India
Ministry of Home Affairs
Ministry of Power
Andaman and Nicobar Administration
Electricity Department

Preparatory Survey Report on the Project for Improvement of Power Supply in Andaman and Nicobar Islands in India

April 2021

JAPAN INTERNATIONAL COOPERATION AGENCY

NIPPON KOEI CO., LTD.
OKINAWA ENETECH CO.,INC

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PREFACE

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey and entrust the survey to Nippon Koei Co., Ltd. and OKINAWA ENETECH CO.,INC.

The survey team held a series of discussions with the officials concerned of the Government of India, and conducted a 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 India for their close cooperation extended to the survey team.

April, 2021

Kiyoshi AMADA
Director General,
Infrastructure Management Department
Japan International Cooperation Agency

Summary

1. Overview of Andaman and Nicobar Islands

The Andaman and Nicobar Islands (hereinafter referred to as the AN Islands) are one of the Indian union territories. The administrative location of the islands is Port Blair. The AN Islands are an archipelago consisting of 572 large and small islands in the Bay of Bengal, extending about 780 km from north to south. Out of the 572 islands, only 31 are inhabited.

Port Blair is far from the central government of mainland India and around 1,200 km from Chennai and Kolkata. South Andaman Island, where the project site is located, is the largest island in the AN Islands and Port Blair is toward the southeastern cost of the island.

The climate of the AN Islands belongs to the tropics category and is affected by the southwest and northeast monsoons. Thus, the rainy season is from May to October and the dry season is from November to April, and the average annual rainfall exceeds 3,000 mm. The annual average temperature reaches about 28 degrees Celsius; the monthly average maximum temperature reaches around 32 to 34 degrees Celsius from April to May, and the monthly average minimum temperature reaches around 24 degrees Celsius from January to February.

Of the AN Islands, the South Andaman Island, where the project site is located, features hills with narrow, elongated north-south ridges, and relatively flat land. It is roughly classified into hills, hilly slopes, plains, and wetlands.

The population of the AN Islands temporarily declined around 1947, when it became independent from Britain, but has been steadily increasing since then. In particular, the population of South Andaman District, which is the target of this grant aid, has increased remarkably, recording 238,142 in 2011, and accounting for 63% of the total population of the AN Islands.

Looking at the real gross state domestic product (GSDP) over the past 10 years under the direct control of the AN Islands, the growth of the primary and secondary industries is small, and the increase of the tertiary industry is conspicuous. The nominal net state domestic product (NSDP) per capita of the AN Islands in 2015-16 was INR 124,360.

2. Background of the Project

As of November 2020, the power supply to South Andaman Island is provided by six diesel engine power plants (42.0 MW) and solar power plants (29 MW), for a total of approximately 71 MW of power generation and transmission and distribution facilities. The problem faced in terms of power supply is the lack of supply capacity for increasing power demand (about 40 MW at peak). In the evening, when electricity demand peaks, only diesel engine generator (DEG) will be the power source. Power generation by DEG in the independent power producer (IPP) is increasing to secure supply reserves.

Meanwhile, plans are underway to introduce 100 MW of solar power in the AN Islands to increase power supply capacity from renewable energy. If the number of photovoltaic power generation facilities, which are unstable power sources, is increased excessively, stable operation of the system becomes difficult. For this reason, the issue is how to ensure the stability of the grid under the planned grid interconnection of photovoltaic power generation system in the future.

In addition, the current power development plan for South Andaman Island has indicated a policy of switching from diesel engine generators, which account for about 90% of the island's power sources, to liquefied natural gas (LNG) engine generators and renewable energy, which emit less carbon dioxide. In fact, a total of about 17.5 MW of solar power plant is built in 2020, and 50 MW of LNG engine power plant is planned to be built in 2022.

Under these circumstances, in 2015, the Government of India issued a request to the Government of Japan for grant aid to improve the power supply capacity of South Andaman Island. Based on the power development plan for South Andaman Island mentioned above, this project aims to contribute to the enhancement of industrial competitiveness by effectively utilizing renewable energy derived power and stabilizing the power supply through the construction of storage batteries and related facilities on the premises of the Phoenix Bay Power Plant in South Andaman.

3. Outline of Study Result and Contents of the Project

The periods of this survey are as follows:

- 1st Field Survey: 14 August 2016 ~ 6 September 2016, 31 October 2016 ~ 23 November 2016, and 5 February 2018 ~ 11 February 2018
- 2nd Field Survey: 7 January 2019 ~ 18 January 2019
- 3rd Field Survey: 23 December 2019 ~ 28 December 2019 and 27 January 2020 ~ 3 February 2020

The target components agreed in consultation with the Indian side are as follows:

- Storage battery
- Grid connecting equipment
- SCADA system (Local SCADA system for the control management of storage battery, system stabilizer equipment, PCS)
- Building (for installation of the abovementioned components)

In addition, based on the content of the request from the Indian side and the results of the field survey, a basic policy was formulated regarding the purpose of introducing the storage battery, the connection location of the storage battery, and the installation location of the storage battery equipment. As a result of the discussions with the Indian side based on the formulated basic policy, the design outline of the storage

battery equipment planned for this project is as follows:

Table 1 Design Overview

Item	Contains
Storage battery type	Lithium-ion battery
Power	30 MW
Capacity	15 MWh

Source: Prepared by the JICA Survey Team

4. Construction Time Schedules and Project Cost Estimation

The total period of the project is expected to be about 24 months from the date of G/A. The implementation design period is expected to be about 6 months, including the period from the conclusion of the G/A to bidding and contracting. The equipment procurement period is expected to be about 18 months, including equipment manufacturing, transportation, installation, adjustment and commissioning, and acceptance inspection and handover.

Expenses borne by the Indian side is estimated at JPY 680,000.

5. Project Evaluation

5.1 Project Evaluation

This project can be judged to be highly appropriate for Japanese grant aid based on the following points:

1) The implementation of the project is expected to improve the quality of electricity supply. The direct benefit is expected to accrue to all residents receiving electricity from the South Andaman power grid, which is around 60,000 households (2011 Census).

2) The target area includes Port Blair, the main city of Andaman and Nicobar Islands, which has many educational and medical facilities. Although there are many educational and medical facilities here, the standard of living of local residents is currently declining due to insufficient power supply and grid instability caused by the introduction of renewable energy. Improving the quality of electricity supply to these facilities will greatly contribute to improving the quality of education and medical services, which are basic social services for the residents.

3) India has set a target of 175 GW of installed renewable energy capacity for the entire country by 2022. Of this, 100 GW is aimed to be installed for solar power. In addition, the AN Islands are aiming to move away from fossil fuels in energy supply in the medium to long term planning under the Green Island Initiative. This project is sure to make a significant contribution to the realization of this goal.

4) Japan’s assistance policy is to cooperate with other countries in reducing carbon dioxide emissions and aims to become carbon neutral by 2050. In addition, Japan's Country Assistance

Policy for India stipulates "Strengthening Connectivity", "Enhancing Industrial Competitiveness", and "Supporting Sustainable and Inclusive Growth" as priority areas for cooperation to realize the basic policy of "Faster, More Inclusive, and Sustainable Growth". This project is highly consistent with Japan's aid policy because it fits the development issue of "stable energy supply" in the priority area of "strengthening industrial competitiveness.

5.2 Effectiveness

In addition, the beneficial effects (quantitative and qualitative effects) expected from the implementation of this project are summarized below.

(1) Quantitative Effects

The quantitative effects from the project are shown below.

Table 2 Quantitative Evaluation of the Project

	Indicator	Standard Value (year 2020)	Target Value (year 2026)
1	Maximum battery power (MW)	-	30
2	Maximum battery capacity (MWh)	-	14.25
3	Discharge power* (MWh/year)	-	2,971
4	System frequency fluctuation range (Hz)	49.08 ～ 51.83	50 ± 0.5
5	Reduction of greenhouse gas (tCO_2 /year)	-	2,683

(Note) * : This is the assumed amount of annual surplus power discharged from solar power generation.
Source: Prepared by the JICA Survey Team

(2) Qualitative Effects

The implementation of this project can also be expected to have the qualitative effects described below.

1) Facilitation of industrial activities

Improvement of electricity supply quality through this project will directly lead to the improvement of the quality of services provided by tourist facilities such as hotels. In addition, reducing carbon dioxide emissions in the energy supply enhances the environmental image of the AN Islands. With these, the number of tourists can be expected to increase. Thus, the implementation of this project will greatly contribute to the tourism industry, which is the center of economic activity in the islands and is expected to facilitate industrial activities.

2） Promotion of climate change measures

This project will directly contribute to the reduction of greenhouse gas emissions. This is expected to further promote of climate change measures.

3） Improvement of the living standards of local residents

This project will contribute to the improvement of the living standards of local residents. Specifically, it is expected to improve the quality of medical care and education.

A stable power supply to medical facilities is extremely important from the perspective of human security. In a hospital such as a large central hospital, it is possible to install a DEG as an emergency power source to supplement the instability of the power supply from the grid, but in a small health center, it is not possible due to economic strain. The implementation of this project will improve the stability of power supply from the grid to the medical facilities. This can be expected to improve the quality of medical activities provided by medical facilities.

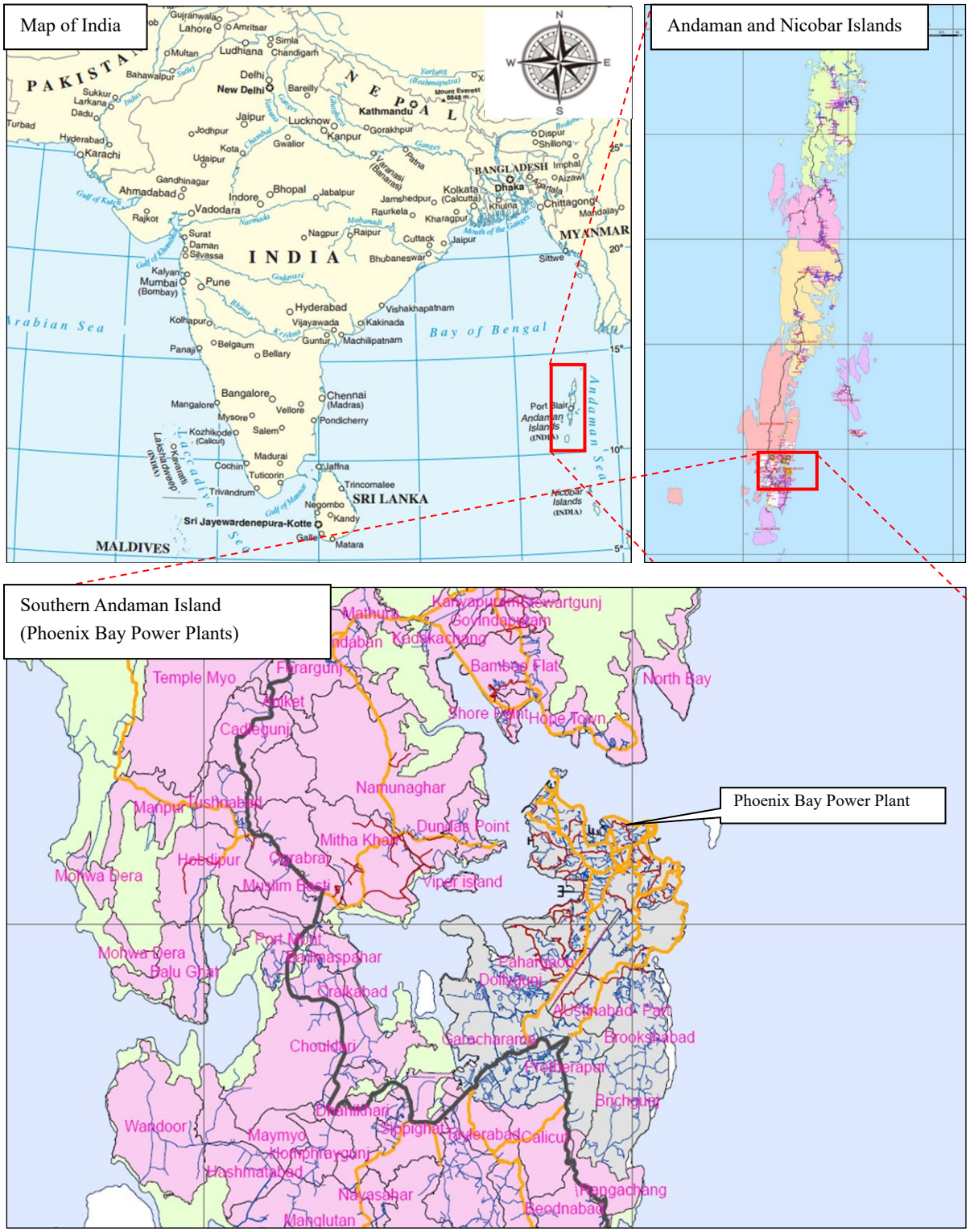
Most elementary schools (primary) and above secondary schools are 100% electrified. From this, it is considered that the use of electric power is well established in the education sector. In daily education, computers are being promoted, so stable power supply to schools will become even more important in the future. It can be said that improving the stability of power supply through this project will greatly contribute to improving the quality of education.

Based on the above, it is judged that the validity of this project is high, and its effectiveness is expected.

Contents

[Attachment]

Location Map / Perspective



Source: Captured by the JICA Survey Team

Source: JICA Survey Team

Perspective 1 for Battery Room

Source: JICA Survey Team

Perspective 2 for SCADA Room

Source: JICA Survey Team

Perspective 3 for Building

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Abbreviations

ANI	Andaman and Nicobar Islands
ANIIDCO	Andaman & Nicobar Islands Integrated Development Corporation
BHN	Basic Human Needs
BPL	Below Poverty Line
CEA	Central Electricity Authority
CERC	Central Electricity Regulatory Commission
CEO	Chief Executive Officer
CPH	Chatham Power House
DEG	Diesel Engine Generator
DG	Diesel Generator
DMS	Distribution Management System
ERC	Electricity Regulatory Commission
ED	Electricity Department
EMC	Energy Management Center
EMS	Energy Management System
E&F	Environment & Forest
FSP	Forecast Service Provider
GDP	Gross Domestic Product
GPS	Global Positioning System
GSDP	Gross State Domestic Product
HMI	Human Machine Interface
HPP	Hired Power Plant
IPP	Independent Power Producer
IS	Indian Standard
ISO	International Organization for Standardization
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers, Inc.
INR	Indian Rupee
ITU	International Telecommunication Union
JERC	Joint Electricity Regulatory Commission
JICA	Japan International Cooperation Agency
JEC	Japanese Electrotechnical Committee
JEITA	Japan Electronics and Information Technology Industries Association
JEM	Japan Electrical Manufacturers' Association
JIS	Japanese Industrial Standards
JPY	Japanese Yen
KVM	Keyboard, Video and Mouse
LFC	Load Frequency Control
LNG	Liquefied Natural Gas
MT	Metric Ton
MRI	Magnetic Resonance Imaging
MU	Million Unit
N&M Andaman	North and Middle Andaman
NSDP	Net State Domestic Product
NTPC	National Thermal Power Corporation
O&M	Operation and Management
OJT	On the Job Training
PBPH	Phoenix Bay Power House
PBSS	Phoenix Bay Substation
PC	Personal Computer

PCCF	Principal Chief Conservator of Forest
PCS	Power Conditioning System
PGCIL	Power Grid Corporation of India Limited
PPA	Power Purchase Agreement
PV	Photovoltaic
PMB	Port Management Board
RTCC	Remote Tap Changer Control
RTU	Remote Terminal Unit
SERC	State Electricity Regulatory Commission
SA	South Andaman
SCADA	Supervisory Control and Data Acquisition
SE	Superintendent Engineer
S/S	Substation
TRF	Transformer
UPS	Uninterruptible Power Supply
USD	U.S. Dollar
VPN	Virtual Private Network

Chapter 1 Background of the Project

1-1 Background of the Project

In Andaman and Nicobar Islands (hereinafter AN Islands), South Andaman Island is the largest island, and Port Blair, which is the administrative location of the central government of India, lies on the southeastern coast of the island.

The island is powered by six diesel engine power plants (42.0 MW) and solar power plants (29 MW), for a total of approximately 71 MW of power generation and transmission and distribution facilities. In the evening, when electricity demand peaks, only diesel engine generator (DEG) will be the power source. Power generation by DEG in the independent power producer (IPP) is increasing to secure supply reserves. In addition, the supply capacity of DEG, which is the main power source, is declining in terms of power generation efficiency due to aging and the frequent occurrence of failures.

Meanwhile, the current power development plan for South Andaman Island has indicated a policy of switching from diesel engine generators, which account for about 90% of the island's power sources, to liquefied natural gas (LNG) engine generators and renewable energy, which emit less carbon dioxide. In fact, a total of about 17.5 MW of solar power plant is built in 2020, and 50 MW of LNG engine power plant is planned to be built in 2022.

However, solar power plants have the characteristic of generating the maximum amount of electricity during the daytime when demand is relatively low in the South Andaman grid. In the current operation of the grid, there are no facilities or capacities to store the surplus power during the daytime and discharge it during the peak hours at night, so low environmental impact of solar power generation is not being effectively utilized throughout the grid, and the introduction of storage batteries is an issue. In addition, if the number of PV power generation facilities, which are unstable power sources, is increased excessively, it will be difficult to ensure stable operation of the grid due to significant fluctuations in frequency and other factors. Furthermore, since no backup system has been established that can respond in the event that main power sources such as LNG engine power generation drop out or are cut off due to disturbances on distribution line, the introduction of highly responsive storage batteries is essential to achieve the stable supply of electricity. Therefore, the issue of how to ensure the stability of the grid under the planned grid connection of solar power generation facilities in the future has become an issue.

1-2 Natural Conditions

A survey of natural conditions was conducted within the premises of the Phoenix Bay Power Plant. The following results were obtained in the topographical and geological surveys.

(1) Topographical Survey

The following table shows the work contents of the topographic survey:

Table 1-2-1 Topographic Survey Work Contents

Survey Item	Qty.	Work Content
Topographic Survey	1 Set	・Benchmarking ・Leveling, Horizontal Survey ・Longitudinal Survey ・Creating Related Drawings

Source: Prepared by the JICA Survey Team

Photographs of the survey work are shown in the following figure:

Source: Snapshot by the JICA Survey Team

Figure 1-2-1 Photograph of Topographic Survey Work

■Topographic Survey Result

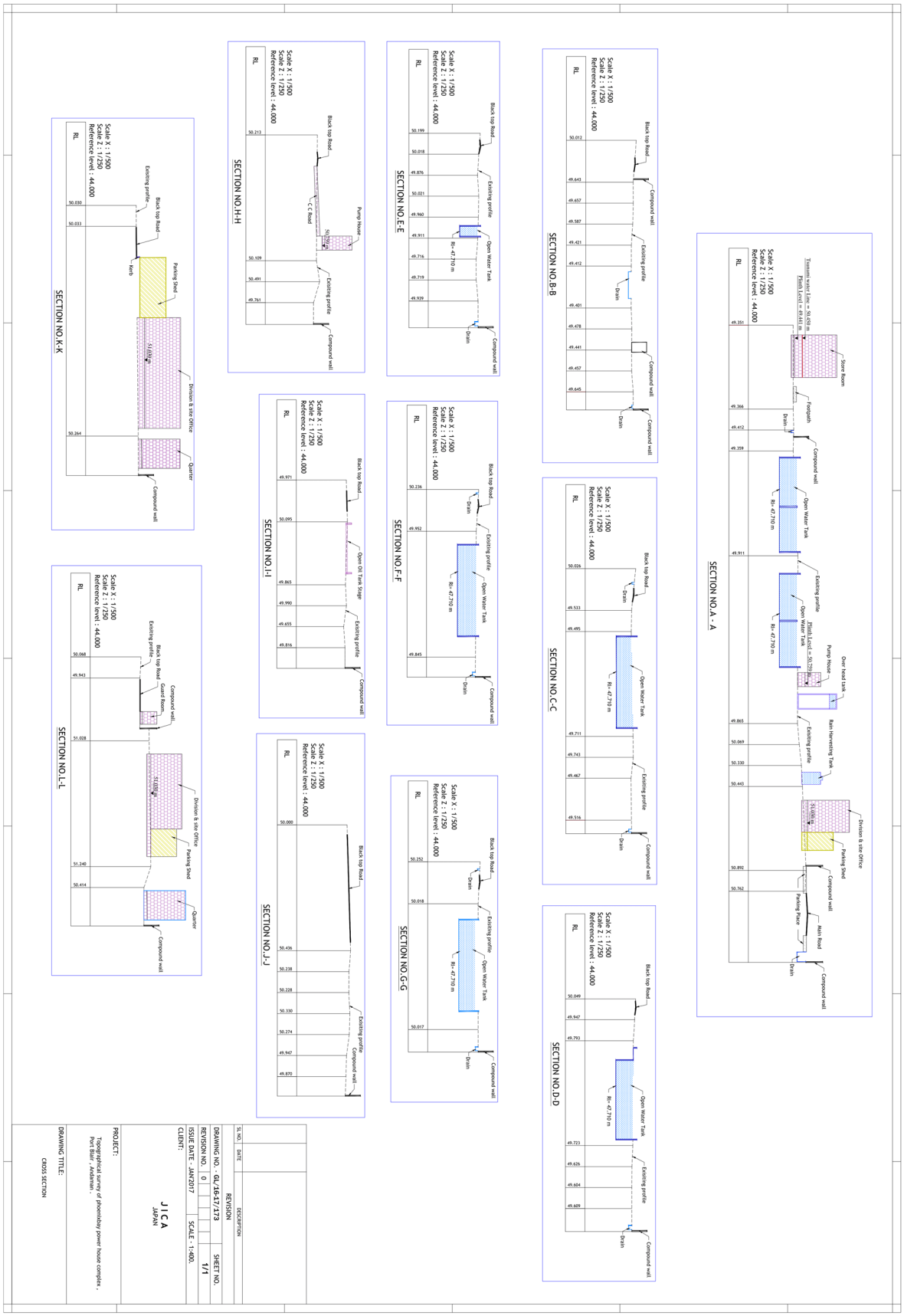
The plan and cross-sectional views of the topographic survey results are shown in the following figures:

As shown in the floor plan, the Phoenix Bay Power Plant site (hereafter referred to as "the site") faces the road on the east and south sides. The building toward east, on the other side of the road is the administrative office of the ED. The main gate to the site is located on the east side toward the road, and the largest building on the site, about 32 meters stands straight after entering the main gate, is the ED power plant building, where the DEG's, owned by ED is installed and operated. On the north side of the ED power plant building, there is a ground water storage tank across the road. The storage tank has been reclaimed by the ED as of March 2021. The installation site of the storage battery system is planned to locate inside new building constructed covering the claimed ground water tank area to the northern boundary wall. The installation site is about 55 meters from east to west and about 40 meters from north to south, with the widest part (the west end) being about 57 meters. The transformer and switchgear are planned to install outside toward the west side of newly constructed building, and the south side of the ED power plant building lies the existing switchyard, where the storage battery system will be connected to the South Andaman grid .

From the cross-sectional view, the site is almost flat in both the east-west and north-south directions.

Source: Prepared by the JICA Survey Team

Figure 1-2-2 Plan View of Survey Results



Source: Prepared by the JICA Survey Team

Figure 1-2-3 Cross Sectional View of Survey Results

(2) Geological Survey

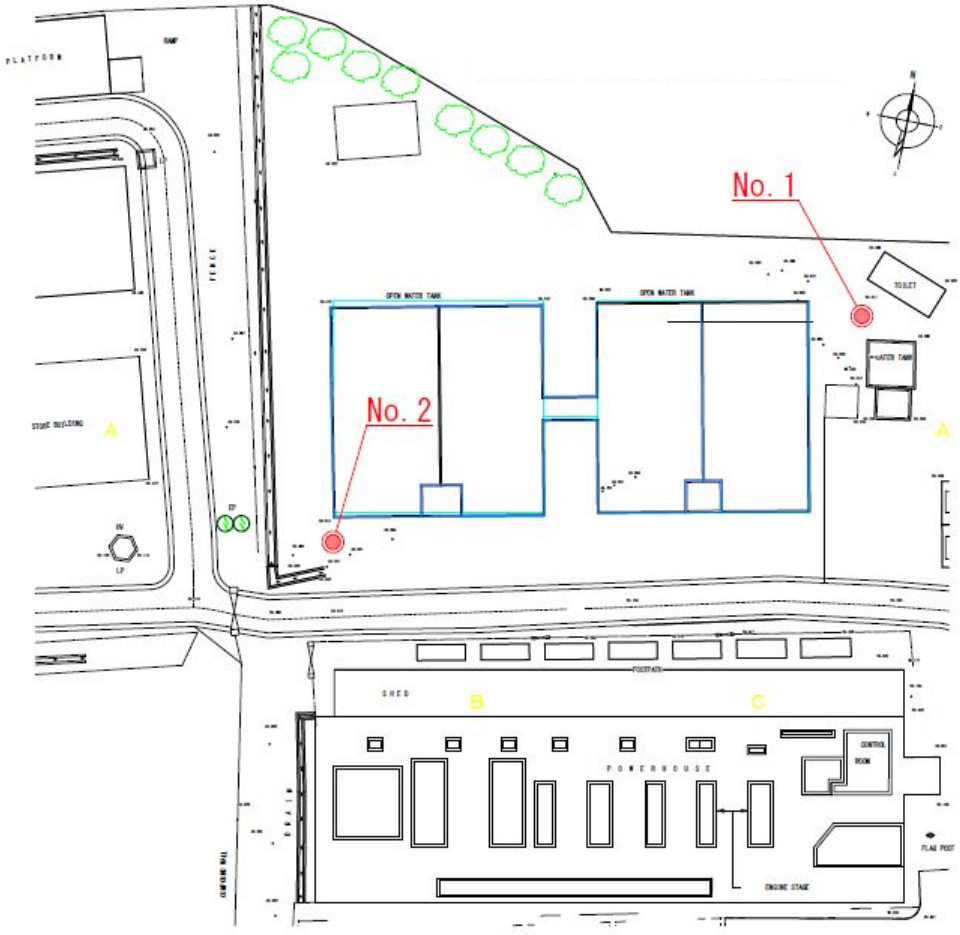
The following table shows the work contents of the geological survey:

Table 1-2-2 Geological Survey Work Contents

Survey Item	Qty.	Work Content
Geological Survey	1 Set	・Geological Survey: Entire target area ・Core Drilling: 2 points (max. depth 20.0 m) ・Standard Penetration Test: Interval 1.0 m for each penetration ・Report Writing

Source: Prepared by the JICA Survey Team

The geological survey was conducted in the east (No.1) and west (No.2) locations of the existing cooling water tank as shown in the following figure:



Source: Prepared by the JICA Survey Team

Figure 1-2-4 Geological Survey Position within the Premises of the Phoenix Bay Power Plant

A photograph of the geological survey work is shown in the following figure:

East of the Existing Cooling Water Tank (No.1)

West of the Existing Cooling Water Tank (No.2)

Source: Snapshot by the JICA Survey Team

Figure 1-2-5 Photograph of Geological Survey Work

■Geological Survey Results

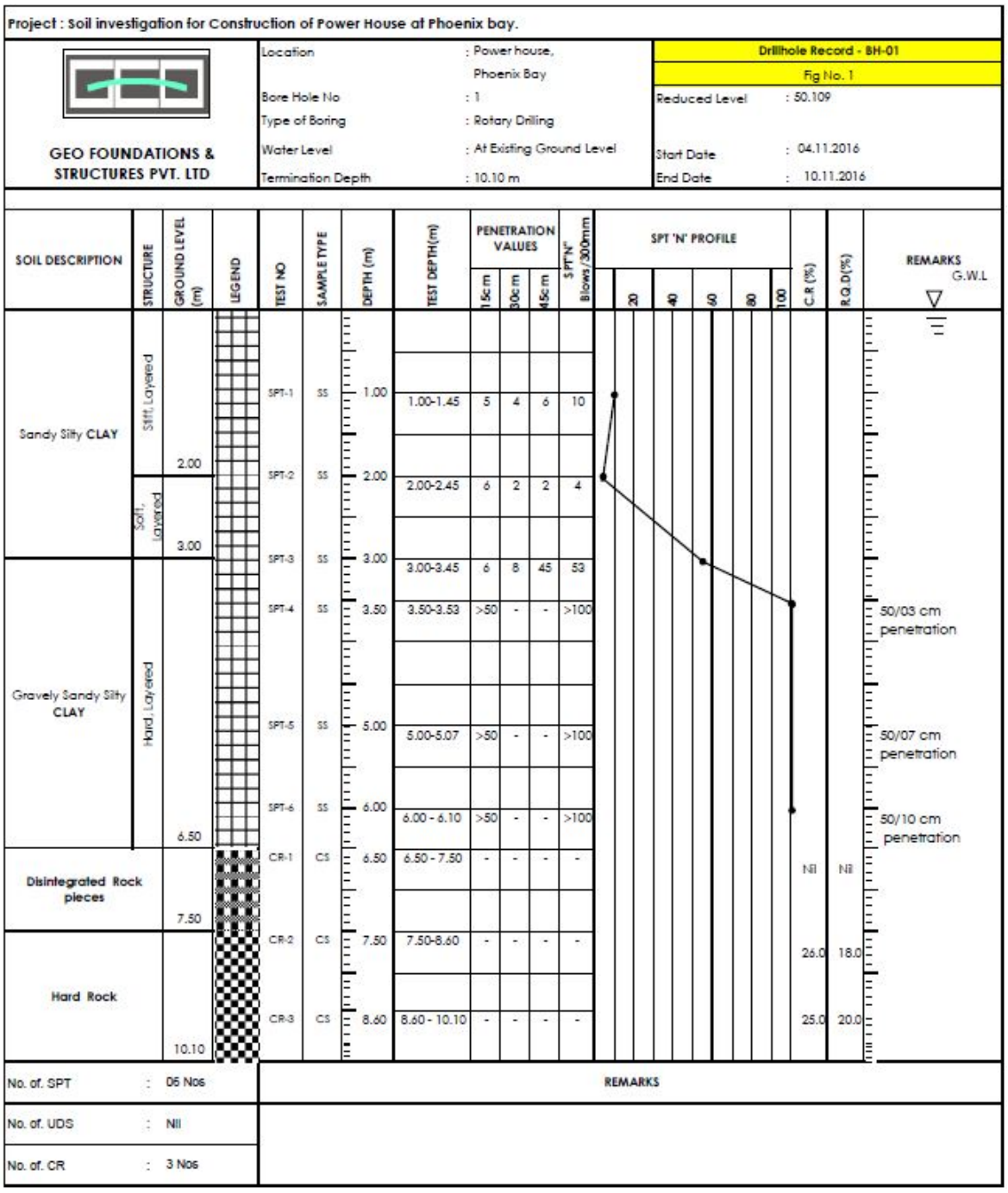
The result of the boring survey at the two locations found that the water level was at the ground level. The foundation of buildings in this area will need to be reinforced with piles.

The survey results for the No.1 boring location are shown in Table 1-2-3 and Figure 1-2-6. A standard N-value of 100 was achieved near 3.5 m below the ground surface.

Table 1-2-3 Geological Analysis Result for No.1 Location

TEST RESULTS	Project : Soil investigation for construction of Power house at Phoenix Bay			Boring Date 04.11.2016				Termination Depth 10.10 m												Table No. 1		
				Reduced Level 50.109				Water Level At existing ground level												Bore Hole No 1		
			SOIL DESCRIPTION	GRAIN SIZE ANALYSIS				ATTERBERG LIMITS												SHEAR PARAMETERS		
N VALUE	DEPTH,mtrs	SAMPLE		IS CLASSIFICATION	GRAVEL, %	SAND, %	SILT & CLAY, %	LIQUID LIMIT %	PLASTIC LIMIT %	PLASTIC INDEX %	SHRINKAGE LIMIT, %	FIELD MOISTURE CONTENT, %	DRY DENSITY, gm/cc	WET DENSITY, gm/cc	VOID RATIO	CONSOLIDATION TEST (Cc)	SPECIFIC GRAVITY OF SOIL	COMPRESSIVE STREENGHT OF ROCK (Kg/cm2)	SPECIFIC GRAVITY OF ROCK	FREE SWELLING INDEX, %	PERMEABILITY (cm/sec)	TEST METHOD	Cohesion,c in Kg/cm²	ANGLE OF SHEARING RESISTANCE Ø IN DEGREES
10	1.00	SPT-1	Sandy Silty CLAY	CI	4	15	81	37	22	15	....	14	....	....	....	....	....	....	....	22	....		....	....
4	2.00	SPT-2	Sandy Silty CLAY	CI	3	18	79	39	20	19	....	22	....	....	....	....	....	....	....	24	....		....	....
53	3.00	SPT-3	Gravely Sandy Silty CLAY	CI	14	20	66	42	22	20	....	15	....	....	....	....	....	....	....	22	....		....	....
>100	3.50	SPT-4	Gravely Sandy Silty CLAY	CI	12	22	66				....	16	....	....	....	....	....	....	....	28	....			
>100	5.00	SPT-5	Gravely Sandy Silty CLAY	CI	16	19	65	38	24	14	....	18	....	....	....	....	....	....	....	26	....		....	....
>100	6.00	SPT-6	Gravely Sandy Silty CLAY	CI	14	16	70				....	15	....	....	....	....	....	....	....	24	....		....	....
-	6.50-7.50	CS-1	Disintegrated rock pieces	Disintegrated rock pieces collected														....	....	...				
-	7.50-8.60	CS-2	Hard Rock	CR-26 %,RQD-18 %																...				
-	8.60-10.10	CS-3	Hard Rock	CR-25 %,RQD-20 %																...				

Source: Prepared by the JICA Survey Team



Source: Prepared by the JICA Survey Team

Figure 1-2-6 Column Diagram for No.1 Location

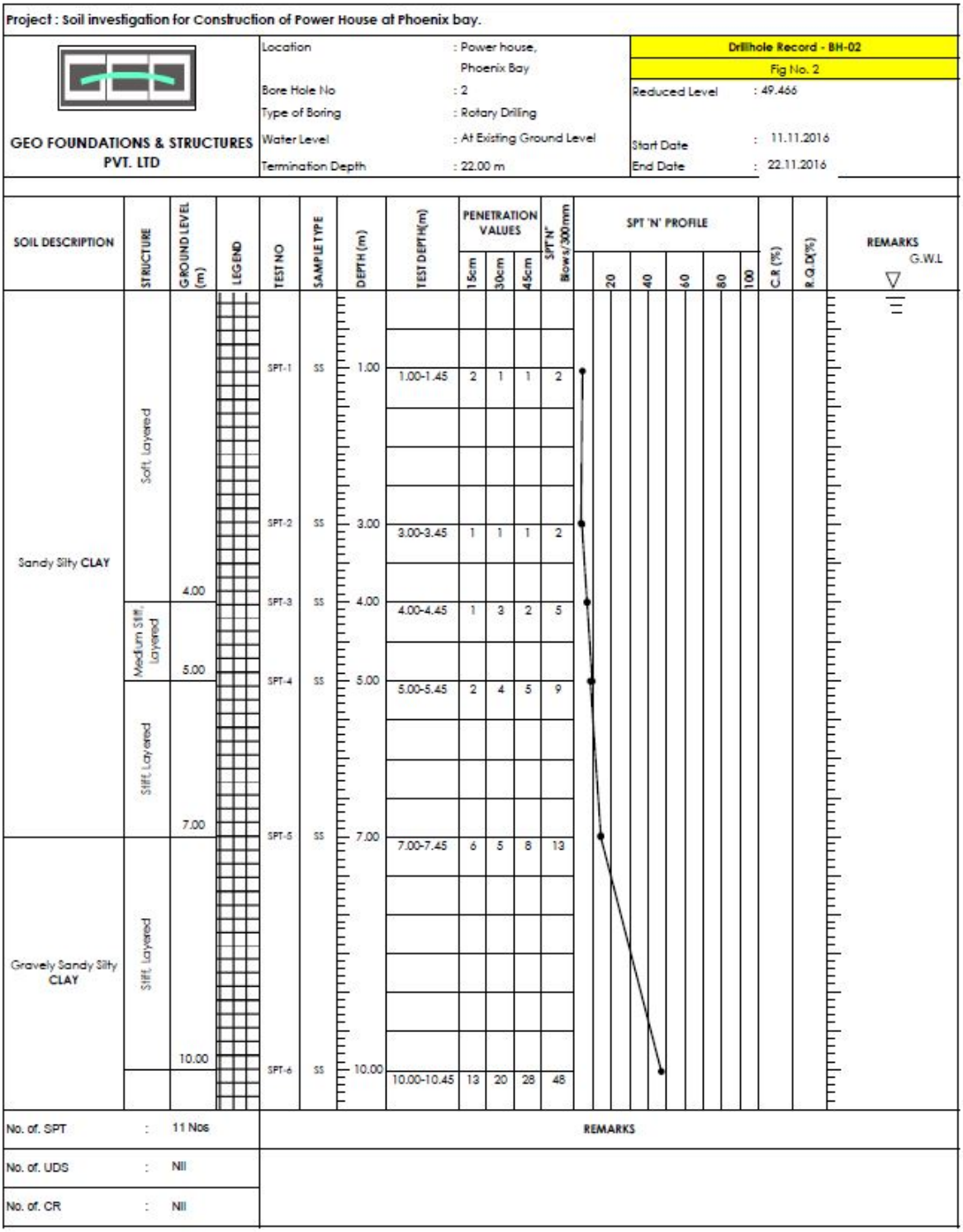
The survey results for No.2 site are shown in Table 1-2-4 and Figure 1-2-7. A standard N-value of 100 was achieved near 15 m below the ground surface.

Table 1-2-4 Geological Analysis Result for No.2 Location

TEST RESULTS			Project : Soil investigation for construction of Power house at Phoenix Bay					Boring Date 11.11.2016			Termination Depth 22.10 m											Table No. 2		
								Reduced Level 49.466			Water Level At existing ground level											Bore Hole No 2		
			SOIL DESCRIPTION	GRAIN SIZE ANALYSIS				ATTERBERG LIMITS														SHEAR PARAMETERS		
N VALUE	DEPTH in mtrs	SAMPLE		IS CLASSIFICATION	GRAVEL, %	SAND, %	SILT & CLAY, %	LIQUID LIMIT %	PLASTIC LIMIT %	PLASTIC INDEX %	SHRINKAGE LIMIT, %	FIELD MOISTURE CONTENT, %	DRY DENSITY, gm/cc	WET DENSITY, gm/cc	VOID RATIO	CONSOLIDATION TEST (Cc)	SPECIFIC GRAVITY OF SOIL	COMPRESSIVE STREENGHT OF ROCK (Kg/cm2)	SPECIFIC GRAVITY OF ROCK	FREE SWELLING INDEX, %	PERMEABILITY (cm/sec)	TEST METHOD	Cohesion,c in Kg/cm²	ANGLE OF SHEARING RESISTANCE Ø IN DEGREES
2	1.00	SPT-1	Sandy Silty CLAY	CI	2	18	80	36	19	17	....	18	....	....	....	....	....	....	....	22	....	....	....	....
2	3.00	SPT-2	Sandy Silty CLAY	CI	6	23	71	38	20	18	....	20	....	....	....	....	....	....	....	24	....	....	....	....
5	4.00	SPT-3	Sandy Silty CLAY	CI	4	19	77	41	24	17	....	19	....	....	....	....	....	....	....	22	....	....	....	....
9	5.00	SPT-4	Sandy Silty CLAY	CI	7	24	69	43	23	20	....	17	....	....	....	....	....	....	....	28	....	....	....	....
13	7.00	SPT-5	Gravely Sandy Silty CLAY	CI	14	20	66	40	26	14	....	20	....	....	....	....	....	....	....	26	....	....	....	....
48	10.00	SPT-6	Gravely Sandy Silty CLAY	CI	16	24	60	45	23	22	....	24	....	....	....	....	....	....	....	24	....	....	....	....
81	12.00	SPT-7	Gravely Sandy Silty CLAY	CI	18	26	56	42	24	18	....	23	....	....	....	....	....	....	....	20	....	....	....	....
>100	15.00	SPT-8	Gravely Sandy Silty CLAY	CI							....	....	....	....	....	....	....	....	....	....	....	....	....	....
>100	19.00	SPT-9	Gravely Sandy Silty CLAY	CI	18	20	62	38	22	16	....	22	....	....	....	....	....	....	....	26	....	....	....	....
>100	20.00	SPT-10	Gravely Sandy Silty CLAY	CI	13	23	64				....	20	....	....	....	....	....	....	....	28	....	....	....	....
>100	22.00	SPT-11	Gravely Sandy Silty CLAY	CI	16	25	59				....	23								24	....	....	....	....

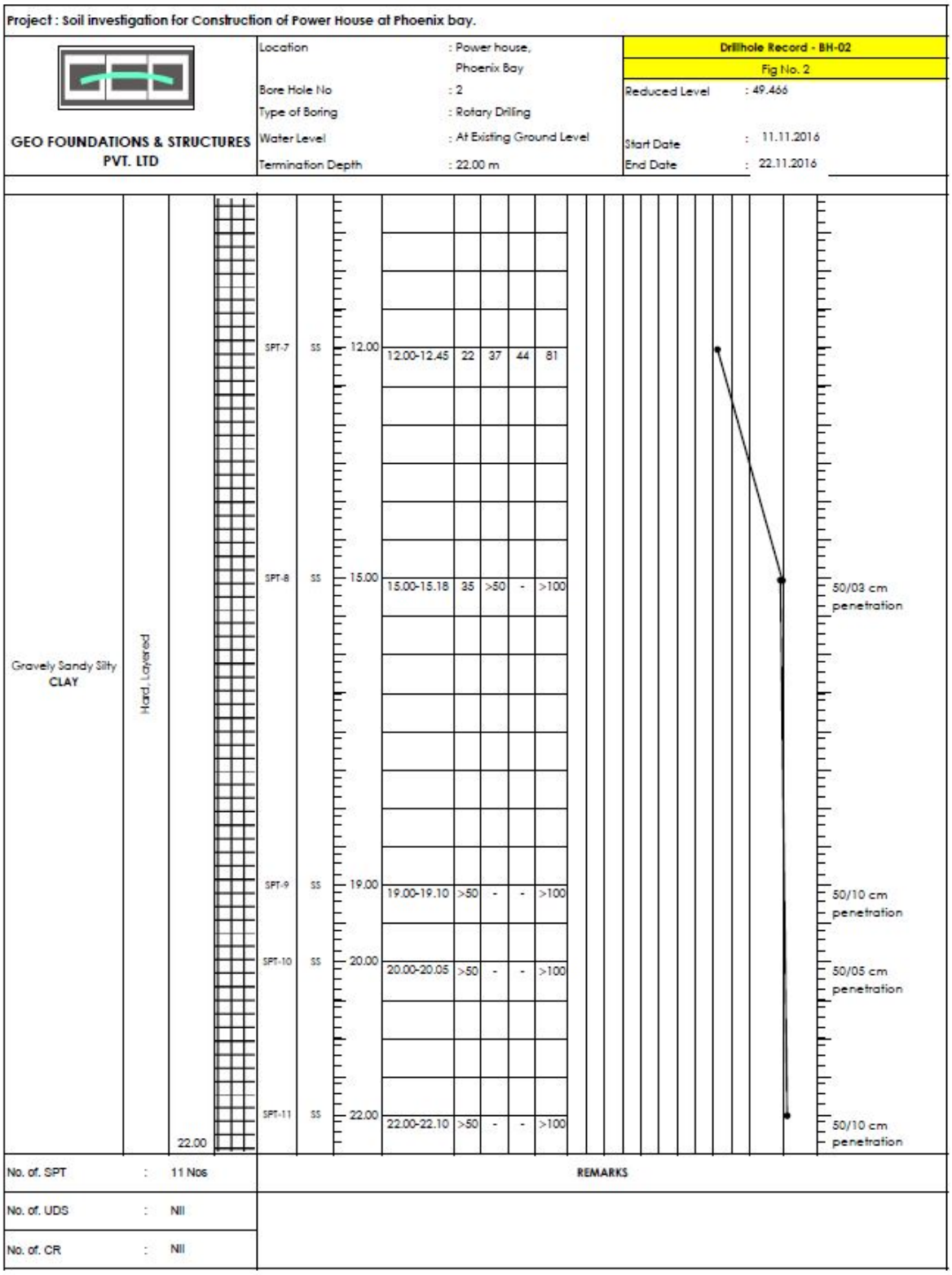
Geo Foundations and Structures pvt. Ltd.

