. Kyoji FUJII
Chief Consultant
Preparatory Survey Team
Yachiyo Engineering Co., Ltd.

H.E. Jackson R. NGIRAINGAS
Minister
Ministry of Public Infrastructure, Industries and Commerce
Republic of Palau

Mr. Kenneth T. UYEHARA
CEO and General Manager
Palau Public Utilities Corporation
Republic of Palau

(witness)

H.E. Victor M. YANO
Minister
Ministry of State
Republic of Palau

ATTACHMENT

1. Power and authority of PPUC's management

Mr. Kenneth T. Uyehara was appointed as the interim Chief Executive Officer/General Manager of Palau Public Utilities Corporation (PPUC) and has taken over the responsibility of PPUC from the Minister of Public Infrastructure, Industries and Commerce.

2. Effectiveness of the previous Minutes of Discussions

Even though all the previous management of PPUC who were involved in discussions with JICA Study Team during the first field survey have resigned, the Palauan side and the Japanese side confirmed that the Minutes of Discussions on the Project signed on November 4th, 2011 remains valid and effective.

3. Policy on the rehabilitation of Aimeliik power station

Post-fire assessment on the Aimeliik power station has been conducted by PPUC and third party engineers. In consideration of the results of the assessment, the Palauan side expressed an intention to rehabilitate unit No.2 and No.3 of the Aimeliik power station for backup power supply purposes.

4. Post-fire assessment on electrical equipment of Aimeliik power station

The Team has conducted an inspection and assessment on the following electrical equipment of the Aimeliik power station to decide whether they can be used for the Project or not.

(1) Control panel for Aimeliik substation
(2) Protection panels for Aimeliik substation
(3) 13.8kV switch boards for station electricity service
(4) DC and AC power supply boards

As a result of inspection, the Team concluded that the electrical equipment listed above is not damaged by the fire and in a working condition. However, the following maintenance activities are recommended by the Team to maintain the reliability and accuracy of the equipment.

(a) further cleaning inside the panels/boards to completely remove soot and dust
(b) adjustment of relays and meters
(c) application of conductive grease on electrical contacts of 13.8kV switch boards
(d) high voltage insulation test on 13.8kV switch boards

The Palauan side accepted the recommendation and shall take necessary measures.

5. Progress of the Environmental and Social Consideration permit

PPUC submitted an application for Environmental Permit on the Project to Environmental Quality Protection Board on November 30, 2011. The permit will be granted from EQPB by the end of January 2012.

(End)

Minutes of Discussions
on the Preparatory Survey on the Project
for Enhancing Power Generation Capacity in the Urban Area
in the Republic of Palau
(Explanation on Draft Final Report)

In response to the request from the Government of the Republic of Palau (hereinafter referred to as "Palau"), the Japan International Cooperation Agency (hereinafter referred to as "JICA"), in consultation with the Government of Japan, decided to conduct a Preparatory Survey (hereinafter referred to as "the Survey") on the Enhancing Power Generation Capacity in the Urban Area of Palau (hereinafter referred to as "the Project").

From October 19 to November 15, 2011, JICA dispatched the Survey Team to Palau; and through discussions, field surveys and the result of technical examination in Japan, JICA prepared a Draft Final Report of the Survey.

In order to explain and to consult with the officials of concerned authorities in Palau (hereinafter referred to as "the Palauan side") on the contents of the Draft Final Report, JICA dispatched to Palau the Preparatory Survey Team for Draft Final Report Explanation (hereinafter referred to as "the Team"), which is headed by Mr. Hiroo TANAKA, Deputy Director General and Group Director for Natural Resources and Energy Group, Industrial Development and Public Policy Department, JICA. The Team is scheduled to stay in Palau from March 23 to April 2, 2012. The Team held discussions with the Palauan side. In the course of the discussions, both sides have confirmed the main items described in the sheets attached hereto.

Koror State, Palau, March 28, 2012

Mr. Hiroo TANAKA
Leader
Preparatory Survey Team
Japan International Cooperation Agency
Japan

H.E. Jackson R. NGIRAINGAS
Minister
Ministry of Public Infrastructure, Industries & Commerce
Republic of Palau

Mr. Temmy Shmull
Chairman of the Board of Directors
Palau Public Utilities Corporation
Republic of Palau

(witness)

H.E. Victor M. YANO
Minister
Ministry of State
Republic of Palau

ATTACHMENT

1. Objective of the Project

The objective of the Project is to enhance the continuous supply of electric power to the island of Koror and Babeldaob, the Republic of Palau.

2. Effectiveness of the previous Minutes of Discussions

The Team reconfirmed that the Minutes of Discussions on the Project signed on November 4, 2011 remains valid and effective.

3. Contents of the Draft Final Report

The Palauan side agreed and accepted in principle the contents of the Draft Final Report and the Draft Technical Specifications of the Survey explained by the Team.

4. Responsible and Implementing Organizations

(1) The responsible ministry is the Ministry of Public Infrastructure, Industries & Commerce (MPIIC).
(2) The implementing organization is Palau Public Utilities Corporation (PPUC).
(3) The organization chart of MPIIC and PPUC are shown in Annex-1 and Annex-2, respectively.

5. Components of the Project

The following (1) and (2) are selected as the Project Components and the location of project site is shown in Annex-3 and Annex-4.

(1) Installation of 5 MW medium speed diesel generators x 2 units
(2) Construction of a new power house in the existing Aimeliik Power Station

The Team explained that the above components are considered as candidate components to be implemented. However, the components might be reduced due to the budget constraints of the Japanese side.

6. Confidentiality of the Project

(1) Project Cost

The Team explained the estimated cost of the Project as described in Annex-5. The Palauan side also agreed that the cost for the Project contains procurement cost of equipment, construction cost of facility, transportation cost up to the Project site, installation cost and the Consultant fees.

The Palauan side agreed that the cost for the Project should not exceed the amount agreed on the Exchange of Notes (E/N) to be signed between the governments. The Palauan side understood that the estimated cost for the Project attached as Annex-5 is not the final and is subject to change as a result of the detailed design to be implemented after the E/N. Both sides agreed that the estimated cost for the Project should never be duplicated or disclosed to any outside parties (i.e. outside of JICA and the Palauan side) before tender for the Project.

(2) Detailed specifications of the Facilities and Equipment

Both sides agreed that all the information related to the Project including detailed drawings and specifications of the facilities and equipment and other technical information shall not be disclosed to any outside parties (i.e. outside of JICA and the Palauan side) before the conclusion of all contract(s) for the Project.

7. Possibility of Change in Scope, Schedule and Cost of the Project

The Team stressed that the scope, the schedule, and the cost for the Project are tentative and subject to change due to the domestic circumstances in Japan and in Palau. The Palauan side understood it.

8. Other Relevant Issues

(1) Project site location

Both sides reconfirmed that the final location of new power house is the Site-2 that as shown in Annex-4.

(2) Major Activities to be undertaken by the Palauan side.

The Palauan side agreed to undertake the following particular items out of undertakings described in Annex-6 and the Draft Final Report.

a) To complete partial demolition work of the existing powerhouse, relocation of the relevant equipment, removal of obstacles and land leveling of the project site.
b) To take permission(s) necessary for enforcement of traffic controls during the installation of 5 MW diesel generator and construction of power house from relevant authorities prior to the commencement of the Project.
c) To take building permits necessary for the construction of power house and switch house.
d) To construct of permanent fencing and gate at the new substation.
e) To complete branch piping work from the existing main city water pipe and installation of a stop valve in the project site.

The Palauan side agreed that the commencement of the work "a)" by Palauan side is a condition of conclusion of Grant Agreement (G/A). Therefore after the approval of the project by the cabinet of Japan, Palauan side agreed to execute the contract of the work that is now about offering a tender.

(3) Environmental and Social Considerations

The Palauan side explained the latest progress on this issue that PPUC had submitted the application for environmental permit for the Project to Environmental Quality Protection Board (EQPB) on November 30, 2011, and the permit had been granted from EQPB on February 16, 2012. According to that, Environmental Assessment Report is not required for the Project.

(4) Progress of Structure for Operation and Maintenance

The Palauan side explained the plan for operation and maintenance of the Aimeliik Power Station to the Team.

(5) Budget for operation and maintenance

The Palauan side promised to share the latest budget plan by middle of April, 2012, including budget for operation and maintenance, and explained that the new tariff is planned to be applied from June 1, 2012. The Palauan side re-committed to secure budget allocation sufficient to maintain the Project equipment.

(6) Counterpart Personnel

The Team requested the Palauan side that necessary number of counterpart personnel shall be assigned to the Project and necessary arrangements with related organizations be made during the Survey and implementing stage in Palau.

(7) Customs Duties and Tax Exemption

The Palauan side agreed that the Government of the Republic of Palau shall take necessary measures for the exemption of all customs, tax, levies and duties incurred in Palau for the implementation of the Project.

(8) The Palauan side shall bear the banking commissions as a condition for the Japan's Grant Aid to be implemented, and secure the sufficient budget to cover the following cost.

a) The commissions for the banking services based upon Banking Arrangement (B/A)
b) The advising commission of the Authorization to Pay (A/P)

9. Japan's Grant Aid Scheme

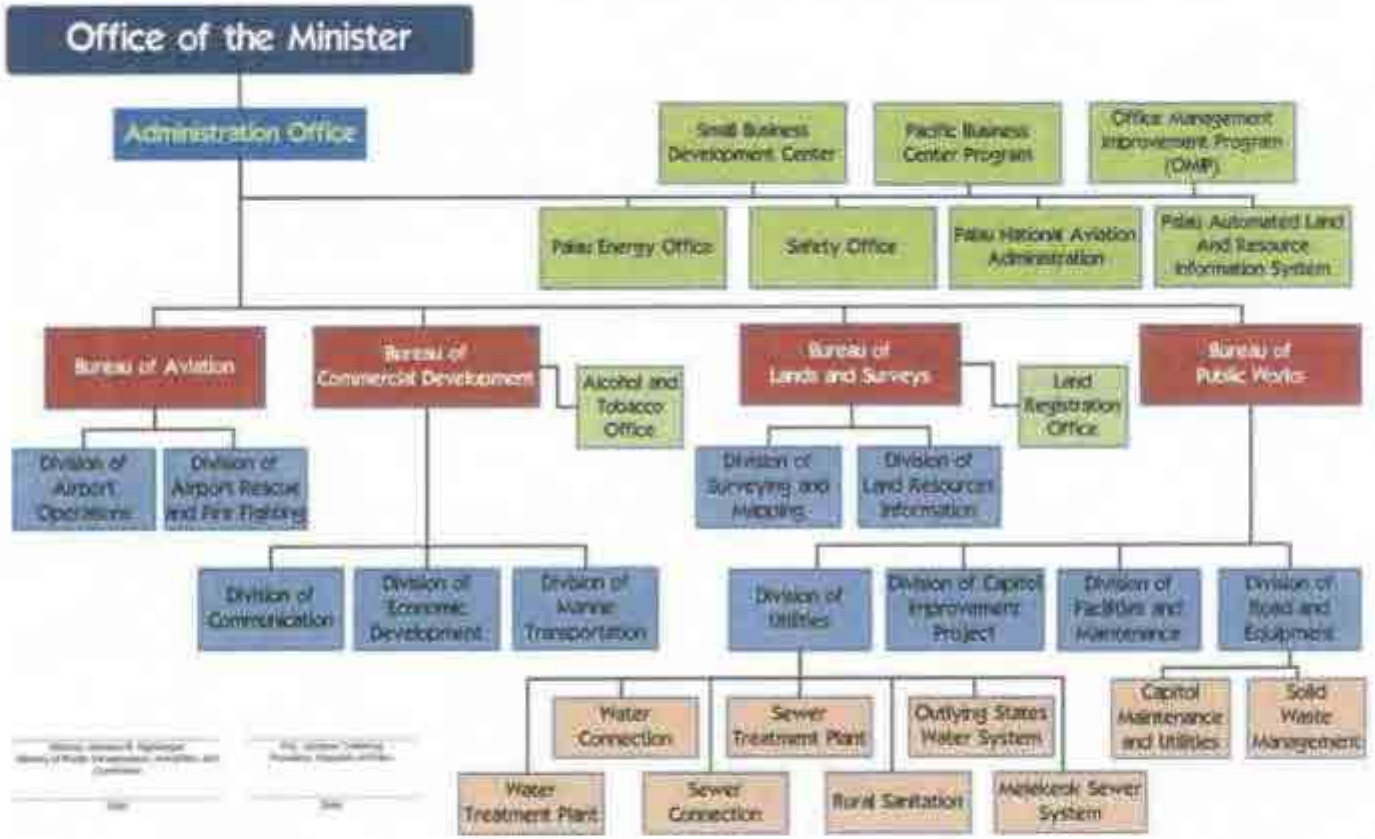
The Palauan side reconfirmed the Japan's Grant Aid Scheme and the necessary measures to be taken by the Palauan side explained by the Team as described in Annex-7 and Annex-8 respectively. The Palauan side also understood that the Team is not in the position to guarantee implementation of the Project.

