The Republic of Mozambique
ELECTRICIDADE DE MOÇAMBIQUE, E.P. (EDM)

Preparatory Survey for the Project for Construction of Nacala Emergency Power Plant

Final Report

November 2019

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO ELECTRIC POWER SERVICES CO., LTD.
ORIENTAL CONSULTANTS GLOBAL CO., LTD.

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PREFACE

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey and entrust the survey to TOKYO ELECTRIC POWER SERVICES CO.,LTD./ORIENTAL CONSULTANTS GROBAL CO.,LTD.JV.

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

November, 2019

Toshiyuki Nakamura
Director General,
Industrial Development and Public Policy Department
Japan International Cooperation Agency

SUMMARY

1. Country Brief

The Republic of Mozambique is a country in Southeast Africa bordered by the Indian Ocean to the east, Tanzania to the north, Malawi and Zambia to the northwest, Zimbabwe to the west, and Swaziland and South Africa to the southwest, and its land area is 799,000 km2.

The country is divided into two topographical regions by the Zambezi River. To the north of the Zambezi River, the narrow coastline moves inland to hills and low plateaus, and further west to rugged highlands. To the south of the Zambezi River, the lowlands are broader with the Mashonaland plateau and Lebombo Mountains located in the deep south.

Mozambique has a tropical climate in the northern region and a subtropical climate in the southern region with two seasons, a wet season from November to April and a dry season from May to October. Annual precipitation in the northern region ranges from 1,000 mm to 1,400 mm, and less in the southern region.

The population of Mozambique is 3,03 million (2018: World Bank). The project site is in the Nacala area, and about 2 km south of the major port in the northern region, the Nalaca port.

After the conclusion of the civil war in 1992, the country enjoyed remarkable recovery in its economic growth and maintained an economic growth rate of 7～8% in 2015, and acutual growth rate in 2016 is 3.6%(World Bank). However, GNI per capita is 590 US dollars (2013: World Bank) and the poverty rate is 54. 7% (2009: World Bank). Mozambique is still one of the least-developed countries in the world.

The industrial structure consists of 29% agriculture, 20.8% industry, and 50.2% service industry (2013 World Bank). About 80% of the nations are engaged in agriculture mainly for home and neighbouring use with low productivity. On the other hand, Mozambique is a country wealthy in natural resources such as coal and natural gas. Large-scale development projects by international companies and investments in the development of related infrastructures are driving recent economic growth.

2. Background and Summary of the Project

Mozambique’s power demand rapidly increases annually at a rate of more than 10% due to its latest strong economic development; however, its national electrification rate still remains at 25% as of 2015. In addition, the national grid consists of two regional grids (North-Central and Southern areas), but the regional grids are not linked to each other. Consequently, the Northern and Central electrification rate remains at only 17.4% as of 2016, which is considerably lower than the Southern rate of 56%.

The Northem and Central grids depend on the Cahora Bassa hydro-power Plant （“HCB”） with a capacity of 2,075 MW as its major power source. However, much of the HCB power is exported directly to South Africa which means the Northern and Central grids can’t meet increasing demand due to very limited generation resources. As such, it is crucial to develop new power generation and to reinforce the existing transmission and substation network.

The short-term challenges in securing electric power supply in the North Central System are identified in the technical cooperation for development planning, “The Project for ‘Integrated Master Plan on Mozambique Power System Development’ in the Republic of Mozambique (2016 to 2018).” Meanwhile, JICA has also implemented the Grant Aid Project for Reinforcement of the Transmission Network in Nacala Corridor (2015; Grant Aid) in response to the poor transmission network in Nampula, which is the capital of Nampula Province, and eastward. Furthermore, as a more comprehensive measure, JICA implemented the Preparatory Survey on the Nacala Corridor Transmission & Distribution Network Reinforcement Project (2015 to 2017) with the idea in mind of ODA loan assistance for providing power generation facilities and a power transmission and distribution network but this was not realized because of non-disclosed debt on the part of the Government of Mozambique.

Under such circumstances, from among the facilities specified in the Preparatory Survey on the Project for Reinforcement of Transmission Network in Nacala Corridor, Mozambique made a request to Japan for grant assistance for the power generation facilities as an independent project with simplified specifications with the objective of the stable supply of power in the North Central System.

3. Summary of Study and Components of the Project

(1) Summary of Study

This preparatory survey proposes the appropriate project components for the stable power supply in the Nacala corridor that will be a necessary and optimum investment as Japan’s Grant Aid project.

The survey in Mozambique was conducted according to the schedule mentioned below and, as a result of these survey works, JICA and EDM, the counterpart of the project, agreed to the project components and scope of the works for both countries.

・The first survey: 17/4/2019-4/27/2019
Site survey and discussions with EDM on the project scope and components
・The second survey: 28/5/2019-25/5/2019
Site survey and discussions with EDM on the undertaking between EDM and JICA
・The third survey:1/9/2019-7/9/2019
Agreement on the project components and undertakings by EDM

(2) Components of the Project

The project shall be composed of the following main components.

- Installation of New Gas Turbine Power Generation Unit
- Installatio of New Fuel Oil Tanks
- Installation of New substation facility
- Installation of New Water treatment and waste water treatment system (if water for NOx reductionis required)

1) Outline of the Equipment

Outline of the equipment for the project is shown in the tables below.

Table-1 Nacala Emergency Power Plant equipment

	Main equipment	Specification	Quantity
1	Gas Turbine Power Generation Unit, and foundations (if driving piles is required)	≧ 30MW	1 set
2	Fuel oil tanks (including pumps) and foundations (if driving piles is required)	≒ 200kL	1 set
3	Substation facility (transformer, switchgear, control and protection system), and foundations	110kV	1 set
4	Water treatment (demineralization) system, and foundations		1 set (if required)

2) Outline of the Facility

The installation of the equipment requires detailed design and construction of the foundation of each piece of the equipment. As heavy equipment, including the gas turbine, generator unit and transformer, will be installed in this project, a detailed study will have to be conducted to decide whether the driving piles is required for the construction of the foundation after an equipment supplier has been selected and exact load data of the equipment have been made available. Meanwhile, as shipping container buildings will be delivered to the project site as the structures of the electrical room, control room, etc. it will be possible to install them only with the foundation work without any construction work.

4. Estimated Project Cost and Implementation Schedule

The implementation period is estimated to be 26.5 months in total, comprising 7.5 months for the detailed design and tender and 19 months for the procurement and construction‘

The project cost to be born by Mozambican side is estimated at about 52 million yen for the project implementation under the Japanese Grant Aid scheme.

5. Project Evaluation

(1) Relevance

The improvement of the electric power infrastructure is one extremely important challenge for Mozambique to achieve sustainable economic development, and the Japanese government promotes the "Nacala Corridor Development and Infrastracture Programme" . This project contributes not only to a stable power supply in the Northern region of Mozambique but also to the economic development of the Nacala corridor.

(2) Effectiveness

1) Quantitative Evaluation

The project is expected to achieve the quantitative effectiveness as follows after completing the construction of Nacala Emergency power plant, on account of its aim to contribute to the improvement of a stable power supply in the Nacala corridor area by reinforcing the transmission network.

Table-2 Quantitative Effectiveness Index

Index	Base Value（2018）	Target Value（2023*） *3 years after the completion
Net Output at seding end （MW）（at 31℃）	N.A	30MW
Annual Power Generation（MWh）（Note1）	N.A	54,750MWh
Availability（%） (Note2)	N.A	20.8%

Note-1 30MW x 5 hr/day x 365 = 54,750MWh

Note-2 5hr/24hr x100 = 20.8%

2) Qualitative Evaluation

Construction of Nacala Emergency Power Plant can encourage the economic development and the improvement of living standards in this area by improvement of credibility of power supply for Nacala area.

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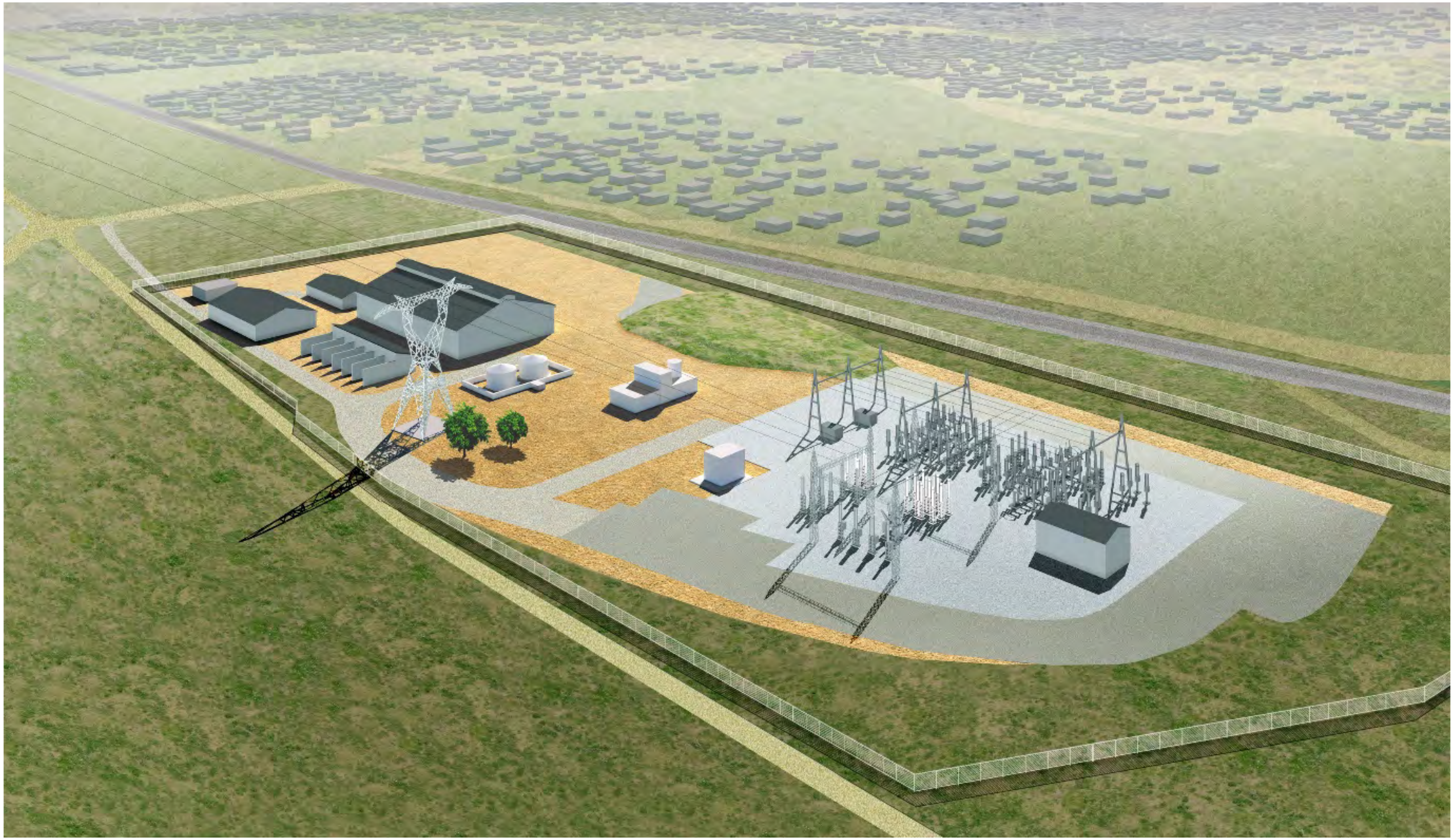
Location Map

Architectural rendering (new building section shown in white)



Photograph-1 Proposed site for emergency Nacala power plant; taken in direction of Nacala Bay

Photograph-2 Proposed site for emergency Nacala power plant; taken in direction of existing switchgear

Photograph-3 Proposed site for emergency Nacala power plant; taken in direction of existing Nacala substation control building

Photograph-4 Temporary storage containers at proposed site for emergency Nacala power plant; taken in inland direction

Photograph-5 Existing switchgear in Nacala substation

Photograph-6 Proposed site for emergency Nacala power plant; taken in direction of existing pylon and existing substation maintenance building

【Figures】

【Tables】

【Photographs】

【Abbreviation】

Abbrrebiation	English
AC	Alternating Current
AIS	Air Insulated Switchgear
AVR	Auto Voltage Regulator
BCT	Bushing Current Transformer
CFM	Caminhos de Ferro de Moçambique (Mozambique Railways)
DC	Direct Current
DINAB	National Directorate of Environment
DPCA	Directorate for the Coordination of Environmental Action
EDM	Mozambican Electricity Company (No official English Name)
EIA	Environmental Impact Assessment
EPDA	Environmental Pre-feasibility and Scoping Report
EPP	Emergency Power Plant
EWS	Engineering Work Station
FIPAG	Fundo de Investimento e Patrimonio de Abastecimento de Agua
G/A	Grant Agreement
GSUT	Generator Step Up Transformer
GT	Gas Turbine
GTG	Gas Turbine Generator
GT OPS	Gas Turbine Operator Station
IEC	International Electrotechnical Commission
IFC	International Financial Corporation
IPP	Imdependent Power Producer
ISO	International Organization for Standardization
JETRO	Japan External Trade Organization
JICA	Japan International Cooperation Agency
JIS	Japanese Industrial Standards
LV	Low Voltage
MICOA	Ministry of Coordination of Environmental Affairs
MITADER	Ministry of Land, Environment and Rural Development
NFPA	National Fire Protection Association
OPS	Operator Station
PIU	Project Implemetation Unit
PSS	Power System Stabilizer
PSSE	Power System Simulator for Engineering
Ry	Relay
SAPP	Southern African Power Pool
SC	Special Customer
SCS	Substation Control & Protection System
SEA	Simplified Environmental Assessment
SF6 gas	Sulfur hexa (6) Fluoride gas
SP	Station Post insulator
TAC	Technical Assessment Committee
TOR	Terms of Reference
Tr	Transfor
TL	Transmisson Line
UAT	Unit Auxiliary Transformer
UPS	Uninterruptible Power Supply

Chapter 1 Background of the Project

1.1 Current Status and Future Challenges for This Sector

1.1.1 Current Status and Future Challenges

(1) Status of the Power Sector in Mozambique

The Mozambique power system is divided into two systems, the South system and the North Central System, but the rate of electrification in the North Central provinces as of 2016 was as low as approximately 17.4%, which is considerably lower than the southern provinces (approx. 56.3%). Construction of power lines (backbone project) that connect the two systems is planned by 2024 in the Integrated Electricity Master Plan of Mozambique that was enacted on the basis of the technical cooperation for development planning, "The Project for 'Integrated Master Plan on Mozambique Power System Development' in the Republic of Mozambique" (2016 to 2018), implemented by JICA, but the plan has been delayed and, currently, there is no scheduled construction.

In the North Central System, it is expected that there will be a huge increase in the demand for power in the Nacala Corridor area (five northern provinces), which has potential in terms of natural resources and agriculture development. On the other hand, although there are domestic power generation facilities, including the Cahora Bassa Hydroelectric Power Plant (output of 2,075MW) managed by an IPP (Independent Power Producer), much of this power is supplied to South Africa via DC power lines, and the supply within Mozambique is as low as 500MW, including the supply to the South System. Even in the North Central System, although the government and IPPs have future plans for electric power development, supply cannot keep up with the growing demand for power, particularly in Nampula Province and Cabo Delgado Province located in the north-eastern area of the System. After leasing barges from private companies (30MW power received; heavy oil), the Mozambique Electricity Company (EDM) has been supplying power with the provision of fuel for power generation, for example, from grant aid cooperation (socioeconomic development plan) from the Government of Japan. However, this provision is coming to the final stage, and from now on it is expected that the above-mentioned practice will place a huge economic burden on the Government of Mozambique. The short-term challenges in securing electric power supply in the North Central System are identified in the technical cooperation for development planning, "The Project for 'Integrated Master Plan on Mozambique Power System Development' in the Republic of Mozambique (2016 to 2018)."

(2) Power Circumstances in the North Central System

In this Project, the introduction of an emergency power supply is planned in Nacala city, which is located on the eastern side of the North Central System, and, in line with the Nacala Corridor Economic Development Strategy, the demand for power is expected to increase in this region due to business development, for example. The capacity for power supply in the North Central System is unevenly distributed toward the west side of Mozambique, while the east relies on long-distance power supply from the Cahora Bassa Hydroelectric Power Plant and other power generation facilities for almost all of its power.

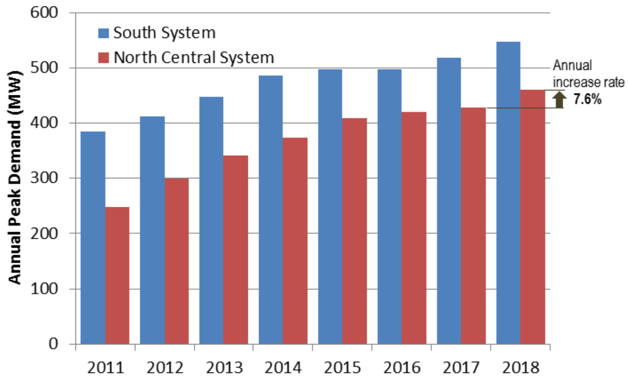


Figure 1-1 Transition in Annual Peak Demand

(Source: Prepared by Survey Team based on materials from EDM)

(a) Power Demand Results

1) Peak Demand Increase Results

Figure 1-1 shows the peak demand results in recent years. The peak demand in the North Central System is continually increasing, with a high rate of increase in 2018 at 7.6%.

2) Daily Peak Demand

Figure 1-2 shows the results for average power demand per month (2018) in the Nacala region. Every month, the peak power demand is between evening and night (roughly 7PM to 12AM), and it tends to slowly decrease until the morning. This characteristic is the same every month, and there is no major difference in demand between the months.

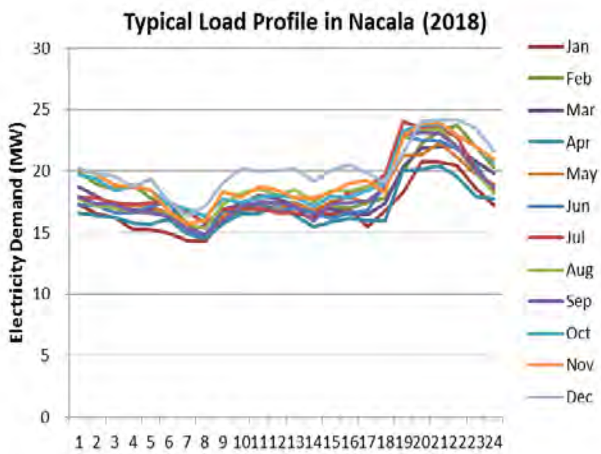


Figure 1-2 Daily Power Consumption

(Source: Pre1ared by Survey Team based on materials from EDM)

(b) Power Demand Estimates

1) Past Power Demand Estimates and Results

The latest demand estimates were investigated in The Project for 'Integrated Master Plan on Mozambique Power System Development' in the Republic of Mozambique" (JICA, 2018; referred to hereafter as the "Master Plan"). The estimates were made on the basis of the results up to 2015.

Figure 1-3 and Figure 1-4 show the relationship between demand results until 2018 and demand estimates (Base case). The resulting demand in recent years is lower than the estimates, and this trend is the same for demand in the entire country.

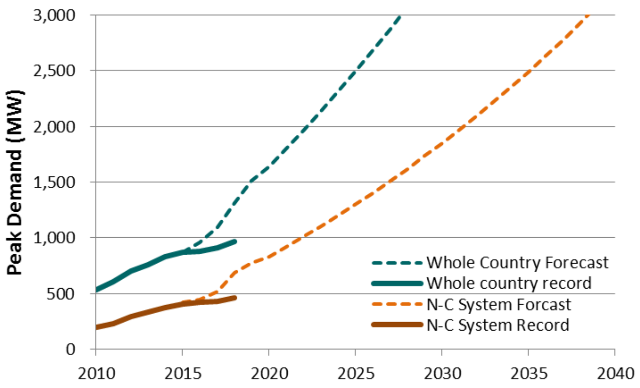


Figure 1-3 Power Demand Results and Estimates (Peak Demand)

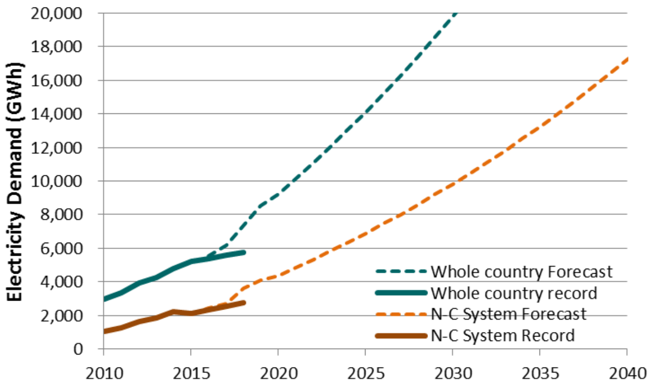


Figure 1-4 Power Demand Results and Estimates (Annual Demand)

(Source: Prepared by Survey Team based on materials from EDM)

2) Categorization of demand

In the Master Plan, in addition to the Base case, estimates are made for High/Low cases. The assumptions for the breakdown of the Base case are as follows:

i) Demand including supply for new Special Customers (SC)

ii) Demand corresponding to a natural increase, such as demand for energy in the household/agricultural sector, etc. (the expected new SC demand is deducted from the total estimate values and the natural increase demand is referred to as “Natural Growth” in the figures below)

Of this, most of the SC demand included in item (i) is dependent on investment projects accompanying large-scale facility investment, which is highly likely to be delayed. On the other hand, the demand in item (ii) is expected to steadily increase along with economic development.

Figure 1-5 shows the peak demand results and the demand estimates up to 2018 (total demand including SC and Base/High/Low cases for natural growth). As shown in the Figure, the peak demand results up to 2018 are lower than demand estimates and its increase rate is close to that of natural growth estimates (Low case). The High/Low cases for natural growth were newly produced from the data recorded in the Master Plan report.

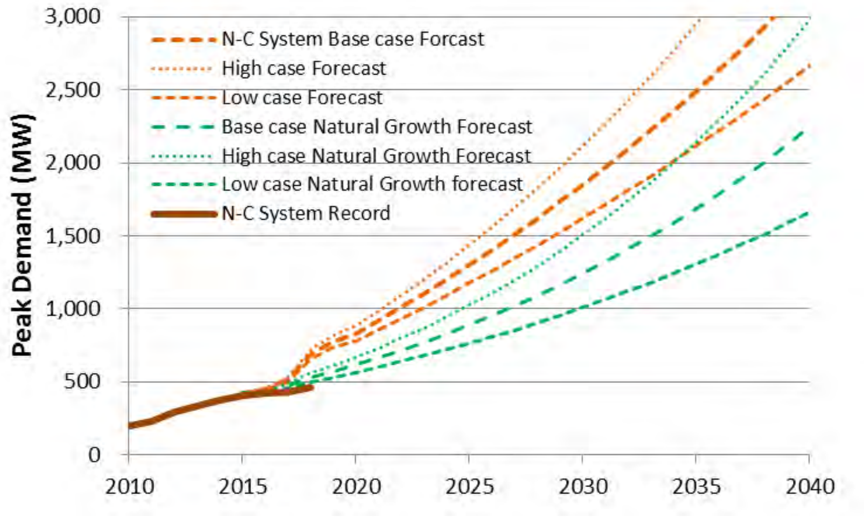


Figure 1-5 Peak Demand Estimates in the Master Plan and Recent Results

(Source: Prepared by Survey Team based on materials from EDM)

3) Demand Estimate Correction Based on Demand Results

Due to the difference between the demand estimates and the results in 2018, as shown in the previous paragraph, a correction toward smoothing was made to the peak demand assumptions in line with the demand in 2018 in order to facilitate a study of the balance in supply and demand in the future. Figure 1-6 to Figure 1-8 show the corrected demand assumptions

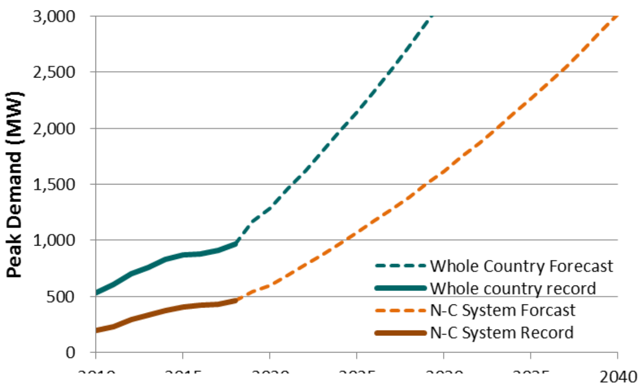


Figure 1-6 Corrected Demand Estimates (Base case, peak demand)

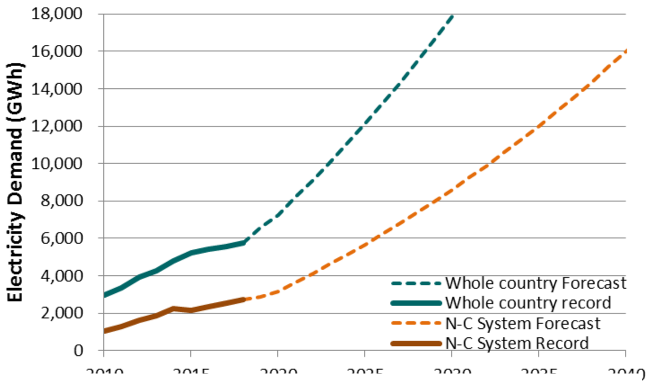


Figure 1-7 Corrected Demand Estimates (Base case, annual demand)

(Source: Prepared by Survey Team based on materials from EDM)

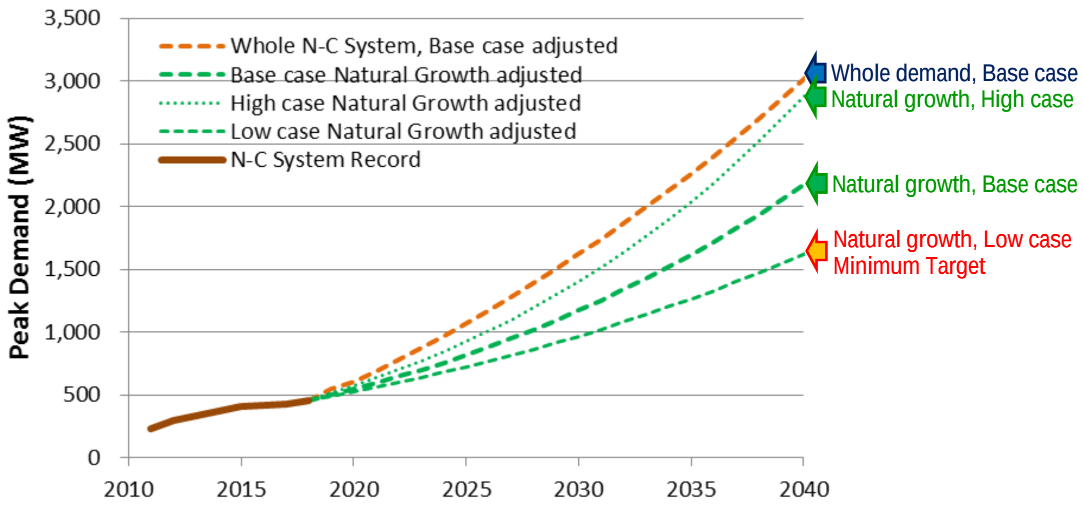


Figure 1-8 Corrected Peak Demand Estimates (natural growth Base/High/Low cases)

(Source: Prepared by Survey Team based on materials from EDM)

1.1.2 Development Plan

The most recent supply and demand balance assumptions are shown below based on the current supply/development plans for the North Central System and the demand assumptions stated above.

(1) Existing Power Generation Facilities

Table 1-1 shows the power generation facilities in the North Central System. Of these, No.11 is a rented electric power supply introduced in order to compensate for the shortage in power supply. This power source supplies power from a power-generating barge (powership) operated by Karpower that has been moored at Nacala Bay since 2016. The generation capacity of the power-generating barge is approximately 100MW, and EDM has concluded a contract with Karpower to receive 30MW (with an optional increase to a maximum of 48MW) until March 2023.

Table 1-1 Current Power Generation Facilities (North Central System)

No	Plant Name	Type	Installed Capacity (MW)	Supply Power to EDM North-Central Grid (MW)	Year of start generation (COD)
1	Mavuzi (EDM)	Hydro	57	57	1955-1957
2	Chicamba (EDM)	Hydro	44	44	1968-1969
3	Nampula Emergency (EDM)	Thermal (D/E)	4	1.5	1971
4	Cahora Bassa (HCB)	Hydro	2,075	200 *	1975
5	Quelimane Emergency (EDM)	Thermal (D/E)	6.88	2.5	1980
6	Lichinga (EDM)	Hydro	0.73	0.5	1983
7	Beira GT35 (EDM)	Thermal (OCGT)	14	12	1988
8	Cuamba (EDM)	Hydro	1.1	0.5	1989
9	Pemba Emergency (EDM)	Thermal (D/E)	1.46	1	2002
10	Lichinga Emergency (EDM)	Thermal (D/E)	1.5	1.2	2003
11	Nacala Barcassa -IPP (Karpower)	Thermal (Powership)	102.5	30	2016

* Indicates standard allocation volumes to North System (Source: Prepared by Survey Team based on materials from EDM)

(2) Current Status of the Electric Power Development Plan

Table 1-1 Current Power Generation Facilities (North Central System) shows the power generation facilities planned for development in the North Central System. The table lists the year of development stated in the Master Plan and the current estimate of the year of development.

Although there are many plans for power plant construction, there are only four power plants that are genuinely expected to be developed (No.1-4; 3 x solar power generation plants, 1 x diesel power generation plant). It is also planned that a gas-fired power plant, which will be developed in conjunction with the start of the supply of natural gas from the Rovma Basin, will start operation in 2027. This plan is dependent on the progress of gas development, but EDM expects it to be highly feasible.

Meanwhile, a sufficient capacity for supply will be secured as long as the many plans for coal-fired/hydroelectric power plants are developed in the near future, which will make the emergency power supply unnecessary. However, in order to implement the construction of large-scale power plants, in particular, in addition to a huge amount of capital investment, south-north connection (backbone) power lines and international connection lines with SAPP must be newly established, so it is expected that some time will be needed for the implementation of this plan.

Therefore, the study of the balance of supply and demand in the near future, which is described later, excludes the hydroelectric/coal-fired power plants.

Table 1-2 Electric Power Development Plan (North Central System)

No	Plant Name	Type	Installed Capacity (MW)	Supply Power to EDM Grid (MW)	Year of start generation (COD)	
					Integrated MP 2018	Current Estimate as of May 2019
1	Mocuba-(PPP)	Solar	40	30	2018	May 2019
2	Metoro (IPP)	Solar	30	30	2019	2020
3	Pemba (emergency)	Thermal (D/E)	6	6	2017	2020
4	PV Cuamba	Solar	40	30	2019	2021
5	Nacala GT (emergency)	Thermal OCGT	40	40	2019	2022
6	ENI-(IPP)	Thermal (Gas Fired)	75	75	2027	2027; depend on Gas supply
7	SHELL-(IPP)	Thermal (Gas Fired)	80	80	2027	ditto
8	Quelimane (emergency)	Thermal (D/E)	6	6	2017	-
9	Nampula (emergency)	Thermal (D/E)	6	6	2017	-
10	Lichinga (emergency)	Thermal (D/E)	6	6	2017	-
11	Nacala Thermal Power	Thermal (Coal Fired)	200	200	2022	-
12	Jindal-(IPP)	Thermal (Coal Fired)	150	150	2018	-
13	ENRC (Estima)- (IPP)	Thermal (Coal Fired)	300	300	2020	-
14	Tete 1200-(PPP)	Thermal (Coal Fired)	1,200	1,200	2022	-
15	Central Termica da Baobab	Thermal (Coal Fired)	200	200	2022	-
16	Mphanda Nkuwa- (PPP)	Hydro	1,500	1,500	2024	-
17	Alto Molocue	Hydro	50	50	2025	-
18	Mugeba	Hydro	50	50	2025	-
19	Alto Malema	Hydro	60	60	2025	-
20	Messalo	Hydro	50	50	2025	-
21	Lugenga	Hydro	50	50	2025	-
22	Lurio II	Hydro	120	120	2025	-
23	Muenezi	Hydro	21	21	2025	-
24	Tsate	Hydro	50	50	2025	-
25	Mutelete	Hydro	40	40	2025	-
26	Moatize	Thermal (Coal Fired)	300	300	2025	-
27	Ncondezi	Thermal (Coal Fired)	300	300	2025	-
28	Cuamba	Thermal (Coal Fired)	300	300	-	-
29	Cahora Bassa North–(IPP)	Hydro	1,245	1,245	2026	-
30	Lurio I	Hydro	120	120	-	-
31	Lurio III	Hydro	60	60	-	-
32	Nacala Thermal Power	Thermal (Coal Fired)	400	400	-	-
33	Buzi-(IPP)	Thermal (Gas Fired)	260	260	-	-
34	Benga-(IPP)	Thermal (Coal Fired)	300	300	-	-
35	Lupata	Hydro	650	650	-	-
36	Boroma	Hydro	200	200	-	-
37	Mphanda Nkuwa Phase-2(PPP)	Hydro	1,125	1,125	-	-
38	Central Hidrica de Pavue-(IPP)	Hydro	120	120	-	-
39	Chemba 1	Hydro	600	600	-	-
40	Chemba 2	Hydro	400	400	-	-

(Source: Prepared by Survey Team based on materials from EDM)

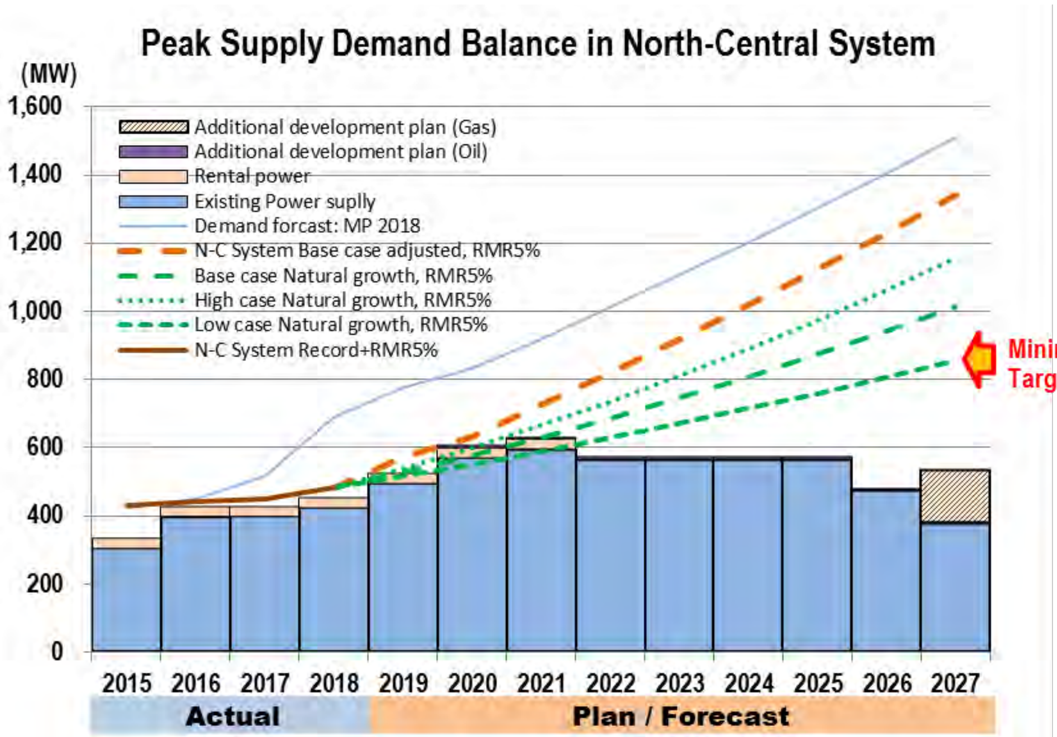


Figure 1-9 Balance in Supply and Demand in Recent Years (relationship between peak demand estimates and supply capacity)

(3) Balance of Supply and Demand

Based on the (corrected) peak demand estimates described in 1.1.1(2) (b)3) and the power generation facility development plan shown in (2), Figure 1-9 shows the results after organizing the recent relationship between demand and supply.

The dotted orange line in the Figure shows the estimates that include demand from new Special Customers (SC) (Base Case), while the dotted green line shows the estimates for a natural increase in demand excluding SC (Base/High/Low cases; addition of 5% in supply reserves as a minimum requirement). Also, the bar graph shows the supply volume expected at peak times. Of the supply, power generation from barges (30MW) shall continue until 2021 (the year before the introduction of the emergency power supply in 2022).

In the Figure, in the case that demand exceeds supply capacity, the corresponding difference in supply capacity will be insufficient each year. From 2022 and thereafter, even in comparison with the lowest estimate values for natural growth (Low case), supply capacity will be insufficient and the shortage will increase each year. Also, while there will be an increase in supply capacity in line with the plan to newly establish two gas-fired power plants by 2027 (total of 155MW), this is not sufficient to cancel out the annually-expanding shortage in supply capacity, so it is assumed that there is a need to secure an even greater capacity for supply.

(4) Assumed Shortage in the Supply Capacity

Figure 1-10 and Figure 1-11 show the assumed shortage in supply capacity against total demand and natural growth (Base case).

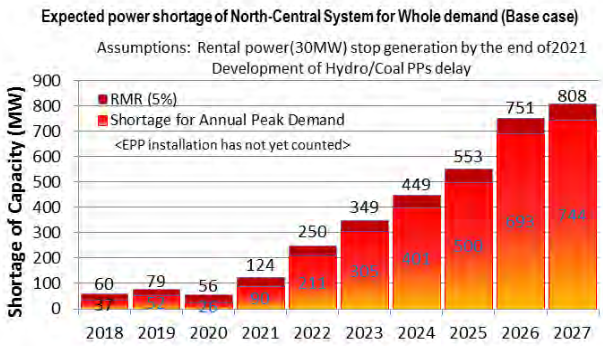


Figure 1-10 Shortage in Supply Capacity against Demand (whole demand/Base case)

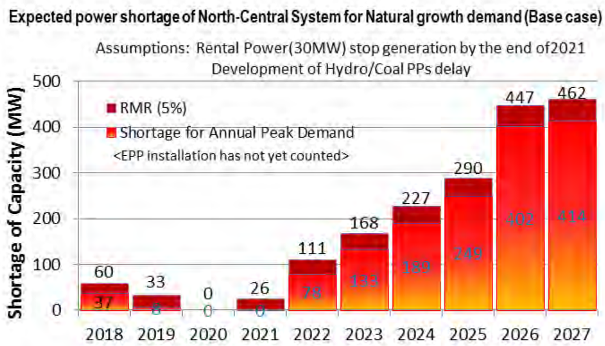


Figure 1-11 Shortage in Supply Capacity against Demand（natural growth demand, Base case）

Figure 1-12 shows the shortage in supply capacity against natural growth (Base/High/Low cases). The increase in demand from new Special Customers (SC) is mainly from new investment in large-scale business such as factories on industrial parks, but a delay is highly likely to occur in the situation of being unable to secure a stable supply of power. Meanwhile, demand from other sources including demand for energy in the household/agricultural sector, etc. is expected to continuously increase (natural growth). Therefore, it is thought that one of the important objectives of the introduction of the emergency power supply is the contribution to the natural growth of demand.