Source: Prepared by the JICA Survey Team



Source: Prepared by the JICA Survey Team

Figure 1-2-7 (1/2) Column Diagram for No.2 Location



Source: Prepared by the JICA Survey Team

Figure 1-2-7 (2/2) Column Diagram for No.2 Location

1-3 Environmental and Social Considerations

1-3-1 Environmental Impact Assessment

1-3-1-1 Overview of Business Components with Environmental and Social Impact

This project is a project to install ancillary equipment such as storage battery and grid stabilizer in order to effectively utilize the excess energy generated by renewable energy such as solar power in the Andaman and Nicobar Islands, India.

- Lithium-ion battery installation
- Grid stabilizer
- SCADA system (battery, system stabilizer, power conditioner, local SCADA for ancillary transformation equipment)
- Building (for storing the above target components)

The main purpose of this project is to install a storage battery system on the premises of an existing power plant, so negative environmental and social impacts on the surrounding area after the system is put into service are expected to be negligible. Construction work to accompany the installation of the building is a potential project component that may have a negative impact on the surrounding area, but since the scope of construction is limited to a part of the existing power plant, there will be no topographical changes to the natural environment such as natural forests and coasts, and relocation of residents and land acquisition will not occur, so any negative environmental and social impacts are expected to be localized and limited.

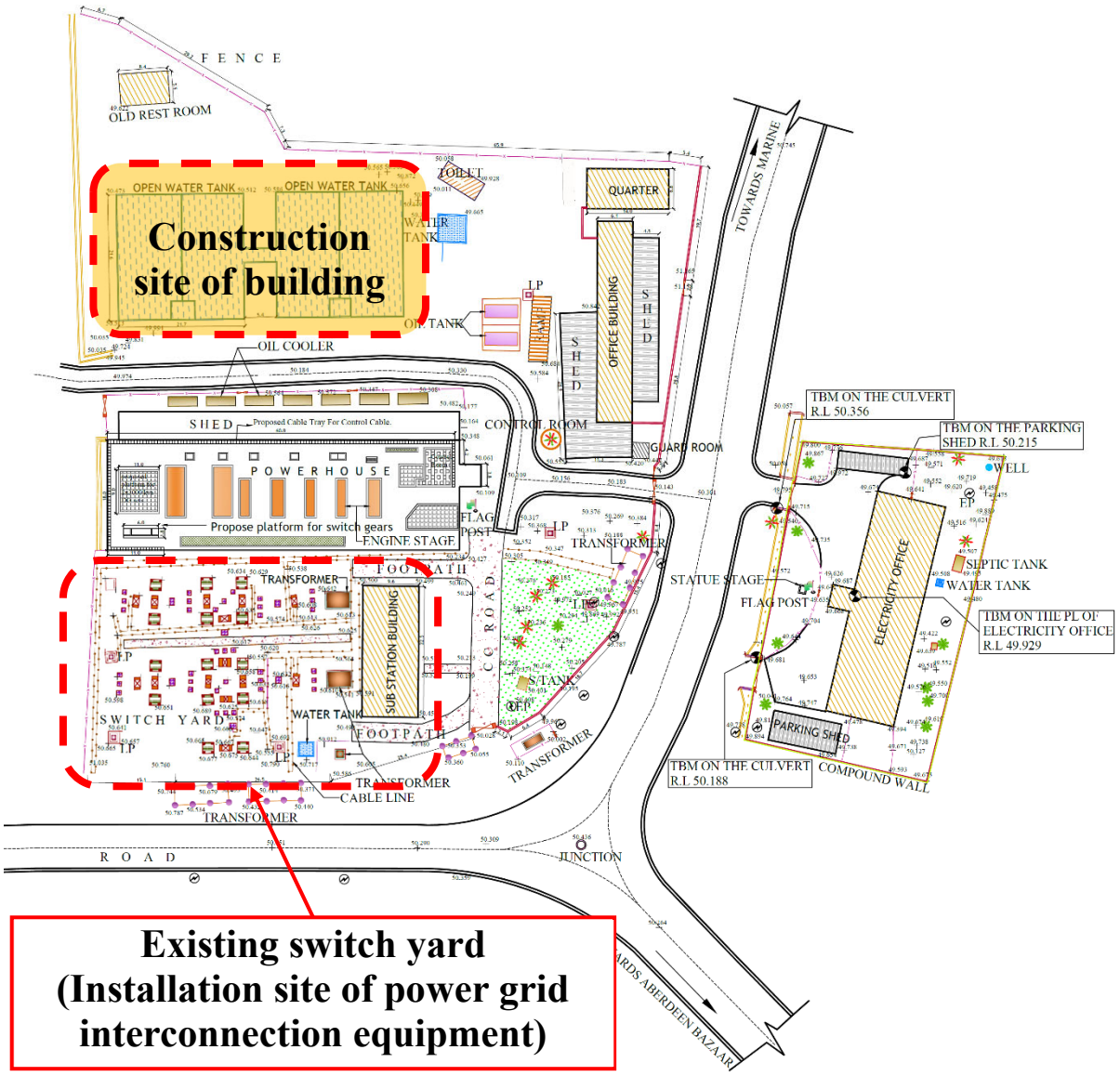
In addition, this project falls under environmental category C of the "Japan International Cooperation Agency Environmental and Social Consideration Guidelines (April 2010) (hereinafter the JICA Environmental Guidelines)", which states " Considered to have minimal or no undesirable effects on the environment or society, so normal measures can be taken to mitigate such issues."

1-3-1-2 Base Environmental and Social Conditions

(1) Location of the Project Site

The Andaman and Nicobar Islands, a union territory of India, is an archipelago of 572 large and small islands in the Bay of Bengal, extending approximately 780 km from north to south. Of the 572 islands, 31 are inhabited. Port Blair, where the planned project site is located, is far from India, and Chennai and Kolkata are approximately 1,200 km away, and Southeast Asian countries such as Indonesia, Thailand, and Myanmar are closer.

The project site, Phoenix Bay Power Plant, is located in the commercial area of Port Blair, facing the Phoenix Bay port facilities on the north side and the busy trunk roads on the south and east sides. The project site is shown in Figure 1-3-1.



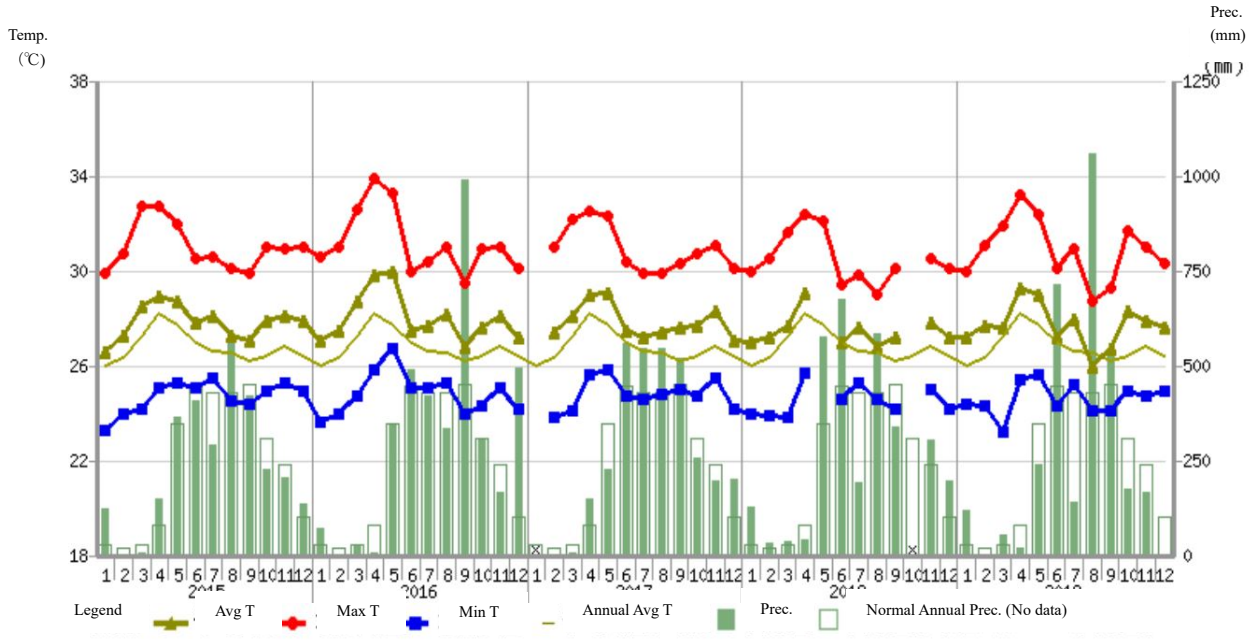
Source: Prepared by the JICA Survey Team

Figure 1-3-1 Project Site

(2) Weather Conditions

The climate of the Andaman and Nicobar Islands is tropical and is affected by the southwest and northeast monsoons, so the rainy season is from May to October and the dry season is from November to April, with an average annual precipitation of over 3,000 mm.

The annual average temperature is approximately 28 °C. The monthly average maximum temperature reaches approximately 32 °C to 34 °C from April to May, and the monthly average minimum temperature is approximately 24 °C from January to February.



Source: Japan Meteorological Agency HP (Prepared by the JICA Survey Team over 5 years from 2015-2019 using ClimatView)

Figure 1-3-2 Monthly Average, Maximum and Minimum Temperatures, and Precipitation in Port Blair

(3) Topography and Geology

Of the Andaman and Nicobar Islands, the South Andaman Island, where the project site is located, is characterized by steep hills with narrow and elongated ridges in the north and south, and there is relatively little flat land. It is roughly classified into hills, hilly slopes, plains, and wetlands. The Andaman Islands have high altitudes on the eastern side, and the highest altitude is 732 m at Saddle Peak in the northern part of the Andaman Islands. The area where the project site is located is along the coast and the altitude is low. Geologically, the rocks of the Andaman and Nicobar Islands are composed of metamorphic rocks, sedimentary rocks, and igneous rocks.

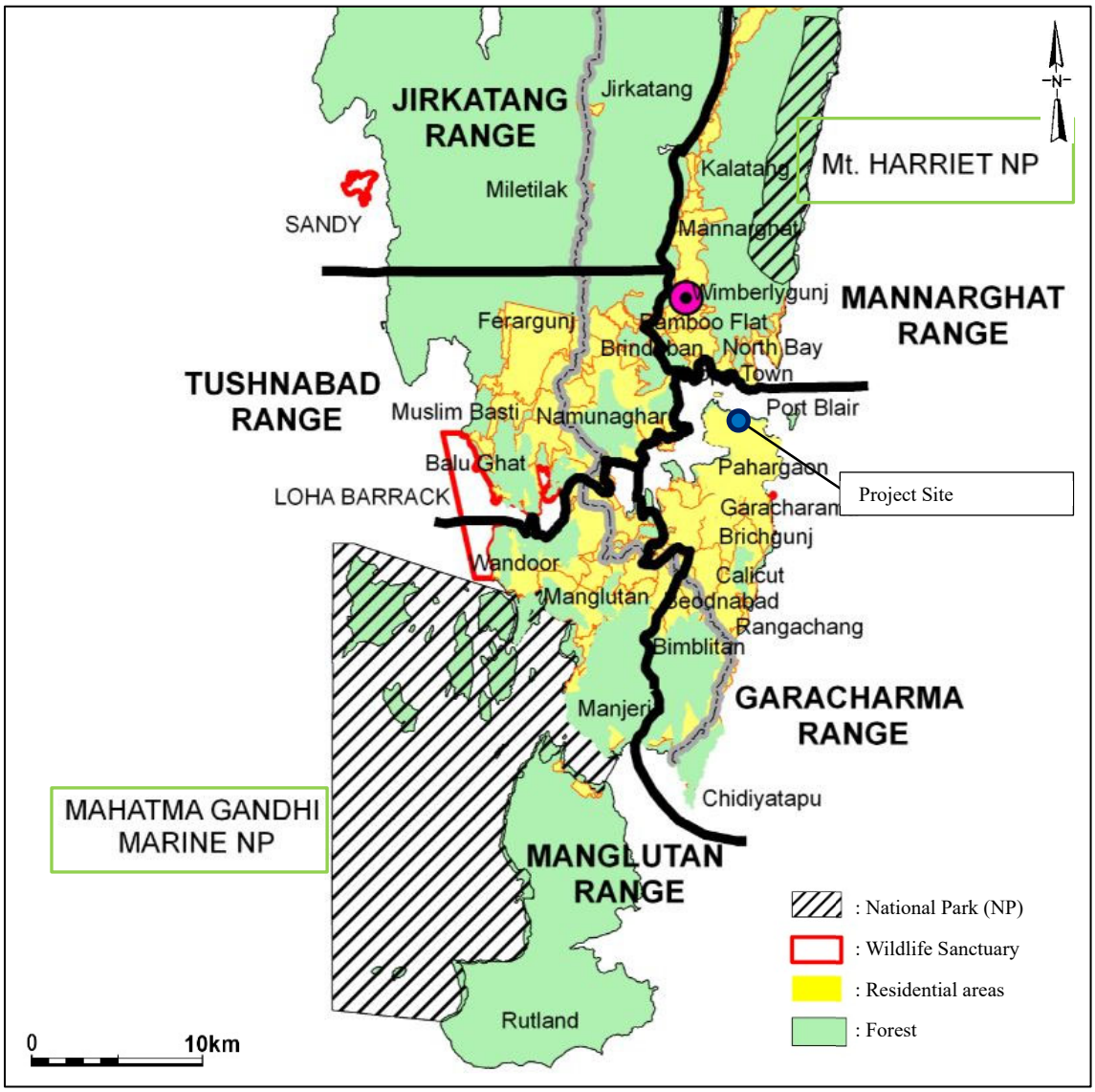
(4) Water Conditions

In the Andaman Islands, the hills and the sea are in close proximity, so rainwater from rainfall quickly flows into the sea. The only large river is the Kalpong River in Northern Andaman, and there are several perennial streams called "*nala*". The most densely populated South Andaman region of the Andaman Islands is home to several streams such as Burma Nala and Dhanikari.

(5) Natural Parks and Nature Reserves

The Andaman and Nicobar Islands are home to many nature-rich islands covered with evergreen forests. Known as a biodiversity hotspot, 95 wildlife sanctuaries, including six national parks, have been designated for environmental preservation and protection of rare organisms. Two national parks near the project site are Mahatma Gandhi Marine National Park, which was designated as a national park in 1983 to protect coral and sea turtles, and Mount Harriet National Park, which was designated as a national park in 1979 to protect evergreen virgin forests and precious flora and fauna. National parks near the project site are shown in Figure 1-3-3.

The project site is located on the premises of the Phoenix Bay Power Plant, which is located in a commercial area, and is more than 5 km away from all national parks and wildlife sanctuaries, so no significant conversion or degradation of the area due to the project is expected.



Source: Prepared by the JICA Survey Team based on information provided by the South Andaman Forest Division

Figure 1-3-3 National Parks Near the Project Site

(6) Cultural Property

Built in 1906 in South Andaman, the Cellular Jail was a prison where Indians who fought for freedom were exiled in the battle with Britain, and it was declared a national memorial in 1979 making it a historically important cultural heritage. The planned project site is located approximately 1.4 km from the Cellular Jail, so it is not visible from the memorial.

(7) Environmental Standards

The Environment Protection Rules 1986, established based on the Environmental Protection Act, set standards for air quality, water quality, noise, etc. for each industry. Substances subject to these rules and criteria differ depending on the industry.

Since this project will install a storage battery, ancillary equipment, and a building to store them, environmental factors that have negative impacts on the surrounding environment after the facility is installed are not expected. However, temporary emission of exhaust gas and noise due to the operation of heavy machinery are expected in the construction of the building which will store the storage battery. The land use classification of the project site is public facilities and quasi-public facilities (see Figure 1-3-5 Land Use Map), and the adjacent area is mainly used as a commercial area and port facility. The environmental standards for air quality and noise in India are shown in Tables 1-3-1 and 1-3-2.

Table 1-3-1 Air Quality Standards in India

Area Characteristics	SO2 (μg/m³)		NO2 (μg/m³)		SPM (μg/m³)		PM10 (μg/m³)		Pb (μg/m³)	
	Annual Average	Daily Average	1-year Average	Daily Average	Annual Average	Daily Average	Annual Average	Daily Average	Annual Average	Daily Average
Industrial Area	80	120	80	120	360	500	120	150	1.0	1.5
Residential Area	60	80	60	80	140	200	60	100	0.75	1.00
Sensitive Area	15	30	15	30	70	100	50	75	0.50	0.75

Source: The Air (Prevention and Control of Pollution) Act, 1981

Table 1-3-2 Noise Standards in India

Area	Area characteristics	Daytime standard dB (A)	Night standard dB (A)
(A)	Industrial Area	75	70
(B)	Commercial Area	65	55
(C)	Residential Area	55	45
(D)	Silence Zone	50	40

Source: The Noise Pollution (Regulation and Control) Rules, 2000

(8) Land Use Status

The land use map of Port Blair is shown in Figure 1-3-4, and the environment near the project site is shown in Figure 1-3-3. Most of Port Blair is a residential area, but since it is the capital, much of the land is used as public facilities. The project site, Phoenix Bay Power Plant, is located in the northern part of Port Blair, which is a mixture of public and commercial areas. The north side of the power

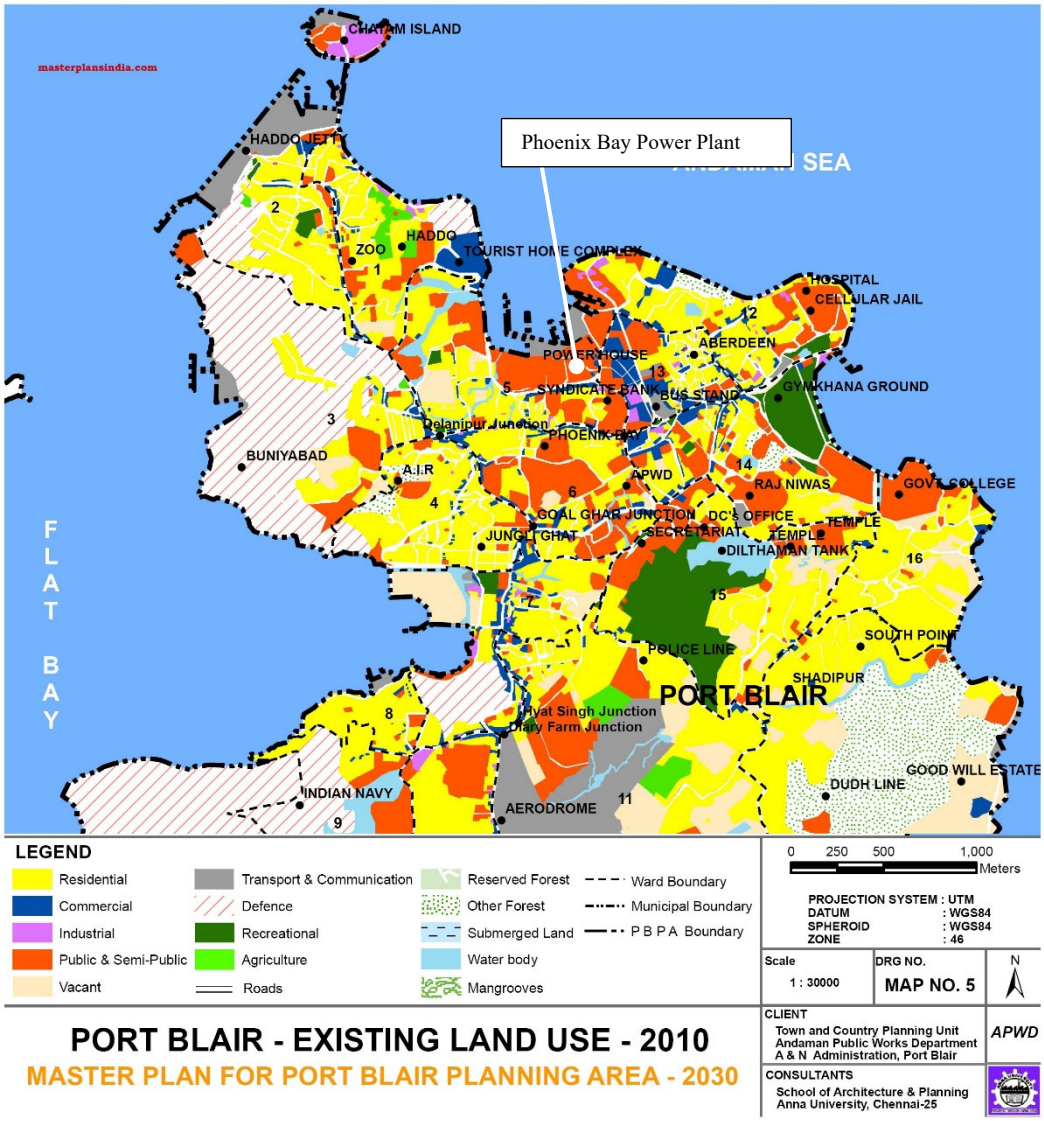
plant faces the Phoenix Bay port facility, and the south and east sides face a busy road (Foreshore Road). A photo of the area near the boundary of the power plant premises facing the road is shown in Figure 1-3-4, and the land use map of Port Blair is shown in Figure 1-3-5.

Environment near the boundary of the east side of the power plant premises

Environment near the boundary of the south side of the power plant premises

Source: Photographed by the JICA Survey Team

Figure 1-3-4 Photo of the Area Near the Boundary of the Phoenix Bay Power Plant Premises



Source: Prepared by the JICA Survey Team using "Existing Land Use Port Blair" (www.MasterPlansIndia.com)

Figure 1-3-5 Land Use Map of Area Near the Project Site

1-3-1-3 Systems and Organizations for Environmental and Social Considerations in India

(1) Environment-related Laws

Laws related to the environmental field in India are shown in Table 1-3-3. The Environment (Protection) Act, 1986 (amended 1991) is the basic law on the environment in India. The purpose of the law is to protect and improve the environment, allowing the central government to establish institutions that can prevent various forms of environmental pollution and address environmental problems in various ways in different regions.

Table 1-3-3 Environment-related Laws in India

Name	Year Enacted (Amended)
The Environment (Protection) Act	1986 (1991)
The Water (Prevention and Control of Pollution) Act	1974 (1988)
The Air (Prevention and Control of Pollution) Act	1981 (1987)
The Indian Forest Act	1927
The Forest Conservation Act	1980（1988）
The Wildlife (Protection) Act	1972 (1993)
The Wildlife (Protection) Amendment Act	2002 (2013)
The Environment Protection Rules	1986 (2018)
Environment Impact Assessment Notification	2006
Coastal Regulation Zone Notification	1991 (2018)
Hazardous Wastes Management Rules	2016
Hazardous and Other Wastes (Management and Transboundary Movement) Rules	2016
The Noise Pollution (Regulation and Control) Rules	2000 (2010)
The Chemical Accidents (Emergency Planning, Preparedness and Response) Rules	1996 (2015)
Solid Waste Management Rules	2016
Construction and Demolition Waste Management Rules	2016
The Batteries (Management and Handling) Rules	2001
The Forest Conservation Rules	2003

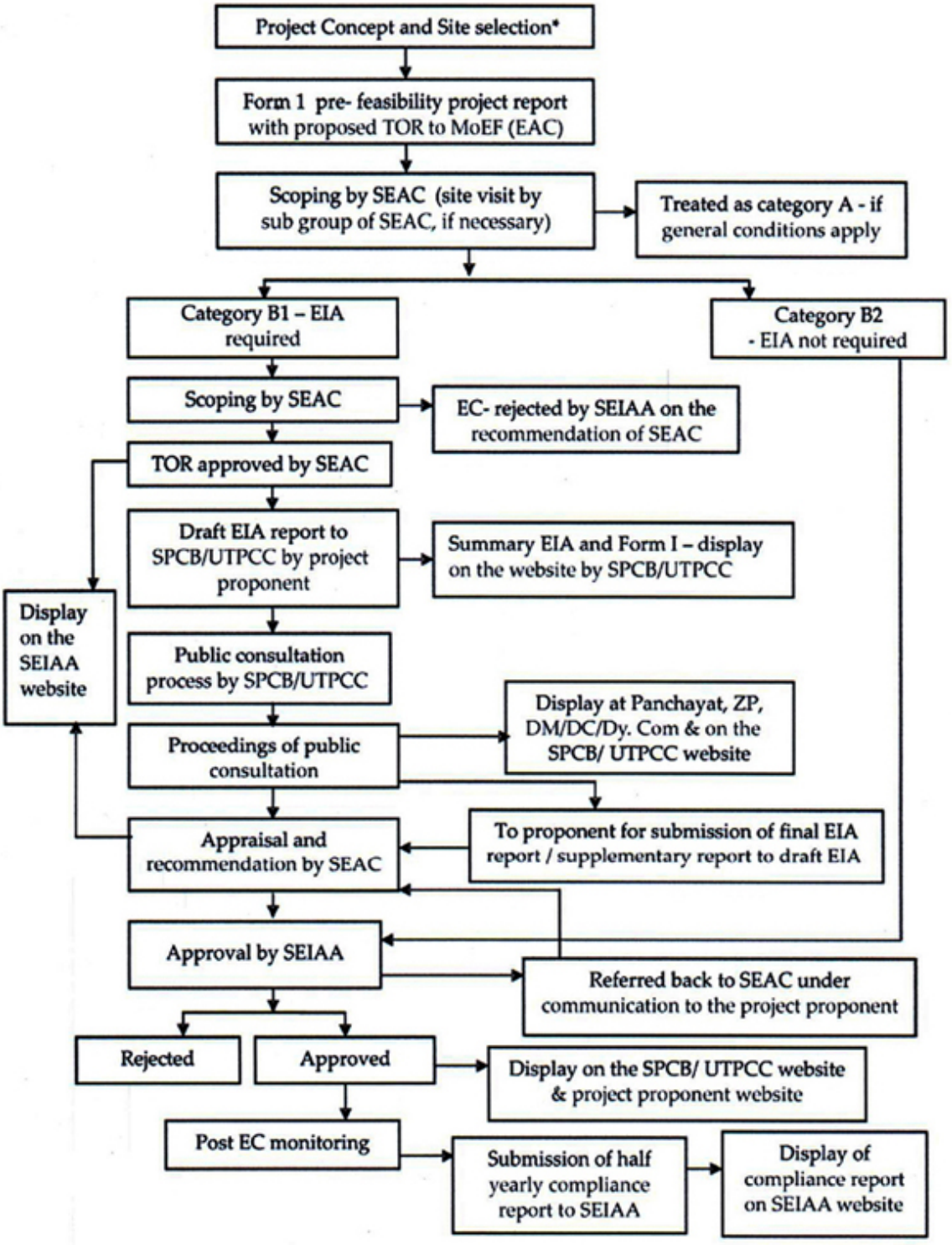
(2) Relevant Organizations and Environmental Impact Assessment

In India, an environmental impact assessment (EIA) is a process required in the process of obtaining the environmental clearance (hereinafter EC) which is required when implementing a project that may have a significant impact on the environment. The EC system is regulated by the EIA Notification 2006 (hereinafter EIA Notification) issued by the Ministry of Environment, Forest and Climate Change (hereinafter MoEFCC) of the Government of India.

According to the EIA Notification, it is necessary to obtain an EC when implementing 39 types of projects (new construction and expansion). However, some projects do not require a detailed EIA, and whether an EIA is necessary is determined in the process of obtaining an EC. Projects subject to obtaining an EC are classified as "A" or "B" according to the degree of impact on human health and resources and the scale of the project, and the process of obtaining an EC differs depending on the classification.

Projects that fall under Category A must obtain an EC from MoEFCC with the recommendation of the Environmental Appraisal Committee (hereinafter EAC) established by the central government. On the other hand, projects that fall under Category B must obtain an EC from the State Environment Impact Assessment Authority (hereinafter SEIAA) established by the central government at the state level. SEIAA issues an EC upon recommendation of the State Level Expert Appraisal Committee (hereinafter SEAC). States that do not have an SEIAA or SEAC must obtain an EC for Category B projects through the same process as Category A. The procedure for acquiring an EC in India is shown in Figure 1-3-6.

Regarding the necessity of obtaining an EC for this project, the department of the A & N Administration in charge cannot respond to queries without a formal application from the organization implementing the project. Therefore, the JICA Survey Team inquired from an SEIAA committee member, but have not yet received a response, so it is not known at this stage. However, the installation of a storage battery and the associated building does not fall under the 39 types of projects that require obtaining an EC as stipulated in the EIA Notification. In addition, the site area of the building planned to be constructed in this project (about 920 m²) is less than the area subject to EC acquisition for construction projects (20,000 m² or more), so it is very unlikely that an EC acquisition will be required for this project.



Source: https://desthp.nic.in/hpseiaa_EC_Procedures.html

Figure 1-3-6 Procedure for Obtaining Environmental Clearance (EC)

1-3-1-4 Comparative Study on Alternatives

The storage battery installation location for utilizing excess energy from solar power generation in this project is where the currently unused cooling water tank is located on the premises of the existing power plant. Since the land will be leveled to install the storage battery system, no new land acquisition or relocation of residents will occur, and no topographical changes to forests, etc. will occur. Therefore, almost no impact on the habitat of flora and fauna is expected. Regarding the location of the storage battery installation, if the same amount of land is purchased, it could be installed at another site, but in terms of convenience of connection to the grid, cost of land acquisition, and time and cost required for the survey, an alternative site superior to the current plan could not be found.

Furthermore, if the project is not implemented, the excess energy generated by solar power in the daytime could not be utilized at night which will result in power being supplied at night by diesel generators. Since the above plan is to rapidly convert Andaman's power source from the current diesel generators to a power source with low carbon dioxide emissions, choosing not to implement the project would be unreasonable as it would run counter to efforts to reduce carbon dioxide emissions. In addition, the installation of storage batteries plays a major role in maintaining the power system in the event of a generator trip, which greatly contributes to system stabilization, so choosing not to implement the project is unreasonable.

1-3-1-5 Scoping

The results of the scoping carried out for this project are shown in Table 1-3-4.

This project aims to level the part of the existing power plant premises where the currently unused cooling water tank is located to install a storage battery and a building to store it. Therefore, no new land acquisition or relocation of residents will occur, so it is assumed that there will be no significant social impact. In addition, since no negative environmental impact is expected even after the facility is put into service, the main environmental impact is the impact during the construction of the building for storing the storage battery. Regarding negative environmental impacts during construction, the impact can be managed by having the entity implementing the construction perform the work in compliance with the laws and regulations. Moreover, since a large-capacity lithium-ion battery will be installed, proper recycling of the lithium-ion battery in the future is another challenge. The table below shows the presence of influence for each assessment item assessed on a scale of 4 from A to D and the reason for the assessment.

Table 1-3-4 Scoping

Classification	Impact	Impact Assessment		Reason for Assessment
		During Construction	When in Service	
Environmental pollution	Air pollution	B-	D	During construction: Temporary emission of exhaust gas from construction vehicles and heavy machinery is expected. When in service: No air pollutants will be emitted from the facility when it is in service.
	Water pollution	D	D	During construction/when in service: No water pollution will occur in this project.
	Waste	B-	C	During construction: It is expected that cut-down trees, excess soil, and waste materials will be generated during the construction work. When in service: Proper recycling of the lithium-ion battery after its service life (approx. 20 years) is another challenge.
	Soil contamination	D	D	During construction/when in service: No soil contamination will occur in this project.
	Noise and vibration	B-	D	During construction: Noise is expected to occur due to the operation of heavy machinery and the passage of construction vehicles. When in service: No noise and vibration will be emitted from the facility when it is in service.
	Ground subsidence	D	D	During construction/when in service: No ground subsidence will occur in this project.
	Offensive odor	D	D	During construction/when in service: No offensive odors will be generated in this project.
	Sediment	D	D	During construction/when in service: No work in this project is expected to cause the sedimentation of any river or stream.

Natural environment	Protected areas	D	D	During construction/when in service: Since this project aims to level the part of the existing power plant premises and install a storage battery system, it is not expected to affect protected areas such as national parks and wildlife sanctuaries.
	Ecosystem and biota	D	D	During construction/when in service: Since this project aims to level the part of the existing power plant premises and install a storage battery system, it is not expected to affect the ecosystem and biota.
	Water conditions	D	D	During construction/when in service: No work in this project is expected to cause water flow, etc.
	Topography and geology	D	D	During construction/when in service: Since this project aims to level the part of the existing power plant premises and install a storage battery system, it is not expected to affect the topography and geology.
Social environment	Relocation of residents	D	D	During construction/when in service: No relocation of residents will occur in this project.
	Life/design	D	D	During construction/when in service: This project will not affect the lives and livelihoods of local residents.
	Cultural heritage	D	D	During construction/when in service: Since the facility will be constructed on the premises of the existing power plant and there is no adjacent cultural heritage, there will be no impact on cultural heritage.
	Landscape	D	D	During construction/when in service: Since the facility will be constructed on the premises of the existing power plant and there is no special landscape in the surrounding area that should be considered, there will be no impact on the landscape.
	Ethnic minorities, Indigenous peoples	D	D	During construction/when in service: Since the facility will be constructed on the premises of an existing power plant, there will be no impact on ethnic minorities or indigenous peoples.
Other	Work environment (Including accidents)	B-	D	During construction: If the contractor fails to take appropriate safety measures, the safety and health of construction workers will deteriorate, leading to an accident. When in service: No impact from this project is expected.
	Impact of crossing borders and climate change	D	D	During construction: Since this project aims to level the part of the existing power plant premises and install a storage battery system, no impact of crossing borders will occur. When in service: Since this project aims to install a storage battery system, no cross-border pollutants or carbon dioxide will be generated.

A: A relatively significant impact is expected (+: positive impact, -: negative impact)
B: Some impact is expected (+: positive impact, -: negative impact)
C: Since the degree of impact is unknown at this stage, further investigation is required (+: positive impact, -: negative impact).
D: No or little impact is expected

1-3-1-6 Terms of Reference (TOR) for Survey on Environmental and Social Considerations

As a result of scoping, it was assessed that it is appropriate to investigate four items including air pollution, waste, noise and vibration, and work environment (including accidents) as environmental and social consideration items for this project. Each survey item and survey method are summarized in Table 1-3-5 as the proposed TOR.

Table 1-3-5 Survey Items and Proposed TOR

Impact	Survey Items	Survey Method
Air pollution	① Confirmation of environmental standards ② Current air pollution status ③ Impact during construction	① Survey of existing documents ② Survey of existing documents and interview of relevant parties ③ Confirmation of construction details, heavy machinery used for construction, and construction vehicles
Waste	① Confirmation of disposal method for construction waste ② How to dispose of lithium-ion batteries that have reached the end of their service life	① Survey of existing documents, collection of information from relevant organizations, confirmation of disposal sites ② Survey of existing documents and confirmation of relevant laws
Noise and vibration	① Confirmation of environmental standards ② Current noise status ③ Impact during construction	① Survey of existing documents ② Survey of existing documents and field measurements ③ Confirmation of construction details, heavy machinery used for construction, and construction vehicles
Work environment (Including accidents)	① Construction site environment ② Impact of vehicles during construction	① Survey of existing documents, confirmation of relevant laws and safety measures ② Confirmation of road conditions around the project site and safety measures

1-3-1-7 Results of the Survey on Environmental and Social Considerations

(1) Air Quality

The air quality in the Andaman and Nicobar Islands is good as it is located far away from the Indian mainland. Since there are no air pollution monitoring points in the Andaman and Nicobar Islands, the past measurement results of air quality in the commercial areas of Port Blair are shown in Table 1-3-6. Comparing the measured values with the environmental standards, the environmental standards were met each year, and even in the years when the concentration was high, it was for the most part 50% or less.

In this project, the only environmental impact on air quality expected is during construction where a part of the power plant premises is leveled and the building is constructed. Temporary emission of exhaust gas is expected due to the operation of heavy machinery during construction and the passage of construction vehicles, but since it will be constructed on the premises of an existing power plant, there will be few topographical changes, and the floor area of the building is small at 920 m², so few construction vehicles and heavy machinery will be used, and the construction period is expected to be limited. Therefore, since the impact on the air quality is limited in time and area, it was assessed that there will be almost no impact on the surrounding air quality. However, regarding the impact of exhaust gas during construction, the State Pollution Control Committee may require contractors to periodically conduct environmental monitoring in the process of obtaining consent for construction.

Table 1-3-6 Air Quality Measurement Results in the Commercial Areas of Port Blair

City	Year	SO2 ($\mu g/m^3$)		NO2 ($\mu g/m^3$)		PM10 ($\mu g/m^3$)	
		Daily Average	Environmental Standards** (Daily Average)	Daily Average	Environmental Standards** (Daily Average)	Daily Average	Environmental Standards** (Daily Average)
Port Blair*	2014	29	80	37	80	32	100
	2015	15		9		48	
	2016	31		39		64	
	2017	15		10		51	

* Value measured on a normal day at Aberdeen Bazar in Port Blair.
** Environmental Standards for Residential, Rural & Other Area.
Source: Prepared by the JICA Survey Team using AMBIENT AIR QUALITY AND NOISE LEVELS Deepawali Festival Monitoring Report 2017

(2) Waste

Excess soil and waste materials will be generated during the construction. The entity implementing the construction, the Electricity Department (ED) of the A & N Administration, must sort and collect the generated construction and demolition waste based on the Construction and Demolition Waste Management Rules 2016 and deliver it to the collection center or authorized disposal facility. Construction and demolition waste generated during the construction in this project is not expected to have a significant negative impact as the ED and the implementing entity will properly dispose of them at the designated disposal site in accordance with the local laws. However, the status of disposal during construction will be confirmed by monitoring.

In this project, it is planned to use a lithium-ion battery to store and utilize excess energy generated during the day and for stabilizing the grid. In this case, the lithium-ion battery will need to be disposed of as waste in approximately 20 years. Currently, there are no lithium-ion battery recycling facilities in the Andaman and Nicobar Islands, and there are only a limited number of such facilities in India, but the Indian counterpart is fully aware of the need for proper recycling and waste disposal of the lithium-ion battery. The Batteries (Management and Handling) Rules, 2001, enacted in 2001, mainly contain regulations on the management and disposal of lead-acid batteries, and there are no specific regulations on lithium-ion batteries. However, a draft of the Battery Waste Management Rules, 2020, which is an amendment to the above law aimed at ensuring the safe and formal recycling of batteries in use with an emphasis on tracking all types of batteries, was published in February 2020. For lithium-ion batteries that have reached the end of their service life, it is assumed that if the executing agency, ED, under the responsibility of the A & N Administration, which is the main government agency in charge of this project, properly recycles them in accordance with future local laws, they can be disposed of without any negative impact on the environment.

(3) Noise and Vibration

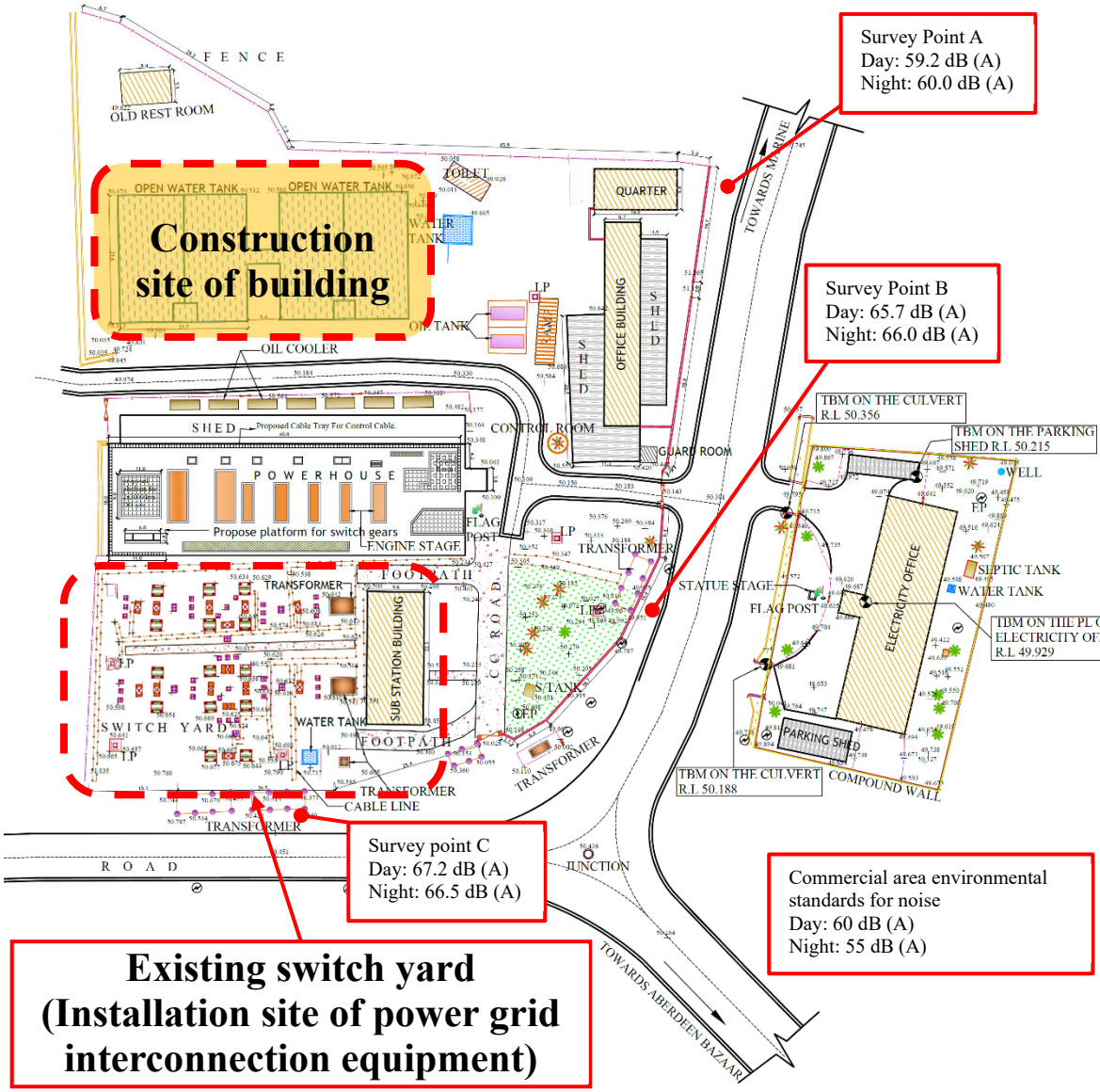
During construction: Noise is expected to occur due to the operation of heavy machinery and the passage of construction vehicles. The project site faces busy roads, port facilities, and other government-related facilities and is not adjacent to residential areas. In addition, the project site is at an existing power plant with a concrete wall approximately 2 m high at the boundary of the site as shown in the photograph in Figure 1-3-7. Comparing the results of on-site noise measurements at the three points along the boundary of the project premises (Figure 1-3-8) with the environmental standards for noise (60 dB [A] during the day and 55 dB [A] at night) in the commercial areas of India, 2 out of 3 points exceeded the standards during the day and 3 out of 3 points exceeded the standards at night, so the area surrounding the project site was not quiet. The main source of noise was vehicle traffic.

Photo taken from inside the power plant

Photo taken from outside the power plant

Source: Photographed by the JICA Survey Team

Figure 1-3-7 Photo of the Boundary of the Project Site Premises



Source: Prepared by the JICA Survey Team

Figure 1-3-8 Noise Measurement Results at the Boundary of the Power Plant Premises

Since the project site faces a busy road, the background noise level due to vehicle traffic is high, and the current values exceed the environmental standards, and such conditions are expected to continue during construction. In this project, the only environmental impact expected due to noise is during construction where a part of the power plant premises is leveled and the building is constructed. Temporary emission of noise is expected due to the operation of heavy machinery during construction and the passage of construction vehicles, but since it will be constructed on the premises of an existing power plant, there will be few topographical changes, and the floor area of the building is small at 920 m², so few construction vehicles and heavy machinery will be used, and the construction period is expected to be limited. In addition, the location of the building which will house the storage battery is surrounded by the structures of the existing power plant and is more than 100 m away from areas where people live, so the noise caused by the operation of heavy machinery will have no significant

impact on the surrounding area. Therefore, it was assessed that the noise and vibration generated during construction in this project would not have a significant negative impact on the surrounding environment. However, regarding the impact of noise during construction, the State Pollution Control Committee may require contractors to periodically conduct environmental monitoring in the process of obtaining the consent for construction.

(4) Work Environment, Accidents

During construction, there are concerns about traffic accidents caused by construction vehicles and accidents due to the operation of heavy machinery at the construction site. Since the construction scale is small, few construction vehicles and heavy machinery will be used, and the construction period is expected to be limited, so the risk of an accident is not expected to be high. However, during construction, it is necessary to formulate an appropriate safety plan as a mitigation measure, implement reliable safety measures based on this, and take safety into account where possible.