(End)

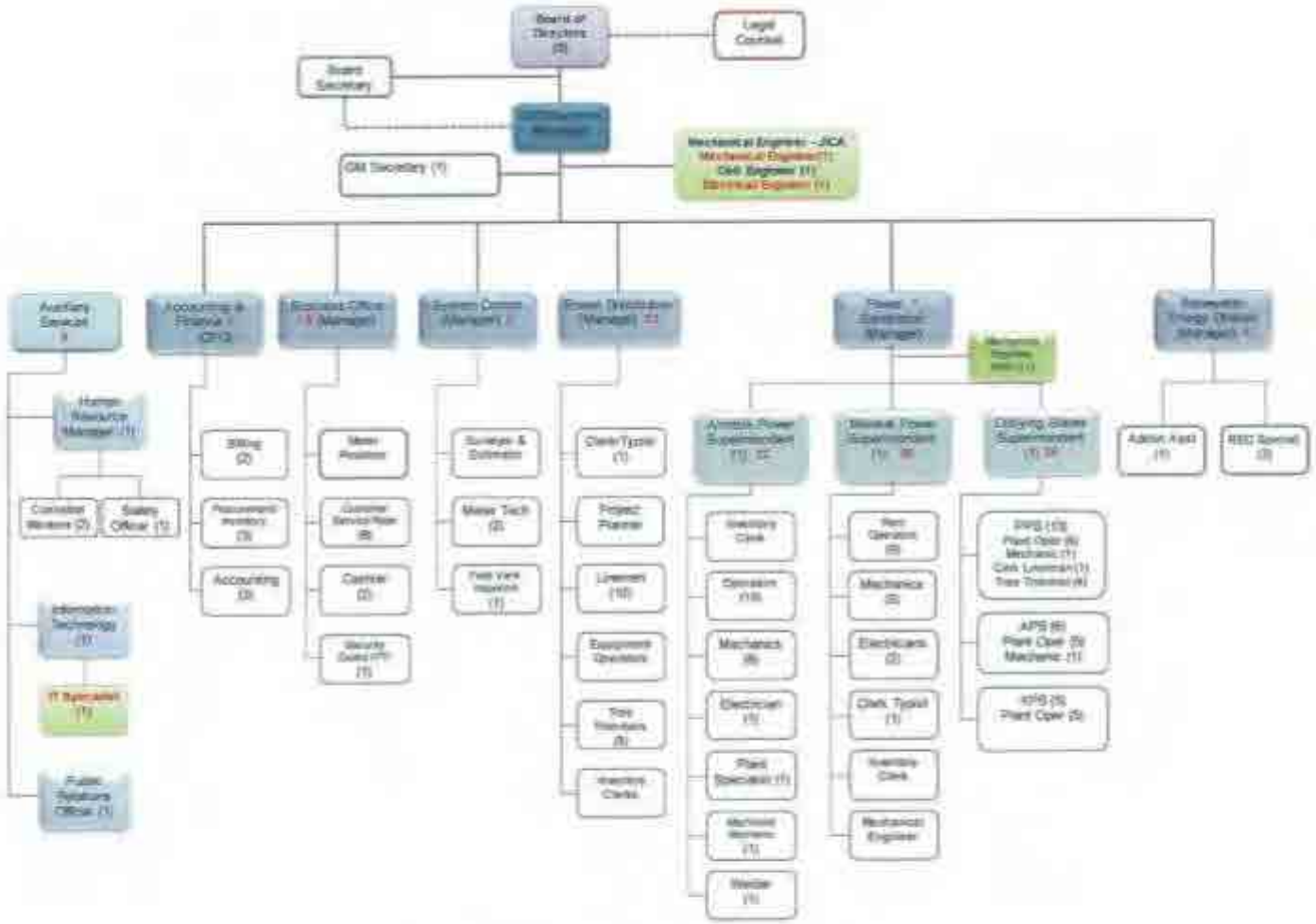
[List of Annex]

Annex-1: Organization Chart of MPIIC
Annex-2: Organization Chart of PPUC
Annex-3: The Project Site
Annex-4: Location of New Power House
Annex-5: Estimated Project Cost (Confidential)
Annex-6: Major undertakings to be taken by each Government
Annex-7: Japan's Grant Aid
Annex-8: Flow Chart of Japan's Grant Aid Procedures

Ministry of Public Infrastructure, Industries, and Commerce

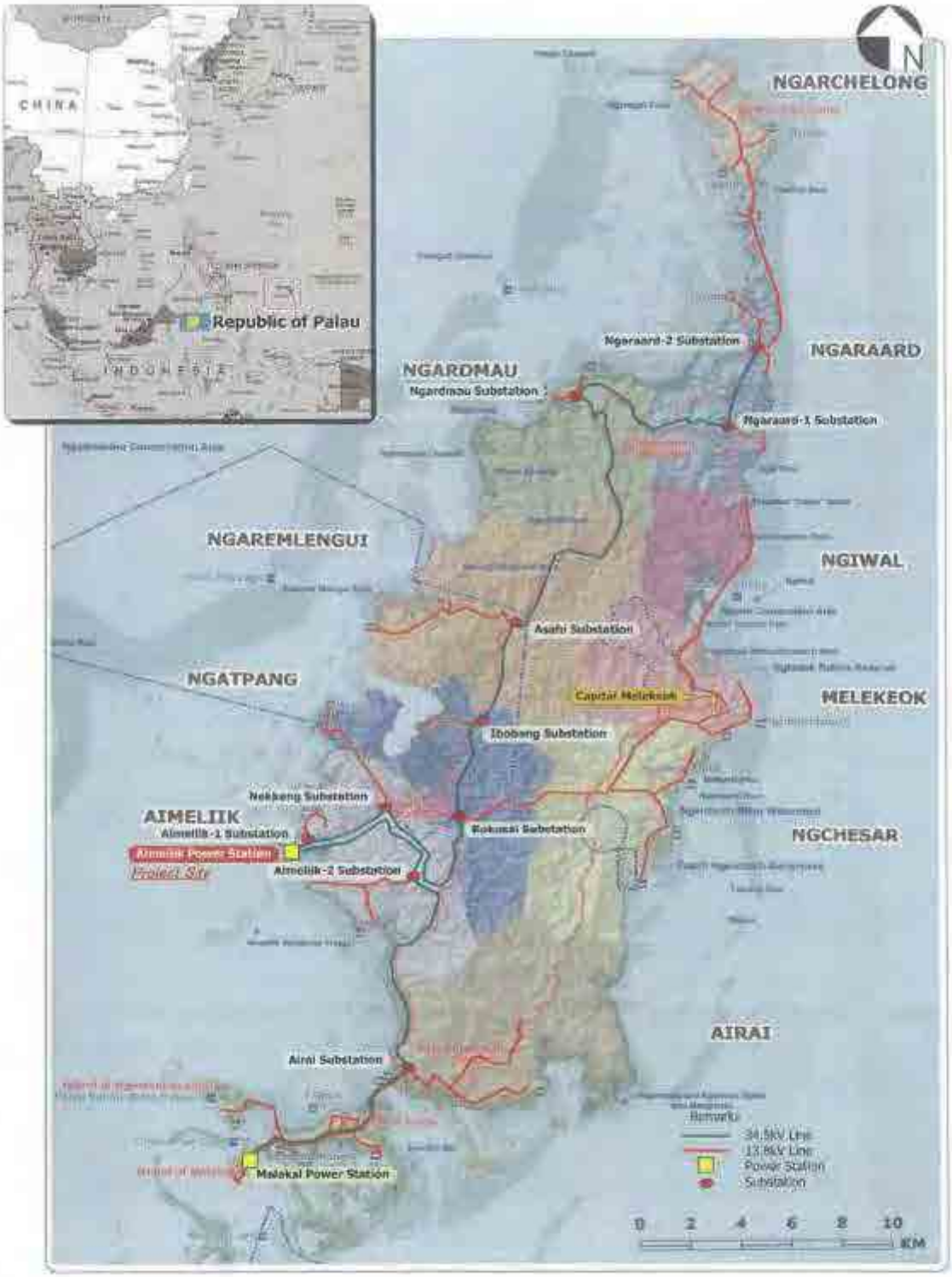


Organization Chart of MPIIC



Organization Chart of PPUC

Annex-3



The Project Site

7

Location of New Power House

Annex-5

Project Cost Estimation (Confidential)

This page is closed due to confidentiality

Annex-6

Major undertakings to be taken by each Government

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	to secure [a lot] /[lots] of land necessary for the implementation of the Project and to clear the [site]/[sites];		●
2	To construct the following facilities		
	1) The building	●	
	2) The gates and fences in and around the site		●
	3) The parking lot	●	
	4) The road within the site	●	
	5) The road outside the site		●
3	To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities necessary for the implementation of the Project outside the [site]/[sites]		
	1)Electricity		
	a. The distributing power line to the site		●
	b. The drop wiring and internal wiring within the site	●	
	c. The main circuit breaker and transformer	●	
	2) Water Supply		
	a. The city water distribution main to the site		●
	b. The supply system within the site (receiving and elevated tanks)	●	
	3) Drainage		
	a. The city drainage main (for storm sewer and others to the site)		●
	b. The drainage system (for toilet sewer, common waste, storm drainage and others) within the site	●	
	4) Gas Supply		
	a. The city gas main to the site		●
	b. The gas supply system within the site	●	
	5) Telephone System		
	a. The telephone trunk line to the main distribution frame/panel (MDF) of the building		●
	b. The MDF and the extension after the frame/panel	●	
	6) Furniture and Equipment		
	a. General furniture		●
	b. Project equipment	●	
4	To ensure prompt unloading and customs clearance of the products at ports of disembarkation in the recipient country and to assist internal transportation of the products		
	1) Marine (Air) transportation of the Products from Japan to the recipient country	●	
	2) Tax exemption and custom clearance of the Products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site	●	
5	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and the services [be exempted] / [be borne by the Authority without using the Grant]		●
6	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●
7	To ensure that [the Facilities and the products]/[the Facilities]/ [the products] be maintained and used properly and effectively for the implementation of the Project		●
8	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project		●
9	To bear the following commissions paid to the Japanese bank for banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
10	To give due environmental and social consideration in the implementation of the Project.		●

*1 B/A : Banking Arrangement, A/P : Authorization to pay) *2 If the environmental screening category is C, No. 10 is unnecessary

Japan's Grant Aid

The Government of Japan (hereinafter referred to as "the GOJ") is implementing the organizational reforms to improve the quality of ODA operations, and as a part of this realignment, a new JICA law was entered into effect on October 1, 2008. Based on the law and the decision of the Government of Japan (hereinafter referred to as "the GOJ"), JICA has become the executing agency of the Grant Aid for General Projects, for Fisheries and for Cultural Cooperation, etc.

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

1. Grant Aid Procedures

The Japanese Grant Aid is conducted as follows-

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

2. Preparatory Survey

(1) Contents of the Survey

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

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

The contents of the original request by the recipient country are not necessarily approved in their initial form as the contents of the Grant Aid project. The Basic Design of the Project is confirmed considering the guidelines of the Japan's Grant Aid scheme.

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

Discussions.

(2) Selection of Consultants

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

(3) Result of the Survey

The Report on the Survey is reviewed by JICA, and after the appropriateness of the Project is confirmed, JICA recommends the GOJ to appraise the implementation of the Project.

3. Japan's Grant Aid Scheme

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

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

(2) Selection of Consultants

The consultant firm(s) used for the Survey will be recommended by JICA to the recipient country to also work on the Project's implementation after the E/N and the G/A, in order to maintain technical consistency.

(3) Eligible source country

Under the Japanese Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. When JICA and the Government of the recipient country or its designated authority deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm are limited to "Japanese nationals".

(4) Necessity of "Verification"

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

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

In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as Annex-6.

(6) "Proper Use"

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

(7) "Export and Re-export"

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

(8) Banking Arrangements (B/A)

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

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

(9) Authorization to Pay (A/P)

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

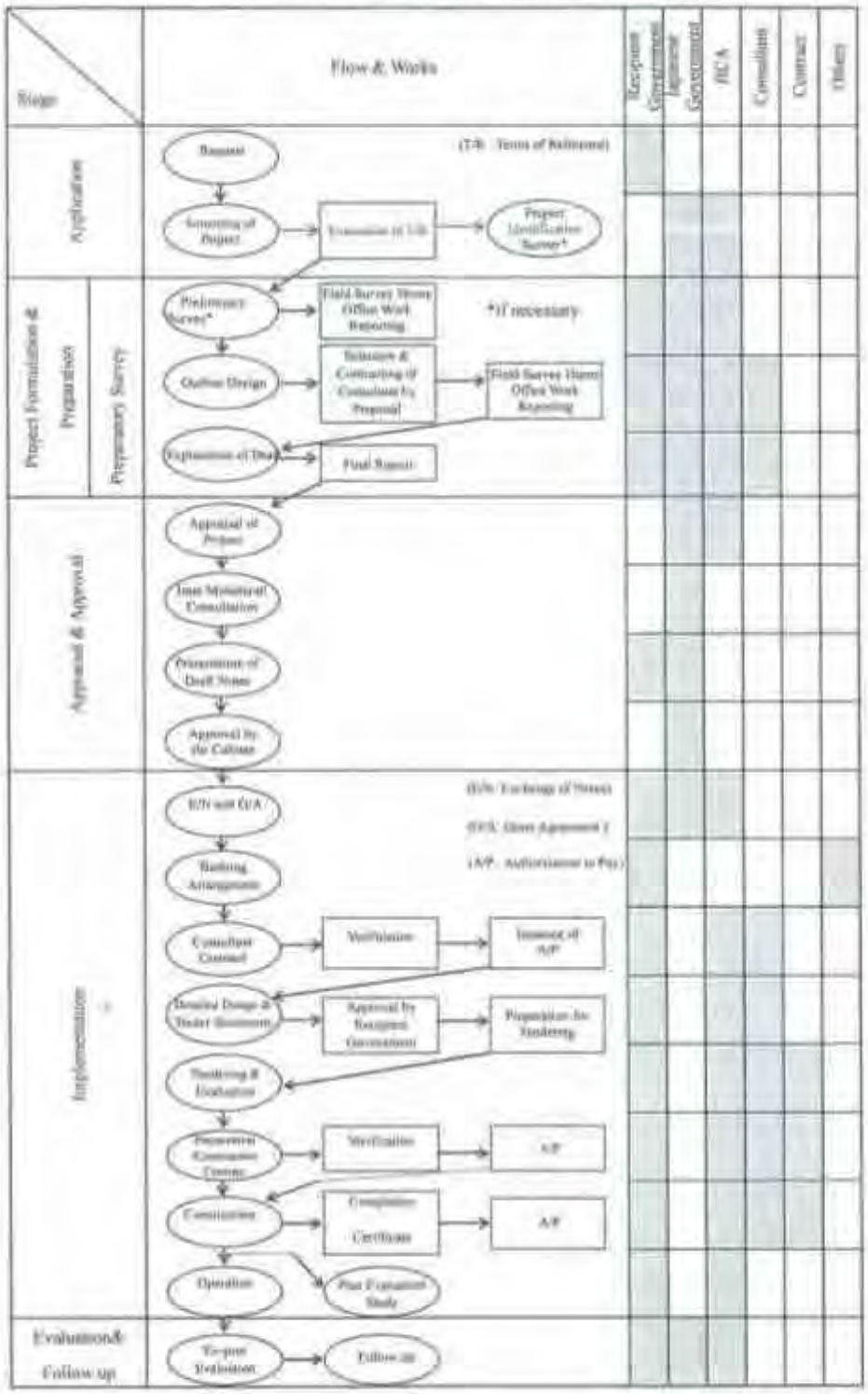
(10) Social and Environmental Considerations

A recipient country must ensure the social and environmental considerations for the Project and must follow the environmental regulation of the recipient country and JICA socio-environmental guideline.