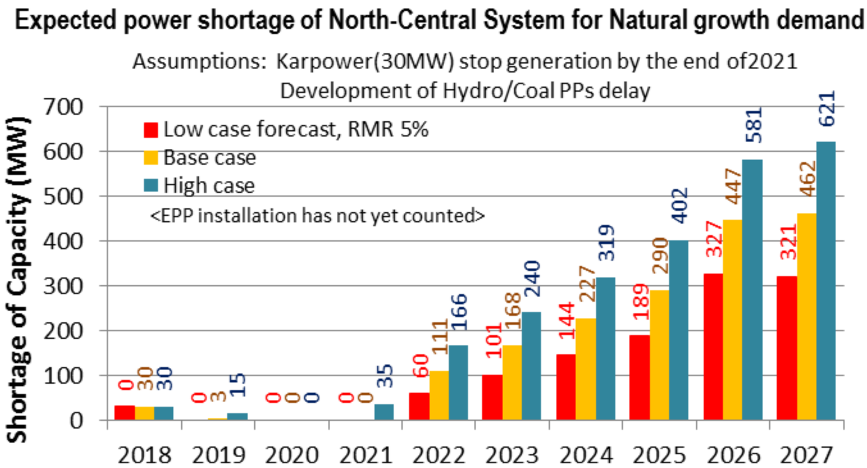


Figure 1-12 Shortage in Supply Capacity again

(Source: Prepared by Survey Team based on materials from EDM)

As for the supply capacity against the natural growth in demand, a shortage of 111MW (Base case) will occur in 2022, and thereafter it is expected that the shortage in supply capacity will increase at a scale of around 70MW annually. Therefore, in order to secure a balance in supply and demand, it is necessary to plan for the introduction of a sufficient scale of supply capacity.

Meanwhile, as mentioned before, although the most recent peak demand results describe an increase in natural growth that is close to the Low case, the increase in demand from now on will extend between the High case and Low case estimates. Therefore, it is preferable that a plan is made for an increase in supply capacity against the rise in demand in the near future that satisfies the minimum natural growth (Low case).

In the case that the minimum required amounts in the Low case of natural growth are used as target amounts, the shortage in supply capacity will expand to 60MW in 2022 and 321MW in 2027. This shortage in supply capacity has been calculated on the condition that the barges (30MW) currently in operation are suspended from 2022 and thereafter, which is the earliest possible time for the introduction of the emergency power supply. Therefore, even in the case that the situation of generating power using the barges continues as it is after the introduction of emergency power supply introduction, the shortage in supply capacity will be 30MW in 2022 and 291MW in 2027. Therefore, it is preferable that the emergency power supply has a supply capacity at a scale of at least 30MW to 60MW in 2022. Note that, because of the large scale of the shortage in supply capacity in recent years shown in these supply and demand balance assumptions, other than the emergency power supply, it will be difficult to secure a supply capacity. For this reason, in practice, it is thought that the continued use of the barges (or alternative rental power generation facilities) will be required even beyond 2022, but it is preferable that the increase in the scale of the contract accompanying the large burden of expenses is determined with respect to demand trends, the status of hydroelectric power supply, and the potential for electric power interchange, for example.

1.1.3 Socio-economic Status

The population of Mozambique is approximately 30.34 million (2018; JETRO). Mozambique’s largest city is the capital city, Maputo, located on the south coast, which has a population of approximately 2.88 million people (2015; JETRO). Construction in this Project is scheduled for Nakala Area located about 2km to the south from Nacala Port, which is the main harbor in the north region of Mozambique.

In conjunction with the progress of peace since the end of the civil war in 1992, the Mozambique economy has grown by around 6% per year since the mid-1990s and, despite suffering an economic setback caused by flood disasters in 2000 and 2001, the economy is once again recovering due to infrastructure repair projects for reconstruction and direct foreign investment, with economic growth rising to between 7% and 8% in 2015, although the real economic growth rate in 2016 was 3.6% (World Bank). On the other hand, GNI per person (national income) is at 480 USD (2016; World Bank), poverty is at 54.7% (2009; World Bank) and it is ranked 180th of 189 countries on the Human Development Index (2018; UN Development Program), so Mozambique remains one of the poorest countries in the world.

As for the industrial structure, 29.0% of GDP is placed into agriculture, 20.8% into manufacturing and 50.2% into the service industry (2013; World Bank). Approximately 80% of the population is engaged in agriculture, producing corn and cassava, etc., for home and local use, as well as export/monetized items such as cotton, cashew nuts, sesame and tobacco, although productivity is low. Mozambique is a resourceful country with abundant natural resources such as coal and natural gas, and the recent favorable economic growth has been supported by large development projects by foreign companies and the accompanying active investment in infrastructure for transport, communications and energy.

Infrastructure development in the Nacala area is visibly progressing, including the opening of the Nacala International Airport in December 2014, and the implementation of Japan's grant aid project for Urgent Rehabilitation of Nacala Port and the Nacala Port Development Plan using Japanese ODA loan, as well as the Project for Reinforcement of the Transmission Network in Nacala Corridor in June 2015 as grant assistance from Japan. In this way, as per the initial assumptions, there is a great need and urgency to this Project as there continues to be rapid economic growth in the Nacala region.

1.2 Background, Context and Outline of Grant Aid Provided By Japan

Even in the North Central System, although the government and IPPs have future plans for electric power development, supply cannot keep up with the growing demand for power, particularly in Nampula Province and Cabo Delgado Province located in the north-eastern area of the System. After leasing barges from private companies (110MW facility capacity; heavy oil), the Mozambique Electricity Company (EDM) has been supplying power with the provision of fuel for power generation, for example, from grant aid cooperation (socioeconomic development plan) from the Government of Japan. However, this provision is coming to the final stage, and from now on it is expected that the above-mentioned practice will place a huge economic burden on the Government of Mozambique.

The short-term challenges in securing electric power supply in the North Central System are identified in the technical cooperation for development planning, "The Project for 'Integrated Master Plan on Mozambique Power System Development' in the Republic of Mozambique (2016 to 2018)." Meanwhile, JICA has also implemented the Grant Aid Project for Reinforcement of the Transmission Network in Nacala Corridor (2015; Grant Aid) in response to the poor transmission network in Nampula, which is the capital of Nampula Province, and eastward. Furthermore, as a more comprehensive measure, JICA implemented the Preparatory Survey on the Nacala Corridor Transmission & Distribution Network Reinforcement Project (2015 to 2017) with the idea in mind of ODA loan assistance for providing power generation facilities and a power transmission and distribution network but this was not realized because of non-disclosed debt on the part of the Government of Mozambique.

Under such circumstances, from among the facilities specified in the Preparatory Survey on the Project for Reinforcement of Transmission Network in Nacala Corridor, Mozambique made a request to Japan for grant assistance for the power generation facilities as an independent project with simplified specifications with the objective of the stable supply of power in the North Central System.

On this basis, along with gathering information in order to confirm the necessity and relevance of implementing this Project as grant assistance, it was decided to carry out a Preparatory Survey in order to establish suitable preliminary plans and project plans and to calculate the approximate project costs.

In this Project, 30-40MW power generation facilities and ancillary facilities will be constructed in the Nacala region with the objective of improving and stabilizing power supply in the North Central System and contributing to improved living standards for local residents and the promotion of economic activity in the region by means of the construction of power generation facilities in the Nacala region.

1.3 Trends in Japanese Assistance

As shown in the table below, with regard to the power sector in Mozambique, Japan is promoting continuous assistance, and ODA loan assistance projects are scheduled for the future.

Table 1-3 Japanese Assistance Trends in the Power Sector

Type of Cooperation	Year of implementation	Project name/Other	Project budget (100 million yen)	Outline
Preparatory survey	September 2012 to March 2013	Preparatory Survey on Gas Fired Power Plant Development in Southern Mozambique	1.73	FS related to thermal power plant construction project using ODA loan assistance
ODA Loan assistance	October 2013 to August 2023	Maputo Gas Fired Combined Cycle Power Plant Development	172.69	Project to provide gas-fired combined cycle power plant in Maputo using ODA loan assistance
Preparatory survey	March 2014 to March 2016	Preparatory Survey on the Nacala Corridor Transmission & Distribution Network Reinforcement Project	1.08	FS related to Nacala Corridor transmission & distribution network reinforcement project using ODA loan assistance
Preparatory survey	March 2014 to April 2015	Support for Formulation of Power Development Plan in Northern Mozambique	0.38	Collection and analysis of information required for the formulation and investigation of a power development plan in Northern Mozambique
Grant aid	June 2013 to March 2014	Preparatory Survey on the Project for Reinforcement of Transmission Network in Nacala Corridor	0.96	Preliminary survey in connection to construction of a new substation in Nampula, etc.
Grant aid	June 2014 to August 2019	Project for Reinforcement of Transmission Network in Nacala Corridor	20.67	Construction of a new substation in Nampula, etc.

Type of Cooperation	Year of implementation	Project name/Other	Project budget (100 million yen)	Outline
Technical cooperation for development planning	October 2015 to February 2017	The Project for "Integrated Master Plan on Mozambique Power System Development" in the Republic of Mozambique	1.72	Study for the formulation of an Electricity Master Plan for Mozambique as a whole
Technical Cooperation through JICA's Loan Account	August 2015 onwards (under implementation)	Special Assistance for Caia－Nacala 220 kV Transmission Line Project Formation	1.08	FS related to a project for transmission lines between Caia and Nacala using ODA loan assistance

1.4 Trends in Assistance from Other Donors

(1) Construction of Solar Power Plants

The construction of the two large-scale solar power plants shown in the table below is being promoted with cooperation from Norway and France, and the start of operation is scheduled for 2019-2020.

These power plants will connect to the North Central System. Peak power demand occurs between evening and night (roughly 7PM to 12AM), so these power plants will not provide peak power supply capacity because solar power plants cannot generate power during this time slot, but, by generating power during the day, they are expected to the effect of saving fuel from petrol-fired power generation. Therefore, there is no contradiction in the relationship between the emergency power supply and solar power plants because they will operate in conjunction with each other.

Table 1-4 Power Plant Construction Projects in assistance from other donors

Plant Name	Capacity for EDM	Year of start generation	Notes
Mocuba (Solar)	30 MW	May 2019	Norwegian investment
Metoro (Solar)	30 MW	2020	French investment

1.5 Natural Condition

1.5.1 Climate

The site for this Project is located in Nacala-Porto, which has a tropical dry climate with an average annual temperature of no less than 22℃. During the rainy season between November and March, monthly precipitation is 150 mm or more, particularly between January and April, while average precipitation in the dry season from April to October is no more than 50 mm. Also, there is a prevailing south-southeast wind (followed by northeast, south and north-northeast) that is largely comprised of wind speeds of 6 m/s or less in any case. The details are shown in Chapter 3.2.1.

Due to heavy rains that occurred in 2018, sediment fell from the slope on the east side of the project site to the lower area on the west side. As a result, a large amount of sediment inundated the northwest side of the project site (vacant area on the east side of the former generator facility).

1.5.2 Topographical and Geological Features

The project site is located on the generally sloped area on the east side of Nacala Bay where there is almost no level ground. On the other hand, the area from the interior of the Bay to the west side of the Bay is relatively level terrain.

The site has an elevation of about 20 m, with the highest elevation being on the east side of the site at about 120 m. The highest elevation in the area can be observed mainly in the area to the south-southeast of the site, which has an elevation of 140-160 m.

The project site is located in the Rovuma sedimentary basin, which covers an area of approximately 29,000 km^2.

As for the geological characteristics around the project site, the sloped area of Nacala Bay where the project site is located is mostly formed of cretaceous sandstone (CrMo).

Chapter 2 Content of Project

2.1 Basic Concept of the Project

(1) Objectives of the Project

This project will develop 30-40 MW class power plant and associated facilities in the Nacala region, with the objective of improving and stabilizing the electrical power supply in the North Central System and contributing to improving the lifestyle and economic activities of the local residents of the region, by developing a power plant in the Nacala region.

(2) Implementing Organization

The competent ministry and implementing organization are as follows.

Responsible ministry: Ministério dos Recursos Minerais e Energia (MIREME)

Implementing organization: Electricidade de Moçambique (EDM)

(3) Overview of Facilities

The Nacala Emergency Power Plant is composed of the following facilities.

・Gas Turbine Power Generation Unit
- Net Power Output: 30 MW or higher
- NO_x emission concentration : 74 ppm (15% O_2 conversion,based on IFC/WBG standard） or less
- PM emission concentration : 50 mg/Nm^3 (15% O_2 conversion,based on IFC/WBG standard) or less

・Fuel oil tanks
- 100 m^3×2 Unit.

・Substation facility
- Transformer, switchgear (110 kV)

・Water treatment (demineralization) system (if water is required for NO_x reduction measures)
- Demineralization system, wastewater treatment system

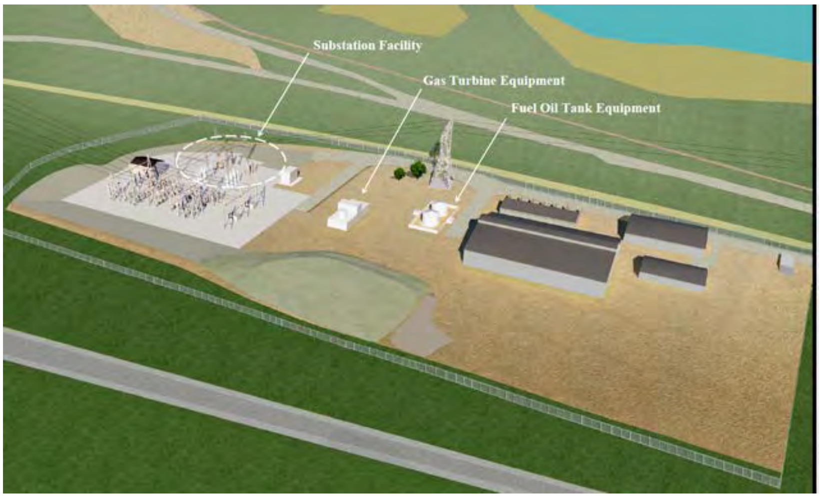


Figure 2-1 Aerial view of Nacala Emergency Power Plant

2.2 Outline Design of the Japanese Assistance

2.2.1 Design Policy

(a) Power Plant

Technical Requirements of Power Plant

The basic specifications of the gas turbine and generator unit for Nacala emergency power supply as discussed with EDM are as follows.

■Power Output

As explained in "1.1.2 Balance of Supply and Demand of the Development Plan," the Second Field Survey on the Nacala Emergency Power Plant revealed that "the power supply from the power barge will be at least 30 MW short of the demand in 2022." Therefore, the technical requirement for the power output of the Emergency Plant has been set at 30 MW at sending end.

And, the following aspects also are considerd.

- Mozambiique made a request to Japan for grant aid for power plant facilities of 40MW class.(at least 30MW as net)
- As Present power-generating barge (powership) needs higher rental cost, this is burden on EDM's finance.

■Temperature and Humidity Conditions for Power Output

According to the meteorological data of Nacala Area between 2003 and 2013 published by the Mozambique National Institute of Meteorology, maximum temperature of monthly average of the highest daily maximum temperature in the past 11 years was 30.17°C. Therefore, 31°C, obtained by rounding up 30.17 to the nearest whole number, has been set as the temperature up to which the Nacala Emergency Power Plant is guaranteed to generate 30 MW output at the sending end.

■Mobile Type

A mobile type is required for the Nacala Emergency Power Plant, taking into consideration the following circumstances in Mozambique.

As a result of these requirements, the gas turbine for Nacala Emergency Power Plant shall be an aero-derivative type.

- Mozambique has chronic electrical power shortages, so there is a need to commence power generation soon after the emergency power supply is provided to Mozambique.
- In the near future, there is a wish to transfer it to the natural gas supply region and rapidly commence power generation, associated with the production of natural gas in Mozambique.

To meet the two output conditions mentioned above and the mobility condition in the previous paragraph, it has been decided to procure and install an aeroderivative gas turbine.

■ Water-saving Type

The water resources in the area of Nacala Emergency Power Plant are not plentiful, so it is required that the emergency power supply have a fully air-cooled structure, not a water-cooled structure. If a conventional water-cooled structure, but not a fully air-cooled structure, is installed, the water-cooled structure shall be of water-saving type because it needs a cooling water circulation system (installation of a cooling tower) or a system operating with seawater (installation of a seawater intake pump, a heat exchanger, etc.)

■ Compatibility with both oil fuel and gas fuel

Nacala Emergency Power Plant will use oil fuel, but it is required that the specifications shall enable it to use gas fuel in preparation for the production of natural gas in Mozambique. This compatibility has been included in the requirements with the plan of the Government of Mozambique of the use of gas fuel for power generation taken into consideration.

■ Quality and Stability of Supply of Fuel Oil

As a result of analytical investigations into the specifications, and interviews with PETROMOC, the supplier of the diesel oil (Gasoil 50 ppm) and jet fuel (Jet-A1) recommended by EDM, the suitability of the specifications for use in the Nacala Emergency Power Plant in terms of quality and stability of supply, as well as the required fuel tank capacity, etc. were investigated. The details of such investigations are as follows.

(1) Suitability of the specifications for Nacala Emergency Power Plant

The specifications of the diesel oil (Gasoil 50 ppm) and jet fuel (Jet-A1) , which is available at the site, are as shown in Reference-4. It has been concluded that there is no problem in the specifications for the diesel oil and jet fuel for use in the Nacala Emergency Power Plant.

(2) Quality control of both fuel oils

As a result of verbal questions and answers regarding the quality control system for both fuel oils, it was found that there were no problem points.

The results of the verbal questions and answers regarding the quality control system for both fuel oils were as follows, from which it was concluded that there were no problem points.

There is no experience of oil-fired gas turbines in Mozambique, so there is no knowledge of or experience in the specifications, selection, quality control, etc., of fuel oil suitable for gas turbines. The Nacala Emergency Power Plant will be the first.

- The suppliers of diesel oil will include IPG of Kuwait, Trafigura of Genova, Blemco of the UK, Switzerland, etc., and buying is done every 6 months at spot prices using the World Pricing System.
- The suppliers bear the responsibility for transport and guarantee the quality until it is unloaded in Mozambique, and PETROMOC performs a quality inspection every time to judge whether to accept the cargo. Therefore the suppliers take responsibility for contamination with corrosive components such as chlorides, etc., during marine transport.

(3) Stability of Supply

In discussions with EDM and managers of PETROMOC, it was confirmed that the stability of supply of diesel oil (Gasoil 500 ppm) is superior to that of jet fuel. For this reason EDM decided to choose diesel oil. PETROMOC explained that the current capacity for transport and supply of fuel to Nacala Emergency Power Plant is 150 m^3 per day by tank truck. A supply of 150 m^3 per day corresponds to about 15 hours operation of the Nacala Emergency Power Plant at full load .

(4) Fuel Oil Tank Capacity

The plan is that fuel oil will be received by tank truck from the PETROMOC oil storage site a distance of 500 m away from installation area of Emergency Power Plant. Because the distance is short the fuel oil tank storage capacity should be 2 days or more.

■ Quality and Stable Supply Capacity of Raw Water for Injection to Reduce NOx

The gas turbines for the Nacala Emergency Power Plant include a model that requires the injection of demineralized water into the burners in order to reduce NOx, and it was confirmed with FIPAG (Fundo de Investimento e Patrimonio de Abastecimento de Agua) whether mains water can be used as the raw water for the demineralized water.

In this case, 15 t/h (Note) of mains water is required for the gas turbine operating at a full load .

FIPAG has a plan to strengthen the supply of mains water, and it was confirmed that the piping for the mains water has already been laid along the EPP site. The quality of the mains water , which is available at the site, is as shown in Reference-5.

Therefore, a gas turbine that requires water for NOx reduction is a candidate for use in the Nacala Emergency Power Plant.

(Note) The quantity of demineralized water for reducing the NOx a full load is about 10 t/h. Assuming that the yield of the demineralized water production plant for production of demineralized water from mains water is 2/3, then the required quantity of mains water is about 15 t/h.

■ Design Conditions for the Natural Environment

The design temperature conditions for the Nacala Emergency Power Plant corresponds to the minimum value of the lowest daily temperature, 20.3°C, and the maximum value 30.17°C, based on the Nacala climate data from the Mozambique National Institute of Meteorology (2003 to 2013), but taking the wishes expressed by EDM into consideration, spot temperatures of 15°C to 40°C have been adopted.

In the case of the humidity conditions, the same data provide an average humidity of 77%, minimum humidity 67.54%, and the maximum humidity of 85.85%, so the guaranteed humidity condition was set at 77%, and the design humidity conditions from 68% to 86%.

Design Conditions for the Natural Environment in the Area surrounding Nacala Emergency Power Plant:

Dry bulb temperature	15°C to 40°C
Relative humidity	68% to 85%
Atmospheric pressure at height above sea level	1.013 kPa

■ Common Specifications for Equipment

From the above, the common specifications for equipment are as follows.

○ Power generation equipment Basic requirements for equipment specifications

Planning Conditions

(1)	Site location	:	Site in Electric Power Substation Premise in Nacala City, Mozambique
(2)	Frequency	:	50 Hz
(3)	System voltage	:	110 kV
(4)	Fuel		
	1) Type	:	Gas Oil 50ppm / Jet-A1 Firing of Gas as a future fuel shall also be possible.
	2) Properties	:	See Reference-4 Fuel Properties
(5)	Design conditions		
	1) Ambient Temperature	:	15°C ～ 40°C
	2) Relative humidity	:	68% ～ 85%
	3) Atmospheric pressure	:	1.013 kPa
	4) Noise	:	90 dB or less at 1 m from the equipment
	5) Wind velocity (for structural design)	:	45 m/s or higher
	6) Rainy season	:	December to March
	7) Rainfall	:	Average:800~1700mm/ year Maximum:160mm/(24hour)
	8) Maximum solar radiation	:	1000W/m2
	9) Isokeraunic level	:	60~70days/year
	10) Design seismic force	:	0.2G
(6)	Guaranteed performance and conditions		
	1) Ambient Temperature	:	31°C
	2) Relative humidity	:	77%
	3) Atmospheric pressure	:	1.013 kPa
	4) Net Power Output	:	30MW or higher at Transmission End With Air Inlet Losses, Exhaust Losses and Water Injection Effect for NOx Reduction.
	5) NOx emission concentration	:	74 ppmv dry @ 15 percent of oxygen content (at 75-100% load)
	6) PM emission concentration	:	50 mg/Nm^3 dry @ 15 percent of oxygen content (at 75-100% load)
(7)	Operating conditions	:	Base Load Continuous & Partial Load Operation. (With Load Change)
(8)	Paint	:	Corrosion protection and paint, considering site location beside the seaside.
(9)	Maintainability	:	Equipment shall be designed so as for easy Patrol Check, Overhaul Inspection and Inspection/Repair etc.
(10)	Water Quality Analysis	:	See Reference-5 Water Quality Data
(11)	Effluent quality	:	See Reference-6 Effluent Standards
(12)	Code and Standard	:	JIS, ANSI, ASME, ISO, JEC, IEC, NFPA, manufacturer

standards, etc.

(13) Packaging Type : Mobile function shall be important so as to be able to relocate in short period of time (about one month)

(14) Special requirements : ・The gas turbine component shall be capable of burning gas with no hardware modification.
・Power plant shall be outdoor use specifications with stairs and handrails where necessary.
・Power plant shall be capable to start up even under both Black-Out and External Power Loss happens at the same time.
・Power plant shall be self-sufficient in power supply so that it cannot be damaged in the event of loss of external power or In-House Transformer Failure at site.

(b) Substation

Technical Requirements for Substation Equipment

1) Design Standards

IEC and EDM standards shall be applied to the design of the substation equipment.

In the event of a difference between the two standards, the IEC standard shall have priority over the EDM standard, for cost reduction.

2) Basic Substation Equipment Specifications

The conditions of use of the substation equipment are shown in the following tables.

Table 2-1 Environmental Conditions

		Outdoor	Indoor
Ambient temperature	Maximum temperature	+45°C	+45°C
	Maximum 24 hour average temperature	+30°C	+30°C
	Minimum temperature	-5°C	-5°C
Maximum humidity (+45°C)			100%
Ground surface temperature	Maximum temperature	+35°C	---
	Minimum temperature	+5°C	---
Thermal resistivity	Average	1.2	---
	Maximum	3.0	---
Design wind velocity			---
Rainfall	Average	800-1,700 mm/year	---
	Maximum	160 mm (24h)	---
Maximum solar radiation			---

Table 2-2 Standard Insulation Levels

System voltage	Highest system voltage	Lightning impulse withstand voltage	Short-duration power frequency withstand voltage
110 kV	145 kV	650 kV	275 kV
33 kV	36 kV	170 kV	70 kV
11 kV	12 kV	75 kV	28 kV
0.4 kV	420 V	----	2.5kV

Table 2-3 Minimum Clearances in Air

Highest system voltage	Outdoor	
	Phase-phase Phase-ground	Between Busbar sets
145 kV	1,300 mm	2,500 mm
36 kV	360 mm	700 mm
12 kV	180 mm	---

Table 2-4 Bushing Minimum Creepage Distance

Pollution level	Minimum creepage distance
IV very heavy	31 mm/kV

3) Use of Mobile Transformer

During the field survey, EDM requested the use of a mobile transformer in the project. However, the Survey Team decided not to use such a transformer because no manufacturer manufactured a mobile transformer for a gas turbine power plant with a net output of 30 MW or above and a large amount of money would be required for developing a new large transformer. The Team explained these reasons to EDM and EDM agreed not to use a mobile transformer

For reference, general information on maximum capacity and price of mobile transformer is as follows.

- The maximum capacity of commercially available mobile (truck-mounted) transformer: 25 MVA
- Comparison of the prices of mobile and fixed transformers (of 25 MVA capacity)
  Price of mobile transformer: 180 % of the price of fixed transformer
  Total installation cost: 120 % of that of fixed transformer

(c) System Analysis

Project Scope from the Viewpoint of System Analysis

1) Analysis Conditions

a) Power Flow Conditions

It is envisaged that the Nacala Emergency Power Plant will commence operation about the year 2022, and, in general, a study on the power flow conditions should be conducted at that point. However, at present, the scheduled scheme to strengthen the 400 kV transmission lines and the 220 kV transmission lines is delayed, and there is a strong possibility that the work will not be in accordance with the master plan. Therefore, by using the present system data instead of the power flow data, which is an element of uncertainty, the system connection conditions (connecting bus voltage) and the necessary countermeasures will be investigated based on the results of analysis that will provide more severe results than at the time of commencement of operation.

First, for the investigation the PSSE data for the peak demand in 2019 was obtained from EDM, and this was selected as the base case. The power flow status in this base case is shown in Figure 2-2. Also, the off-peak demand was estimated based on the demand data for each substation, using the data from the "Preparatory Survey on the Nacala Corridor Transmission & Distribution Network Reinforcement Project", and off-peak PSSE data was prepared. The power flow during off-peak times is shown in Figure 2-3.

Based on this PSSE data the voltages and power flow were confirmed, with which the survey team has identified no particular problems, so attention was focused on the stability analysis. The PSSE data for the generators and control systems used in the analysis was data provided by EDM.

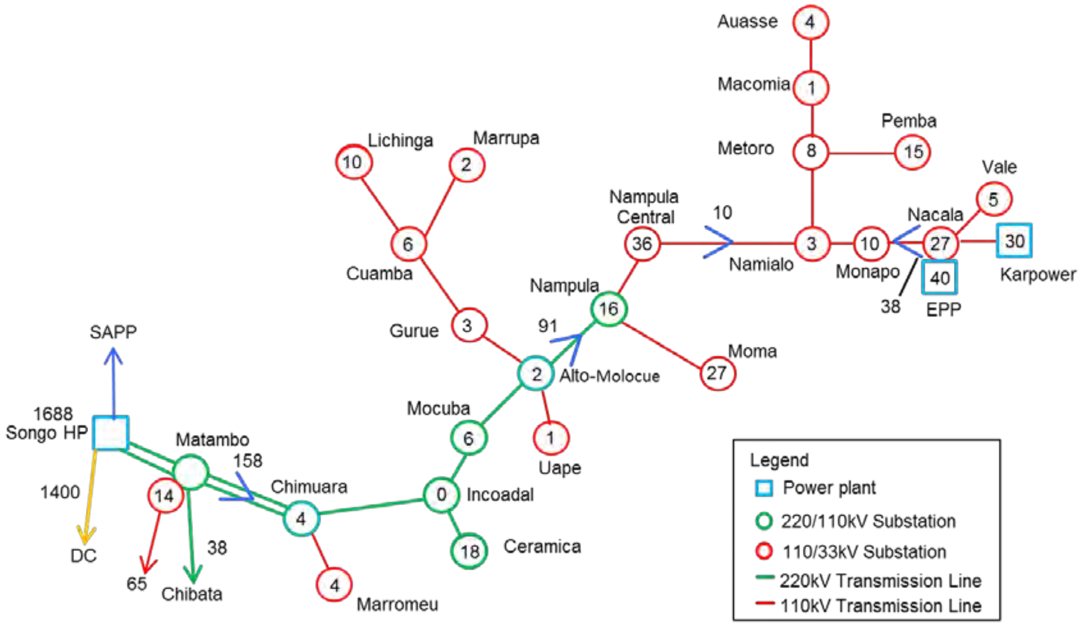


Figure 2-2 2019 Peak Power Flow

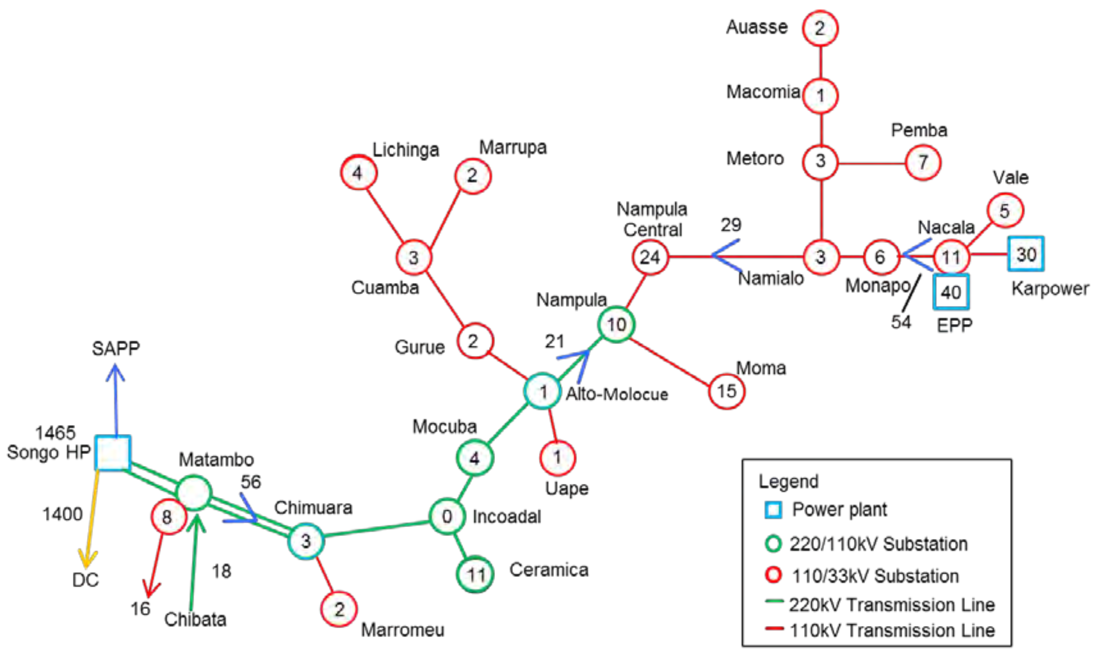


Figure 2-3 2019 Off-peak Power Flow

b) Simulation of the South African Power Pool

The North Central System of Mozambique is connected to the South African Power Pool (SAPP) via the 330 kV bus of Songo (Cahora Bassa Hydroelectric Power Plant). However, viewed from SAPP it is located at the end, and is connected to the center of the SAPP system with quite a large impedance.

Therefore, it was judged that the impact of SAPP on the Nacala EPP would be small, and the SAPP system was modeled as one generator and one load connected via an equivalent impedance as shown in Figure 2-4.

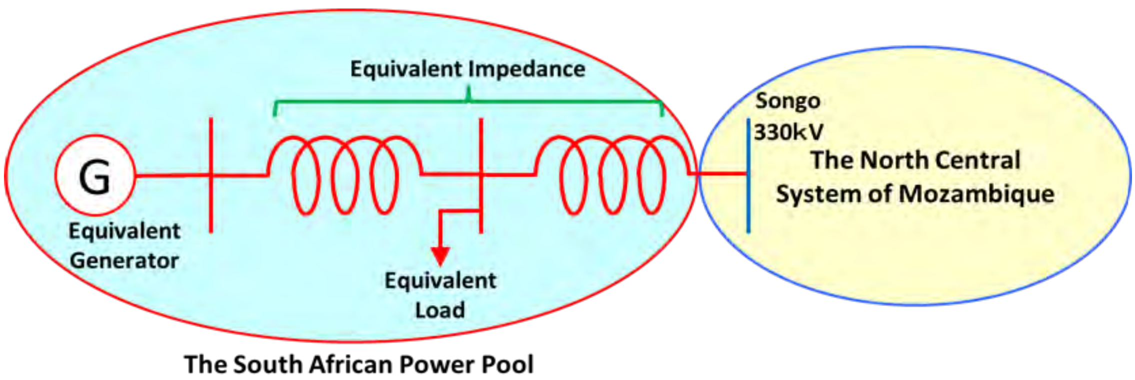


Figure 2-4 Simplified Model of SAPP

c) Breakdown Sequence

In normal analytical investigations, a transmission line breakdown is envisaged to occur near the terminal of a bus, and the breakdown sequence in which the breakdown is eliminated and the transmission line is temporarily open is adopted. However, the majority of the North Central System of Mozambique is single circuit power transmission, so if the transmission lines are opened, the Nacala region will be isolated from the system, and the analysis cannot continue. Therefore, in this investigation it was decided that the transmission lines would not be opened, and the breakdown sequence analysis was conducted envisaging bus breakdown as indicated below.

- 0.0 seconds: Start of analysis
- 0.1 seconds: Occurrence of three-phase earth leakage bus breakdown
- 0.2 seconds: Elimination of three-phase breakdown
- 10.0 seconds: End of analysis

d) Emergency Power Plant (EPP) Operating Status

The operating status of the barge generator after commencement of EPP operation is not clear at present, and it was envisaged that the continued utilization of the barge generator would be more challenging, and an investigation was carried out with the assumption that the operation of the barge would be continued.

e) Generator Connection Bus Voltage

Two cases can be considered for connection of the EPP to the Nacala substation, 110 kV and 33 kV. Therefore, stability analysis was performed for the connection conditions of both, the results were compared in order to consider the connection bus voltage.

f) Necessity of PSS

One of the means for strengthening the stability of the generator is a device known as a Power System Stabilizer (PSS), a device that is added to an exciter. In order to identify the necessity for such a device, analysis was made under the conditions both with and without a PSS, and the necessity was judged by comparing the analysis results.

2) Analysis Results

a) Peak Demand (No PSS)

Under the conditions of the peak demand with no PSS, the results for the two cases of connection to 33 kV and 110 kV busbars are shown in Figure 2-5 and Figure 2-6.

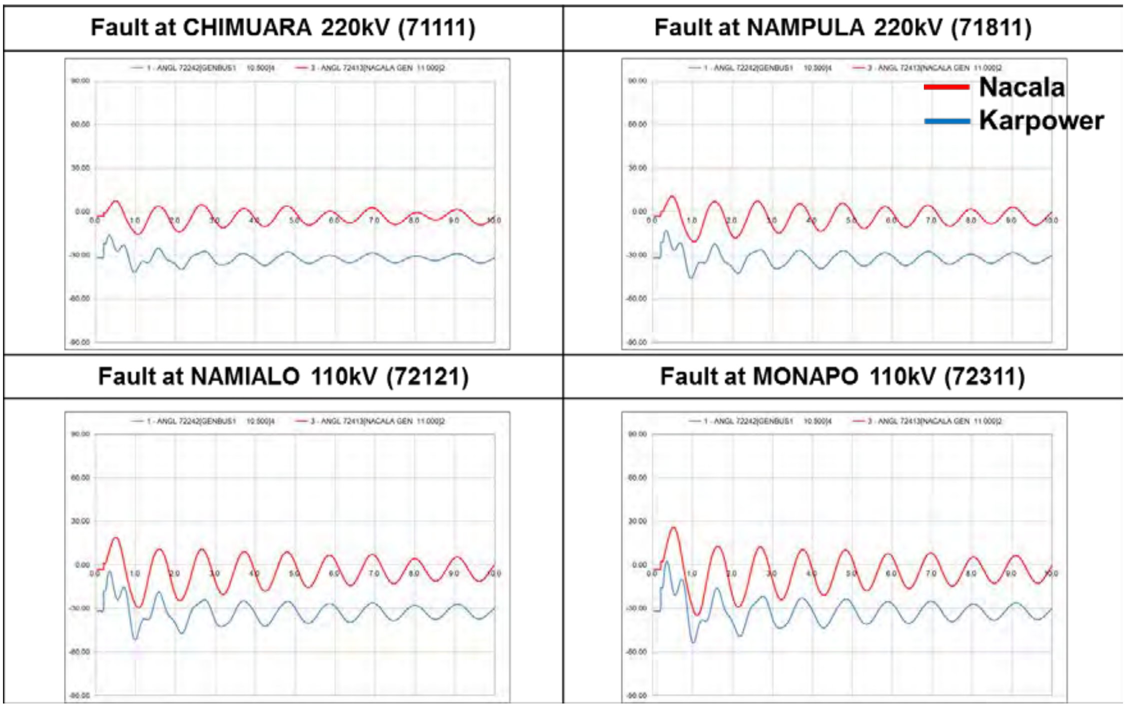


Figure 2-5 Peak Demand, 33 kV connection, no PSS

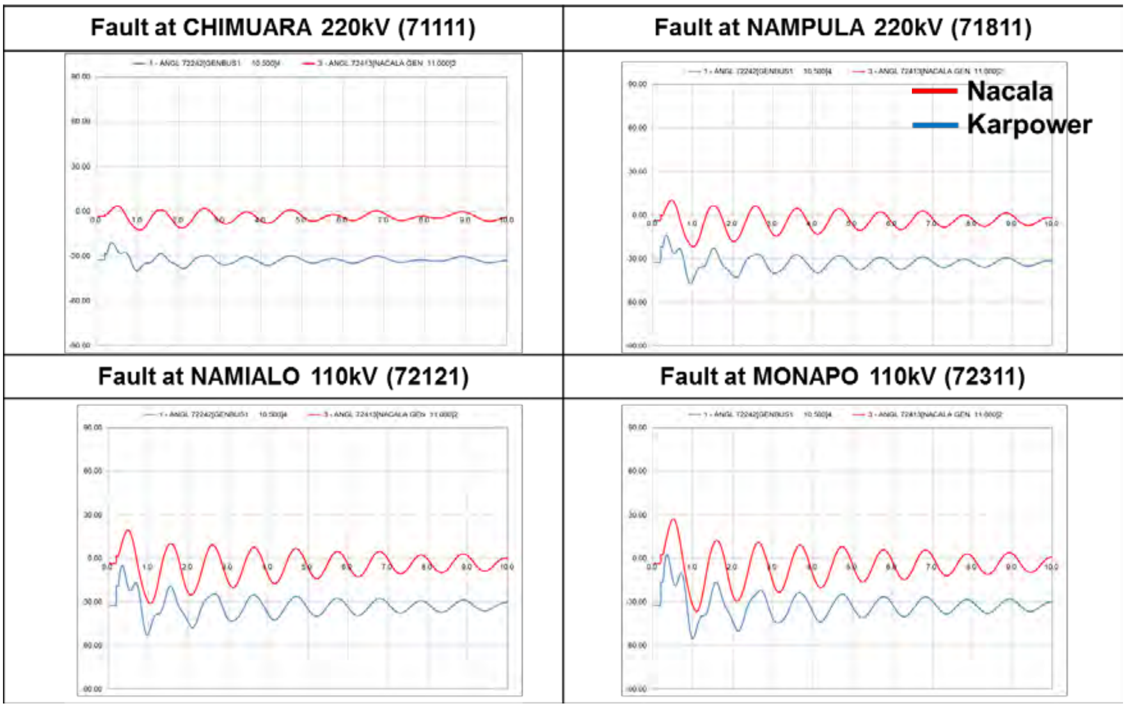


Figure 2-6 Peak Demand, 110 kV connection, no PSS

Figure 2-7 compares these two results, from which it can be seen that the attenuation tends to be weak, but the attenuation is slightly faster in the case of 110 kV connection.