1-3-1-8 Impact Assessment

The environmental impact of the project is assessed based on the results of the survey on environmental and social considerations in the previous section, and the changes in the impact assessment from the proposed scoping are shown in Table 1-3-7.

Table 1-3-7 Results of Environmental Impact Assessment

Item	Assessment Based on Scoping		Assessment Based on Survey Results		Reason for Assessment
	During Construction	When in Service	During Construction	When in Service	
Air pollution	B-	D	D	N/A	During construction: Temporary emission of exhaust gas from construction vehicles and heavy machinery is expected, but since construction will occur on the premises of an existing power plant, there will be little topographical change, and the floor area of the building is small at 920 m², so the construction scale will be small. Accordingly, few construction vehicles and heavy machinery will be used, and the construction period will be limited. Therefore, since the impact on the air quality is limited in time and area, it was assessed that the exhaust gas emitted during the construction in this project will have almost no impact on the surrounding environment.
Water pollution	D	D	N/A	N/A	—

Waste	B-	B-	B-	D	During construction: It is expected that cut-down trees, excess soil, and waste materials will be generated during the construction work. However, since construction will occur on the premises of an existing power plant, there will be little topographical change, and the floor area of the building is small at 920 m², so the construction scale will be small. Therefore, it was assessed that by implementing mitigation measures and taking appropriate measures in accordance with local laws, there would be no significant negative impact on the surrounding environment. When in service: Legislative reform on the disposal of lithium-ion batteries is underway. Therefore, it was assessed that if the executing agency, ED, under the responsibility of the A & N Administration, which is the main government agency in charge of this project, properly recycles lithium-ion batteries that have reached the end of their service life (approx. 20 years) in accordance with future local laws, they can be disposed of with almost no negative impact on the surrounding environment.
Soil contamination	D	D	N/A	N/A	—
Noise and vibration	B-	D	B-	N/A	During construction: Noise and vibration are expected to occur due to the operation of heavy machinery and the passage of construction vehicles, but due to the small scale of construction and the small number of construction vehicles and heavy machinery used, it was assessed that there would be no significant impact on the noise level of the roads surrounding the project site, which already exceeds the environmental standards. In addition, since the construction location of the building is surrounded by the structures within the existing power plant premises, and the boundary of the power plant premises is surrounded by a concrete wall with a certain degree of noise insulation, it was assessed that if mitigation measures are taken, the current noise level would not be significantly worsened.

Item	Assessment Based on Scoping		Assessment Based on Survey Results		Reason for Assessment
	During Construction	When in Service	During Construction	When in Service	
Ground subsidence	D	D	N/A	N/A	—
Offensive odor	D	D	N/A	N/A	—
Sediment	D	D	N/A	N/A	—
Protected areas	D	D	N/A	N/A	—
Ecosystem, Biota	D	D	N/A	N/A	—
Water conditions	D	D	N/A	N/A	—
Topography and geology	D	D	N/A	N/A	—
Relocation of residents	D	D	N/A	N/A	—
Life/design	D	D	N/A	N/A	—
Cultural heritage	D	D	N/A	N/A	—
Landscape	D	D	N/A	N/A	—
Ethnic minorities, Indigenous peoples	D	D	N/A	N/A	—
Work environment (including accidents)	B-	D	B-	N/A	During construction: During construction, there are concerns about traffic accidents caused by construction vehicles and accidents due to the operation of heavy machinery at the construction site. During construction, it is necessary to take mitigation measure, and take safety into account where possible.
Impact of crossing borders and climate change	D	D	N/A	N/A	—

A: A relatively significant impact is expected (+: positive impact, -: negative impact)
B: Some impact is expected (+: positive impact, -: negative impact)
C: Since the degree of impact is unknown at this stage, further investigation is required (+: positive impact, -: negative impact).
D: No or little impact is expected
N/A: Impact assessment has not been conducted as it was classified as D at the scoping stage.

1-3-1-9 Mitigation Measures and Cost of Implementing Mitigation Measures

Regarding the item assessed as “B-”, which was assessed to have an impact in the environmental impact

assessment, the following measures are proposed to avoid or mitigate the negative impact:

Table 1-3-8 Mitigation Measures for Items Predicted to Have Environmental Impact

Item	Period	Mitigation Measures	Responsible Agency	Supervisory Authority	Cost
Waste	During construction	・Secure a temporary disposal area within the site under construction. ・Confirm the status of the secured disposal area once a month. ・Do not burn materials outdoors. ・Confirm once a month whether the waste generated during construction is disposed of at the designated disposal site. ・Appropriately dispose of any household waste generated by workers in accordance with the disposal of municipal waste.	ED Construction contractor	A & N Administration	Included in construction costs.
Noise pollution	During construction	・Observe the speed limit for construction vehicles. ・Limit work hours to daytime only and do not work at night. ・Do not idle heavy machinery unnecessarily. ・Use a simple noise level meter to periodically measure and record the noise level during the construction period to confirm that the level is appropriate. ・Confirm whether there have been complaints from local residents.	ED Construction contractor	A & N Administration	Included in construction costs.
Work environment (Including accidents)	During construction	・Observe the speed limit for construction vehicles. ・Prepare personal protective equipment such as helmets, gloves, and safety vests. ・Periodically educate personnel involved in the construction work to mitigate the occurrence of occupational accidents. ・Hold regular safety meetings. ・To prevent electric shocks, only allow workers with technical capacity and experience to install electrical equipment. ・For the operation of construction vehicles, create a traffic plan that takes safety into consideration and provide safety education to drivers to prevent accidents from occurring.	ED Construction contractor	A & N Administration	Included in construction costs.

Source: JICA Survey Team

1-3-1-10 Monitoring Plan

The monitoring plan during the construction for the storage battery system is shown in the table below. Furthermore, regarding the environmental monitoring items during construction, the items that could be implemented were inquired from the department of the A & N Administration in charge, but they said that they could not respond without a formal construction application from the project executing entity. Therefore, additional environmental monitoring items may be added.

Table 1-3-9 Monitoring Plan

Item	Period	Location	Mitigation Measures	Responsible Agency	Supervisory Authority
Waste	During construction	Construction site	・Inspect disposal area within the site. ・Confirm delivery from the site to the disposal site. ・Once a month	ED Construction contractor	A & N Administration
	At the time of disposal	Storage battery installation site	・Appropriately recycle in accordance with the local law currently under revision (Battery Waste Management Rules, 2020).	ED	A & N Administration
Noise and vibration	During construction	Power plant premises boundary	・Measure noise level at the boundary of the premises with a simple sound level meter during the construction period when heavy machinery is in operation. ・Once a month, two points along the boundary	ED Construction contractor	A & N Administration
Work environment (Including accidents)	During construction	Construction site	・Hold safety meetings ・Once a month	ED Construction contractor	A & N Administration

Source: JICA Survey Team

1-3-1-11 Stakeholder Meeting

Since this project aims to level the part of the existing power plant premises where the currently unused cooling water tank is located to install a storage battery and a building to store it, land acquisition and resident relocation will not occur, and no direct impact is expected. In addition, environmental impact on air quality, noise level, and vibration, which is limited in time and area due to the operation of construction vehicles and heavy machinery during construction, is expected, but since the project site is not adjacent to any residential area and the building to be constructed is small, almost no impact on the neighboring residents is expected.

Unlike the replacement of diesel generators before the project was amended, the installation of storage batteries is a project that is unlikely to have a serious environmental impact, and the need for EC acquisition is low. Therefore, it is not planned to hold a stakeholder meeting for affected parties. It will be held if deemed necessary during the approval process when moving forward.

1-3-2 Land Acquisition and Relocation of Residents

Since this project aims to level the part of the existing power plant premises where the currently unused cooling water tank is located to install a storage battery and a building to store it, land acquisition and resident relocation will not occur, and no direct impact will occur. Therefore, there is no need to investigate this item.

1-3-3 Others

1-3-3-1 Draft Monitoring Form

(1) Waste

Item	Purpose	Measurement Method, Location	Measured Value	Measured Value (Frequency)
Waste	① Confirm whether waste has accumulated in the disposal area within the site ② Confirm whether it is delivered to the disposal site	① Visually patrol the site and record in daily work report, etc. ② Interview the person in charge and record in daily work report, etc.	(Example) ① Checked for the accumulation of waste. There was no illegal dumping in the surrounding area. ② Confirmed delivery to the disposal site.	① Designated disposal area (once a month) ② Transportation status to the designated disposal site (once a month)

Source: JICA Survey Team

(2) Noise

Item	Purpose	Measuring Method	Measured Value	Frequency
Noise	① Confirm whether the noise level during construction has significantly worsened ② Confirm whether there have been complaints from local residents	① Using a simple measuring instrument with a logger, measure at two points along the premises boundary when heavy machinery is in operation and record in daily work report. ② Confirm whether there have been complaints from local residents and record in daily work report.	(Example) ① Point A: 60 dB Main noise source: Vehicle traffic noise ・Point B: 65 dB Main noise source: Vehicle traffic noise ② No complaints from local residents have been confirmed	① Once a month when heavy machinery is operating on the project site ② For complaints from local residents, check as needed

Source: JICA Survey Team

(3) Work Environment (Including Accidents)

Item	Purpose	Measuring Method	Measured Value	Frequency
Work environment (Including accidents)	① Confirm efforts to reduce the risk of accidents	① Record the work performed in the daily work report, etc. ① Perform safety patrol	(Example) ① Bring together persons in charge to inform them to strictly adhere to the wearing of personal protective equipment and the proper disposal of waste.	① Conduct once a month during the construction period. In addition, conduct before events where there is a high risk of accidents

Source: JICA Survey Team

1-3-3-2 Environmental Checklist

JICA's environmental checklist and other infrastructure development forms were used.

Classification	Environmental Items	Main Check Items	Yes: Y No: N	Specific Environmental and Social Considerations (Reason, Basis, Mitigation Measures, etc. for Yes/No)
Authorization, explanation	(1) EIA and environmental clearance	(a) Has an environmental assessment evaluation report (EIA report), etc. been prepared? (b) Has the EIA report, etc. been approved by the government of the country concerned? (c) Are there conditions associated with the approval of the EIA report, etc.? If there are associated conditions, are those conditions satisfied? (d) If necessary for conditions other than the above, has an environmental clearance been obtained from the local competent authority?	(a) N (b) N (c) N (d) N	(a) (b) (c) This project is not classified as a project that requires EIA. (b) The state environmental monitoring committee may issue comments on the content during the construction application process if necessary.
	(2) Explanation to local stakeholders	(a) Have the content and impact of the project including information disclosure been appropriately explained to local stakeholders, and has their consent been obtained? (b) Have the comments from the residents been reflected in the project content?	(a) N (b) N	(a) (b) Since this project aims to level the part of the existing power plant premises where the currently unused cooling water tank is located to install a storage battery system, land acquisition and resident relocation will not occur. In addition, since no negative impact on the environment or directly affected people are expected, these have not been conducted at this stage.
	(3) Study on alternatives	(a) Were multiple alternatives to the project plan (including environmental and social matters during the study) considered?	(a) Y	The method which would have the least environmental and social impact in terms of the environment, cost, technology, and energy in case another plot of land was purchased and in case that the project is not implemented was used has been examined.

Source: JICA Survey Team

Classification	Environmental Items	Main Check Items	Yes: Y No: N	Specific Environmental and Social Considerations (Reason, Basis, Mitigation Measures, etc. for Yes/No)
Pollution control measures	(1) Air quality	(a) Will air pollutants (sulfur oxides [SOx], nitrogen oxides [NOx], dust, etc.) that will be emitted by the target infrastructure facility and its ancillary facilities be consistent with the emission standards and environmental standards of the country concerned? Will measures be taken for air quality? (b) Will accommodation facilities use fuels with low emission factors (carbon dioxide, nitrogen oxides, sulfur oxides, etc.) as power and heat sources?	(a) N (b) N	(a) (b) No air pollutants will be generated from the battery system. Since the construction will be localized within the premises of the existing power plant and small (floor area of the building: 920 ㎡), and it is expected that there will be few heavy machinery in operation, it was assessed that there will be almost no impact on the surrounding area.
	(2) Water quality	(a) Will the wastewater or leachate from infrastructure facilities and ancillary facilities be consistent with the emission standards and environmental standards of the country concerned?	(a) N	(a) No cause of water pollution will be generated from the storage battery system. No work that will cause water pollution will be conducted even during construction.
	(3) Waste	(a) Will the waste from the infrastructure facility and its ancillary facilities be properly treated and disposed of in accordance with the regulations of the country concerned?	(a) Y	(a) Since the useful life of the lithium-ion battery is approximately 20 years after it is put into service, it will be necessary to dispose of it as waste. Currently, legislative reform is underway with the aim of ensuring the safe and formal recycling of batteries in use, and it is assumed that if the executing agency, ED, under the responsibility of the A & N Administration, which is the main government agency in charge of this project, properly recycles them in accordance with future local laws, they can be disposed of without any negative impact on the environment. During construction, it is thought that the impact can be reduced by establishing a temporary waste disposal area within the site, delivering it to an appropriate disposal site, and taking mitigation measures such as patrol.

	(4) Soil contamination	(a) Will measures be taken to prevent soil and groundwater from being contaminated by drainage and leachate from the infrastructure facility and its ancillary facilities?	(a) N	(a) No cause of soil contamination will be generated from the storage battery system. No work that will cause soil contamination will be conducted even during construction.

Source: JICA Survey Team

Classification	Environmental Items	Main Check Items	Yes: Y No: N	Specific Environmental and Social Considerations (Reason, Basis, Mitigation Measures, etc. for Yes/No)
Pollution control measures	(5) Noise and vibration	(a) Are noise and vibration levels consistent with the standards of the country concerned?	(a) N	(a) No noise or vibration will be generated from the storage battery system. Noise is expected to be generated by construction vehicles and heavy machinery during construction, but judging from the scale of construction and the construction location surrounded by the structures of the existing power plant, it was assessed that the noise will not have a significant impact on the surrounding area. In addition, in the survey on the current noise level conducted at the boundary of the power plant site, it was confirmed that the current noise level exceeded the environmental standards due to the impact of vehicle traffic noise, so such conditions are expected to continue during construction and when the facility is in service. During the construction period, measures such as limiting the operating hours of heavy machinery to daytime will be taken to mitigate noise.
	(6) Ground subsidence	(a) Will there be a risk of ground subsidence when a large amount of groundwater is drawn?	(a) N	(a) The storage battery system will not cause ground subsidence. No work that will cause ground subsidence will be conducted even during construction.
	(7) Offensive odor	(a) Will there be a source of offensive odors? Will measures be taken to prevent offensive odors?	(a) N	(a) No cause of offensive odors will be generated by the storage battery system. No work that will cause offensive odors will be conducted even during construction.
Natural environment	(1) Protected areas	(a) Is the site located in a protected area stipulated by the laws, international treaties, etc. of the country concerned? Will the project affect protected areas?	(a) N	(a) There are no protected areas at the project site (within the premises of the existing power plant) or in the adjacent area. In addition, the battery system will not affect protected areas when in service.

	(2) Ecosystem	(a) Does the site include virgin forests, tropical natural forests, or ecologically important habitats (coral reefs, mangrove wetlands, tidal flats, etc.)? (b) Does the site include habitats of rare species that require protection under the laws and international treaties of the country concerned? (c) If there are concerns about significant impacts on the ecosystem, will measures be taken to mitigate the impact on the ecosystem?	(a) N (b) N (c) N	(a) There are no virgin forests, tropical natural forests, or ecologically important habitats (coral reefs, mangrove wetlands, tidal flats, etc.) on the project site. (b) There is no habitat for rare species within the project site. (c) The storage battery system and installation work will not affect the ecosystem, so there will be no concerns.

Source: JICA Survey Team

Classification	Environmental Items	Main Check Items	Yes: Y No: N	Specific Environmental and Social Considerations (Reason, Basis, Mitigation Measures, etc. for Yes/No)
Natural environment	(2) Ecosystem	(d) Will the water used (surface water, groundwater) by the project affect the water environment such as rivers? Will measures be taken to mitigate the impact on aquatic organisms?	(d) N	(d) The storage battery system and installation work will not affect the water environment such as rivers.
	(3) Water conditions	(a) Will the change in the water system due to the project adversely affect the flow of surface water or groundwater?	(a) N	(a) The storage battery system and installation work will not affect the flow of surface water, groundwater, etc.
	(4) Topography and geology	(a) Will the project significantly alter the topography and geological structure of the site and its surroundings?	(a) N	(a) There will be no impact from the storage battery system that will cause changes in topography or geology. No work will be conducted that will change the topography and geology even during construction.
Social environment	(1) Relocation of residents	(a) Will involuntary relocation of residents occur as a result of the implementation of the project?	(a) N	(a) Residents will not be relocated due to the implementation of the project.

	(2) Livelihood	(a) Will the project have a negative impact on the lives of the residents? Will consideration be given to mitigate the impact if necessary?	(a) N	(a) The project will not have a negative impact on the lives of the residents.
	(3) Cultural heritage	(a) Is there a risk that the project will damage archaeologically, historically, culturally, and religiously valuable heritage, historic sites, etc.? In addition, will measures stipulated by national laws of the country concerned be taken into account?	(a) N	(a) The existence of archaeologically, historically, culturally, and religiously valuable heritage sites, historic sites, etc. has not been identified within the project site or in the adjacent area.
	(4) Landscape	(a) If there is landscape that needs special consideration, will the project have an adverse effect on it? Will necessary measures be taken if there is an impact? (b) Is there a risk that the landscape will be spoiled by high-rise buildings and large-scale accommodation facilities?	(a) N	(a) There is no landscape that should be considered within the project site and adjacent area. In addition, the building to be installed by the project is small and will not spoil the surrounding landscape.

Source: JICA Survey Team

Classification	Environmental Items	Main Check Items	Yes: Y No: N	Specific Environmental and Social Considerations (Reason, Basis, Mitigation Measures, etc. for Yes/No)
Social environment	(5) Ethnic minorities, Indigenous peoples	(a) Have considerations been taken to reduce the impact on ethnic minorities and indigenous cultures and lifestyles? (b) Will the rights on land and resources of ethnic minorities and indigenous peoples be respected?	(a) N	(a) (b) The storage battery system and installation work will not affect ethnic minorities or indigenous peoples.
	(6) Work environment	(a) Will the laws on work environment of the country concerned that apply to this project be observed? (b) Will tangible safety considerations be taken for those involved in the project, such as the installation of safety equipment to prevent occupational accidents and the management of harmful substances? (c) Will abstract measures be taken for those involved in the project, such as formulating a safety and health plan and implementing safety education (including traffic safety and public health) for workers, etc.? (d) Will appropriate measures be taken to prevent the security personnel involved in the project from invading the safety of project personnel and local residents?	(a) Y (b)Y (c)Y (d) N	(a) Compliance with laws concerning the work environment will clearly be stated in the contract with the contractor and managed. (b) (c) As a mitigation measure, a waste area will be established and patrolled. In addition, tangible and intangible measures, such as preparing personal protective equipment, periodical education of construction personnel and safety meetings, will be taken. (d) Since this project will be conducted on the premises of the existing power plant, security personnel will not infringe on the safety of local residents.

Source: JICA Survey Team

Classification	Environmental Items	Main Check Items	Yes: Y No: N	Specific Environmental and Social Considerations (Reason, Basis, Mitigation Measures, etc. for Yes/No)
Other	(1) Impact during construction	(a) Will there be mitigation measures in place for pollution during construction (noise, vibration, muddy water, dust, exhaust gas, waste, etc.)? (b) Will the construction have an adverse effect on the natural environment (ecosystem)? In addition, will there be any mitigation measures in place for the impact? (c) Will the construction have an adverse effect on the social environment? In addition, will there be any mitigation measures in place for the impact?	(a) Y (b) N (c) N	(a) Measure will be taken to mitigate noise and waste that are evaluated to have a negative impact during construction. (b) Since this project aims to level the part of the existing power plant premises where the currently unused cooling water tank is located to install a storage battery system, there will be no alteration of the natural environment or adverse effect on the ecosystem. (d) Since this project aims to level the part of the existing power plant premises where the currently unused cooling water tank is located to install a storage battery system, no factors that will require land acquisition and resident relocation are expected.

	(2) Monitoring	(a) For items from the above environmental items that may have an impact, will the monitoring of the business operator be planned and implemented? (b) How will the items, methods, frequency, etc. of the said plan be defined? (c) Will a monitoring system (organization, personnel, equipment, budget, etc. and their continuity) for the business operator be established? (d) Is the method, frequency, etc. of reporting by the business operator to the competent government agency, etc. regulated?	(a) Y (b)Y (c)Y (d) N	(a) A monitoring plan for items that may have an impact will be developed, and the ED and the construction contractor will comply with and implement it. However, items, frequency, etc. may change in the process of obtaining consent for construction, under the guidance of the state's environmental monitoring committee. (b) Monitoring will be conducted once a month during the period when the impact of construction is large, such as when heavy machinery is in operation. (c) Mostly included in construction costs. (d) The reporting of the monitoring results will be clearly stated in the contract with the contractor and managed.

Source: JICA Survey Team

Classification	Environmental Items	Main Check Items	Yes: Y No: N	Specific Environmental and Social Considerations (Reason, Basis, Mitigation Measures, etc. for Yes/No)
Points to note	Reference of other environmental checklists	(a) If necessary, add and assess applicable check items from checklists for roads, railways, and bridges (when access roads, etc. are installed in connection with infrastructure facilities, etc.). (b) For laying telephone lines, steel towers, submarine cables, etc., the applicable check items in the checklist for transmission, transformation, distribution shall be added and assessed as necessary.	(a) N (b) N	(a) (b) N/A
	Precautions for using environmental checklists	(a) If necessary, confirm the impact on cross-border or global environmental problems (when factors related to cross-border treatment of waste, acid rain, ozone depletion, global warming, etc. can be expected).	(a) N	(a) Since the useful life of the lithium-ion battery is approximately 20 years after it is put into service, it will be necessary to dispose of it as waste. A bill with the aim of ensuring the safe and formal recycling of batteries in use was deliberated in February 2020 in India, and it is assumed that if the executing agency, ED, under the responsibility of the A & N Administration, which is the main government agency in charge of this project, properly recycles them in accordance with future local laws, they can be disposed of without any negative impact on the environment.

Source: JICA Survey Team

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

This project includes the installation of a battery storage facility (30 MW, 15 MWh) at the Phoenix Bay Power Plant site within the ED jurisdiction. Specifically, the following facilities will be installed.

- Storage battery
- Grid connecting equipment
- SCADA system (Local SCADA system for the control management of storage battery, system stabilizer equipment, PCS)
- Building (for installation of abovementioned components)

Above components are agreed in consultation with the Indian side.

The storage battery system is capable of recharging the daytime surplus power from solar power generation and discharging it during the evening peak demand period. This allows for the effective use of solar power. Since the amount of electricity generated by DEGs or LNG generators can be reduced to the extent that solar power is effectively used, greenhouse gases are expected to be reduced. In addition, the recharging and discharging of storage batteries can stabilize the supply and demand of the grid in the event of a generator dropout accident or distribution line accidental interruption, and the fluctuation range of the grid frequency can be controlled.

As a result of these effects, the battery storage facilities will contribute to the stabilization of the grid, which is an issue in South Andaman. The realization of grid stabilization is expected to contribute to the improvement of the quality of social services and the facilitation of industrial activities in the future.

Therefore, this project aims to contribute to the enhancement of industrial competitiveness by effectively utilizing renewable energy derived power and stabilizing the power supply through the construction of storage batteries and related facilities on the premises of the Phoenix Bay Power Plant in South Andaman.

2-2 Outline Design of the Requested Japanese Assistance

2-2-1 Design Policy

(1) Basic Policy

The basic policies of the project are as follows:

1) The purposes of the introduction of storage batteries are: (1) Shifting peak of the surplus power generated by PV power generation system (charging surplus power from PV power generation system during daytime and utilizing during the peak demand in the evening), (2) Stabilizing the imbalance of supply and demand of the power grid due to generator dropouts and distribution line accidents.

2) The storage battery system is connected to the existing 33 kV substation bus of the Phoenix Bay Power Plant.

3) The storage battery system is planned to be installed on the premises of the Phoenix Bay Power Plant within the ED jurisdiction, which is the executing agency of the project.

(2) Policy for Natural Condition

The natural weather conditions around the project location are as mentioned below. The given values are from March 2009 to March 2020.

1) Ambient Temperature: Max. 36 ℃, Min. 14 ℃ and annual average is 27.4 ℃.
2) Humidity: Max. 100%, Min. 29% and annual average is 82%

The normal operating temperature of SCADA system is often set to 30 ℃ or less by the supplier/manufacturer. In addition, the normal operating humidity conditions of storage battery equipment, including SCADA equipment, are often set to 80 to 85% RH or less. Therefore, in the new building construction plan for the installation of the procured equipment for the project, air conditioning system is planned to be installed to maintain indoor temperature and humidity within the permissible operating conditions of the equipment.

(3) Policy on Applicable Standards

The equipment procured in Japan for this project is subject to the Japanese Industrial Standards (JIS) and International Electrotechnical Commission Standards (IEC). In addition to IEC and JIS, Indian Standard (IS) will be applied to the locally procured equipment.

(4) Policy on Utilization of Local Contractors

There are local contractors who have enough construction capacity and experience working on power generation and transformation equipment construction project of ED. Therefore, it is desirable to utilize a local contractor for the construction of this project. In addition, during the construction period, experienced Japanese engineers will be assigned for technical guidance, supervision, and management of the project works.

2-2-2 Basic Plan (Equipment Plan)

As a result of the discussion with the Indian side counterpart based on “2-1 Design Policy (1) Basic Policy”, the basic plan for the storage battery component for this project is as follows:

- Storage battery type: Lithium-ion
- Capacity: 15 MWh
- Power: 30 MW

(1) Overall Plan

All equipment is located within the premises of the Phoenix Bay Power Plant under the ED jurisdiction.

Main equipment is as follows:

- Storage battery system capacity 15 MWh
- 11 kV switchgear
- 33 kV switchgear for power grid interconnection
- Main transformer (15 MVA, 33/11 kV, 2 sets)
- SCADA system (Local SCADA system for storage battery system)
- Building

Objectives of this project are the decrease of diesel engine fuel, carbon dioxide emissions, and improvement of power system stability.

(2) Material Procurement Plan

1) Power Grid Interconnection Equipment

① Basic Policy

The proposed storage battery system is connected to the existing 33 kV substation bus in the Phoenix Bay Power Plant. The power (30 MW) of this new storage battery is set to supply power even during the severe system disturbance in the South Andaman power system. The planed storage battery system has a capacity of 15 MWh and a short-term power of 30 MW, and the connections to the existing 33 kV substation are planned by two circuits with two main transformers of 15 MVA (33 kV/11 kV) capacity. Maintenance of interconnection lines is possible to be performed for each connection separately, making it possible to handle normal battery charging and discharging without complete shutdown.

② Applicable Standards

The power grid interconnection equipment conforms to the following standards:

- Indian Standard (IS)
- International Electrotechnical Commission (IEC)
- Japanese Industrial Standards (JIS)

③ Installation Location and Equipment Plan

The power grid interconnection equipment is planned to be installed in the existing switchyard of the Phoenix Bay Power Station, in the existing control building, and in the outdoor space next to the newly constructed building. Below is a summary of the necessary materials for the system interconnection for the project.

Table 2-2-1 Main Equipment for Power Grid Interconnection

No.	Equipment	Specification	Q'ty	Purpose of Use
1	Circuit breaker	Rated voltage: 36 kV Rated current: 1,250 A Rated breaking capacity: 25 kV Including support and foundation	2 sets	Separation and protection from the grid in the event of an accident in the power grid interconnection equipment
2	Steel structure	Modification of existing structures including foundation	1 lot	Branch the power grid interconnection line from the existing outdoor substation
3	Control panel	Two feeders of 33 kV interconnection switchgears and power cables. Protection relays (51,51G, 64, 87) including telecom. cables	1 set	Monitoring and control of the power grid interconnection equipment
4	Main transformer for grid interconnection	Outdoor type, 3 phase, 33 kV/11 kV, 50 Hz, 15 MVA, with oil thermometer, pressure relief valve and foundation	2 sets	AC voltage conversion to meet the supply voltage

Source: JICA Survey Team

2) Storage Battery System

① Basic Policy

In consideration of unpredictable power fluctuations of renewable energy generations, rapid response of suitable charge/discharge, ease of following the ever-changing supply and demand, and ease of maintenance, Lithium-ion (Li-ion) storage battery system is adopted in this project. The storage batteries mainly store the surplus power during the day for use in the night peak demand, contributing fossil fuel reduction in electricity supply. After boosting the power supplied from this system (PCS AC output → 11 kV → 33 kV), it connects to the existing 33 kV bus to enable bidirectional supply of charge/discharge. Furthermore, this system will also play an effective role as spinning reserve for measures against fluctuations of renewable energy generation and supply, momentary fluctuation of supply and demand due to grid accident, which translates to the reduction of existing diesel operation in the low efficiency power band and fossil fuel consumption.

② Applicable Standards

- International Electrotechnical Commission (IEC)
- Japanese Industrial Standards (JIS)

③ Equipment and Installation Location

To avoid outer influence and to ensure safety, the storage battery and related equipment is planned to be installed inside the newly constructed building within the premises of ED, the executing organization. In the newly constructed building, the storage battery and necessary related equipment together with PCS will be installed in accordance with the following plan:

- PCS is planned to be purchased as a commercial product considering economic impact and workability for smooth long run.
- The step-up transformer and other electrical equipment necessary to connect the storage battery system and grid is planned to be purchased locally considering operation and maintenance together with economic efficiency.

The equipment planned for installation are as follows:

Table 2-2-2 Main Equipment of Storage Battery System

No.	Item	Main Composition	Qty	Purpose
1	11 kV outdoor switchgear	Indoor type, 2 circuits, Power cable, Signal wire/cable, Protection relay: 51, 51G	1 Set	For charge/discharge and AC power supply
2	Step-up TR (SUTR) from LV to HV (11 kV)	Outdoor, 3-phase 11 kV 50 Hz, Thermometer (Alarm contact) Foundation		
3	Transformer (STR) (for in-house use)	Outdoor, 3-phase 11 kV/0.4-0.2 kV, 50 Hz, Temperature (Alarm contact), Foundation		
4	PCS (Power Conditioning Subsystems)	Indoor, Power: 30 MW (Total), with necessary system control device and equipment, including power and signal cables		
5	Control panel (Including charge/discharge)			
6	Terminal panel			
7	In-house power supply Distribution board	Indoor type, 3-phase 4-wire, 400/200 V		
8	Storage battery	Indoor installation, Total Capacity: 15 MWh, Type: Li-ion (with necessary power and signal cables)		

Source: JICA Survey Team

④ System Voltage

- Depending on the manufacturer, the DC side voltage of battery system depends on the type of material and combination of series and parallel connections to meet the specification of connecting equipment for efficient operation. Hence, DC voltage is left for bidder's/supplier's design.
- The AC output voltage of PCS varies depending on the specification of the manufacturer's equipment and input design for supply connection and efficient operation. The AC output voltage of PCS is boosted to the distribution voltage (11 kV) level and again boosted up to 33 kV transmission level for power grid interconnection. As a result, in consideration of the operation and maintenance of the distribution supply, it is possible to purchase locally manufactured products such as switchgear panels, transformers, distribution boards and so on.

⑤ Detailed Specifications of Storage Battery

The detailed specifications of the storage battery are assumed to be as follows:

- Storage battery capacity: 15 MWh at 1.0 C
- Discharge capacity: Capacity capable of outputting 30 MW continuously for at least 20 minutes
- Charge/discharge performance: 0-100% charge/discharge at 2.0 C
- Cycle life: 10,000 cycles or more at 1.0 C and 95% maximum discharge
- Calendar life: 15 years or more

3) SCADA

① Basic Plan

The SCADA system is introduced to monitor and control the equipment such as the storage battery system and the grid interconnection equipment which is newly introduced in the project. Monitoring and control of existing equipment are outside the scope of the SCADA system. The SCADA system is positioned as a 'local SCADA' which is dedicated to the storage battery system introduced by the project while the monitoring and control of the entire South Andaman grid will be done by the Energy Management Center (EMC).

The main functions of the SCADA system are monitoring and charge/discharge control of the storage battery system and monitoring and control of the grid interconnection equipment.

The SCADA system also incorporates a function to communicate with EMC, by which the operating status of the storage battery system is transmitted online to EMC.

It is assumed that the operation of the storage battery system is performed by the operator of the SCADA system in accordance with the operational command provided by the South Andaman grid operator located in EMC by means such as telephone and wireless.

Since the detailed specifications of the EMC have not been disclosed, it is necessary to confirm during the implementation design period whether the frequency adjustment control function

will be implemented in the EMC and whether the EMC is designed to control the power plants and substations in the grid either remotely or directly. Based on conformation of information of EMC control system, the control method of the storage battery system will be considered.

Applicable Standards

The applicable standards for individual devices and functions composing the SCADA system are IEC, ISO, ITU-T, IEEE, JIS, JEC, JEM, JEITA, etc.

② Installation Location and Equipment Plan

The SCADA system is planned to be installed inside the newly constructed building in the premises of the Phoenix Bay Power Plant.

The devices composing the SCADA system are planned as below. Since the composition of the system devices varies depending on the manufacturers, the devices below are shown as a typical example. Some other device configuration may also be allowed if it satisfies the required system configuration and functions described later.

Table 2-2-3 Main Compositions of SCADA System

No.	Item	Main Composition	Q'ty	Purpose
1	SCADA System	EMS server HMI, HMI monitor Data historian Engineering PC GPS time server Network switch VPN KVM Communications cable UPS Gateway (for EMC communications) Color laser printer Desk, chair	1 Set	1. Monitoring and charge/ discharge control of storage battery system 2. Monitoring and control of grid interconnection equipment 3. Communications with EMC (Energy Management Center)

Source: JICA Survey Team

③ System Configuration

- Doubled system is adopted for the system redundancy. This allows the system to maintain the system functionality even in case of a single failure in the system. This also allows the system maintenance without interrupting system functionality.
- An international standard protocol (e.g., IEC 61850, etc.) is applied to the communications within the SCADA system for ensuring the communications interoperability. The storage

battery system including PCSs and the grid interconnection equipment are also connected with the communications protocol.

- Optical communications (composed of two lines in consideration of redundancy), not wireless, is assumed for the connection with EMC since both EMC and the SCADA system are installed in the same premises of the Phoenix Bay Power Plant. The protocol of IEC 60870-5-104 is applied to the communications with EMC in accordance with the interview with PGCIL. Under this configuration, EMC is positioned as an upper station (i.e., master station) and the SCADA system as one of the lower stations (i.e., slave stations).
- In order to enable remote maintenance from the SCADA system supplier, access from the manufacturer's remote maintenance base is provided through the Internet via VPN.
- UPS is employed to cope with power supply failures such as instantaneous voltage drop, etc.

④ System Functions

The SCADA system is planned to have but not limited to the following functions. The following shows the required functions, and not the composition of system devices, since they vary depending on the manufacturers.

1. EMS server
   a) Charge/discharge control of storage battery system
      - Peak-shift control of PV surplus power
        - Scheduled control (operation in accordance with the charge/discharge schedule preset by the SCADA operator)
        - Control in accordance with online commands by EMC
      - Frequency stabilizing control
        - LFC (monitor grid frequency, and charge/discharge batteries accordingly)
      - General purpose control
        - Manual control (on-demand)

   b) Monitoring of storage battery system status (battery status, PCS status, measured values, etc.)
   c) Control of grid interconnection equipment (manual control) (switchgears, transformers, etc.)
   d) Monitoring of grid interconnection equipment (switchgear status, transformer status, measured values, etc.)
   e) Self-monitoring of the SCADA system status
2. HMI
   - Provide information display to operators
   - Accept inputs by operators for operation and setting
3. Data historian
   - Data collection (equipment status, measured values, etc.)
   - Data storing and archiving
   - Report production (tabular reports, trend graphs, event lists, etc.)

Note: To prepare a dedicated device for this function is not mandatory if the functions can be integrated in the other devices.

4. Engineering PC
   - PC for configuring the SCADA system
5. GPS time server
   - Receive GPS signal
   - Distribute time signal to devices composing the SCADA system
6. Network switch
   - Switches within the SCADA system network
7. VPN
   - For access from the manufacturer's remote maintenance base
8. KVM
   - Switches for handling keyboard, monitor, and mouse for EMS servers, data historians, etc.
9. Gateway
   - Communications interface with EMC
     - Receive control commands and setting commands from EMC
     - Transmit status, measured values, and setting values to EMC
     - Communications protocol with EMC is IEC 60870-5-104
10. Laser printer
    - Print tabular reports, trend graphs, event lists, HMI screenshots, etc.
11. Desk
    - For placing HMI monitors and printers
    - With box drawers

4) Building

① Basic Policy

The building space is required for the installation of storage batteries, switchgear, and other related equipment according to the requirements for the system operation. Since a number of equipment will be installed in a limited space, it is difficult to install all the components within the same floor of the building. Hence, two-storey building is designed, and the perimeter of the building is planned for exterior equipment such as transformer and maintenance and delivery space.

It has been difficult for the Indian side counterpart to dismantle the existing concrete ground tank (all the submitted bid prices were above the budget). The dismantling of the existing water tank is also considered to be an option for the Japanese side, but this will increase not only the total cost of the project but also the time and effort required for removal, disposal of waste, etc.,

that will also force to extend the construction period. Therefore, it was decided that the water tank would be removed only at those part of the building where the foundation of the building would be installed (maximum size: about 2 m x 2 m for each column).

Since the scale and load of the storage battery system vary from one manufacturer to another, the contractor is required to scrutinize the architectural design of the system based on the specifications of the equipment and make changes to the design approved by the supervisor as necessary.

② Applicable Standards

In principle, the Indian Standards are adopted. In India, in addition to the National Building Code (NBC), which is the building code, there are Indian Standards (IS) for design, manufacturing, and inspection, etc., with detailed regulations for each item. For construction specifications, the Central Public Works Department (CPWD) has an extensive set of specifications.

(Applicable Indian Standards)

・National Building Code (NBC) 2016

・Indian Standards (IS) (Various types are available depending on the subject.)

・Central Public Works Department (CPWD) Specifications (Civil) 2019

（A number of equipment specifications are available separately.）

The application of international standards (JIS, BS, ISO, NFPA, IEC, etc.) will also be considered if there are issues that cannot be addressed by the Indian Standards.

③ Floor Plan Design

The building is two-story with the electrical room and SCADA room on the first floor, and the storage battery facilities are located on the first and second floors.

In the Battery Room, a space of 1.5 m around the equipment for installation and maintenance, and a space of 4 m at the door side for loading works are considered. Similarly, in the Electrical Room, a space of 2 m around the equipment is secured.

In addition, for the uploading and necessary replacement of large size and heavy equipment, the deck with a 3,000 W x 3,000 H (mm) door and a removable handrail were installed on the south side of the building.

The size of each room is as follows:

Floor	Room Name	Floor Area (m^2)	Remarks
1	Electrical Room	305.00	For electrical components
1	Battery Room – 1	550.00	Battery and related equipment
1	SCADA Room	45.00	Local SCADA and related components
1	Staircase	20.00	
2	Battery Room – 2	870.00	Battery and related equipment
2	Storeroom	30.00	To store parts and components for replacements
2	Staircase	20.00	

Source: JICA Survey Team

④ Sectional Design

The first floor level of the building was set equal to the floor level of the control room of the existing generator building (EL=51.500 m) as established by the ED. This level is higher than the maximum water level of the historical tsunami (EL=50.450 m).

The space between the floor of the building and the current ground level (EL=49.900 m) is planned to be used as a cable gallery (about 1.2 m in height). The floor of the building has openings for cable penetration (the openings will be closed after the cable laying works).

The ceiling height (height under the beam) of the Battery Room and Electrical Room is designed to be 3.5 m based on the standard dimensions of the equipment to be installed.

⑤ Foundation Structural Design

Boring data (two locations) shows that the ground conditions vary greatly depending on the survey location. On the east side, a solid ground with an N-value of more than 100 was found about 3 m below the ground surface. On the other hand, in the west side, the ground is soft and an N-value of less than 10 was found up to 5 m below the ground surface; around 10 m below the ground surface, the ground with N-value of 50 is found.

The design is made considering that the building will be supported by pile foundation. Reinforced concrete piles (7-10 m long) are assumed to be used, and the pile length will be adjusted after reconfirming the ground conditions at the construction stage.

⑥ Superstructure Structural Design

The superstructure of the building is a reinforced concrete frame structure, and the walls are made of concrete blocks, which are the most common practice in India.

Structural calculations will be made in accordance with the Indian national standards (NBC, IS, etc.). Seismic forces will be calculated as per the Indian Standards (IS 1893) based on the regional classification (Zone V) and the regional factor (0.36) for the Andaman and Nicobar region. This zone classification is the most severe in India.

The design load is calculated as the sum of the estimated weight of the equipment and materials.

In case of the roof, considering the poor waterproofing accuracy of the flat roof, the sloped roof is adopted.

⑦ Material Design

The materials for the building frame and finishes will be those that can be procured locally and have a good track record in construction. While most of the materials to be used for this building can be procured locally (including import and transportation from the mainland of India), the following materials are not used in this project because they have a limited track record in construction and it is difficult to ensure the accuracy of construction:

a) Heavy structural steel (H-section steel beam, etc.)

Although transport from the interior of India is possible, there is little experience in construction on the island and it is difficult to ensure the accuracy of construction (most of the existing steel-framed buildings are trusses or lattice structures made of angle steel, flat plate steel, etc.).

b) Waterproof materials (asphalt/sheets/coatings, etc.)

There are few buildings on the island with flat roofs. The accuracy of the construction cannot be ensured, which is causing leaks, according to the report.

⑧ Finishing Design

The finishing design for the building is as follows:

（External Finishing）

Wall	Roof	Doors and Windows
Mortar＋Silicone Painting	Aluminum corrugated iron plate (t = 0.71 mm), Silicone painting	Steel door, aluminum sash

Source: JICA Survey Team

（Interior Finishing）

Room Name	Floor	Wall	Ceiling
Electrical Room	Epoxy coated floor	Mortar＋EP Painting	Concrete markings
Battery Room -1	Epoxy coated floor	Mortar＋EP Painting	Concrete markings
Battery Room -1	Epoxy coated floor	Mortar＋EP Painting	Board + EP painting
SCADA Room	Free access floor H = 200 mm + Anti-static PVC tiles	Mortar＋EP Painting	Board + EP painting
Storage	Epoxy coated floor	Mortar＋EP Painting	Exposed concrete

Source: JICA Survey Team

⑨ Air Conditioning System Plan

Electrical Room, Battery Rooms, and SCADA Room are equipped with air conditioning according to the heat generation of the equipment.

⑩ Electrical Facility Plan

Power for the building is supplied from the power supply of the plant and equipment in the Electrical Room and distributed to various parts of the building by the distribution board.

Lighting is LED, and the illumination intensity is set in accordance with the Indian Standards. Each room will be equipped with an electrical outlet for maintenance.

⑪ Firefighting Equipment Plan

Fire extinguishing and fire alarm systems shall be installed as per the Indian Fire Services Act. Special (gas) fire extinguishing system media is assumed to be NOVEC-1230 or FM200.

⑫ Building Outline

- Structure: 2-story RC structure, pile foundation, steel-frame sloping roof
- Floor space: (1st floor) approx. 920 ㎡, (2nd floor) approx. 920 ㎡, (total floor space) approx. 1,840 ㎡

2-2-3 Outline Design Drawing

The outline design of the project is as shown in the following Table 2-2-4:

Table 2-2-4 List of Outline Design

No.	Dwg. No.	Drawing Title
1	No.1	Project site / Cable route layout plan
2	No.2	33 kV outside switchgear and BESS feeder single line diagram
3	No.3	33 kV outside switchgear layout plan
4	No.4	33 kV outside switchgear sectional plan
5	No.5	SCADA System Architecture (for reference)
6	No.6	SCADA Panel Arrangement (for reference) SCADA Room Layout (for reference)
7	No.7 – No.11	Building Drawings (Site layout, Floor plan, Elevation, Section)

Source: JICA Survey Team (based on site survey)

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

This project will be implemented based on the framework of the grant aid program of the Government of Japan (GoJ). After the approval of the project by GoJ, an Exchange of Note (E/N) between the two governments (Japan and India) will be signed. For the implementation of the program, the Grant Agreement (G/A) will be signed between JICA and the Indian side, and the Bank Arrangement (B/A)

and Authorization of Payment (A/P) will be issued subsequently. After that, the Indian side needs to conclude the consultant contract. The consultant will prepare the tender document and will commence the bidding. The wining Japanese contractor decided by tender evaluation process will prepare the drawings and documents for the approval and procurement of necessary items for construction and manufacturing, and commence the installation and construction works at site.