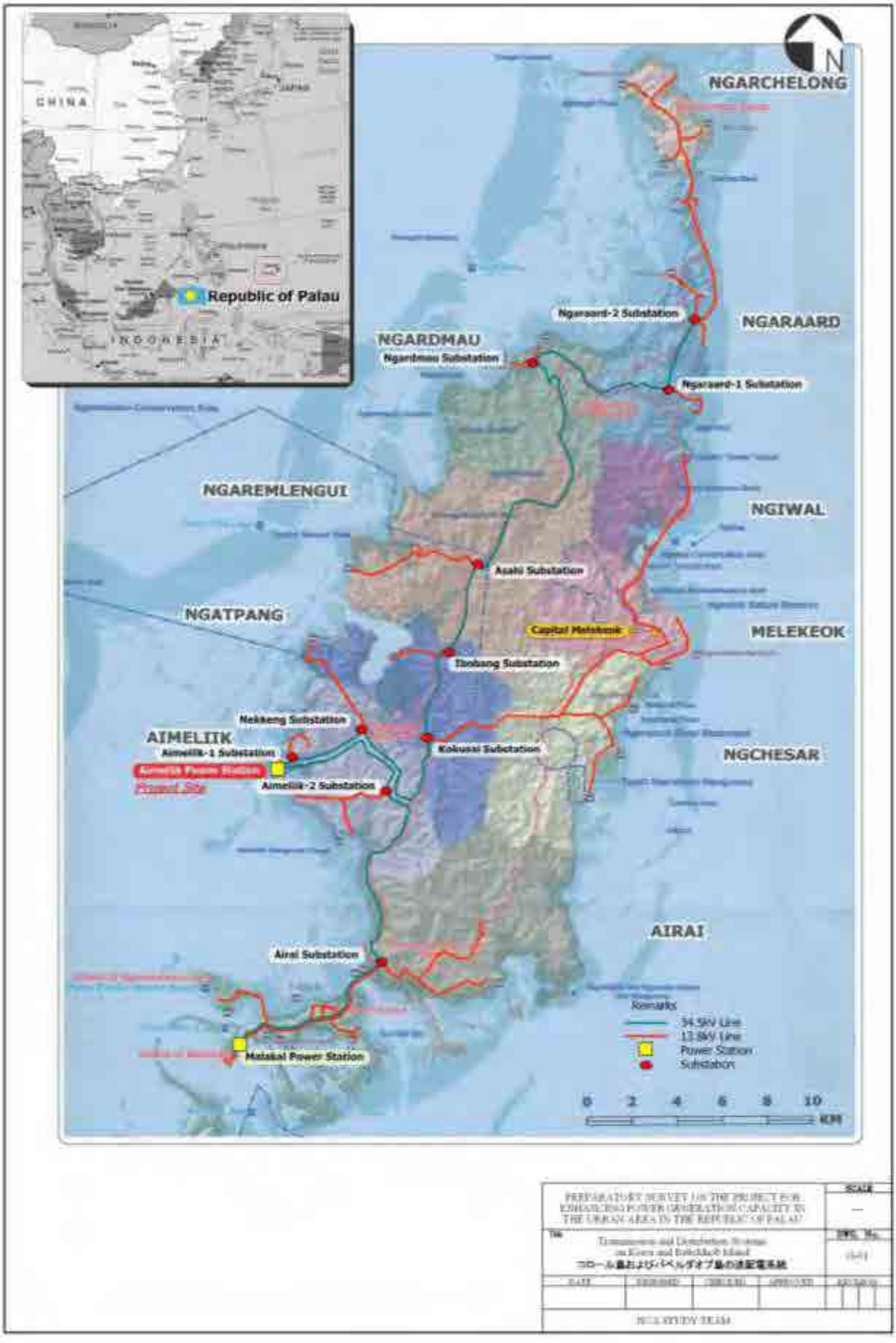
(End)

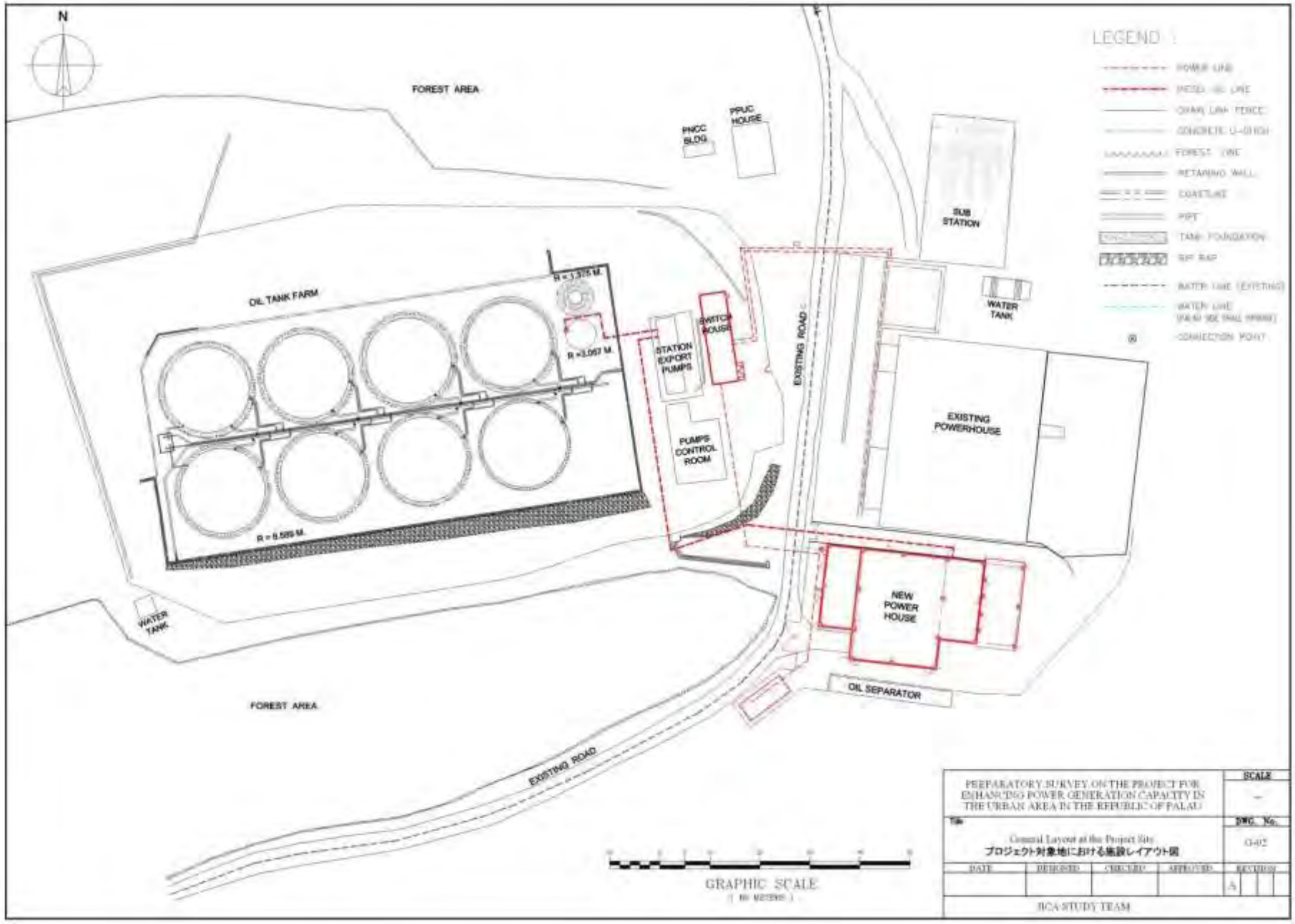
Annex-8

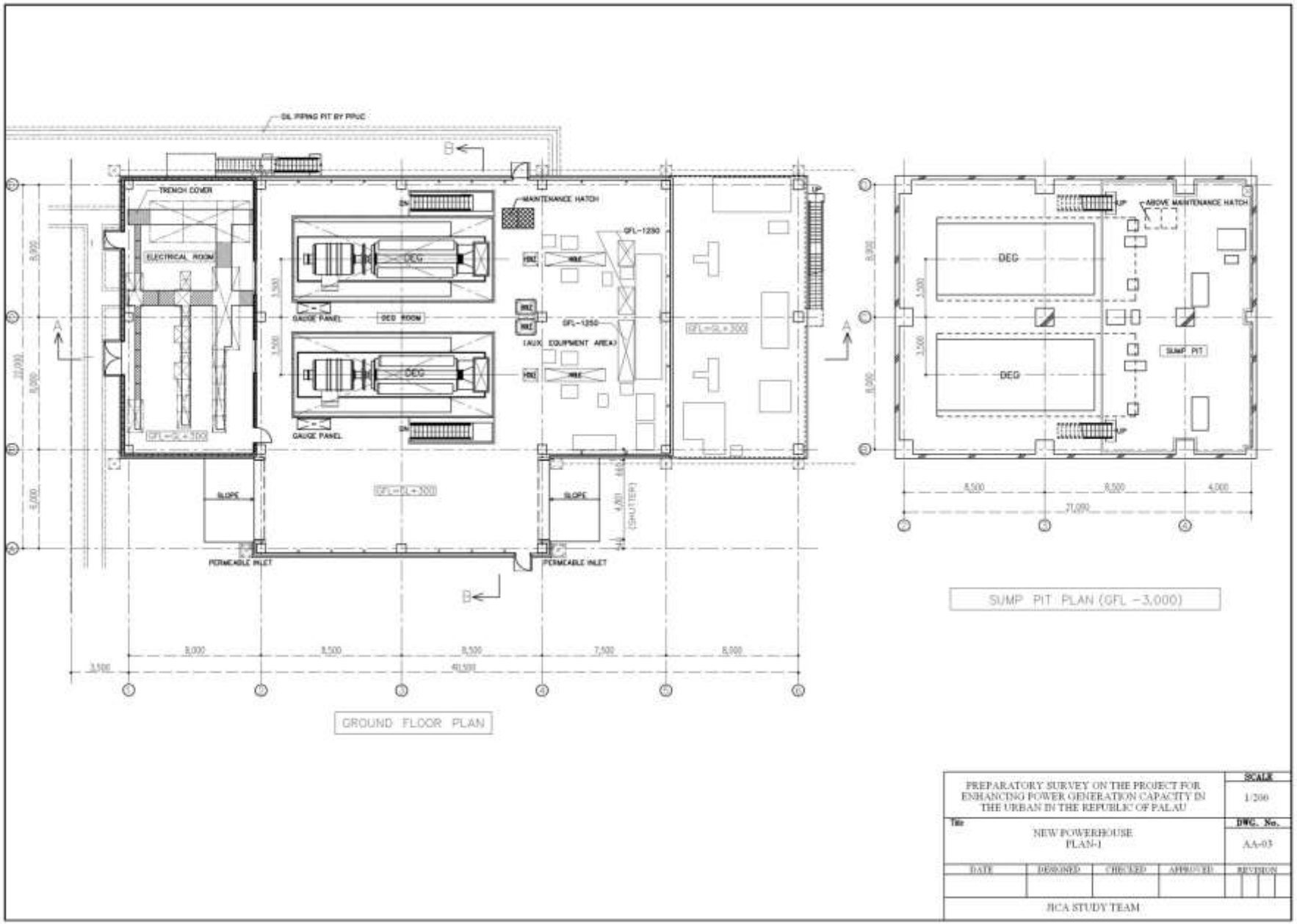
Flow Chart of Japan's Grant Aid Procedures



A-５　Drawings


CHINA
INDONESIA
Republic of Palau
N
NGARCHELONG
NGARAARD
NGARDMAU
NGAREMLENGUI
NGIWAL
NGATPANG
MELEKEOK
NGCHESAR
AIMELIIK
AIRAI
Ngaraard-2 Substation
Ngardmau Substation
Ngaraard-1 Substation
Asahi Substation
Capital Melekeok
Ibobang Substation
Nekkeng Substation
Kokusai Substation
Aimeliik-1 Substation
Aimeliik Power Station
Project Site
Aimeliik-2 Substation
Airai Substation
Matakal Power Station
Remarks
34.5kV Line
13.8kV Line
Power Station
Substation
0 2 4 6 8 10
KM
SCALE
—