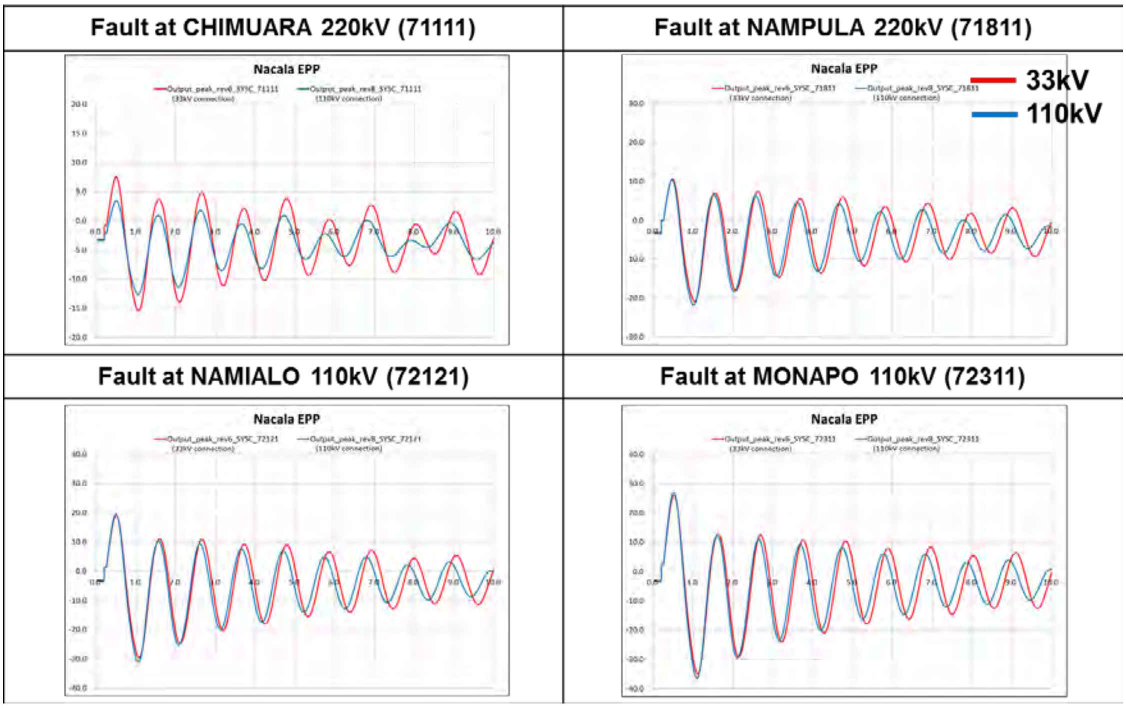


Figure 2-7 Peak Demand, Comparison of 110 kV connection and 33 kV connection, no PSS

b) Off-peak Demand (No PSS)

Figure 2-8 and Figure 2-9 show the results of the two cases of 33 kV busbar and 110 kV busbar connected under the conditions of off-peak demand and no PSS.

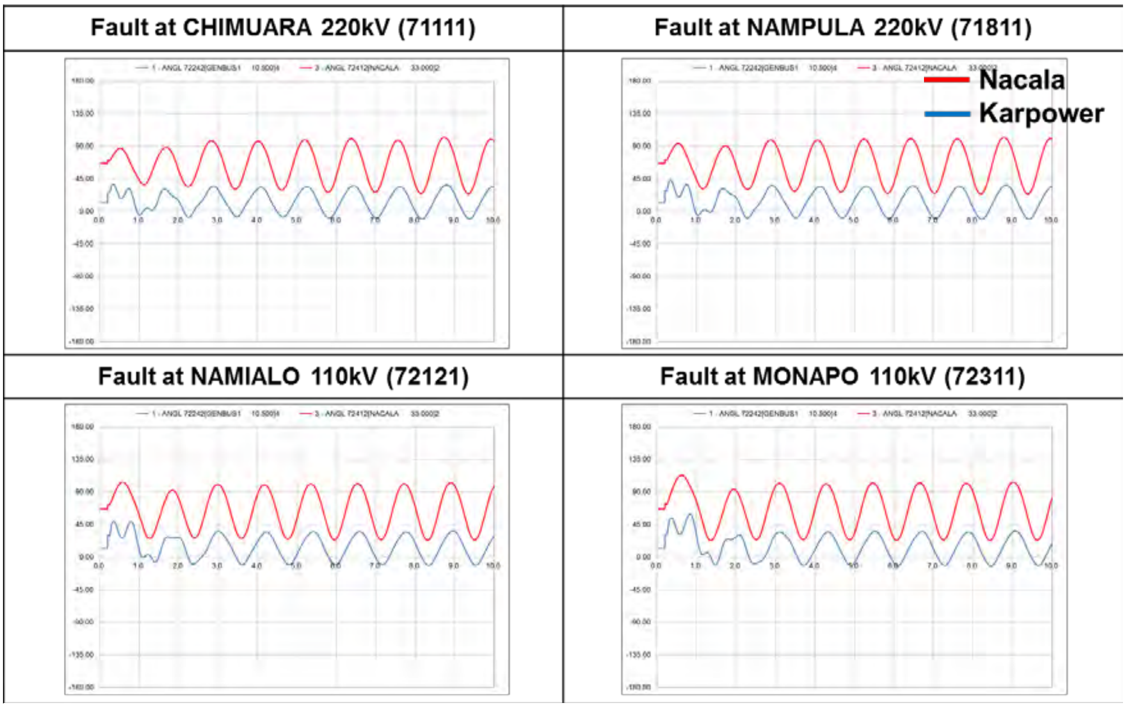


Figure 2-8 Off-peak Demand, 33 kV connection, no PSS

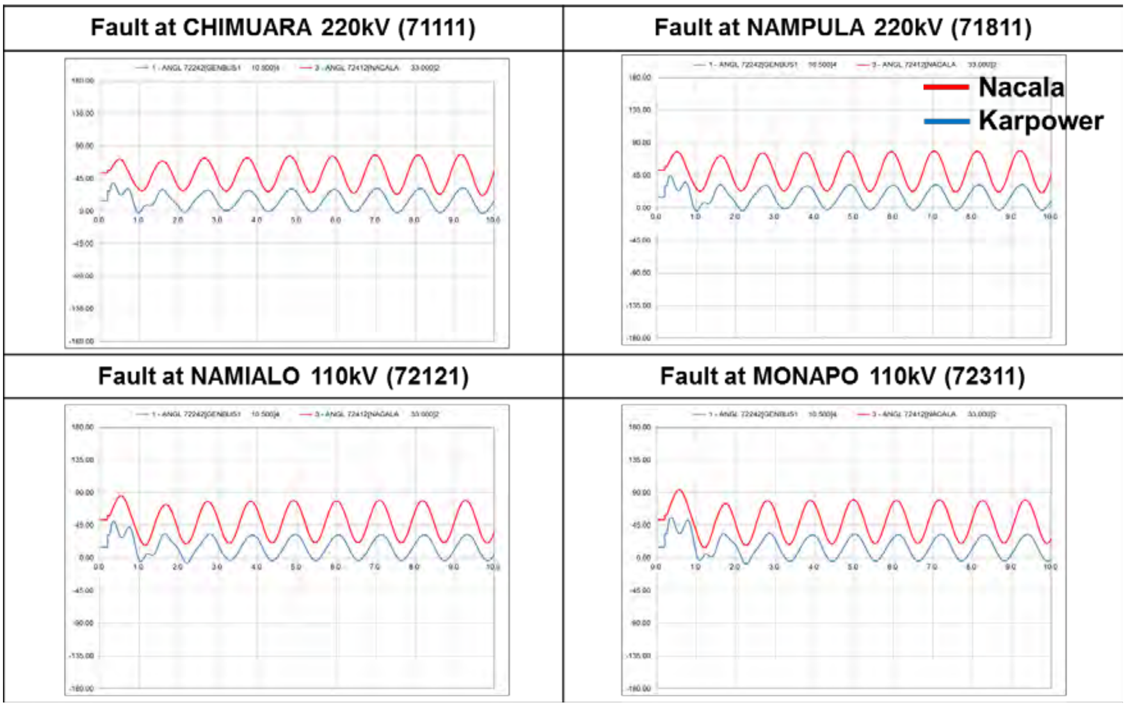


Figure 2-9 Off-peak Demand, 110 kV connection, no PSS

The two results for 33 kV connection and 110 kV connection are compared in Figure 2-10, which shows that in the case of 33 kV connection divergent vibrations are generated causing instability.

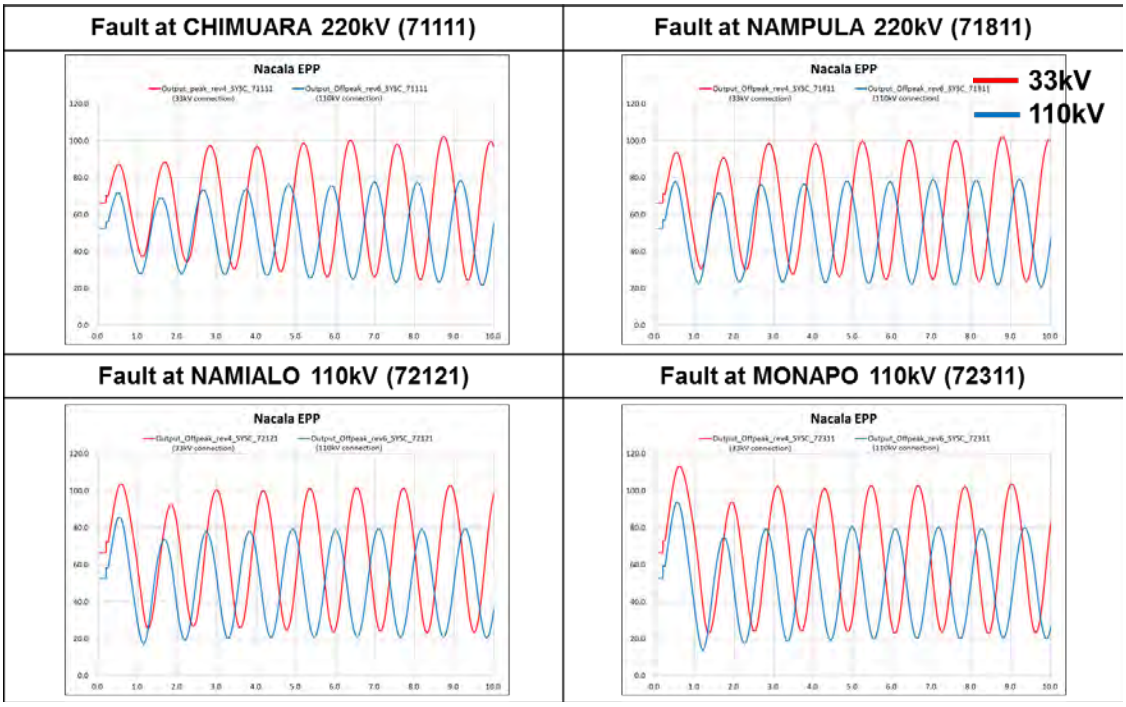


Figure 2-10 Off-peak Demand, Comparison of 110 kV connection and 33 kV connection, no PSS

Also, continuous vibrations are generated in the case of 110 kV connection, but the attenuation is stronger compared with the 33 kV connection, although the condition cannot be described as stable. Therefore, it is considered necessary to add a PSS to the generator, so an investigation was performed with the PSS added under off-peak demand.

c) Off-peak Demand (with PSS)

Under the conditions of off-peak demand with a PSS added to the Nacala EPP, analysis was made for the two cases of 33 kV busbar and 110 kV busbar connections. The results are shown in Figure 2-11 and Figure 2-13, from which it ca n be seen that the attenuation properties are improved by the PSS, but the results show that in the case of 33 kV the attenuation properties are weak and there are still continuous vibrations. On the other hand, in the case of the 110 kV connection with PSS, very good attenuation properties are obtained. The differences in the 110 kV connection and the 33 kV connection are shown in Figure 2-12, which clearly shows the superiority of the 110 kV connection.

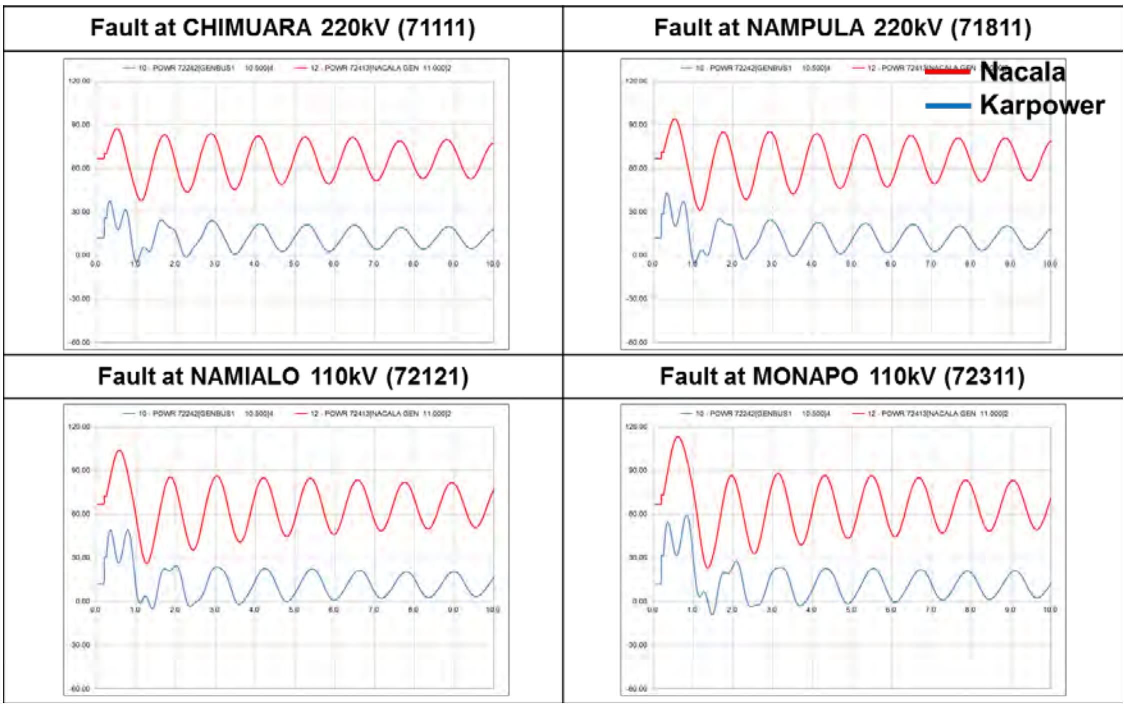


Figure 2-11 Off-peak Demand, 33 kV connection, with PSS

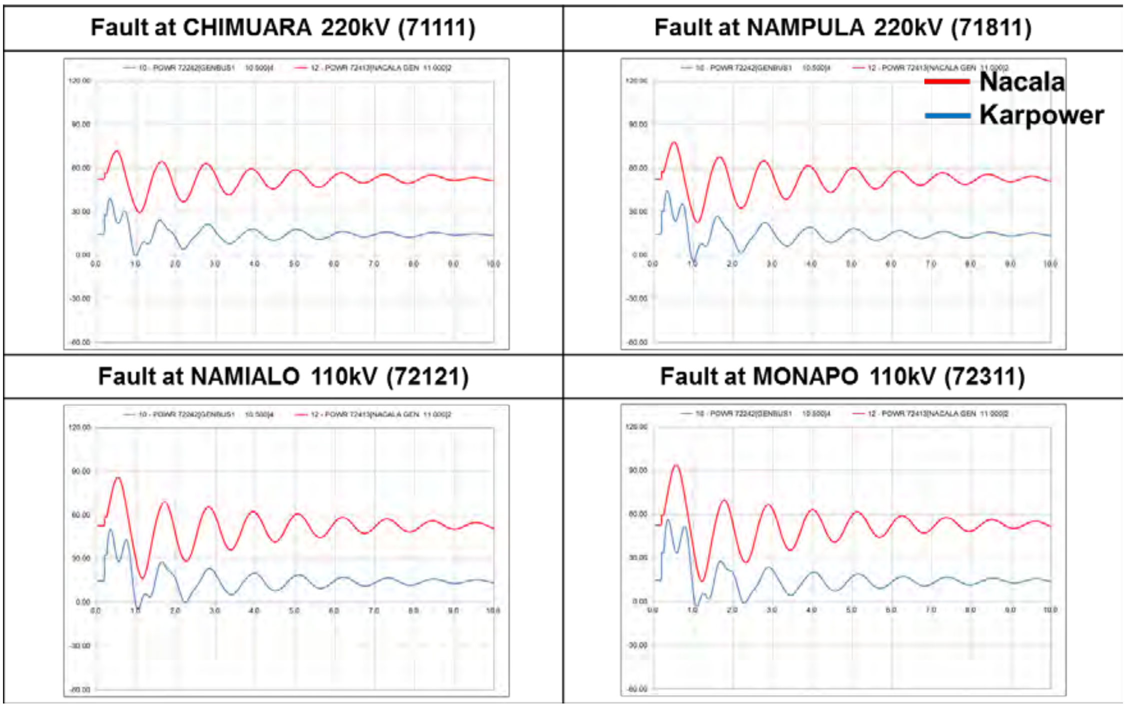


Figure 2-13 Off peak Demand, 110 kV connection, with PSS

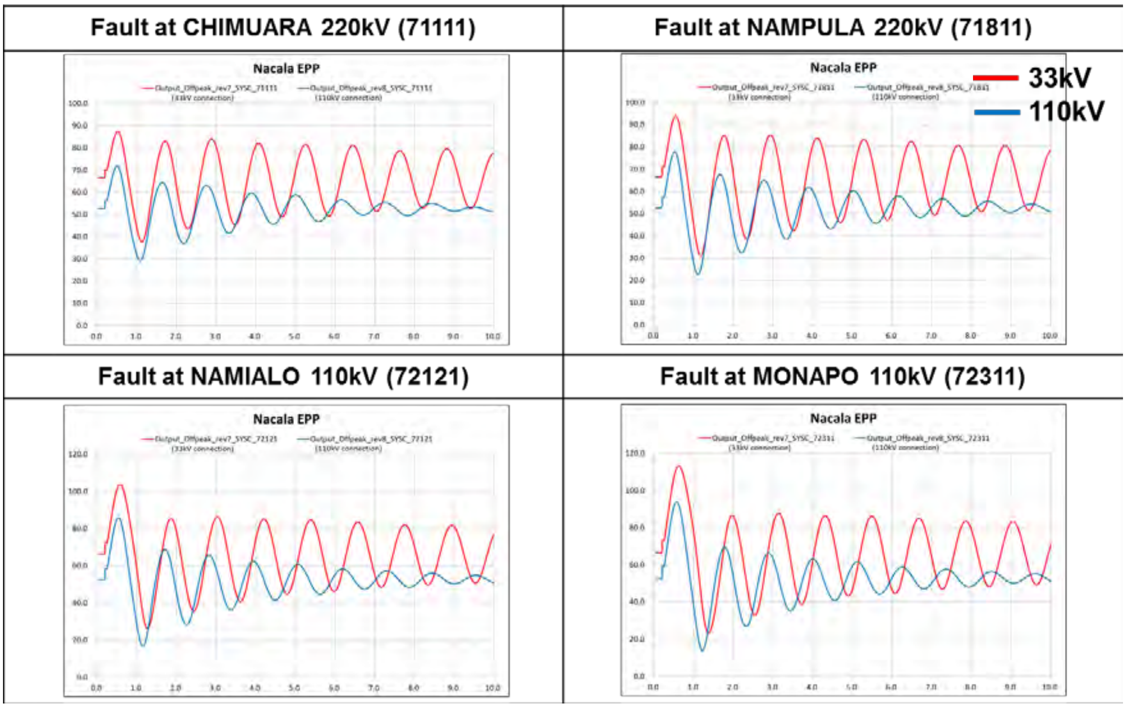


Figure 2-12 Off-peak Demand, Comparison of 110 kV connection and 33 kV connection, with PSS

d) When there is a Delay in Removing the Risk of Breakdown (Off-peak Demand, with PSS)

In the analyses described so far, with the assumption that the risk of breakdown would be removed by the main protective relay, a breakdown duration of 100 ms was adopted. However, analysis was also made with the assumption that the risk of breakdown would be removed by a backup protective relay with a breakdown duration of 200 ms. This analysis was made under the condition of 110 kV connection, and the results are shown in Figure 2-14. From this figure it can be seen that when a breakdown occurs at a location close to Nacala EPP, loss of synchronization occurs at the first wave (first vibration).

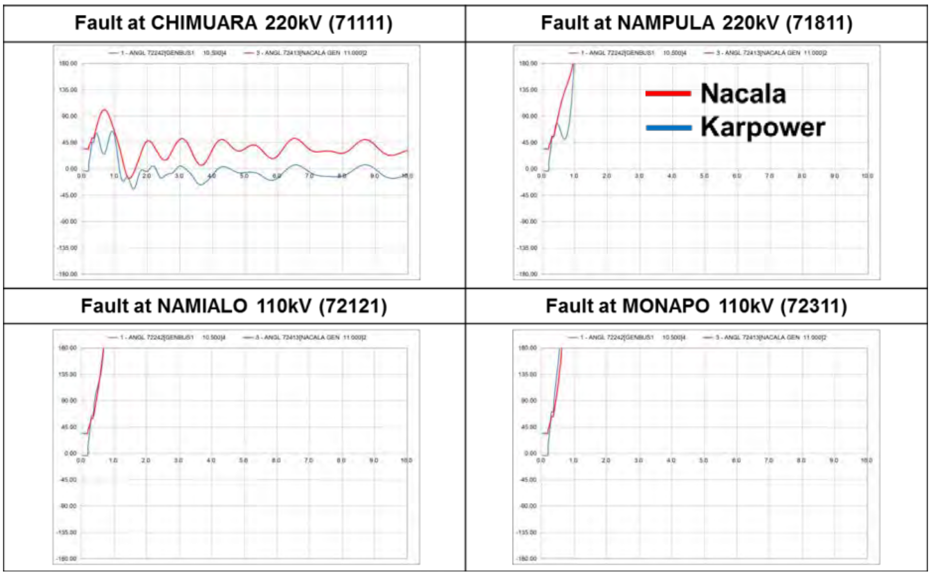


Figure 2-14 Off-peak Demand, Effect of Delay in Removing the Risk of Breakdown

3) Evaluation Based on Analysis Results

a) Connection Busbar Voltage

As stated previously, compared with the 33 kV connection, the 110 kV connection is greatly superior from the point of view of stability, so it was decided that the Nacala EPP should be connected to a 110 kV busbar.

b) Necessity for PSS

From the analysis results for off-peak demand, it was found that without a PSS the attenuation properties are extremely weak and there is concern over the generation of continuous vibrations. Therefore, it is essential to add a PSS which is capable of improving such instabilities.

c) Necessity for Out-of-step Protective Relay

According to the analysis results as described above, when there is a delay in removing the risk of breakdown, there is a possibility of occurrence of loss of synchronization, so it was decided to provide Nacala EPP with an out-of-step protective relay.

2.2.2 Basic Plan (Construction/Equipment Plan)

(1) Overall Plan

(a) Project Scope

Of the equipment proposed by Mozambique to Japan in the "Preparatory Survey on the Nacala Corridor Transmission & Distribution Network Reinforcement Project", it was requested that the power generation facility part be introduced into Nacala Substation with the specifications simplified. As a result of the field survey conducted based on the request from Mozambique, the project scope was determined as shown in Table 2-5.

Table 2-5 Project Scope

	Main equipment	Specification	Quantity
1	Gas Turbine Power Generation Unit, and foundations (if driving piles is required)	≧ 30MW	1 set
2	Fuel oil tanks (including pumps), and foundations (if driving piles is required)	≒ 200kL	1 set
3	Substation facility (transformer, switchgear, control and protection system), and foundations	110kV	1 set
4	Demineralized water system & waste water treatment system, and foundations		1 set (if required)

(b) Outline System Diagram

Figure 2-15 shows an outline system diagram of the power plant and substation facilities to be newly installed.

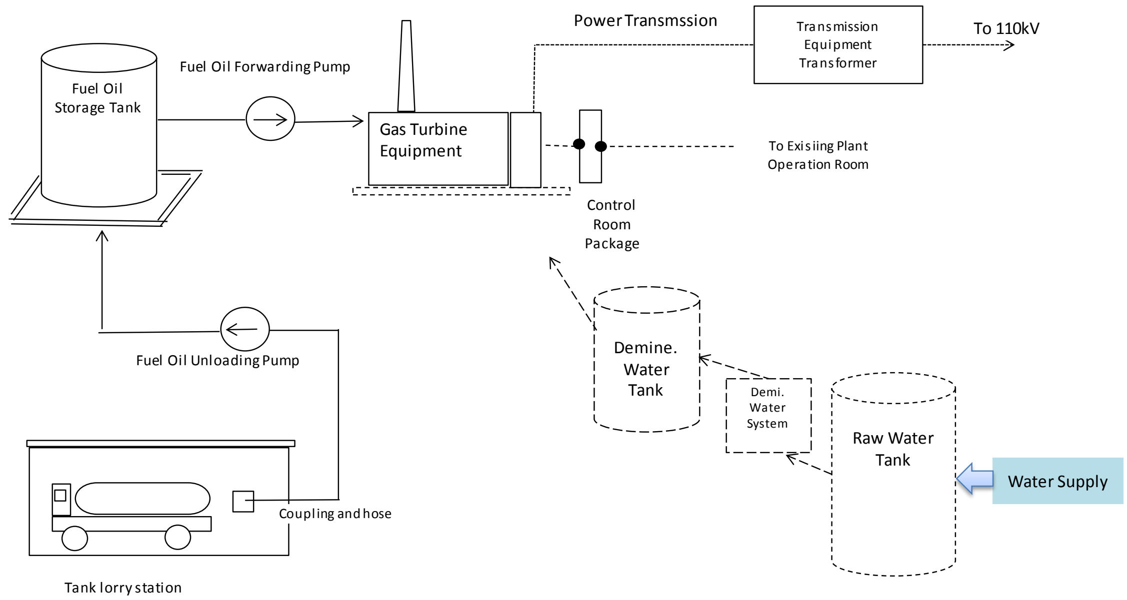
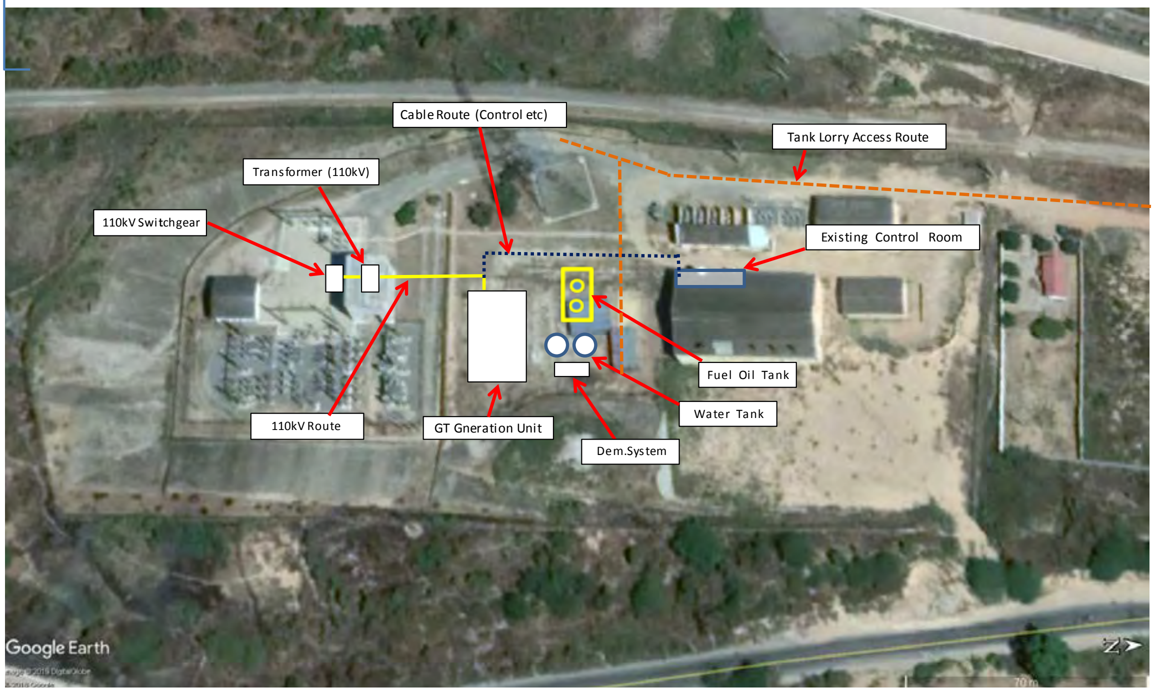


Figure 2-15 Outline system diagram

(c) Layout Plan

Figure 2-16 shows the layout plan for the power plant and substation facility to be newly installed.

A comment was received from EDM that, in order to avoid the sediment inflow from the high ground towards the fuel oil tank, vacant areas on the side of the transformer of the existing substation control building should be used to install the facilities, so the installation location was changed.



(Source: Prepared by Survey Team using Google Earth)

Figure 2-16 Layout Plan

(d) Outline of the Substation Facility and Results of the Field Survey

1) Outline of the Connection of the Emergency Power Plant (EPP) to the Nacala Substation

Regarding the method of connection of the EPP to the Nacala Substation, as a result of a field survey in connection with the 3 cases in Figure 2-17, it was confirmed that apart from the case of using the power receiving switchgear for the barge as the EPP power receiving switchgear (Case 2), the cases were feasible.

According to the results of the PSSE simulation, the system stability of a 110 kV busbar connection (Case 1) was superior to that of a 33 kV busbar connection (Case 3), so a 110 kV busbar connection (Case 1) was proposed to EDM, and it was agreed.

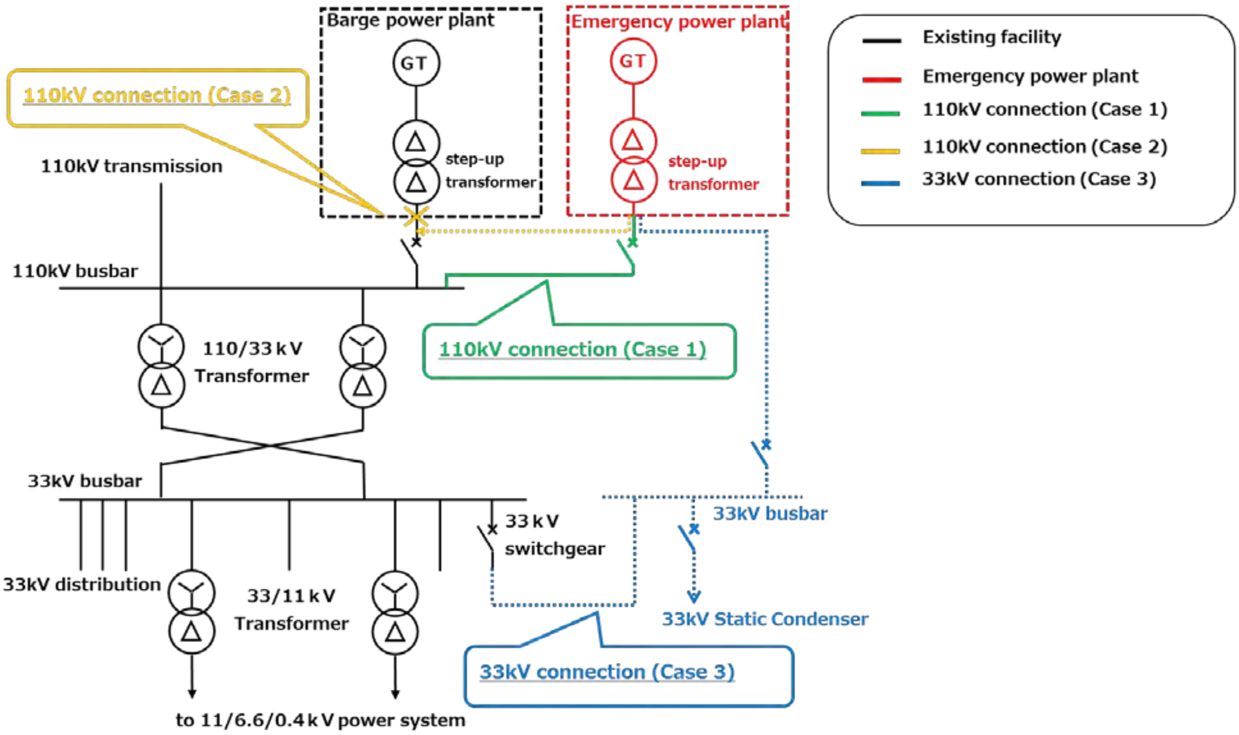


Figure 2-17 Outline of Connection of Emergency Power Plant to Nacala Substation

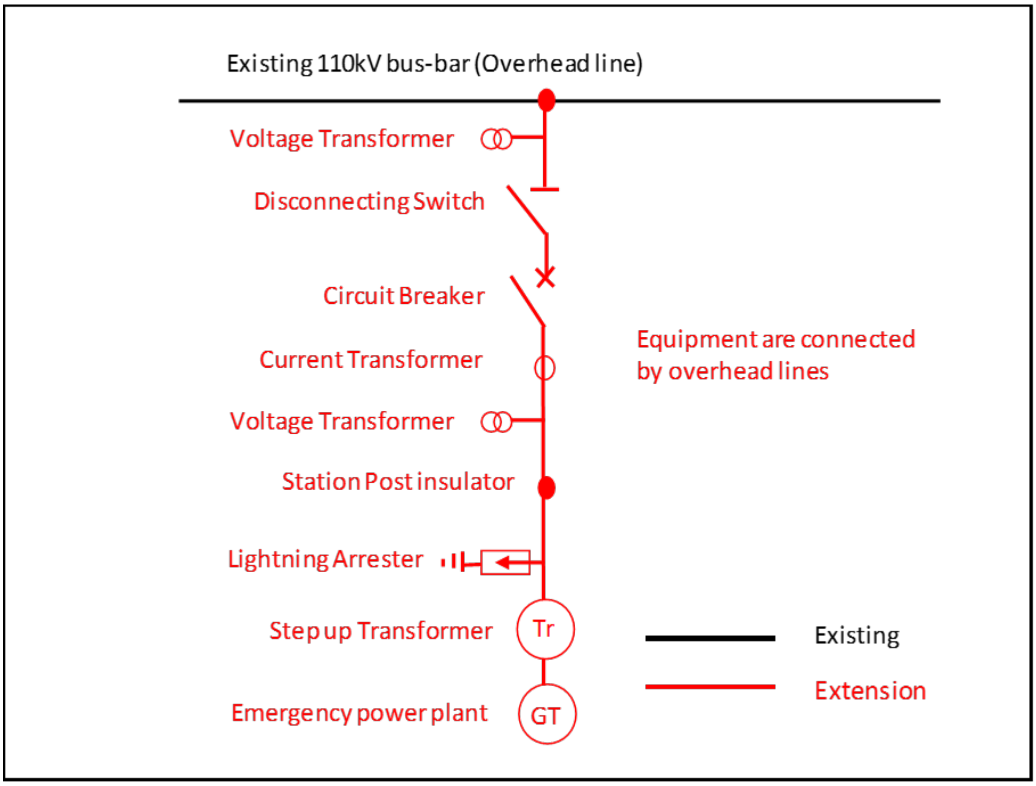
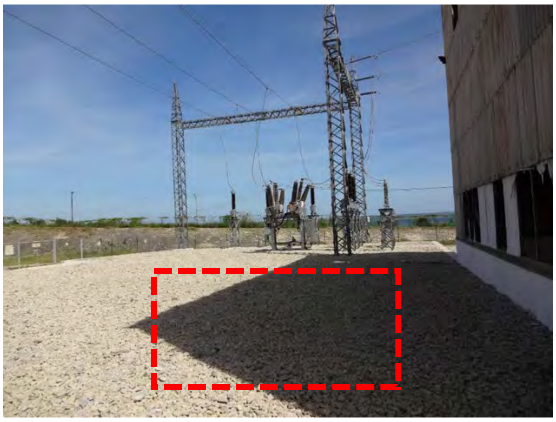


Figure 2-18 Substation Single Line Diagram (for Planning)

a) 110 kV Busbar Connection (Case 1): 110 kV transformer bay installation

The following is an outline of the 110 kV transformer bay installation.

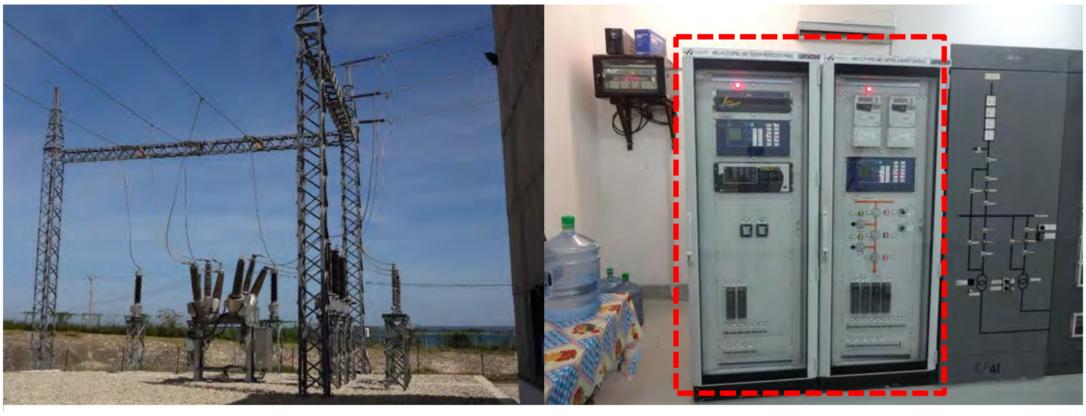
- Installation of the 110 kV transformer bay for receiving the EPP power adjacent to (on the east side of) the barge power receiving facility.
- The 110 kV switchgear to be outdoor AIS type, the same as the existing 110 kV switchgear.
- The connection between the 110 kV switchgear and the step-up transformer to be made via the 110 kV overhead line.
- The connection between the step-up transformer and the power generation facility to be made via the 11 kV power cable.



Photograph 2-1 110 kV Switchgear Installation Location

b) 110 kV Busbar Connection (Case 2): Use of the power receiving switchgear for the barge as the EPP power receiving switchgear

It was found that the power receiving switchgear for the barge (including protection and control panels) was owned by KARPOWERSHIP, so it is not possible to use this switchgear as the EPP power receiving switchgear.



Photograph 2-2 Power Receiving Switchgear for the Barge, and Protection and Control Panels

c) 33 kV Connection (Case 3): 33 kV transformer bay installation

If the EPP power receiving switchgear is 33 kV switchgear for indoor use, the same as the existing, there is no vacant space for the new switchgear in the existing 33 kV switchgear building, so it would be necessary to build a new 33 kV switchgear building. Note that if a new 33 kV switchgear building is to be constructed, it has been confirmed that it can be located to the south side of the existing 33 kV switchgear building.

In order to avoid stopping the 33 kV power line for a long period of time during the 33 kV busbar extension construction period, it would be necessary to extend the 33 kV busbar using the existing condenser circuit.

Photograph 2-3 Location where the 33 kV Switchgear Building can be Installed

2) Installation of Protection and Control System

The results of the field survey regarding the installation of the protection and control system was as follows.