(1) Implementing Agency of the Indian Side

The responsible organization and executing organization for this project from the Indian side are as follows:

- Responsible Organization: Ministry of Home Affairs, Ministry of Power, Andaman and Nicobar Administration (ANA)
- Executing Organization: Electrical Department (ED)

(2) Consultant

Based on the result of the preparatory survey and discussion results with the executing organization of the Indian side, the consultant will prepare the tender document that meets the requirements of the framework of Japan's grant aid program. The process includes request for proposals, clarifications to tender queries, attendance to tender closing and opening, tender evaluation, assistance during tender negotiations, and conclusion of the implementation contracts.

The consultant will hold the meeting among the concerned parties after the selection of the contractor before commencing site work and perform the approval process of design drawings and documents, factory inspection before shipments, and supervision of site works. During the implementation period, the consultant will also prepare the progress report and inform to the relevant organizations of the Japanese side.

After the completion of the project works, the consultant will issue a completion certificate, assist in the taking over procedure and prepare the completion report, and initiate defects liability tests to be carried out one year after the date of taking over.

(3) Contractor

The Japanese contractor selected through the competitive bidding based on Japan's grant aid rule will carry out the procurement of materials and equipment to perform the construction and installation work for the project.

The contractor will conduct the design, procurement, manufacture, factory test, transportation packing and transport to the site for the installation work in accordance with the specifications as stipulated in the bidding document. The contractor will have the overall responsibility of executing all the works, which include ensuring the quality, guarantee of equipment, defects liability, schedule management, etc.

2-2-4-2 Implementation Conditions

(1) Consideration during Construction

The implementation work for the project is roughly divided into building construction and equipment installation work. Of these, part of the equipment installation work is planned to be carried out within the existing 33 kV switch yard. And it will be necessary to implement widespread power outages to ensure safety. Therefore, it is necessary to envisage installation work under limited conditions during the time of low demand and/or favorable timing.

(2) Consideration on Procurement

It is necessary to procure and dispatch the equipment according to the construction schedule in order to execute the project works smoothly. The contractor for the project needs to manage procurement, manufacturing, transportation, and timely unloading.

Under the program, the equipment and component that are exported from Japan will not incur Japanese consumption tax.

2-2-4-3 Scope of Works

(1) Demarcation of Construction Works

The demarcation of construction works of the project between the Japanese side and the Indian side is shown in Table 2-2-5.

Table 2-2-5 Demarcation of Construction Works

No.	Item	Japanese Side	Indian Side
1	Cutting and clearing of vegetations at the planned installation site for storage batteries and related equipment		○
2	Removal of the existing “Old Rest Room” at the proposed equipment installation site		○
3	Construction of building for storage battery and equipment	○	
4	Installation of equipment and related works	○	

Source: JICA Survey Team

(2) Demarcation of Procurement and Installation

All procurement covered by this program will be borne by the Japanese side.

2-2-4-4 Consultant Supervision

For executing the project supervision works, the consultant will pay attention to the following:

① Project implementation background

② Content details of the preparatory survey

③ Grant aid framework of Japan

④ Site work conditions

⑤ Stakeholders' concern on the project including sustainability

For the smooth execution of the project, the nominated senior engineer as the project manager is required to have ample experience in similar types of services and enough understanding on the contents of the project. Moreover, it is necessary to establish an efficient organization consisting of engineers for detailed design, tendering, review and approval of design, factory inspection, and site supervision.

The following engineers will be assigned in the project to ensure the work progress:

- Project Manager: In-charge of coordination of the project works and instruction to the contractor.
- Resident Supervisor/Engineer: In-charge of supervision of schedule, quality control, procurement, daily project works.
- In charge Inspection Engineer / Experts: In-charge of construction supervision, electrical works, installation of equipment, relevant trial and test.

The contents of the abovementioned supervision items are as shown below.

(1) Basic Policies of Construction Supervision

The consultant shall manage and supervise the whole phase of the works of the contractor for safety and smooth project works executed based on schedule, considering the following items:

1) Schedule Management

① The progress of the works of the Indian side shall be confirmed before commencing the works of the contractor.

② The confirmation of the construction works of the Japanese contractor and coordination with the Indian side for smooth process shall be carried out.

③ Schedule coordination meetings shall be held at appropriate times for overall schedule management and shall be adjusted as necessary.

2) Safety Management

① Explaining the details of works and safety measures to the executing agency (including not only within the construction site but also ensuring safety during commuting).

② A meeting regarding the scheduled work of the day and safety measures shall be held before the commencement of works, and a safety patrol shall be carried out periodically.

③ In case multiple parallel works are executed at the same place, necessary safety measures shall be taken to avoid accidents by confirming works and schedules of concerned parties.

④ Work at heights or nearby high-voltage sections are permitted under the continuous supervision of safety personnel and strict scheduling.

⑤ Appropriate countermeasures, such as isolation rope, barricades, and warning signs, shall be taken for areas that have pits, openings or electrical charging sections.

3) Quality Control

① The contractor shall submit drawings, specifications, and calculation data for the approval of the consultant who will review the submitted documents to confirm conformity to standards and quality to contract specifications.

② The consultant shall attend factory inspections before the shipment of major equipment to confirm whether facilities have been manufactured according to the approved drawings and contract specifications.

③ The completion of construction works shall be tested at the site before the project handover.

(2) Procurement Management Plan

1) Transport Supervision

In order to carry out the site works smoothly according to the coordinated schedule, it is important to transport the equipment and material procured for the project to the site without delay. The contractor in the project shall pay attention to the timely arrangement, procurement, manufacturing of equipment and materials so as not to delay customs clearance procedures, etc., to avoid any effect to the progress of the project works. The consultant shall instruct and supervise the contractor to ensure that the tax exemption process is implemented sufficiently and smoothly.

2-2-4-5 Quality Control Plan

Quality management of the equipment and materials to be supplied under the project will be carried out through the following steps:

1) Review of Design and Specifications

After the conclusion of the contract, the consultant will review the drawings, specifications, and calculations submitted for approval by the contractor to confirm conformity to applied standards, contract specifications, etc. Manufacturing will start after the approval by the consultant.

2) Factory Inspection

After the equipment is manufactured, factory inspection through visual inspection and function tests will be carried out by the consultant to confirm that the equipment is produced in accordance with the applied standards and contract specifications before delivery to the site.

3) Site Supervision and Commissioning Test

The consultant will carry out construction supervision with the cooperation of the Indian side counterparts so that site construction and installation works are performed in accordance with the contract specifications and approved drawings. Commissioning tests are to be performed in the presence of Indian counterparts before taking over to confirm whether the works are completed in accordance with the specifications.

2-2-4-6 Procurement Plan

(1) Purchasing Sources

The origins of each equipment and material to be procured for the project are shown in Table 2-2-6

1) The storage battery and power conditioning system with local SCADA will be procured from Japan.
2) Except for the above equipment, all equipment will be purchased in India because conventional technology products for supply electricity can be produced in India.
3) Building materials will be procured in India.

Table 2-2-6 Procurement List of Equipment

No.	Item	Origin			Remark
		Local	Japan	Third Countries	
I	System Interconnection Equipment				
I-1	Conductor, insulator with fitting	✓	-	-	
I-2	Grounding wire with fitting	✓	-	-	
I-3	Lightning arrester	✓	-	-	
I-4	Circuit breaker	✓	-	-	
I-5	Disconnecting switch	✓	-	-	
I-6	Disconnecting switch with earthing switch	✓	-	-	
I-7	Current transformer	✓	-	-	
I-8	Potential transformer	✓	-	-	
I-9	33 kV power cable	✓	-	-	
I-10	Cable termination for 33 kV power cable	✓	-	-	
I-11	Earthing rod	✓	-	-	
I-12	Steel structure and beam	✓	-	-	
I-13	Control panel and protection relay	✓	-	-	
II	Main Transformer (MTR)		-	-	
II-1	33 kV/11 kV 15 MVA oil immersed outdoor type transformer	✓	-	-	
III	Storage Battery System			-	
III-1	11 kV indoor type distribution cubicle	✓	-	-	
III-2	Step-up transformer	✓	-	-	
III-3	Station service transformer	✓	-	-	
III-4	Power conditioning system	-	✓	-	
III-5	Control panel including charge/discharge	-	✓	-	
III-6	Terminal panel / Battery panel	-	✓	-	
III-7	Station service distribution panel for building	✓	-	-	
III-8	Storage battery	-	✓	-	
III-9	11 kV power cable	✓	-	-	
III-10	Earthing material	✓	-	-	
IV	SCADA			-	
IV-1	SCADA system	-	✓	-	
V	Cable Laying Work			-	
V-1	Cable pit	✓	-	-	
V-2	Manhole for power and control cable	✓	-	-	
V-3	Underground cable duct for 33 kV power cable	✓	-	-	
V-4	Underground cable duct for telecommunication cable	✓	-	-	
VI	Building			-	
VI-1	Building	✓	-	-	

Source: Request by the Indian side

(2) Procurement Plan of Spare Parts and Consumables

The spare parts are limited to important parts that may interfere with the operation in the event of a failure and consumable parts are limited to equipment that may occur frequently after one year of operation.

The list of spare parts under the project is shown in Table 2-2-7 below.

Table 2-2-7 Spare Parts List

III	Spare Parts			
III-1	Switchgear Component			
III-1-1	Switchgear component related spare parts	Coil	1 lot	Inside new building
		Digital power meter, auxiliary relay	1 pc/each type	
		Circuit breaker	1 pc/each type	
III-2	Storage Battery System			
III-2-1	Storage battery system related spare parts	Fuse of battery panel	1 lot	Inside new building
		PCS inverter unit	1 set	
		Fuse of control panel, cooling fan, printed circuit board	1 lot	
		SPD, MCCB, dust filter	1 lot	

Source : JICA Survey Team

2-2-4-7 Initial Operation / Operation Planning Guidance

Three Japanese engineers from the manufacturers of PCS, storage batteries, and SCADA systems will be dispatched to the site for initial operation guidance of the procured equipment. Of these, the initial operation instructor for the storage battery shall also serve as an operation instructor in order to instruct the operation of the storage battery system.

It is assumed that the initial operation guidance is 1 day for the PCS and 10 days each for the storage battery and SCADA system. In addition, 10 days are assumed for the operation guidance of the whole system.

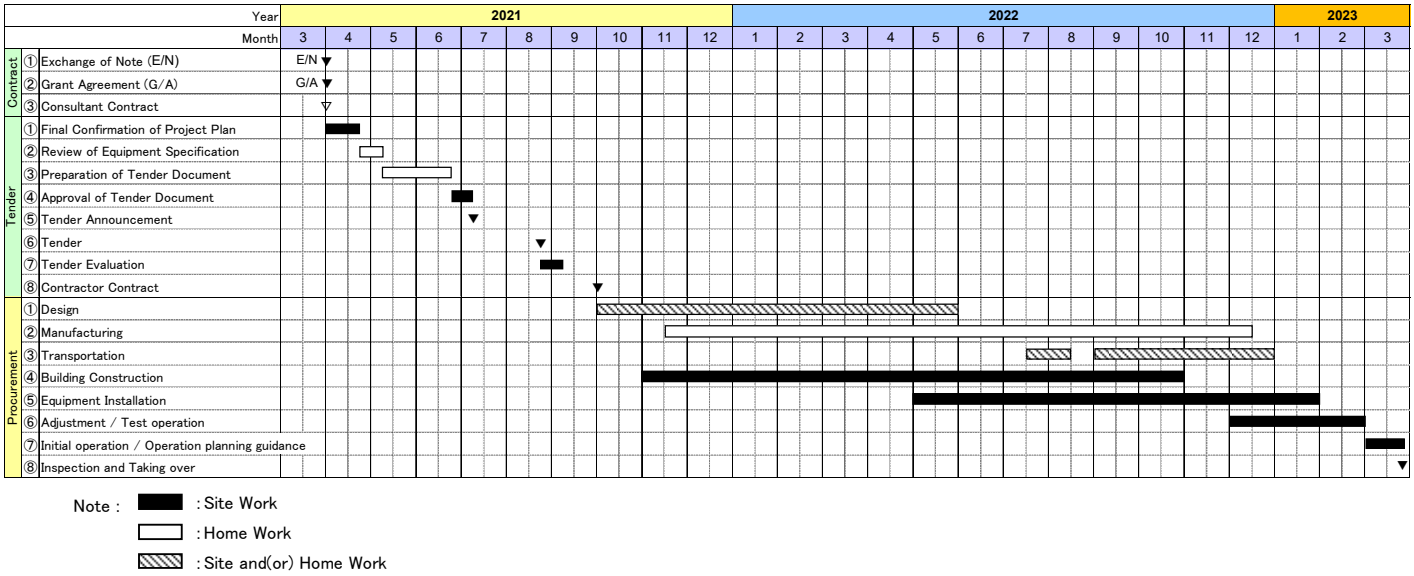
2-2-4-8 Soft Component Plan

As for the storage battery equipment procured in this plan, a similar type of equipment has constructed in the ED jurisdiction. Therefore, no separate special technology transfer other than the initial guidance and system operation guidance are required for maintenance management. Hence, soft component for the project is not planned.

2-2-4-9 Implementation Schedule

The implementation schedule of this project is shown in Table 2-2-8 below.

Table 2-2-8 Implementation Schedule



Note : : Site Work
: Home Work
: Site and(or) Home Work

Source: JICA Survey Team

2-3 Security Plan

The project site location, which is within the premises of the Phoenix Bay Power Plant in the ED jurisdiction, is fenced and under safety control such as locking of the entrance and exit of the Phoenix Bay Power Plant with 24 hour duty guard and is controlled by the ED staff. Therefore, it is considered that there is no security threat risk at the planned project site.

2-4 Obligations of Recipient Country

Items to be arranged by the Indian side for the project are as follows:

(1) Undertaking of the Recipient Country

The origins of each equipment and material to be procured for the project are shown as below.

1) Before the Project Execution

① Obtaining all necessary permits and approvals of the Indian government related to the implementation of the project

② Cutting and clearing of vegetations at the planned installation site for storage batteries and related equipment

③ Removal of the existing “Old Rest Room” at the proposed equipment installation site

④ Cleaning up the remains of preparatory work for the installation of new DEG at the project

site (restoration or preparation of the site to a condition where the installation of the storage battery and related equipment can be carried out immediately)

2) During the Project Execution

① Overall coordination of power outage operations related to the plan, and assignment of the field supervisor of ED

② Provision of office space for consultants

③ Provision of field offices for project contractor

④ Provision of rest space for workers

⑤ Provision of parking spaces for construction vehicles

⑥ Provision of power and water for project works

⑦ Provision of temporary storage space for the procured equipment (at the Phoenix Bay Power Plant site)

3) After the Project Execution

① Securing the budget and staff necessary for efficient daily operation, and maintaining the equipment installed and handed over through the grant aid

(2) Items to be Arranged by the Indian Side

1) Arrangement on Tax Exemption

Arrangement of exemption from all taxes in India and central government levied on corporations and individuals, and materials and equipment involved in the implementation of the project. For tax exemption information on this matter, please refer to the "References" in the appendix.

2) Expedient Provision

Indian side will provide the necessary permission for the entry and stay in India of the Japanese and non-Indian nationals involved in the implementation of the project.

3) Documentation of Banking Arrangement and Authorization to Payment

The processing of B/A, issuance of A/P, and payment of charges under the project shall be arranged.

2-5 Project Operation Plan

After the taking over of the project, the procured equipment shall be operated and maintained by the ED's Port Blair Power Generation Division. The operation and maintenance management for the equipment of the installed system is assumed to be done on rotation in three shifts in a day consisting of four groups of two members in a pair. The operation and maintenance personnel are planned to be stationed in the SCADA Room of the building constructed by this project.

In addition, initial operation/operation planning guidance will be provided by the contractor during the commissioning period prior to handover. The plan is for the ED staff in the field to learn the operation and maintenance management methods of the procured equipment through this process. Details of operation and maintenance management methods will be described in the O&M manual prepared by the manufacturer.

The main tasks of the operation and maintenance management personnel are as follows:

- Daily operation of storage battery system
- Daily and periodic inspections of storage battery system equipment
- Replacement of faulty parts and consumables

As described earlier in Section 2-2-4-6 (2) Procurement Plan of Spare Parts and Consumables, the procured equipment includes critical parts that may interfere with the operation in the event of a failure, and consumables which need to be replaced periodically.

2-6 Project Cost Estimation

2-6-1 Initial Cost Estimation

(1) Expenses Borne by the Indian Side

In case the project is executed under a grant aid, the expenses to be borne by the Indian side are shown in Table 2-6-1.

Table 2-6-1 Expenses Borne by the Indian Side

Item	Cost [million JPY]
1) Cutting and clearing of vegetations at the planned installation site for storage batteries and related equipment	0.51
2) Removal of the existing “Old Rest Room” at the proposed equipment installation site	0.17
Total	0.68

Source: JICA Survey Team

In addition to the above, expenditures for the B/A and A/P to obtain an import permit from the government will be arranged. For the smooth execution of such duties, the Indian side needs to secure the required budget in advance.

2-6-2 Operation and Maintenance Cost

(1) Assignment Plan for O&M Staff

The operation and maintenance staffing plan for the ED after the handover of the installed system is assumed as shown in the table below.

Table 2-6-2 Assignment Plan for O&M Staff

Location	Number	Remarks
SCADA Room of the building constructed in this project	2	Three shifts per day on rotation with four pairs of 2 staffs
Total	8	2 staffs × 4 pairs

Source: JICA Survey team

(2) O&M Cost per Year

The O&M cost of the procured equipment is assumed as shown in the table below.

Table 2-6-3 O&M Cost per Year

Item		Cost	Remarks
Operation and maintenance of the procured facilities	Personnel expenses	INR 6,480,000	Costs for operation and maintenance personnel (22.5 [days / staff・month] × INR 3,000 [/day] × 8 [staffs] × 12 [months]＝INR 6,480,000 [/year])
	Equipment maintenance fee	INR17,751,000	1% of the procured facilities cost
Operation and maintenance of the building		INR 1,200,000	1% of the building construction cost
Total		INR 25,431,000	

Source: JICA Survey Team

The timing of the replacement of the procured equipment is assumed as shown in the following table.

Table 2-6-4 Timing of the Replacement of the Procured Equipment

Item	Timing of Replacement
PCS (Power Conditioning Subsystem), Control panel (Including charge / discharge), Terminal panel / Battery panel, Battery	About 15 years
SCADA system	About 5 - 10 years
Equipment other than the above	About 20 - 30 years

Source: JICA Survey Team

Chapter 3 Project Evaluation

3-1 Preconditions

For implementing the project, the Indian side is required to undertake the following administrative matters and arrangements securely and timely:

- Obtaining all necessary permits and approvals of the Indian government related to the implementation of the project
- Cutting and clearing of vegetations at the planned installation site for storage batteries and related equipment
- Removal of the existing "Old Rest Room" at the proposed equipment installation site
- Cleaning up the remains of the preparatory work for the installation of new DEG at the project site (restoration or preparation of the site to a condition where the installation of the storage battery and related equipment can be carried out immediately)
- Overall coordination of power outage operations related to the plan, and assignment of the field supervisor of ED
- Provision of office space for consultants
- Provision of field offices for project contractor
- Provision of rest space for workers
- Provision of parking spaces for construction vehicles
- Provision of power and water for project works
- Provision of temporary storage space for the procured equipment (at the Phoenix Bay Power Plant site)
- Securing the budget and staff necessary for efficient daily operation, and maintaining the equipment installed and handed over through the grant aid
- Arrangement on tax exemption

3-2 Necessary Inputs by Recipient Country

The following are some of the issues that need to be addressed on the part of the Indian side in order to achieve and sustain the effectiveness of the project:

(1) Assignment of Engineer

During and after the implementation of the project, the following technical personnel shall be assigned to the project:

1) During the Installation Work

① Assignment of the field supervisor of the ED

② Assignment of a person in charge of the project from the EMC management department

2) After the Installation Work

① Operation and maintenance personnel for the system (the number of personnel required is as described above in "5-2 Operation and Maintenance Cost")

(2) Prediction or Monitoring of Surplus Power Generation by EMC

EMC will predict or monitor the surplus solar energy on the South Andaman power grid and communicate this to the SCADA operator of the battery storage system allocated inside the newly constructed building for the project.

(3) Operate the Existing DEG by Constant Power Operation in the High Efficiency Power Band

Since the storage battery also functions as the governor-free function for the ED-owned DEG, the DEG shall be operated by constant power operation in a high-efficiency power band. When large adjustments of the supply and demand balance are needed, the number of unit power is assumed to be controlled by turning the DEG on and off.

3-3 Important Assumptions

The primary purpose of the storage batteries to be installed in this project is to store the surplus solar energy in the South Andaman power grid and discharge during the evening/night peak demand period. The primary purpose is to be realized subject to the installation of PV power generation facilities in accordance with the long-term power development plan in South Andaman.

3-4 Project Evaluation

3-4-1 Relevance

This project can be judged to be highly appropriate for Japanese grant aid based on the following points:

1) The implementation of the project is expected to improve the quality of electricity supply. The direct benefit is expected to accrue to all residents receiving electricity from the South Andaman power grid, which is around 60,000 households (2011 Census).

2) The target area includes Port Blair, the main city of Andaman and Nicobar Islands, which has many educational and medical facilities. Although there are many educational and medical facilities here, the standard of living of local residents is currently declining due to insufficient power supply and grid instability caused by the introduction of renewable energy. Improving the quality of electricity supply to these facilities will greatly contribute to improving the quality of education and medical services, which are basic social services for the residents.

3) India has set a target of 175 GW of installed renewable energy capacity for the entire country by 2022. Of this, 100 GW is aimed to be installed for solar power. In addition, the AN Islands are aiming to move away from fossil fuels in energy supply in the medium to long term planning under the Green Island Initiative. This project is sure to make a significant contribution to the realization of this goal.

4) Japan's assistance policy is to cooperate with other countries in reducing carbon dioxide emissions and aims to become carbon neutral by 2050. In addition, Japan's Country Assistance Policy for India stipulates "Strengthening Connectivity", "Enhancing Industrial Competitiveness", and "Supporting Sustainable and Inclusive Growth" as priority areas for cooperation to realize the basic policy of "Faster, More Inclusive, and Sustainable Growth". This project is highly consistent with Japan's aid policy because it fits the development issue of "stable energy supply" in the priority area of "strengthening industrial competitiveness.

3-4-2 Effectiveness

The expected benefits (both quantitative and qualitative) from the implementation of the project are summarized below.

(1) Quantitative Effect

The quantitative effects of the project are shown in the table below.

Table 3-4-1 Quantitative Effects of the Project

	Indicator	Standard Value (year 2020)	Target Value (year 2026)
1	Maximum battery power (MW)	-	30
2	Maximum battery capacity (MWh)	-	14.25
3	Discharge power* (MWh/year)	-	2,971
4	System frequency fluctuation range (Hz)	49.08 ～ 51.83	50 ± 0.5
5	Reduction of greenhouse gas (tCO_2 /year)	-	2,683

(Note) * : This is the assumed amount of annual surplus power discharged from solar power generation.
Source: JICA Survey Team

The details of the above quantitative evaluation and the calculation method are shown below.

1) Maximum battery power (Ability Decline Within Allowable Range)

The evaluation is made on whether the decrease in the amount of maximum battery power is within the allowable value or not.

The target value is set as the rated power when the facility is put into service.

The maximum battery power can be measured by the SCADA system or the battery control panel.

2) Maximum battery capacity (Ability Decline Within Allowable Range)

The evaluation is made on whether the decrease in the amount of Maximum battery capacity is within the allowable value or not. The decrease in the capacity of the storage battery depends on the number of charge/discharge cycles (times) and the depth of charge/discharge.

For the calculation of the target value, assumption is made that the reduction in rated capacity of battery after three years of project completion would be approximately 5% (based on the interviews with manufacturers) and calculated as following.

15 MWh (the rated capacity when the facility is put into service) × 95% = 14.25 MWh

The maximum battery capacity can be measured by the SCADA system or the battery control panel.

3) Annual Discharge of Surplus Solar PV Energy (MWh/year)

This is an evaluation of the increase in effective utilization of solar energy generation through the installation of storage batteries. In general, when the amount of solar energy generated is large and surplus energy is about to be generated within the grid, power is limited in order to maintain the balance between supply and demand. To avoid the generation limitation control, surplus energy is absorbed by the storage batteries without limiting power, and this absorbed energy is discharged during peak demand periods at night. This makes it possible to make effective use of the electricity generated by solar PV energy generation that would not have been generated due to power control without the storage batteries.

The detailed calculation process of the target values is shown in "Appendix 5: Other Relevant Data.

For monitoring, it is important to record the amount of charged surplus energy from the solar PV generation as accurately as possible. For this purpose, the EMC needs to predict or recognize the generation of surplus solar PV energy and provide instructions and/or information to the SCADA operator for the battery charge/discharge control. Upon receiving this information, it identifies the surplus photovoltaic power generated and records the amount of charge energy. The annual total of this recharging energy minus the amount of storage battery recharge/discharge loss is the annual discharge of surplus solar PV energy generation (MWh/year).

4) Fluctuation Range of System Frequency

When the balance of power supply and demand in the grid stabilizes, the grid frequency is stabilized. The balance of power supply and demand in the grid is stabilized by the charging and discharging of storage battery, and the effect of this stabilization is evaluated in terms of the range of variation in grid frequency.

To calculate the reference value, an average of three data points from the smallest values and three data points from the largest values are used as the minimum and maximum frequencies as the monthly average for that month in order to reduce errors of data recording and other reasons. From the monthly average data of the twelve months in one year, the three smallest and three largest data are averaged again, and these are defined as the annual minimum and maximum frequency values for the evaluation index of the variation range comparing to the reference frequency of 50 Hz.

Target value shall be the value of the grid code in India.

The fluctuation range of system frequency can be measured by the SCADA system.

5) Reduction in Greenhouse Gas Emissions (tCO2/year)

Evaluate the additional CO2 reductions due to installation of storage batteries.

The amount of electricity generated by diesel or LNG engine generators can be reduced by the amount of electricity discharged from the surplus solar PV energy generated as mentioned above. The reduction in fossil fuel consumption for electricity generation by the engine generators is an additional amount of CO2 reduction by the utilization of installed storage batteries system.

The target value was calculated by multiplying the aforementioned annual discharge of surplus solar PV energy by the CO2 emission factor (0.903 t-CO2/MWh) for India in the JICA Climate-FIT (adaptation measures).

The detailed calculation process of the target values is shown in "Appendix 5: Other Relevant Data.

(2) Qualitative Effects

The implementation of this project is also expected to have the following qualitative effects:

1) Facilitation of industrial activities

Improvement of electricity supply quality through this project will directly lead to the improvement of the quality of services provided by tourist facilities such as hotels. In addition, reducing carbon dioxide emissions in the energy supply enhances the environmental image of the AN Islands. With these, the number of tourists can be expected to increase. Thus, the implementation of this project will greatly contribute to the tourism industry, which is the center of economic activity in the islands and is expected to facilitate industrial activities.

2） Promotion of climate change measures

This project will directly contribute to the reduction of greenhouse gas emissions. This is expected to further promote of climate change measures.

3） Improvement of the living standards of local residents

This project will contribute to the improvement of the living standards of local residents. Specifically, it is expected to improve the quality of medical care and education.

A stable power supply to medical facilities is extremely important from the perspective of human security. In a hospital such as a large central hospital, it is possible to install a DEG as an emergency power source to supplement the instability of the power supply from the grid, but in a small health center, it is not possible due to economic strain. The implementation of this project will improve the stability of power supply from the grid to the medical facilities. This can be expected to improve the quality of medical activities provided by medical facilities.

Most elementary schools (primary) and above secondary schools are 100% electrified. From this, it is considered that the use of electric power is well established in the education sector. In daily education, computers are being promoted, so stable power supply to schools will become even more important in the future. It can be said that improving the stability of power supply through this project will greatly contribute to improving the quality of education.

Based on the above, it is concluded that the project is reasonable and likely to be effective.

Attachment

1. Member List of the JICA Survey Team
2. Study Schedule
3. List of Parties Concerned in the Recipient Country
4. Minutes of Discussions
5. Other Relevant Data
6. Outline Design Drawing

Attachment-1

Member List of the JICA Survey Team

Member List of the JICA Survey Team

1. 1st Field Survey

No.	Name	Designation	Company / Organization
1	Mr. Tomoyasu FUKUCHI	Team Leader of Consultant Team and Power Planning	Nippon Koei Co., Ltd.
2	Mr. Luis KAKEFUKU	Diesel Power Generation Facility Planning	OKINAWA ENETECH CO.,INC
3	Mr. Ryosuke OGAWA	Power Grid Planning	Nippon Koei Co., Ltd.
4	Mr. Akinari ISHIMURA	Equipment Planning (1)	Nippon Koei Co., Ltd.
5	Mr. CHOWDHURY TANVIR AHMED	Equipment Planning (2)	Nippon Koei Co., Ltd.
6	Mr. Yuma UEZU	System Stabilizing Facility Planning (1)	OKINAWA ENETECH CO.,INC
7	Mr. Shogo TOBARU	System Stabilizing Facility Planning (2)	OKINAWA ENETECH CO.,INC
8	Ms. Mika MATSUMURA	Economic and Financial Analysis	Nippon Koei Co., Ltd.
9	Mr. Hideyasu HOKAMA	Facility Planning and Natural Conditions	OKINAWA ENETECH CO.,INC
10	Mr. Kota MATSUI	Procurement Planning / Cost Estimation (1)	Nippon Koei Co., Ltd.
11	Mr. Mitsuru YAMANOHA	Cost Estimation (2)	OKINAWA ENETECH CO.,INC

2. 2nd Field Survey

No.	Name	Designation	Company / Organization
1	Mr. Tomoyasu FUKUCHI	Team Leader of Consultant Team and Power Planning	Nippon Koei Co., Ltd.
2	Mr. Luis KAKEFUKU	Diesel Power Generation Facility Planning	OKINAWA ENETECH CO.,INC
3	Ms. Mika MATSUMURA	Economic and Financial Analysis	Nippon Koei Co., Ltd.
4	Mr. Hideyasu HOKAMA	Facility Planning and Natural Conditions	OKINAWA ENETECH CO.,INC
5	Mr. Kota SATO	Procurement Planning / Cost Estimation (1)	Nippon Koei Co., Ltd.
6	Mr. Hiroyoshi SUZUKI	Environmental and Social Consideration	OKINAWA ENETECH CO.,INC
7	Mr. Toshiya WATANABE	Building Planning	Nippon Koei Co., Ltd.
8	Mr. Osamu TSUBOI	SCADA Planning	Nippon Koei Co., Ltd.

3. 3rd Field Survey

No.	Name	Designation	Company / Organization
1	Mr. Tomoyasu FUKUCHI	Team Leader of Consultant Team and Power Planning	Nippon Koei Co., Ltd.
2	Mr. BISTA DEEPAK BAHADUR	Storage Battery System Planning	Nippon Koei Co., Ltd.
3	Mr. Takahiro IDEI	Equipment Planning (2), Procurement Planning / Cost Estimation (1)	Nippon Koei Co., Ltd.
4	Mr. Toshiya WATANABE	Building Planning	Nippon Koei Co., Ltd.
5	Mr. Toshiaki KOBAYASHI	Facility Planning and Natural Conditions (2)	Nippon Koei Co., Ltd.
6	Mr. Kota SATO	Procurement Planning / Cost Estimation (1)	Nippon Koei Co., Ltd.

Attachment-2

Study Schedule

1. 1st Field Survey (1/3)

	Date		Consultant								
			Mr. FUKUCHI	Mr. OGAWA	Mr. KAKEFUKU	Mr. ISHIMURA	Mr. CHOWDHURY TANVIR AHMED	Mr. UEZU	Mr. HOKAMA	Ms. MATSUMURA	Mr. MATSUI
			Team Leader of Consultant Team and Power Planning	Power Grid Planning	Diesel Power Generation Facility Planning	Equipment Planning (1)	Equipment Planning (2)	System Stabilizing Facility Planning (1)	Facility Planning and Natural Conditions	Economic and Financial Analysis	Procurement Planning / Cost Estimation (1)
1	2016/8/14	Sun	NRT to HKG HKG to CCU								
2	2016/8/15	Mon	CCU to IXZ								
3	2016/8/16	Tue	Meeting with ANA								
4	2016/8/17	Wed	Arrangement and contract for national staff, rent-a-car, and others.			NRT to HKG HKG to CCU				NRT to HKG HKG to CCU	
5	2016/8/18	Thu	Preliminary survey			CCU to IXZ				CCU to IXZ	
6	2016/8/19	Fri	Preliminary survey		OKA to HKG HKG to CCU	Preliminary survey		OKA to HKG HKG to CCU		Preliminary survey	
7	2016/8/20	Sat	Data analyses		CCU to IXZ	Data analyses		CCU to IXZ		Data analyses	
8	2016/8/21	Sun	Meeting with study team member								
9	2016/8/22	Mon	Kick off meeting with ANA								
10	2016/8/23	Tue	Meeting with ANA, Preliminary survey			Preliminary survey					
11	2016/8/24	Wed	Meeting with ANA, Preliminary survey			Preliminary survey					
12	2016/8/25	Thu	Data analyses								
13	2016/8/26	Fri	Preliminary survey								
14	2016/8/27	Sat	Data analyses								
15	2016/8/28	Sun	holiday								
16	2016/8/29	Mon	Preliminary survey								
17	2016/8/30	Tue	Preliminary survey			IXZ to DEL DEL to HKG		IXZ to CCU		Preliminary survey	
18	2016/8/31	Wed	Preliminary survey			HKG to NRT		CCU to HKG HKG to OKA		Preliminary survey	

	Date		Consultant								
			Mr. FUKUCHI	Mr. OGAWA	Mr. KAKEFUKU	Mr. ISHIMURA	Mr. CHOWDHURY TANVIR AHMED	Mr. UEZU	Mr. HOKAMA	Ms. MATSUMURA	Mr. MATSUI
			Team Leader of Consultant Team and Power Planning	Power Grid Planning	Diesel Power Generation Facility Planning	Equipment Planning (1)	Equipment Planning (2)	System Stabilizing Facility Planning (1)	Facility Planning and Natural Conditions	Economic and Financial Analysis	Procurement Planning / Cost Estimation (1)
19	2016/9/1	Thu	Preliminary survey							Preliminary survey	
20	2016/9/2	Fri	Meeting with ANA							Meeting with ANA	
21	2016/9/3	Sat	Data analyses							Data analyses	
22	2016/9/4	Sun	holiday							holiday	
23	2016/9/5	Mon	IXZ to DEL Meeting with JICA India office DEL to HKG							IXZ to DEL Meeting with JICA India office	
24	2016/9/6	Tue	HKG to NRT							HKG to NRT	

Legend NRT: Narita
OKA: Naha
BKK: Bangkok
HKG: Hong Kong
SIN: Singapore
DEL: Delhi
MAA: Chennai
CCU: Kolkata
IXZ: Port Blair

ANA: Andaman & Nicobar Administration
ED: Electricity Department

1. 1st Field Survey (2/3)

	Date		Consultant									
			Mr. FUKUCHI	Mr. CHOWDHURY TANVIR AHMED	Mr. KAKEFUKU	Mr. OGAWA	Mr. ISHIMURA	Mr. TOBARU	Mr. HOKAMA	Mr. YAMANOHA	Ms. MATSUMURA	Mr. MATSUI
			Team Leader of Consultant Team and Power Planning	Equipment Planning (2)	Diesel Power Generation Facility Planning	Power Grid Planning	Equipment Planning (1)	System Stabilizing Facility Planning (2)	Facility Planning and Natural Conditions	Cost Estimation (2)	Economic and Financial Analysis	Procurement Planning / Cost Estimation (1)
1	2016/10/31	Mon	NRT to BKK BKK to CCU									NRT to BKK BKK to CCU
2	2016/11/1	Tue	CCU to IXZ									CCU to IXZ
3	2016/11/2	Wed	Preliminary survey									Preliminary survey
4	2016/11/3	Thu	Preliminary survey				NRT to BKK BKK to CCU					Preliminary survey
5	2016/11/4	Fri	Preliminary survey		OKA to HKG HKG to CCU	NRT to BKK BKK to CCU	CCU to IXZ	OKA to HKG HKG to CCU			NRT to BKK BKK to CCU	Preliminary survey
6	2016/11/5	Sat	Preliminary survey		CCU to IXZ	CCU to IXZ	Preliminary survey	CCU to IXZ			CCU to IXZ	Preliminary survey
7	2016/11/6	Sun	Preliminary survey									
8	2016/11/7	Mon	Preliminary survey									
9	2016/11/8	Tue	Preliminary survey									
10	2016/11/9	Wed	Preliminary survey									
11	2016/11/10	Thu	Preliminary survey									
12	2016/11/11	Fri	Preliminary survey									IXZ to CCU
13	2016/11/12	Sat	Preliminary survey									CCU to BKK BKK to NRT
14	2016/11/13	Sun	Preliminary survey									
15	2016/11/14	Mon	Preliminary survey									
16	2016/11/15	Tue	Preliminary survey									
17	2016/11/16	Wed	Preliminary survey									
18	2016/11/17	Thu	Preliminary survey					IXZ to CCU			IXZ to MAA	
19	2016/11/18	Fri	Preliminary survey					CCU to BKK BKK to OKA			MAA to BKK BKK to NRT	

	Date		Consultant									
			Mr. FUKUCHI	Mr. CHOWDHURY TANVIR AHMED	Mr. KAKEFUKU	Mr. OGAWA	Mr. ISHIMURA	Mr. TOBARU	Mr. HOKAMA	Mr. YAMANOHA	Ms. MATSUMURA	Mr. MATSUI
			Team Leader of Consultant Team and Power Planning	Equipment Planning (2)	Diesel Power Generation Facility Planning	Power Grid Planning	Equipment Planning (1)	System Stabilizing Facility Planning (2)	Facility Planning and Natural Conditions	Cost Estimation (2)	Economic and Financial Analysis	Procurement Planning / Cost Estimation (1)
20	2016/11/19	Sat	Preliminary survey									
21	2016/11/20	Sun	Preliminary survey				IXZ to CCU					
22	2016/11/21	Mon	Preliminary survey				CCU to BKK BKK to NRT					
23	2016/11/22	Tue	IXZ to DEL Meeting with JICA India office									
24	2016/11/23	Wed	DEL to BKK BKK to NRT									

Legend NRT: Narita
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HKG: Hong Kong
SIN: Singapore
DEL: Delhi
MAA: Chennai
CCU: Kolkata
IXZ: Port Blair

ANA: Andaman & Nicobar Administration
ED: Electricity Department

1. 1st Field Survey (3/3)

	Date		Consultant		
			Mr. FUKUCHI	Mr. KAKEFUKU	Mr. CHOWDHURY TANVIR AHMED
			Team Leader of Consultant Team and Power Planning	Diesel Power Generation Facility Planning	Equipment Planning (2)
1	2018/2/5	Mon	NRT to DEL		
2	2018/2/6	Tue	Meeting with Ministry of Power, Meeting with JICA India office		
3	2018/2/7	Wed	DEL to IXZ Meeting with ANA and ED		
4	2018/2/8	Thu	Meeting with ANA and ED, Signing of Minutes		
5	2018/2/9	Fri	Meeting with ANA and ED		
6	2018/2/10	Sat	IXZ to DEL		
7	2018/2/11	Sun	DEL to NRT		

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CCU: Kolkata
IXZ: Port Blair

ANA: Andaman & Nicobar Administration
ED: Electricity Department

2. 2nd Field Survey

	Date		Consultant							
			Mr. FUKUCHI	Mr. KAKEFUKU	Mr. SATO	Mr. WATANABE	Mr. TSUBOI	Ms. MATSUMURA	Mr. HOKAMA	Mr. SUZUKI
			Team Leader of Consultant Team and Power Planning	Diesel Power Generation Facility Planning	Procurement Planning / Cost Estimation (1)	Building Planning	SCADA Planning	Economic and Financial Analysis	Facility Planning and Natural Conditions	Environmental and Social Consideration
1	2019/1/7	Mon	NRT to BKK BKK to CCU							
2	2019/1/8	Tue	CCU to IXZ						OKA to HKG HKG to CCU	
3	2019/1/9	Wed	Meeting with ANA and ED						CCU to IXZ	
4	2019/1/10	Thu	Meeting with ANA and ED						Meeting with ANA and ED	
5	2019/1/11	Fri	Preliminary survey						Preliminary survey	
6	2019/1/12	Sat	Preliminary survey					NRT to BKK BKK to CCU	Preliminary survey	
7	2019/1/13	Sun	Holiday			IXZ to CCU	Holiday	CCU to IXZ	Holiday	
8	2019/1/14	Mon	Preliminary survey			CCU to BKK BKK to NRT	Preliminary survey			
9	2019/1/15	Tue	Preliminary survey				Preliminary survey			
10	2019/1/16	Wed	Preliminary survey				IXZ to CCU	Preliminary survey		
11	2019/1/17	Thu	IXZ to DEL				CCU to BKK BKK to NRT	IXZ to CCU	IXZ to CCU	
12	2019/1/18	Fri	DEL to BKK BKK to NRT					CCU to BKK BKK to NRT	CCU to HKG HKG to OKA	

Legend NRT: Narita
OKA: Naha
BKK: Bangkok
HKG: Hong Kong
SIN: Singapore
DEL: Delhi
MAA: Chennai
CCU: Kolkata
IXZ: Port Blair
ANA: Andaman & Nicobar Administration
ED: Electricity Department

3. 3rd Field Survey

	Date		Consultant					
			Mr. FUKUCHI	Mr. WATANABE	Mr. BISTA DEEPAK BAHADUR	Mr. IDEI	Mr. KOBAYASHI	Mr. SATO
			Team Leader of Consultant Team and Power Planning	Building Planning	Storage Battery System Planning	Equipment Planning (2), Procurement Planning / Cost Estimation (1)	Facility Planning and Natural Conditions (2)	Procurement Planning / Cost Estimation (1)
1	2019/12/23	Mon	NRT to BKK to MAA					
2	2019/12/24	Tue	MAA to IXZ Meeting with ED					
3	2019/12/25	Wed	Meeting with Globe Consultancies, Preliminary survey					
4	2019/12/26	Thu	Meeting with ANA and ED					
5	2019/12/27	Fri	IXZ to CCU					
6	2019/12/28	Sat	CCU to BKK to NRT					
1	2020/1/27	Mon					NRT to SIN to CCU	
2	2020/1/28	Tue					CCU to IXZ Meeting with ED	
3	2020/1/29	Wed					Preparing Minutes and Drawings	
4	2020/1/30	Thu					Preliminary survey	
5	2020/1/31	Fri					Preliminary survey	
6	2020/2/1	Sat					Preliminary survey, Signing of Minutes	
7	2020/2/2	Sun					IXZ to CCU	
8	2020/2/3	Mon					CCU to SIN to NRT	

Leger NRT: Narita
OKA: Naha
BKK: Bangkok
HKG: Hong Kong
SIN: Singapore
DEL: Delhi
MAA: Chennai
CCU: Kolkata
IXZ: Port Blair

ANA: Andaman & Nicobar Administration
ED: Electricity Department

Attachment-3

List of Parties Concerned in the Recipient Country

List of Parties Concerned in the Recipient Country

Sr. No.	Name	Post
ANA		
	Mr. Sanjeev Khirwar	Commissioner-cum-Secretary, Shipping/Civil Aviation/APWD/Power
	Mr. Sudhir Mahajan	Secretary (Power)
ED		
	Mr. Uttam Kumar Paul	Superintendent Engineer, ED
	Mr. AJIT Kumar	Superintending Engineer, ED
	Mr. Karuna Jaydhar	Executive Engineer, Power Generation
	Mr. Yogesh Tiwari	Assistant Engineer, Planning
	Mr. Richpal Singh	Assistant Engineer, Store
	Mr. K. Madhara Rao	Assistant Engineer, IPP
	Mr. R. Revi Kumar	Junior Engineer, (Phoenix Bay) Maintenance
	Mr. Anil	Junior Engineer, Chatham power house
	Mr. Sandeep Mukherjee	Junior Engineer, Chatham Power House
	Mr. K. Ravi Kumar	Junior Engineer, Operation, Chatham Power House
	Mr. N. Durga Rao	Assistant Engineer, Operation, Chatham Power House
	Mr. Vinay Sandesh	Junior Engineer (Tech), Operation, Chatham Power House
	Mr. Subrata nag	Assistant Engineer, Garacharma Sub Station

Attachment-4

Minutes of Discussions

Minutes of Discussions
on the Preparatory Survey for the Project for Improvement of Power Supply in Andaman and Nicobar Islands in India

In response to the request letter from the Government of India (Ministry of Finance) dated 19th October, 2015 (No.4/8/2015-Jap II) and the subsequent letter dated 9th May, 2019 (D.O. No. 4/8/2015-JICA Projects (J.II)), related to the Project for Improvement of Power Supply in Andaman and Nicobar Islands (hereinafter referred to as "the Project"), JICA sent the Mission for confirming the components of the Project (hereinafter referred to as "the JICA Mission") to India, headed by Mr. Toru Kobayakawa, Senior Director (Energy), Industrial Development and Public Policy Department, JICA, from 19th to 23rd August, 2019.