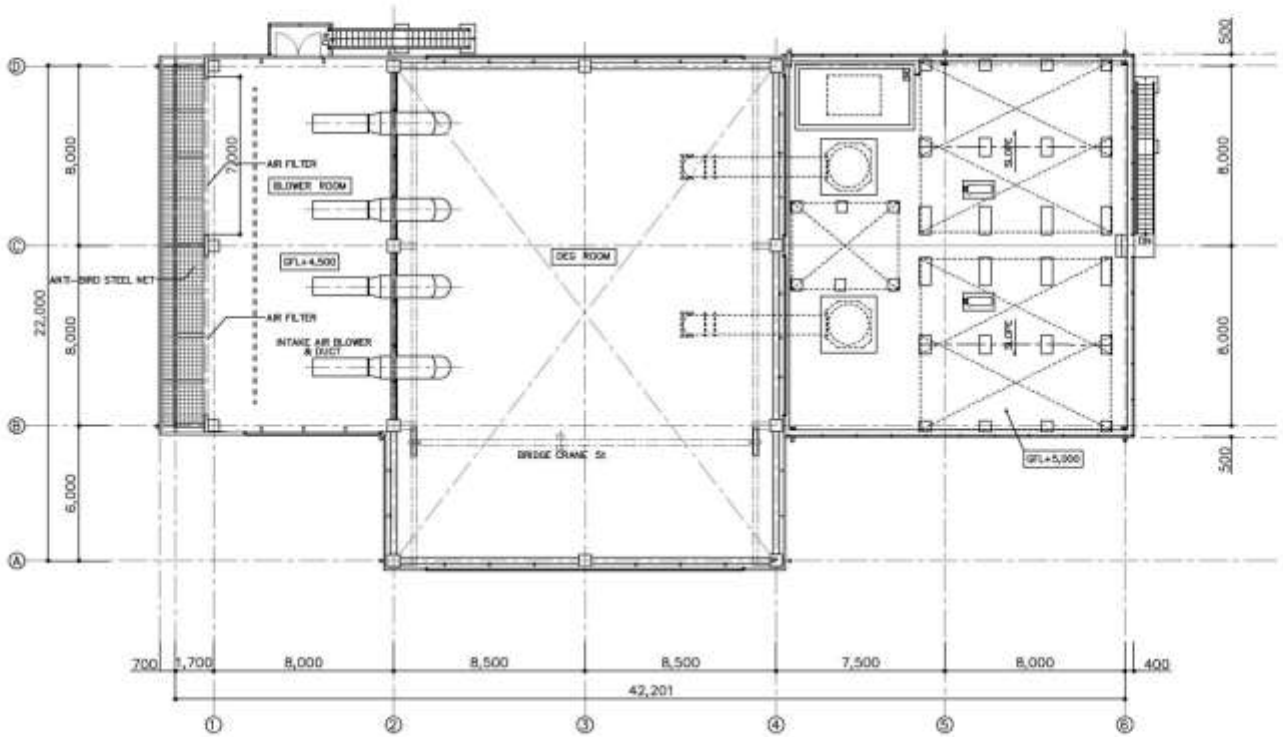

N
FOREST AREA
PNCC BLDG.
PPUC HOUSE
SUB STATION
WATER TANK
OIL TANK FARM
R = 1,375 M.
R = 3,097 M.
R = 8,589 M.
STATION EXPORT PUMPS
SWITCH HOUSE
PUMPS CONTROL ROOM
EXISTING ROAD
EXISTING POWERHOUSE
NEW POWER HOUSE
OIL SEPARATOR
WATER TANK
FOREST AREA
EXISTING ROAD
LEGEND :
POWER LINE
FENCE (E) LINE
CHAIN LINK FENCE
CONCRETE U-DITCH
FOREST LINE
RETAINING WALL
COASTLINE
PIPE
TANK FOUNDATION
RIP RAP
WATER LINE (EXISTING)
WATER LINE (F&B 100 SMALL HYDRANT)
CONNECTION POINT
GRAPHIC SCALE
(IN METERS)
PREPARATORY SURVEY ON THE PROJECT FOR ENHANCING POWER GENERATION CAPACITY IN THE URBAN AREA IN THE REPUBLIC OF PALAU
SCALE
–
Title
General Layout at the Project Site
プロジェクト対象地における施設レイアウト図
DWG. No.
G-02
DATE
DESIGNED
CHECKED
APPROVED
REVISION
A
JICA STUDY TEAM



GROUND FLOOR PLAN

SUMP PIT PLAN (GFL -3,000)

PREPARATORY SURVEY ON THE PROJECT FOR ENHANCING POWER GENERATION CAPACITY IN THE URBAN IN THE REPUBLIC OF PALAU	SCALE: 1/200
Title: NEW POWERHOUSE PLAN-1	DWG. No.: AA-03
DATE / DESIGNED / CHECKED / APPROVED / REVISION	
JICA STUDY TEAM	



1FL PLAN (GFL+5,000, 4,500)

MARK SHOW FITTINGS, SEE FITTING DRAWING

PREPARATORY SURVEY ON THE PROJECT FOR ENHANCING POWER GENERATION CAPACITY IN THE URBAN IN THE REPUBLIC OF PALAU	SCALE 1/200
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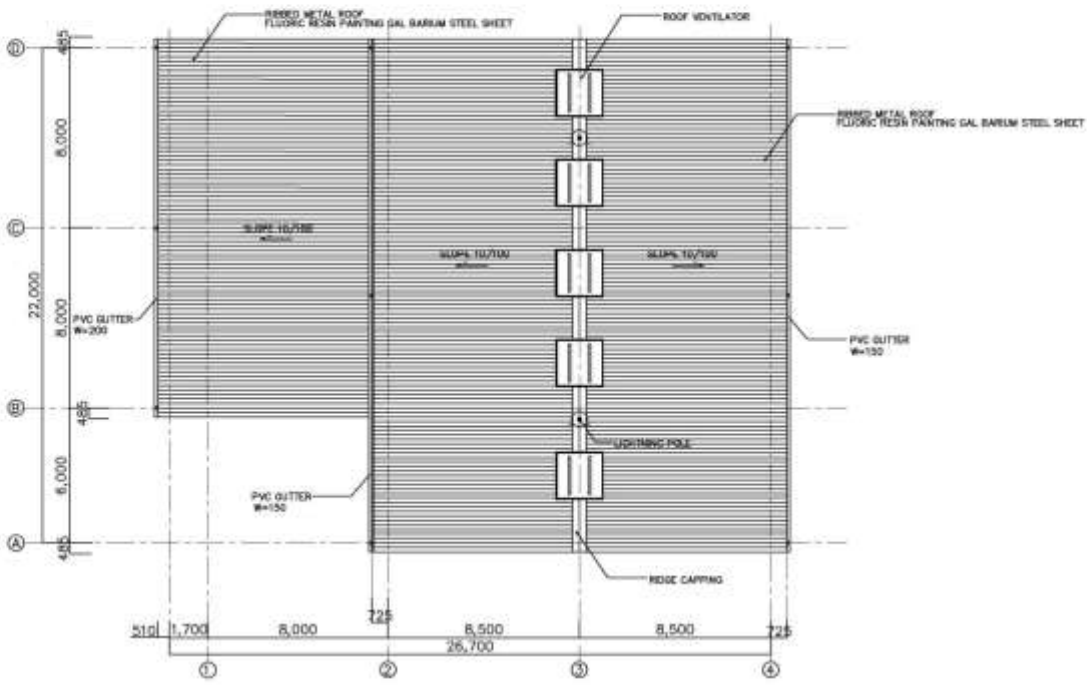
DATE / DESIGNED / CHECKED / APPROVED / REVISION	
JICA STUDY TEAM	



ROOF PLAN 1/200

PREPARATORY SURVEY ON THE PROJECT FOR ENHANCING POWER GENERATION CAPACITY IN THE URBAN IN THE REPUBLIC OF PALAU				SCALE 1/200
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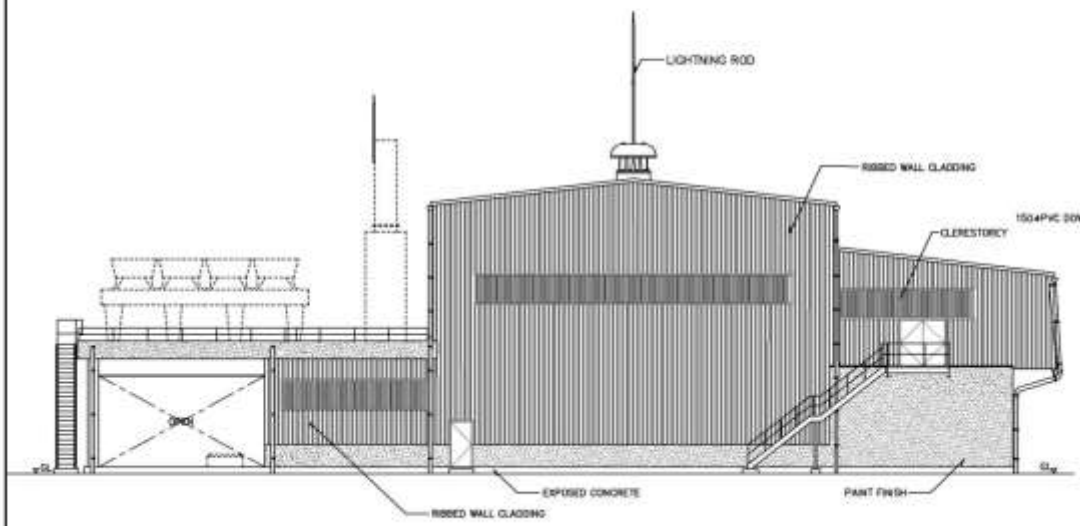
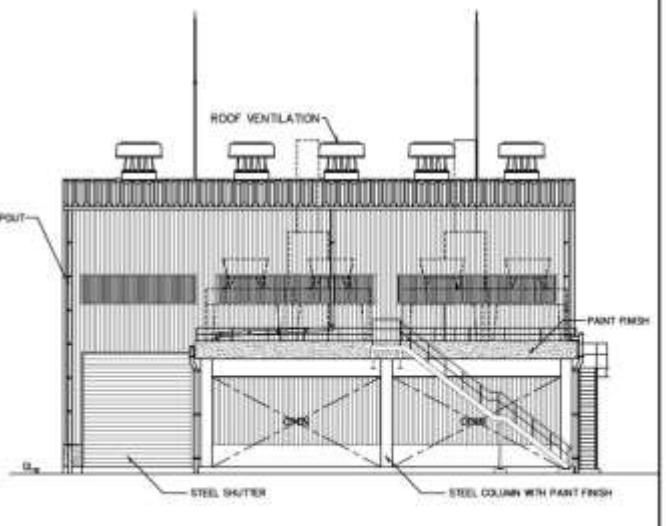
DATE	DESIGNED	CHECKED	APPROVED	REVISION
JICA STUDY TEAM				



NORTH ELEVATION 1/200



EAST ELEVATION 1/200

PREPARATORY SURVEY ON THE PROJECT FOR ENHANCING POWER GENERATION CAPACITY IN THE URBAN IN THE REPUBLIC OF PALAU	SCALE 1/200
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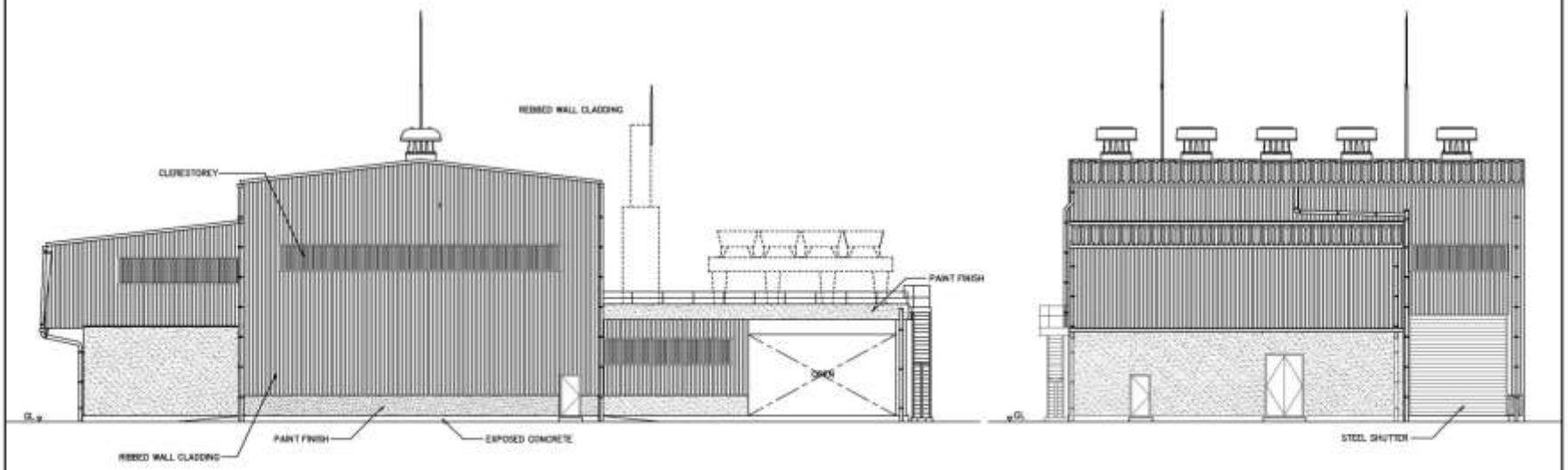
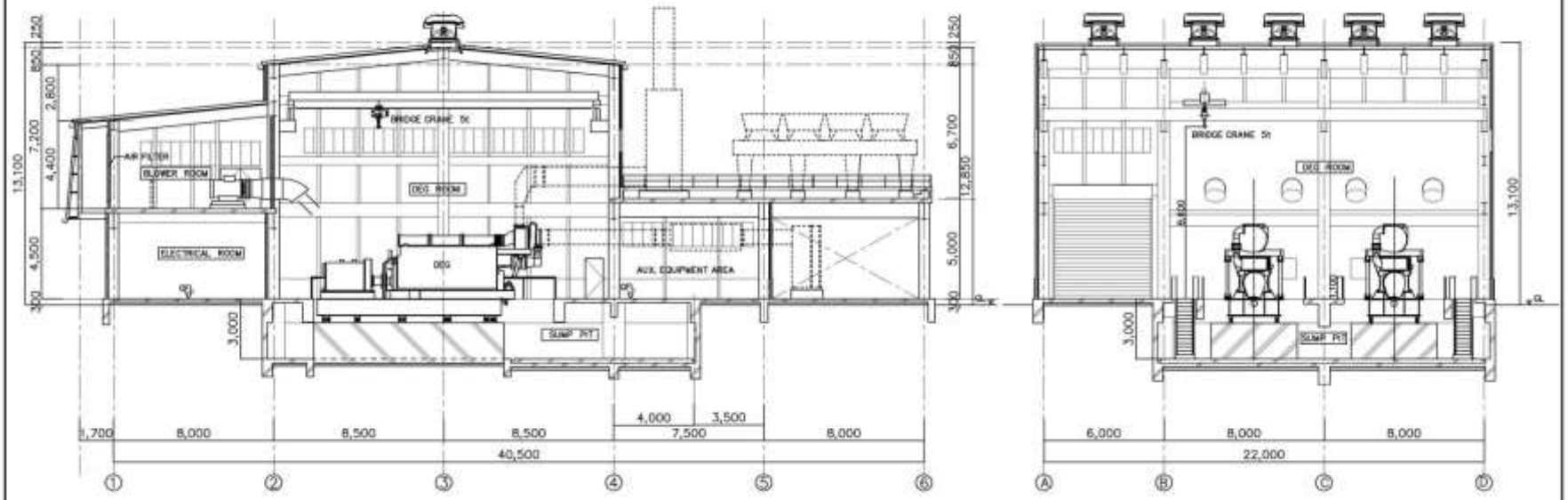
DATE / DESIGNED / CHECKED / APPROVED / REVISION	
JICA STUDY TEAM	