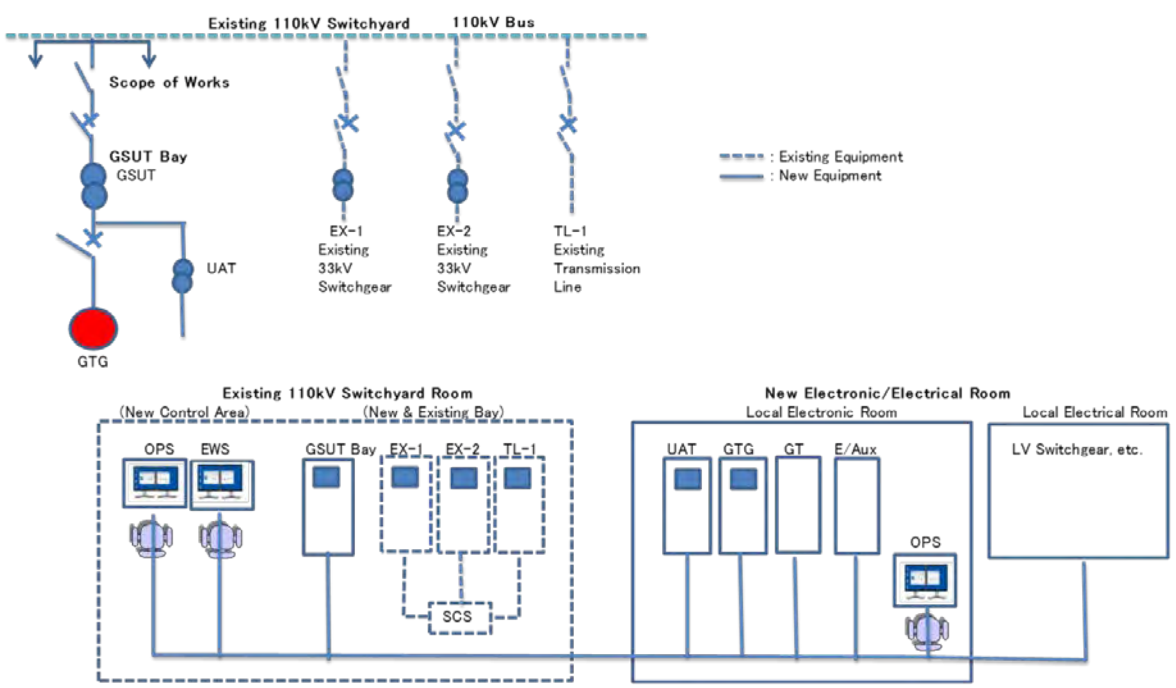
- Installation of the protection and control panels beside the barge control panels within the existing control building.
- The cable route has been provided within the existing control building, so it has been confirmed that it is not necessary to provide a new cable route.
- It is necessary to install a cable trench for the protection and control cables from the 110 kV transformer bay to the existing control room.

Photograph 2-4 Existing Cable Route

- The protection and control system of the 110 kV transformer bay will be connected not to the Substation Control System (SCS) of the Nacala Substation but to the remote monitoring system (OPS: Open Path System) of the gas turbine power plant to be installed in the scope of this project for the monitoring and control of the bay. The Survey Team has explained to EDM and EDM has agreed that the protection and control system of the bay is to be monitored and controlled from the OPS.

  The main reasons for the selection of the connection to the OPS are as follows:

  - By making it possible to monitor and control the power generation plant and substation to be installed in this project from the OPS of the gas turbine power plant, SCS will require no modification if the plant and substation are relocated in future.
  - If the protection and control system of the 110 kV transformer bay is connected to the existing SCS, the software of the SCS will have to be modified and the data submission format of the protection and control system will have to be the same as the data intake format of the SCS. When the emergency plant is relocated to another site, the data submission format of the protection and control system will have to be modified if SCS at the site uses a data intake format different from that of the SCS of the Nacala Substation.



Object Bay	Place of Operation / Monitor	
EX-1 33kV Switchgear	Local Control Panel	SCS
EX-2 33kV Switchgear	Local Control Panel	SCS
TL-1 Transmission Line	Local Control Panel	SCS
GSUT Bay	**Local Control Panel**	**OPS & Electronic Room OPS**

Note:

GT OPS:	GT Operator Station
GSUT:	Generator Step Up Transformer

Figure 2-19 Conceptual Diagram of Connection of Monitoring and Control System

(2) Equipment Plan

Based on the basic plan and overall plan as described above, the equipment required for this project has been planned, and the list of equipment and outline specifications are shown below.

Table 2-6 List of Equipment for the Nacala Emergency Power Plant

No.	Equipment name	Quantity	Units	Applicable standards	Notes
1	Nacala Emergency Power Plant				
1-1	Gas Turbine Power Generation Unit				
EPP-01	Gas turbine	1	set	JIS, international standards, manufacturer's standards, etc.	
EPP-02	Generator	1	set	IEC manufacturer's standards, etc.	
EPP-03	Power plant control system	1	set	JIS, manufacturer's standards, etc.	
EPP-04	Power plant electrical equipment	1	set	JIS, IEC, IEEE manufacturer's standards, etc.	
1-2	Fuel oil tanks				
EPP-05	Fuel oil tanks	1	set	NFPA	
1-3	Substation facility				
EPP-06	Transformer	1	set	IEC	
EPP-07	Switchgear	1	set	IEC	
EPP-08	Control and Protection System	1	set	IEC	
1-4	Demineralized water system & waste water treatment system (if necessary)				
EPP-09	Demineralized water system (if necessary)	1	set	International standards, manufacturer's standards, etc.	If water for NOx reduction is required,
EPP-10	Waste water treatment system (if necessary)	1	set	International standards, manufacturer's standards, etc.	If water for NOx reduction is required,
1-5	Demineralized water production device				
EPP-11	Demineralized water production device	1	set	International standards, manufacturer's standards, etc.	If EPP-09 is supplied, this is not provided.

Table 2-7 Specifications of equipment for Nacala Emergency Power Plan

Equipment No.:	1	Equipment name:	Nacala Emergency Power Plant	Quantity:	1 set
Component No.:	1-1	Component Name:	Gas Turbine Power Generation Unit	Quantity:	1 set

Purpose of use:
Installation of Gas Turbine Power Generation Unit, a unit of Nakala Emergency Power Plant

Component

EPP-01.	Gas turbine	: 1 set
EPP-02.	Generator	: 1 set
EPP-03.	Power plant control system	: 1 set
EPP-04.	Power plant electrical system	: 1 set

Specifications

EPP-01 Gas turbine

(1)	Type	:	Aero-Derivative Gas Turbine
(2)	Rating (ISO condition)	:	Manufacturer's standards
(3)	Thermal efficiency (ISO conditions)	:	Manufacturer's standards
	Fuel consumption	:	In accordance with the manufacturer
(4)	Combustor	:	Manufacturer's standards
(5)	Lube Oil System	:	Air cooled type
(6)	Air inlet system	:	Inlet Air Filter, Silencer, FOD Protection Screen
(7)	Stack	:	Height 9 m or higher
(8)	Fire Fighting System	:	CO_2 fire extinguisher
(9)	Protection Device	:	Protection Device shall be equipped with necessary functions for Gas Turbine Unit
(10)	Enclosure	:	Steel made (with internal noise absorbing material)
(11)	Accessories	:	Special tools (if necessary), etc.
(12)	Auxiliary equipment	:	1) Compressor Blade Washing Device 2) Fuel Oil Transfer Pump (Fuel Oil Tank to Gas Turbine) 3) Pipe, Valve etc. (Fuel Oil Tank to Gas Turbine)
(13)	Operation Records	:	There shall be sufficient actual operating time records with oil fuel burning or gas fuel burning in specific engines respectably.
(14)	Special requirement	:	The operating time records shall be submitted.

EPP-02 Generator

(1)	Type	:	Rotating Field type three-phase alternating current synchronous Generator
(2)	Number of poles	:	Manufacturer's standards
(3)	Number of phases	:	3
(4)	Maximum Power	:	To match Gas turbine maximum power output
(5)	Rated capacity	:	To match Gas turbine maximum power output
(6)	Rated frequency	:	50 Hz
(7)	Terminal voltage	:	Manufacturer's standards
(8)	Power factor	:	0.85 (lagging), -0.95 (leading)

(9)	Rotor Cooling System	:	Manufacturer's standards
(10)	Stator Cooling System	:	Manufacturer's standards
(11)	Nutral grounding system	:	Manufacturer's standards
(12)	Excitation System	:	Manufacturer's standards (including AVR, PSS function)
(13)	Generator protection System	:	Microprocessor based numerical protection relay (including protection for out of step)
(14)	Accessories	:	Special tools (if necessary), etc.

EPP-03 Power plant control system

(1)	Power plant control system	:	The power plant shall have a function to enable automatic operation and control.
(2)	Power plant monitoring and operating system (Local)	:	The local control room shall have the function to enable starting and stopping operations, control of the various equipment and processes, monitoring, recording of trends, and determining alarms.
(3)	Fire Fighting operation board	:	This board shall have a function that enables monitoring and operation of the gas turbine fire fighting system.
(4)	Engineering Work Stattion (EWS)	:	These shall have functions that enable setting and changing of the control system, etc.
(5)	HVAC	:	This shall have a function that enables temperature adjustment, etc., of the control room.
(6)	Power plant monitoring and operating system (the existing control room)	:	- A monitor, personal computer, printer, desk, etc., shall be installed in the control room of the existing substation. Power plant monitoring and operating system shall have the function to enable starting and stopping operations, control of the various equipment and processes, monitoring, recording of trends, and determining alarms. - Cables shall be installed to the control room in the existing substation. - Telephones shall be installed between the local control room and the existing control room. - The power output and status of the switchgear of the generator shall be displayed on a monitor for the substation equipment to be installed in the control room in the existing substation.
(7)	CEMS	:	The device shall have a function capable of continuous monitoring of SO_2, NO_2, dust, O_2, etc. Also, the device shall enable monitoring at the local control room and the existing control room.
(8)	Accessories	:	As required
(9)	Auxiliary equipment	:	Compressed air supply system, etc.

EPP-04 Power plant electrical system

(1)	Electrical power supply system	:	The equipment shall include unit transformers, switchgears, uninterruptible power supply system (UPS), DC power system, Electnic control panels, emergency diesel generator, and other necessary

			equipment, and shall have the function to supply the necessary electrical and control power for power plant.
(2)	Generator circuit breaker	:	For synchronigation of generaror
(3)	Protective device	:	The device shall have a function for protecting each item of equipment/ system
(4)	Accessories	:	Cable and cabling system, grounding system, lighting and small power supply system, Lightning arrester, etc.

Equipment No.: 1	Equipment name: Nacala Emergency Power Plant	Quantity: 1 set
Component No.: 1-2	Component Name: Fuel oil tanks	Quantity: 1 set

Purpose of use:

Facilities for storage of fuel oil to be supplied to the gas turbine power plant within the Nacala Emergency Power Plant.

Component

EPP-05 Fuel oil tanks : 1 set

Specifications

EPP-05 Fuel oil tanks

(1)	Fuel oil tank type	:	Steel plate cylindrical type
(2)	Fuel oil tank capacity	:	$100m^3$ ×2 units or more
(3)	Fuel oil tank effective capacity	:	Shall provide the necessary capacity for 2 days at 100% power output and 8 hours continuous operation under the guaranteed conditions.
(4)	Firefighting equipment	:	The necessary firefighting equipment shall be installed.
(5)	Accessories	:	Ladder or staire,cradle, piping, valves, oil level gauge, equipment lighting, etc.
(6)	Receiving pumps	:	Shall have the capacity to unload a tank truck (38 kL) within 2 hours.
(7)	Oil weir	:	Shall have the required capacity during a tank leakage.
(8)	Special notes	:	- Shall have the function to enable the operation of receiving from a tank truck on site. - It shall be possible to operate and monitor (level of the fuel oil tank, pump operation status, etc.) the device from the local control room and the existing control room. - It shall be envisaged that fuel oil will be received at night time, so lighting shall be installed at the location on site where the fuel oil receiving operation is performed.

Equipment No.:	1	Equipment name:	Nacala Emergency Power Plant	Quantity:	1 set
Component No.:	1-3	Component Name:	Substation facility	Quantity:	1 set

Purpose of use:

Facility for transmitting 110 kV electric power generated by the gas turbine and generator unit within the Nacala Emergency Power Plant to the Nacala Substation.

Component

EPP-06	Transformer	: 1 set
EPP-07	Switchgear	: 1 set
EPP-08	Control and protection system	: 1 set

Specifications

EPP-06 Transformer

(1)	Type	:	Outdoor type
(2)	Rated primary voltage	:	In accordance with the generator voltage
(3)	Rated secondary voltage	:	110 kV
(4)	Rated capacity	:	In accordance with the generator capacity
(5)	Phase connection	:	YNd11
(6)	Cooling method	:	In accordance with the manufacturer's standards
(7)	Number of phases	:	3
(8)	Rated frequency	:	50 Hz
(9)	Rated short time withstand current	:	31.5 kA (1 s)
(10)	Impedance	:	15% or less
(11)	No-load tap changer	:	Tap voltage: 110 kV +5% to -5% Number of taps: 5 taps Step voltage: 2.5%
(12)	Bushing (minimum creepage distance)	:	31 mm/kV
(13)	Accessories	:	BCT for neutral point, Insulation oil, Buchholz relay, Oil level gauge, Oil temperature gauge, Pressure release device, Dehydrating breather, Elevating ladder, Handle for tap changer, etc.
(14)	Auxiliary equipment	:	Power cables Power cable ancillary items (compression terminal, etc.)
(15)	Special notes	:	Aux. Power (AC/DC) shall be supplied from the generating plant. Grounding wire shall be connected.

EPP-07 Switchgear

(1)	Circuit breaker, Disconnecting switch	:	Outdoor type for 110 kV connection Circuit breaker: SF6 gas insulated Disconnecting switch, etc.: Air insulated (AIS)
(2)	Rated voltage	:	110 kV
(3)	Number of phases	:	3
(4)	Rated frequency	:	50 Hz
(5)	Rated current	:	2,500 A or more
(6)	Rated short time withstand	:	31.5 kA (1s)

		current		
	(7)	Bushing (minimum creepage distance)	:	31 mm/kV
	(8)	Accessories	:	Operating box, Supporting steel structure, Manual operating handle, etc.
	(9)	Auxiliary equipment	:	Current transformer, Voltage transformer, Lightning arrester, Station post insulator, Supporting steel structure, Over-head wire, Over-head wire ancillary items (compression terminals, etc.)
	(10)	Special notes	:	Aux. Power (AC/DC) shall be supplied from the generating plant. Grounding wire shall be connected.
EPP-08	Control and protection system			
	(1)	Control panel	:	1) Shall include a function that enables operation and monitoring of switchgear, etc. 2) Install a monitor for substation equipment in the existing substation control room, and monitor and control the switchgear from the remote plant monitoring operation equipment installed in the power plant control equipment. In addition, the status of the generator output, etc. (MW, Var, A) and the open / close status of the generator breaker shall be indicated on the substation equipment monitor.
	(2)	Protection panel	:	A function for protecting the transformer, etc., shall be provided.
		1) Main protection	:	Current differential Ry, Overcurrent Ry, Ground fault overcurrent Ry
		2) Backup protection	:	Overcurrent Ry, Ground fault overcurrent Ry
	(3)	Installation location	:	Within the control room in the existing substation
	(4)	Auxiliary equipment	:	Protection and control cables, Grounding cables, etc.
	(5)	Special notes	:	Aux. Power (AC/DC) shall be supplied from the generating plant. After removal of the old control panel, control and protection panel shall be installed, and if there are any openings they shall be protected. Grounding wire shall be connected.

Equipment No.: 1	Equipment name: Nacala Emergency Power Plant	Quantity: 1 set
Component No.: 1-4	Component Name: Demineralized water system & waste water treatment system (if necessary)	Quantity: 1 set

Purpose of use:

Systems for demineralized water used for Gas Turbine water injection in case which is a necessary countermeasure for NOx reduction, and for processing the wastewater after generating the demineralized water within the Nacala Emergency Power Plant.

Component

EPP-9	Demineralized water system (if necessary)	: 1 set
EPP-10	Waste water treatment system (if necessary)	: 1 set

Specifications

EPP-9 Demineralized water system (if necessary)

(1)	Processing capacity	: The system shall have the capacity to supply the required quantity of demineralized water for a countermeasure against NOx.
(2)	Operation monitoring	: - It shall be possible to operate and monitor the system from the local control room. - It shall be possible to monitor the system from the existing control room.
(3)	Accessories	: Ladder or stair, cradle, piping, valves, tanks, water level gauge, pumps, equipment lighting, and other necessary items.

EPP-10 Wastewater treatment system (if necessary)

(1)	Processing capacity	: The system shall have the capacity to enable the wastewater generated from the demineralized water system to be processed to satisfy the wastewater standards.
(2)	Operation monitoring	: - It shall be possible to operate and monitor the system from the local-control room. - It shall be possible to monitor the system from the existing control room.
(3)	Accessories	: Ladder or stair, cradle, piping, valves, tanks, water level gauge, pumps, equipment lighting, and other necessary items.

Equipment No.: 1	Equipment name: Nacala Emergency Power Plant	Quantity: 1 set
Component No.: 1-5	Component Name: Demineralized water production device	Quantity: 1 set
Purpose of use: Production device of demineralized water used for Gas Turbine compresser blades'pediodic washing.		
Component EPP-11 Demineralized water production device : 1 set		
Specifications EPP-11 Demineralized water production device (1) Processing capacity : The device shall have the capacity to supply the required water quality and quantity of demineralized water for the Gas Turbine compresser blades washing. (2) Operation monitoring : Operation and monitoring shall be possibile on the device. (3) Accessories : Necessary items such as pipe, valves, tanks etc.		

(3) Facilities Plan

In projects for constructing power plant such as this project, the foundation design for each item of equipment is performed by the supplier, based on the loading conditions of each item of equipment to be procured. However, at the present stage, it is envisaged that the approximate cost shall be estimated based on the following.

1) Gas Turbine and Generation Unit

a) Gas Turbine Package Fundations

Foundations for the gas turbine package such as gas turbine, generator, intake air filter, etc. (There is a possibility that piling will be required depending on the equipment weight)

b) Electrical room, Control room Foundations

It is envisaged that a container type shed will be installed on continuous footings.

c) Auxiliary equipment, Emergency generator Foundations

Direct foundations are envisaged for each item of equipment.

2) Fuel oil Tanks

a) Oil Weir and Tank Foundations

The following are envisaged.

・The height of the oil weir shall be 1.2 m.

・The outer periphery of the fuel oil tank foundations shall be ring foundations, and the inside of the ring foundations shall be filled with fine sand.

・Ground improvement shall be carried out on the underside of the oil weir and the tank using rubble concrete.

3) Substation facility

a) Transformer Foundations

Direct foundations including an oil weir of height 1.0 m

b) Switchgear and Control and Protection System foundations

Direct foundations for each item of equipment is envisaged.

4) Others

a) Cable Trench

A cable trench with effective internal cross-sectional dimensions 1.0 m × 1.0 m is envisaged for power cables from the generating unit to the transformer. A cable trench with effective internal cross-sectional dimensions 0.5 m × 0.5 m is envisaged for control cables between the control and gas turbine package and the existing control room.

b) Pipe Sleepers

Pipe sleepers having direct foundations are envisaged for installation of the fuel pipes between the gas turbine package and the fuel oil tank.

2.2.3 Implementation / Procurement Plan

2.2.3.1 Implementation / Procurement Policy

(1) Policy for Equipment Procurement and Implementation

It is necessary under this project to procure highly reliable equipment. Equipment for which Japanese manufacturers have a technological advantage shall be procured in Japan, while general-purpose equipment and materials/supplies that can be procured overseas at lower costs shall be procured mainly in third countries. The procurement of equipment such as the gas turbine power generation unit, fuel tanks, and substations shall be conducted based on the policy as follows: As all the equipment to be procured in the project is not manufactured locally, there will be no local procurement of equipment in this project.

1) Gas Turbine Power Generation Unit

Gas Turbine Power Generation Unit manufactured by Japanese manufacturers that show Japan’s technological advantages shall be procured under this project. They shall have specifications based on standards including JIS, international standards and manufacturer’s standards.

2) Fuel Oil Tanks

As the fuel tanks are general-purpose equipment, they can be procured in third countries for cost saving purposes so long as they have specifications based on NFPA international standards.

3) Substation facility

As substation facility is general-purpose equipment, they can be procured in third countries for cost saving purposes so long as they have specifications based on IEC international standards.

4) Water Treatment Facilities (if necessary)

As water treatment facilities are general-purpose facilities, they can be procured in third countries for cost saving purposes so long as they have specifications based on international standards, manufacturer's standards, etc.

5) Demineralized water production device

As demineralized water production device is general-purpose device, they can be procured in third countries for cost saving purposes so long as they have specifications based on international standards, manufacturer's standards, etc.

When procuring equipment, it is important to confirm not only that the specifications provided in the tender documents are met, but also that after-sales service systems are well established, for example, whether maintenance can be performed easily and whether support or spare parts can be promptly provided when any trouble occurs. Equipment that meets these conditions shall be chosen.

It is necessary that the manufacturer’s technicians install, commission and test-run the equipment as well as offer guidance/instruction for initial operation and full-scale operation (maintenance). Usually, the labor for installing the equipment has to be provided by workers with experience in this type of work, but it is significantly difficult to find such workers locally in Mozambique, as has already been experienced in the previous construction works for the Maputo Thermal Power Plant that were implemented in the city of Maputo in Mozambique. Therefore, based on such experience in the Maputo Thermal Power Plant Construction Project in which a similar construction program was implemented, it is planned to establish a policy to employ quality workers in third countries and appoint them to support workers employed in Mozambique and to transfer technology to them under the supervision of the manufacturer’s technicians.

(2) Procurement and Implementation Policy Regarding Facilities

The facilities necessary for this project (equipment foundations and cable trenches) can be constructed using traditional construction methods and specifically high-level technological capability is not necessary. As a result, it is considered that these works can be contracted to local construction companies, while it will be necessary to dispatch technicians specialized in civil engineering from Japan for quality management and work schedule control. In addition, the detailed design of the facilities should be carried out by appropriate structural designers who have experience in civil engineering related to power plants.

2.2.3.2 Points to Note during the Implementation/Procurement Processes

(1) Transportation of Equipment

The gas turbine, generator and transformer to be procured weigh approximately 50-75 t including packing materials for transportation and they have to be transported in such a way so as not to cause any huge shock to the equipment in both the lengthwise and crosswise directions. In addition, especially when transporting equipment inland in Mozambique, arrangements will need to be made with the local road management agency and the police as the travel speed of the transportation trailers will be slow.

With respect to transportation of heavy equipment, a field survey was conducted to find out if there will be any problems in Mozambique including problems concerning unloading, inland transportation and on-site equipment handover/installation.

1) Unloading

The port where the equipment will be unloaded in Mozambique is the port of Nacala located near the project site, but the port has no wharf machinery strong enough to unload cargo of such weight as above mentioned. It is planned, therefore, that the procured heavy equipment will be transported by sea on a ship equipped with a crane that can unload the heavy cargo at the port. When the ship arrives at the port of Nacala, a multi-axle trailer will be there to be loaded with the cargo directly from the ship.

2) Inland Transportation

As a result of the above-mentioned field survey, it was found that such multi-axle trailers that can carry the heavy equipment are available in Mozambique.

Also, the route for inland transportation from the port of Nacala to the project site where the existing Nacala Substation is was inspected on-site. Although it will be necessary to improve the unpaved roads from the end of the paved road on the east side of the Nacala Substation to the gate of the Nacala Substation by reinforcing and leveling with crushed stones, this reinforcing work can be conducted locally. Aside from this issue, no other obstacles were found to transportation of such heavy equipment. Details of the survey results are shown in Reference-7.

3) On-site Unloading and Installation

For on-site unloading and installation of the procured heavy equipment, a crane that can lift and unload the heavy equipment will be necessary and according to our survey, it was found that self-propelled cranes of 250-ton class are available locally in Mozambique. Therefore, unloading and installation of the heavy equipment on-site is possible.

4) For work to relocate the emergency power plant to a new location in the future, the above-mentioned multi-axle trailers and cranes can be employed.

(2) Construction Process of the Emergency Power Plant

The Nacala Emergency Power Plant is planned to be constructed on the premises of the existing Nacala Substation. There exist 110kV transmission lines above the planned construction site and, therefore, due safety management measures will have to be taken to secure enough space between the lines and the heavy equipment such as cranes and back hoes when they are used at the construction site.

2.2.3.3 Allocation of Implementation Work/Procurement and Installation Works

Table 2-8 shows the allocation of different works for implementation/procurement and installation of this project between Japan and Mozambique.

Table 2-8 Work Allocation between Japan and Mozambique

No.	Work Items	Japan	Mozambique
1.	**Preparation work**		
1-1)	Securement of construction site (access roads, temporary storage place for materials, supplies and equipment, office for construction works, parking space)		○
1-2)	Installation of temporary storage places for materials, supplies and equipment and office for construction works	○	
2)	Road surface leveling works for unpaved road running to the Nacala Substation		○
3)	Land improvement and surface leveling of the construction site		○
	1) Measures against inflow of earth and sand from h on the east side of the Nacala Substation (as needed)		(○)
	2) Removal works for remaining foundations at the former power plant (as needed)		(○)
	3) Removal of existing containers that were temporarily set up		○
4)	Step up transformer and switchgear for protection/control panel		
	1) Removal of existing transformer maintenance building		○
	2) Reinforcement of existing cable trenches		○
	3) Removal of the old control panels located in the existing control room		○
	4) Install the new control and protection panel, connection to the OPS of the gas turbine power plant	○	
5)	Supply of water and installation of a sewerage system (drainage) for operators (as needed)		(○)
6-1)	Preparation of power supply points (connection points in the existing substation) for construction works within the construction area and supply of power (including tariff)		○
6-2)	Installation of facilities to supply power needed for construction works within the construction area (from the connecting points)	○	
7-1)	Preparation of water supply points (connection points in the existing substation) for the construction area and supply of water (including water fee)		○
7-2)	Installation of water supply facilities within the construction area (from the connecting points)	○	

No.	Work Items	Japan	Mozambique
8-1)	Construction of fences and gates at the Nacala Substation (as needed)		○
8-2)	Installation of temporary fences and gates for the emergency power plant construction area	○	
9)	Advance procedures necessary for receiving tax exemption		○
10)	Procedures for acquiring licenses/approvals necessary for the commencement of construction works		○
11)	Acquisition of EIA license prior to the commencement of construction works		○
2.	**Emergency power plant facilities installation work**		
1)	Installation of equipment, commissioning/test-run, guidance/instruction for initial operation and full-scale operation	○	
	1) Gas Turbine Power Generation Unit (gas turbine, generator, electric equipment and control system)	○	
	2) Fuel oil tanks (fuel tanks and receiver pumps)	○	
	3) Substation facility (transformer, switchgear and protection/control system)	○	
	4) Water treatment facilities (demineralization and wastewater treatment) (as needed)	(○)	
	5) Procurement of equipment to manufacture demineralized water for washing gas turbine blades	○	
2)	Foundation works for equipment and pile driving (as needed)	○	
3)	Improvement of access roads for transportation for heavy equipments etc.		○
4)	Maintenance and improvement of access roads for tank trucks after the construction of the emergency power plant is completed		○
5)	Maintenance and improvement of the area surrounding the equipment within the construction area (external structures, crushed stones, etc.) (as needed)		(○)
6)	Installation of water supply pipes from the water distributing pipe to the construction area (as needed)		(○)
7)	Until equipment handover		
	1) Power blackout within the area where construction will be carried out for the project in order to install 110kV switchgears (including removal of the bus wire and bypassing works)		○
	2) Works to connect to 110kV transmission line		○
	3) Travel costs and hotel and living expenses if attendance at the on-site inspections at the manufacturer's factory is necessary		○
	4) Costs to procure fuel oil and service water (as needed) for the test-run period		○
	5) Securement of a temporary office for the consultant		○
	6) Securement of operation and maintenance personnel for the power plant		○

No.	Work Items	Japan	Mozambique
8)	Operation and maintenance (after equipment handover)		
	1) Procurement of fuel oil and service water (as needed)		○
	2) Personnel costs (operation and maintenance personnel)		○
	3) Maintenance costs (LTSA, etc.)		○
3.	**Common items**		
1)	Marine transportation from the country where equipment was procured to Mozambique	○	
2)	Works to be implemented for tax exemption and customs clearance at the port of discharge		○
3)	Inland transportation from the port of discharge to the project site	○	
4)	Tax exemption procedures concerning the project implementation		○
5)	Provision of benefits to those concerned on the Japanese side engaged in equipment procurement and facilities construction including benefits related to immigration formalities and tax exemption		○
6)	Implementation of appropriate operation and maintenance after the introduction of equipment and facilities		○
7)	Cost sharing for items not included in the grant aid project (to be borne by the Mozambican government) that may arise during procurement and construction works		○
8)	Commission payment to Japanese banks in relation to the authorization to pay (A/P) based on the bank arrangement (B/A)		○
9)	Commission payment to Japanese banks in relation to the payment based on the bank arrangement (B/A)		○

(　): As needed

2.2.3.4 Implementation Work Supervision Plan/Procurement Supervision Plan

(1) Procurement and Implementation Work Supervision Plans (Equipment)

1) Manufacturing of Equipment

Prior to the commencement of manufacturing in the factory, the consultant’s technical inspectors will confirm the content of the production drawings that will be provided by the manufacturer of the equipment. Manufacturing in the factory shall be implemented after the production drawings are approved.

2) Completion Inspection

The completion inspection of the Gas Turbine Power Generation Unit manufactured in Japan shall be implemented at the manufacturer’s factory prior to shipping, concerning whether each function meets the relevant specifications including performance testing. The inspection will be led by the manufacturer of the equipment, while the consultant’s technical inspectors will be present to confirm technical matters.

The completion inspection of the equipment to be procured in third countries shall be implemented through documentary inspection of the results of the tests performed at the manufacturer’s factory to confirm whether the specifications of each function are met as well as to confirm the performance.

3) Transportation of Equipment (Pre-shipment inspection)

For the Gas Turbine Power Generation Unit manufactured in Japan, pre-shipment inspection will be contracted to a third-party organization. The place of this inspection will be the warehouse where the equipment is kept at the port of shipment.

For equipment to be procured in third countries, pre-shipment inspection will be implemented under the responsibility of the manufacturer and the results of such inspection will be submitted to the consultant’s technical inspectors.

4) Installation of Equipment

After the procured equipment arrives in Mozambique, the procurement manager of the procurement service provider will implement an appearance inspection and confirm whether or not the equipment has any damage, in the presence of the consultant’s technician technician in charge of procurement supervision.

With respect to construction of facilities such as the Gas Turbine Power Generation Unit, fuel oil tanks and substation facility, the consultant’s technician in charge of procurement supervision will be present to confirm the following matters together with the procurement manager of the procurement service provider.

- Confirmation of the installation conditions of each of the facilities
- Confirmation of whether or not the implementation works have been conducted precisely in accordance with the drawings

When starting installation of the Gas Turbine Power Generation Unit, fuel oil tanks and substation facility, and at appropriate times during the period of the construction works, the consultant’s technician in charge of procurement supervision will be present at the construction works. When starting the installation works for these facilities, confirmation will be carried out as to whether or not the foundations for installing the facilities have been built accurately in accordance with the drawings as well as confirmation of their transportation condition (confirmation of the gravitation acceleration recorder) and installation condition. At the period of the construction works, confirmation will be carried out as to whether the works are progressing as scheduled as well as whether the facilities are installed as shown in the drawings.

5) Commissioning and Test-run

As soon as the fuel oil tanks are installed, the fuel oil acceptance test will be conducted. In addition, as soon as the substation facility are installed, electricity will be received through 110kV transmission lines and commissioning/test-run will be implemented for the Gas Turbine Power Generation Unit and/or substation facility. The inspection will be conducted by the procurement manager of the procurement service provider in the presence of the consultant's technician in charge of procurement supervision and at the same time the tests necessary for the acceptance inspection will be conducted with the equipment operated by the manufacturer's technician in order to confirm its functions and quantity procured.

6) Acceptance Inspection and Equipment Handover

When the commissioning and test-run of the Gas Turbine Power Generation Unit, fuel tanks and substation facility are completed and guidance/instruction for initial operation and full-scale operation have been provided to EDM operators, the acceptance inspection and equipment handover will be implemented.

The acceptance inspection will be implemented in the presence of the personnel in charge at EDM and the consultant. The procurement manager of the procurement service provider and the manufacturer's technician will demonstrate that the equipment to be delivered provides the performance and functions as required in the specifications, and the consultant and EDM will confirm this.

When the procurement service provider, the consultant and EDM confirm the results of the acceptance inspection including the results of commissioning and test-run, the equipment will be handed over to Mozambique.

(2) Procurement and Implementation Supervision Plans (Facilities)

The equipment foundations and cable trenches, etc. will be designed by the contractor in accordance with the loading conditions of the delivered equipment. Therefore, at an appropriate time prior to the commencement of the relevant construction works, the detailed design drawings prepared and submitted by the contractor must be checked and confirmed by the technician in charge.

In addition, while the construction works are being implemented, a Japanese engineer in charge of procurement supervision will be dispatched from Japan to conduct on-site supervision as follows. For the implementation supervision work, an assistant technician employed in Mozambique will assist the Japanese engineer.

- Supervision of quality and work schedule
- Attendance at tests and inspections (test-mixing of concrete, confirmation of the ground to be excavated, inspection of reinforcement arrangement, etc.)
- Inspection of the work quality of finished structures
- Construction completion inspection

2.2.3.5 Quality Management Plan

Under this project, important points to bear in mind for quality management (control) are as follows:

(1) Transportation of Gas Turbine Power Generation Unit and Substation Facilities

The Gas Turbine Power Generation Unit and substation facilities may be damaged if they are subjected to major shock during transportation. In order to confirm how much shock was received during transportation, a gravitation acceleration recorder will be installed.

(2) Management of Insulation Oil for Transformer

Insulation oil enclosed in the transformer is important for maintaining the insulation performance of the equipment. The insulation oil must be kept in a drum can when transporting the transformer and during transportation there is a chance that moisture will get into the oil depending on the transportation condition or the drum can. If such moisture-mixed insulating oil is used, the insulation performance of the oil will deteriorate and may cause damage to the transformer. In order to prevent this, as soon as the insulation oil arrives at the substation construction site, a visual inspection will be conducted of the drum can and the oil components will be checked before the oil is supplied to the transformer using a vacuum oil purifier.

(3) Management of Current Breaker

The contactor for the 110kV current breaker is placed in a tank filled with sulfur hexafluoride gas. The gas plays an important role in terms of extinguishing the arc that may be caused when the current breaker is switched on and off and in terms of the breaker's insulating function. During transportation, the pressure of the gas will be reduced and after arriving at the power plant construction site, the gas will be recharged to the predetermined tension. If the current breaker is used without the gas reaching the predetermined tension, it can lead to damage to the breaker. In order to prevent this, the tension of the sulfur hexafluoride gas will be checked prior to the installation and test-run of the breaker.

2.2.3.6 Procurement Plan for Materials and Supplies

(1) Procurement Plan for Materials and Supplies for Equipment

Of the equipment to be procured under this project, it is planned that the gas turbines and the power plant control system will be procured in Japan. Meanwhile, it is considered that general-purpose equipment such as the generators, electric equipment for the power plant, fuel oil tanks and substation facility can be procured in third countries and the specifications were drawn up without special requirements so that such general-purpose equipment can be manufactured by most domestic and international equipment manufacturers. In the specifications, it is defined that the Gas Turbine Power

Generation Unit, fuel oil tanks and substation facility will have replacement parts that require replacement after one year, and the consumables such as lamps and fuses and trip coils for the breaker will be relatively easily replaceable or repairable by the power plant personnel.

Many Gas Turbine Power Generation Unit and substation facility malfunctions occur within one year of the commencement of full-scale operation. Therefore, the defect warranty period will be one year so that the manufacturer's repair service can be utilized free of charge.

(2) Procurement Plan for Materials and Supplies for Facilities

Building construction is not included in the materials and supplies procurement work implemented under the construction work of this project, and in principle, construction materials such as concrete, formwork and reinforcing steel that are necessary for framework construction will be procured. Concrete can be procured from freshly-mixed concrete suppliers located in Nacala City and there will be no need to construct a batching plant within the project site. In addition, both formwork and reinforcing steel are generally available in the local market and there will be no problem in procuring these materials.

(3) Procurement in Third Countries

In implementing this project, it is planned to procure some items in third countries as listed in Table 2-9: List of Items to be Procured in Third Countries.

Table 2-9 List of Items to be Procured in Third Countries

No.	Item	Country	Remarks
1	Equipment		
1-1	Generator	Sweden, Germany, France, Italy, Portugal, Thailand, South Korea, Taiwan, China, India, Vietnam, South Africa and Turkey	Although, for the time being, it is not possible to select the countries to procure the equipment from, the countries listed in the left column were candidates for each item when making the cost estimation.
1-2	Power plant electrical system		
1-3	Other control panels		
1-4	Fuel oil tanks		
1-5	Transformer		
1-6	Switchgear		
1-7	Control and protection system		
1-8	Demineralized water system (if necessary)		
1-9	Waste water treatment system (if necessary)		
1-10	Demineralized water production device		
2	Facilities		
2-1	Deformed bars	South Africa	

2.2.3.7 Guidance/Instruction for Initial Operation and Full-scale Operation

As part of the equipment procurement work, the equipment manufacturers will provide guidance/instruction in initial operation and full-scale operation and maintenance to help EDM operators and maintenance personnel understand how to operate the Gas Turbine Power Generation Unit, fuel oil tanks and substation facility, how to conduct daily inspections and initial response and measures to be taken when any failure occurs.

In this regard, the gas turbine, etc. to be delivered under this project do not have any special features compared with the equipment for the Maputo Thermal Power Plant where full-scale operation has just begun in Mozambique. Therefore, in this project, it is considered that soft (intangible) components related to equipment operation after the completion of the construction work will be unnecessary.

(1) Guidance/Instruction for Initial Operation

For the Gas Turbine Power Generation Unit, fuel oil tanks and substation facility, guidance/instruction in initial operation will be provided as shown in the following plan.

Table 2-10 Plan for Provision of Guidance/Instruction for Initial Operation

Name of Equipment	Number of target personnel	Number of Days	Details of Guidance/Instruction
Gas Turbine Power Generation Unit ・Gas turbine ・Generator ・Power plant control system ・Power plant electrical system	13	4	Outline of the Gas Turbine Power Generation Unit
Fuel tanks	13	2	Outline of the fuel tanks
Substation facility ・Transformer ・Switchgear ・Control and protection system	13	2	Outline of the substation facility
Water Treatment Facilities (if necessary) ・Demineralized water system ・Waste water treatment system	13	2	Outline of the Water Treatment Facilities
Demineralized water production device ・Demineralized water production device	13	Included for Gas Turbine Power Generation Unit	Outline of the Demineralized water production device

(2) Guidance/Instruction for Operation and Maintenance

As in the case of initial operation, guidance/instruction will be provided in accordance with the following plan.