The JICA Mission held a series of discussions with the officials concerned of the Andaman and Nicobar Administration (hereinafter referred to as "the A&NA") from 19th to 22nd August, 2019, and conducted a field survey in the tentative Project site. In the course of the discussions, both the A&NA side and the JICA Mission (hereinafter referred to as "both sides") have confirmed the main items described in ATTACHMENT, as an updated Minutes of Discussion signed on 8th February, 2018.

Port Blair, 23rd August, 2019

小早川 徹

Mr. Toru Kobayakawa
Senior Director (Energy)
Industrial Development and Public Policy Department
Japan International Cooperation Agency
Japan

Mr. Sudhir Mahajan
Secretary (Power)
Andaman and Nicobar Administration
India

ATTACHMENT

1. Objective of the Project

The objective of the Project is to improve power supply efficiency, reliability and stability of entire energy system in South Andaman, by introducing necessary equipment and facilities for energy storage of solar PV generation, thereby contributing to social and economic development and poverty reduction in Andaman and Nicobar Islands.

It was noticed that the objective of the Project is to be confirmed through the Preparatory Survey.

2. Title of the Preparatory Survey

Both the A&NA side and the JICA Mission (hereinafter referred to as "both sides") confirmed the title of the Preparatory Survey as "The Preparatory Survey for the Project for Improvement of Power Supply in Andaman and Nicobar Islands".

3. Project Site

Both sides confirmed that the site of the Project is Port Blair, which is shown in Annex 1. Both sides confirmed that the location for the installation of facilities under the Project should be identified, based on the capacity of necessary batteries. In case the location needs to be changed from the previous one, i.e. Phoenix Bay power house, Electricity Department, Andaman and Nicobar Administration (hereinafter referred to as "ED") confirmed to arrange the alternative land. The Preparatory Survey team will review the proposed site.

4. Executing Agency

4.1. Both sides confirmed the executing agency of the Project is ED. The executing agency shall ensure that the undertakings for the Project shall be managed by relevant authorities properly and on time. The organization charts are shown in Annex 2.

4.2. ED shall also coordinate with all the relevant agencies to ensure smooth implementation of the Project.

5. Items requested by the Indian side

The Indian side requested the modified scope of the work through the letter dated 9th May, 2019 (D.O. No. 4/8/2015-JICA Projects (J.II)). ED explained to the JICA Mission that the Island Development Authority (IDA) meeting dated on 30th June, 2018 and its review meeting dated on 18th December, 2018, directed that Islands of Union Territories (UTs), including Andaman and Nicobar Islands, should become self-sufficient in energy, for which solar PV generation should be given topmost priority. Based on those decisions above, ED was directed to further increase the renewable energy generation, i.e. solar PV generation. ED also explained to the JICA Mission that A&NA is moving towards de-dieselization of power generation.

5.1. Rationale

ED explained to the JICA Mission that the grid code for solar PV generation has been enforced to IPPs, who are responsible for installing grid stabilization system with batteries for the purpose of mitigating short-term fluctuation. Therefore, new IPPs for solar PV generations are to install batteries, while the existing IPPs for solar PV generation have also been requested to stabilize the fluctuating output of solar PV generation for the interconnection with the grid.

In addition, according to ED, the 50 MW LNG based power plant has been approved and is to be operated by M/s NTPC/NVVN, which is scheduled to commence its operation in the end of CY2021. Planned LNG plant is the sum of several units (i.e. 10MW x 5). ED also explained to the JICA Mission that the proposed LNG based power generation would be IPP, who will operate the plant in accordance with the demand and the power supply from solar PV generation. ED confirmed to the JICA Mission that the power supply from solar PV generation would be prioritized over the supply from LNG based power generation, and the excess from solar PV generation during daytime needs to be stored for meeting peak demand during evening. ED also explained to the JICA Mission that, according to ED's demand/supply plan from 2022 to 2026, the average daily output from the LNG will be 25 MW and the minimum output will be 8 MW (with the presumption of 10MW of each unit).

Under such circumstances, ED and the JICA Mission confirmed that the main purpose of storage batteries under the Project is to shift energy of solar PV output from daytime to peak time during evening. Such operation of batteries is expected to reduce the fuel consumption of conventional power plants. In addition, the installation of storage batteries could contribute to secure the stability of grid in case of sudden drop of power generation caused by faults depending on the magnitude.

5.2. Details of items requested by the Indian side

As a result of discussions, both sides confirmed that the items requested by the Indian side are as follows:

- Batteries

The purpose of storage batteries under the Project is to shift excess energy of solar PV output from daytime to peak time during evening, to secure the grid stability and to reduce fossil fuel consumption. Both sides confirmed that the total capacity and detailed specifications of batteries would be determined, based on the analysis of the future grid operation, which will be conducted during the course of the Preparatory Survey.

- Set of Power System Stabilizer

The power system stabilizer under the Project will function as "battery management unit", which is to control charge/discharge of batteries.

- SCADA.

  The SCADA system under the Project is to supervise, control and acquire data of the batteries and system stabilizer, which are the scope of the Project. Although the coverage of this SCADA will be limited to the equipment of the Project, the supervision/control/data acquisition of wider range of facilities in the South Andaman network is to be covered by Energy Management Centre (EMC), which will control all of power generation plants, substations and batteries. EMC could function as load dispatch center of South Andaman, under which the SCADA of the Project will be connected.

- Building

  Building under the scope of the Project is for the purpose of installing batteries, power system stabilizer and SCADA. The potential site for the construction of building will be decided based on the necessary capacity of batteries. Depending on the specification and cost estimation, the batteries might be installed in the containers.

5.3. JICA will assess the feasibility of the above requested items through the survey and will report the findings to the Government of Japan. The final scope of the Project will be decided by the Government of Japan.

6. Japanese Grant Scheme

6.1. The A&NA side agreed that the procedures and basic principles of Japanese Grant as described in Annex 3 shall be applied to the Project.

6.2. The A&NA side agreed to take the necessary measures, as described in Annex 4, for smooth implementation of the Project, as a condition for the Japanese Grant to be implemented. The contents of the Annex 4 will be elaborated and refined during the Preparatory Survey and be agreed in the mission dispatched for explanation of the Draft Preparatory Survey Report. The contents of Annex 4 will be updated as the Preparatory Survey progresses, and eventually, will be used as an attachment to the Grant Agreement.

7. Schedule of the Survey

7.1. Subject to the clarification on battery capacity and land allocation by A&NA, JICA will dispatch the Preparatory Survey Team with the modified TOR, for the further survey in India, tentatively in September/October 2019.

7.2. JICA will prepare a draft Preparatory Survey Report in English and dispatch a mission to India in order to explain its contents, tentatively around April 2020.

7.3. If the contents of the draft Preparatory Survey Report is acceptable in principle and the undertakings are fully agreed by the Indian side, JICA will finalize the Preparatory Survey Report and send it to Indian side, tentatively around July 2020.

7.4. The schedule is subject to be changed, depending upon land availability, battery size and the report of survey team.

8. Environmental and Social Considerations

8.1. The A&NA side confirmed to give due environmental and social considerations during implementation of the Project, and after completion of the Project, in accordance with the JICA Guidelines for Environmental and Social Considerations (April, 2010).

8.2. The A&NA side also confirmed that all the mandatory clearances shall be obtained from the relevant agencies, before signing of Grant Agreement.

9. Other Relevant Issues

9.1. Harmonization between EMC and SCADA

9.1.1. For SCADA under the Project and EMC functions appropriately, smooth and fast transmission of data between those systems will be necessary. Therefore, the compatibility of those two systems needs to be carefully reviewed during the process of detailed designing of components of the Project. ED agreed to share to JICA India Office the information regarding specification of EMC's system, by 15th September, 2019.

9.1.2. EMC will control all of power generation plants, substations and batteries for optimizing energy efficiency of the entire network of South Andaman. Connecting to EMC is critical for the equipment under the Project to be able to function effectively and appropriately. Therefore, EMC should be installed before the installation of SCADA under the Project. ED agreed to it.

9.1.3. The interconnecting works of SCADA should consider the compatibility with the entire system of EMC, as an upper system. A&NA agreed that the Indian side should be responsible for the works to interconnect EMC and SCADA.

9.2. Customs Duties, Internal Taxes and Other Fiscal Levies

As described in Annex 4, the JICA Mission explained to the A&NA that it is necessary to ensure that customs duties, internal taxes and other fiscal levies which may be imposed in India with respect to the purchase of the products and/or the services be exempted or be borne by its designated authority without using the Grant. The JICA Mission requested that the A&NA side will confirm the detailed procedure to exempt/refund the duties and taxes including GST (The Goods and Service Tax act, 2017). A&NA agreed to provide to JICA India Office with the detailed procedure in writing, by the end of CY2019.

9.3. Necessary permit to stay in Andaman & Nicobar Islands for Consultants and Contractors

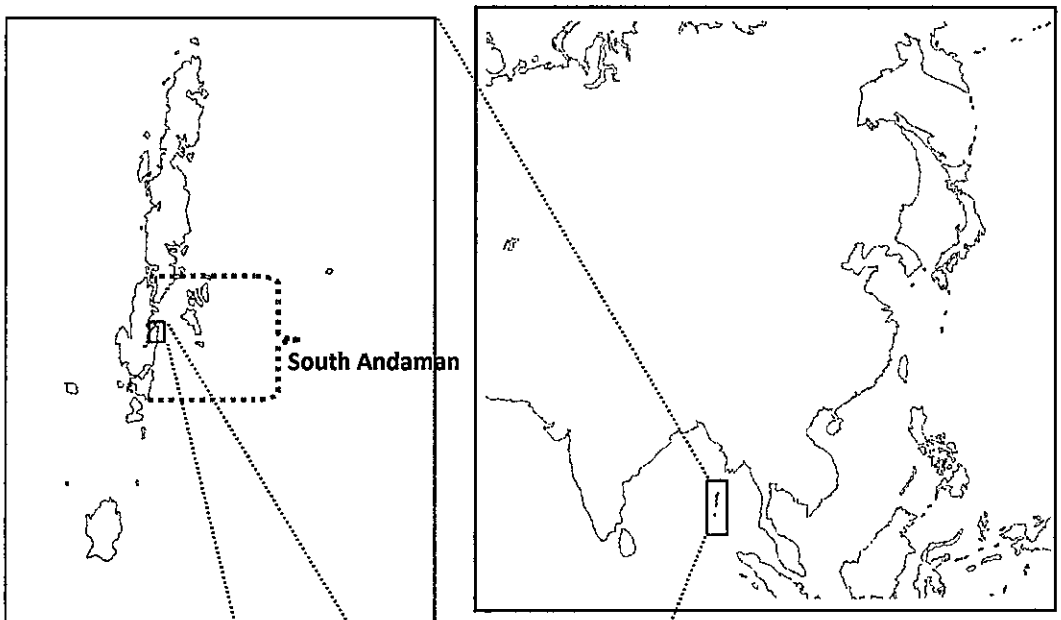
In order to secure the implementation of the Project, the JICA Mission explained that the sufficient length of stay of consultants and contractors in Andaman & Nicobar Islands is necessary. On the other hand, current regulation allows foreigner to stay at the Andaman & Nicobar Islands up to 2 weeks. During the Preparatory Survey, the schedule of implementation and the length of stay of the consultants and contractors will be elaborated. The JICA Mission requested the A&NA side to coordinate with relevant authorities to make necessary arrangement to ensure issuing the permit for the implementation of the Project, based on the necessary length of stay elaborated during the Preparatory Survey. The A&NA side agreed to it.

9.4. Necessary Project Management by ED

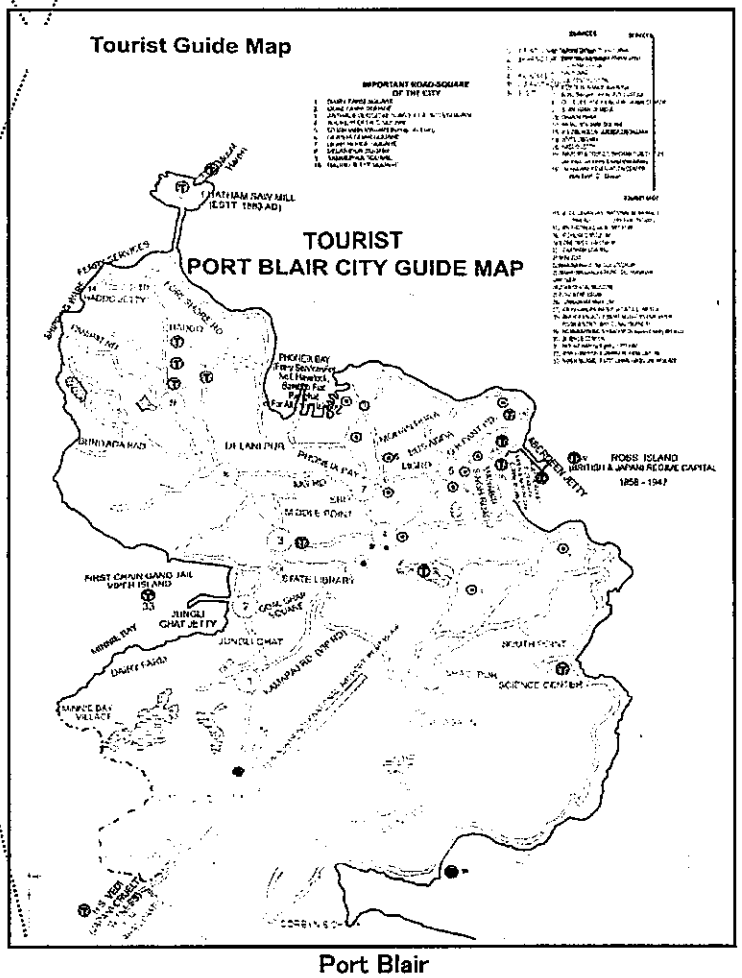
For an efficient implementation of the Project, the JICA Mission requested the A&NA side that ED will manage technical matters in the course of the Project implementation, such as RoW, signing authorities of official letter or minutes related to the meetings with consultants and contractors. The A&NA side agreed to it.

Annex 1 Project Site
Annex 2 Structure of A&NA
Annex 3 Japanese Grant
Annex 4 Major Undertakings to be taken by the Government of India

Tentative Project Site



Andaman and Nicobar Islands

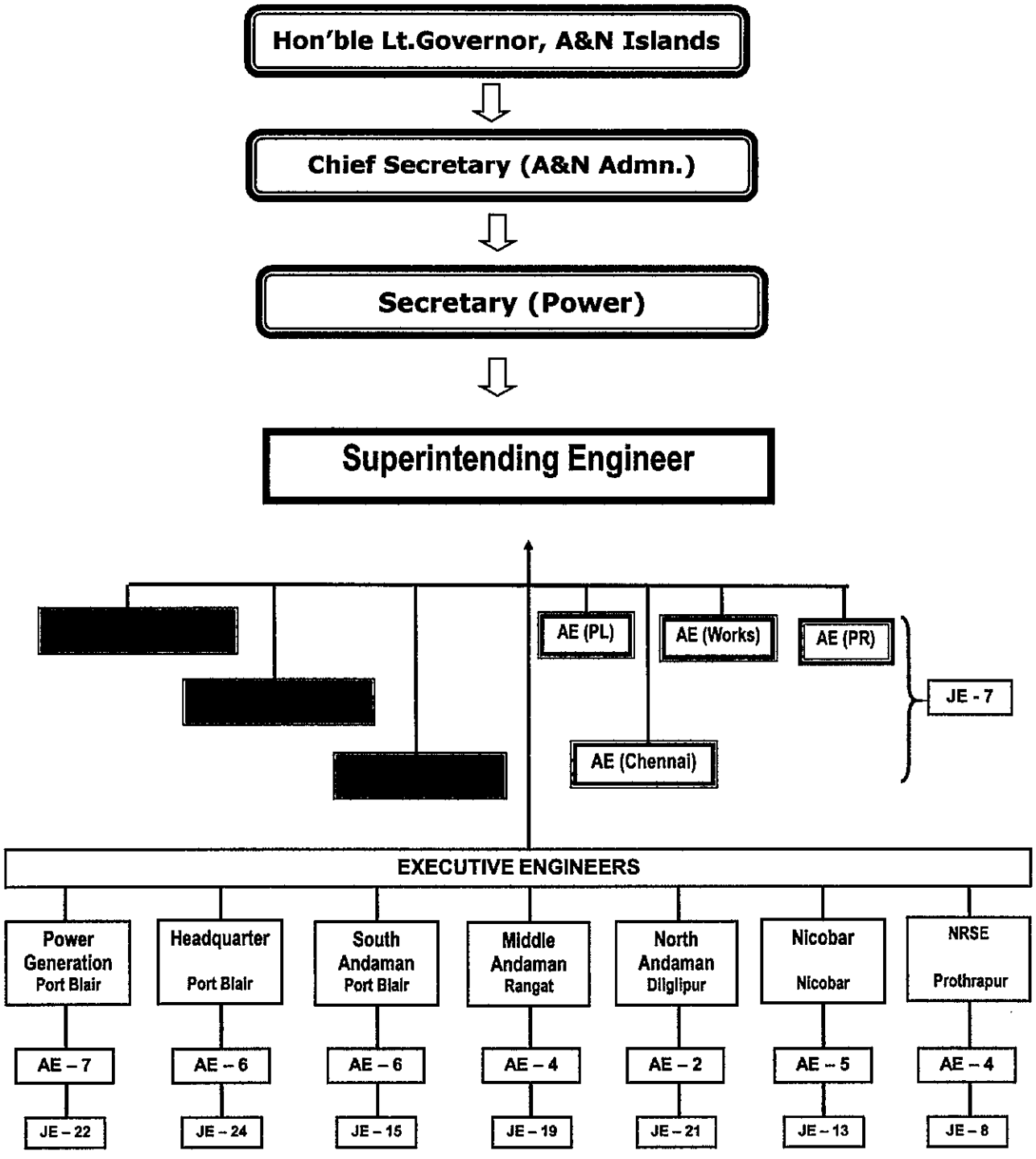


Port Blair

Source: d-maps.com / Tourist Guide Maps (Four in One) of A&N Islands, Port Blair City, Havelock & Neil Islands

Annex 2

Structure of A&NA



JAPANESE GRANT

The Japanese Grant is non-reimbursable fund provided to a recipient country (hereinafter referred to as "the Recipient") to purchase the products and/or services (engineering services and transportation of the products, etc.) for its economic and social development in accordance with the relevant laws and regulations of Japan. Followings are the basic features of the project grants operated by JICA (hereinafter referred to as "Project Grants").

1. Procedures of Project Grants

Project Grants are conducted through following procedures (See "PROCEDURES OF JAPANESE GRANT" for details):

(1) Preparation

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

(2) Appraisal

-Appraisal by the government of Japan (hereinafter referred to as "GOJ") and JICA, and Approval by the Japanese Cabinet

(3) Implementation

Exchange of Notes

-The Notes exchanged between the GOJ and the government of the Recipient

Grant Agreement (hereinafter referred to as "the G/A")

-Agreement concluded between JICA and the Recipient

Banking Arrangement (hereinafter referred to as "the B/A")

-Opening of bank account by the Recipient in a bank in Japan (hereinafter referred to as "the Bank") to receive the grant

Construction works/procurement

-Implementation of the project (hereinafter referred to as "the Project") on the basis of the G/A

(4) Ex-post Monitoring and Evaluation

-Monitoring and evaluation at post-implementation stage

2. Preparatory Survey

(1) Contents of the Survey

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

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of relevant agencies of the Recipient necessary for the implementation of the Project.

- Evaluation of the feasibility of the Project to be implemented under the Japanese Grant from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of an outline design of the Project.
- Estimation of costs of the Project.
- Confirmation of Environmental and Social Considerations

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

JICA requests the Recipient to take measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the executing agency of the Project. Therefore, the contents of the Project are confirmed by all relevant organizations of the Recipient based on the Minutes of Discussions.

(2) Selection of Consultants

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

(3) Result of the Survey

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

3. Basic Principles of Project Grants

(1) Implementation Stage

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 to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Recipient to define the necessary articles, in accordance with the E/N, to implement the Project, such as conditions of disbursement, responsibilities of the Recipient, and procurement conditions. The terms and conditions generally applicable to the Japanese Grant are stipulated in the "General Terms and Conditions for Japanese Grant (January 2016)."

2) Banking Arrangements (B/A) (See "Financial Flow of Japanese Grant (A/P Type)" for details)

a) The Recipient shall open an account or shall cause its designated authority to open an account under the name of the Recipient in the Bank, in principle. JICA will disburse the Japanese Grant in Japanese yen for the Recipient to cover the obligations incurred by the Recipient under the verified contracts.

b) The Japanese Grant will be disbursed when payment requests are submitted by the Bank to JICA under an Authorization to Pay (A/P) issued by the Recipient.

3) Procurement Procedure

The products and/or services necessary for the implementation of the Project shall be procured in accordance with JICA's procurement guidelines as stipulated in the G/A.

4) Selection of Consultants

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

5) Eligible source country

In using the Japanese Grant disbursed by JICA for the purchase of products and/or services, the eligible source countries of such products and/or services shall be Japan and/or the Recipient. The Japanese Grant may be used for the purchase of the products and/or services of a third country as eligible, if necessary, taking into account the quality, competitiveness and economic rationality of products and/or services necessary for achieving the objective of the Project. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm, which enter into contracts with the Recipient, are limited to "Japanese nationals", in principle.

6) Contracts and Concurrence by JICA

The Recipient will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be concurred by JICA in order to be verified as eligible for using the Japanese Grant.

7) Monitoring

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

8) Safety Measures

The Recipient must ensure that the safety is highly observed during the implementation of the Project.

9) Construction Quality Control Meeting

Construction Quality Control Meeting (hereinafter referred to as the "Meeting") will be held for quality assurance and smooth implementation of the Works at each stage of the Works. The member of the Meeting will be composed by the Recipient (or executing agency), the Consultant, the Contractor and JICA. The functions of the Meeting are as

followings:

a) Sharing information on the objective, concept and conditions of design from the Contractor, before start of construction.

b) Discussing the issues affecting the Works such as modification of the design, test, inspection, safety control and the Client's obligation, during of construction.

(2) Ex-post Monitoring and Evaluation Stage

1) After the project completion, JICA will continue to keep in close contact with the Recipient in order to monitor that the outputs of the Project is used and maintained properly to attain its expected outcomes.

2) In principle, JICA will conduct ex-post evaluation of the Project after three years from the completion. It is required for the Recipient to furnish any necessary information as JICA may reasonably request.

(3) Others

1) Environmental and Social Considerations

The Recipient shall carefully consider environmental and social impacts by the Project and must comply with the environmental regulations of the Recipient and JICA Guidelines for Environmental and Social Considerations (April, 2010).

2) Major undertakings to be taken by the Government of the Recipient

For the smooth and proper implementation of the Project, the Recipient is required to undertake necessary measures including land acquisition, and bear an advising commission of the A/P and payment commissions paid to the Bank as agreed with the GOJ and/or JICA. The Government of the Recipient shall ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the Recipient with respect to the purchase of the Products and/or the Services be exempted or be borne by its designated authority without using the Grant and its accrued interest, since the grant fund comes from the Japanese taxpayers.

3) Proper Use

The Recipient is required to maintain and use properly and effectively the products and/or services under the Project (including the facilities constructed and the equipment purchased), to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Japanese Grant.

4) Export and Re-export

The products purchased under the Japanese Grant should not be exported or re-exported from the Recipient.

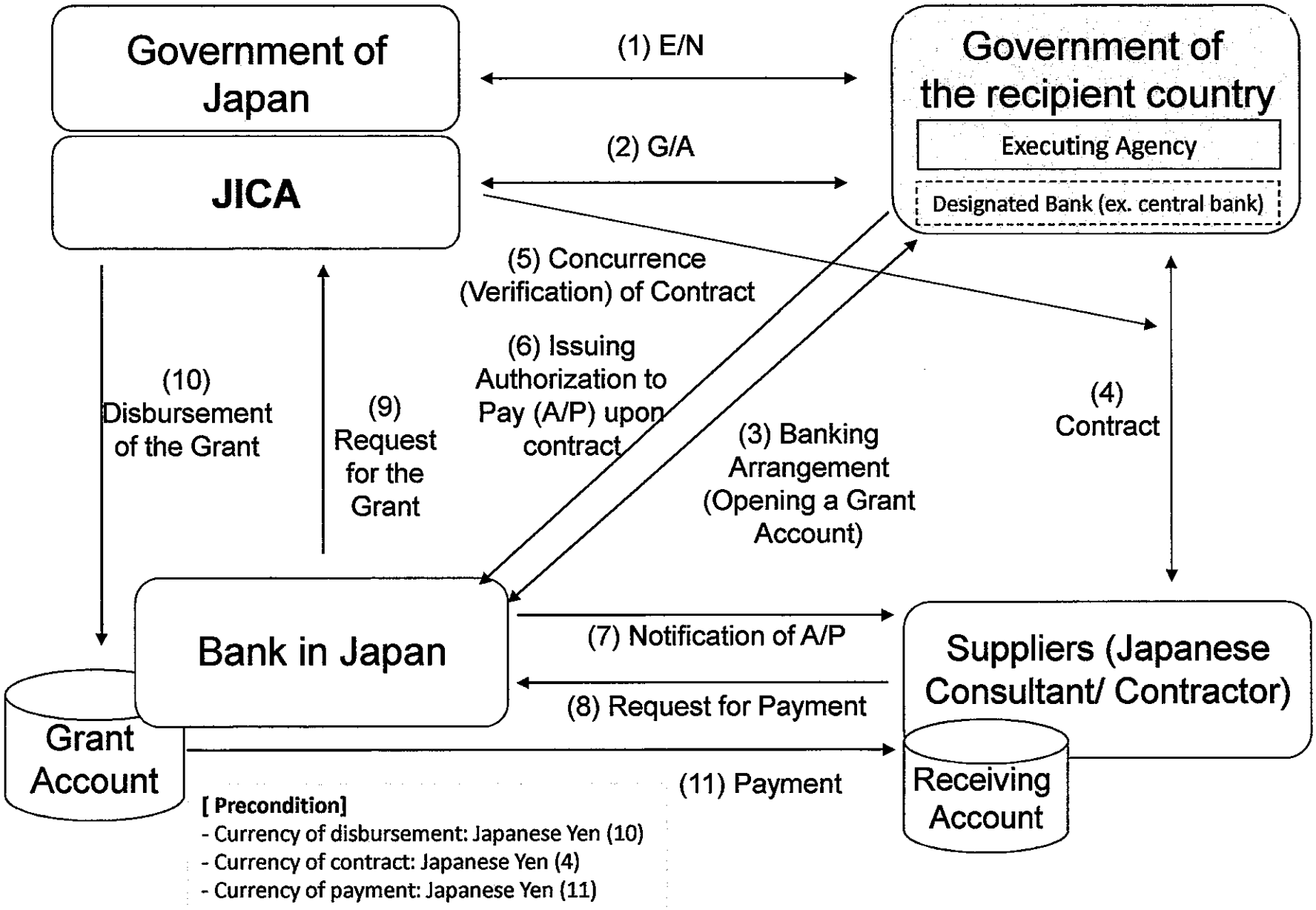
PROCEDURES OF JAPANESE GRANT

Stage	Procedures	Remarks	Recipient Government	Japanese Government	JICA	Consultants	Contractors	Agent Bank
Official Request	Request for grants through diplomatic channel	Request shall be submitted before appraisal stage.	x	x				
1. Preparation	(1) Preparatory Survey Preparation of outline design and cost estimate		x		x	x		
2. Appraisal	(2)Preparatory Survey Explanation of draft outline design, including cost estimate, undertakings, etc.		x		x	x		
	(3)Agreement on conditions for implementation	Conditions will be explained with the draft notes (E/N) and Grant Agreement (G/A) which will be signed before approval by Japanese government.	x	x (E/N)	x (G/A)			
	(4) Approval by the Japanese cabinet			x				
3. Implementation	(5) Exchange of Notes (E/N)		x	x				
	(6) Signing of Grant Agreement (G/A)		x		x			
	(7) Banking Arrangement (B/A)	Need to be informed to JICA	x					x
	(8) Contracting with consultant and issuance of Authorization to Pay (A/P)	Concurrence by JICA is required	x			x		x
	(9) Detail design (D/D)		x			x		
	(10) Preparation of bidding documents	Concurrence by JICA is required	x			x		
	(11) Bidding	Concurrence by JICA is required	x			x	x	
	(12) Contracting with contractor/supplier and issuance of A/P	Concurrence by JICA is required	x				x	x
	(13) Construction works/procurement	Concurrence by JICA is required for major modification of design and amendment of contracts.	x			x	x	
	(14) Completion certificate		x			x	x	
4. Ex-post monitoring & evaluation	(15) Ex-post monitoring	To be implemented generally after 1, 3, 10 years of completion, subject to change	x		x			
	(16) Ex-post evaluation	To be implemented basically after 3 years of completion	x		x			

notes:
1. Project Monitoring Report and Report for Project Completion shall be submitted to JICA as agreed in the G/A.

Annex 3-3

Financial Flow of Japanese Grant (A/P Type)



Annex 4

Major Undertakings to be taken by the Government of India

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

(1) Before the Tender

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To open Bank Account (Banking Arrangement (B/A))	within 1 month after the signing of the G/A	To be confirmed by ED		
2	To issue A/P to a bank in Japan (the Agent Bank) for the payment to the consultant	within 1 month after the signing of the contract(s)	To be confirmed by ED		
3	To approve IEE or EIA (If necessary) (* To be confirmed)	within 1 month after the signing of the G/A	To be confirmed by ED		
4	To secure and clear the following lands 1) project site for building for the purpose of installing batteries, power system stabilizer and SCADA	before notice of the bidding document(s)	ED		
5	To obtain the planning, zoning, building permit (If necessary) (* To be confirmed)	before notice of the bidding document(s)	ED		
6	Earth filling, elevation raising, and preparing retaining wall for the sites of power house building and other facilities necessary for the Project	before notice of the bidding document(s)	ED		
7	To submit Project Monitoring Report (with the result of Detail Design)	before preparation of bidding document(s)	ED		
8	To accord Japanese physical persons and/or physical persons of third countries 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 country of the Recipient and stay therein for the performance of their work	before the tender	To be confirmed by A&NA		
9	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the products and/or the services be exempted or be borne by its designated authority without using the Grant.	before the tender	To be confirmed by A&NA		

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

(2) During the Project Implementation

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To issue A/P to a bank in Japan (the Agent Bank) for the payment to the Supplier(s)	within 1 month after the signing of the contract(s)	To be confirmed by ED		
2	To bear the following commissions to a bank in Japan for the banking services based upon the B/A				
	1) Advising commission of A/P	within 1 month after the signing of the contract(s)	To be confirmed by ED		
	2) Payment commission for A/P	every payment	To be confirmed by ED		
3	To ensure prompt unloading and customs clearance at ports of disembarkation in the country of the Recipient and to assist the Supplier(s) with internal transportation therein	during the Project	ED		
4	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project	during the Project	A&NA, ED		
5	1) To submit Project Monitoring Report after each work under the contract(s) such as shipping, hand over, installation and operational training	every month	ED		
	2) To submit Project Monitoring Report (final)	within one month after signing of Certificate of Completion for the works under the contract(s)	ED		
6	To submit a report concerning completion of the Project	within six months after completion of the Project	ED		
7	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(s)		ED		
	1) Electricity The distributing line to the site	before start of the construction			
	2) Water Supply The city water distribution main to the site	before start of the construction			
	3) Drainage The city drainage main (for storm, sewer and others) to the site	before start of the construction			
	4) Furniture and Equipment General furniture	1 month before completion of the construction			
8	To take necessary measure for safety construction- - rope off - necessary power shutdown for the work	during the construction	ED		
9	To implement Environment Management Plan (EMP) and Environment Monitoring Plan (EMoP)	during the construction	ED		
10	To submit results of environmental monitoring to JICA, by using the monitoring form, on a quarterly basis as a part of Project Monitoring Report	during the construction	ED		

(3) After the Project

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

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

NO	Items	Deadline	Amount (Million Japanese Yen)*
1	To construct XXX (To be finalized by the end of next mission) 1) To conduct the following transportation a) Marin (Air) transportation of the products from Japan to the country of the Recipient b) Internal transportation from the port of disembarkation to the project site		
	2) To provide equipment with installation and commissioning		
2	To implement detailed design, bidding support and procurement supervision (Consulting Service)		
3	To prepare XXX		
4	Contingencies		
	Total		XXX

*The Amount is provisional. This is subject to the approval of the Government of Japan.

Minutes of Meeting for Technical Matters
for
Preparatory Survey for the Project for Improvement of Power Supply
in
Andaman and Nicobar Islands in India

between

The Consultant of JICA Survey Team
and
Electricity Department, Andaman and Nicobar Administration

Port Blair
December 26, 2019

Mr. FUKUCHI Tomoyasu
The Consultant Team Leader of
JICA Survey Team
Nippon Koei Co., Ltd.

Mr. AJIT Kumar
Superintending Engineer
Electricity Department,
Andaman and Nicobar Administration

The Consultant Team of Preparatory Survey (the Consultant) for the Project for Improvement of Power Supply in Andaman and Nicobar Islands, which is carried out by Japan International Cooperation Agency (JICA), arrived in Port Blair on December 24, 2019.

On the same date December 24, the Consultant had a meeting with Electricity Department, Andaman and Nicobar Administration (ED), and the Consultant and ED (both sides) confirmed the followings.

1. **Selection of battery type** : The Consultant explained the evaluation result of battery type with the Evaluation Table for Battery Type Selection (Attachment-1). Based on the evaluation result, ED selected the lithium-ion battery for this Project.

2. **Interim result of battery capacity analysis**: The Consultant explained to ED the interim result of battery capacity analysis for the lithium-ion battery with Attachment-2. The battery capacity is optimized for the surplus power generated by solar in the daytime to be utilized to the maximum extent. The result indicates that the the capacity is 14.8 MWh to 15.6 MWh. The Consultant explained that the design of the Project would be carried out with the battery capacity of 15 MWh, and the output power of 5 MW in three hours and 30 MW in short term. ED agreed to the battery capacity and the output power for the design work.

3. **Energy Management Center (EMC) Specification**: ED provided the Consultant with a copy of Establishment of Energy Management Center in South Andaman (Detailed Proposal). Besides, ED informed that Power Grid India gave the award of the EMC bidding to General Electric (GE) on December 18, 2019. The Consultant requested ED to provide the technical specification of EMC.

4. **Joint Electricity Regulatory Commission (JERC)'s approval of the project** : ED explained the Consultant that JERC's approval is not required for this Project. However, in case if any approval of JERC is required at later stage, this same shall be taken by ED.

5. **Stockyard** : ED explained that the stockyard for the Project during the implementation is available in Phoenix Bay Power Station premises as shown in Attachment-3

6. **Connection voltage and point to the south Andaman grid** :
   Both sides agreed that the connection voltage of the Project to the south Andaman grid is 33 kV and the connection point is shown in Attachment-3 in

7. **Design Standard**: Both sides agreed that the design standards for the Project are Indian Standard (IS), International Electrotechnical Commission (IEC), Japanese Industrial Standards (JIS), and other equivalent standards.

8. **Meteorological Data**: ED recommended the Consultant to check the data that was supposed to have been given to the Consultant from Mr. Vinay of ED in Chatham Power Station. The Consultant agreed to do so.

9. **Land preparation of the Project site**: The Consultant requested ED to dismantle Old Rest Room, and handover the Project site indicated in Attachment-3, free from vegetation. The Consultant agreed to take over the pond area in its as is condition in place of earlier of concrete removal and earth filling.

10. **Office space for the Consultant in the implementation stage**: ED explained that ED would provide the Consultant with the office space in Phoenix Bay Power Station premises in the implementation stage.

11. **For the Contractor, temporary site office, resting place for workers and space for parking for vehicles to be used for the construction works**: ED explained that the Contractor would be able to manage such space in Phoenix Bay Power Station premises under the control of ED.

12. **Water and electricity supply to the site**: ED explained that the supply points of water and electricity to the Project site are available in Phoenix Bay Power Station premises for temporarily in the implementation period and for permanent purpose.

13. **Clearance**: ED explained that all the required statutory clearance for establishing the Project would be carried out by ED.

14. **Allowable variation range of voltage and frequency of the south Andaman grid**: ED explained that the allowable variation range shall be as for stated at Grid Code Regulations 2010 notified by Central Electricity Regulatory Commission (CERC) and lists amendment made time to time by JERC/CERC.

15. **Expected overall schedule**: The Consultant explained the expected overall schedule as shown in Attachment-4.

16. **Update of ongoing projects:** ED updated the status of ongoing projects as shown below.

Project Name	Present Status	Expected Completion Date
Solar Generation Attam Pahad and Dollygunj 20 MW with battery 16 MW	2.5 MW solar already installed. Balance of 17.5 MW solar with 16 MW-8 MWh Battery Energy Storage System (BESS) will be installed at the end of March 2020	March 2020
EMC	The contractor was decided on December 18, 2019.	March 2021
LNG Duel Fuel Power Plant	(1) Letter of Award to EPC contractor for the power plant (28/02/2020) (2) Letter of Award to fuel supply (15/03/2020)	August 2022

17. **Next Site Work** : The next site work of the Consultant is shown below.

Around one week in Port Blair at end of January 2020

End

Attachment:

1. Evaluation Table for Battery Type Selection
2. Required Battery Capacity (Lithium-ion)
3. Project Site Area
4. Expected Overall Schedule

Preparatory Survey for the Project for Improvement of Power Supply in Andaman and Nicobar Islands

Evaluation Table for Battery Type Selection

2019/12/24 Nippon Koei Co., Ltd.

Battery Types for Evaluation: (1) Lithium-ion (LiB), (2) Lead Acid (LA), and (3) Sodium-Sulfur (NAS)

Evaluation Method: By scoring 3 (excellent), 2 (good), and 1 (poor)

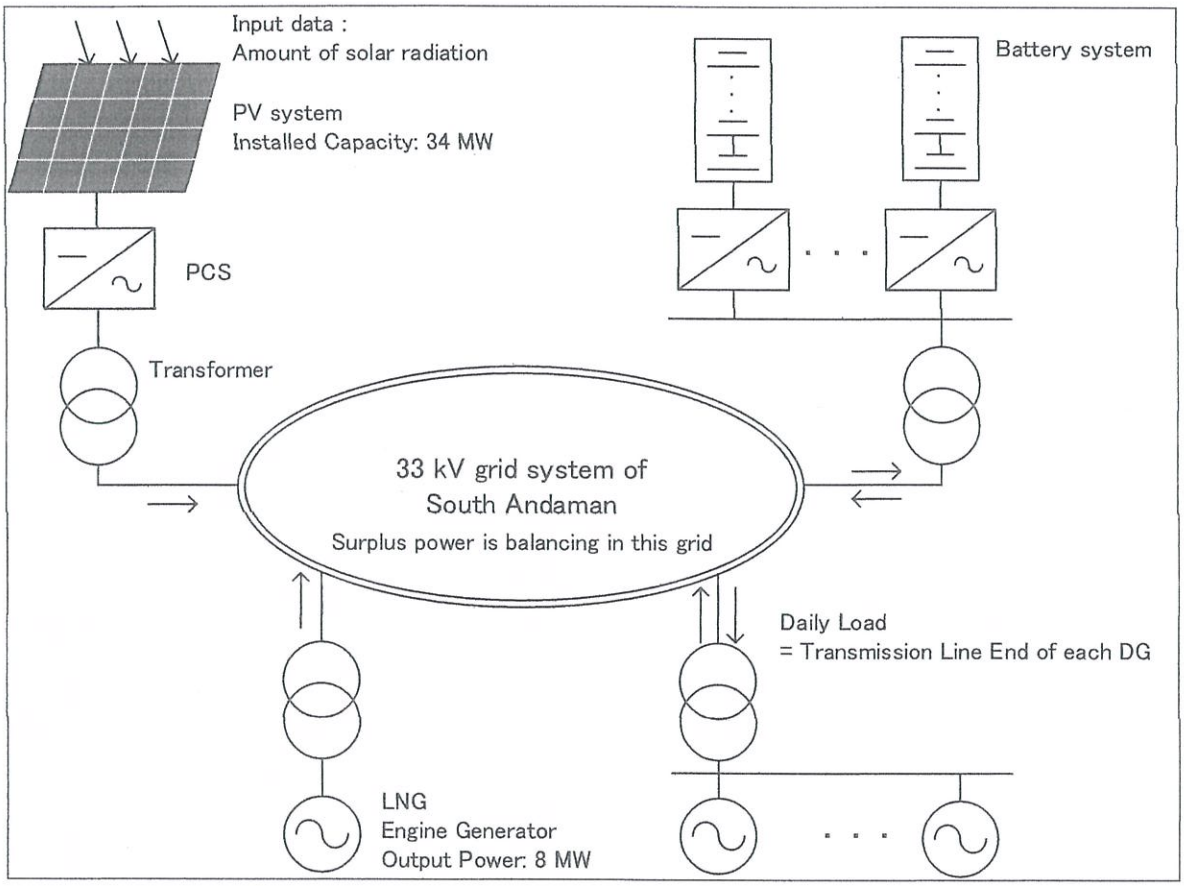
No.	Evaluation Item	Evaluation Score			Evaluation Criteria*	Remarks
		LiB	LA	NAS		
1	Contribution to secure the grid stability against short-term demand-and-supply unbalance in the grid.	3	1	2	3: high contribution to the short-term large instability caused by changes of solar radiation, feeder trip, and power source fault drop, 2: contribution to the short-term small instability, 1: contribution to the short-term small instability but reduce life-span of battery	Judged by characteristic of each battery
2	Easiness of operation and maintenance	3	2	2	3: maintenance free, 2: daily and periodic inspection is required, 1: hands on operation is required	Judged by characteristic of each battery
3	Efficiency of charge and discharge	3	1	2	3: 85% or more, 2: 80% or more but less than 85%, 1: less than 80%.	Charged energy is AC low-voltage input energy to charger and discharged energy is AC low-voltage output energy from inverter. Judged by characteristic of each battery
4	Life-span	2	1	1	3: 21 years or more, 2: 16 years or more but less than 21 years, 1: 15 years or less.	The expected life-span is lifetime in year with the condition that discharge and charge is one time per day. Judged by characteristic of each battery
	Total score	**11**	**5**	**7**		

Evaluation Result: Lithium-ion battery was evaluated best for battery type selection of this Project.