SOUTH ELEVATION 1/200

WEST ELEVATION 1/200

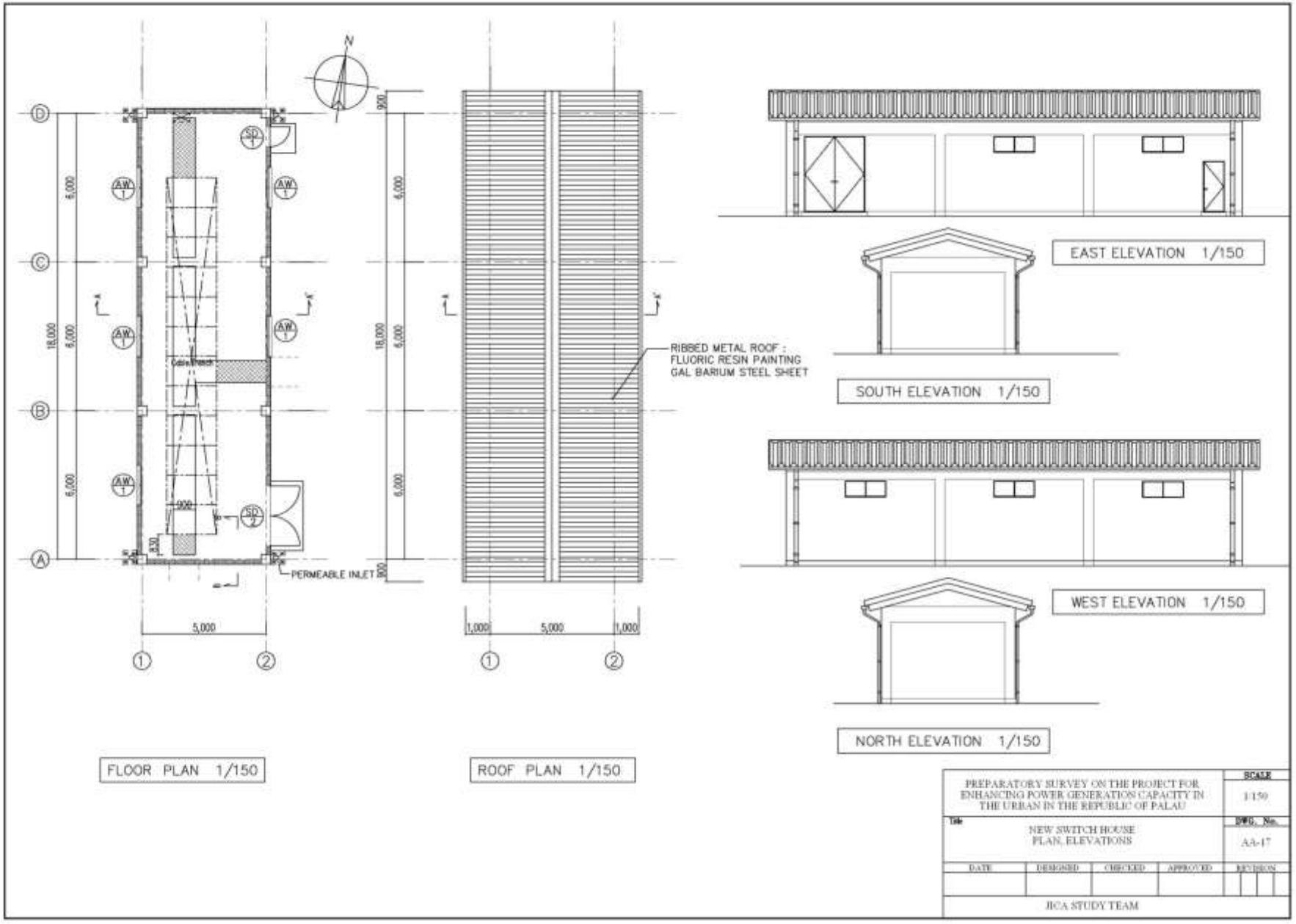
PREPARATORY SURVEY ON THE PROJECT FOR ENHANCING POWER GENERATION CAPACITY IN THE URBAN IN THE REPUBLIC OF PALAU	SCALE 1/200
Title: NEW POWERHOUSE ELEVATION-2	DWG. No. AA-07
DATE / DESIGNED / CHECKED / APPROVED	REVISION
JICA STUDY TEAM	



SECTION A – A' 1/200

SECTION B – B' 1/200

PREPARATORY SURVEY ON THE PROJECT FOR ENHANCING POWER GENERATION CAPACITY IN THE URBAN IN THE REPUBLIC OF PALAU	SCALE 1/200
Title: NEW POWERHOUSE SECTION	DWG. No. AA-08
DATE / DESIGNED / CHECKED / APPROVED / REVISION	
JICA STUDY TEAM	


N
RIBBED METAL ROOF :
FLUORIC RESIN PAINTING
GAL BARIUM STEEL SHEET
PERMEABLE INLET
EAST ELEVATION 1/150
SOUTH ELEVATION 1/150
WEST ELEVATION 1/150
NORTH ELEVATION 1/150
FLOOR PLAN 1/150
ROOF PLAN 1/150
PREPARATORY SURVEY ON THE PROJECT FOR ENHANCING POWER GENERATION CAPACITY IN THE URBAN IN THE REPUBLIC OF PALAU
SCALE
1/150
Title
NEW SWITCH HOUSE
PLAN, ELEVATIONS
DWG. No.
AA-17
DATE
DESIGNED
CHECKED
APPROVED
REVISION
JICA STUDY TEAM

1. PIPING AND ACCESSORIES

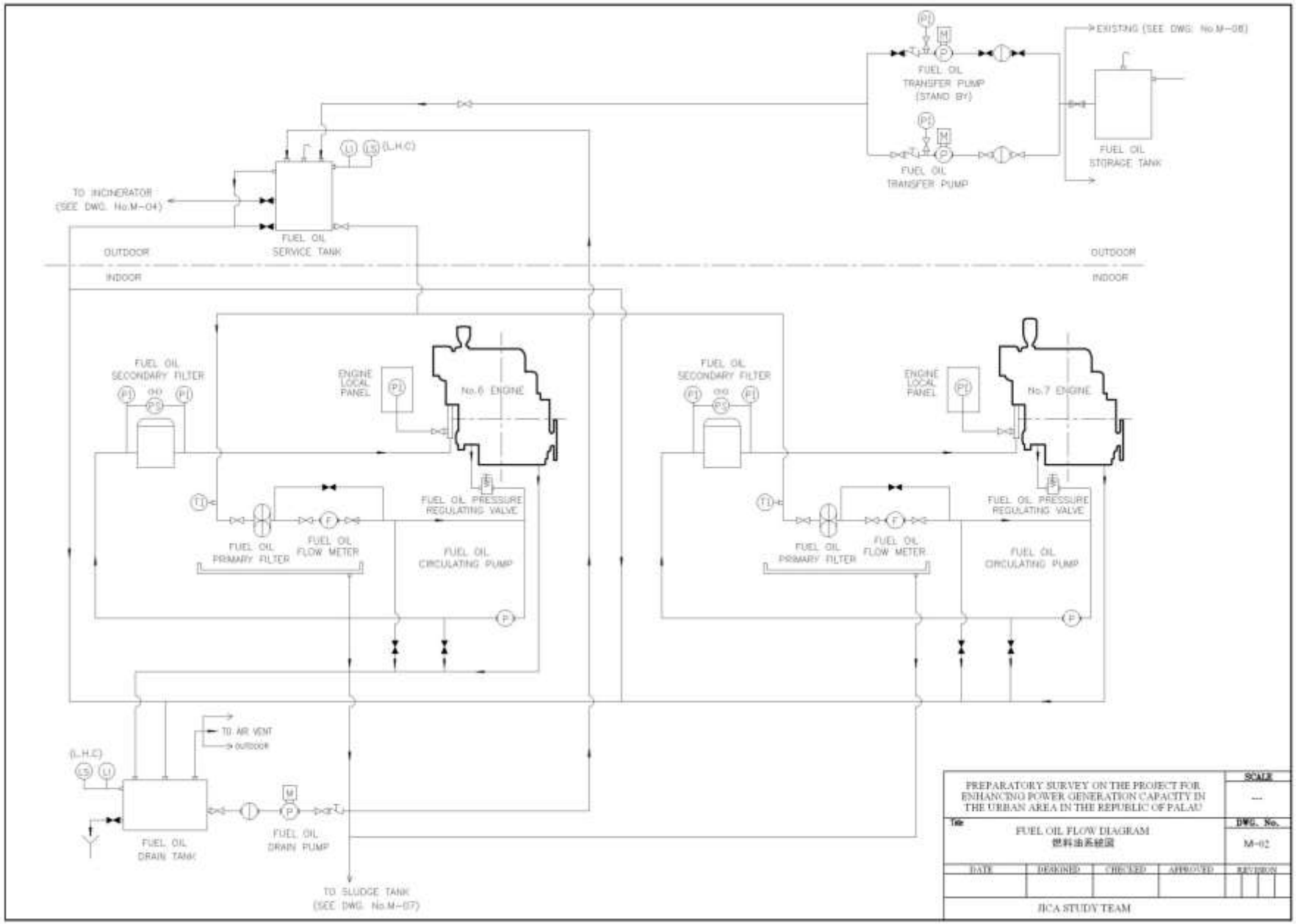
SYMBOL	DESCRIPTIONS
	PIPING LINE
	INSULATED PIPING LINE
	CONNECTED PIPE
	NON-CONNECTED PIPE
	GLOBE VALVE
	CLOSED VALVE AT NORMAL OPERATION
	CHECK VALVE
	SCREW-DOWN CHECK VALVE
	AUTOMATIC TEMP. CONTOROL VALVE
	PRESSURE REGULATING VALVE
	PRESSURE REDUCING VALVE
	SOLENOID VALVE
	SAFETY VALVE

SYMBOL	DESCRIPTIONS
	MOTOR DRIVEN PUMP
	DUPLEX FILTER
	SINGLE FILTER OR Y TYPE FILTER
	EXPANTION JOINT
	TO DRAIN
	AIR VENT
	OIL DRAIN PAN
	DRAIN TRAP