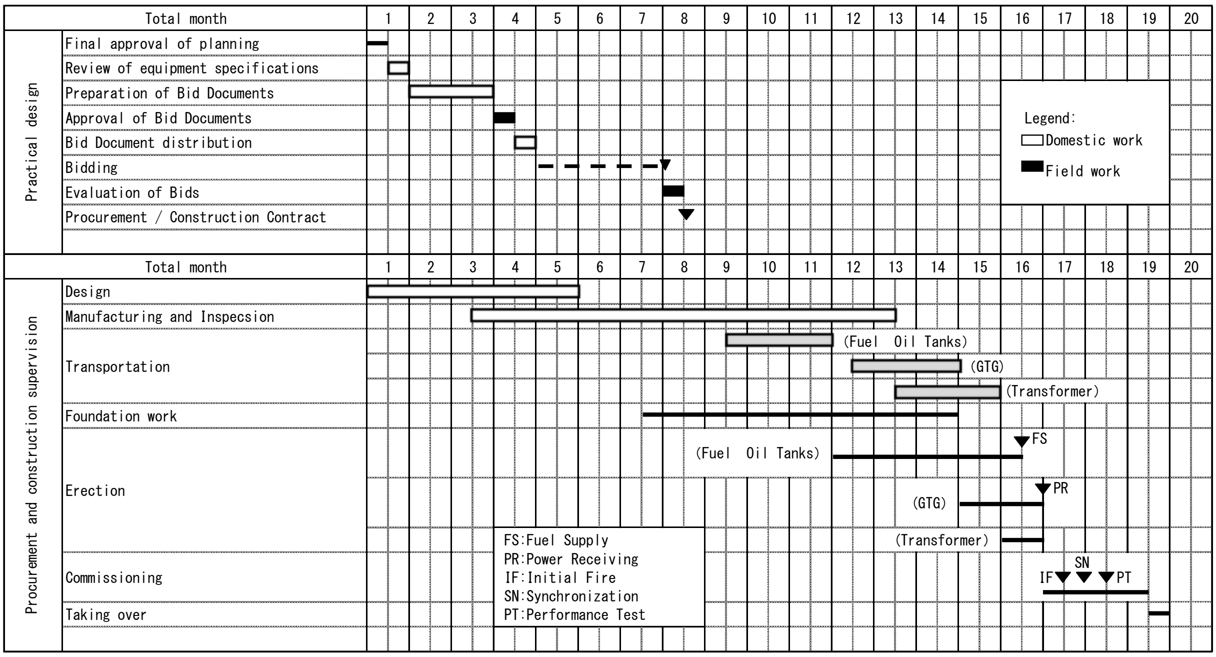
Table 2-11 Plan for Provision of Guidance/Instruction for Operation and Maintenance

Name of Equipment	Number of target personnel	Number of Days	Details of Guidance/Instruction
Gas Turbine Power Generation Unit ・Gas turbine ・Generator ・Power plant control system ・Power plant electrical system	13	4	How to operate the equipment, maintenance inspection methods, maintenance management and measures to take in case of failure or trouble
Fuel tanks	13	2	How to operate, methods for maintenance inspection, maintenance management and measures to take in case of a failure or trouble
Substation facility ・Transformer ・Switchgear ・Control and protection system	13	2	How to operate, methods for maintenance inspection, maintenance management and measures to take in case of a failure or trouble
Water Treatment Facilities (if necessary) ・Demineralized water system ・Waste water treatment system	13	2	How to operate, methods for maintenance inspection, maintenance management and measures to take in case of a failure or trouble
Demineralized water production device ・Demineralized water production device	13	Included for Gas Turbine Power Generation Unit	How to operate, methods for maintenance inspection, maintenance management and measures to take in case of a failure or trouble

2.2.3.8 Work Implementation Schedule

The work implementation schedule of this project is shown in Table 2-12 below.

Table 2-12 Project Implementation Schedule



2.3 Obligations of Recipient Country

Of the implementation and procurement/installation works to be shared between the Japanese side and the Mozambican side under this project as shown in Section 2.2.4.3, the outline of the obligations of the Mozambican side are as follows:

(1) Inflow of Earth and Sand Due to Heavy Rain

- According to EDM, due to heavy rainfall that occurred in 2018, sediment (fine-grained sand) flowed in from higher ground on the east side of the power plant to lower ground on the west side. A large amount of earth and sand flowed into the empty space on the east side of the former generator building from the northeastern end of the substation site.
- This kind of incident should be solved comprehensively using flood control works, etc., by the Mozambican side, not only in the substation's surrounding area but also in the entire area affected by such inflow of earth and sand.
- For details, refer to Reference-8.

(2) Improvement of Unpaved Roads

As reported in Reference-7, the access road running along the east side of the Nacala Substation to the substation is unpaved and therefore, in order to transport important equipment, it is necessary to reinforce and level the surface of the road by paving with crushed stones and roller-compacting. Under grant aid projects, the securement of access to the project site is, in principle, the responsibility of the recipient country and therefore it is a matter for EDM to deal with.

(3) Removal of the Existing Transformer Maintenance Building

Since it is planned to install an overhead line between the step up transformer and 110kV switchgear, an obstacle to the installation of the overhead line, namely the existing building for transformer maintenance, needs to be completely removed from the current location prior to the commencement of the main construction works.

Photograph 2-5 Existing Transformer Maintenance Building

(4) Reinforcement of Existing Cable Trenches

Since there exist cable trenches on the access road for the tank trucks and trucks that will deliver the major equipment, prior to the commencement of the main construction works, reinforcement is necessary so that heavy vehicles can cross the cable trenches.

Photograph 2-7 Existing Cable Trench (1)

Photograph 2-6 Existing Cable Trench (2)

(5) Removal of Old Control Panels Located in the Existing Control Room

Since it is planned to install the protection/control panel for the transformer bay next to the protection/control panel for the barges in the existing controller room, the old control panels will be in the way when installing the new protection/control panel and needs to be removed prior to the commencement of the main construction works.

Photograph 2-8 Old Control Panels (Planned Space for Installing the New Protection/Control Panel)

2.4 Project Operation Plan

(1) Organization and Section in Charge of Management

1) Creation of Project Implementation Unit (PIU)

The survey team will propose that an organization be established as the Project Implementation Unit (PIU) for the construction of the Nacala Emergency Power Plant directly under the Power Generation, Transmission & Market Operation of EDM. PIU will act as the section responsible for the management of this project and play a leading role in implementing the project.

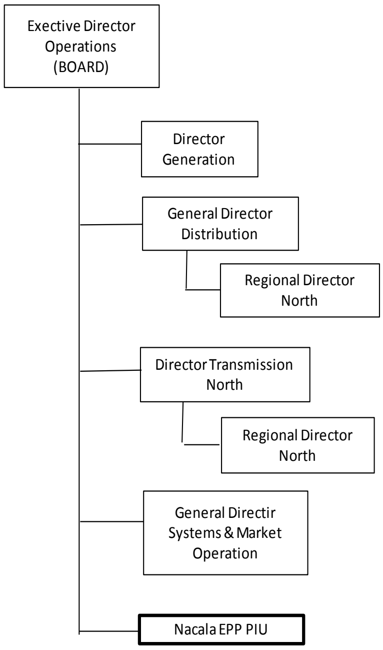


Figure 2-20 Positioning of PIU within EDM

(Source: Survey Team)

The organizational structure considered necessary for operation and maintenance of the emergency power plant (2 shifts a day) is shown in Figure 2-21. If a head of the night watch team is appointed, the new organization will require 10 persons to work as operators and 2 persons to work as maintenance workers and hence the total number of personnel necessary will be 13.

Director

Operator		Number
1st	Shift supervisor – Duty Operator	2
2nd	Shift supervisor – Duty Operator	2
3rd	Shift supervisor – Duty Operator	2
4th	Shift supervisor – Duty Operator	2
Backup	Shift supervisor – Duty Operator	2

Mechanical Maintenance Engineer	1
Electrical Control Maintenance Engineer	1

Figure 2-21 Operation and Maintenance Structure of the Nacala Emergency Power Plant

(Source: Survey Team)

2.5 Project Cost Estimation

2.5.1 Approximate Cost Estimation of Cooperation Project

(1) Cost to be Borne by the Japanese Side

Not to be disclosed until the construction/procurement contractor agreement is approved.

(2) Cost to be Borne by the Mozambican Side

The cost to be borne by the Mozambican side is estimated at approximately 469,800USD as shown in Table 2-13 below.

Table 2-13 Items for which Mozambique Bears the Cost and the Cost Amounts in Japanese Yen

No.	Item	Estimated Cost (1,000 USD)	Estimated Cost (1,000 yen)
1	Mozambique Community Network Fee for customs clearance	232.8	25,821
2	Surface leveling work for unpaved access road to the Nacala Substation	9.9	1,099
3	Land improvement and leveling at the construction site	―	―
	1) Removal works for remaining foundations of the former power plant (as needed)	20.0	2,218
	2)Removal of existing containers temporarily set up	1.7	193
4	Step up transformer and switchgear for protection/control panel	―	―
	1) Removal of existing transformer maintenance building	50.0	5,545
	2) Reinforcement of existing cable trenches	9.6	1,068
	3) Removal of the old control panels located in the existing control room	9.0	1,000
5	Improvement of access roads for tank trucks	2.4	262
6	Tax for environment-related license/approval	89.2	9,890
7	Commission to banks in relation to A/P based on B/A and payment	45.1	5,000
8	Refund equivalents of Personal Income Tax(IRPS), Corporate Income Tax(IRPC)	TBD*	TBD*
	Total	469.8	52,096

*The amount for Item 8 to be determined during the project implementation.

The following items are outside the scope of the grant aid project and will be handled in the future.

No	Item	Amount in Japanese Yen (Unit: Million yen)
1	Arrangement for fuel gas skid	60
2	Long-term operation and maintenance contract (LTSA) (Note 1)	1600

(Note1) Amount for LTSA is based on application for operation time perid 50,000hr. In case of 5hours' daily operation, annual opearation hours are caluculated as 5hr/day x 365days/year = 1,825hr/year and LTSA apllication hours (50,000hr) are calculated as about 27years.

Meanwhile, the Survey Team has concluded that a long-term service agreement (LTSA) for 50,000 operating hours will be sufficient for the plant operation by the Mozambican side as they are expected to accumulate experience and achievement in the operation of the Maputo Thermal Power Plant.

It is necessary to appropriate separately the personnel cost for EDM including the cost of managing and supervising staff which will arise during the equipment procurement, facility construction and equipment installation and construction, but the personnel cost is not included in the above estimation.

In addition, as it is a grant aid project, if the personnel in charge at EDM are present at the factory for inspections while the equipment is being manufactured, the travel, hotel and living expenses for such in-factory inspections (in Japan or in third countries) must be borne by the implementing agency (EDM). Therefore, EDM has to separately appropriate the necessary costs as EDM costs.

(1) Conditions for Estimation

The estimation conditions are as follows:

1) Time of estimation: May 2019 (the month when the second field survey ended)

2) Currency exchange rate: 1.00 USD = 110.90 yen

1 MZN (local currency) = 1.72 JPY

3) Construction and procurement period

The periods of time necessary for detailed design, equipment procurement and installation works are shown in the Project Work Schedule in Section 2.2.3.8.

4) Others

Cost estimation was conducted in accordance with the grant aid project scheme of the Government of Japan.

2.5.2 Operation and Maintenance Cost

(1) Necessary Costs

The expenses appropriated are 5.7 million MZN (approx. 19 million yen) per year as personnel expenses for the operation and maintenance staff of the power plant and approx. 2.7 million MZN (approx. 9 million yen) as repair cost, totaling 8.4 million MZN (approx. 28 million yen). 7.6 million MZN (approx. 13 million yen) per year (as personnel expenses for the operation and maintenance staff of the power plant) and approx. 34 million MZN (approx. 58 million yen) as repair cost, totaling 41.6 million MZN (approx. 71.6 million yen)

Table 2-14 Operation and Maintenance Cost per Year of the Nacala Emergency Power Plant

Item	Details	Annual Costs (million MZN)
Operation and maintenance personnel cost	Operators: 10 Mechanical and electrical technicians: 2	7.6
Repair cost	Maintenance of the power plant	34 (Note 1)
Total		41.6

(Note 1) Inclusive of the cost of the LTSA for 50,000 operating hours and exclusive of price escalation

(2) Budgetary Measures

In relation to the above maintenance cost, EDM's balance sheet data is shown in Table 2-15 below.

As shown in this Table, net income has shifted to minus value since 2014. However, the difference bewtween sales cost of EPP itself and power generation cost is estimated as about 100million yen. Therefore, EDM is expected to be able to contract LTSA and keep reliable operation.

Table 2-15 EDM's Balance Sheet (2014-2017)

Unit: 1000MZN

	2017	2016	2015	2014
Revenue	27,073,222	29,122,397	16,348,820	10,739,768
Cost of Sales	-21,509,834	-22,269,768	-9,810,415	-3,792,157
Gross Result	5,563,388	6,852,629	6,538,405	6,947,611
Personnel Cost	-3,084,527	-3,124,741	-2,439,981	-2,005,917
Supply and Services (to third party)	-2,460,774	-2,372,463	-2,285,428	-2,377,535
Depreciations and Amortizations	-2,809,775	-2,900,794	-3,046,764	-2,360,114
Loss due to impairment	2,171	-26,246	0	0
Provisions	-1,542,687	-543,144	-838,983	-374,457
Loss due to fair value	-117,265	-307,440	-158,508	-161
Other earnings and operational loss	612,608	-6,477	647,832	271,794
	-9,400,248	-9,281,305	-8,121,834	-6,846,390
Operational Result	-3,836,861	-2,428,676	-1,583,429	101,221
Financial Income	6,684,334	7,022,881	2,327,393	425,519
Financial Expense	-6,278,199	-5,605,821	-3,459,102	-598,592
(Expense)/Revenue of Liquid Finance	406,135	1,417,060	-1,131,709	-173,073
Income beofre Tax	-3,430,726	-1,011,616	-2,715,137	-71,852
Income Tax	597,704	28,183	769,800	10,678
Net Income	-2,833,022	-983,433	-1,945,338	-61,174

Chapter 3 Environmental and Social Considerations

3.1 Outline of Components in this Project which will cause Environmental and Social Impacts

3.1.1 Location of the Proposed Site

The proposed power plant site is planned inside the old Nacala power plant and existing Nacala substation site, which is located on the east side of Nacala Bay as shown in Location Map of this Report. The old Nacala power plant stopped its operation in 2000. Currently, some buildings and foundations still remain on the site.

A CFM (a local railway company) railway runs parallel to the west boundary of power plant site. The land between the site boundary and railway is owned by EDM, whereas the land between the railway and Nacala Bay belongs to CFM. There are no residences in the area between the site boundary and Nacala Bay. The discharge channel used by the old Nacala power plant and the Nacala substation runs through CFM's land to the Nacala Bay under an agreement on land use with CFM.

The east side of the power plant site is currently vacant, and to the east of this vacant area is a public road with a residential area located on the other side of the road (Figure 3-1).

It is about 100m from the site boundary to the nearest residential area, and this point is about 15 meters above sea level. The residential area is located on a hill slope, which slopes higher away from the boundary.

To the north of the power plant site there is an access road owned by EDM from the main road to the site. Also, a wheat warehouse is located to the north of the access road.

The location of the emergency power source facility, the existing power plant building, and the switchyard is shown in Figure 3-2.

Figure 3-1 The Old Nacala Power Plant, a Public Road and the Nearest Residential Area

(Source: Final Report of The Preparatory Survey for Nacala Corridor Transmission & Distribution Network Reinforcement Project)

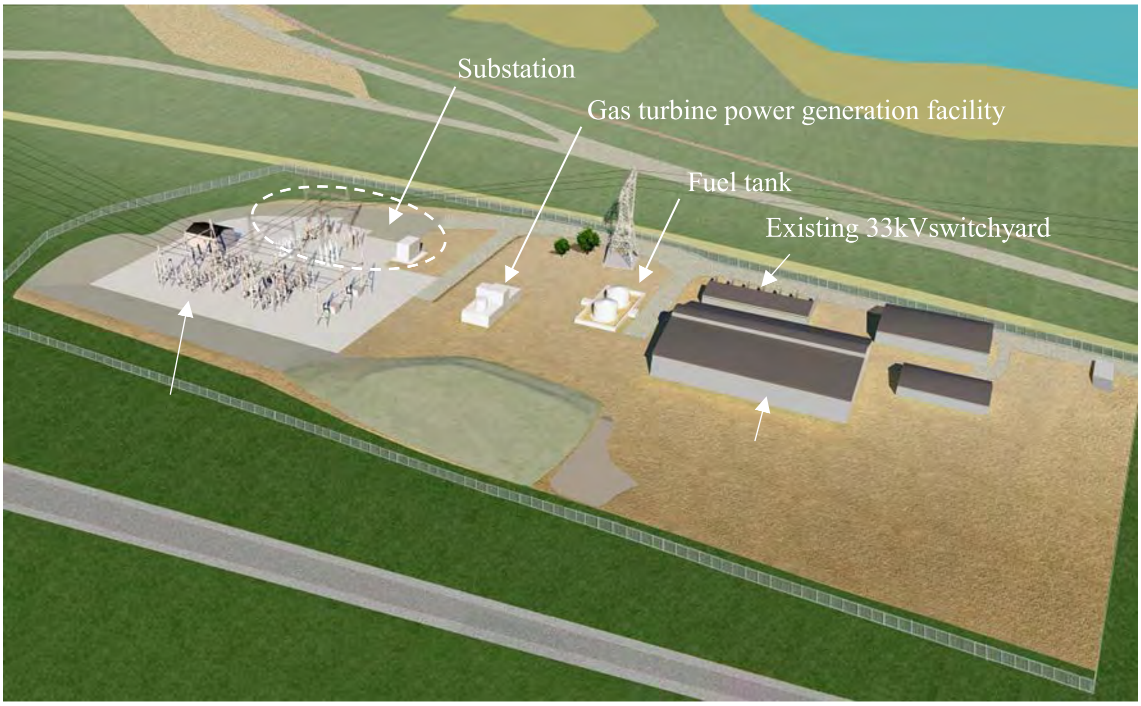


Figure 3-2 Location of the emergency power source facility, the former Nacala PowerPlant and the existing switchyard

3.1.2 Overview of the Project

This Project is a power plant construction project implemented by EDM. After removing the buildings and foundations of the old Nacala Power Plant, the facilities shown in Table 3-1 will be constructed.

Table 3-1 Main Facilities Equipped in Nacala Power Plant

No.	Facility	Specification
1	Gas turbine and generator unit	● Aero-derivative ● Fuel: Diesel oil or jet fuel, and, in future, natural gas ● Net power output: >=30MW ● NOx concentration at stack: <=74ppm (convert at 15%O_2) ● PM volume: <=50mg/Nm3 (convert at 15%O_2) ● CO2 fire-fighting system
2	Fuel tank	● 100m^3 x 2 tanks at least ● Fire-fighting system
3	Substation facility	● 110kV
4	Water treatment (demineralization) system (if necessary)	● If water is used for NOx reduction by water injection, the facilities demineralizing water for injection and treating wastewater from demineralization are needed.

(Source: Prepared by Survey Team)

3.1.3 Associated facilities

It is not necessary to construct new transmission lines because this Power Plant will use the electric power system that was connected during the operation of the old Nacala Power Plant.

It is not necessary to construct new access roads because the existing roads will be repaired for use.

It is not necessary to construct fuel pipelines because fuel will be brought in using tankers.

Also, it will not be necessary to have temporary storage areas for construction materials and supplies because there is sufficient space on the site.

Furthermore, it is not necessary to have a borrow pit or quarry as this Project will be implemented on a site where land preparation has already been completed.

3.2 Environmental and Social Baselines

Most of the site is comprised of structures for the old power plant facility, with grass vegetation visible in only a small area. There is no agricultural land or residential area on the site.

3.2.1 Meteorology

(1) Temperature

The meteorology of Nacala-Porto City where the project site is located is a tropical dry climate, with an anual average temperature of over 22°C.

Figure 3-3 describes the monthly average temperature in Nacala-Porto City between 2003-2013. The monthly average temperature is higher from December to April, approximately 27sidential wer from June to August, approximately 24°C.

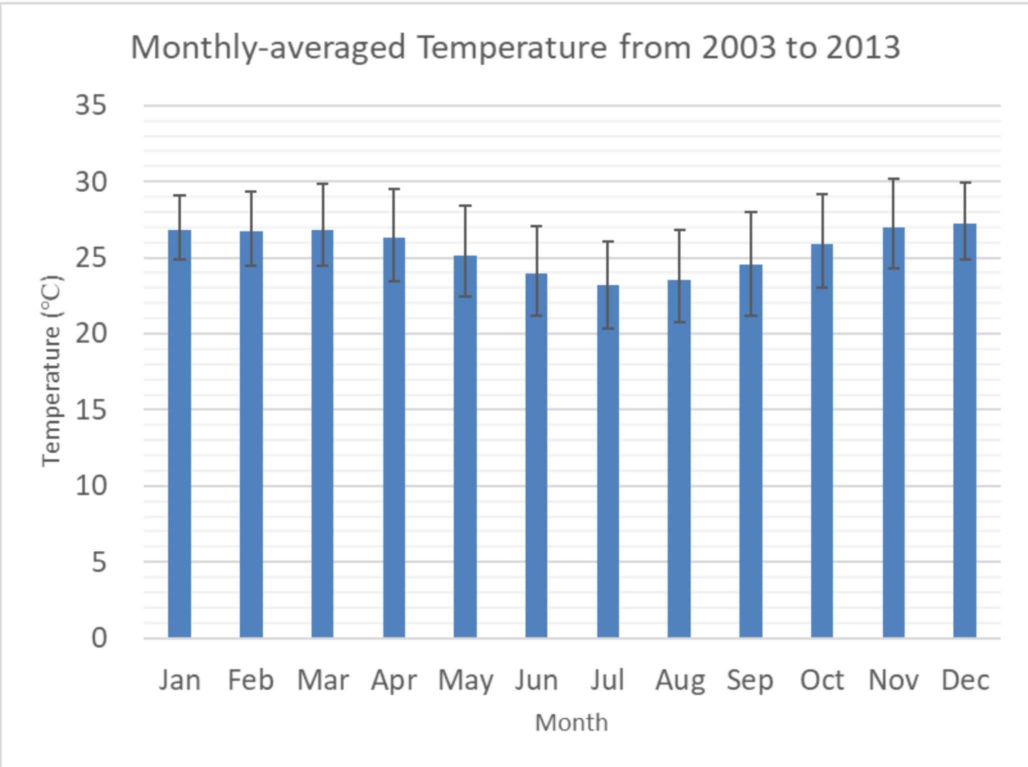


Figure 3-3 Monthly average temperature in Nacala-Porto City between 2003-2013

(Source: Instituto Nacional de Meteorologia de Mozambique)

(2) Precipitation

A year in Mozambique consists of a short rainy season from November to March and a dry season from April to October.

It has not been possible to find the average monthly precipitation data for Nacala-Porto in recent years. Figure 3-4 describes the monthly average precipitation of Lumbo City, which is 30km to the south of Nacala-Porto City and is located along the coast similarly to Nacala-Porto City, between 1999-2009.

In the rainy season, especially from January to April, monthly precipitation reaches 150mm. Monthly precipitation rarely exceeds 500mm even between January and April when it has largest precipitation in a year but drastic precipitation was experienced in 2007 (917.6mm in January, 592.6mm in February, 847.7mm in April).

Average precipitation in the dry season from April to October is no more than 50 mm.

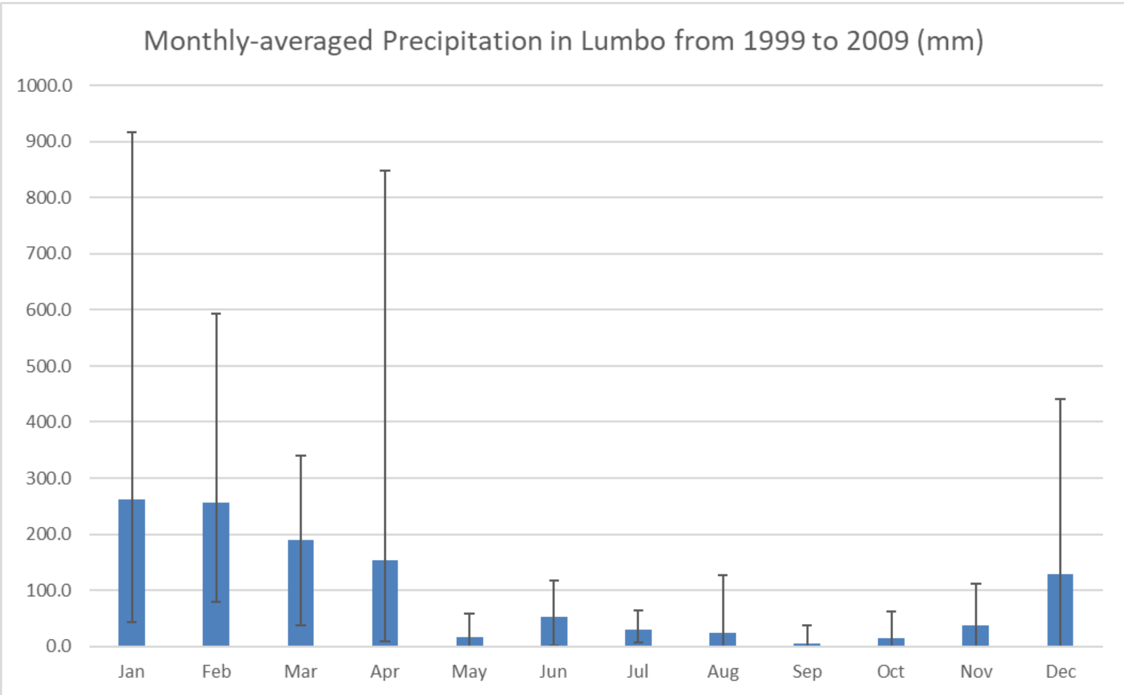


Figure 3-4 Monthly average precipitation in Lumbo area between 1999-2009

(Source: Instituto Nacional de Meteorologia de Mozambique)

(3) Humidity

Figure 3-5 describes the monthly humidity in Nacala-Porto City between 2003 and 2013. The humidity in the project area is approximately 74% in dry season and 80% in rainy season. The highest humidity appears in January and sometimes exceeds 83%. The average humidity is generally not over 77% throughout the year.

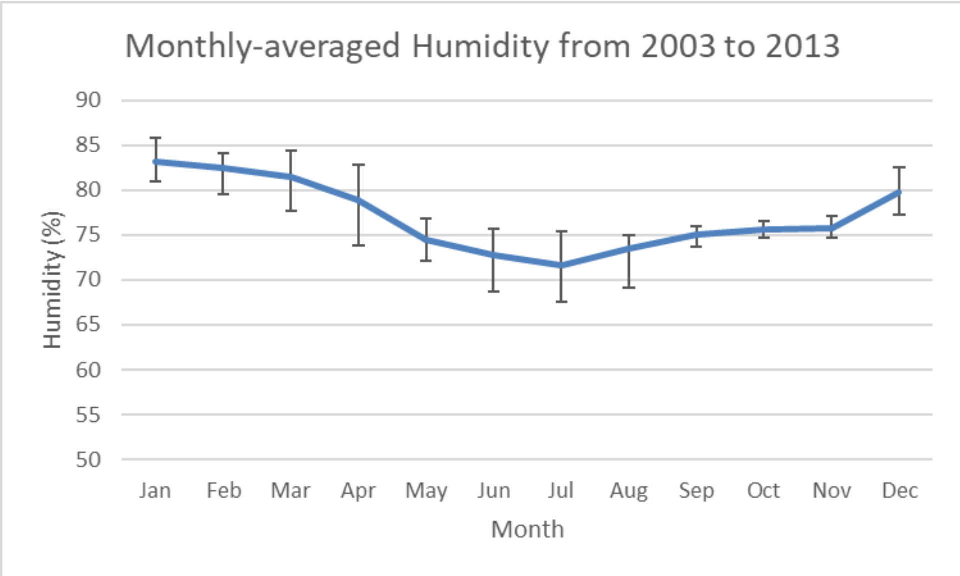


Figure 3-5 Monthly average humidity in Nacala-Porto City between 2003-2013

(Source: Instituto Nacional de Meteorologia de Mozambique)

(4) Wind Direction/speed

The measurement of long-term wind direction/speed in the surrounding area of Nacala-Porto City has not been conducted.

Figure 3-6 indicates the estimated frequency of wind direction/speed between 2007-2009 as described in the EIA report of the Nacala coal terminal project based on the weather model (MM5).

Although the frequency of wind direction slightly varies year by year, the wind direction appears in a higher frequency in the order of south-south-west, north-east, south and north-north-east. Regarding the frequency of appearance, south-south-west wind occupies 15-17%, north-east wind 12-13%, south wind 9-13%, and north-north-east wind 7-12%.

South-south wind appears frequently at night, whereas north-east and north-north-east wind appears in daytime.

The wind speed is mostly below 6m/s in every wind direction. Wind speed of 6-10m/s appears approximately 4%, whereas wind over 10m/s seldom appears.

The northern part of Mozambique, where the Nacala region is located, is a region where there is relatively little cyclone damage in the country, and the impact of cyclones is rated as risk 3 (medium) on a 6-point scale. According to the data from 2008 to 2014, two cyclones invaded the area. In 2009, two large cyclones passed Moambique and caused significant damages. Detailed official data the cyclones has not been confirmed. Cyclone Idai in March 2019 did not affect significantly Nalara region, but Cyclone Kenneth in April 2019 brought heavy rain to this region. Cyclone occurs from November to April （INGC, 2009; Østergaard, 2008; UNDP/GRIP/BCPR, 2010）.

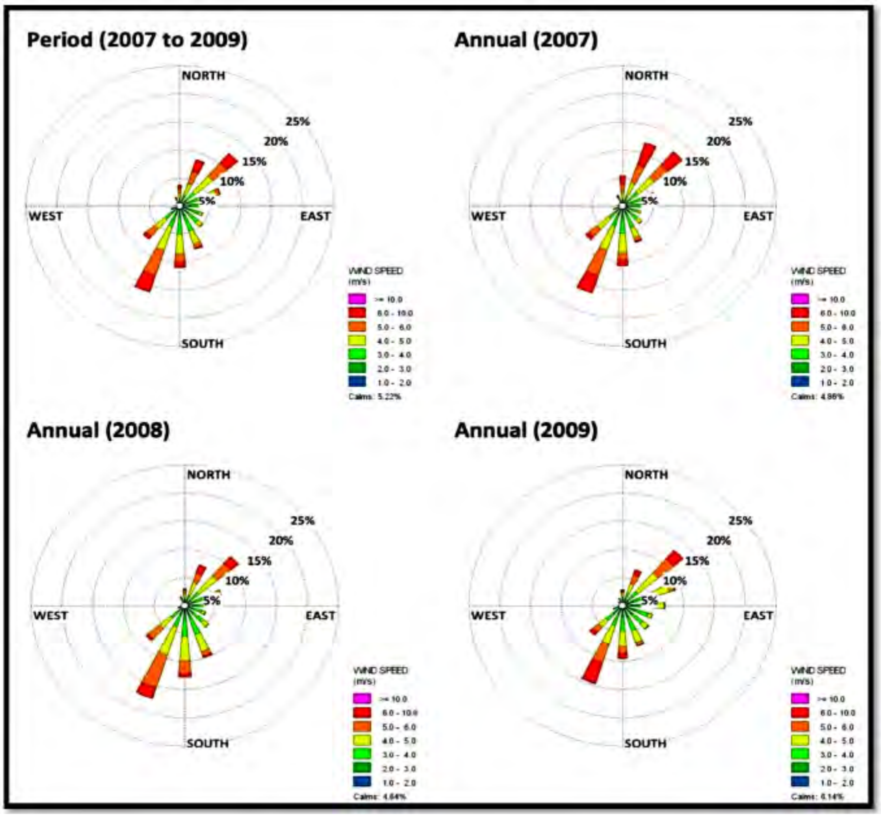


Figure 3-6 Estimated frequency of wind direction/speed between 2007-2009 based on the weather model (MM5)

(Source: EIA report of Nacala coal terminal project (Aurecon, 2010))

(5) Atmospheric Stability

The air stability has significant impact on the diffusion of air pollutants from exhaust gas. Air stability is categorized by Pasquill as follows according to wind speed and solar radiation.

A: Very unstable
B: Moderately unstable
C: Unstable
D: Neutral
E: Stable
F: Very stable

Figure 3-7 shows the frequency of atmospheric stability estimated from the weather model (MM5) between 2007-2009 as cited in the EIA report of Nacala coal terminal project.

The data indicates that the frequency of stability varies depending on the wind direction. Stability D appears most often under the dominant wind direction south-south-west, stability C appears most often under north-east wind, and appearance of stability A and B, which may cause air pollution, is below 1%.

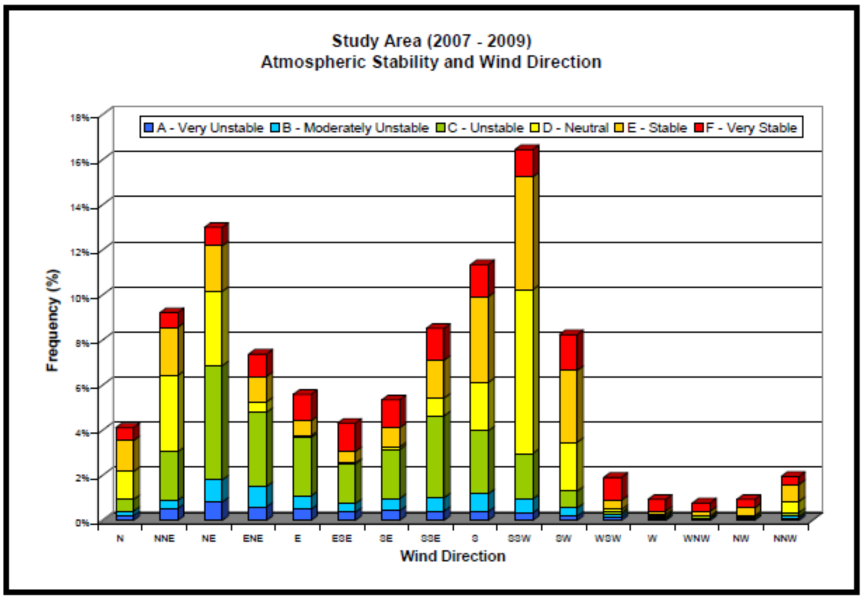


Figure 3-7 Frequency of atmospheric stability estimated from the weather model (MM5) between 2007-2009

(Source: EIA report of Nacala coal terminal project (Aurecon, 2010))

3.2.2 Marine Hydrology

(1) Wave Height

Wave intrusion from the sea does not occur in Nacala Bay, so it is considered that the Bay is only affected by rough waves. Even during cyclones, the Bay is relatively calm, with damage only caused by wind and rain. The results of wave height estimations during strong northeast seasonal winds (8m/s) are shown in Figure 3-8. (Source: EIA report of Nacala coal terminal project (Aurecon, 2010)).

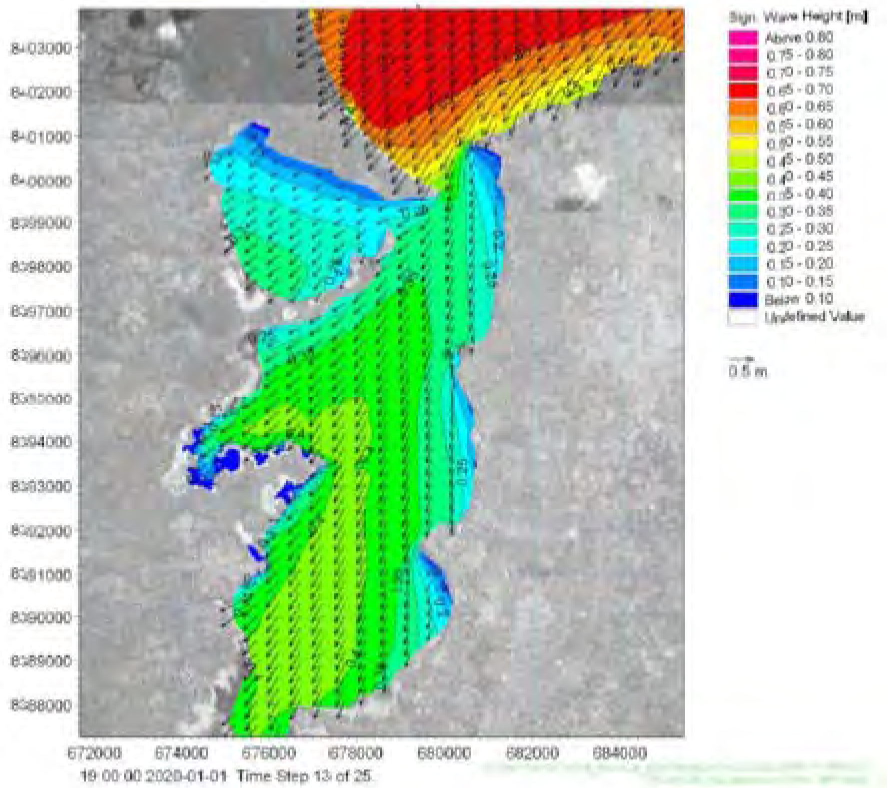


Figure 3-8 Result of wave height estimates in Nacala Bay (during period of strong northeast winds at 8m/s)

(Source: EIA report of Nacala coal terminal project (Aurecon, 2010))

(2) Tide Level

The tide level in Nacala Bay is generally HWL = +4.25m, LWL = +0.25m, and difference of tidal level = 4.0m. (Feasibility Study Report for High Efficiency Coal-fired Power Plant in Mozambique (Promotion project of Supply and Demand Relaxation Type Infrastructure System), 2015)

(3) Currents

Figure 3-9 shows the estimates of prevailing currents during strong northeast seasonal winds in Nacala Bay. (Source: EIA report of Nacala coal terminal project (Aurecon, 2010)

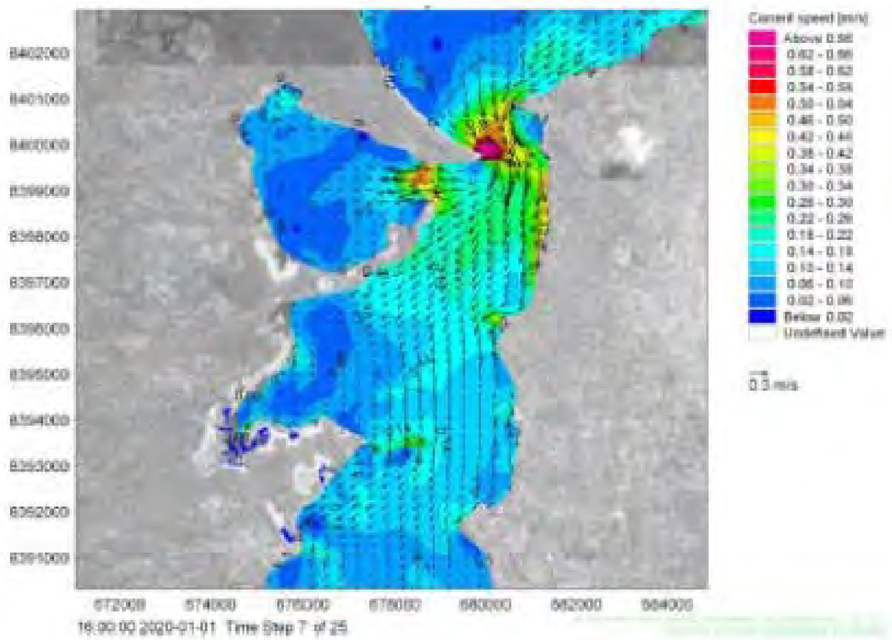


Figure 3-9 Current distribution in average water depth levels in Nacala Bay

(Source: EIA report of Nacala coal terminal project (Aurecon, 2010))

3.2.3 Geography

As shown in Figure 3-10, the project site is located to the east of Nacala Bay, where most of the terrain is sloped and no flatlands are observed. However, land to the west of the deeper reaches of the Bay shows relatively flat terrain.

The altitude of the project site is 20m, whereas the highest altitude to the east reaches approximately 120m. The highest altitudes are observed in a region located south-southeast from the project site, where they reach between 140-160m.