Attachment-1

Required Battery Capacity (Lithium-ion)

2019/12/24



System Model

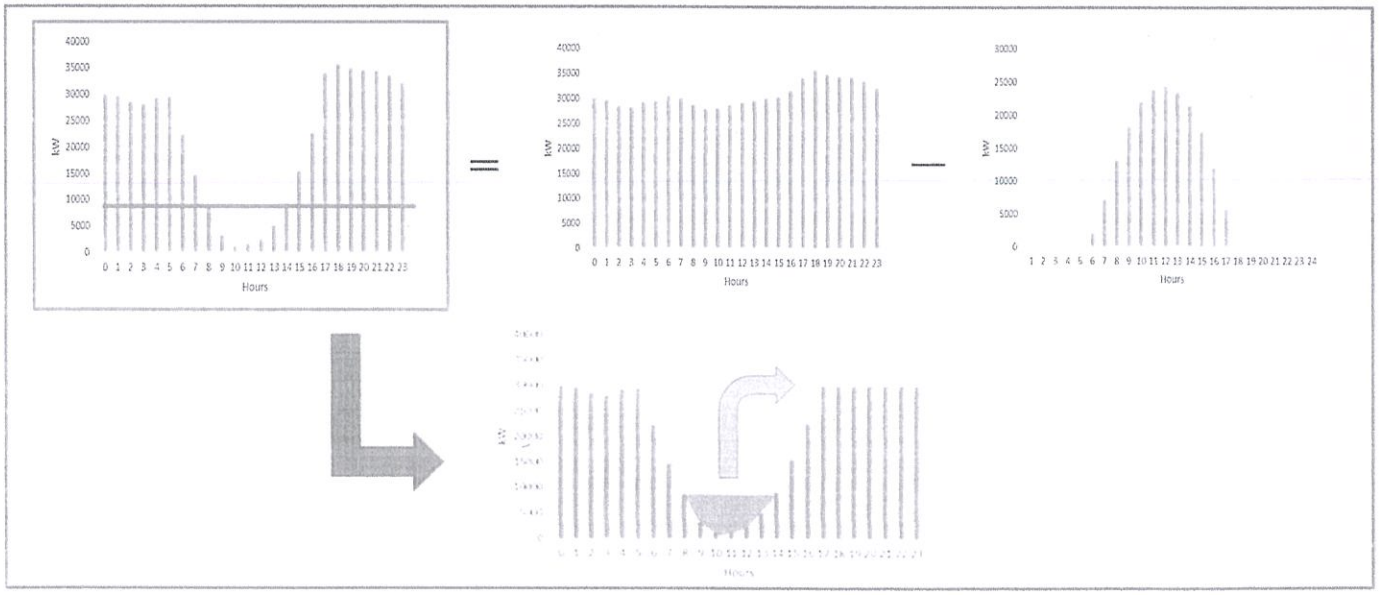
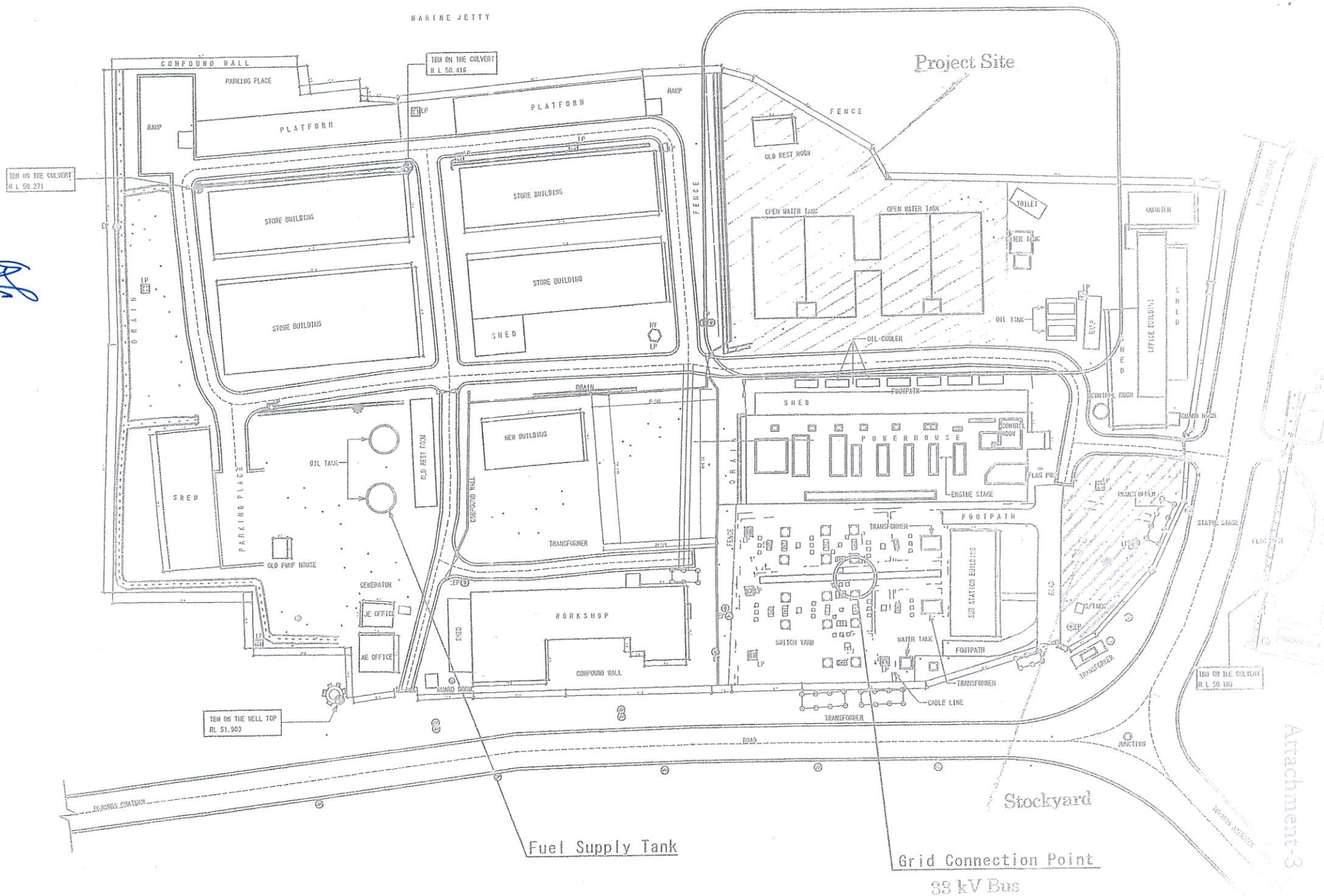


Image of Solar Surplus Energy in Daytime to Night-time

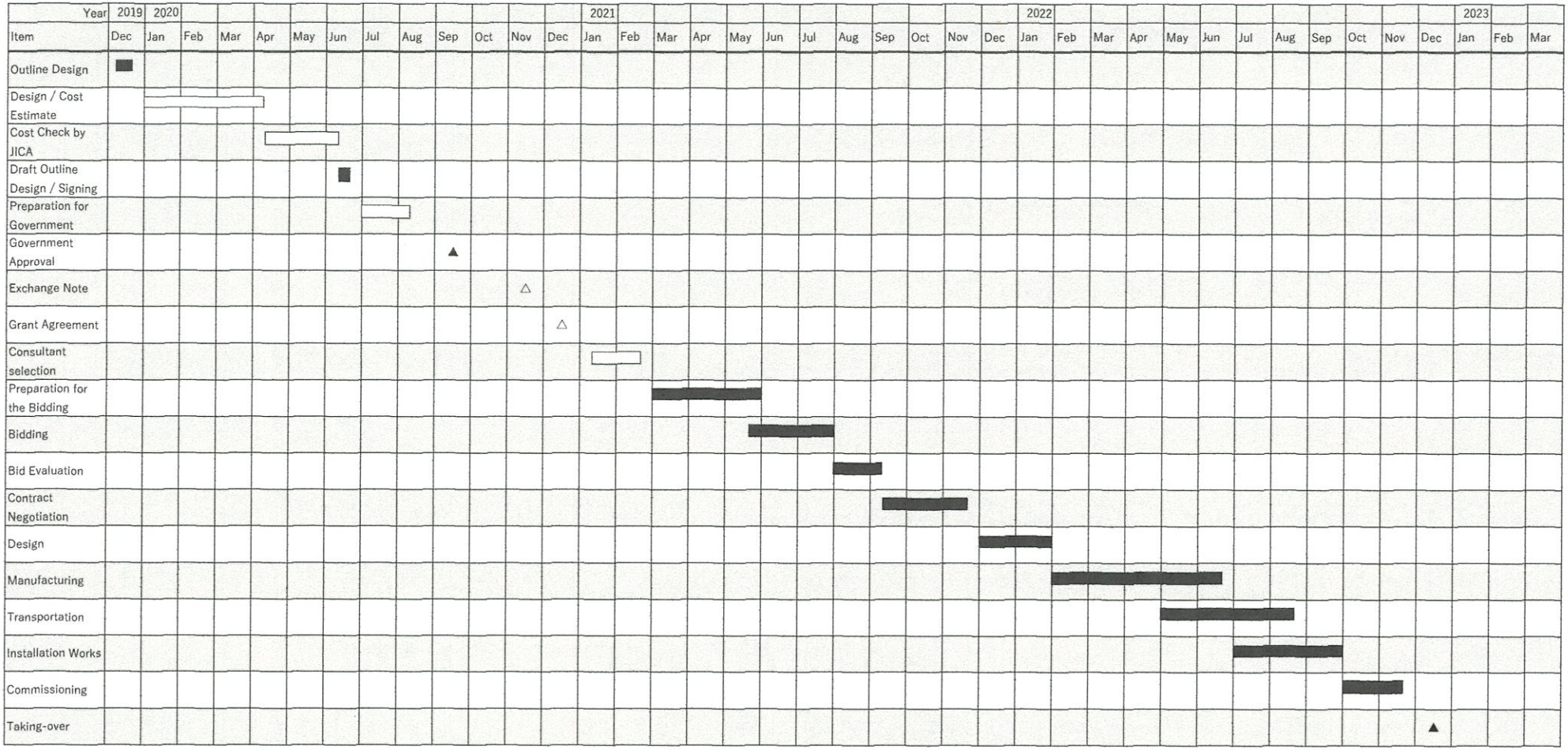
Required Battery Capacity (Lithium-ion): 14.8 to 15.6 MWh

depending on depth of discharge



Attachment-3

Expected Overall Schedule



Attachment-4

Technical Understandings
for
Preparatory Survey for the Project for Improvement of Power Supply
in
Andaman and Nicobar Islands in India

between

The Consultant of JICA Survey Team
and
Electricity Department, Andaman and Nicobar Administration

Port Blair
February 1, 2020

Mr. KOBAYASHI Toshiaki
Senior Electrical Engineer of
JICA Survey Team
Nippon Koei Co., Ltd.

Mr. AJIT Kumar
Superintending Engineer
Electricity Department,
Andaman and Nicobar Administration

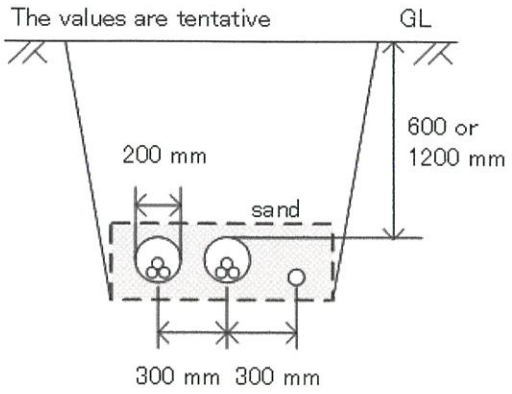
The Consultant Team of Preparatory Survey (the Consultant) for Project for Improvement of Power Supply in Andaman and Nicobar Islands (the Project), which is carried out by Japan International Cooperation Agency (JICA), arrived in Port Blair on January 28th, 2020.

The Consultant and Electricity Department, Andaman and Nicobar Administration (ED) discussed how to interconnect the battery energy storage system (BESS) to existing ED's 33 kV grid in the Phoenix Bay power plant (PB power plant) to prepare the outline design of the Project. The Consultant and ED (both sides) confirmed the following topics regarding the design work by the Consultant.

1. **33 kV Grid connection outline:** The Project will install 33 kV metal-clad switchgear [5 panels: 2 incomer, 2 outgoing, 1 bus-coupler] (JICA's cubicles) in BESS building and 33 kV 2 circuits power cable from JICA's cubicles to ED's outside 33 kV switchgear bay via west side of BESS building as shown in Attachment. Besides, for this connection, the Project will provide and install the following equipment.
    - Surge Arrester
    - Circuit Breaker
    - Disconnection Switch
    - Current Transformer
    - Potential Transformer
    - Support Structures (similar to the existing bus connection)
    - 33 kV Cable Terminals
    - Control Panel (inside substation building)

ED agreed for the Consultant to carry out the design work according to the above 33 kV grid connection outline. ED will make arrangement of power suspensions for safety work.

2. **Cable Route:** The Project will lay protection pipe for 33 kV power cables and control cables from outside of BESS building to the road crossing point as section drawing below, and the manholes will be installed both side of the internal road. The Project will construct new cable trench for 33 kV power cables and control cables from the internal road edge to existing cable trench. The both cable trench will be jointed. The materials of new cable trench will be RCC (Reinforced Cement Cover) with L angle. ED allowed to demolish the old wall which will disturb the joint work of both cable trench.



Section drawing of underground protection pipe

Old wall

New cable trench route

3. **Existing Specification:** ED supplied the specifications of existing 33 kV switchgear including transformer, 33 kV metal-clad switchgear and underground cable.

4. **Update of ongoing projects:** ED updated the status of ongoing projects as shown below.

Project Name	Present Status	Expected Completion Date
Solar Generation Attam Pahad and Dollygunj 20 MW with battery 16 MW	2.5 MW solar already installed. Balance of 17.5 MW solar with 16 MW-8 MWh Battery Energy Storage System (BESS) will be installed at the end of March 2020	March 2020
EMC	The contractor (GE) was decided on December 18, 2019. According to PGCIL, GE do	March 2021

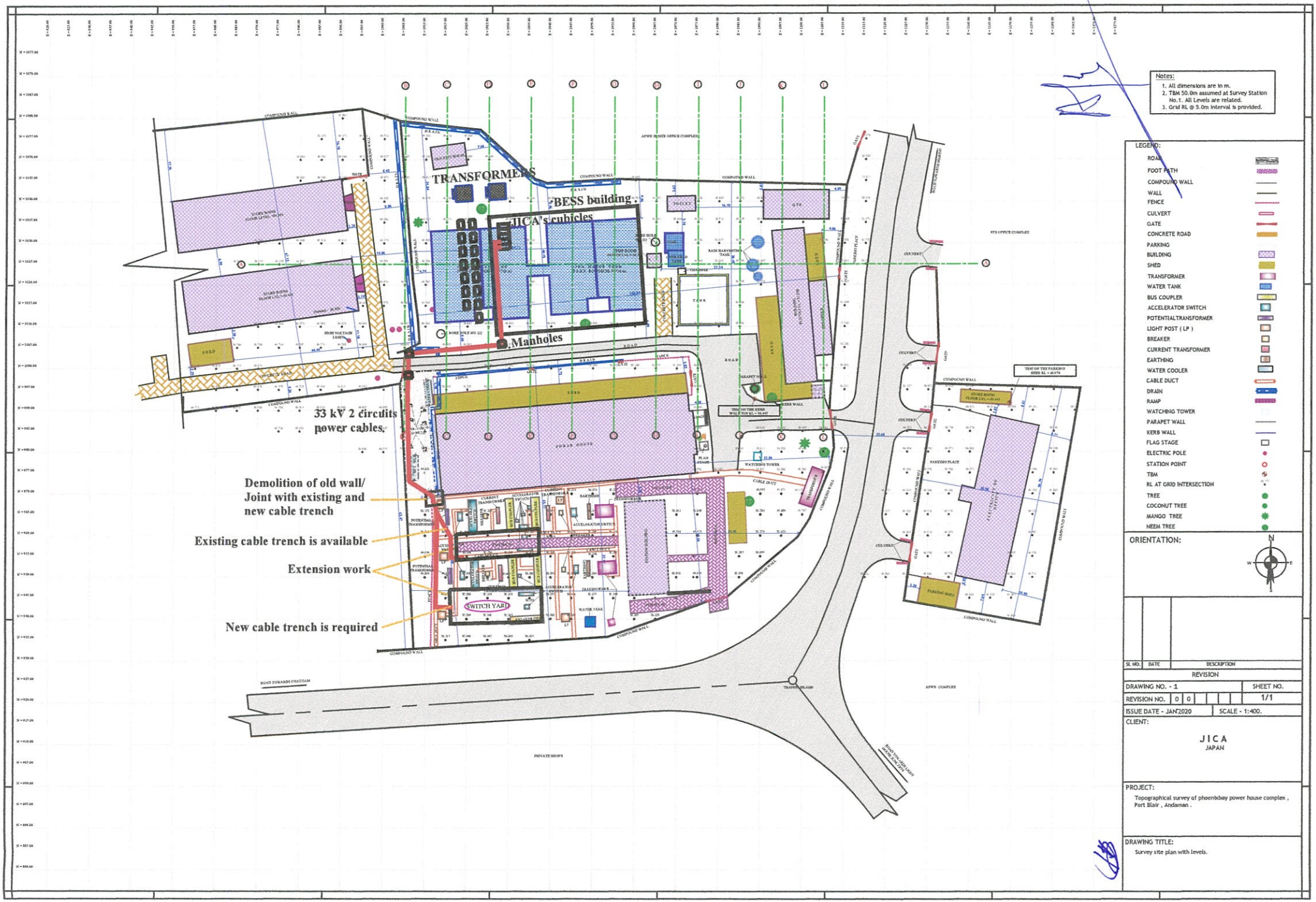
	not start submission of design documents and drawings. GE started modification work of EMC building from Jan 20th.	
LNG Duel Fuel Power Plant	(1) Retendering for EPC contractor (before 15/02/ 2020) (2) Expected bid opening date (end of March 2020) (3) Letter of Award to fuel supply (15/04/2020)	December 2022

5. **Other Information:** Existing HPP-1 (5 MW) and HPP-2 (10 MW) which are interconnecting to existing 33 kV switchyard inside PB power plant will be removed after LNG power plant start operation.

End

Attachment:

1. Location plan



Notes:
1. All dimensions are in m.
2. TBM 50.0m assumed at Survey Station No.1. All Levels are related.
3. Grid RL @ 5.0m interval is provided.

LEGEND:
- ROAD
- FOOT PATH
- COMPOUND WALL
- WALL
- FENCE
- CULVERT
- GATE
- CONCRETE ROAD
- PARKING
- BUILDING
- SHED
- TRANSFORMER
- WATER TANK
- BUS COUPLER
- ACCELERATOR SWITCH
- POTENTIALTRANSFORMER
- LIGHT POST (LP)
- BREAKER
- CURRENT TRANSFORMER
- EARTHING
- WATER COOLER
- CABLE DUCT
- DRAIN
- RAMP
- WATCHING TOWER
- PARAPET WALL
- KERB WALL
- FLAG STAGE
- ELECTRIC POLE
- STATION POINT
- TBM
- RL AT GRID INTERSECTION
- TREE
- COCONUT TREE
- MANGO TREE
- NEEM TREE

ORIENTATION: N, W, E, S

SL NO.	DATE	DESCRIPTION
REVISION		

DRAWING NO. - 1 | SHEET NO. 1/1
REVISION NO. 0 0
ISSUE DATE - JAN'2020 | SCALE - 1:400.

CLIENT:
JICA
JAPAN

PROJECT:
Topographical survey of phoenixbay power house complex , Port Blair , Andaman .

DRAWING TITLE:
Survey site plan with levels.

Minutes of Discussions
on the Preparatory Survey for the Project for
Improvement of Power Supply in Andaman and Nicobar Islands in India
(Explanation on Draft Preparatory Survey Report)

In response to the request letter from the Government of India (Ministry of Finance) dated 19th October, 2015 (No.4/8/2015-Jap II) and the subsequent letter dated 9th May, 2019 (D.O. No. 4/8/2015-JICA Projects (J.II)), related to the Project for Improvement of Power Supply in Andaman and Nicobar Islands (hereinafter referred to as "the Project"), and with reference to the minutes of discussions signed between Andaman and Nicobar Administration (hereinafter referred to as "ANA") and the Japan International Cooperation Agency (hereinafter referred to as "JICA") on 21st August, 2019, JICA dispatched the Preparatory Survey Team (hereinafter referred to as "the Team") for the explanation of Draft Preparatory Survey Report (hereinafter referred to as "the Draft Report") for the Project.

As a result of the discussions, both sides agreed on the main items described in the attached sheets. The both parties acknowledge and agree that the signing of this Minutes of Discussions may be executed by electronic signature, which is considered as an original signature, and therefore has the same force and effect as an original signature. "Electronic signature" includes electronically scanned and transmitted versions (e.g. via pdf) of an original signature.

Port Blair, December, 2020
Tokyo, 4th December, 2020

Mr. YUZURIO Susumu
Director
Energy and Mining Group
Infrastructure Management Department
Japan International Cooperation Agency
Japan

Mr. Sudhir Mahajan
Secretary (Power)
Andaman and Nicobar Administration
India

Mr. Vivek Kumar Dewangan
Additional Secretary (IC)
Ministry of Power
India

Mr. Govind Mohan
Additional Secretary (UT)
Ministry of Home Affairs
Government of India

ATTACHEMENT

1. Objective of the Project

   The objective of the Project is to utilize the power generated from renewable energy sources and stabilize power supply in South Andaman, by introducing necessary equipment and facilities for energy storage of solar PV generation, thereby contributing to promotion of actions towards climate change and improvement of living standard in Andaman and Nicobar Islands.

2. Title of the Preparatory Survey

   Both the ANA side and the JICA Mission (hereinafter referred to as "both sides") confirmed the title of the Preparatory Survey as "The Preparatory Survey for the Project for Improvement of Power Supply in Andaman and Nicobar Islands".

3. Project Site

   Both sides confirmed that the site of the Project is in Phoenix Bay power house in Port Blair, which is shown in Annex 1. ANA confirmed that the Project site will not be shifted to other locations, nor reduce the size of the above mentioned site. ANA agreed to the JICA Mission that, before the bidding procedure starts, ED will conduct cutting/clearing of vegetation and removal of existing structure etc, in order to make the project site ready for construction, and will hand over the site to Contractor right after contract signing without delay.

4. Responsible authority for the Project

   Both sides confirmed that Electricity Department, Andaman and Nicobar Administration (hereinafter referred to as "ED") will be the executing agency for the Project (hereinafter referred to as "the Executing Angency"). The Executing Agency shall coordinate with all the relevant authorities to ensure smooth implementation of the Project and ensure that the undertakings for the Project shall be taken care by relevant authorities properly and on time. The organization charts are shown in Annex 2.

5. Contents of the Draft Report

   After the explanation of the contents of the Draft Report by the Team, the Indian side agreed to its contents. JICA will finalize the Preparatory Survey Report based on the confirmed items. The report will be sent to the Indian side around March 2021.

6. Cost estimate

   Both sides confirmed that the cost estimate including the contingency explained by the

Team is provisional and will be examined further by the Government of Japan for its approval. The contingency would cover the additional cost against natural disaster, unexpected natural conditions, etc.

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

8. Procedures and Basic Principles of Japanese Grant
The ANA side agreed that the procedures and basic principles of Japanese Grant (hereinafter referred to as "the Grant") as described in Annex 3 shall be applied to the Project. In addition, the ANA side agreed to take necessary measures according to the procedures.

9. Timeline for the project implementation
The Team explained to the ANA side that the expected timeline for the project implementation is as attached in Annex 4.

10. Expected outcomes and indicators
Both sides agreed that key indicators for expected outcomes are as follows. The ANA side will be responsible for the achievement of agreed key indicators targeted in year 2026 and shall monitor the progress for Ex-Post Evaluation based on those indicators.

[Quantitative indicators]

Indicators	Baseline (2020)	Target (2026) (3 years after completion of the new facilities)
Maximum Output of Battery (MW)	-	30
Maximum Capacity of Battery (MWh)	-	14.25
Annual discharge of energy derived from surplus PV energy (MWh /year)	0	**
Fluctuation range of system frequency (Hz)	49.08 – 51.83	50 +/- 0.5
Reduction in greenhouse gas emissions (tCO2 /year)	-	**

** Figures of indicators will be calculated and described in the Final Report of the Preparatory Survey

[Qualitative indicators]

- Promotion of actions towards climate change
- Improvement of living standard

11. Ex-Post Evaluation

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

12. Undertakings of the Project

Both sides confirmed the undertakings of the Project as described in Annex 5. With regard to exemption of customs duties, internal taxes and other fiscal levies as stipulated in Item No. 9 of Annex 5, both sides confirmed that such customs duties, internal taxes and other fiscal levies, which shall be clarified in the bid documents by ED, ANA during the implementation stage of the Project.

The ANA side assured to take the necessary measures and coordination including allocation of the necessary budget which are preconditions of implementation of the Project. It is further agreed that the costs are indicative, i.e. at Outline Design level. More accurate costs will be calculated at the Detailed Design stage.

Both sides also confirmed that the Annex 5 will be used as an attachment of G/A.

13. Monitoring during the implementation

The Project will be monitored by the Executing Agency and reported to JICA by using the form of Project Monitoring Report (PMR) attached as Annex 6. The timing of submission of the PMR is described in Annex 5.

14. Project completion

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

15. Environmental and Social Considerations

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

the environment under the Guidelines.

16. Other Relevant Issues

16.1. Harmonization between EMC and SCADA

For SCADA under the Project and EMC functions appropriately, smooth and fast transmission of data between those systems will be necessary. Therefore, the compatibility of those two systems needs to be carefully reviewed during the process of detailed designing of components of the Project. ED agreed to coordinate with supplier of EMC system, in order for consutlant under the Proect to design the SCADA system in a harmonized manner.

EMC will control all of power generation plants, substations and batteries for optimizing energy efficiency of the entire network of South Andaman. Connecting to EMC is critical for the equipment under the Project to be able to function effectively and appropriately. Therefore, EMC should be installed before the installation of SCADA under the Project. ED agreed to it.

The interconnecting works of SCADA should consider the compatibility with the entire system of EMC, as an upper system. ANA agreed that the Indian side should be responsible for the works to interconnect EMC and SCADA.

16.2. Customs Duties, Internal Taxes and Other Fiscal Levies

As described in Annex 5, the JICA Mission explained to the ANA that it is necessary to ensure that customs duties, internal taxes and other fiscal levies which may be imposed in India with respect to the purchase of the products and/or the services be exempted or be borne by its designated authority without using the Grant. The JICA Mission requested that the ANA side will confirm the detailed procedure to exempt/refund the duties and taxes including GST (The Goods and Service Tax act, 2017). ANA agreed to provide to JICA India Office with the detailed procedure in writing, before signing of Grant Agreement.

16.3. Necessary permit to stay in Andaman & Nicobar Islands for Consultants and Contractors

In order to secure smooth implementation of the Project, the JICA Mission explained that the sufficient length of stay of consultants and contractors in Andaman & Nicobar Islands is necessary. On the other hand, current regulation allows foreigner to stay at the Andaman & Nicobar Islands up to 2 weeks. JICA mission provided the staff assignment schedule (Annex 7). The JICA Mission requested the ANA side to coordinate with relevant authorities to make necessary arrangement to ensure issuing the permit for the implementation of the Project, based on the staff assignment schedule. The ANA side agreed to it.

16.4. Necessary Project Management by ED

For an efficient implementation of the Project, the JICA Mission requested the ANA side that ED manage technical matters in the course of the Project implementation, such as RoW, signing authorities of official letter or minutes related to the meetings with consultants and contractors. The ANA side agreed to it.

16.5. Disclosure of Information

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

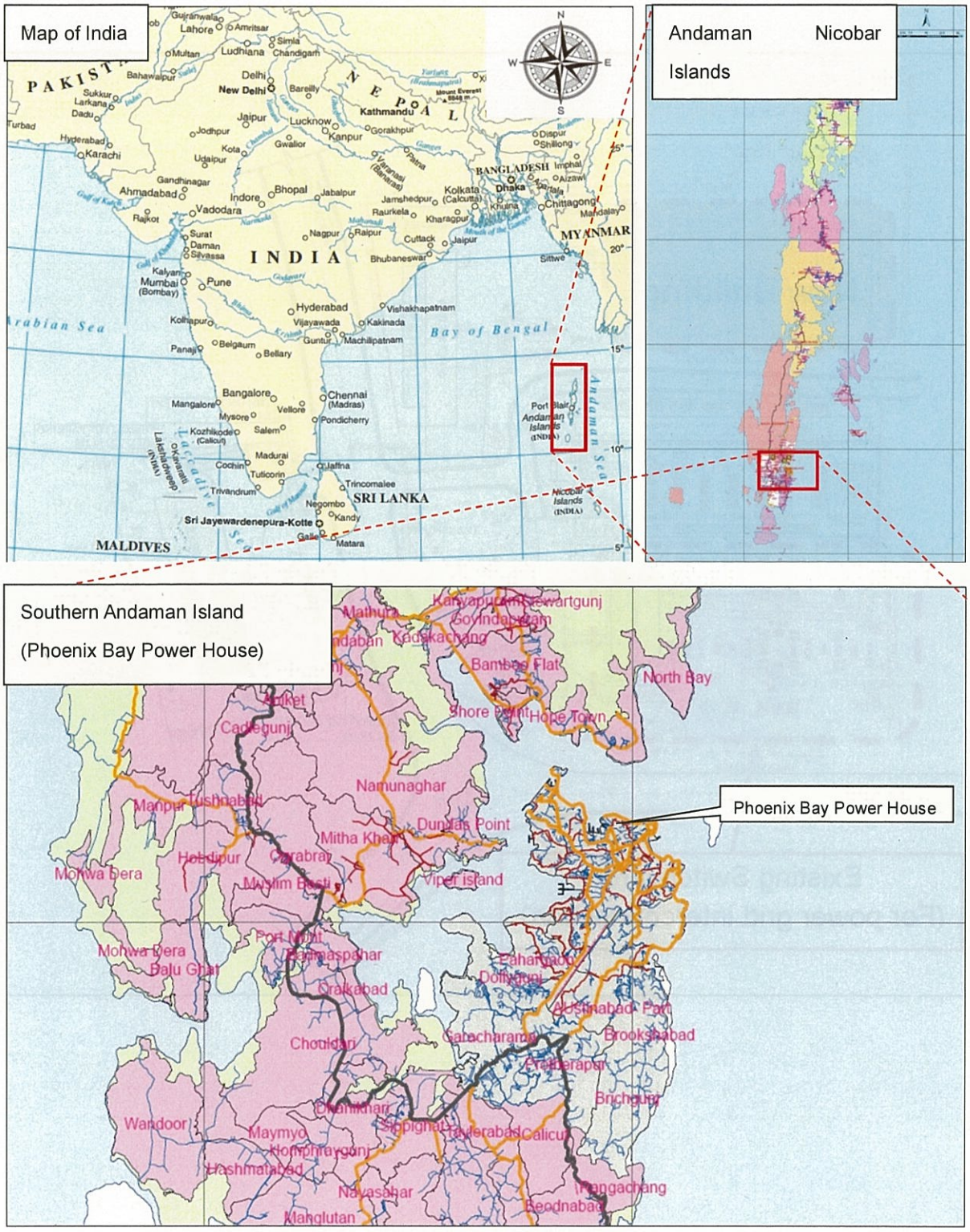
End.

Annex

Annex 1 Project Site
Annex 2 Organization Chart
Annex 3 Japanese Grant
Annex 4 Project Implementation Schedule
Annex 5 Major Undertakings to be taken by the Government of India
Annex 6 Project Monitoring Report (template)
Annex 7 Staff Assignment Schedule

Annex 1-1

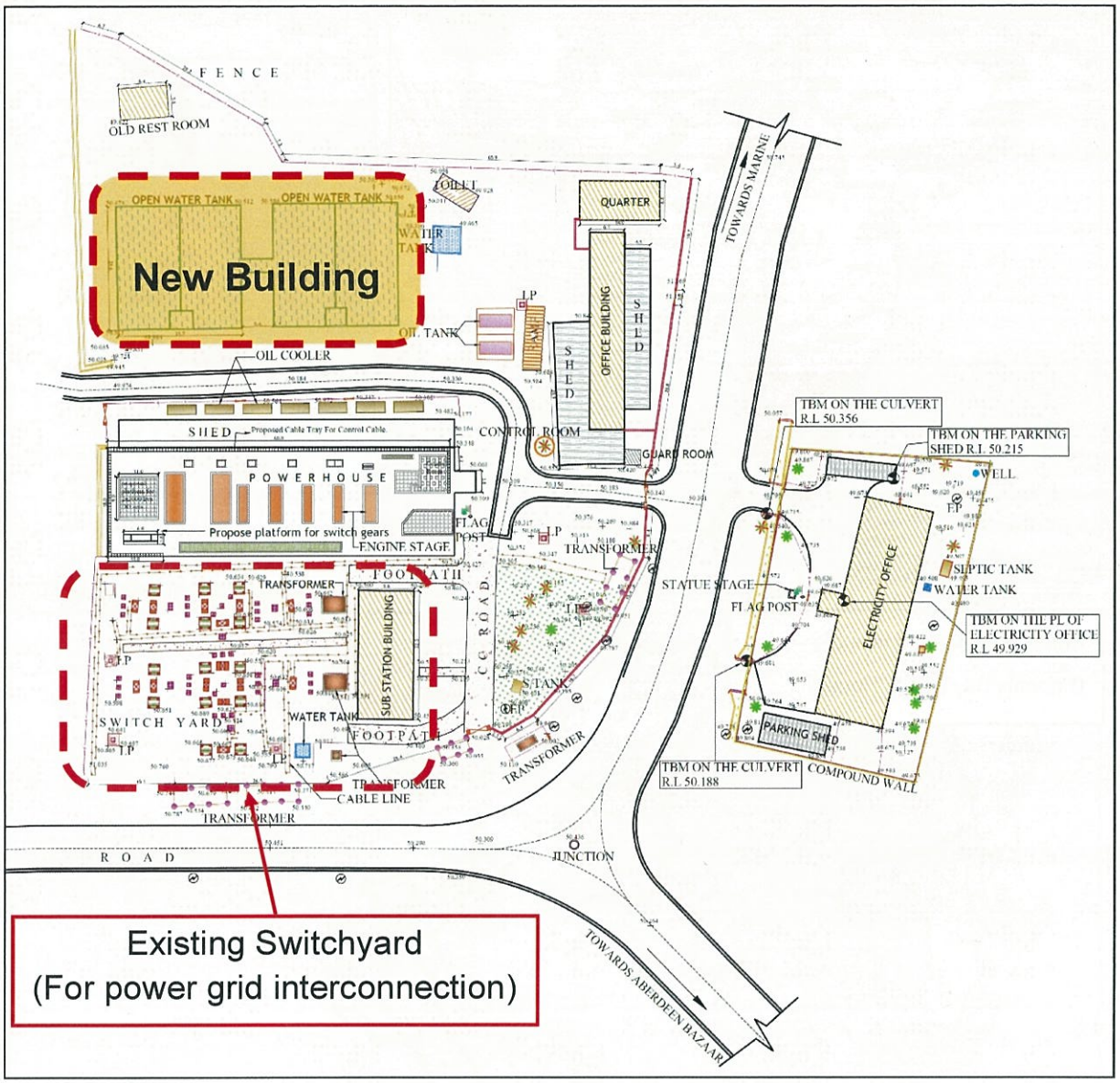
Project Site



Annex 1-2

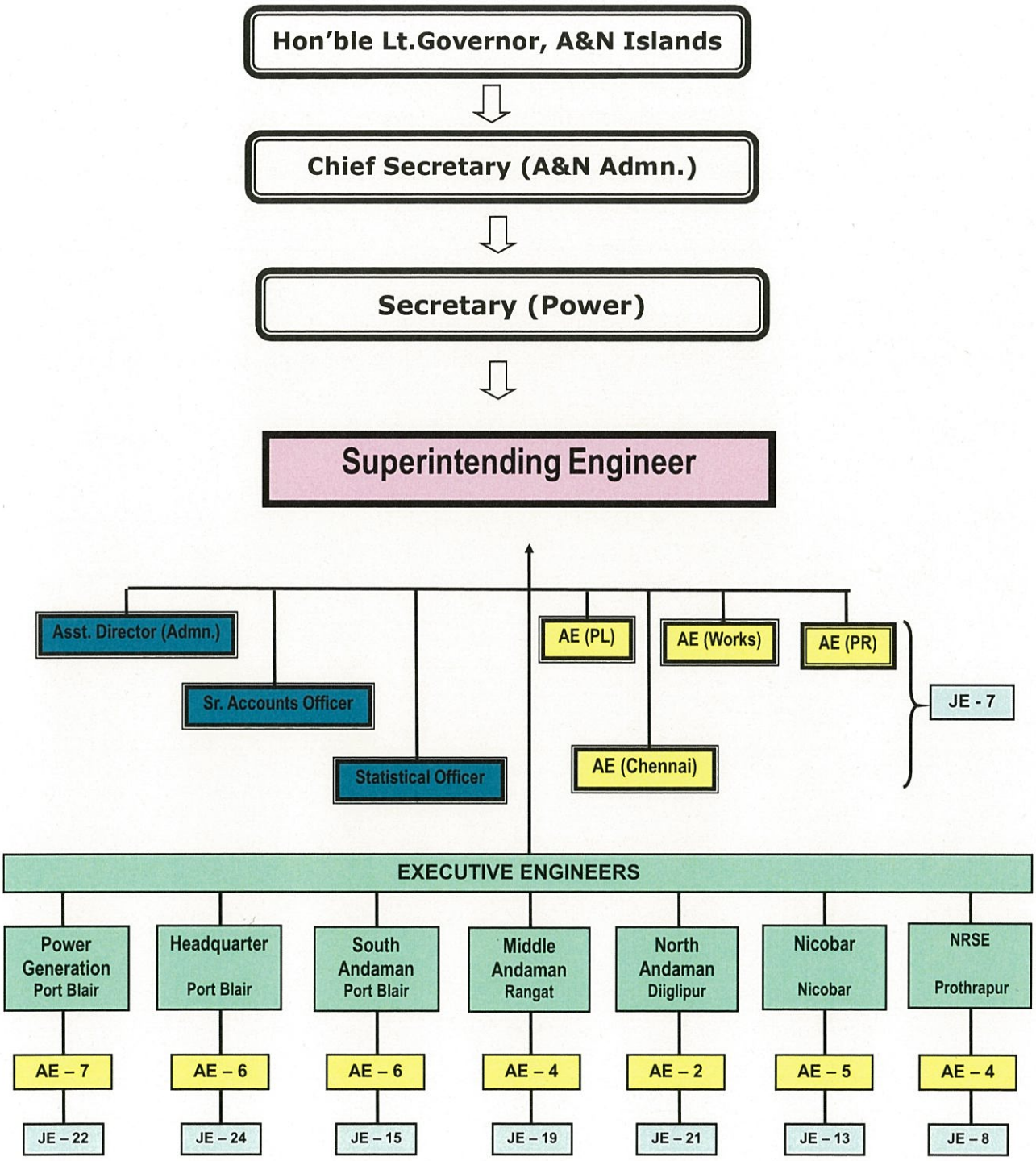
Project Site

(Specific location inside Phoenix Bay Power House)



Annex 2

Structure of A&NA



Annex 3

JAPANESE GRANT

The Japanese Grant is non-reimbursable fund provided to a recipient country (hereinafter referred to as "the Recipient") to purchase the products and/or services (engineering services and transportation of the products, etc.) for its economic and social development in accordance with the relevant laws and regulations of Japan. Followings are the basic features of the project grants operated by JICA (hereinafter referred to as "Project Grants").

1. Procedures of Project Grants

Project Grants are conducted through following procedures (See "PROCEDURES OF JAPANESE GRANT" for details):

(1) Preparation

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

(2) Appraisal

-Appraisal by the government of Japan (hereinafter referred to as "GOJ") and JICA, and Approval by the Japanese Cabinet

(3) Implementation

Exchange of Notes

-The Notes exchanged between the GOJ and the government of the Recipient

Grant Agreement (hereinafter referred to as "the G/A")

-Agreement concluded between JICA and the Recipient

Banking Arrangement (hereinafter referred to as "the B/A")

-Opening of bank account by the Recipient in a bank in Japan (hereinafter referred to as "the Bank") to receive the grant

Construction works/procurement

-Implementation of the project (hereinafter referred to as "the Project") on the basis of the G/A

(4) Ex-post Monitoring and Evaluation

-Monitoring and evaluation at post-implementation stage

2. Preparatory Survey

(1) Contents of the Survey

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

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of relevant agencies of the Recipient necessary for the implementation of the Project.

- Evaluation of the feasibility of the Project to be implemented under the Japanese Grant from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of an outline design of the Project.
- Estimation of costs of the Project.
- Confirmation of Environmental and Social Considerations

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

JICA requests the Recipient to take measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the executing agency of the Project. Therefore, the contents of the Project are confirmed by all relevant organizations of the Recipient based on the Minutes of Discussions.

(2) Selection of Consultants

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

(3) Result of the Survey

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

3. Basic Principles of Project Grants

(1) Implementation Stage

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 to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Recipient to define the necessary articles, in accordance with the E/N, to implement the Project, such as conditions of disbursement, responsibilities of the Recipient, and procurement conditions. The terms and conditions generally applicable to the Japanese Grant are stipulated in the "General Terms and Conditions for Japanese Grant (January 2016)."

2) Banking Arrangements (B/A) (See "Financial Flow of Japanese Grant (A/P Type)" for details)

a) The Recipient shall open an account or shall cause its designated authority to open an account under the name of

the Recipient in the Bank, in principle. JICA will disburse the Japanese Grant in Japanese yen for the Recipient to cover the obligations incurred by the Recipient under the verified contracts.

b) The Japanese Grant will be disbursed when payment requests are submitted by the Bank to JICA under an Authorization to Pay (A/P) issued by the Recipient.

3) Procurement Procedure

The products and/or services necessary for the implementation of the Project shall be procured in accordance with JICA's procurement guidelines as stipulated in the G/A.

4) Selection of Consultants

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

5) Eligible source country

In using the Japanese Grant disbursed by JICA for the purchase of products and/or services, the eligible source countries of such products and/or services shall be Japan and/or the Recipient. The Japanese Grant may be used for the purchase of the products and/or services of a third country as eligible, if necessary, taking into account the quality, competitiveness and economic rationality of products and/or services necessary for achieving the objective of the Project. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm, which enter into contracts with the Recipient, are limited to "Japanese nationals", in principle.

6) Contracts and Concurrence by JICA

The Recipient will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be concurred by JICA in order to be verified as eligible for using the Japanese Grant.

7) Monitoring

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

8) Safety Measures

The Recipient must ensure that the safety is highly observed during the implementation of the Project.

9) Construction Quality Control Meeting

Construction Quality Control Meeting (hereinafter referred to as the "Meeting") will be held for quality assurance and smooth implementation of the Works at each stage of the Works. The member of the Meeting will be composed by the Recipient (or executing agency), the Consultant, the Contractor and JICA. The functions of the Meeting are as followings:

a) Sharing information on the objective, concept and conditions of design from the Contractor, before start of

construction.

b) Discussing the issues affecting the Works such as modification of the design, test, inspection, safety control and the Client's obligation, during of construction.

(2) Ex-post Monitoring and Evaluation Stage

1) After the project completion, JICA will continue to keep in close contact with the Recipient in order to monitor that the outputs of the Project is used and maintained properly to attain its expected outcomes.

2) In principle, JICA will conduct ex-post evaluation of the Project after three years from the completion. It is required for the Recipient to furnish any necessary information as JICA may reasonably request.

(3) Others

1) Environmental and Social Considerations

The Recipient shall carefully consider environmental and social impacts by the Project and must comply with the environmental regulations of the Recipient and JICA Guidelines for Environmental and Social Considerations (April, 2010).

2) Major undertakings to be taken by the Government of the Recipient

For the smooth and proper implementation of the Project, the Recipient is required to undertake necessary measures including land acquisition, and bear an advising commission of the A/P and payment commissions paid to the Bank as agreed with the GOJ and/or JICA. The Government of the Recipient shall ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the Recipient with respect to the purchase of the Products and/or the Services be exempted or be borne by its designated authority without using the Grant and its accrued interest, since the grant fund comes from the Japanese taxpayers.