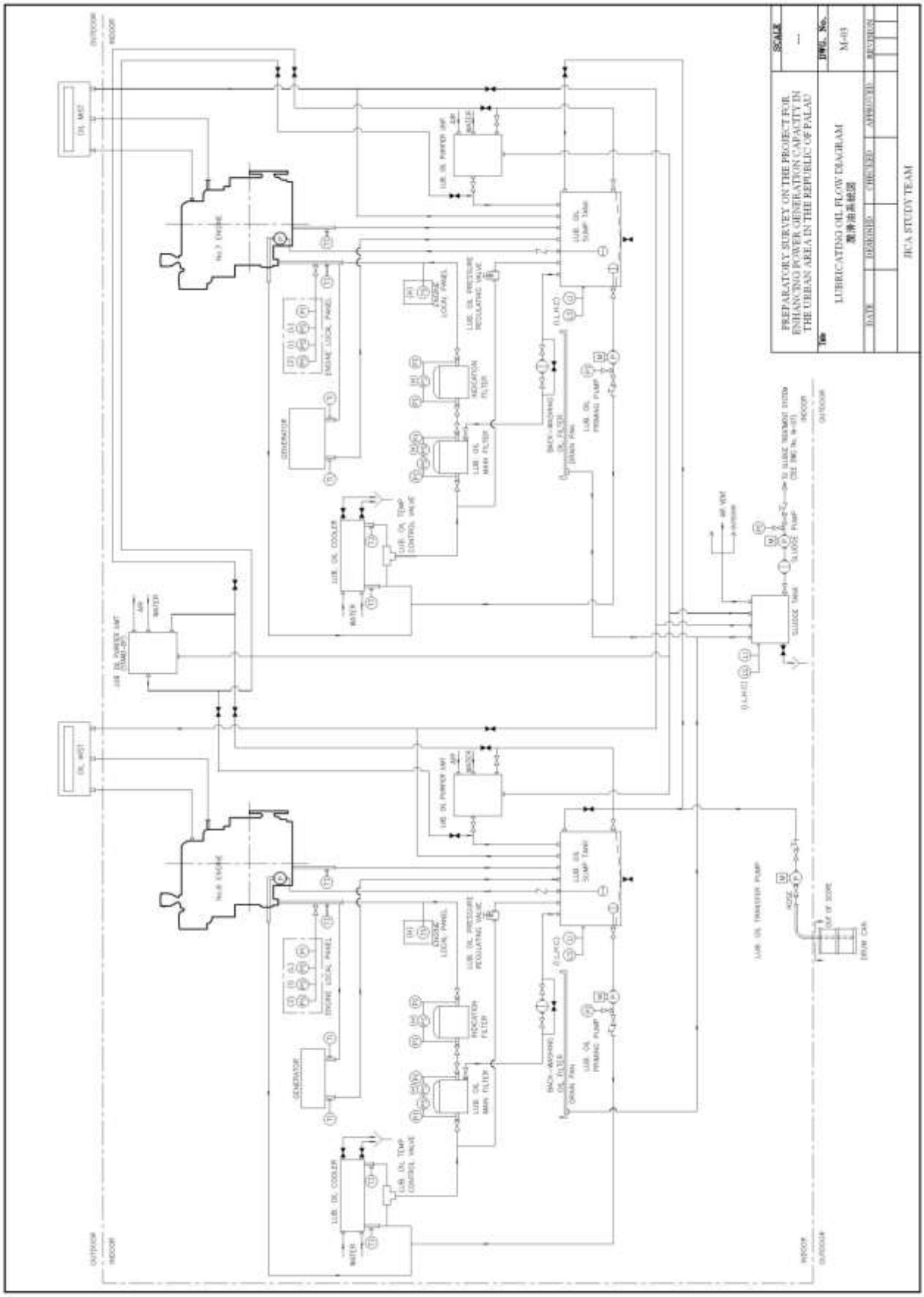
2. INSTRUMENTS

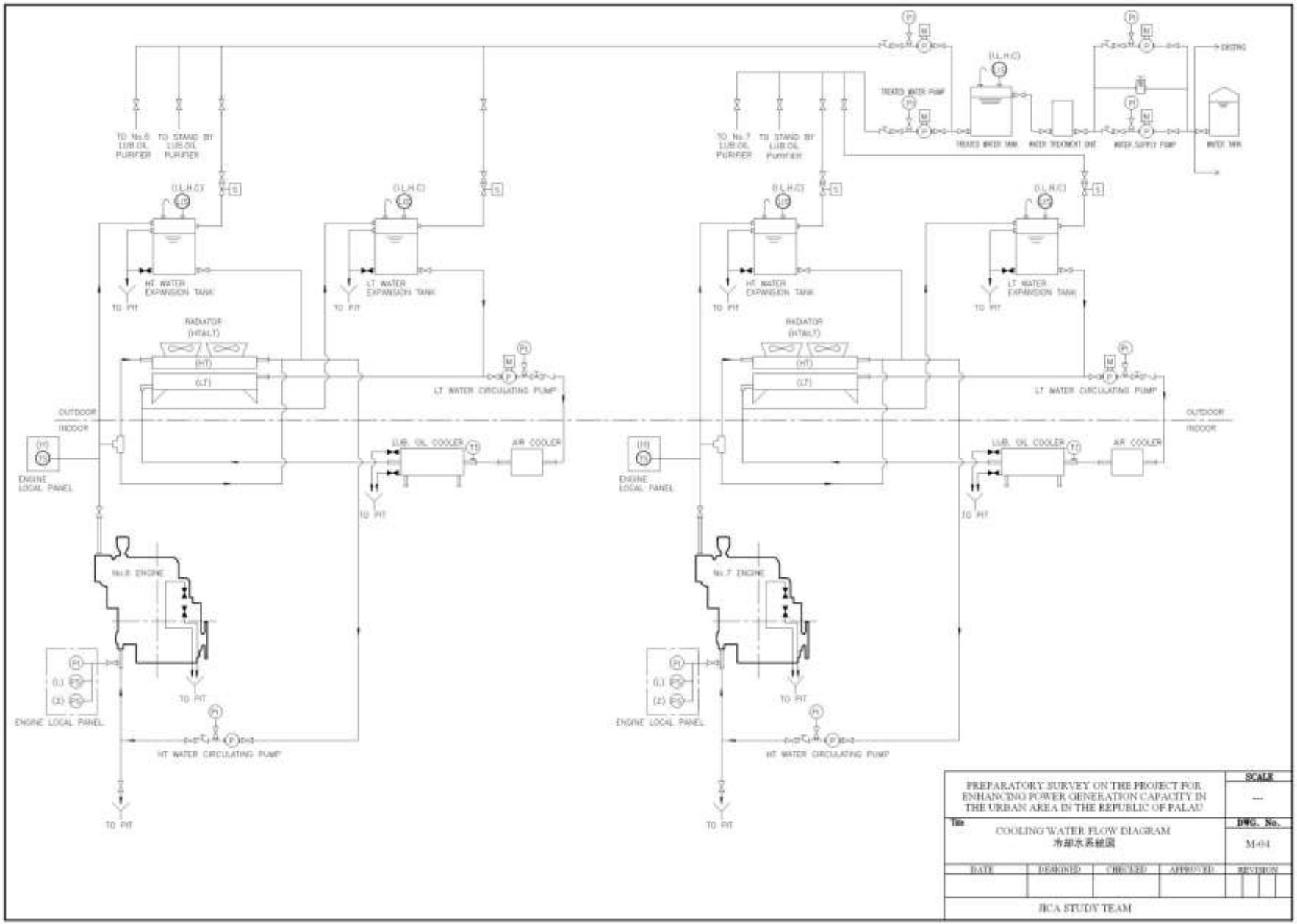
SYMBOL	DESCRIPTIONS
P	PRESSURE
T	TEMPERATURE
L	LEVEL
D	DIFFERENTIAL
I	INDICATOR
S	SWITCH
E	ELEMENT
TRS	TEMPERATURE RECORDER WITH SWITCH
MS	OIL MIST ABNORMAL SWITCH
(C)	AUTOMATIC CONTROL
(L)	LOW (FOR CONTROL)
(H)	HIGH (FOR CONTROL)
(LL)	EXTRA LOW (ALARM)
(HH)	EXTRA HIGH (ALARM)
(I)	INTERLOCK
(Z)	ALARM AND ENGINE SHUT DOWN BY HEAVY FAULT

PREPARATORY SURVEY ON THE PROJECT FOR ENHANCING POWER GENERATION CAPACITY IN THE URBAN AREA IN THE REPUBLIC OF PALAU	SCALE: ---
Title: SYMBOL LIST シンボルリスト	DWG. No.: M-01
DATE / DESIGNED / CHECKED / APPROVED	REVISION
JICA STUDY TEAM	

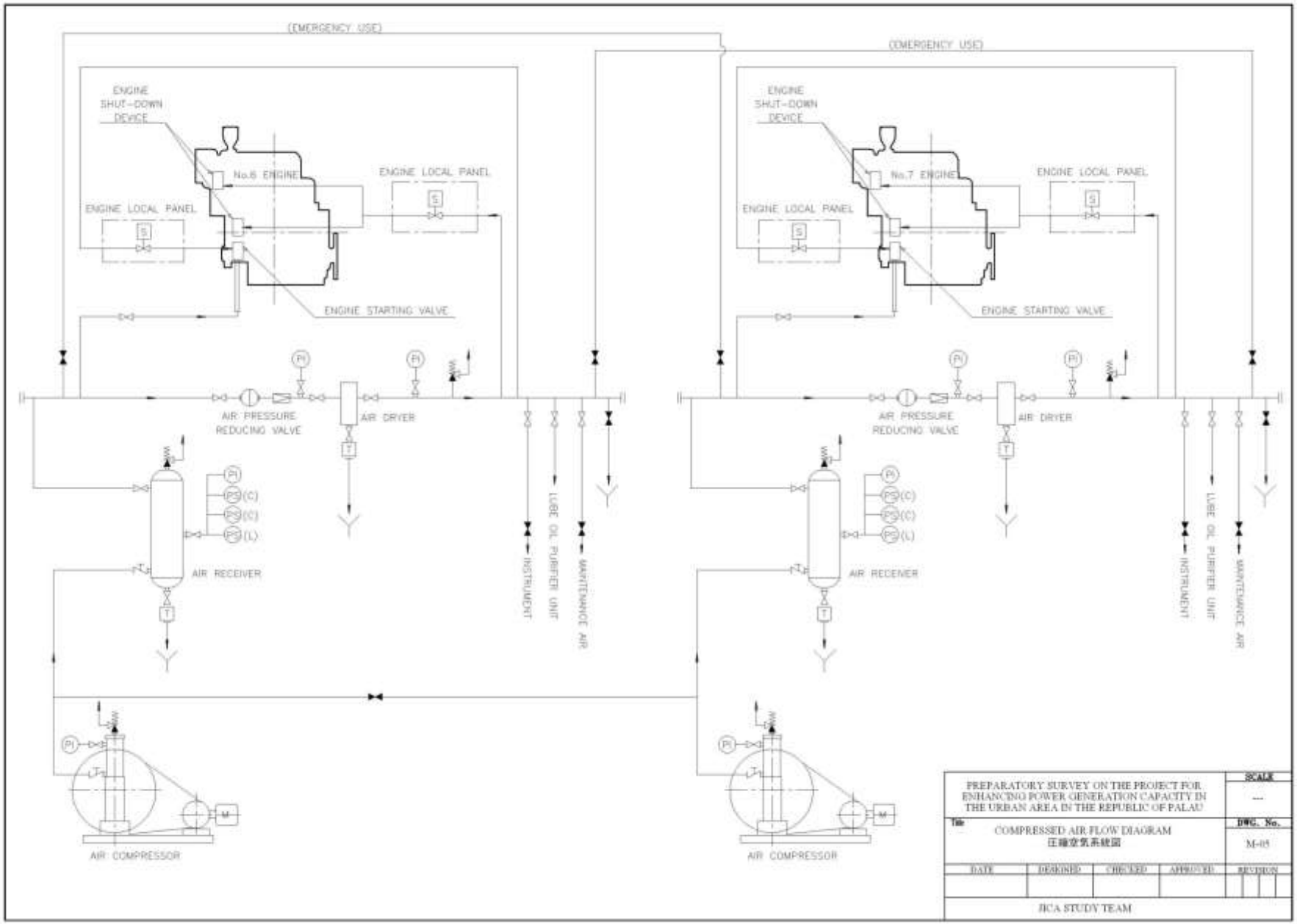

EXISTING (SEE DWG. No.M-08)
FUEL OIL TRANSFER PUMP (STAND BY)
FUEL OIL TRANSFER PUMP
FUEL OIL STORAGE TANK
TO INCINERATOR (SEE DWG. No.M-04)
(L,H,C)
FUEL OIL SERVICE TANK
OUTDOOR
INDOOR
FUEL OIL SECONDARY FILTER
ENGINE LOCAL PANEL
No.6 ENGINE
No.7 ENGINE
FUEL OIL PRESSURE REGULATING VALVE
FUEL OIL PRIMARY FILTER
FUEL OIL FLOW METER
FUEL OIL CIRCULATING PUMP
TO AIR VENT
FUEL OIL DRAIN TANK
FUEL OIL DRAIN PUMP
TO SLUDGE TANK (SEE DWG. No.M-07)
PREPARATORY SURVEY ON THE PROJECT FOR ENHANCING POWER GENERATION CAPACITY IN THE URBAN AREA IN THE REPUBLIC OF PALAU
SCALE

Title
FUEL OIL FLOW DIAGRAM
燃料油系統図
DWG. No.
M-02
DATE
DRAWN
CHECKED
APPROVED
REVISION
JICA STUDY TEAM

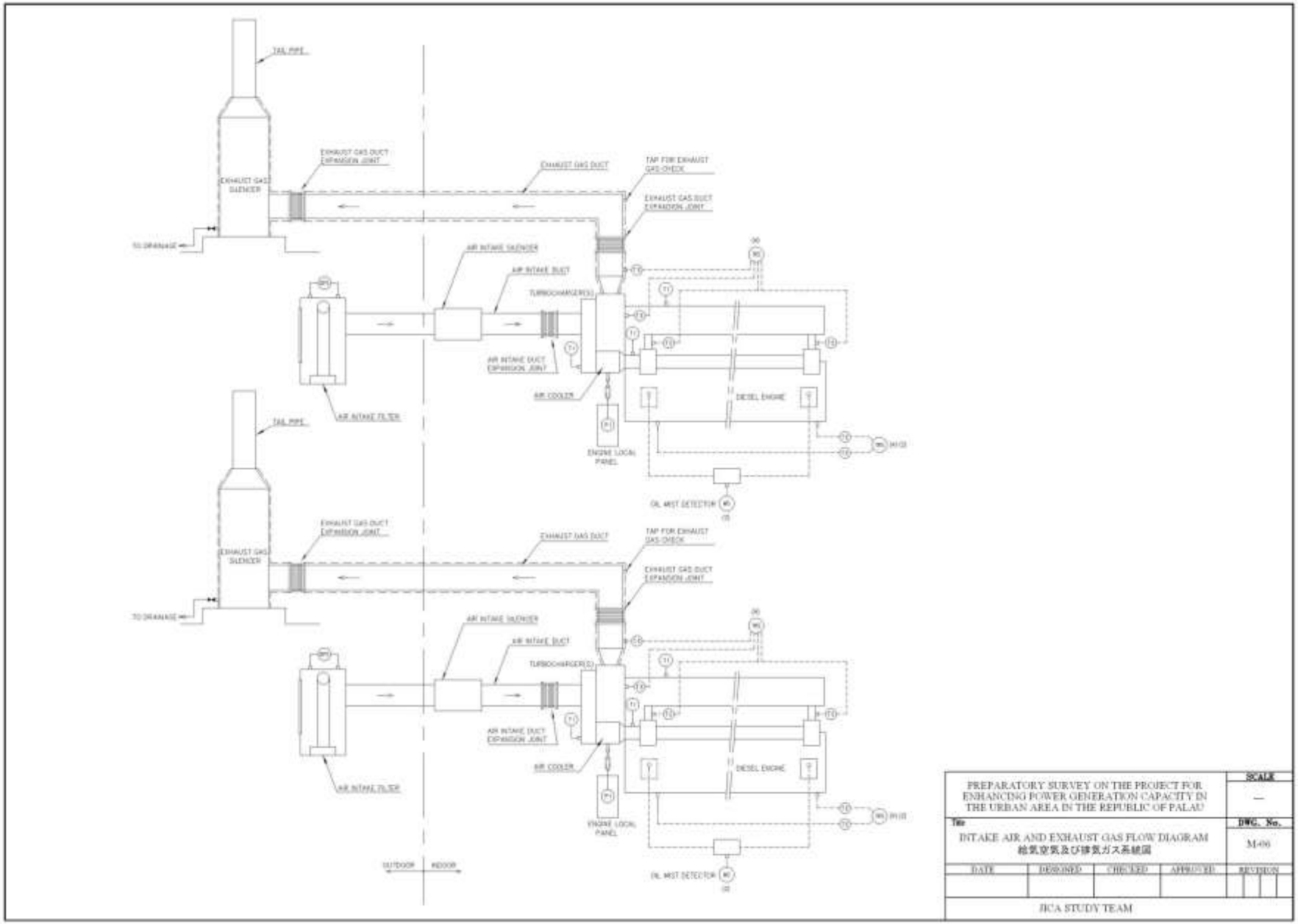

PREPARATORY SURVEY ON THE PROJECT FOR ENHANCING POWER GENERATION CAPACITY IN THE URBAN AREA IN THE REPUBLIC OF PALAU
LUBRICATING OIL FLOW DIAGRAM
M-03
JICA STUDY TEAM