Due to heavy rains that occurred in 2018, sediment fell from the slope on the east side of the project site to the lower area on the west side, which caused a large amount of sediment to inundate the northwest side of the project site (vacant area on the east side of the former generator facility).

It is difficult to take measures to control the occurrence of sediment runoff in the surrounding area under the remit of this Project because sediment runoff is caused by the status of drainage facilities in the entire region around the project site, for example. Therefore, the Government of Mozambique has been advised that the implementation of drastic flood-control works in the region is a fundamental countermeasure to sediment runoff, and, in order for power generation project not to be affected by sediment runoff, the project survey team has selected the area not affected by sediment runoff as the area for the establishment of power generation facilities, etc.

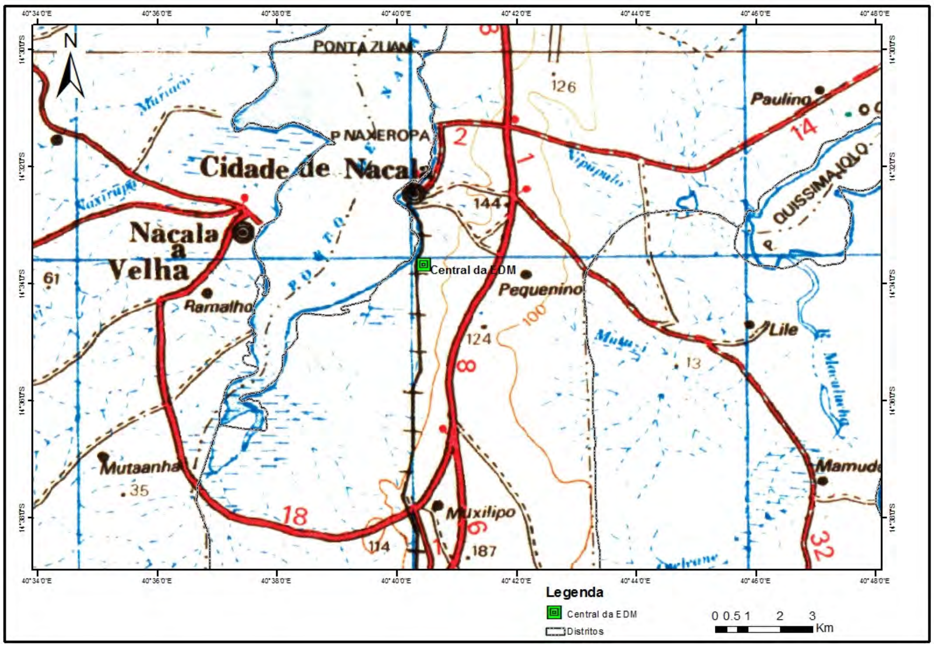


Figure 3-10 Geographic features around the project site

(Source: Topographic map with a scale of 1 to 250,000 (National Geological Department, 2006))

3.2.4 Geology

As shown in Figure 3-11, the project site is located within the Rovuma sediment basin of 29,000km^2. The terrain around Nacala Bay is sloped and mainly composed of cretaceous sandstone (CrMo).

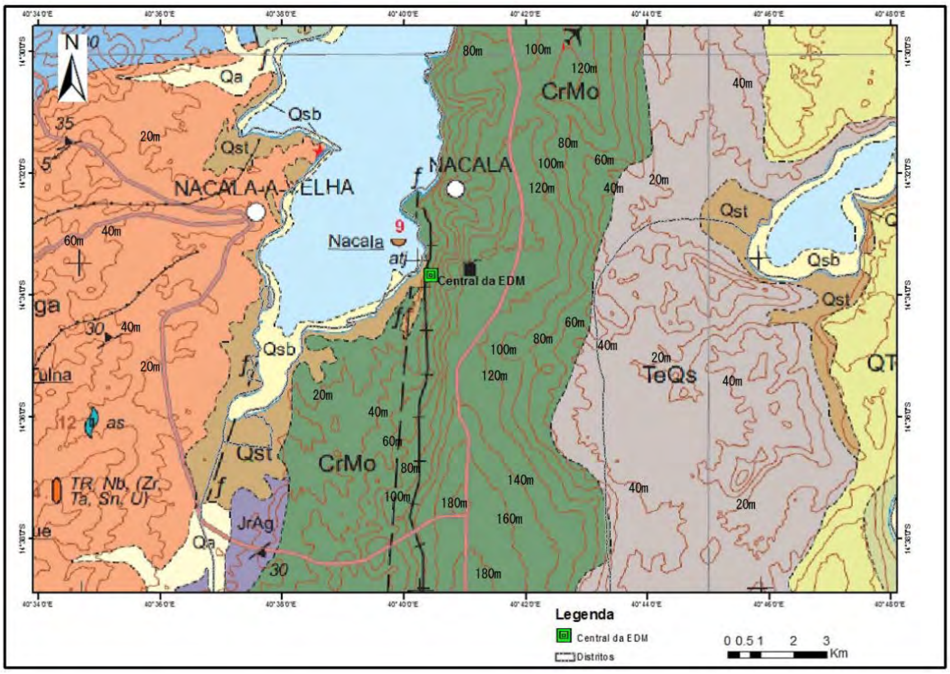


Figure 3-11 Geography and Geological features around the project site

(Source: Topographic map with a scale of 1 to 250,000 (National Geological Department, 2006))

3.2.5 Air Quality

There are no large factories or any other facilities generating soot and smoke around the project site. The main generation sources of air pollutants are shipping vessels in the Bay and transportation vehicles in the surrounding roads or domestic fuel, all of which are small in scale.

There is an Aggreko generator for emergency use in the project site, which is not regularly in operation.

In the "Preparatory Survey for Nacala Corridor Transmission & Distribution Network Reinforcement Project", air quality survey was conducted in June 25, 2015 at one-hour intervals between 5am and 11pm at 3 points around the project site (Figure 3-12). Also, the measurement of SO2 and NO2 was conducted with a simple portable measuring equipment (MULTIRAE V 1.18), because available measuring equipment is limited in Mozambique. For this reason, although the detection/quantification limits are high and low concentrations cannot be detected, the equipment serves the purpose of verifying the compliance with local environmental standards.

Number	Latitude	Longitude
1	14°32'54.42"S	40°41'4.37"E
2	14°32'34.08"S	40°40'44.32"E
3	14°34'32.88"S	40°39'54.04"E

Figure 3-12 Air quality measurement points around the project site

(Source: Final Report of The Preparatory Survey for Nacala Corridor Transmission & Distribution Network Reinforcement Project)

Measurement results of air quality around the project site are shown in Table 3-2 and Table 3-13~ and the outline of the results is described as below.

(1) Sulfur Dioxide (SO_2)

Regarding SO2 concentrations, one-hour values lie between 0~784.43)n in smission & Distribution Network Reinforcement Project)ailable measuring equipment is limited in Mozambique. For thits. 24-hour values lie between 47.5~165.1μg/m3. The value measured at Point No. 3 satisfied the environmental standard of Mozambique (24-hour average value of 365μg/m3) while the values at No. 1 and 2 exceed it (Table 3-2). Points No. 1 and 2 are located along the road in the east of Nacala Port, so the exceedance is possibly because of the traffic and the emission gas of vessels using Nacala Port (Figure 3-13).

(2) Nitrogen Dioxide (NO_2)

Regarding nitrogen dioxide (NO2) concentrations, one-hour average values lie between 0 ~ 563.4 is possibly because of the traftween 29.7 ~ 69.2ion gas of vesseone-hour value measured early in the morning exceeded the environmental standard of Mozambique (one-hour average value of 190μg/m3) at all of three measurement points but NO2 was below the measurable limits later than the morning, satisfying the standard. The 24-hour environmental standard value is neither established in Mozambique, nor by WHO (Table 3-2).

Consequently, the measurement results indicate that the air quality around the project site, as regards to NO2, overall may be said to be in a clean status (Figure 3-14).

(3) Particulate Matter (PM)

Regarding the concentration of particulate matter (PM10) with radius lower than of 10t site, as regards to NO2, overall may be sa～905arding the concentration of particulate matter～90.0rding the concentration of particulate mattvalue is neither established in Mozambique, nor by WHO (Table 3-2). The 24-hour average value satisfies the environmental standard of Mozambique and the WHO standard (150μg/m3) at all the measurement points. Consequently, the measurement results indicate that the air quality around the project site is not polluted by PM10 and overall in a clean status (Figure 3-15).

The measurement was conducted in the dry season. Measurements in the rainy season are likely to show even lower concentrations due to pollutant deposition by rain.

Table 3-2 Measurement results of air quality around the project site (µg/m3)

Item	Measurement point	1-hour value (Average)		24-hour value	Mozambican Environmental Standards (Decree No. 67/2010)	WHO Guidelines
		Min.	Max.	Average value measured between 5am~11pm		
Sulfur dioxide (SO_2)	1	ND	522.5	**123.9**	800 (1 hour) 100 (24 hour)	500 (10 min) 125 (24 hour, Interim target 1)
	2	ND	784.4	**165.1**		
	3	ND	261.5	47.5		
Nitrogen dioxide (NO_2)	1	ND	**563.4**	69.2	190 (1 hour) - (24 hour)	200 (1hour) - (24 hour)
	2	ND	**563.4**	29.7		
	3	ND	**375.6**	68.3		
Particulate matter（PM_{10}）	1	20.0	363.0	84.4	- (1 hour) 150 (24 hour)	- (1 hour) 150 (24 hour, Interim target 1)
	2	19.0	321.0	83.6		
	3	16.0	905.0	90.0		

ND: Not detected (Source: Prepared by Survey Team)

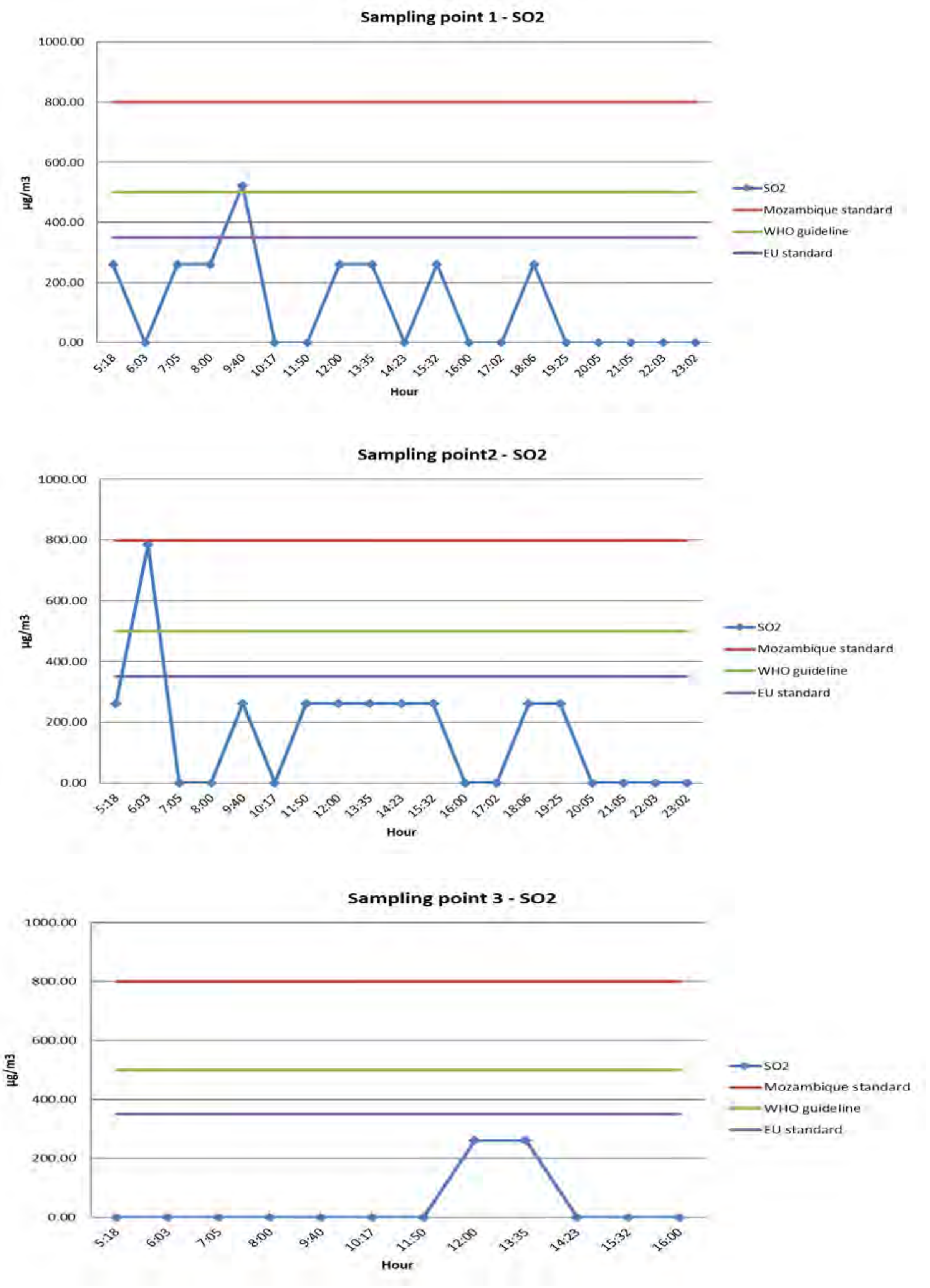


Figure 3-13 Sulfur dioxide (SO2) measurement results

(Source: Prepared by Survey Team)

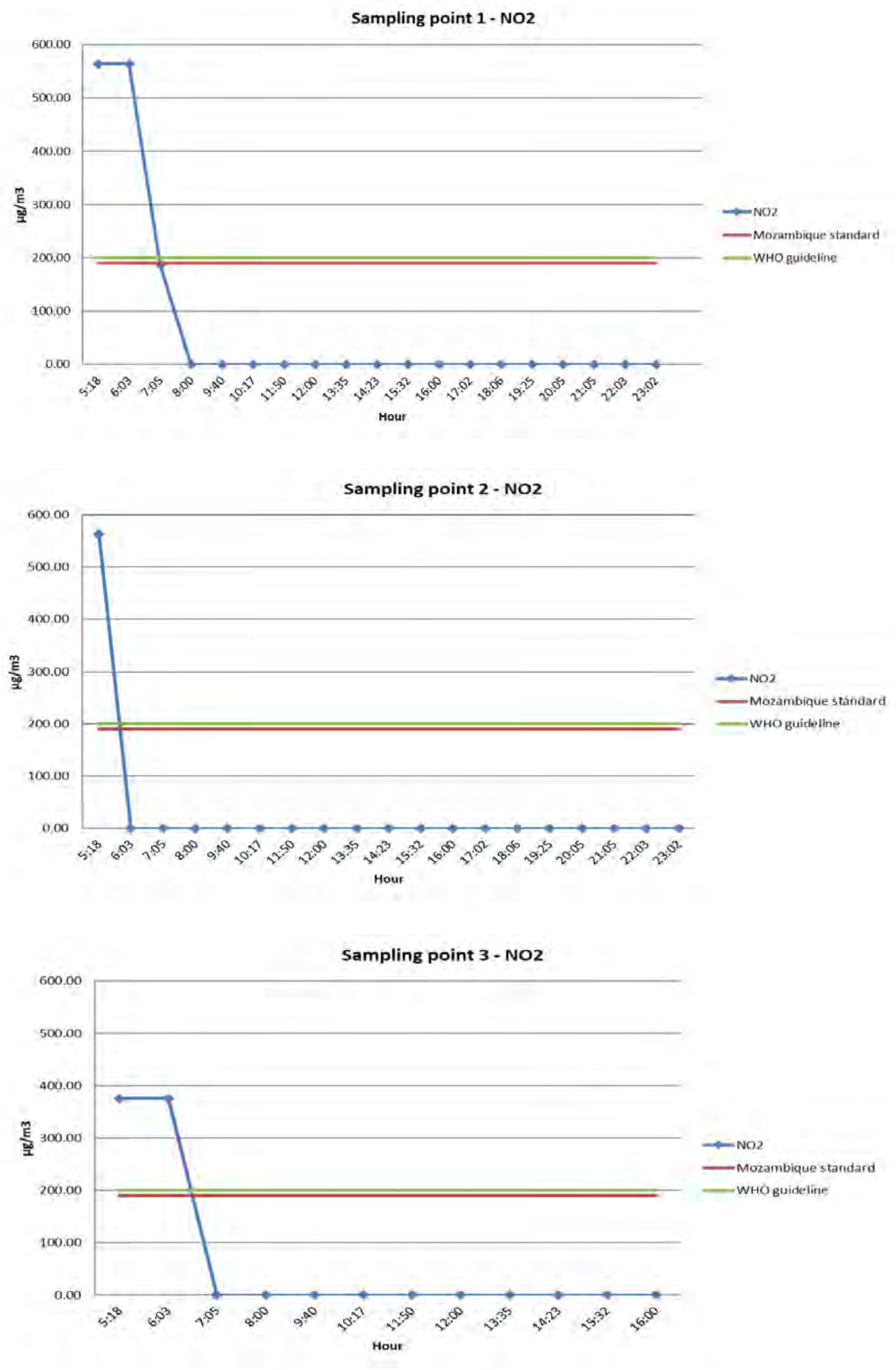


Figure 3-14 Nitrogen dioxide (NO2) measurement results

(Source: Prepared by Survey Team)

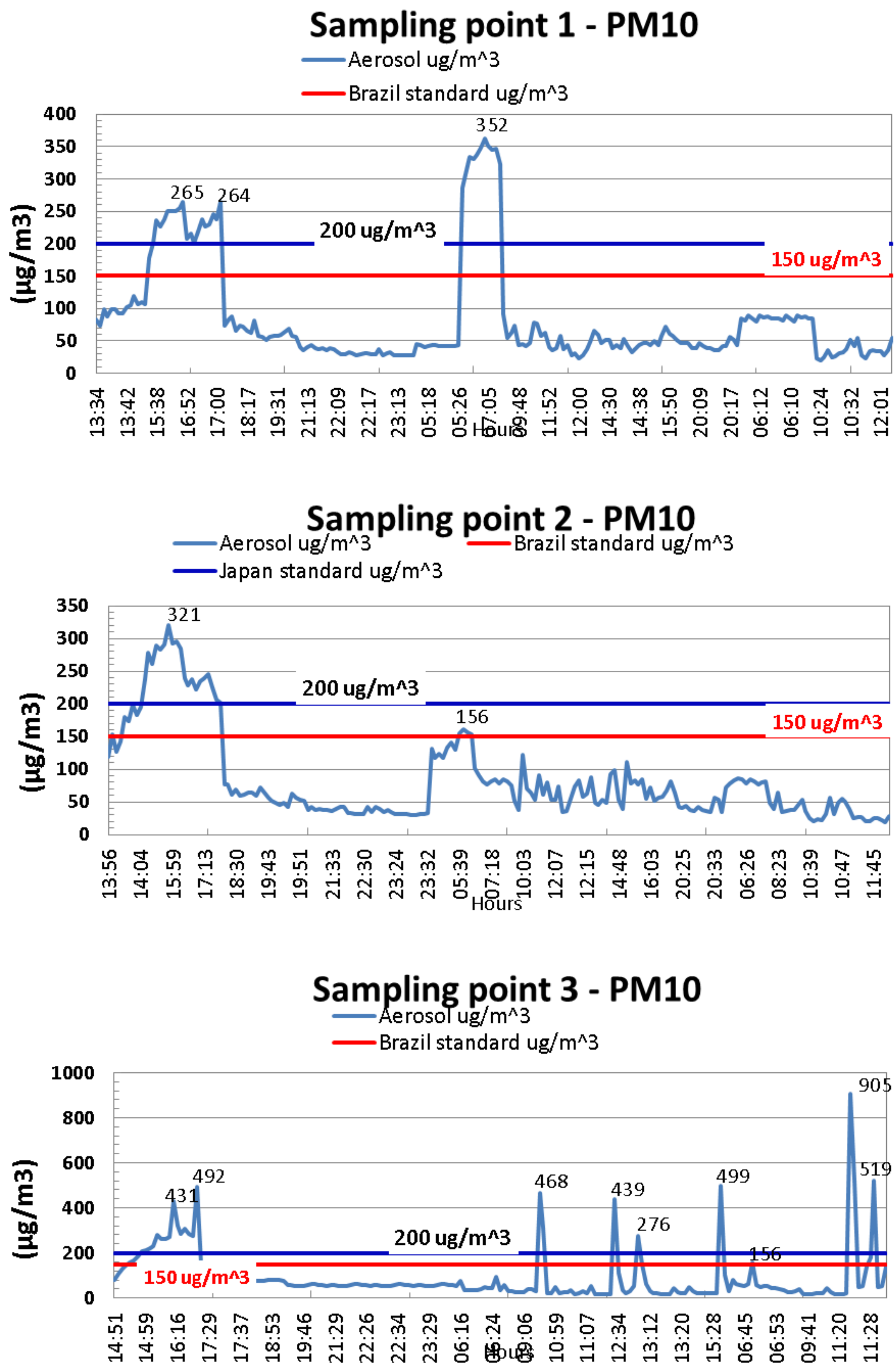


Figure 3-15 Particulate matter (PM10) measurement results

(Source: Prepared by Survey Team)

3.2.6 Water Quality

The past survey of algae in the bay verified that water quality of Nacala Bay is physically and chemically stable and not polluted with microorganisms.

Table 3-3 describes the results of water quality survey conducted in the south-east side of Nacala port.

Table 3-3 Water quality survey result conducted at the south-east side of Nacala Port

Parameter	Unit	No1	No2	No3	Water Quality Standard (Decree 67/2010)
pH	—	8.4	8.4	8.3	6.5 －8.5
DO	mg/L	6.58	7.02-	6.72	-
PO_4-P	mg/L	0.03	0.03	0.02	-
NH_3-N	mg/L	0.63	0.61	0.63	5.0
NO_3-N	mg/L	0.00	0.01	0.00	10.0
NO_2-N	mg/L	0.02	0.02	0.02	1.0

(Source: Prepared by the Survey Team)

Water sampling was conducted at 2 points as shown below near the project site in Nacala Bay on July 15, 2015 for which water quality analysis was conducted.

No.	Latitude	Longitude
1	14°33’31.96”S	40°40’6.78”E
2	14°33’26.06”S	40°40’9.92” E

(Source: Prepared by the Survey Team)

Figure 3-16 Water quality measurement points around the project site

The results of the water quality survey are shown in Table 3-3.

The value of pH, oil, BOD and COD meet the water quality standard in Mozambique, and the area may be classified as a clean water area.

High concentration of suspended matter (590mg/l) results from the sediment disturbed by trawl or roll net operated nearby and is only temporary.

Faecal Coliforms are high in No. 2. This results from the fact that the water way flowing into the sea is used as a latrine.

Table 3-4 Results from water quality measurement survey (locations near the project site)

Item	Unit	No. 1	No. 2	Water Quality Standard (Decree 67/2010)
pH	—	7.24	7.31	6.5 －8.5
Total suspend solid（TSS）	—	590	-	ND
Oil & Grease	mg/L	ND	ND	ND
BOD	mg/L	ND	ND	≤ 5
COD	mg/L	ND	ND	≤ 6
Total Nitrogen	mg/L	ND	ND	-
Total Phosphorus	mg/L	<0.25	<0.25	-
Total Coliforms	MNP/100mL	16	4	-
Faecal Coliforms	MNP/100mL	4	14	-

ND: Not detected (Source: Prepared by the Survey Team)

3.2.7 Noise

There are no large factories or any other facilities generating noise around the project site, except for vehicles running on the surrounding roads. Most of the surrounding roads are paved.

No noise level measurement data is available for the project site area. In June 13-14, 2015, a noise level survey was conducted at one-hour intervals between 6 am and 9 pm at 3 points around the project site (Table 3-17).

No.	Latitude	Longitude
1	14°33'22.26"S	40°40'25.99"E
2	14°33'34.98"S	40°40'26.83"E
3	14°33'47.89"S	40°40'27.16"E

(Source: Prepared by Survey Team using Google Earth)

Figure 3-17 Noise measurement points around the project site

Figure 3-5 describes the results of the noise measurement.

All the three measurement points are located roadside and the noise level (Leq) is largely affected by the traffic of trucks and vehicles related to Nacala Port and the fuel terminal.

No. 1: noise level (Leq) is 55.2～66.7dBA in daytime and 56.8 dBA at nighttime.

No. 2: noise level (Leq) is 41.6～67.9dBA in daytime and 51.2 dBA at nighttime.

No. 3: noise level (Leq) is 46.4～65.8dBA in daytime and 56.6 dBA at nighttime.

These noise levels exceed the noise level standard of World Bank Group guideline 55dBA in daytime and 45dBA in nighttime in most cases.

However, the residential area is actually located more than 5 m away from the road, and according to the distance attenuation formula cited in Chapter 3.7.1(5) (a), actual noise level is estimated to be lower more than 10dBA from the measurement result.

Consequently, the actual noise level at the residential area is predicted to meet the IFC/WB EHS Guidelines except for very limited times.

Table 3-5 Results of noise level (Leq) measurement around the project site

(Unit: dBA)

Time	Time	No. 1	No. 2	No. 3	IFC/WB EHS Guideline General 2007
Nighttime	6:00	56.8	51.2	56.6	Residential: 45, Industrial: 70
Daytime	8:00	62.0	66.1	58.8	Residential: 55, Industrial: 70
	9:00	62.2	58.5	56.9	
	10:00	63.5	64.5	62.4	
	11:00	62.6	65.9	59.2	
	12:00	61.8	63.1	58.9	
	14:00	59.9	61.0	56.5	
	15:00	61.8	66.6	65.8	
	16:00	66.7	67.9	57.9	
	17:00	61.8	58.8	61.4	
	19:00	60.2	53.0	57.2	
	21:00	55.2	41.6	46.4	

(Source: Prepared by the Survey Team)

3.2.8 Terrestrial Ecosystem and Rare Species

(1) Terrestrial Flora

The project site is the site where the former Nacala power plant, and where currently the emergency power generation plant and the Nacala substation are established. The land is already prepared and limited terrestrial flora is observed, including grass and low trees. The table below (Table 3-6) shows the terrestrial plant species commonly observed around the project site. Also, the Red List of Mozambique uses the same criteria established for the Red List of IUCN regarding y prepared and limited terrestrial flora is obse

Table 3-6 Terrestrial plant species commonly observed around the project site

Scientific name	IUCN red list/ Protected species of Mozambique
Cyperus crassips	N/A
Helycrysum kraussii	N/A
Flagellaria Guinea	N/A
Cleome gynandra (Luni)	N/A
Sporobulos virginicus	N/A
Indigofera spp.	N/A

(Source: Prepared by the Survey Team)

(2) Terrestrial Fauna

The project site is developed land and only a limited number of terrestrial animals inhabit the area including rodents, birds and reptiles such as lizard and gecko. Also, the Red List in Mozambique uses the same criteria established for the Red List of IUCN regarding “threatened species designated for protection” (Table 3-7).

Table 3-7 Terrestrial species commonly seen around the project site

Scientific name	IUCN red list/ Protected species of Mozambique
Ratus ratus	N/A
Hemidactylus frenatus	LC
Agama spp.	N/A

(Source: Prepared by the Survey Team)

Since the location of the project is exactly where the former Nacala power plant used to operate and the land is already developed, the species mentioned in the table above have not been identified in the field survey.

3.2.9 Marine Ecosystem and Rare Species

No coral reef exists in the marine area around the project site. Some mangrove ecosystems are seen along the coast, and the main species observed around the site are listed in the table below. Also, the Red List in Mozambique uses the same criteria established for the Red List of IUCN regarding "threatened species designated for protection" (Table 3-8).

Table 3-8 Mangrove species commonly seen around the project site

Scientific name	IUCN red list/ Protected species of Mozambique
Avicennia marina (Mpedge)	LC
Bruguiera gymnorhiza (Mfinse)	LC
Tagal Ceriops (Nkandala)	N/A
Rhyzophora mucronata (Nhantanzira)	N/A
Racemosa Lumnitzera (Mpiripito)	N/A
Sonneratia alba (M'pia)	LC

(Source: Prepared by the Survey Team)

Figure 3-18 below shows the location of the mangrove area (green contour areas) neighboring the project site.

Figure 3-18 The location of the mangrove area close to the project site (green contour area)

(Source: Prepared by the Survey Team using Google Earth)

The table below is the list of fish species inhabiting Nacala Bay according to the fishery survey of Nacala Bay conducted by Fishery Laboratory of Mozambique. Also, the Red List in Mozambique uses the same criteria established for the Red List of IUCN regarding "threatened species designated for protection" (Figure 3-9).

Table 3-9 Main fish species inhabiting Nacala Bay

Scientific name	IUCN Red List/Protected species of Mozambique
Stolephorus heteroloba	N/A
S. holondon	N/A
Carangoides malabaricus	N/A
C. oblongus	N/A
Fenneropenaeus indicus	N/A
Penaeus monoceros	N/A
P. semisulcatus	N/A
Chirocenthrus nudus	N/A
Liza melinoptera	N/A
Hyporhamphus capensis	N/A
Sphyma mokarran	N/A
Carcharhinus leucas	NT
Squalus asper	N/A

Scientific name	IUCN Red List/Protected species of Mozambique
S. megalops	N/A
Plectorinchus chubby	N/A
P. gaterinus	N/A
Rastrelliger kanagurta	N/A
Scomberomorus commerson	NT
Parupeneus indicus	N/A
Plectorinchus orientalis	N/A
P. gaterinus	N/A
Euthinnus affinis	N/A
Carangoides armatus	N/A
C. chrysophrys	N/A

(Source: Prepared by the Survey Team)

Table 3-10 is the list of macrobenthos commonly seen in Nacala Bay. Also, no information could be obtained from the literature or survey regarding the species of macrobenthos.

Table 3-10 Macrobenthos commonly seen in Nacala Bay

Scientific name
Anthozoa
Sipunculidea
Phascolosomatidea
Polychaeta
Crustacea
Bivalvia
Gastropoda
Echinoidea
Ophiuroidea
Leptocardii
Osteichthyes

(Source: Prepared by the Survey Team)

The habitat of dolphins and dugongs is not observed in Nacala Bay, which can be attributed to the port development conducted during several years in the past.

3.2.10 Population

According to the population survey in 2007 by Department of Statistics, Nacala-Porto city, where the project site is located, had a population of 211,915 which represents 5 % of Nampula State, and was estimated to have increased to 241,066 in 2015 and to increase to 251,395 in 2020. The gender ratio was approximately 98.3 men to 100 women in the city of Nampula and Meconta. The population density is 725 people/km2 which largely exceeds the average of Nampula State (59 people/km2). The area of Nacala-Porto city is 324 km2 according to the Department of Statistics, which is 0.4 % of Nampula State.

3.2.11 Land Use

The project site is the site of the former Nacala power plant. The land is leased by EDM (Public Electricity company of Mozambique) from the Mozambique government.

The land around the project site is used for industry, commerce and residence.

The western side of the project site is the coast line. According to local legislation, land within 250m from the coastline is generally limited to public use only, and permission from the state government is required for use. The area between the project site and the coastline is managed by the national port and railway company (CFM), and traditional self-sufficient agriculture and livestock are not permitted.

3.2.12 Water Use

Water used in Nacala-Porto city is mainly supplied from Bayou Nacala-Porto dam, under the control of Water Supply Assets Fund. The dam extension was recently executed to increase water supply, but most of the people living in the suburban area are still not able to access potable water. According to the Department of Statistics of Mozambique, approximately 48.9% of the households in Nacala-Porto City have direct access to water supply through water pipeline.

The area around the project site is not equipped with irrigation systems and depends on rain water during rainy season.

Fishery in the area is small scale run by the local fishermen along the coast of Nacala Bay. They fish without official fishing license, which is essentially illegal.

3.2.13 Local Economy Including Employment and Livelihood

The main economic activity of Nacala-Porto is related to export and import, port and railway industry. Manufacturing industries such as cement and cashew nut also exist. The main industry of people living distant from Nacala-Porto city is agriculture and fishery, and livestock raising is not popular.

3.2.14 Existing Social Infrastructure and Social Service

There are 88 elementary schools and 23 secondary schools in Nacala-Porto City. The number of teachers is currently insufficient, and quality of teaching is low. The literacy rate of Nacala-Porto City is only around 50%.

In Nacala-Porto City, only 3.9% of households are equipped with a toilet with a septic tank, 60% have toilets but with insufficient sewage treatment. The rest of households (approximately 36%) have no toilet at home.

There are 11 medical facilities in the City, including 1 general hospital, 9 large healthcare centers, and 2 small healthcare centers.

Electricity is supplied from the national power network through 110kV transmission line running parallel to the railway installed in Nacala Corridor area and through 33kV distribution lines reaching each household. 24.8% of the residents of Nacala-Porto City are able to access to electricity at present.

72% of households use heating oil as energy source, and 2% of households use firewood.

Regarding traffic infrastructure, Nacala port is the third deepest port on the eastern coast of Africa and a large number of vessels navigate in and out every day. In terms of railways, a railway is under construction connecting Vale coal mine located in Moatize and Nacala port (912km) which will be completed in 2016. Nacala-Porto City is connected to Nampula and Namialo with Route 12, and to Nacala-a Velha with the state road 702.

In terms of the communication in Nampula State, communication services such as telephone, internet, data transmission are provided by 2 national companies and 2 private companies.

3.2.15 Public Health

The average lifetime of people in Nampula State where the project is located is 52.9 years, longer than the average of Mozambique (49.4 years). The most frequent cause of death in Nampula State is malaria at 30.6% of the total causes, followed by HIV/AIDS at 20.7%.

The most frequent diseases diagnosed at the hospital are malaria, cholera, and sexually-transmitted infections.

3.2.16 Minority

Table 3-11 shows the main ethnic groups in Mozambique and the respective percentages.

Table 3-11 Main ethnic groups in Mozambique

Ethnic groups	Number of tribes	Percentage (%)
Swahili	1	1
Marave	15	18
Macua-Lomoe	21	25
Chona	11	13
Chope	3	4
Tonga	3	4
Angoni	6	7
Maconde	4	5
Ajaua	10	12
Population living in the lower reaches of the Zambezi river	10	12
Total	84	100

(Source: Prepared by the Survey Team)

85% of Nacala-Porto City residents speak the local language, Emakwa language, and 14% speak the official language of Mozambique, Portuguese. Nacala-Porto city has the presence of a predominantly Muslim ethnic group called Macua-Lomoe, so 79.8% of the city’s population believes in Islam, followed by Christianity with 17%.

Ethnic minorities do not live within and around the project site.

3.3 Procedures and Organizations Related to Environmental and Social Considerations in Mozambique

3.3.1 Environmental Administration

The Ministry of Coordination of Environmental Affairs (MICOA) was established in 1995. Its role is the implementation of the national environmental management plan, enforcement of environmental directives and regulations, handling of environmental issues in cooperation with relevant administrative organizations, as well as to ensure that all environmental activities including planning, programs, policies, and development plans are carried out with due environmental consideration. In January 2015, under government reorganization MICOA was changed to the Ministry of Land, Environment and Rural Development (MITADER).

Figure 3-19 shows MITADER's organigram. DINAB (National Directorate of Environment) is responsible for EIA in MITADER. Other ministries which are also concerned with environmental protection include the National Commission for Sustainable Development, the Ministry of Agriculture and Rural Development, the Ministry of National Directorate of Forestry and Wildlife, the Ministry of Tourism (also known as Directorate for Conservation Areas), the Ministry of Fisheries, and the Ministry of Trade and Industry.

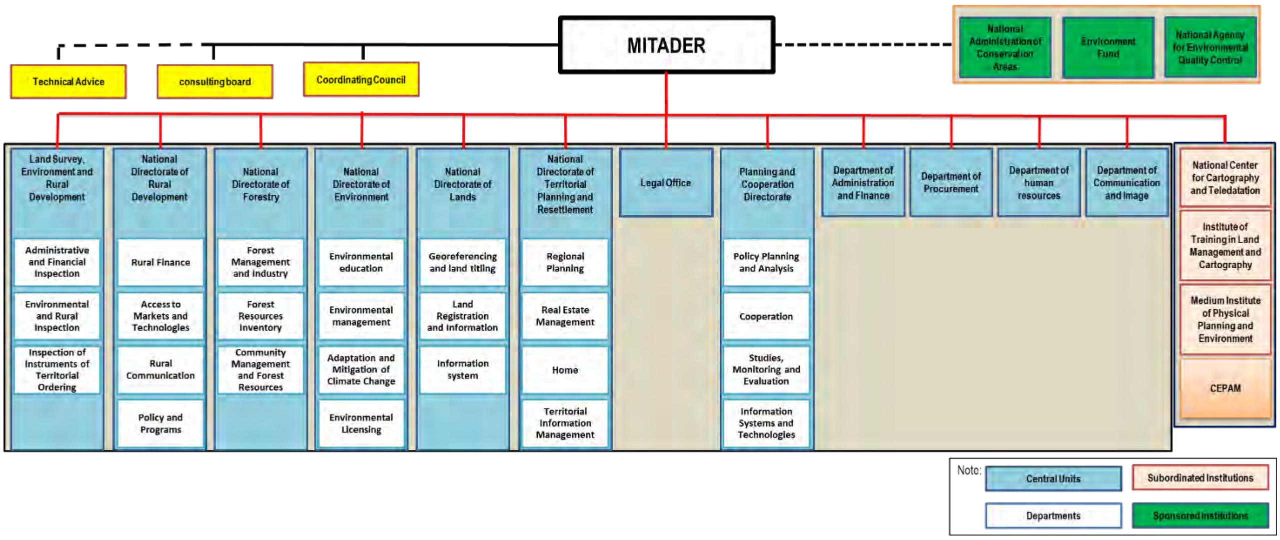


Figure 3-19 Organization Structure of MITADER

(Source: MITADER webpage)

3.3.2 Environmental Impact Assessment (EIA)

(1) EIA Related Laws and Regulations

The main regulations concerning environmental management and protection in Mozambique are listed in Figure 3-12.

The Environment Law No. 20/97 is the principal environmental law in Mozambique, with other regulations, decrees, and programs established to stipulate respective items thereunder. The fundamental policy of the Environmental Law includes the following:

- Use and management of the environment in view of promoting higher standard of life for people and the protection of biodiversity and ecology.
- Conservation of natural resources and the traditional customs and knowledge of local people that are concerned with the environment, as well as promoting the fair distribution of natural resources.
- Encouragement of public participation.

The Environmental Law is applied to all private and governmental activities that have a direct or indirect impact on the articles of the Mozambican constitution that ensure an of natural resources.olicy of the Environmental Law

Table 3-12 Main Environmental-related Legislation in Mozambique

Description of the Environmental Regulation	Legal Instrument Title
Environmental Law	Law No. 20/97
Regulation for Environmental Impact Assessment	Decree No. 54/2015 (Decree 45/2004 and Decree 42/2008 were revoked)
Land Law	Law No. 19/1997
Regulation for Waste Management	Decree No. 13/2006
Forest and Wildlife Law	Law No. 10/1999
Regulation on the Forest and Wildlife Law	Decree No. 12/2002
Regulation on the Environmental Audit Process	Decrees No. 25/2011
Regulation for Industrial Activities	Decree No. 39/2003
Regulations for Environmental Quality Standards and Effluent Emissions	Decree No. 18/2004 (amended by Decree No. 67/2010)
Regulation for Environmental Inspections	Decree No. 11/2006
Regulation for the Resettlement Process Resulting from Economic Activities	Decree No. 31/2012

(Source: Final Report of Preparatory survey on urea fertilizer complex project in the Republic of Mozambique, 2014)

The new Decree No. 54/2015 (in effect since 31st of March 2016), known as the regulation on the EIA process, stipulates the process for implementing, assessing, and managing EIA, and applies to all government and private development activities. According to the EIA regulation, EIA may be implemented only by registered consultants.

The EIA requirements for projects are determined according to the impacted area, sensitivity, scale, and contents of the predicted environmental impact. The project, according to Decree No. 54/2015 of Mozambique, is then categorized as shown in Figure 3-13.