3) Proper Use

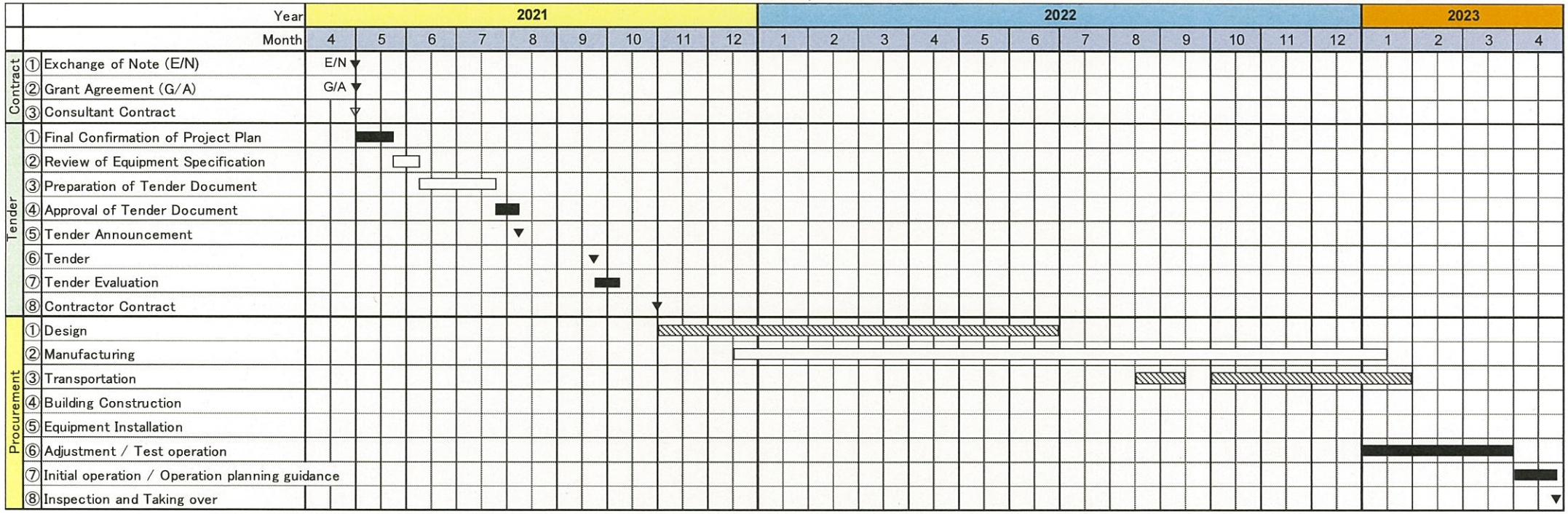
The Recipient is required to maintain and use properly and effectively the products and/or services under the Project (including the facilities constructed and the equipment purchased), to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Japanese Grant.

4) Export and Re-export

The products purchased under the Japanese Grant should not be exported or re-exported from the Recipient.

Annex 4

Expected timeline for the project implementation



Annex 5

Major Undertakings to be taken by the Government of India

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

(1) Before the Tender

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To open Bank Account (Banking Arrangement (B/A))	within 1 month after the signing of the G/A	ANA		
2	To issue A/P to a bank in Japan (the Agent Bank) for the payment to the consultant	within 1 month after the signing of the contract(s)	ANA		
3	To approve IEE or EIA (Not necessary)	within 1 month after the signing of the G/A			
4	To secure and clear the following lands 1) project site for building for the purpose of installing batteries, power system stabilizer and SCADA	before notice of the bidding document(s)	ED	USD 6,200	
5	To obtain the planning, zoning, building permit (If necessary)	before notice of the bidding document(s)	ED		
6	Earth filling, elevation raising, and preparing retaining wall for the sites of power house building and other facilities necessary for the Project	before notice of the bidding document(s)	ED		
7	To submit Project Monitoring Report (with the result of Detail Design)	before preparation of bidding document(s)	ED		

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

(2) During the Project Implementation

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To issue A/P to a bank in Japan (the Agent Bank) for the payment to the Supplier(s)	within 1 month after the signing of the contract(s)	ANA		
2	To bear the following commissions to a bank in Japan for the bankin g servicesbased upon the B/A				
	1) Advising commission of A/P	within 1 month after the signing of the contract(s)	ANA	6,000 JPY/each issue	
	2) Payment commission for A/P	every payment	ANA	This is closed due to the confidentiality.	
3	To ensure prompt unloading and customs clearance at ports of disembarkation in the country of the Recipient and to assist the Supplier(s) with internal transportation therein	during the Project	ED		
4	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project	during the Project	ANA, ED		
5	1) To submit Project Monitoring Report after each work under the contract(s) such as shipping, hand over, installation and operational training	Within one month after completion of Each work	ED		
	2) To submit Project Monitoring Report (final)	within one month after signing of Certificate of Completion for the works under the contract(s)	ED		
6	To submit a report concerning completion of the Project	within six months after completion of the Project	ED		
7	To accord Japanese physical persons and/or physical persons of third countries whose services may be required in connection with the supply of the products and the services such fa dilities as may be necessary for their entry into the country of the Recipient and stay therein for the performance of their work	before the tender	Secretary (Power), ANA		
8	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the country of the Recipient with respect to the purchase of the products and/or the services be exempted or be borne by its designated authority without using the Grant.	before the tender	Secretary (Power), ANA		
9	To provide facilities for distribution of electricity, water supply and drainage and other incidental fac ilities necessary for the implementation of the Project outside the site(s)		ED		
	1) Electricity The distributing line to the site	before start of the construction			
	2) Water Supply The city water distribution main to the site	before start of the construction			
	3) Drainage The city drainage main (for storm, sewer and others) to the site	before start of the construction			
	4) Furniture and Equipment General furniture	1 month before completion of the construction			
10	To take necessary measure for safety construction- - rope off - necessary power shutdown for the work	during the construction	ED		

(3) After the Project

NO	Items	Deadline	In charge	Estimated Cost	Ref.
1	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid 1) Operation and maintenance of the Procured Facilities (Maintenance of equipment)	After completion of the construction	ED	17,751,000 INR /year	
	2) Operation and maintenance of the Procured Facilities (Cost for human resources)	After completion of the construction	ED	6,480,000 INR /year	
	3) Operation and maintenance of the building	After completion of the construction	ED	1,200,000 INR /year	

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

NO	Items	Deadline	Amount (Million Japanese Yen)*
1	Installation of Battery Energy Storage System 1) Installation of Energy Storage System 2) Related equipment 3) Construction of building	April 2023 (Expected project completion)	This is closed due to the confidentiality.
2	Detailed design, bidding support and procurement supervision (Consulting Service)		
4	Contingencies		
	Total		

*The Amount is provisional. This is subject to the approval of the Government of Japan.

Project Monitoring Report
on
Project Name
Grant Agreement No. XXXXXXX

20XX, Month

Organizational Information

Signer of the G/A (Recipient)	Person in Charge (Designation) Contacts Address: Phone/FAX: Email:
Executing Agency	Person in Charge (Designation) Contacts Address: Phone/FAX: Email:
Line Ministry	Person in Charge (Designation) Contacts Address: Phone/FAX: Email:

General Information:

Project Title	
E/N	Signed date: Duration:
G/A	Signed date: Duration:
Source of Finance	Government of Japan: Not exceeding JPY _____ mil. Government of (_____): _____

1: Project Description

1-1 Project Objective

1-2 Project Rationale

- Higher-level objectives to which the project contributes (national/regional/sectoral policies and strategies)
- Situation of the target groups to which the project addresses

1-3 Indicators for measurement of "Effectiveness"

Quantitative indicators to measure the attainment of project objectives		
Indicators	Original (Yr)	Target (Yr)
Qualitative indicators to measure the attainment of project objectives		

2: Details of the Project

2-1 Location

Components	**Original** *(proposed in the outline design)*	**Actual**
1.		

2-2 Scope of the work

Components	**Original*** *(proposed in the outline design)*	**Actual***
1.		

Reasons for modification of scope (if any).

(PMR)

2-3 Implementation Schedule

Items	Original		Actual
	(proposed in the outline design)	*(at the time of signing the Grant Agreement)*	

Reasons for any changes of the schedule, and their effects on the project (if any)

2-4 Obligations by the Recipient

2-4-1 Progress of Specific Obligations

See Attachment 2.

2-4-2 Activities

See Attachment 3.

2-4-3 Report on RD

See Attachment 11.

2-5 Project Cost

2-5-1 Cost borne by the Grant(Confidential until the Bidding)

Components			Cost (Million Yen)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			
Total				

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

2-5-2 Cost borne by the Recipient

Components			Cost (1,000 Taka)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			

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

Reasons for the remarkable gaps between the original and actual cost, and the countermeasures (if any)

(PMR)

2-6 Executing Agency

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

Original *(at the time of outline design)* name: role: financial situation: institutional and organizational arrangement (organogram): human resources (number and ability of staff):
Actual *(PMR)*

2-7 Environmental and Social Impacts

- The results of environmental monitoring based on Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- The results of social monitoring based on in Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- Disclosed information related to results of environmental and social monitoring to local stakeholders (whenever applicable).

3: Operation and Maintenance (O&M)

3-1 Physical Arrangement

- Plan for O&M (number and skills of the staff in the responsible division or section, availability of manuals and guidelines, availability of spareparts, etc.)

Original *(at the time of outline design)*
Actual *(PMR)*

3-2 Budgetary Arrangement

- Required O&M cost and actual budget allocation for O&M

Original *(at the time of outline design)*

Actual *(PMR)*

4: Potential Risks and Mitigation Measures

- Potential risks which may affect the project implementation, attainment of objectives, sustainability
- Mitigation measures corresponding to the potential risks

Assessment of Potential Risks *(at the time of outline design)*

Potential Risks	**Assessment**
1. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
2. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
3. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:

	Contingency Plan (if applicable):

Actual Situation and Countermeasures
(PMR)

5: Evaluation and Monitoring Plan (after the work completion)

5-1 Overall evaluation

Please describe your overall evaluation on the project.

5-2 Lessons Learnt and Recommendations

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

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

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

Attachment

1. Project Location Map
2. Specific obligations of the Recipient which will not be funded with the Grant
3. Monthly Report submitted by the Consultant

Appendix - Photocopy of Contractor's Progress Report (if any)
- Consultant Member List
- Contractor's Main Staff List

4. Check list for the Contract (including Record of Amendment of the Contract/ Agreement and Schedule of Payment)
5. Environmental Monitoring Form / Social Monitoring Form
6. Monitoring sheet on price of specified materials (Quarterly)
7. Report on Proportion of Procurement (Recipient Country, Japan and Third Countries) (PMR (final)only)
8. Pictures (by JPEG style by CD-R) (PMR (final)only)
9. Equipment List (PMR (final)only)
10. Drawing (PMR (final)only)
11. Report on RD (After project)

Attachment 6

Monitoring sheet on price of specified materials

1. Initial Conditions (Confirmed)

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

2. Monitoring of the Unit Price of Specified Materials

(1) Method of Monitoring : ●●

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

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

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

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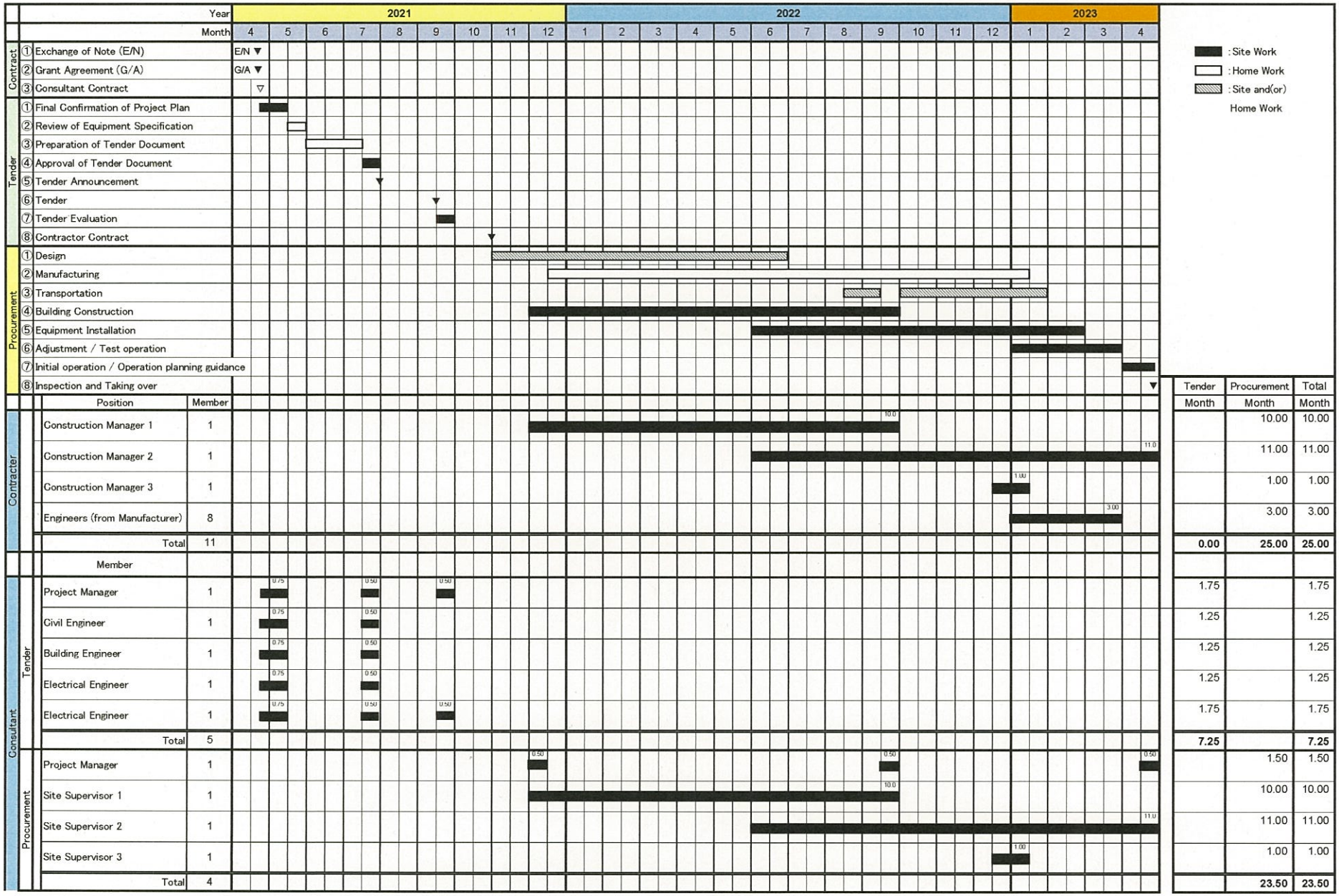
Attachment 7

Report on Proportion of Procurement (Recipient Country, Japan and Third Countries)
(Actual Expenditure by Construction and Equipment each)

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

Annex 7

Staff Assignment Schedule



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Attachment-5

Other Relevant Data

Attachment-5-1. Calculation Process of Annual Discharge of Surplus Solar PV Energy

2026 Storage battery discharge power stored from solar PV power surplus generation

Calculation method and assumptions

1 Calculation method

1) Target year for calculation is 2026 (One year)
2) Establish a peak demand forecast for the South Andaman system in 2026. Att-1
3) From above annual peak demand, setting half-year peaks for the dry and rainy season separately. Att-1
4) Applying the above peak demand to the peak value of the typical daily load curve in the rainy season and dry seasons, proportionate the demand value for each time zone and determine the daily load curve for the dry and rainy seasons. The daily load curve consists of 24 hourly average data. Att-2
5) Prepare the solar irradiation data for the Andaman region as follows.
   - hourly 25 degree inclined irradiation (kW/m2) data of 24 hours
   - the above solar irradiation is the average value of each month from January to December.
6) From above solar radiation data, the average hourly power generation (MW), generated by the solar photovoltaic (PV) power generation facility connected to the South Andaman system is calculated, and 12 monthly PV daily power generation curves (as an average value including fine, cloudy, and rainy days) can be created (for 1 year, 12 months).
7) The minimum operating output of the engine generator during the peak hours of solar PV power generation is determined by the rainy season and the dry season.
8) The following calculation is performed on the base of each hour of each month, and the part where the result is positive is the surplus power.
   (PV generation output + minimum operating output of engine generator)-(Demand)
9) The hourly surplus power (MWh) calculated above for a day is accumulated to calculate the daily surplus power (MWh/day).
10) Multiply the above data by the number of days in the corresponding month (for example, 30 times in the case of the 30th month) to calculate the surplus electric energy
11) The above calculated surplus electric energy for each month is accumulated to calculate the surplus electric energy (MWh/year) for 2026.
12) Assuming that the surplus electric energy is charged and discharged from the storage battery, the annual surplus electric energy is multiplied by the charge/discharge efficiency to calculate the annual discharge electric energy (MWh/year).

2 Assumptions

1) Year 2026, PV power generation facility connected to the South Andaman system
   Solar PV module out put capacity : 55 MW
   Breakdowns: From below planned and existing PV installations
   Mega solar 50MW and Roof top 5MW

(Existing and Planned)

Mega Solar	MW	(Status as of March 2021)
Gharacharma PV plant	5	In operation
Attam Pahad and Dollygunj PV plant	20	Operation (not confirmed)
Chidiyatapu PV plant	8	Planned
Manglutan PV plant	17	Planned
Sub-total	50	

Roof top PV systems	
In operation	4
Planned	5
Sub-total	9

2) Minimum output of engine generator during peak hours of PV power generation is assumed that the engine is operated at an output of 20% or more of the predicted demand of the South Andaman system.
   It is a multiple of 8 MW/unit of LNG engine generator (each 80% output of 10MW/unit).
   Rainy season: Demand Forecast 43.26 MW @ 12:00 noon
   => Engine generator output : 16 MW
   Dry season: Demand Forecast 38.15 MW @ 12:00 noon
   => Engine generator output : 8 MW

3) Function of storage battery of PV power plant
   Storage batteries are mandated to be installed at mega solar power plants those connected to the South Andaman system.

   If daily surplus power of PV power generation exceeds 14 MWh in the South Andaman system, the excess power shall be absorbed by the storage battery of the PV power plant.

2026 Storage battery discharge power stored from solar PV power surplus generation

Annual discharge power calculation result: **2,971 MWh/year**

Total output of solar PV connected to the South Andaman system: 55 MW

Basic deign factor : 83.5%

Array correction factor : 96.6% correction factor : 91.0% PCS efficiency : 95.0%

PV generation surplus power : The accumulated total value of photovoltaic power generation and the output of the engine generator that exceeding the system load

Engine generator output: 16 MW(Rainy) 8 MW(Dry)

(LNG and diesel engine generators operating on minimum to maintain the grid synchronization during PV power generation)

	Inclined (25 degree) irradiation (kW/m2)*1) : 24 hours a day of each month average value for each time zone												PV generation power (MW) : Average power generation for each time zone (1 hour) of each month												Predicted daily load fluctuations for 2026(MW)*2)		PV generation surplus power (MWh) : Average amount of surplus PV power generation of each time zone (hourly) of each month of South Andaman system											
Time zone	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Rainy (May to Oct)	Dry (Nov to Apr)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0 - 1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.40	31.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 - 2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.57	29.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2 - 3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	31.14	28.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 - 4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	31.14	28.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 - 5	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30.19	29.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 - 6	0.0000	0.0000	0.0179	0.0297	0.0401	0.0399	0.0319	0.0247	0.0449	0.0548	0.0987	0.0110	0.00	0.00	0.82	1.37	1.84	1.83	1.47	1.13	2.06	2.52	4.53	0.51	30.76	29.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 - 7	0.2189	0.1980	0.1942	0.2003	0.1582	0.1326	0.1183	0.1297	0.1632	0.1799	0.2383	0.2438	10.05	9.09	8.92	9.20	7.27	6.09	5.44	5.96	7.50	8.26	10.95	11.20	31.23	31.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7 - 8	0.4202	0.4311	0.4151	0.4003	0.3152	0.2414	0.2360	0.2579	0.2844	0.3647	0.3953	0.4096	19.30	19.80	19.07	18.39	14.48	11.09	10.84	11.84	13.06	16.75	18.16	18.81	33.31	32.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8 - 9	0.6399	0.6269	0.6367	0.5775	0.4153	0.3336	0.3620	0.3600	0.4463	0.5105	0.5430	0.5907	29.39	28.79	29.24	26.52	19.08	15.32	16.63	16.53	20.50	23.45	24.94	27.13	32.79	32.10	5.29	4.70	5.15	2.43	2.29	0.00	0.00	0.00	3.71	6.66	0.84	3.04
9 - 10	0.8406	0.8054	0.8441	0.6991	0.5126	0.4299	0.4370	0.4532	0.5351	0.7035	0.6716	0.7370	38.61	36.99	38.77	32.11	23.55	19.75	20.07	20.81	24.58	32.31	30.85	33.85	36.08	33.13	13.48	11.86	13.64	6.97	3.47	0.00	0.00	0.74	4.50	12.24	5.71	8.72
10 - 11	0.9396	0.9311	0.9354	0.8303	0.5705	0.5007	0.5145	0.5065	0.6046	0.7016	0.7496	0.8549	43.16	42.77	42.96	38.14	26.20	23.00	23.63	23.26	27.77	32.22	34.43	39.27	40.66	38.07	13.09	12.70	12.90	8.07	1.54	0.00	0.00	0.00	3.11	7.56	4.36	9.20
11 - 12	0.9385	0.9983	0.9267	0.8174	0.5790	0.5218	0.5229	0.5225	0.6061	0.7054	0.7488	0.8715	43.11	45.85	42.57	37.54	26.59	23.97	24.02	24.00	27.84	32.40	34.39	40.03	43.26	38.15	12.95	15.70	12.41	7.39	0.00	0.00	0.00	0.00	0.58	5.14	4.24	9.88
12 - 13	0.9309	0.9802	0.8953	0.7955	0.5691	0.5067	0.5068	0.5439	0.6001	0.6721	0.6943	0.8160	42.75	45.02	41.12	36.54	26.14	23.27	23.28	24.98	27.56	30.87	31.89	37.48	42.65	33.35	17.40	19.67	15.77	11.19	0.00	0.00	0.00	0.00	0.91	4.22	6.54	12.13
13 - 14	0.7914	0.8639	0.8376	0.7020	0.4768	0.4062	0.4334	0.4804	0.4997	0.5841	0.6180	0.7009	36.35	39.68	38.47	32.24	21.90	18.66	19.91	22.06	22.95	26.83	28.38	32.19	39.15	34.13	10.22	13.55	12.34	6.11	0.00	0.00	0.00	0.00	0.00	3.68	2.26	6.06
14 - 15	0.6206	0.7169	0.6457	0.5440	0.3909	0.3170	0.3468	0.3731	0.3869	0.4280	0.5040	0.5832	28.51	32.93	29.66	24.99	17.95	14.56	15.93	17.14	17.77	19.66	23.15	26.79	37.63	36.21	0.30	4.72	1.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15 - 16	0.4252	0.4957	0.4207	0.3502	0.2626	0.2125	0.2182	0.2436	0.2509	0.2905	0.3302	0.4029	19.53	22.77	19.32	16.08	12.06	9.76	10.02	11.19	11.52	13.34	15.16	18.51	37.94	34.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16 - 17	0.2170	0.2460	0.2027	0.1487	0.0955	0.0950	0.0994	0.1108	0.1051	0.0994	0.1228	0.1735	9.97	11.30	9.31	6.83	4.39	4.36	4.57	5.09	4.83	4.56	5.64	7.97	36.42	34.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17 - 18	0.0000	0.0000	0.0000	0.0000	0.0077	0.0144	0.0151	0.0115	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.35	0.66	0.69	0.53	0.00	0.00	0.00	0.00	39.10	37.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18 - 19	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	38.97	43.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19 - 20	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	36.68	42.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20 - 21	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	37.24	41.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21 - 22	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	36.64	39.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22 - 23	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	34.95	36.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23 - 24	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.92	32.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
kWh/day	6.98	7.29	6.97	6.09	4.39	3.75	3.84	4.02	4.53	5.29	5.71	6.40													*2) From Daily Load Curve sheet												

*1) NASA data of 23 years period (1983-2005)from average value of solar irradiation for each time zone of 8760 hours per year, the average value of each time zone of 24 hours a day for each month.

Avg. daily surplus electricity of each month	72.74	82.90	73.67	42.17	7.30	0.00	0.00	0.74	12.81	39.51	23.96	49.02
Of the above, portion of Japan's ODA proje	14.00	14.00	14.00	14.00	7.30	0.00	0.00	0.74	12.81	14.00	14.00	14.00
Number of days in each month of 2026	31	28	31	30	31	30	31	31	30	31	30	31
Total surplus electricity of each month (MW	434.00	392.00	434.00	420.00	226.35	0.00	0.00	22.86	384.41	434.00	420.00	434.00

Annual surplus electricity (MWh/year)	3,601.62
Charge/discharge coefficient	82.5%
Annual discharge power (MWh/year)	2,971.3

Attachment -1: Peak demand forecast of South Andaman system in 2026

1 Peak demand forecast target year : 2026 Year

Assumed that the project completion is in March 2023.

The project evaluation will be after three years, and the peak demand forecast target year will be 2026.

2 Forecasting method: Calculating the annual average growth rate from the past annual peak demand value, and predicting the peak demand from this annual average growth rate.

As a result of conformation with the ANA Electricity Department (ED), found that the an officially approved demand forecast for the South Andaman system does not exists.

The past annual peak demand values obtained from ED are as follows.

Annual Peak Demand of South Andaman Grid (MW)

Year			2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Recorded	Month							June	April	April	October	April	August
	Date							21	29	4	30	23	31
	Time							18:30	20:30	21:30	18:30	1:30	18:30
Recorded Peak Demand (MW)			30.70	33.50	33.30	36.20	38.00	39.12	40.66	38.75	38.90	42.21	37.30

In the above data, the peak demand in 2020 is significantly lower than the previous year. This is thought to be due to the decline in electricity demand due to the impact of the new coronavirus (COVID-19) in the same year. Therefore, the data used for demand forecasting is from 2010 to 2019.

3 Peak demand forecast

Recorded Values

Year			2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Recorded Peak Demand (MW)			30.70	33.50	33.30	36.20	38.00	39.12	40.66	38.75	38.90	42.21
Annual Increase Ratio (%)				9.12	-0.6	8.71	4.97	2.95	3.94	-4.7	0.39	8.51

From the peak demand value in 2010 and 2019, during this 9 years period, the calculated average annual growth rate value is as follows.

Average annual groth rate : 3.60 %/year

Forecasted Peak Demand **Base Year**

Year			2019	2020	2021	2022	2023	2024	2025	2026
Forecasted Peak Demand (MW)			42.21	43.73	45.30	46.93	48.62	50.37	52.19	54.07
Annual Increase Ratio (%)				3.60	3.60	3.60	3.60	3.60	3.60	3.60

Annual peak demand forecast of 2026: 54.07 MW

4 Peak demand forecast of Rainy and Dry seasons

From the annual rainfall data, the Andaman rainy season and dry season are defined as the following periods.

Rainy Season: May to October (6 months)

Dry Season: November to April (6 months)

In the annual peak demand record shown in above 2 items, within 6 years from 2015 to 2020, from the recored peak demand occurrence date and time, since there is no bias between the peak occurrence period of 3 years in the rainy season and 3 years in the dry season, the peak demand in the rainy season and the dry season is assumed to be the same value.

Peak demand forecast for the 6 months of the rainy season in 2026: 54.07 MW

Peak demand forecast for the 6 months of the dry season in 2026: 54.07 MW

Attachment -2: Daily load fluctuations forecast of South Andaman system in 2026

1 Typical daily load fluctuation records of 2020 (Rainy and Dry season)

The typical daily load fluctuation (hourly) data for the rainy season and dry season in 2020 obtained from the ANA Electricity Department (ED) are as follows.

Rainy Season

Month:	September																							
Data:	07.09.2020																							
Time:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Demand (MW)	25.37	25.51	24.4	24.41	23.64	24.09	24.48	26.1	25.7	28.27	31.86	33.89	33.4	30.67	29.48	29.71	28.55	30.64	30.55	28.73	29.18	28.7	27.39	25.8

Dry Season

Month:	February																							
Data:	26.02.2020																							
Time:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Demand (MW)	27.57	26.36	25.29	25.29	25.91	26.45	27.93	28.72	28.44	29.36	33.74	33.84	29.58	30.25	32.11	30.56	30.98	33.66	38.35	37.46	36.79	35.37	32	28.81

2 Proportional daily load fluctuation with maximum load value set as 1 in 2020.

In the above daily load fluctuation data, the proportional value with the maximum load as 1 is as follows.

Rainy Season

Month:	September																							
Data:	07.09.2020											Maximum Load												
Time:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Demand (MW)	25.37	25.51	24.40	24.41	23.64	24.09	24.48	26.10	25.70	28.27	31.86	33.89	33.40	30.67	29.48	29.71	28.55	30.64	30.55	28.73	29.18	28.70	27.39	25.80
Proportional value with ma	0.749	0.753	0.720	0.720	0.698	0.711	0.722	0.770	0.758	0.834	0.940	1.000	0.986	0.905	0.870	0.877	0.842	0.904	0.901	0.848	0.861	0.847	0.808	0.761

Dry Season

Month:	February																							
Data:	26.02.2020																		Maximum Load					
Time:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Demand (MW)	27.57	26.36	25.29	25.29	25.91	26.45	27.93	28.72	28.44	29.36	33.74	33.84	29.58	30.25	32.11	30.56	30.98	33.66	38.35	37.46	36.79	35.37	32.00	28.81
Proportional value with ma	0.719	0.687	0.659	0.659	0.676	0.690	0.728	0.749	0.742	0.766	0.880	0.882	0.771	0.789	0.837	0.797	0.808	0.878	1.000	0.977	0.959	0.922	0.834	0.751

3 Predicted daily load fluctuations for 2026

It is assumed that the shape of the daily negative load fluctuation in the rainy season and the dry season in 2026 is same with the shape of the daily load fluctuation in the rainy and dry season of 2020.

Based on the above assumptions, the following assumptions are made for the proportional value with the maximum daily load fluctuation in 2020 as 1, and used as a typical daily load fluctuation of rainy and dry season in 2026.

Demand value (MW) corresponding to maximum value 1 = 80% of the peak demand forecast for 2026 rainy season and dry season (6 months each) calculated in the previous demand forecast*)

= **54.1 x 80% = 43.26 MW**

*) Daily peak demand changes depending on the weather of the day, and the difference in operating loads in weekdays and holidays.

Therefore, it is necessary to convert the peak demand forecast value of 6 months to the maximum value of the average daily load fluctuation for 6 months, and the conversion coefficient is assumed to be 80%.

The typical daily load fluctuation forecast values for the 2026 rainy and dry season calculated from the above assumptions are shown below

rainy Season **Demand value corresponding to maximum value 1 : 43.26 MW**

Time:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Demand (MW)	32.40	32.57	31.14	31.14	30.19	30.76	31.23	33.31	32.79	36.08	40.66	43.26	42.65	39.15	37.63	37.94	36.42	39.10	38.97	36.68	37.24	36.64	34.95	32.92
Proportional value with ma	0.749	0.753	0.720	0.720	0.698	0.711	0.722	0.770	0.758	0.834	0.940	1.000	0.986	0.905	0.870	0.877	0.842	0.904	0.901	0.848	0.861	0.847	0.808	0.761

Dry Season **Demand value corresponding to maximum value 1 : 43.26 MW**

Time:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Demand (MW)	31.10	29.72	28.51	28.51	29.24	29.85	31.49	32.40	32.10	33.13	38.07	38.15	33.35	34.13	36.21	34.48	34.95	37.98	43.26	42.26	41.48	39.88	36.08	32.49
Proportional value with ma	0.719	0.687	0.659	0.659	0.676	0.690	0.728	0.749	0.742	0.766	0.880	0.882	0.771	0.789	0.837	0.797	0.808	0.878	1.000	0.977	0.959	0.922	0.834	0.751

Attachment-5-2. Calculation Process of Reduction in Greenhouse Gas Emissions

15. Renewable Energy / Hydropower and Others

Project Name

Sample

Country

India

Emission Reduction

		Value	Unit
ER_y	Emission reduction	2,683	tCO_2/year
BE_y	Baseline emission	2,683	tCO_2/year
PE_y	Project emission	0	tCO_2/year

Inputs

1) Electricity generation projects (Grid connected system or standalone or mini-grid system)

*Input only orange cell

Parameter	Description		Value	Unit
-	The project is a development of geothermal power plant		No	
-	The project is a development of hydro power plant and CH_4 emission from reservoirs of hydro power plants is		No	
EG_y	Power generation by the renewable energy system in year y		2,971	MWh/year
EF_{elec}	CO_2 emission factor of the electricity		0.903	tCO_2/MWh
EF_{Res}	Default emission factor for emissions from reservoirs of hydro power plants		0	$kgCO_{2\text{-}eq}$/MWh
$w_{Main,CO2}$	Average mass fraction of carbon dioxide in the produced steam			tCO_2/t
$w_{Main,CH4}$	Average mass fraction of methane in the produced steam			tCH_4/t
GWP_{CH4}	Global warming potential of methane		25	tCO_2/tCH_4
$M_{S,y}$	Quantity of steam produced in year y			t/year
$FC_{i,y}$	Consumption of fossil fuel i at the power plant in year y			t/year
NCV_i	Net calorific value of the fossil fuel i			TJ/t
$EF_{fuel,i}$	CO_2 emission factor of the fossil fuel i			tCO_2/TJ

2) Solar water system

*Input only orange cell

Parameter	Description		Value	Unit
-	The project is installation of solar water systems		No	
$EF_{fuel,i}$	CO_2 emission factor of fossil fuel i which would have used in the baseline			tCO_2/GJ
ε_{BL}	Efficiency of baseline heating system			-
F_y	Amount of hot water supplied by the solar water heating system in year y			m^3
ΔT	Temperature rise of water (or hear carrier) by the solar water heating system			K
C	Specific heat of water (or hear carrier)			GJ/t.K
ρ	Density of water (or heat carrier)			t/m^3

15. Renewable Energy / Hydropower and Others

Project Name

Sample

Country

India

Calculations

			Value	Unit
Emission reduction			2683	tCO_2/year
Baseline emission			2683	tCO_2/year
Baseline emission (Electricity generation projects (Grid connected system or standalone or mini-grid system))			2683	tCO_2/year
	Power generation by the renewable energy system in year y		2971	MWh/year
	CO_2 emission factor of the electricity		0.903	tCO_2/MWh
Baseline emission (Solar water system)			0	tCO_2/year
	CO_2 emission factor of fossil fuel i which would have used in the baseline		0	tCO_2/GJ
	Efficiency of baseline heating system		0	-
	Amount of hot water supplied by the solar water heating system in year y		0	m^3
	Temperature rise of water (or hear carrier) by the solar water heating system		0	K
	Specific heat of water (or hear carrier)		0	GJ/t.K
	Density of water (or heat carrier)		0	t/m^3
Project emission			0	tCO_2/year
	Default emission factor for emissions from reservoirs of hydro power plants		0	$kgCO_2$-eq/MWh
	Average mass fraction of carbon dioxide in the produced steam		0	tCO_2/t
	Average mass fraction of methane in the produced steam		0	tCH_4/t
	Global warming potential of methane		25	tCO_2/tCH_4
	Quantity of steam produced in year y		0	t/year
	Consumption of fossil fuel i at the power plant in year y		0	t/year
	Net calorific value of the fossil fuel i		0	TJ/t
	CO_2 emission factor of the fossil fuel i		0	tCO_2/TJ

別表 4　系統電力の CO_2 排出係数（コンバインド・マージン）

当該国の値を下表より選択（あるいは IGES の最新版の情報参照）。

（t-CO_2/MWh）

Region	Host Party	Combined Margin EF (Average)
Asia	China	0.874
	India	0.903
	Viet Nam	0.564
	Thailand	0.547
	Republic of Korea	0.631
	Indonesia	0.761
	Philippines	0.508
	Malaysia	0.668
	Pakistan	0.543
	Sri Lanka	0.674
	Papua New Guinea	0.679
	DPR Korea	0.912
	Bangladesh	0.6441
	Cambodia	0.665
	Lao PDR	0.560
	Singapore	0.486
	Mongolia	1.061
	Bhutan	0.892
Latin America	Brazil	0.298
	Mexico	0.528
	Chile	0.614
	Peru	0.598
	Argentina	0.518
	Honduras	0.643
	Colombia	0.335
	Uruguay	0.574
	Panama	0.591
	Ecuador	0.576
	Guatemala	0.587
	Dominican Republic	0.654
	Costa Rica	0.274
	Nicaragua	0.679
	El Salvador	0.682
	Bolivia	0.589
	Cuba	0.874

	Jamaica	0.732
	Bahamas	0.723
	Guyana	0.948
	Belize	0.152
Africa/Middle and Near East	South Africa	0.953
	Israel	0.705
	Kenya	0.603
	Morocco	0.652
	Egypt	0.533
	United Arab Emirates	0.676
	Iran	0.692
	Lebanon	0.650
	Cote d'Ivoire	0.649
	Uganda	0.532
	Nigeria	0.573
	Jordan	0.584
	Tunisia	0.554
	Libya	0.794
	Madagascar	0.552
	Mauritius	0.972
	Namibia	0.920
	Senegal	0.681
	Rwanda	0.654
	Ghana	0.479
	Saudi Arabia	0.654
	Sierra Leone	0.402
	Sudan	0.305
	Tanzania	0.529
	Burkina Faso	0.368
	Zambia	0.964
	Mali	0.614
	Mozambique	0.964
Others	Cyprus	0.798
	The former Yugoslav Republic of Macedonia	0.861
	Azerbaijan	0.590
	Serbia	1.099
	Georgia	0.402
	Armenia	0.436
	Fiji	0.567
	Albania	0.393
	Montenegro	0.984
	Bosnia & Herzegovina	0.973

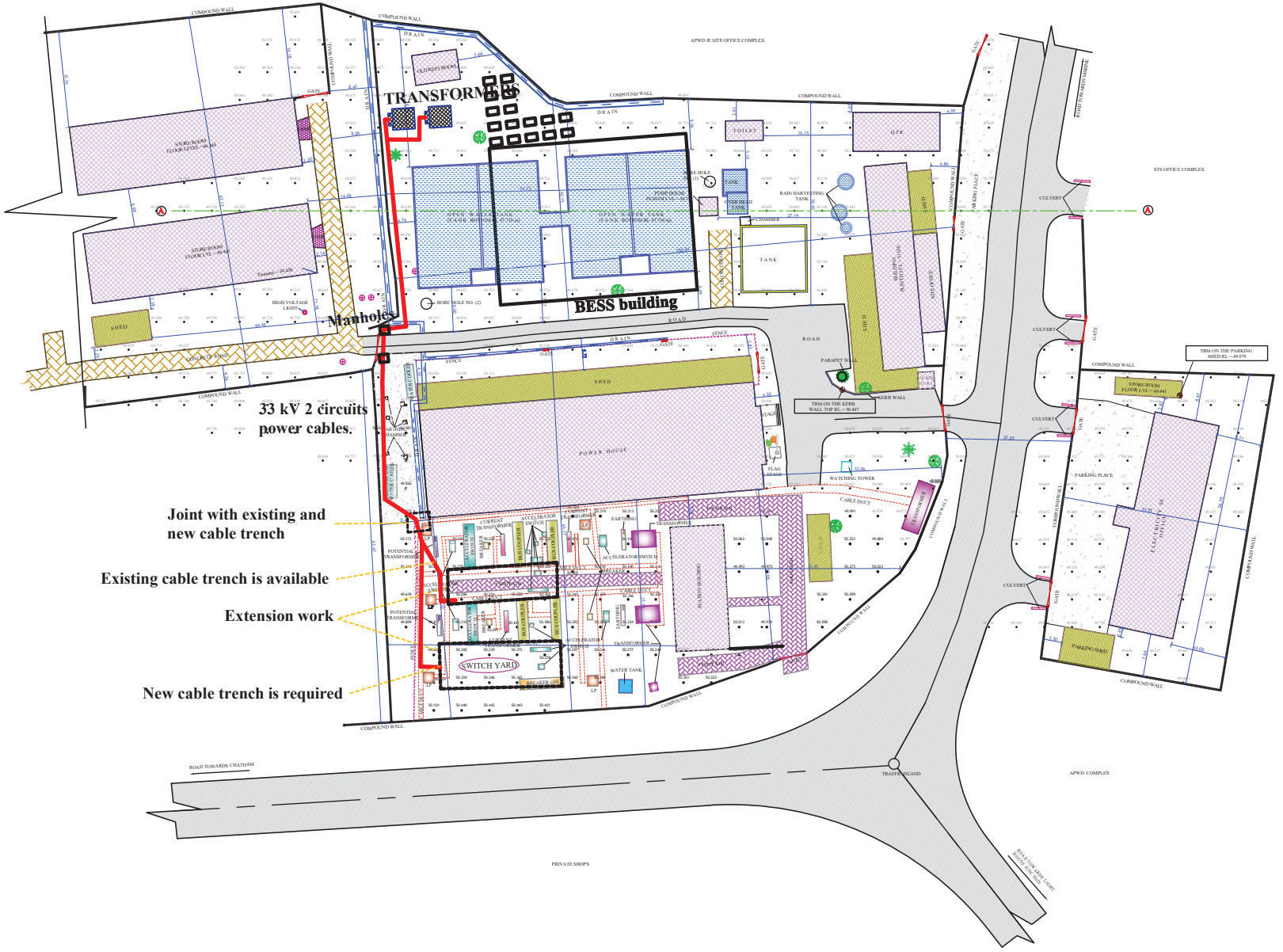
	Uzbekistan	0.593

出典：List of Grid Emission Factor, IGES, version 10.2 (29 May 2018 update)
https://pub.iges.or.jp/pub/iges-list-grid-emission-factors
※南部アフリカ諸国については以下を参照できる。
CDM Standardized baseline, Grid emission factor for the Southern African power pool

Attachment-6

Outline Design Drawing

No.	Dwg. No.	Drawing Title
1	No.1	Project site / Cable route layout plan
2	No.2	33 kV outside switchgear and BESS feeder single line diagram
3	No.3	33 kV outside switchgear layout plan
4	No.4	33 kV outside switchgear sectional plan
5	No.5	SCADA System Architecture (for reference)
6	No.6	SCADA Panel Arrangement (for reference) SCADA Room Layout (for reference)
7	No.7 – No.11	Building Drawings (Site layout, Floor plan, Elevation, Section)



Notes:

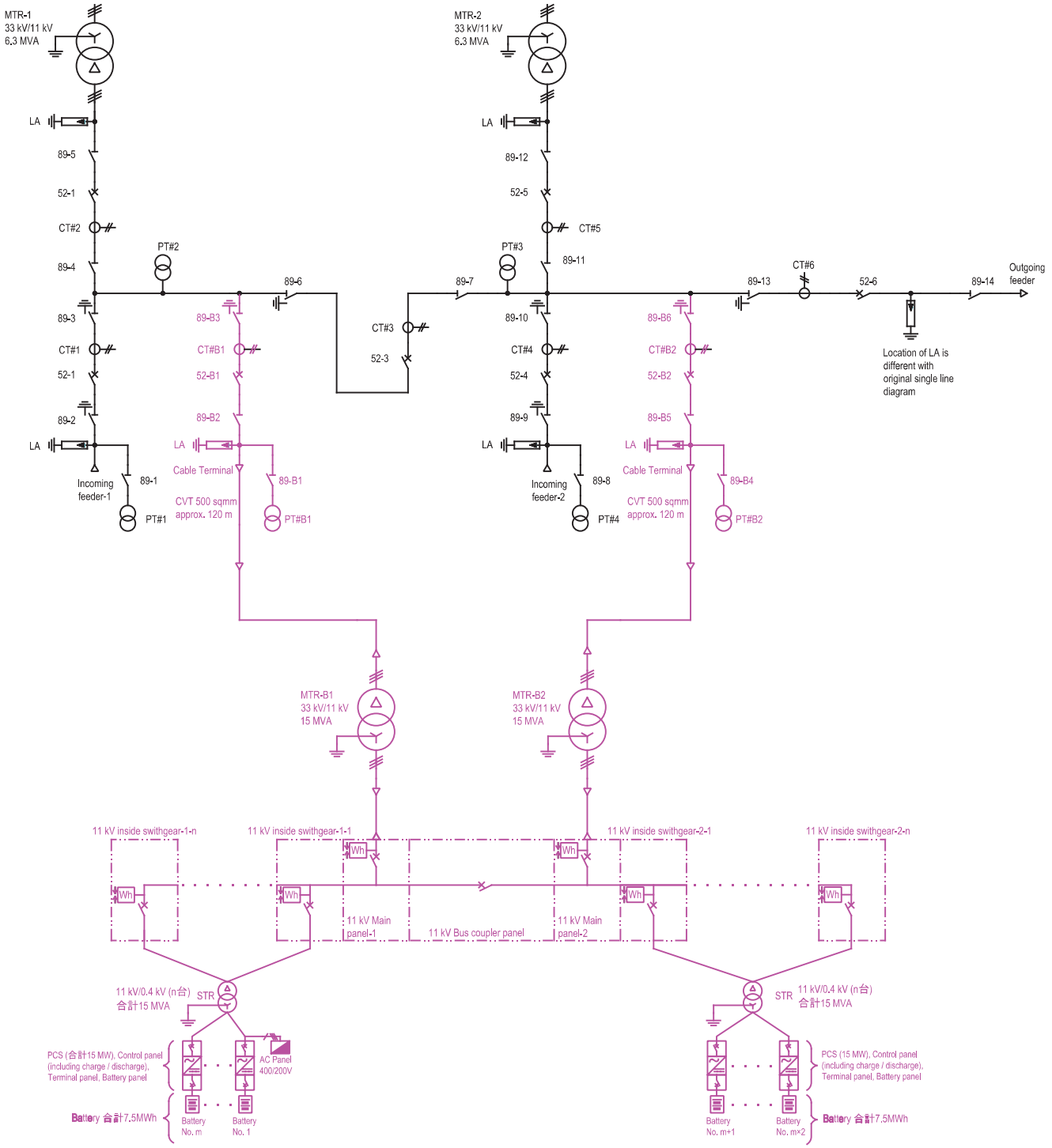
1. All dimensions are in m.
2. TBM 50.0m assumed at Survey Station No.1. All Levels are related.
3. Grid RL @ 5.0m interval is provided.