TO No.6 LUB.OIL PURIFIER
TO STAND BY LUB.OIL PURIFIER
TO No.7 LUB.OIL PURIFIER
TO STAND BY LUB.OIL PURIFIER
TREATED WATER PUMP
TREATED WATER TANK
WATER TREATMENT UNIT
WATER SUPPLY PUMP
WATER TANK
EXISTING
(L.L.H.C)
HT WATER EXPANSION TANK
LT WATER EXPANSION TANK
TO PIT
RADIATOR (HT&LT)
(HT)
(LT)
LT WATER CIRCULATING PUMP
OUTDOOR
INDOOR
LUB. OIL COOLER
AIR COOLER
ENGINE LOCAL PANEL
No.8 ENGINE
No.7 ENGINE
HT WATER CIRCULATING PUMP
PREPARATORY SURVEY ON THE PROJECT FOR ENHANCING POWER GENERATION CAPACITY IN THE URBAN AREA IN THE REPUBLIC OF PALAU
SCALE

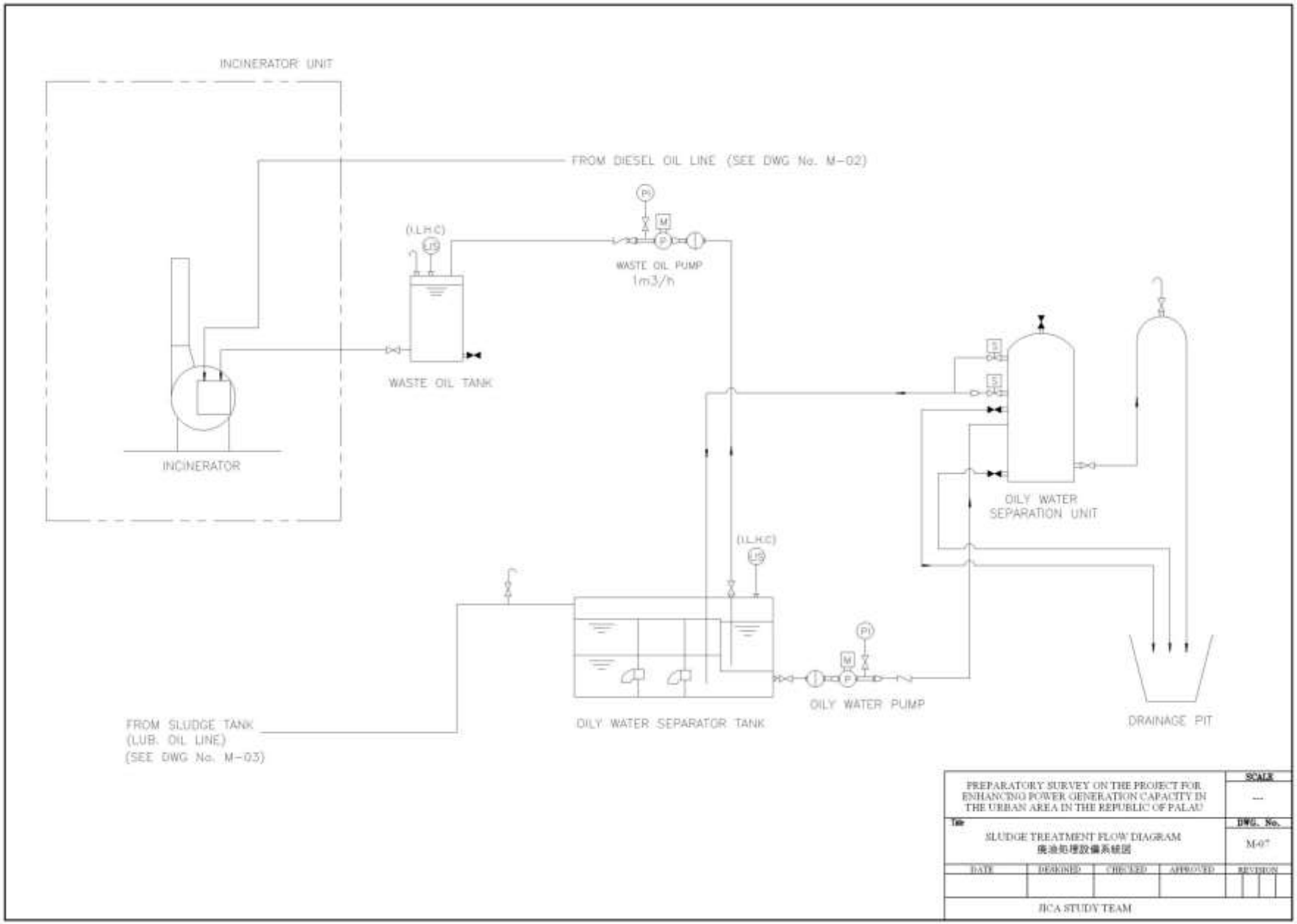
Title
COOLING WATER FLOW DIAGRAM
冷却水系統図
DWG. No.
M-04
DATE
DESIGNED
CHECKED
APPROVED
REVISION
JICA STUDY TEAM


(EMERGENCY USE)
ENGINE SHUT-DOWN DEVICE
No.6 ENGINE
ENGINE LOCAL PANEL
ENGINE LOCAL PANEL
ENGINE STARTING VALVE
AIR PRESSURE REDUCING VALVE
AIR DRYER
AIR RECEIVER
AIR COMPRESSOR
INSTRUMENT
LUBE OIL PURIFIER UNIT
MAINTENANCE AIR
(EMERGENCY USE)
ENGINE SHUT-DOWN DEVICE
No.7 ENGINE
ENGINE LOCAL PANEL
ENGINE LOCAL PANEL
ENGINE STARTING VALVE
AIR PRESSURE REDUCING VALVE
AIR DRYER
AIR RECEIVER
AIR COMPRESSOR
INSTRUMENT
LUBE OIL PURIFIER UNIT
MAINTENANCE AIR
PREPARATORY SURVEY ON THE PROJECT FOR ENHANCING POWER GENERATION CAPACITY IN THE URBAN AREA IN THE REPUBLIC OF PALAU
SCALE

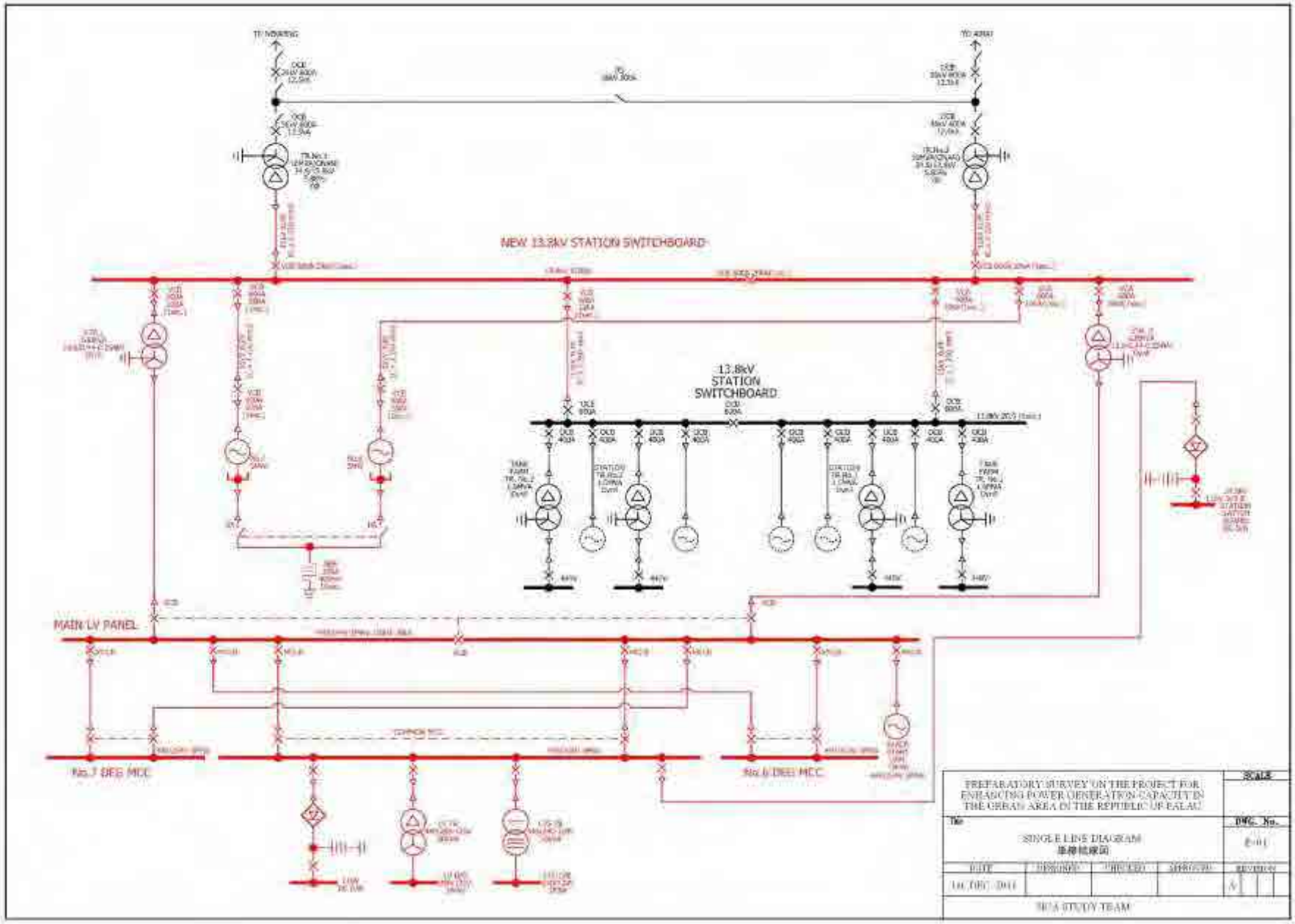
Title
COMPRESSED AIR FLOW DIAGRAM
圧縮空気系統図
DWG. No.
M-05
DATE
DESIGNED
CHECKED
APPROVED
REVISION
JICA STUDY TEAM