Table 3-13 Category and Requirements under Mozambique EIA Regulation

Category	Requirements	Expected project type
Category **A+**	According to the Annex 1 of the EIA regulation, a project that could cause potentially irreversible environmental and social impacts is categorized as Category A+. For instance, in the case of a complex development project in an area of high environmental sensitivity, it is compulsory that the EIA team is highly specialized, and that a commission of external third-party consultants is requested to participate in the review/deliberation of the EIA. Projects in this category are required to prepare and submit a full EIA and an environmental management plan (EMP).	● Nuclear power plants ● Pesticide production plant ● Mining ● Oil and gas ● Flammable gas storage
Category **A**	According to Annex 2, projects classified as Category A are those that may cause substantial but not irreversible impacts to the environment. Since these projects do not have elements as complex as those found in Category A+ projects, external third-party consultants are not required. Projects in this category are required to prepare and submit a full EIA and an environmental management plan (EMP).	● Power plants (no criteria for power output or fuel type) ● Transmission lines (more than 66 kV) ● Gas pipelines (more than 5 km length)
Category **B**	It refers to the projects indicated in the Annex 3 of the EIA regulation. These projects usually have limited or slight impacts on local communities and the environment, and their level and area of influence is smaller than Category A projects. Projects in this category are required to prepare and submit a simplified environmental assessment (SEA) to the concerned authorities, a full EIA and an environmental management plan (EMP).	● Wood processing plant ● Animal feed production plant (larger than 1,000 tons per month) ● Transmission line (less than 66 kV)
Category **C**	The projects types cited in the Annex 4 of the EIA regulation are considered to have very slight or almost no social or environmental impacts. The agency responsible for the EIA or the DPCA do not require the preparation of an EIA or SEA but request the submission of documents explaining the project's environmental management procedures.	● Irrigation systems (between 50-100 ha) ● Re-development of existing port infrastructure ● Transmission line (less than 33 kV)

(Source: Survey Team)

(2) EIA Regulations and Procedures

The EIA approval process of Mozambique is described in Figure 3-20. The outline of the process is as outlined below.

- Application and Review (Categorization)
  The project proponent is required to prepare a screening report and preliminary environmental information form and submit these to MITADER and DPCA. MITADER shall then conduct a preliminary assessment based on the submitted documents to determine the project category. If the project is determined as category C, the EIA process shall end at this stage.
- Environmental Pre-Viability Report and Scope Definition (EPDA)
  Category A+/A projects require an EPDA. EPDA should include determination of environmental and social assessment items subject to the EIA based on impact prediction. EPDA is not required for category B projects.
- Terms of Reference for EIA
  The terms of reference (TOR) is a document prepared by a registered consultant to specify the EIA methodology for category A+/A projects, and SEA methodology for category B projects.

- Process of review and approval

  For category A+/A and B projects, TOR for the EIA or SEA should be submitted to MITADER for review and approval by the Technical Assessment Committee (TAC). After approval, EIA or SEA report should be prepared and submitted to MITADER for review and approval by TAC.

- Public Participation Process

  In the case of category A+/A projects, public participation process is needed at the stage of EPDA and /or TOR for EIA and the EIA report. This process is not required for category B projects.

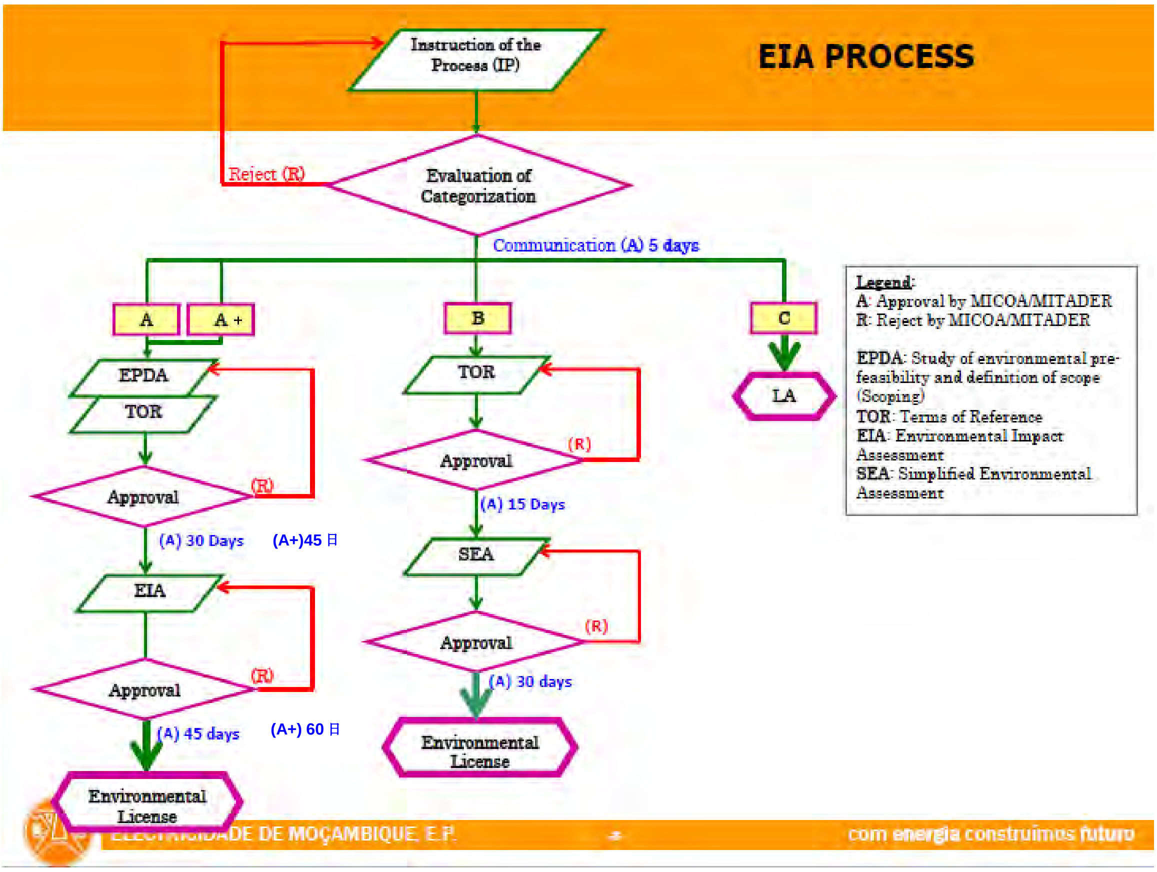


Figure 3-20 EIA Approval Process of Mozambique

(Source: Received from EDM and prepared by Survey Team)

This is a Category A project. In terms of the EIA procedure based on the Mozambican legal system, the local consultant employed in the ort. This process is not required for category B projects.red for category B projects.ted to MITADER for review and approraft EIA report on the basis of the survey results and supported the holding of Stakeholder Meetings. ESIA approval was received from MITADER in April 2017 after completion of the survey.

However, since the estimated Project Outline prepared for the EIA, changes have been made to the stack height and planned operation hours, etc. based on this preparatory survey, so an inquiry was made to MITADER regarding the need for the implementation of an Addendum EIA. As a result, a letter was issued by MITADER on June 12, 2019, concluding that it is necessary to produce an Addendum EIA Report and to hold an addition Stakeholder Meeting. In this regard, the local consultant employed for the "Preparatory Survey on the Project for Reinforcement of Transmission Network in Nacala Corridor" have again been employed to produce the Addendum EIA Report.

The Addendum EIA Report will be submitted to MITADER after public consultation held on 24th September, 2019, and it is expected that approval for the Addendum EIA Report will be obtained before Tender Notice.

Note that, after acquiring approval for the Addendum EIA Report, it will be necessary to acquire an Environmental Permit before starting construction work once EDM has paid the Environmental Permit Tax (approximately 5.75 million meticals).

(3) Comparison between JICA Guidelines for Environmental and Social Consideration and EIA Regulations of Mozambique

This project needs to comply with both JICA Guidelines for Environmental and Social Consideration (April 2010) (JICA Guidelines) and Decree No. 45/2004. As shown in Table 3-14 for comparison of the two regulations/guidelines, there is no huge gap in main environmental and social consideration items between them.

Also, it was confirmed during the ions/guidelines, there is no huge gap in main environmental and social consideration items between thethe instructions will generally be given by MITADER to refer to the World Bank's safeguard policies regarding items not specified in Mozambique's EIA-related laws.

Table 3-14 Comparison on Main Environmental and Social Consideration Items between JICA's Guideline for Environmental and Social Consideration and Mozambican Regulation regarding EIA

Item	JICA Guidelines for Environmental and Social Consideration	Decree No. 54/2015, Mozambique	Identification of Gap and Measures to be taken
Disclosure of information	● Disclosure of environmental assessment report to all people concerned and residents. Release information through JICA website.	● Disclosure of environmental assessment report to residents.	No gap
Resident participation	● Recommend the project proponents to announce project and consult with the local residents and people concerned (especially with the residents directly influenced by the project). ● For category A project, project proponents need to explain to the residents and local people concerned about the necessity of the development, negative impact on the environment/society and the result of alternative analysis. ● Basic idea is to hold stakeholder meeting two times, at the time of scoping and draft EIA report for category A project. Stakeholder	● Article 14 specifies requirements concerning public engagement at the phase of EIA report preparation. ● If necessary, MITADER can look at comments from residents and hold public consultation at the phase of consideration of comments delivered. ● In case of Category A projects, public engagement is necessary. One consultation is necessary at scoping stage and another at EIA report preparation.	No gap

Item	JICA Guidelines for Environmental and Social Consideration	Decree No. 54/2015, Mozambique	Identification of Gap and Measures to be taken
	meeting can be held, if necessary, in case of category B project.	● Notification shall be made 15 days before the consultation to all the stakeholders.	
Relocation of residents	● Prepare resettlement action plan (RAP) and make public notification for it if project causes large scale involuntary resettlement. ● If possible, apply WB's safeguard policies (OP 4.12, Annex A) to the RAP to be prepared.	● Preparation and approval of Resettlement Action Plan is necessary as prerequisite of environmental permit.	No gap
Mitigation measures	● Consider alternative measures to avoid or minimize negative impacts. ● Give priority to avoiding impacts when considering measures. If impossible, consider methods to mitigate or minimize impact ● Consider compensation if any of the above measures cannot avoid impact. ● Appropriate follow-up plan such as monitoring program and the environmental management plan has to be prepared (including cost of related activities and financing). Also prepare a good environmental management plan for project in which significant impact is predicted.	● Compare and consider alternatives, including zero option (Art. 2 of the Regulation) ● Clearly state the Environmental Management Plan (EMP) in EIA/SEA reports, including mitigation measures, monitoring plan, environmental education, measures for preventing labor accident, and emergency plan) ● The MICOA shall regularly make inspection and control of the actions of monitoring and environmental management of the activity, carried out by the tenderer, with a view to ensure the quality of the environment, and may request the conduction of environmental impact audit or make environmental inspections, when the complexity of the issues of environmental control so justify.	No gap

(Source: Prepared by the Survey Team)

3.3.3 Environmental Regulations, Legislation and International Guidelines

(1) Air Quality

In Mozambique, the environmental standards for ambient air quality shown in Table 3-15 and the exhaust gas emission standards from Thermal Power Plants shown in Table 3-16 are the laws that establish standards for environment quality and waste disposal (Decree No. 18/2004 and Decree No.67/2010). To compare the national standards to international guidelines, the said tables also contain the International Finance Corporation (IFC) and the World Bank (WB) environment, health, and safety (EHS) guideline values as well as the relevant EU standards.

Table 3-15 Ambient Air Quality Standards (μg/m^3)

Pollutant	Average time	Mozambican Environmental Standards (Decree No.67/2010)	IFC/WB EHS Guidelines (General 2007)	[Reference] Environmental Standards	
				EU	Japan
SO_2	10 minutes	500	500		
	1 hour	800	—	350	286
	24 hours	100	Interim target: 125 Interim target: 50 Guideline: 20	125	114
	Annual	40	—	—	—

Pollutant	Average time	Mozambican Environmental Standards (Decree No.67/2010)	IFC/WB EHS Guidelines (General 2007)	[Reference] Environmental Standards	
				EU	Japan
NO_2	1 hour	190	200	200	—
	24 hours	—	—	—	82-113
	Annual	10	40	40	—
PM_{10}	1 hour	—	—	—	200
	24 hours	150	Interim target 1: 150 Interim target 2: 100 Interim target 3: 75 Guideline: 50	50	100
	Annual	60	Interim target 1: 70 Interim target 2: 50 Interim target 3: 30 Guideline: 20	40	—
CO	1 hour	30,000	—	—	—
	8 hours	10,000	—	10,000	25,000
O_3	1hour	160	—	—	129
	8 hours	120	—	120	
	24 hours	50	—		—
	Annual	70	—	—	—
Pb	Annual	0.5	—	0.5	—

(Source: Prepared by Survey Team)

Table 3-16 Exhaust Gas Emission Standards for Thermal Power Plants (mg/Nm3)

Pollutant	SOx	NOx	PM
IFC/WB EHS Guidelines (Thermal Power Plant) 2008 Gas Turbine (≧50MW)* (Megawatt thermal input on HHV basis)	Natural gas: N/A Other than natural gas: Sulfur content in fuel is as below; - Area where the air quality exceeds standards = 0.5% - Area where the air quality does not exceed standards = 1.0%	Natural gas: 51 (25ppm) Other than natural gas: Area where the air quality exceeds/does not exceed standards= 152 (74ppm)	Natural gas: N/A Other than natural gas: - Area where the air quality exceeds standards =30 - Area where the air quality does not exceed standards = 50
Standard of Mozambique	2,000	Coal: 750 Diesel: 460 Gas: 320	100 (<50 MW) 50 (>50 MW)

* Dry gas, O_2 15% conversion

(Source: Prepared by Survey Team)

For any items of environmental standards that are not regulated by Decree No. 18/2004 and Decree No. 67/2010, the following standards will be applied where appropriate.

- South African Bureau of Standards
- World Health Organization
- World Bank / International Financial Corporation

(2) Water Quality

In Mozambique, the environment standards for sea water quality, shown in Table 3-17 and Table 3-18, are regulated in Decree No. 67/2010 and the effluent standards for domestic wastewater, shown in Table 3-19, are regulated in Decree No. 18/2004.

Effluent standards for thermal power plants are regulated by Decree No.18/2004. Table 3-20 shows the Mozambican standard together with IFC/WB EHS guideline values for thermal power.

Table 3-17 Sea Water Quality Standards (General Items)

Contaminant	Maximum acceptable concentration in Mozambique (Decree No. 67/2010)
Suspended solids (SS)	Not detected
Oil	Not detected
Color, foul odor or turbid matter	Not detected
Artificial coloration	Not detected
Abrasive deposit	Not detected
BOD5 at 20℃	≤ 5mg/L
COD	≤ 6mg/L
pH	6.5 – 8.5

(Source: Prepared by Survey Team)

Table 3-18 Sea Water Quality Standards (Hazardous Substances) (mg/L)

Contaminants	Maximum acceptable concentration in Mozambique (Decree No. 67/2010)	Contaminants	Maximum acceptable concentration in Mozambique (Decree No. 67/2010)
Aluminum	1.5	Dissolved iron	0.3
Ammonia	5.0	Fluorine	10.0
Antimony	0.2	Manganese	0.1
Arsenic	0.5	Mercury	0.01
Barium	5.0	Nickel	0.1
Beryllium	1.5	Nitrate	10.0
Boron	5.0	Nitrite	1.0
Cadmium	0.02	Silver	0.005
Lead	0.5	Selenium	0.05
Cyanogen	0.2	Surface-activating matter	0.5
Chlorine residue	0.01	Sulfur (H_2S)	1.0
Copper	1.0	Thallium	0.1
Total chromium	0.05	Uranium	0.5
Tin	4.0	Zinc	5.0
Phenol	0.5		

(Source: Prepared by Survey Team)

Table 3-19 Effluent Standards for Domestic Sewage

Contaminant	Unit	Acceptable concentration of Mozambique	IFC/WB EHS guideline (General) 2007
Color	—	dilution1:20 no color	—
Foul odor	—	dilution no foul odor	—
pH	—	6－9	6－9
Water temperature	℃	35	—
BOD	mg/L	—	30
COD	mg/L	150	125
TSS	mg/L	60	50
T-P	mg/L	10	2
T-N	mg/L	15	10
Oil & Grease	mg/L	—	10
Coliform	MPN/100ml	—	400

(Source: Prepared by Survey Team)

Table 3-20 Effluent Standards for Plants

Parameter	Unit	Decree No. 18/2004 of Mozambique	IFC /WB EHS Guidelines (Thermal Power Plants) 2008
pH	—	6-9	6–9
TSS	mg/L	50	50
Oil & Grease	mg/L	10	10
Iron	mg/L	1	1
Zinc	mg/L	1	1
Chromium-Total	mg/L	0.5	0.5 *
Total residual chlorine	mg/L	0.2	0.2
Copper	mg/L	0.5	0.5
Lead	mg/L	-	0.5
Cadmium	mg/L	-	0.1
Mercury	mg/L	-	0.005
Arsenic	mg/L	-	0.5
Temperature increase by thermal discharge from cooling system		3 degrees Celsius or below (at the edge of mixing zone, not at the discharge point)	Elevated temperature areas due to discharge of once-through cooling water (e.g., 1 Celsius above, 2 Celsius above, 3 Celsius above ambient water temperature) should be minimized by adjusting intake and outfall design through the project specific EA depending on the sensitive aquatic ecosystems around the discharge point. *

(Source: Prepared by Survey Team)

(3) Noise

As there are no regulations concerning noise levels in Mozambique, the IFC/WB EHS guideline values will be applied, as shown in Table 3-21.

Table 3-21 Ambient Noise Level Standards of the IFC/WB EHS Guideline (General)

Area	L_{Aeq} (dBA)	
	Daytime: 07:00 – 22:00	Nighttime: 22:00 – 07:00
Residential area, public facilities, educational facilities	55	Residential area, public facilities, educational facilities
Industrial area, commercial area	70	Industrial area, commercial area

(Source: IFC/WB EHS General Guidelines, 2007)

(4) Waste Management

In Mozambique Decree No. 13/2006 governs the treatment and disposal of waste.

There is only one landfill that accepts hazardous waste, which is located in Maputo and operated and managed by a private company called Enviro Serve. General waste is collected and treated by municipality.

(5) National Parks and National Reserves

National parks and protected areas are under administration of the National Director for Conservation Areas, Ministry of Tourism, and categorized into the following three categories in accordance with the Law on Forests and Wildlife (Decree No. 10/1999).

- National Park
- Nature Reserve
- Culturally valuable controlled area

Figure 3-21 shows the map of protected areas in Mozambique. No protected areas are located in and around the proposed project sites.

Figure 3-21 National Parks and Reserves in Mozambique

(Source: Government of Mozambique. 2018. *Nature-based Tourism 2018 Mozambique Conservation Areas.* (http://pubdocs.worldbank.org/en/881051531337811300/Ficha%CC%81rio-ENG-LOW.pdf) accessed on 31 May, 2019)

3.4 Alternatives

The following alternatives are included in the EIA report (approved by MITADER in April 2017) describing the processes to be implemented in Mozambique.

3.4.1 No Project Implementation

The expected impacts by no project implementation (zero option) are described in Table 3-22.

Table 3-22 Expected impacts by no implementation of power plant project

Aspect	Positive Impacts	Negative Impacts
Power Demand and Cost	- None	- Power demand of Nacala area is increased, and frequency of power failure is also increased. High-cost rental-based emergency power generating facilities need to be continuously used.
Environmental Pollution	- Impacts by emission gas and noise are not expected	- None
Natural Environment	- None	- None
Social Environment	- None	- No employment opportunities - Electricity use in Nacala area remains unstable.

(Source: Prepared by Survey Team)

3.4.2 Selection of Site

The location of the power plant site was selected due to the following reasons;

- The existing Nacala power plant is already closed down, and its site is vacant at this moment and not used for residential, agricultural or forest purposes.
- The substation is also located in the existing Nacala power plant site, so that new transmission line to the substation is not necessary to be constructed.
- It is possible to install power plant facilities at earliest time.

There are some other locations to install power generating facilities, but the detailed consideration is not conducted as this Project is an "emergency" power plant and the facilities of this Project should be installed quickly for the following reasons, in comparison to the existing Nacala power plant site;

- Land acquisition of new site and clearance of the site are necessary (more time and cost are necessary).
- It takes longer time to install the power generating facilities.
- New transmission line needs to be constructed to the nearest substation.

3.4.3 Fuel Type

Table 3-23 compares three fuel types: natural gas, oil, and coal.

Power generation with natural gas emits less SOx, ash dust and CO2 than that with other fuels but natural gas is not stably available in Nacala region at this moment. Therefore, oil fuel was selected for this Project. The dual-fuel power generation facilities is planned to be installed so that the facilities can convert the fuels from oil to natural gas when natural gas field under development in northern area of Mozambique can supply natural gas to this power generation.

Table 3-23 Alternatives of fuels

Aspect	Natural gas	Oil	Coal
Technical	● No gas pipeline installed at this moment ● LNG tanks need to be constructed ● Combined-cycle turbine is technically available	● The project can receive oil with tank trucks from oil storage station in Nacala Port in the visinity of the project site ● Oil tanks need to be constructed ● Combined-cycle turbine is technically available	● Railway is necessary for this project to receive coal ● A large area is necessary for coal storage yard and ash disposal site ● Combined-cycle technology with gasification of coal is not technically available in the commercial phase at this moment
Economy	● Gas field is under development in northern part of Mozambique. It takes a long time to start production, construct pipelines. It also costs to construct pipelines	● Only construction cost of tanks is necessary	● Lower fuel cost ● High construction cost of railway ● Cost for land acquisition is necessary to construct coal storage yard and ash disposal site
Environmental and social consideration	● Generally, natural gas contains no ash and less sulphur than oil and coal so combustion of natural gas generates less ash dust and SOx ● CO_2 per MWh is the smallets so the impact is also the smallest	● Oil contains ash and sulphur so combustion of oil generates dust and SOx. Desulphurization facility might be necessary depending on the sulphur content ● CO_2 per MWh is larger so the impact is also larger	● Coal contains much ash and, therefore, dust precipitator is necessary. Desulphurization facility ● ● might be necessary as well depending on the sulphur content ● CO_2 per MWh is the largest so the impact is also the largest
Overall	Natural gas has advantages in availability of combined-cycle generation and in low air quality impact but is unavailable for this project as production of gas has not started in Mozambique. When natural gas is available, the facilities will use natural gas.	Combined-cycle generation is available. Pnly construction of tanks is necessary to receive oil. Therefore, oil has advantages.	Coal is ferior as railways, coal storage yard and ash disposal site need to be constructed and combustion of coal generates more dust, SOx and CO_2.

(Source: Prepared by Survey Team)

3.4.4 Power Plant Type

Two types of generator can be considered for the power plant: diesel generator and simple-cycle gas turbine generator. As shown in Table 3-24, the comparison was made between two types of generator in order to choose one that has more advantages.

Table 3-24 Comparison between a diesel generator and gas turbine generator

Aspect	Diesel generator	Simple-cycle gas turbine generator
Technical aspects	● Electricity generation efficiency is approximately 33%. ● Fuel may be gas, light oil or Diesel type A ● Requires short start up time ● Since output per generator is small if compared to a gas turbine generator, a larger number of generators would be required	● Electricity generation efficiency is approximately 38%, which is higher than the diesel generator (by employing a combined cycle technology in the future, further increase in the efficiency is expected). ● Fuel may be gas or light oil ● Requires short start up time ● Since output per generator is higher if compared to a diesel generator, 1 or 2 generators would be sufficient
Economic aspects	● When compared to a gas turbine generator, maintenance cost is cheaper	● When compared to a diesel generator, maintenance cost is more expensive
Social and environmental aspects	● NOx emissions are higher if compared to a gas turbine generator ● More noise and vibration are expected if compared to a gas turbine generator	● NOx emissions are low if compared to a diesel generator ● Less noise and vibration are expected if compared to diesel generator

(Source: Prepared by Survey Team)

3.5 Scoping

On the basis of the following information, the relevant environmental and social items to be assessed were selected in accordance with the JICA Guidelines. Table 3-25 shows the result of scoping for the power plant.

- Results of "The Preparatory Survey for Nacala Corridor Transmission & Distribution Network Reinforcement Project"
  (The results were reflected into the EIA Scoping Report prepared in accordance with Mozambican legislation)
- The first and second field survey results
- Expected impacts by construction of power plant

Table 3-25 Scoping Results for the Power Plant

No.	Item	Assessment		Reasons of assessment
		Preparation Construction	Operation	
Pollution Control				
1	Air pollution	B-	A-	**Construction period:** - Civil engineering work, such as destruction of the existing facilities and land formation, may cause dust, but the impact should be temporary. - Heavy equipment and trucks are likely to discharge air pollutants (including SOx and NOx). **Operation period:** - Diesel oil will be used as the fuel at the power plant. SOx, NOx, and PM will be emitted by the operation of gas turbine. According to the field survey conducted by the Survey Team, it was found that the east side of the proposed power plant site is a high-elevation area; therefore, there is a possibility that a part of the area may have high concentration of pollutants emitted from the stack, depending on the wind direction.

No.	Item	Assessment		Reasons of assessment
		Preparation Construction	Operation	
2	Water pollution	B-	B-	**Construction period:** - Muddy water may be brought about due to rainfall, but the scope of impact will be temporary. - Domestic wastewater from workers, concrete-containing wastewater and oil-containing wastewater will probably be generated. However, the scope of impact will be temporary. **Operation period:** - A gas turbine will be installed instead of a steam turbine, and thermal wastewater will not be generated. - Plant wastewater, domestic wastewater and oil-containing wastewater will probably be generated, but the amount and its impact will be very limited.
3	Waste	B-	B-	**Construction period:** - Lubrication oil and fuel spilled by/from construction vehicles and machinery are likely to cause contamination to the soil. **Operation period:** - Lubrication oil and fuel may will be spilled and are likely to cause contamination to the soil.
4	Soil contamination	B-	B-	**Construction period:** - Operation of heavy equipment and trucks will cause an impact from the temporary noise and vibrations. In particular, pile driving and destruction of the existing facilities will generate a high level of noise and vibrations that are likely to cause a temporary significant impact to the residential areas located at the east side of the proposed power plant, which was found and confirmed by the Survey Team at the field survey. **Operation period:** - Operation of the plant equipment generating noise and vibrations may cause a significant impact to the residential areas located at the east side of the proposed power plant, which was found and confirmed by the Survey Team at the field survey.
5	Noise and vibrations	B-	A-	**Construction period and operation period:** - Water will not be drawn from underground.
6	Land subsidence	D	D	**Construction period and operation period:** - There is no groundwater intakes.
7	Odor	B-	B-	**Construction period and operation period:** - If untreated wastewater is discharged into the sea, it may cause substratum contamination.
8	Sediment contamination	B-	B-	**Construction period:** - Lubrication oil and fuel spilled by/from construction vehicles and machinery are likely to cause contamination to the soil. **Operation period:** - Lubrication oil and fuel may will be spilled and are likely to cause contamination to the soil.
Natural environment				
1	Wild life preservation area	D	D	**Construction period and operation period:** - No wildlife preservation area is within or near the area.

No.	Item	Assessment		Reasons of assessment
		Preparation Construction	Operation	
2	Terrestrial ecosystems and rare species	B-	B-	**Construction period:** - The site is a developed area for the existing power plant and no tree cutting will be conducted. - Construction work will generate air pollution, noise and vibrations that are likely to have an impact on the terrestrial ecosystems. However, the site is located in a suburban area, so the affected ecosystems are likely to be little and the range of such impact should be very limited and temporary. **Operation period:** - The power plant will generate air pollution, noise and vibrations that are likely to have an impact on the terrestrial ecosystems. However, the site is located in a suburban area, so the affected ecosystems are likely to be little and the range of such impact should be very limited and temporary.
3	Marine ecosystems and rare species	B-	B-	**Construction period:** - Concrete-containing wastewater and oil-containing wastewater are likely to be generated. However, the impact will be temporary. **Operation period:** - A gas turbine will be installed instead of a steam turbine, and the drawing of cooling water and the generation of thermal wastewater is not likely to occur. - Plant wastewater, domestic wastewater, and oil-containing wastewater will probably be generated, but the amount and its impact should be very limited.
4	River ecosystems and precious species	D	D	**Construction period and operation period:** - The site has no rivers nearby and no wastewater shall be discharged into rivers.
5	River hydrology	D	D	**Construction period and operation period:** - The site has no nearby rivers. Water will not be drawn from the rivers.
6	Underground hydrology-	D	D	**Construction period and operation period:** - Water will not be drawn from underground.
7	Marine hydrology	D	D	**Construction period:** - Since no port and harbor facilities will be constructed, there is likely to be no change in flow conditions caused by the structure. **Operation period:** - A gas turbine will be installed instead of a steam turbine. There will be no change in flow conditions in the vicinities of the discharged area due to the cooling water intake and discharge.
8	Topography and geology	D	D	**Construction period:** -The site is a developed area for the existing power plant and land alteration should be very limited. **Operation period:** - Since no port and harbor facilities will be constructed, there will be no soil erosion caused by the structure.
Social environment				
1	Resettlement and Land acquisition	D	D	**Preparation period, construction period, and operation period:** - The site is a developed area for the existing power plant and new land acquisition and resettlement will not occur.
2	Poor people	D	D	**Preparation period, construction period, and operation period:** The site is a developed area for the existing power plant and new land acquisition and resettlement will not occur.

No.	Item	Assessment		Reasons of assessment
		Preparation Construction	Operation	
3	Ethnic minorities	D	D	**Preparation period, construction period, and operation period:** - The site is a developed area for the existing power plant and new land acquisition and resettlement will not occur. - According to the results of "The Preparatory Survey for Nacala Corridor Transmission & Distribution Network Reinforcement Project," ethnic minorities do not live in the vicinity of the site.
4	Local economy including employment and means of livelihood	B+	B+	**Preparation period:** - The site is a developed area for the existing power plant and new land acquisition and resettlement will not occur. **Construction period and operation period:** - Local people may be employed as workers by the power plant. Purchases of local materials and equipment items may increase, which are likely to have a positive effect on the local economy.
5	Land use and utilization of local resources	D	D	**Preparation period, construction period, and operation period:** - The site is a developed area for the existing power plant and new land acquisition and resettlement will not occur. Use of land and local resources are not likely to be affected.
6	Water use	B-	B-	**Construction period:** - Muddy water, concrete-containing wastewater and oil-containing wastewater will probably be generated, and a temporary impact on fishery is predicted. **Operation period:** - No port, harbor and water-intake facilities that may affect the fisheries will be installed. - Cooling water intake or thermal water discharge will not occur. Discharge of plant wastewater, domestic wastewater and oil-containing wastewater is likely to be minimal and its impact on local fishery activity should be very limited.
7	Existing social infrastructure and social service	B-	B-	**Construction period:** - In case where inflows of workers are significant, construction of lodging houses, medical treatment facilities, sewer systems and other infrastructure may be necessary. - Traffic jam caused by increasing traffic is expected, but only temporarily. **Operation period:** - In case where inflows of workers are significant, lodging houses, medical treatment facilities, sewer systems and other infrastructure may be needed for workers.
8	Social bodies including social capitals and social organizations that make local decisions	D	D	**Preparation period, construction period, and operation period:** - The site is a developed area for the existing power plant and new land acquisition and resettlement will not occur. Consequently, social bodies including social capitals and local decision-making organizations will not be affected.
9	Unfair distribution of damage and benefit	B-	B-	**Preparation period, construction period, and operation period:** - The site is a developed area for the existing power plant and new land acquisition and resettlement will not occur. Unfair distribution of damage and benefits caused by compensation should not occur. - If employing local people and/or outsourcing contracts are not fair, benefits may be unfairly distributed.

No.	Item	Assessment		Reasons of assessment
		Preparation Construction	Operation	
10	Conflict of interests within the local area	B-	D	**Preparation period and construction period:** - The site is a developed area for the existing power plant and new land acquisition and resettlement will not occur. Conflicts of interests within the local area are not predicted. - Inflows of many workers from other parts of Mozambique or foreign countries during construction period may cause conflict with local workers, if the local customs are not followed. **Operation period:** - A small inflow of workers from outside the area is predicted, and conflict with local workers due to difference in customs should not occur.
11	Cultural heritage	D	D	**Construction period and Operation period:** - The site is a developed area for the existing power plant and the construction site has no precious historical, cultural, or religious heritage.
12	Scenery	D	D	**Construction period and Operation period:** - The site is a developed area for the existing power plant, and since the site has no scenic spots, no impact is expected.
13	**Gender**	D	D	**Preparation period, construction period, and operation period:** - The site is a developed area for the existing power plant, and new land acquisition and resettlement will not occur. No particular impact is expected to take place regarding gender.
14	Rights of children	B-	D	**Preparation period:** - The site is a developed area for the existing power plant, and new land acquisition and resettlement will not occur. No particular impact is expected to take place to the rights of children. **Construction period:** - Regarding the need for a great number of workers in the construction site, child labor and drop out of school may increase. **Operation period:** - No child workers will be employed for simple work during operation.
15	HIV/AIDS and other infectious diseases	B-	D	**Construction period:** - The inflow of workers from other parts of Mozambique or foreign countries may induce the spread of infectious disease. **Operation period:** - A very small inflow of workers is expected, so the spread of infectious disease is not expected.
16	Work environment (including labor safety)	B-	B-	**Construction period:** - A high risk of accidents is expected for workers. **Operation period:** - Labor accidents involving workers may occur.
Others				
1	Accident	B-	B-	**Construction period:** - Traffic accidents related to the operation of construction vehicles may occur during construction. **Operation period:** - Fire and traffic accidents due to the operation of the facility and construction vehicles are expected.

No.	Item	Assessment		Reasons of assessment
		Preparation Construction	Operation	
2	Impact across the borders and on climatic change	D	B-	**Construction period:** - Although CO_2 will be generated during construction, the impact shall be limited to a temporary period and is highly unlikely to have any impact across the borders and on climatic change. **Operation period:** - CO_2 will be generated during operation of the power plant. However, the introduction of the most advanced gas turbine will reduce generation of CO_2. Hence, no particular impact is expected to take place across the borders and on climatic change.

Note: Categories are classified as follows:

A: There will be a serious impact.

B: There will be a certain impact.

C: The extent of impact will be uncertain. (A further survey will be needed to make the expected impact clear.)

D: Impact will hardly be expected.

+: Positive impact

-: Negative impact

(Source: Prepared by Survey Team)

3.6 Terms of References (ToR) for the Survey of Environmental and Social Considerations

On the basis of the above-mentioned scoping results, Table 3-26 lists necessary surveys item, method of survey and method of predictive impact assessment for the power plant. These methods were reflected into the EIA TOR Report prepared in accordance with Mozambican legislation.

Table 3-26 Survey Items, Survey Method of Predictive Impact and Assessment and Mitigation Measures

Items	Survey items	Survey method	Prediction, Assessment and Mitigation Measures
Air pollution	- Current status of residential area and farm land - Current status of Meteorology - Current status of air quality	- Confirmation of the results of "The Preparatory Survey for Nacala Corridor Transmission & Distribution Network Reinforcement Project" - Acquirement of the latest data (temperature, humidity, wind speed/direction)	**Construction period:** - Consideration of air pollution preventive measures **Operation period:** - Consideration of air pollution preventive measures - Consideration of compliance with emission standards - Predicting atmosphere diffusion by using simulation model and confirming that it meets air quality standards.
Water pollution	- Current status of water quality	- Confirmation of the results of "The Preparatory Survey for Nacala Corridor Transmission & Distribution Network Reinforcement Project"	**Construction period:** - Consideration of wastewater treatment method **Operation period:** - Consideration of wastewater treatment method - Consideration of compliance with effluent standards

Items	Survey items	Survey method	Prediction, Assessment and Mitigation Measures
Waste	- NONE		**Construction period:** - Consideration of waste treatment measure **Operation period:** - Same as the construction period
Soil contamination	- NONE		**Construction period:** - Consideration of oil leakage preventive measures **Operation period:** - Same as the construction period
Noise and vibration	- Present status in the residential area and farm land - Current status of noise		**Construction period:** - Consideration of noise/vibration mitigation measures - Noise simulation and consideration of compliance with noise standards **Operation period:** - Consideration of noise/vibration mitigation measures - Noise simulation and consideration of compliance with noise standards
Odor	- NONE		**Construction period:** - Consideration of waste treatment measure **Operation period:** - Same as the construction period
Sediment contamination	- NONE		**Construction period:** - Consideration of wastewater treatment method **Operation period:** - Same as the construction period
Terrestrial ecosystems and rare species	- Habitat status of flora, mammals, birds, reptiles, amphibians		**Construction period:** - Consideration of air pollution and noise/vibration minimization measure **Operation period:** - Same as the construction period
Marine ecosystems and rare species	- Habitat status of algae, coral reefs, fish, sea turtles		**Construction period:** - Consideration of wastewater treatment method **Operation period:** - Same as the construction period
Ethnic minorities	- Status of land use		**Construction and operation period:** - NONE
Local economy including employment and means of livelihood	- Status of local employment and income - Status of local economy		**Construction period:** - Consideration of necessary mitigation measures **Operation period:** - Same as the construction period
Water use	- Status of fishery		**Construction period:** - Consideration of wastewater treatment method **Operation period:** - Same as the construction period
Existing social infrastructure and social service	- Current status of infrastructure including hospitals and school		**Construction period:** - Consideration of traffic jam mitigation measures and development of infrastructure **Operation period:** - Same as the construction period

Items	Survey items	Survey method	Prediction, Assessment and Mitigation Measures
Unfair distribution of damage and benefit	- Status of local employment and income - Status of local economy		**Construction period:** - Consideration of employment of local people **Operation period:** - Same as the construction period
Conflict of interests within the local area	- Status of local employment and income - Status of local economy		**Construction period:** Consideration of the training method of local customs
Rights of children	- Education status		**Construction period:** - Consideration of child labor preventive measures
HIV/AIDS and other infectious diseases	- Current status of public sanitation - Current status of occurrence of disease		**Construction period:** - Consideration of public sanitation strategy
Work environment (including labor safety)	- NONE		**Construction period:** Consideration of working safety **Operation period:** -- Same as the construction period
Accident	- NONE		**Construction period:** Consideration of traffic accident preventive measures **Operation period:** - Consideration of traffic accident preventive measures Consideration of firefighting facility
Impact across the borders and on climatic change	- NONE		**Construction period:** Consideration of necessary mitigation measures **Operation period:** - Same as the construction period

(Source: Prepared by Survey Team)

3.7 Survey Results of Environmental and Social Considerations

The environmental impact evaluation described below was mostly reflected into EIA Report approved in accordance with Mozambican EIA process. However, there are some changes in the specification of plant facilities and, therefore, the Survey Team simulated noise impact during construction and air pollutant and noise impact during operation again with the latest specification. These changes will be reflected into the Addendum EIA process which will be undertaken in accordance with Mozambican legislation.

3.7.1 Construction Phase

(1) Air Quality

Generation of dust is expected by decommissioning of the existing facilities and land preparation, and flying dust is expected to impact the air quality of the surrounding area.

According to the Beaufort scale, when wind speed exceeds about 6 m/s, dust on the ground may be lifted up. The occurrence ratio of wind speed exceeding about 6 m/s around the project site is only 10%. Consequently, a significant impact is not predicted.

Emission of air pollutants (SOx, NOx, PM) from construction machinery and vehicles may affect air quality. However, the impact is limited to the area near the construction site and only during construction period.

(2) Water Pollution

Muddy water generated by precipitation may cause adverse impact on the water quality of the marine area around the project site mainly during the rainy season.