LEGEND:

- ROAD
- FOOT PATH
- COMPOUND WALL
- WALL
- FENCE
- CULVERT
- GATE
- CONCRETE ROAD
- PARKING
- BUILDING
- SHED
- TRANSFORMER
- WATER TANK
- BUS COUPLER
- ACCELERATOR SWITCH
- POTENTIALTRANSFORMER
- LIGHT POST (LP)
- BREAKER
- CURRENT TRANSFORMER
- EARTHING
- WATER COOLER
- CABLE DUCT
- DRAIN
- RAMP
- WATCHING TOWER
- PARAPET WALL
- KERB WALL
- FLAG STAGE
- ELECTRIC POLE
- STATION POINT
- TBM
- RL AT GRID INTERSECTION
- TREE
- COCONUT TREE
- MANGO TREE
- NEEM TREE

ORIENTATION:

DRAWING NO.	1
REVISION NO.	0 /
CLIENT:	
PROJECT:	Preparatory Survey for the Project for Improvement of Power Supply in Andaman and Nicobar Islands in India
DRAWING TITLE:	Project site /Cable route layout plan
DRAWN BY:	
CHECKED BY: -	
APPROVED BY: -	

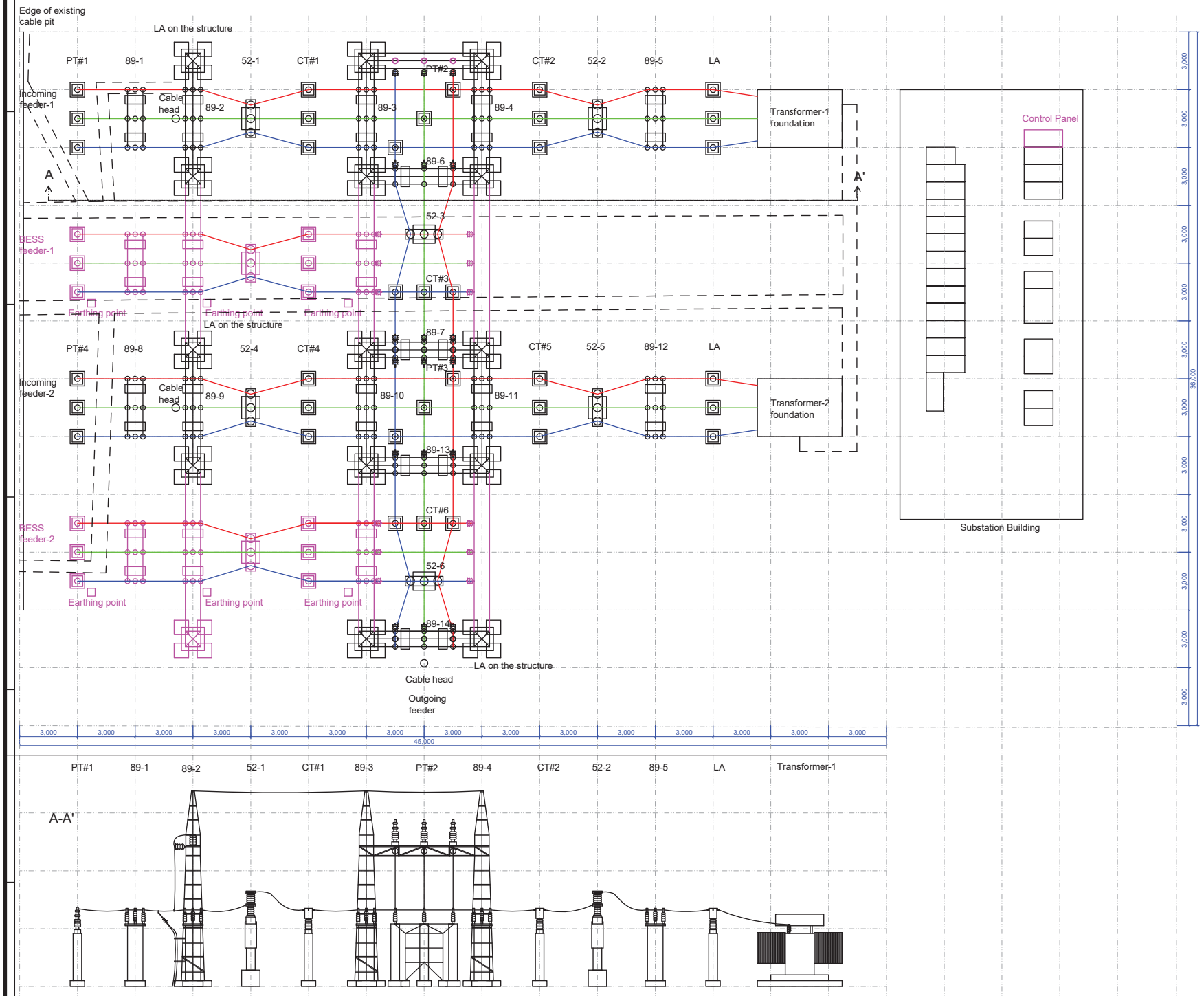


1. Existing equipment

LA: Lighting Arrester
89-1~14: Disconnection Switch
[89-2,3,6,9,10: Disconnection Switch with earthing switch]
52-1~6: Circuit Breaker
CT#1~6: Current Transformer
PT#1~4: Potential Transformer
MTR-1,2: 33 kV/11 kV 6.3 MVA

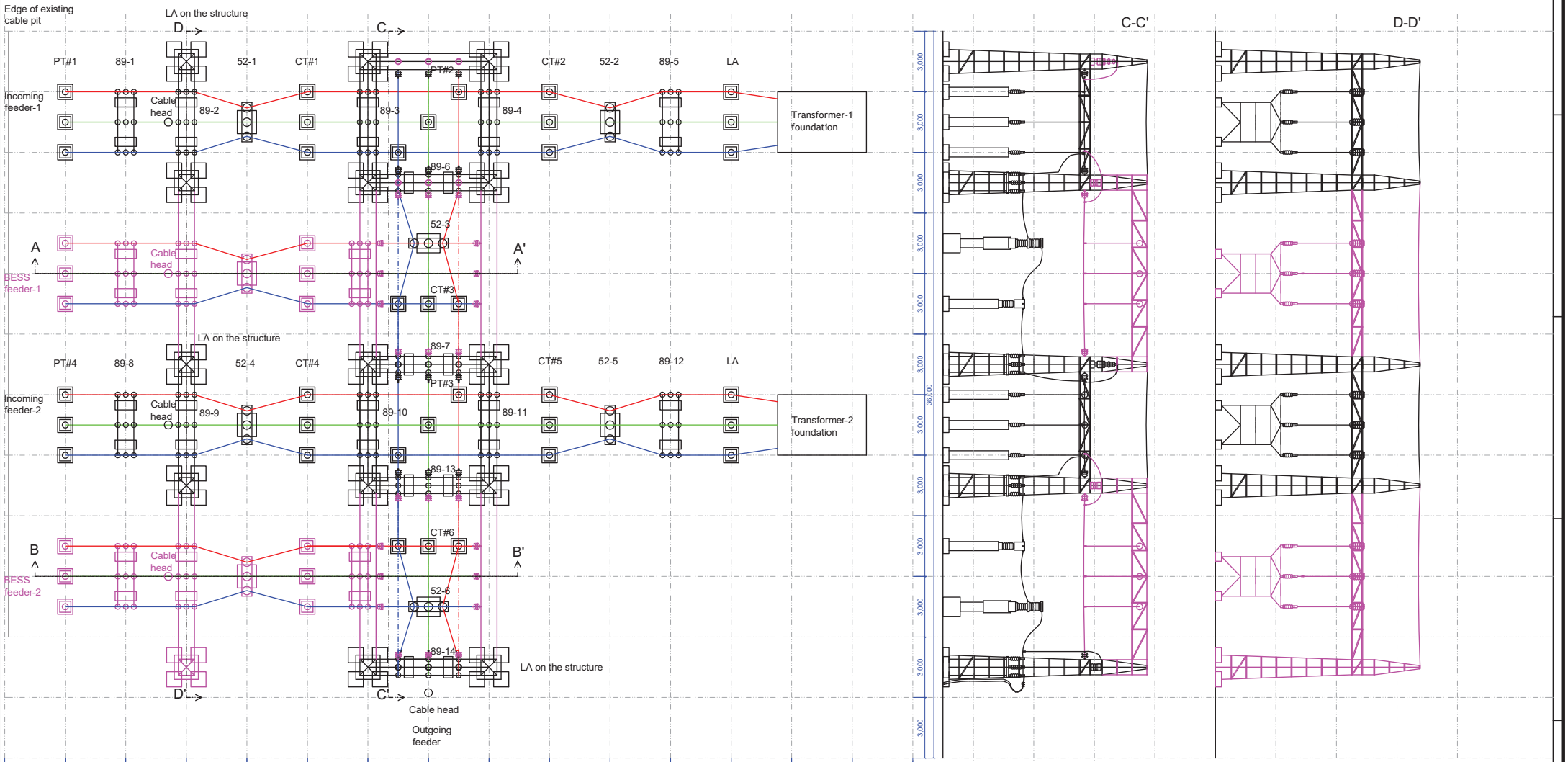
2. Purple line is Project's scope

DRAWING NO. 2	
REVISION NO. 0	/
CLIENT:	
PROJECT: Preparatory Survey for the Project for Improvement of Power Supply in Andaman and Nicobar Islands in India	
DRAWING TITLE: 33 kV outside switchgear and BESS feeder single line diagram	



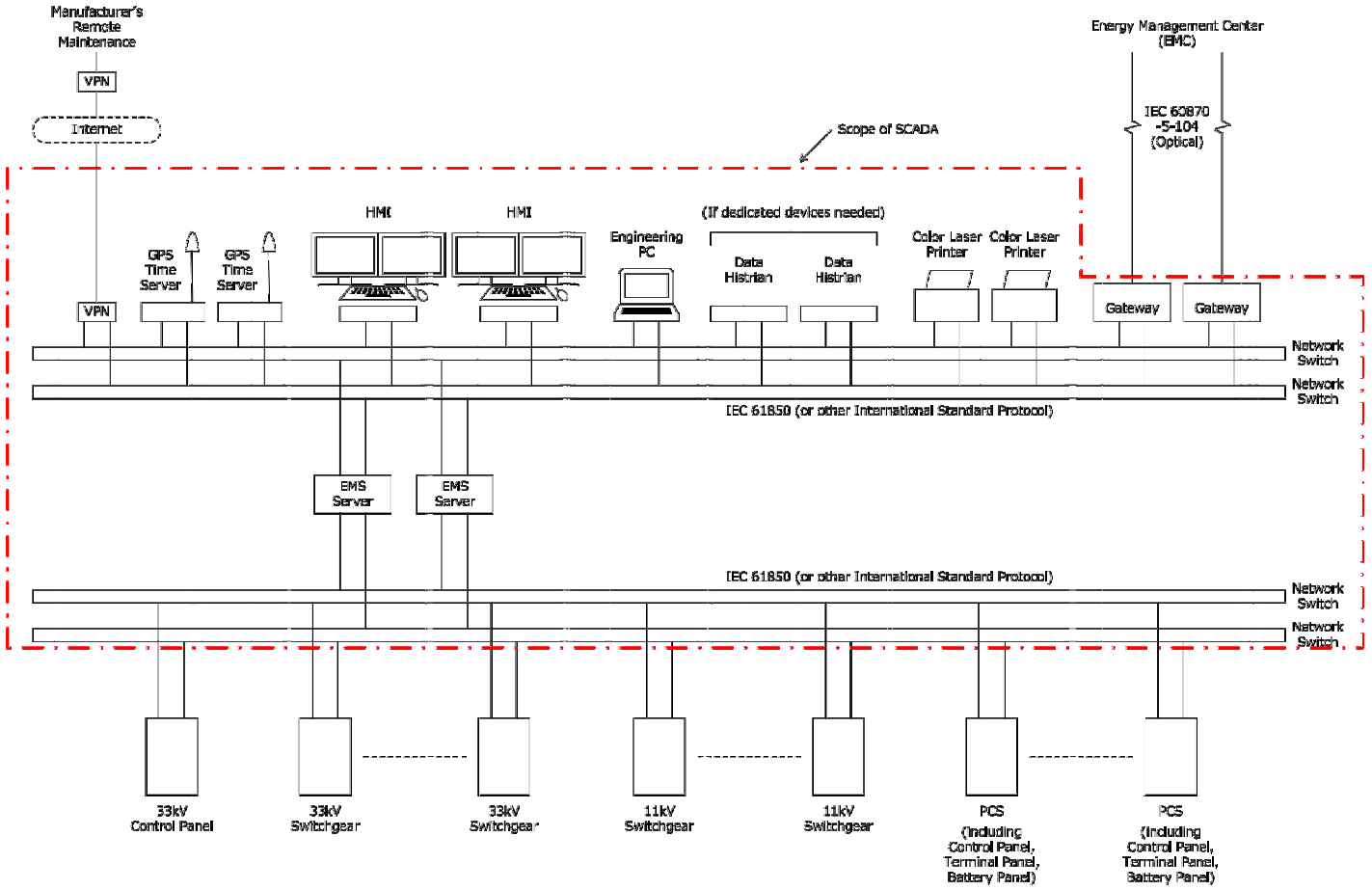
1. Purple line is Project's scope

DRAWING NO. 3	
REVISION NO. 0	/
SCALE -	
CLIENT:	
PROJECT: Preparatory Survey for the Project for Improvement of Power Supply in Andaman and Nicobar Islands in India	
DRAWING TITLE: 33 kV outside switchgear layout plan	

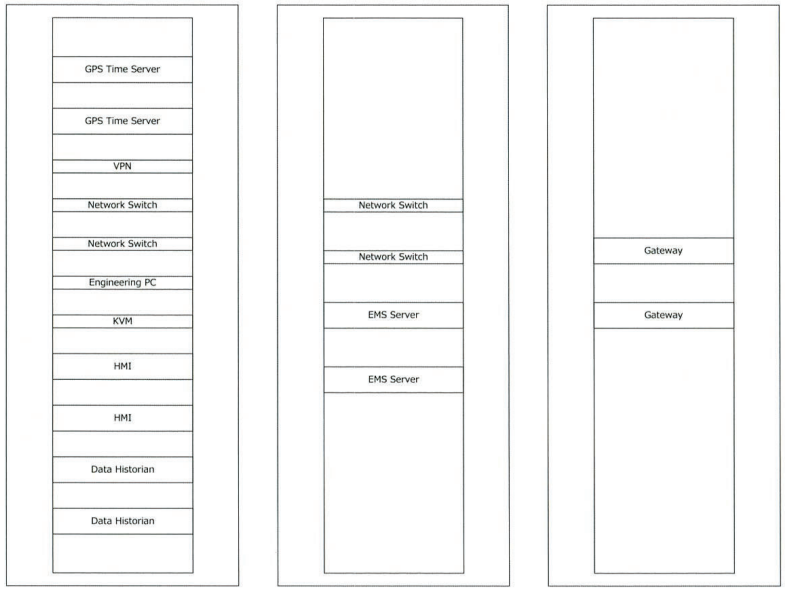


1. Purple line is Project's scope

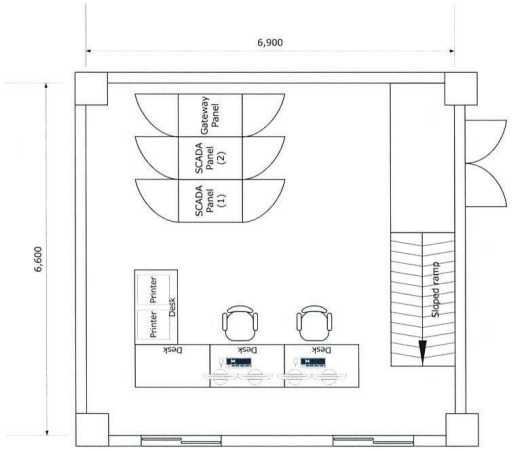
DRAWING NO. 4	
REVISION NO. 0	/
SCALE -	
CLIENT:	
PROJECT: Preparatory Survey for the Project for Improvement of Power Supply in Andaman and Nicobar Islands in India	
DRAWING TITLE: 33 kV outside switchgear sectional plan	



DRAWING NO. 5	
REVISION NO. 0	/
CLIENT:	
PROJECT: Preparatory Survey for the Project for Improvement of Power Supply in Andaman and Nicobar Islands in India	
DRAWING TITLE: SCADA System Architecture (for reference)	



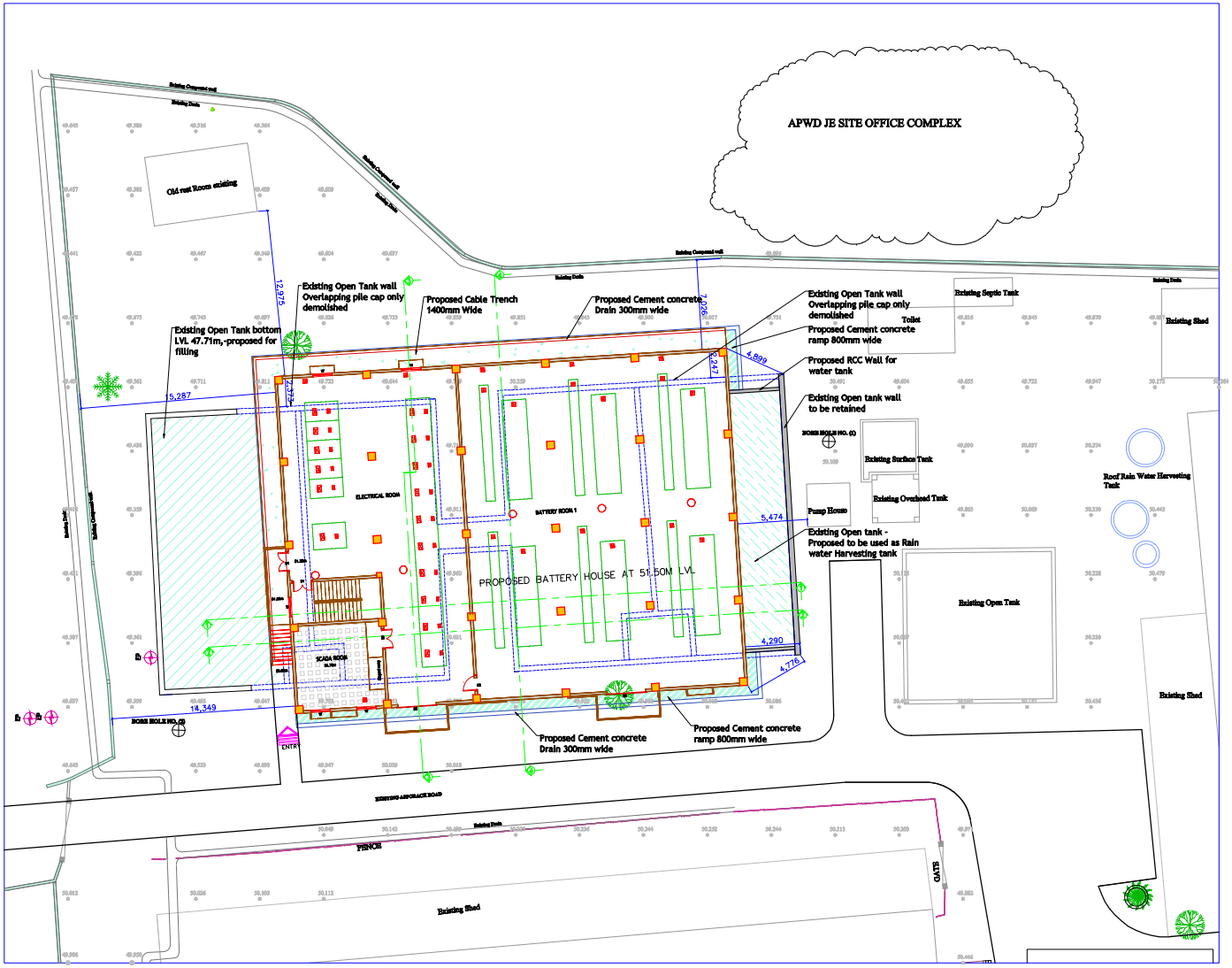
SCADA Panel Arrangement (For Reference)



Room Layout

SCADA Room Layout (For Reference)

DRAWING NO. 6	
REVISION NO. 0	/
CLIENT:	
PROJECT: Preparatory Survey for the Project for Improvement of Power Supply in Andaman and Nicobar Islands in India	
DRAWING TITLE: SCADA Panel Arrangement (for reference) SCADA Room Layout (for reference)	



ORIENTATION:

N
W E
S

SL NO.	DATE	DESCRIPTION
1.	18-06-2020	Landscape arrangement removed, existing wall demolition note modified.

REVISION

DRAWING NO. - GL/20-21/12-1/R1							SHEET NO.	
REVISION NO.	0	1					7	
ISSUE DATE - JUNE'2020							SCALE - 1:250	

PROJECT:

Preparatory Survey for the project for Improvement of Power Supply in Andaman and Nicobar Islands in India.

PROJECT COMPONENT:

Battery House

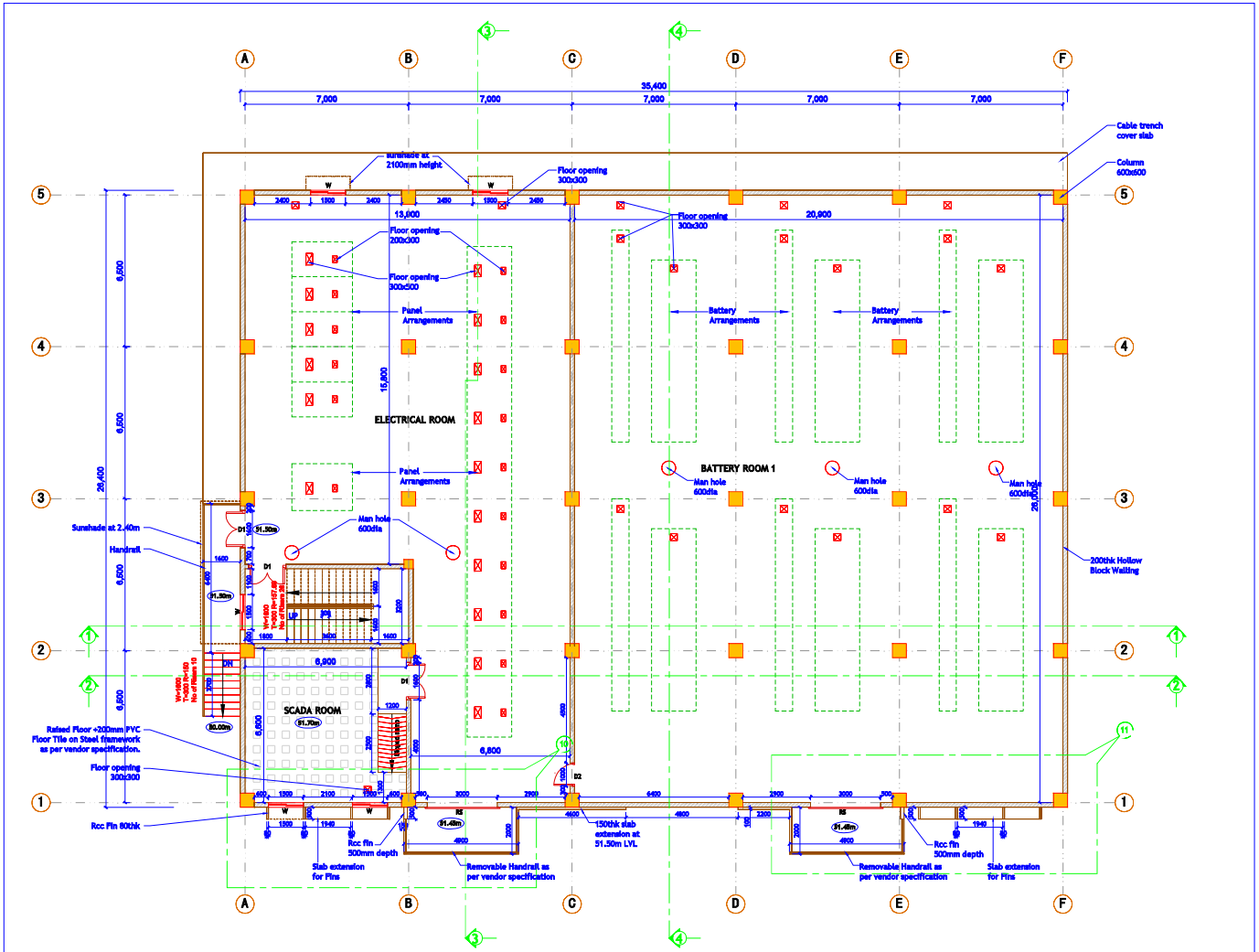
DRAWING TITLE:

Layout Plan.

DESIGN BY:

NIPPON KOEI Co., Ltd.

CONSULTANT



GROUND FLOOR PLAN - 952.16 Sqm

SCHEDULE OF OPENINGS

Sl	Mkd	Description	Width	Height
1	RS	Rolling Shutter	3000	3000
2	D1	Steel Flush door double hung	1600	2100
3	W	Aluminium Glazed sliding window with Grills	1500	1200
4	D2	Steel Flush door Single hung	1000	2100

S.NO	NOTES
01.	ALL THE DIMENSIONS ARE IN MM SCALE UNLESS NOTED OTHERWISE
02.	FOLLOW WRITTEN DIMENSIONS ONLY AND DONOT SCALE THE DRG.
03.	ANY DISCREPENCY FOUND IN THE DRG. SHALL BE BROUGHT TO THE NOTICE OF CONSULTANT IMMEDIATELY
04.	READ THIS DRG. WITH ALL RELEVANT STR./ ELECT./ PLUMBING DRGS. AND AS PER SPECIFICATIONS OF THE CONTRACT.

WORKING DRAWING

SL NO.	DATE	DESCRIPTION
1.	18-06-2020	SCADA Room flooring note modified, Open balcony floor level depressed by 50mm.

REVISION

DRAWING NO. - GL/20-21/12-5/R1 | SHEET NO. 8

REVISION NO. 0 1

ISSUE DATE - JUNE'2020 | SCALE - 1:100

CLIENT:

PROJECT:

Preparatory Survey for the project for Improvement of Power Supply in Andaman and Nicobar Islands in India.

PROJECT COMPONENT:

Battery House

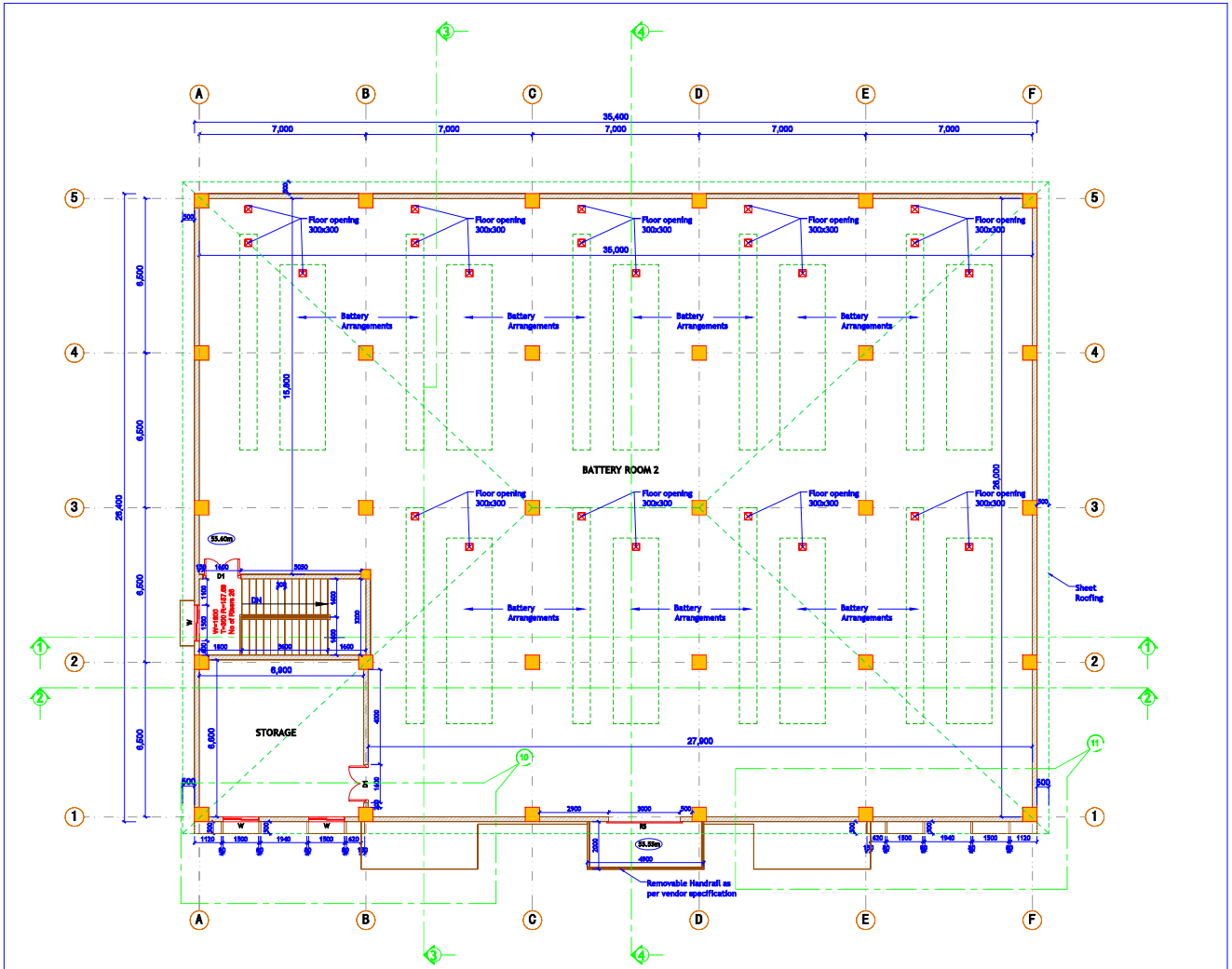
DRAWING TITLE:

Architectural Details- Ground Floor Plan and Opening Schedule.

DESIGN BY:

NIPPON KOEI Co., Ltd.

CONSULTANT



FIRST FLOOR PLAN - 943.36 Sqm

SCHEDULE OF OPENINGS

Sl	Mkd	Description	Width	Height
1	RS	Rolling Shutter	3000	3000
2	D1	Steel Flush door double hung	1600	2100
3	W	Aluminium Glazed sliding window with Grills	1500	1200
4	D2	Steel Flush door Single hung	1000	2100

S.NO	NOTES
01.	ALL THE DIMENSIONS ARE IN MM SCALE UNLESS NOTED OTHERWISE
02.	FOLLOW WRITTEN DIMENSIONS ONLY AND DONOT SCALE THE DRG.
03.	ANY DISCREPENCY FOUND IN THE DRG. SHALL BE BROUGHT TO THE NOTICE OF CONSULTANT IMMEDIATELY
04.	READ THIS DRG. WITH ALL RELEVANT STR./ ELECT./ PLUMBING DRGS. AND AS PER SPECIFICATIONS OF THE CONTRACT.

WORKING DRAWING

SL NO.	DATE	DESCRIPTION
1.	18-06-2020	Open balcony floor level depressed by 50mm.

REVISION

DRAWING NO. - GL/20-21/12-6/R1 | SHEET NO. 9

REVISION NO. 0 1

ISSUE DATE - JUNE'2020 | SCALE - 1:100

CLIENT:

PROJECT:

Preparatory Survey for the project for Improvement of Power Supply in Andaman and Nicobar Islands in India.

PROJECT COMPONENT:

Battery House

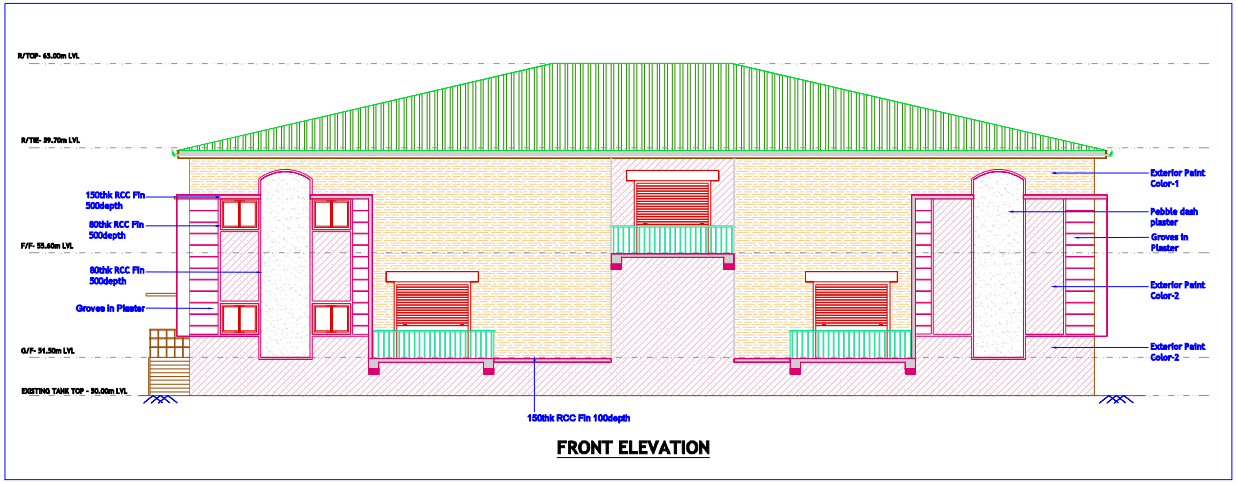
DRAWING TITLE:

Architectural Details- First Floor Plan and Opening Schedule.

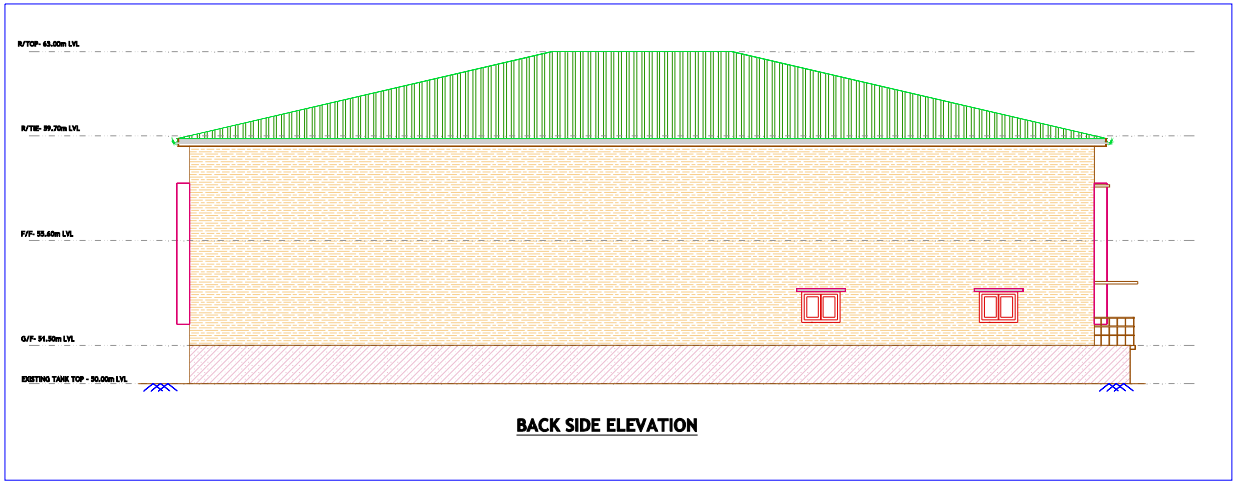
DESIGN BY:

NIPPON KOEI Co., Ltd.

CONSULTANT



FRONT ELEVATION



BACK SIDE ELEVATION

S.NO	NOTES
01.	ALL THE DIMENSIONS ARE IN MM SCALE UNLESS NOTED OTHERWISE
02.	FOLLOW WRITTEN DIMENSIONS ONLY AND DONOT SCALE THE DRG.
03.	ANY DISCREPENCY FOUND IN THE DRG. SHALL BE BROUGHT TO THE NOTICE OF CONSULTANT IMMEDIATELY
04.	READ THIS DRG. WITH ALL RELEVANT STR./ ELECT./ PLUMBING DRGS. AND AS PER SPECIFICATIONS OF THE CONTRACT.

WORKING DRAWING

SL NO.	DATE	DESCRIPTION
1.	18-06-2020	Open balcony floor level depressed by 50mm in front elevation, in front elevation and back side elevation handrail detail modified for Passage area.

REVISION

DRAWING NO. - GL/20-21/12-8/R1 SHEET NO. 10

REVISION NO. 0 1

ISSUE DATE - JUNE'2020 SCALE - 1:100

CLIENT:

PROJECT:

Preparatory Survey for the project for Improvement of Power Supply in Andaman and Nicobar Islands in India.

PROJECT COMPONENT:

Battery House

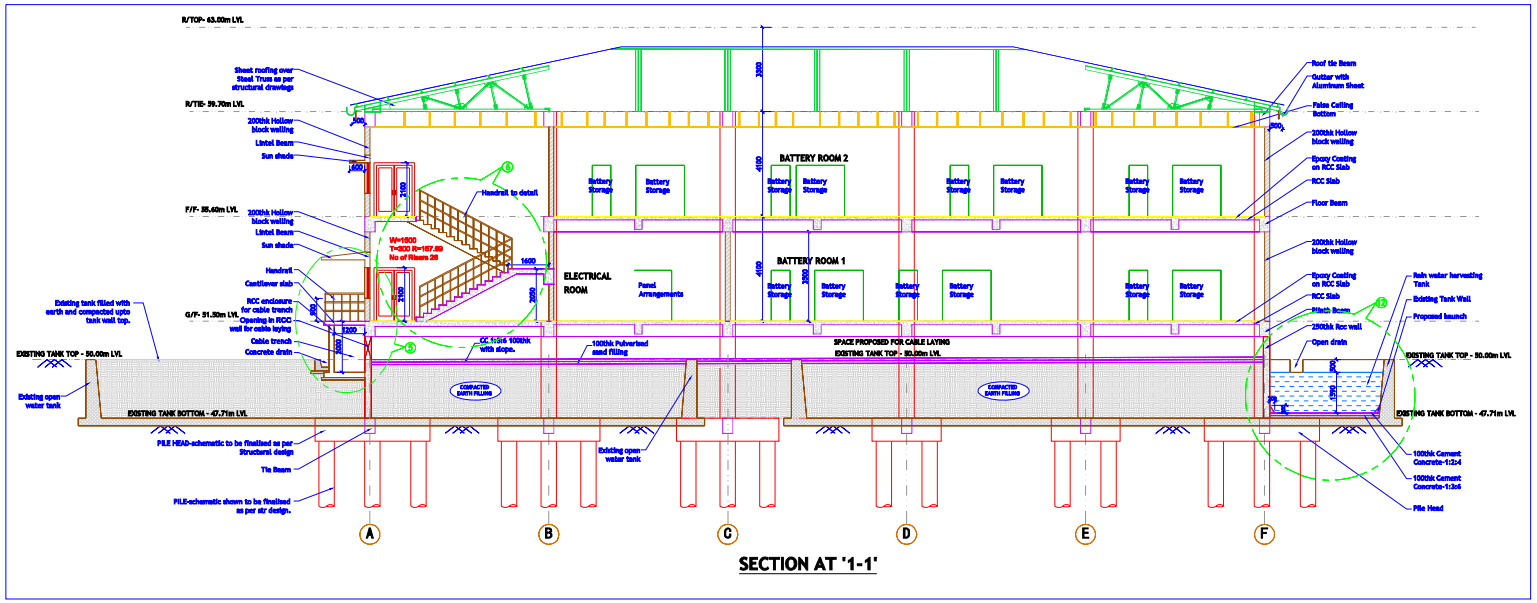
DRAWING TITLE:

Architectural Details- Front elevation and Back side elevation.

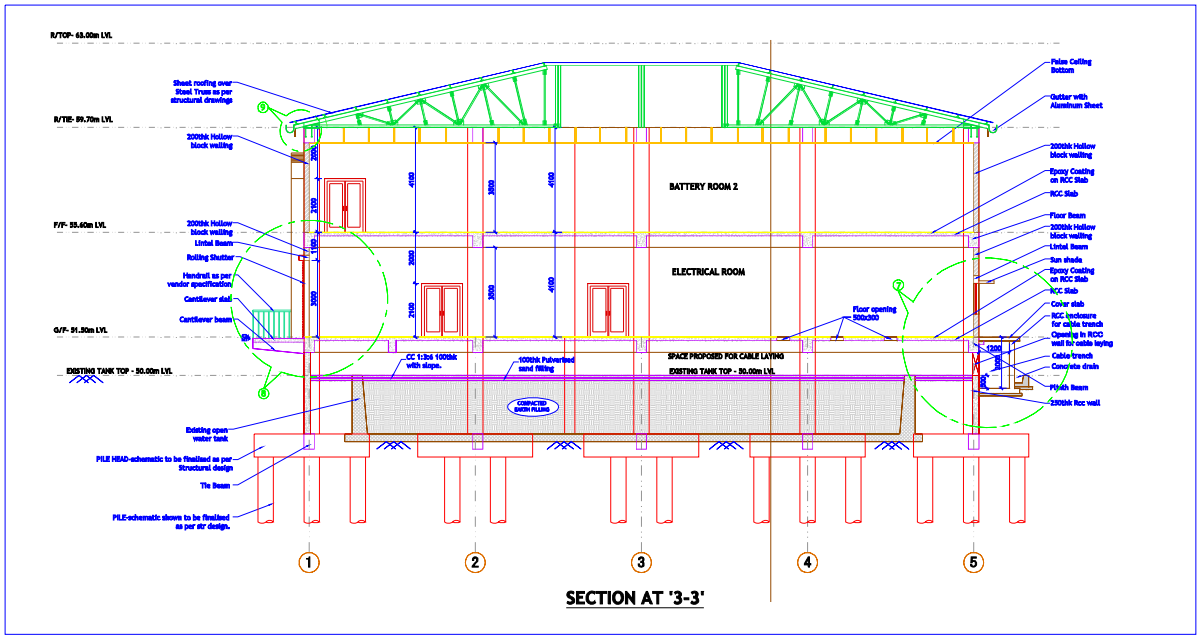
DESIGN BY:

NIPPON KOEI Co., Ltd.

CONSULTANT



SECTION AT '1-1'



SECTION AT '3-3'

S.NO	NOTES
01.	ALL THE DIMENSIONS ARE IN MM SCALE UNLESS NOTED OTHERWISE
02.	FOLLOW WRITTEN DIMENSIONS ONLY AND DONOT SCALE THE DRG.
03.	ANY DISCREPENCY FOUND IN THE DRG. SHALL BE BROUGHT TO THE NOTICE OF CONSULTANT IMMEDIATELY
04.	READ THIS DRG. WITH ALL RELEVANT STR./ ELECT./ PLUMBING DRGS. AND AS PER SPECIFICATIONS OF THE CONTRACT.

WORKING DRAWING

SL NO.	DATE	DESCRIPTION
1.	18-06-2020	In section 1-1 Staircase & Passage Handrail detail modified, In section 3-3 Open balcony floor depressed by 50mm.

REVISION

DRAWING NO. - GL/20-21/12-10/R1 SHEET NO. 11

REVISION NO. 0 1

ISSUE DATE - JUNE'2020 SCALE - 1:100

CLIENT:

PROJECT:

Preparatory Survey for the project for Improvement of Power Supply in Andaman and Nicobar Islands in India.

PROJECT COMPONENT:

Battery House

DRAWING TITLE:

Architectural Details- Section at '1-1' & '3-3'.

DESIGN BY:

NIPPON KOEI Co., Ltd.

CONSULTANT