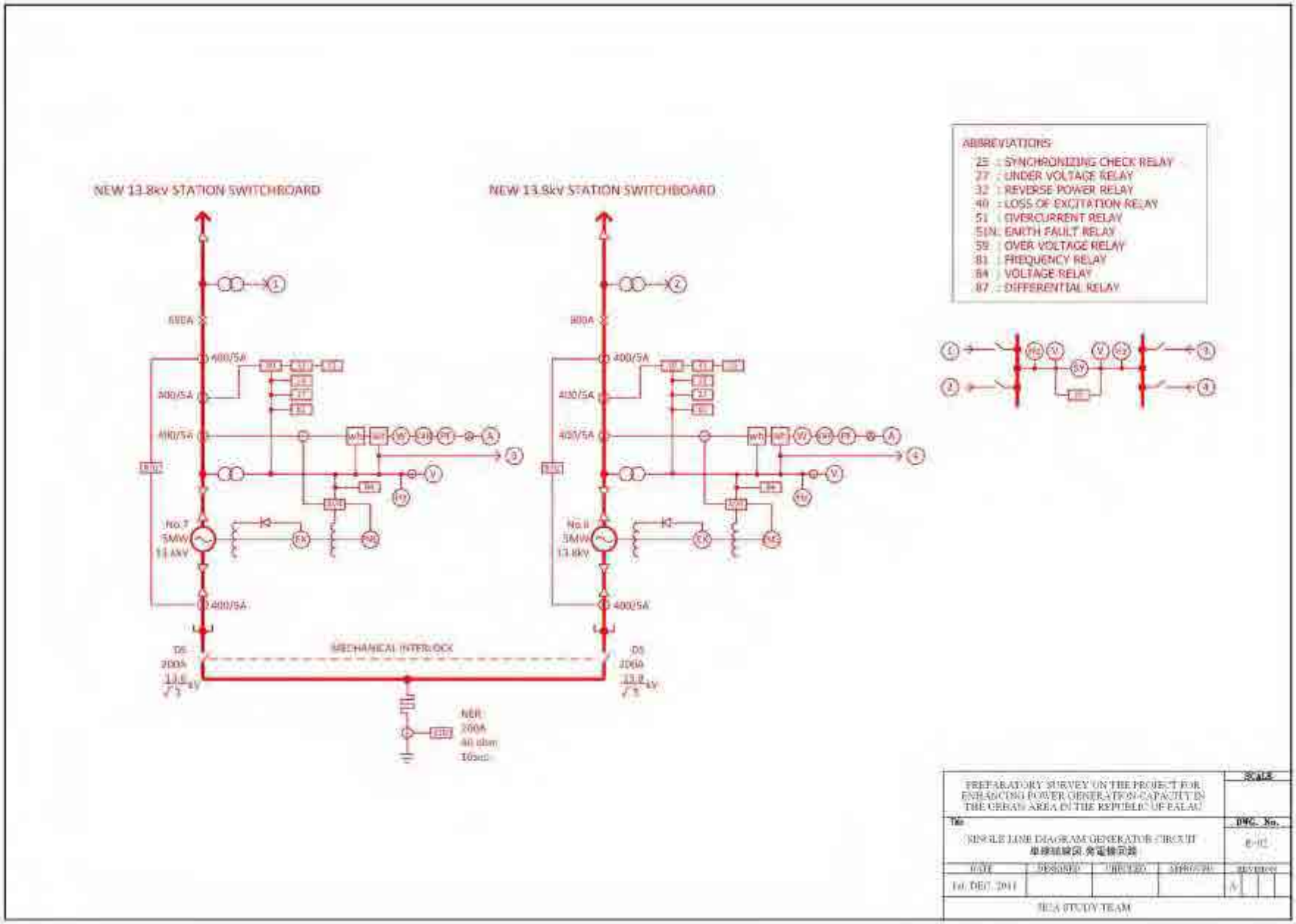


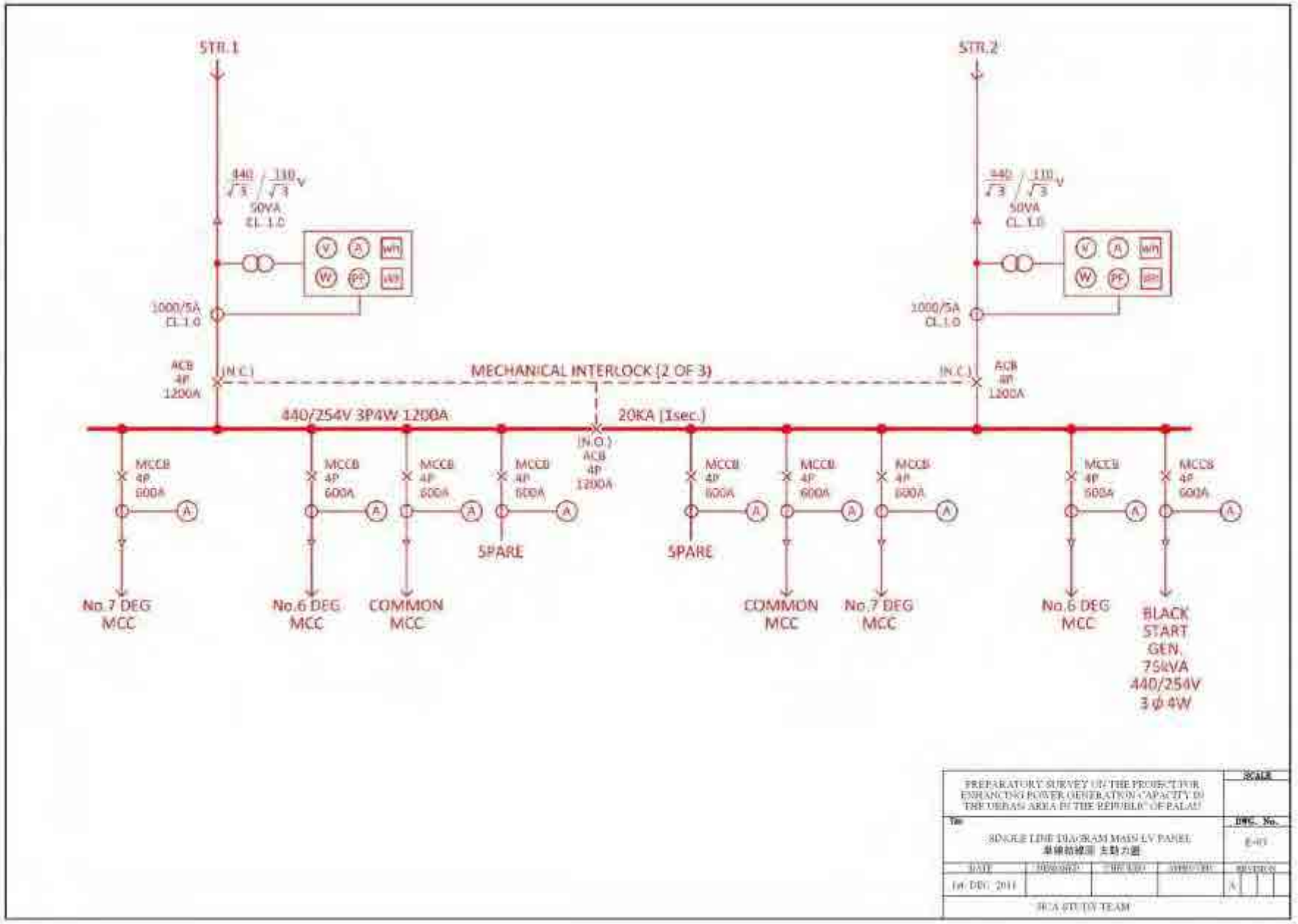
PREPARATORY SURVEY ON THE PROJECT FOR ENHANCING POWER GENERATION CAPACITY IN THE URBAN AREA IN THE REPUBLIC OF PALAU				SCALE: —
Title: INTAKE AIR AND EXHAUST GAS FLOW DIAGRAM 給気空気及び排気ガス系統図				DWG. No.: M-00
DATE	DESIGNED	CHECKED	APPROVED	REVISION
JICA STUDY TEAM				


INCINERATOR UNIT
FROM DIESEL OIL LINE (SEE DWG No. M-02)
(I.L.H.C)
WASTE OIL PUMP
1m3/h
WASTE OIL TANK
INCINERATOR
OILY WATER
SEPARATION UNIT
(I.L.H.C)
OILY WATER PUMP
OILY WATER SEPARATOR TANK
DRAINAGE PIT
FROM SLUDGE TANK
(LUB. OIL LINE)
(SEE DWG No. M-03)
PREPARATORY SURVEY ON THE PROJECT FOR ENHANCING POWER GENERATION CAPACITY IN THE URBAN AREA IN THE REPUBLIC OF PALAU
SCALE

Title
SLUDGE TREATMENT FLOW DIAGRAM
廃油処理設備系統図
DWG. No.
M-07
DATE
DESIGNED
CHECKED
APPROVED
REVISION
JICA STUDY TEAM


NEW 13.8kV STATION SWITCHBOARD
13.8kV
STATION
SWITCHBOARD
MAIN LV PANEL
No.7 DEG MCC
No.6 DEG MCC
PREPARATORY SURVEY ON THE PROJECT FOR
ENHANCING POWER GENERATION CAPACITY IN
THE URBAN AREA IN THE REPUBLIC OF PALAU
SCALE
SINGLE LINE DIAGRAM
DWG. No.
JICA STUDY TEAM


NEW 13.8kV STATION SWITCHBOARD
NEW 13.8kV STATION SWITCHBOARD
ABBREVIATIONS
25 : SYNCHRONIZING CHECK RELAY
27 : UNDER VOLTAGE RELAY
32 : REVERSE POWER RELAY
40 : LOSS OF EXCITATION RELAY
51 : OVERCURRENT RELAY
51N: EARTH FAULT RELAY
59 : OVER VOLTAGE RELAY
81 : FREQUENCY RELAY
84 : VOLTAGE RELAY
87 : DIFFERENTIAL RELAY
600A
800A
400/5A
No.7
5MW
13.8kV
No.8
5MW
13.8kV
MECHANICAL INTERLOCK
NER
200A
40 ohm
10sec
PREPARATORY SURVEY ON THE PROJECT FOR ENHANCING POWER GENERATION CAPACITY IN THE URBAN AREA IN THE REPUBLIC OF PALAU
SCALE
Title
SINGLE LINE DIAGRAM GENERATOR CIRCUIT
単線結線図 発電機回路
DWG. No.
E-02
DATE
DESIGNED
DRAWN
APPROVED
REVISION
1st DEC. 2011
A
JICA STUDY TEAM



PREPARATORY SURVEY ON THE PROJECT FOR ENHANCING POWER GENERATION CAPACITY IN THE URBAN AREA IN THE REPUBLIC OF PALAU

SCALE

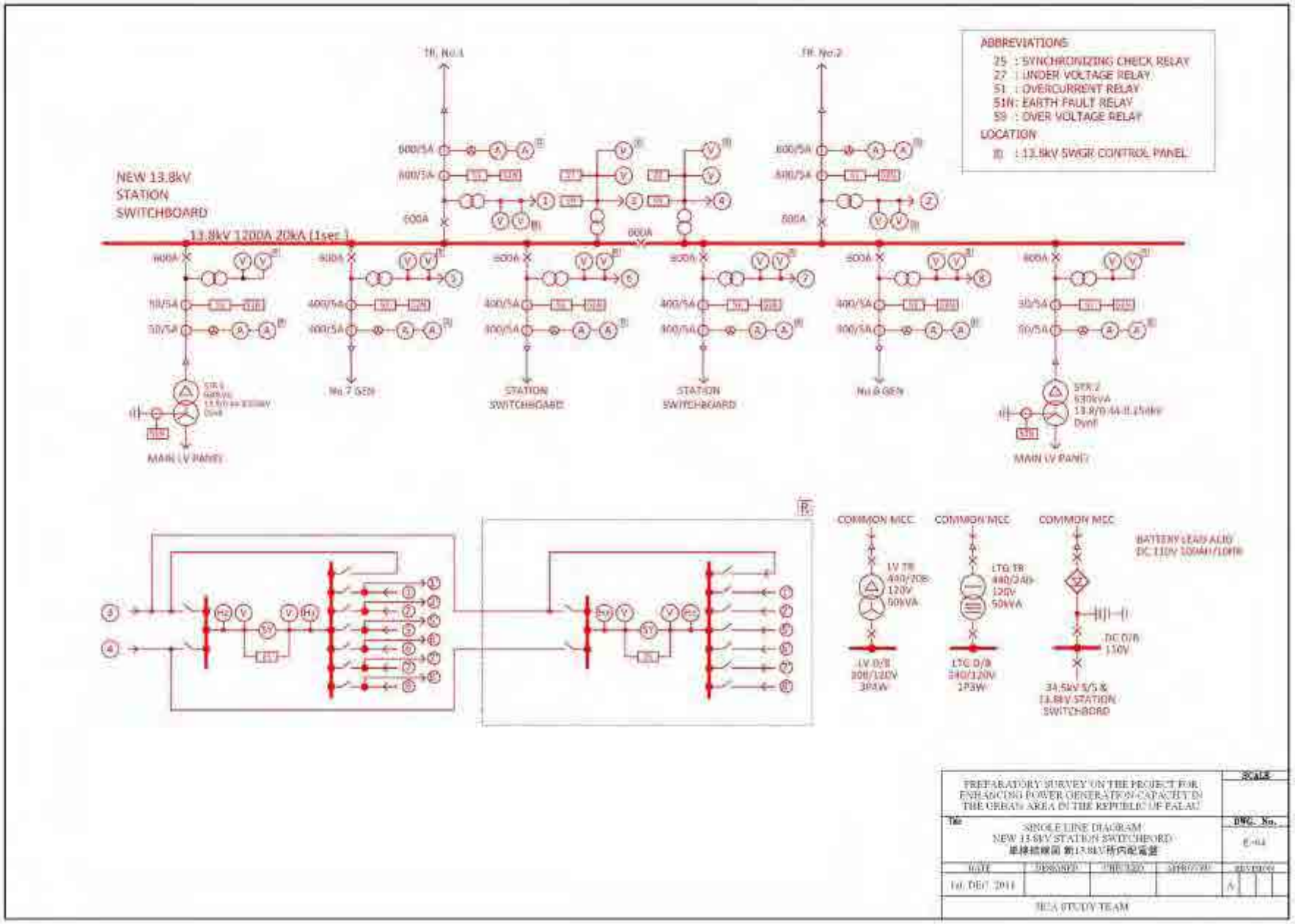
To:

SINGLE LINE DIAGRAM MAIN LV PANEL
単線結線図 主動力盤

DWG. No.
E-03

DATE	DESIGNED	CHECKED	APPROVED	REVISION
1st DEC. 2011				A

JICA STUDY TEAM


ABBREVIATIONS
25 : SYNCHRONIZING CHECK RELAY
27 : UNDER VOLTAGE RELAY
51 : OVERCURRENT RELAY
51N: EARTH FAULT RELAY
59 : OVER VOLTAGE RELAY
LOCATION
(B) : 13.8kV SWGR CONTROL PANEL
NEW 13.8kV STATION SWITCHBOARD
13.8kV 1200A 20kA (1sec.)
TR. No.1
TR. No.2
600/5A
600A
No.7 GEN
No.8 GEN
STATION SWITCHBOARD
MAIN LV PANEL
COMMON MCC
COMMON MCC
COMMON MCC
LV TR 440/208-120V 50kVA
LTG TR 440/240-120V 50kVA
LV D/B 208/120V 3P4W
LTG D/B 240/120V 1P3W
DC D/B 110V
34.5kV S/S & 13.8kV STATION SWITCHBOARD
BATTERY (LEAD ACID) DC 110V 100AH/10HR
PREPARATORY SURVEY ON THE PROJECT FOR ENHANCING POWER GENERATION CAPACITY IN THE URBAN AREA IN THE REPUBLIC OF PALAU
SINGLE LINE DIAGRAM NEW 13.8kV STATION SWITCHBORD
単線結線図 新13.8kV 所内配電盤
SCALE
DWG. No.
E-04
DATE
DESIGNED
CHECKED
APPROVED
REVISION
Jul. DEC. 2014
JICA STUDY TEAM