Domestic wastewater and excretion from workers, concrete effluent and oil-containing effluents are generated and may affect the water quality of the surrounding sea. A wastewater treatment system for workers, such as a septic tank and temporary toilet, will be installed in the workersents are generated and may affect the water quality of the surrounding sea. A wastewater are treated at a neutralization and oil-separation system installed within the construction area. Treated wastewater is finally sent to the temporary sedimentation pond and discharged into the sea. Generation of waste water is only in a limited period during construction, and significant impact is not predicted.

(3) Waste

Waste may be generated at decommission of the existing facility such as concrete and metal chips, oil-containing soil and hazardous waste containing asbestos. Waste generated from the construction work will include general waste such as packing material and domestic waste, and hazardous waste such as waste oil and waste batteries.

Wastes are collected separately and stored appropriately at a designated site. Paper waste and iron scraps will be recycled, and other general wastes will be collected by Nacala city and carried to existing disposal fields.

Non-recyclable and hazardous waste will be stored and disposed of at appropriate sites according to related regulations. Additionally, all of the hazardous waste will be disposed of by a waste management company approved by the government at an approved disposal field following the relevant regulations. Furthermore, according to a staff of EDM, when Nacala area was designated as an industrial area, area and facilities including waste disposal site were developed in consideration of their capacities. Therefore, the capacity of the waste disposal site is enough for this Project. In consequence, no significant impact is predicted.

(4) Soil Contamination

Soil pollution may possibly be caused by leakages of lubricant collected from construction machinery, fuel oil and chemicals.

(5) Noise

Operation of heavy equipment and trucks will cause noise impacts. In particular, pile driving and decommissioning of the existing facilities will cause impact from the large noise.

There are some households located along the road on the east of the project site, and sufficient consideration must be given to minimizing any noise impact.

The level of noise resulting from the operation of the construction machinery was simulated using the following estimation model.

(a) Noise Lovel Estimation Model

Noise predictions were carried out in accordance to International Standard ISO 9613, Acoustics-Attenuation of Sound during Propagation Outdoors.

(b) Noise Level Data of Noise Sources

The major construction machinery used in the construction work will include truck cranes for transporting base materials, mixers for producing concrete and pump trucks for the foundation of structure, piling machines, a breaker for decommissioning of the existing facility, backhoe for excavation, generators, air compressors and other machines.

Table 3-27 shows the noise level of the main construction machinery and the number of machines.

Table 3-27 Noise Level of Major Construction Machinery

Work stage	Machine type	Specification	Noise level (dB)	Number of equipment
Installation of the fuel tanks	Truck crane	25-650t	97	1
	Backhoe	1.0-4.0m^3	102	2
	Concrete pumping vehicle	100m^3/h	98	1
	Concrete mixer	4m^3	101	2
	Air compressor	10.6m^3/min	106	1
	Generator	60-600kVA	101	2
Gas turbine and stack piling work	All casing machine	55kW	110	1
	Concrete pumping vehicle	100m^3/h	98	1
	Concrete mixer	4m^3	101	2
Demolition and decommissioning work	Breaker	0.7m^3	112	1
	Dump truck	4t	106	2
	Backhoe	1.0-4.0m^3	102	2

Note: Data based on the example of gas turbine power plant of similar-scale in Japan

(Source: Prepared by Survey Team)

(c) Calculation Conditions

The calculation was conducted on the assumption that all the aforementioned machines were operating simultaneously.

Construction activities will be carried out based on a step-by-step construction schedule so that all the machinery is not operated simultaneously.

A total of 8 points were selected for simulation at the boundary of the power plant site, and additional 5 points in the residential area near the power plant were also selected for simulation (Figure 3-22).

Calculations were performed in the cases with and without the installation of provisional noise reducing fences (5m high) in the boundary of the power plant site close to the residential area.

Figure 3-22 Location of Simulation Points

(Source: Prepared by Survey Team using Google Earth)

(d) Results of Simulation

Table 3-28 shows the result of simulating the noise level generated by the operation of the construction equipment at 13 measurement points. Figure 3-23 and Figure 3-24 shows the distribution of noise levels.

In the case where the noise reducing fences were not installed, the noise level in the boundary of the power plant site was estimated to lie between 66-77dB (A), and 59-65 dB(A) in the residential area. Noise levels estimated for the boundary of the site on the five points out of eight points exceeded the IFC/WB EHS guideline standards (Industrial zone: Daytime), and in the residential zone noise levels exceeded the standards at all 5 points (Residential zone: Daytime).

However, with the installation of the noise reducing fences within the site boundary in the east and south, the noise in the residential area is predicted to be reduced to 50-55 dB(A). All estimated noise levels are satisfied with the IFC/WB EHS guideline values (residential zone:Daytime).

Table 3-28 Results of Simulating Noise Levels from Construction Work

Point		Baseline noise level (dBA) (day/night)	Project noise level (dBA)		Future noise level (dBA) (day/night)		IFC/WB EHS General Guideline (2007)
			Without noise reducing fences	With noise reducing fences	Without noise reducing fences	With noise reducing fences	
Project Boundary	No. 1	61/51	67	67	68/67	68/67	Industrial zone: Day 70 Night 70
	No. 2	61/51	66	66	67/66	67/66	
	No. 3	61/51	71	71	**71/71**	**71/71**	
	No. 4	61/51	72	72	**72/72**	**72/72**	
	No. 5	61/51	68	68	69/68	69/68	
	No. 6	61/51	73	73	**73/73**	**73/73**	
	No. 7	61/51	77	77	**77/77**	**77/77**	
	No. 8	61/51	75	75	**75/75**	**75/75**	
Residential Area	No.9	**61/51**	65	54	**66/65**	**62/56**	Residential zone: Day 55 Night 45
	No.10	**61/51**	62	53	**65/65**	**62/55**	
	No.11	**61/51**	60	55	**64/64**	**62/56**	
	No.12	**58/57**	61	51	**63/62**	**59/58**	
	No.13	**58/57**	59	50	**62/61**	**59/58**	

(Source: Prepared by Survey Team)

The current noise level in the residential area already exceeds the IFC / WB EHS guideline values. The future noise level (daytime), which is estimated by adding the contribution noise of this project to the existing noise level, is expected to be 1dBA higher than the current level in residential areas. Therefore, the noise level will comply with the IFC / WB EHS Guidelines (if the current noise level exceeds the guideline value, the future noise level shall not increase by more than 3dBA from the current level by the project contribution). The future noise level in night time will increase 3dBA or more trom the current noise level, but dismantling and pile driving of existing facilities, which are high noise source, will not be carried out at night.

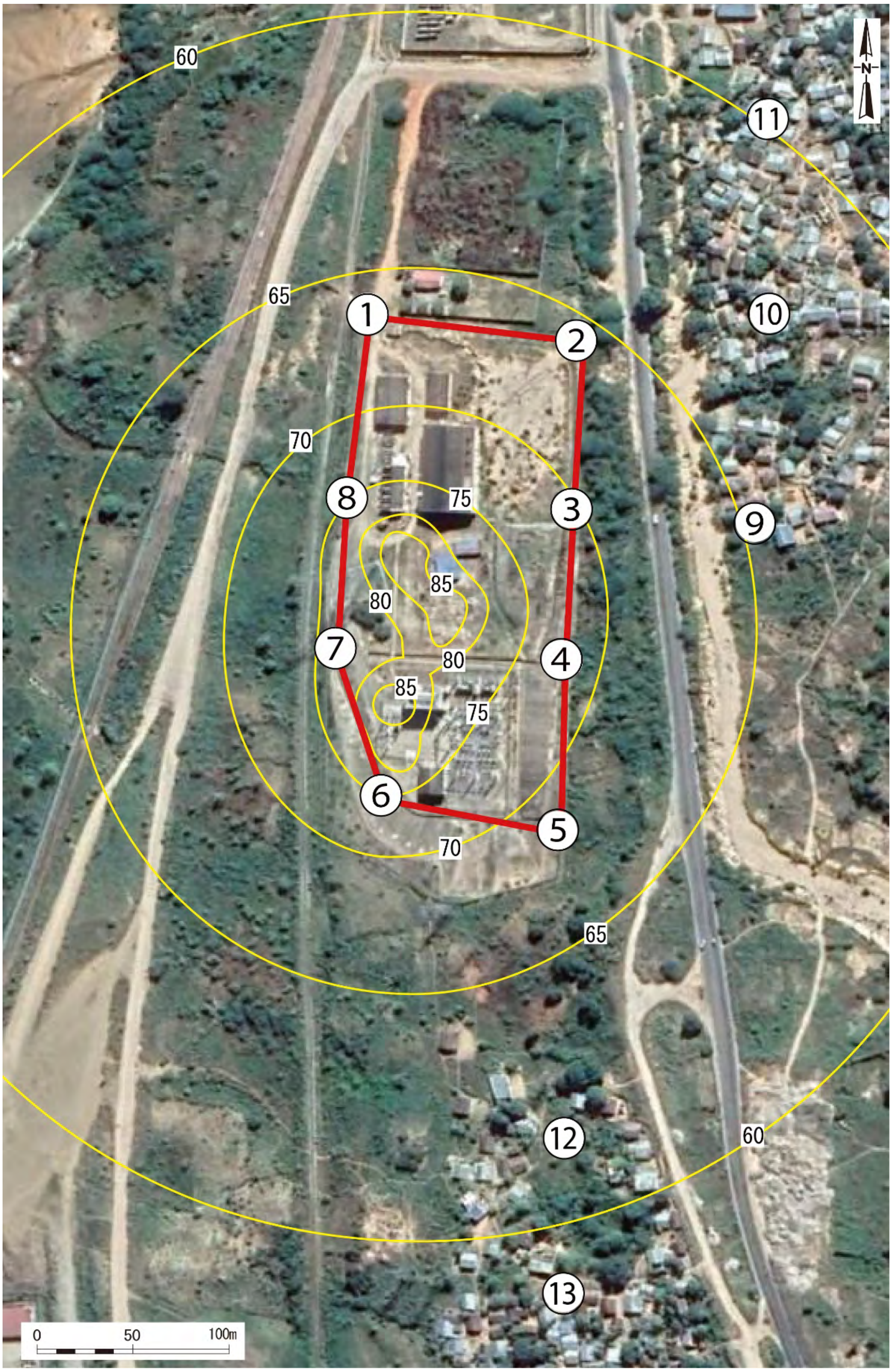


Figure 3-23 Results of Simulating Noise Level (dBA) from Construction Work without Provisional Fence

(Source: Prepared by Survey Team using Google Earth)

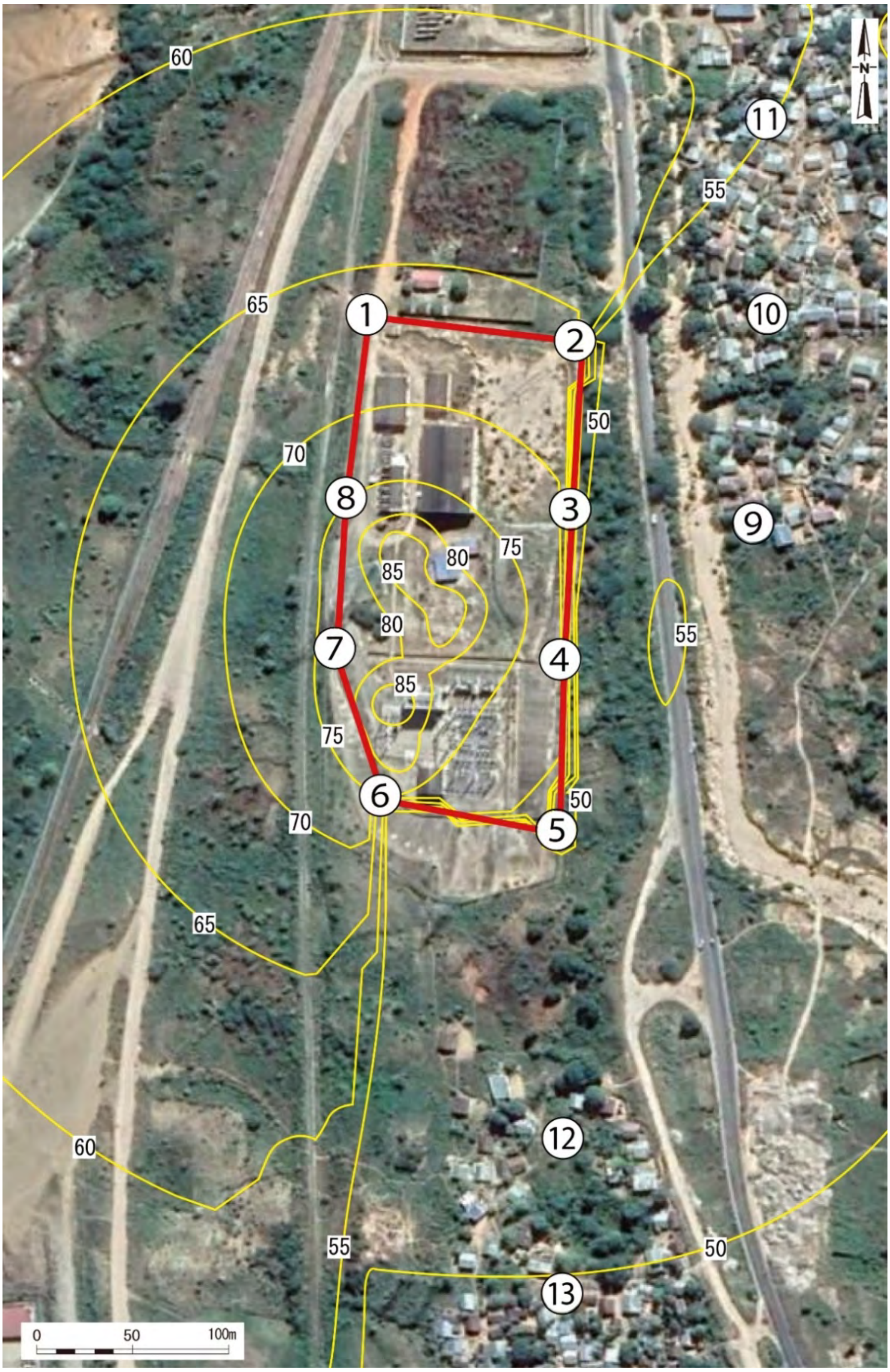
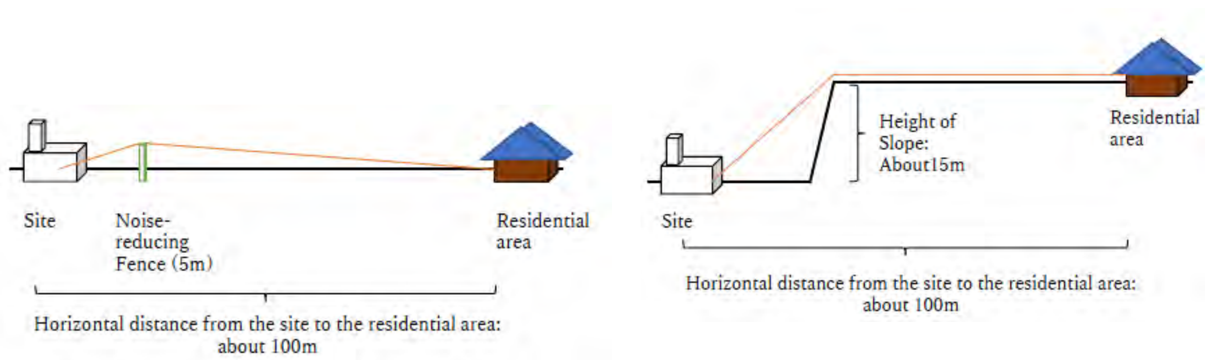


Figure 3-24 Results of Simulating Noise Level (dBA) from Construction Work with Provisional Fence

(Source: Prepared by Survey Team using Google Earth)

The more significantly noise damps, the larger the distance from the noise source to the point of receptor is. The simulation was conducted to predict the noise level at the points of the residential area closest to the site taking into account 5m of noise reducing fence. In fact, the terrain is a steep slope from the eastern boundary of the site to the road, and the altitude of the residential area is more than 15m higher than the site. Noise pathway from the noise source to the residential area which changes due to diffraction through the steep slope (15m) is longer than that through the fence (5m) and, therefore, this natural slope is expected to perform the noise level reduction effect similar to, or more than, the noise-reducing fence. Thus, the temporary noise-reducing fence might not be necessary. A conceptual diagram of pathways through the fence and the slope, respectively, is shown below.



(Left) Condition of simulation: Noise-reducing fence (5m) (Right) Actual terrain: Steep slope (15m)

Figure 3-25 Conceptual Diagram of Noise Pathways
(Comparison between Noise-reducing Fence and Steep Slope)

(6) Vibration

Vibration impact caused by construction activities will be mitigated by managing the construction schedule in order to level out the construction amount and scale.

There are some households located along the road on the east of the project site, and sufficient consideration must be given to minimizing any vibration impact.

Construction work shall be conducted in daytime to the possible extent, and decommissioning of the existing facility and piling shall not be conducted at night, and therefore no significant impact is predicted

(7) Odor

In case domestic waste from the workers daytime to the possible extent, and decommissiduce foul odors.

Food and kitchen waste will be disposed of on a periodic basis using containers with a cover to ensure that the generation of odors are avoided, and transported and disposed of by Nacala city. Consequently, no significant impact is predicted.

(8) Sediment Contamination

If untreated wastewater is discharged into the sea, sediment contamination may occur.

Temporary toilets and septic tanks will be installed in the workersination may occur.a cover to ensure treat wastewater and concrete-generated wastewater and oil-containing effluent are treated at a neutralization and oil-separation system installed within the construction area. Treated wastewater is finally sent to the temporary septic tank and discharged into the sea. Consequently, there is very low possibility of sediment contamination.

(9) Terrestrial Ecosystems and Rare Species

The site is a developed area for the existing power plant mostly covered with artificial structures. Only limited terrestrial flora and fauna are present including rodents and grasses. These are commonly observed, broadly-inhabiting species and no precious species are observed. Consequently, the direct impact of land alteration will be very limited.

Construction work will generate air pollution, noise and vibrations that are likely to have an impact on the terrestrial ecosystems. However, the site is used for industry, residence and service, so the affected ecosystems are likely to be very few. Additionally, the impact is temporary only in the construction period, and significant effect is not predicted.

(10) Marine Ecosystems and Rare Species

Concrete-containing wastewater and oil-containing wastewater are likely to be generated during construction phase and water pollution may cause adverse effects to the marine ecosystem.

Fish and benthic animals inhabiting in Nacala Port are the species commonly seen in the surrounding area, and rare species such as coral reef are not observed. Additionally, the impact is temporary only in the construction period, and significant effect is not predicted.

(11) Local Economy Including Employment and Means of Livelihood

The site is a developed area for the existing power plant and new land acquisition and resettlement will not occur. Local people may be employed as power plant workers. Increased purchase of materials and equipment items in the local area will activate the local economy.

The project proponent will employ as many local residents as possible and make use of the services (i.e. restaurant and catering service etc.) and products offered in the local community, as much as possible.

Nacala area is currently being promoted as a special economic zone as well as a port area, and construction materials are easily available. The power plant construction is expected to contribute to the further development of the local economy.

(12) Water Use

Muddy water, concrete-containing wastewater and oil-containing wastewater may be generated, and a temporary impact on fishery is predicted.

Small scale trawl and roll net fishery is conducted on the west side of the project site, but muddy water, concrete-containing water and oil-containing water generated during construction will be treated as described in 3.7.1(2) "Water pollution", and significant impact is not predicted

(13) Existing Social Infrastructure and Social Service

In case where inflows of workers are significant, construction of lodging houses, medical treatment facilities, schools, sewer systems and other infrastructure may be necessary.

In Nacala-Porto City, a certain level of social infrastructure is already established, and significant impact is not predicted.

Traffic jam caused by increasing traffic is expected during construction. The road on the east of the power plant site is already used by the port vehicles and appropriate consideration will be necessary.

(14) Unfair Distribution of Damage and Benefits

The site is a developed area for the existing power plant and new land acquisition and resettlement will not occur. Unfair distribution of damage and benefits caused by compensation should not occur.

If employment of local people and/or outsourcing contracts is done through unfair schemes such as personal connections of the construction company, benefits may be unfairly distributed among local people.

(15) Conflict of Interests within the Local Area

The site is a developed area for the existing power plant and new land acquisition and resettlement will not occur. Conflicts of interests within the local area are not predicted.

Inflows of many workers from other parts of Mozambique or foreign countries during construction period may cause conflict with local workers, if the local customs are not followed.

(16) Rights of Children

The site is a developed area for the existing power plant, and new land acquisition and resettlement will not occur. Therefore, no particular impact is expected to take place to the rights of children before construction.

During construction, child labor may be expected.

(17) HIV/AIDS and Other Infectious Diseases

The inflow of workers from other parts of Mozambique or foreign countries may induce the spread of infectious diseases.

In Nacala area, HIV/AIDS and other infectious diseases are increasing.

(18) Work Environment (Including Labor Safety)

Workers may have accidents during construction service.

(19) Accident

Traffic accidents may occur during operation of vehicles.

3.7.2 Operation Phase

(1) Air Quality

Diesel oil will be used as the fuel at the power plant. SOx, NOx, and PM will be emitted by the operation of gas turbine, causing impact on a broad area. The east side of the proposed power plant site is a high-elevation area and, therefore, there is a possibility that a part of the area may have high concentration of pollutants emitted from the stack, depending on the wind direction.

The gas turbine adopted in this project is equipped with a dry-type low-NOx burner or water injection as a mitigation measures for reduction of NOx level. In this manner, the emission concentration of air pollutant in the exhaust gas will meet the emission standard of Mozambique and the standard value of IFC/WB EHS guidelines (thermal power plant, 2008) (Table 3-29).

Table 3-29 Emission Concentration and Emission Standard

Item	Unit	Proposed Concentration	Emission Standards of Mozambique (Decree No. 18/2004)	IFC/WB EHS guidelines (Thermal power plants; 2008)
SOx	mg/Nm^3	160.5	2,000	- Sulfur contents in fuel:≦1%)
NOx	mg/Nm^3	152	460	152
PM	mg/Nm^3	50	100	50

Note: O_2＝15% equivalent

(Source: Prepared by Survey Team)

It is essential to take appropriate measures to maintain the current air quality level which satisfies the environmental standard of Mozambique. The contribution of the pollutants from the exhaust gas to atmospheric concentration (SOx, NOx, PM) in the project is estimated through numerical simulation not only under normal dispersion conditions but also under unusual conditions that may lead to higher concentrations as well.

(a) Terrain Conditions

The existence of elevated topography in the dispersion direction may increase the concentration of pollutant. In “Environmental Impact Assessment Guidelines for Power Plant” (2007) published by Ministry of Economy, Trade and Industry of Japan, the impacts of geography on the exhaust gas dispersion shall be considered in case the topography with the conditions below and within a 5km radius from the smoke source:

Maximum altitude / Effective stack height (Actual stack height + Emission gas elevation height) ≧0.6

In this project, the exhaust gas temperature is high, approximately 468°C, and effective stack height is expected to be about 210 m. There is an elevated area higher than 130m within 5km of the power plant, but east wind going in that direction (West, West-northwest, and West-southwest winds) is very rare (less than 5% annually) as Figure 3-25 shows and no prediction shall be necessary.

(b) Prediction Formula and Climate Conditions

- Normal Conditions

The prediction on impact per hour regarding dispersion of air pollutant is approached by mathematical models (Gaussian model) in conformity to the time scale of the environmental standard in Mozambique.

Calculation is performed based on the stability and wind speed as shown in the Pasquill atmospheric stability categories (Table 3-30). With the normal weather conditions, the calculation was conducted based on the stability and wind speed shown in the table below. Also, since considering Stabilities E and F result in extremely low ground level concentrations, those were not left out of the analysis (Table 3-31).

The wind direction is set to south-south-west which is the most frequently observed wind direction in this area.

Table 3-30 Pasquill Stability Categories

Wind speed at Ground Level U (ms-1)	Daytime Rate of Solar Radiation Q (unit 0.01 kWm-2)				Nighttime (Rate of Solar Radiation = 0)
	60 以上	30 - 59	15 - 29	1 – 14	
＜2.0	A	A-B	B	D	F
2.0 - 2.9	A-B	B	C	D	E
3.0 - 3.9	B	B-C	C	D	D
4.0 - 5.9	C	C-D	D	D	D
6.0 – U	C	D	D	D	D

Note: This category shows the stability of the atmosphere proposed by Pasquill. Category A indicates very unstable atmospheric conditions; category B unstable atmospheric conditions; category C less unstable; category D neutral; category E less stable; and category F stable.

(Source: http://www.env.go.jp/recycle/misc/facility_assess/mat02.pdf)

Table 3-31 Condition of the Stability and Wind Speed

Stability		Wind speed at ground level (m/s)
Unstable	A	1, 2
	B	1, 2, 3, 4

Neutral	C	1, 2, 3, 4
	D	1, 2, 3, 4, 6, 8, 10

(Source: Prepared by Survey Team)

■ Dispersion under special conditions

➢ Inversion Layer

If there is a temperature inversion layer above the stack, the exhaust gas may remain under the inversion layer and result in a high concentration. As the meteorological data in high layers is not available, the estimation was conducted assuming the worst case scenario, where an inversion layer occurred. The formula takes into consideration the reflection of emission gas between the inversion layer and the ground (mixed layer).

The calculation of the inversion layer was conducted using air stability A and wind speed 2.0m/s from the above-described normal dispersion data.

➢ Downwash

In general, downwash reportedly occurs with a wind speed 1.5 times or more than the exhaust gas speed. The exhaust gas speed in this project being 9.4 m/s, downwash may occur in case wind speed at the stack outlet is more than 6 m/s. According to data of the location, wind speeds exceeding 6m/s are rare, so downwash is not expected to occur.

➢ Downdraft

In the case the stack is low, downdraft may occur due to the presence of building in the surrounding area.

Around the stack, there is no building that is positioned to the main wind direction, so that downdraft is not expected to occur.

(c) Emission Specification

Table 3-32 shows the exhaust volume, temperature, speed, and emissions of NOx, SOx, and PM emitted from the stack, under the assumption that all NOx, SOx, and PM become SO2, NO2, PM10, respectively.

Table 3-32 Emission Specification

Item	Unit	Data
Emission volume (wet)	Nm^3/h	354,900
Emission volume (dry)	Nm^3/h	336,900
Exhaust temperature	ºC	468.2
Exhaust speed	m/s	9.4
Stack height	m	9
SOx emission	kg/h	54.1
NOx emission	kg/h	51.2
PM emission	kg/h	16.8

Notes: Sulphur content of light oil (fuel) is assumed to be 0.1%

(Source: Prepared by Survey Team)

(d) Prediction Results under Normal Conditions

The prediction results of the maximum concentration and the future concentration at the ground level of sulfur dioxide, nitrogen dioxide and particulate matter emitted from CCGT are as shown in Figure 3-26 ~ Figure 3-28 and Table 3-33 ~ Table 3-35, for normal weather conditions.

- Sulfur dioxide (SO_2)

  The maximum concentration at the ground level of sulfur dioxide is highest at the wind speed of 2.0m/s with atmospheric stability A, where the concentration is 10.3 μg/m3, which corresponds to approximately 1.3 % of the Mozambique's environmental quality standard and approximately 2.1 % of the IFC/WB guidelines (10-minute value).

  According to the IFC/WB Guidelines (General), a single project should not contribute more than 25% of the applicable ambient air quality standards, and compared to this threshold the present project has an extremely low contribution.

  Additionally, the maximum concentration obtained by adding the present concentration to the predicted value is 175.4 μg/m3, which is sufficiently low as compared with Mozambique's environmental quality standards and the IFC/WB guidelines.

- Nitrogen dioxide (NO_2)

  The maximum concentration at the ground level of nitrogen dioxide is highest at the wind speed of 2.0 m/s with atmospheric stability A, where the concentration is 9.7 μg/m3 which corresponds to approximately 5.1% of the Mozambique's environmental quality standard and approximately 4.9% of the IFC/WB guidelines.

  According to the IFC/WB Guidelines (General), a single project should not contribute more than 25% of the applicable ambient air quality standards, and compared to this threshold the present project has an extremely low contribution.

  Additionally, the maximum concentration obtained by adding the present concentration to the predicted value is 78.9 μg/m3 that is sufficiently lower compared with the Mozambique's environmental quality standard and the IFC/WB guidelines.

- Particulate matter (PM)

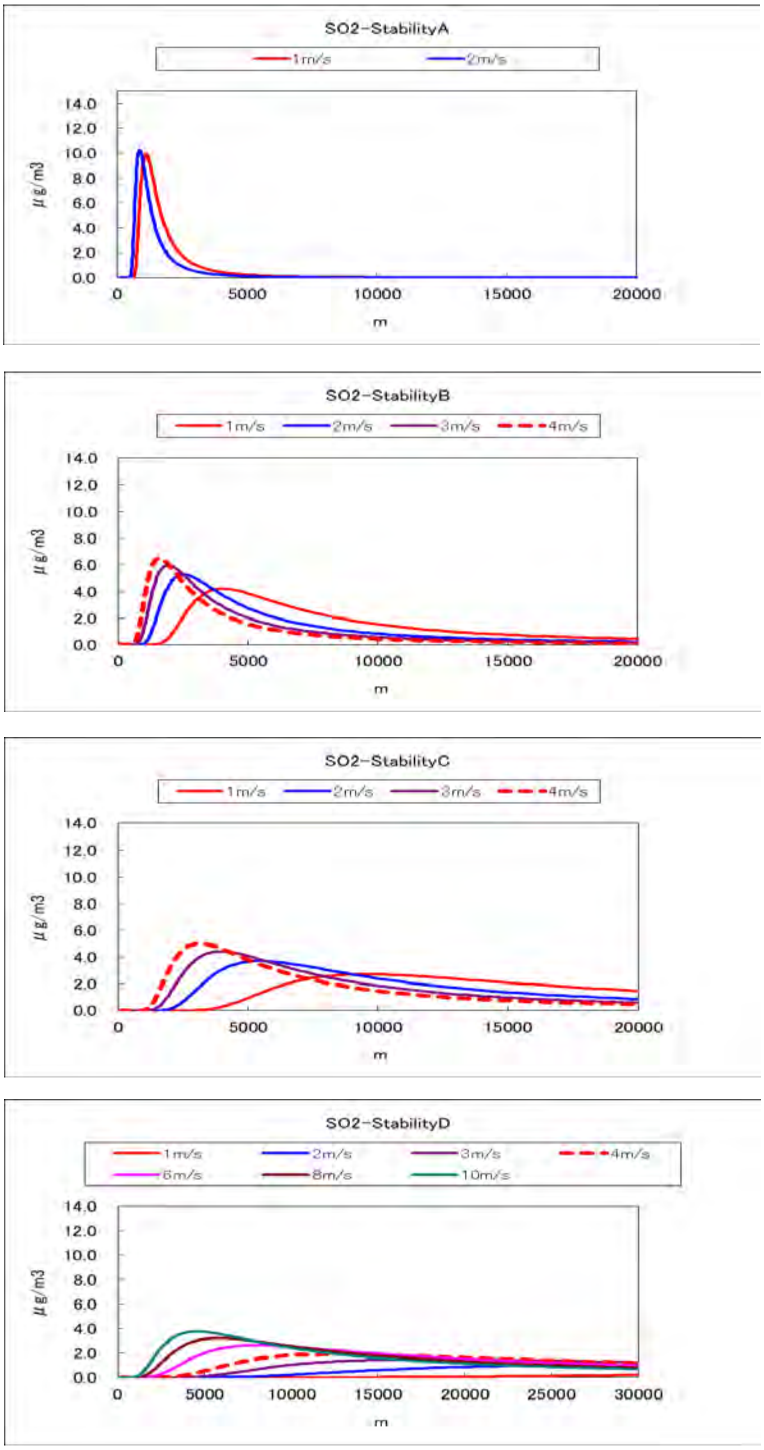
  The maximum concentration at the ground level of PM10 is highest at the wind speed 2.0 m/s with atmospheric stability A, where the concentration is 3.2 μg/m3, which corresponds to approximately 2.1% and 1.6% of the environmental quality standard (PM) of Brazil and Japan, respectively. There is no standard value of PM10 for Mozambique and the IFC/WB guidelines.

  According to the IFC/WB Guidelines (General), a single project should not contribute more than 25% of the applicable ambient air quality standards, and compared to this threshold the present project has an extremely low contribution.

  Additionally, the maximum concentration obtained by adding the present concentration to the predictive value is 93.2 μg/m3, which is a value sufficiently lower than the Mozambique and the IFC/WB guidelines standards.

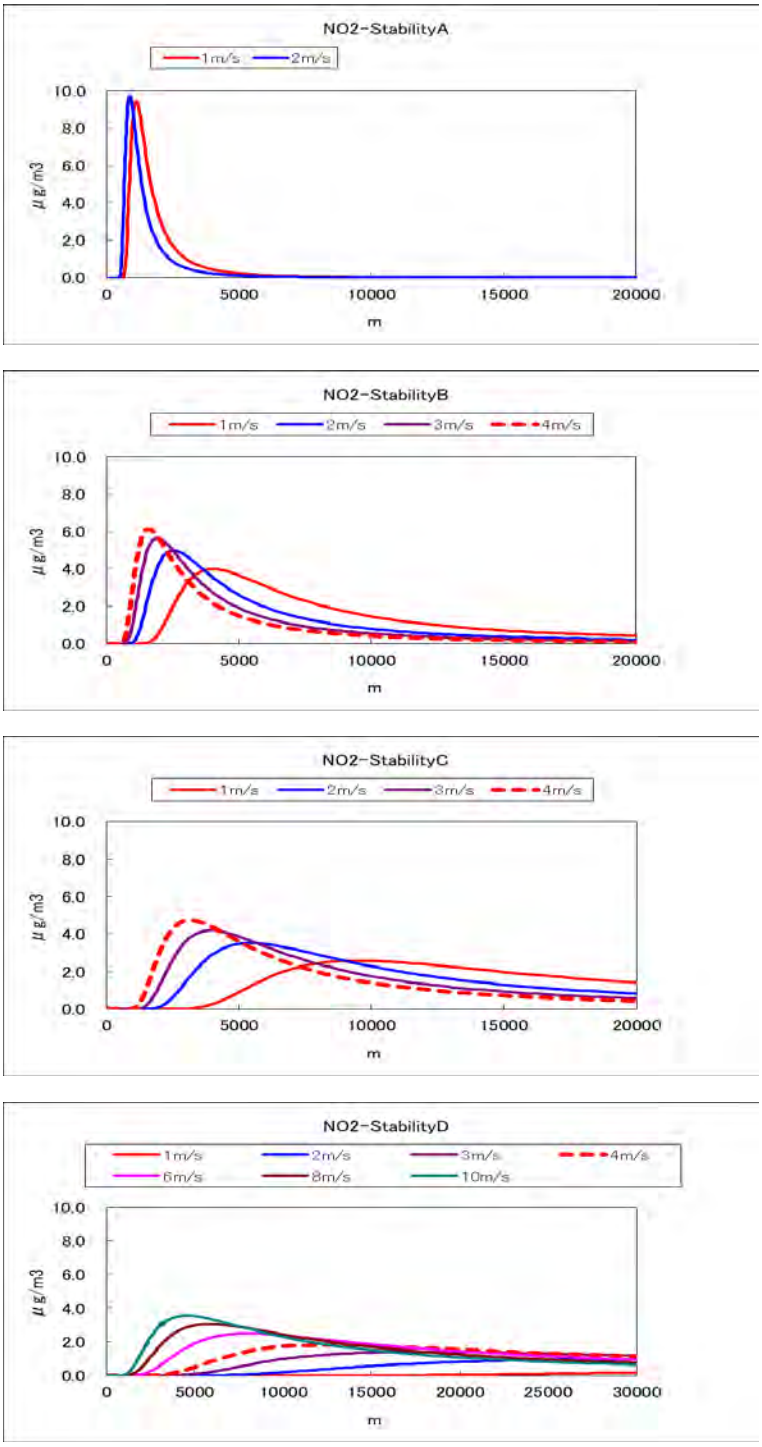
The result of prediction of distribution of the concentration of sulfur dioxide, nitrogen dioxide and particulate matter emitted from the power plant under south-south-west wind for respective stability is shown in Figure 3-26 ~ Figure 3-28.

At most of the locations, the contribution concentrations of SO2, NO2 and PM10 are below detection limits.



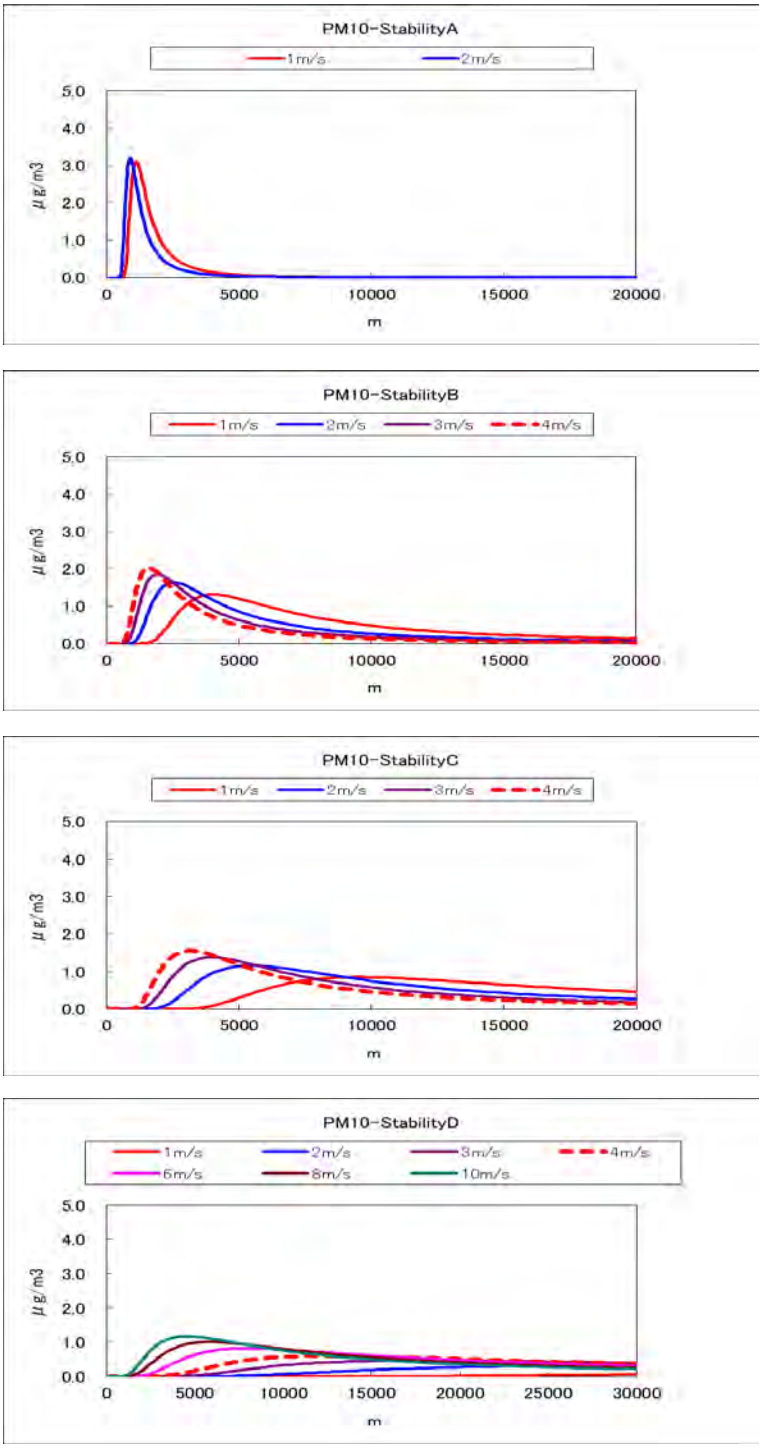
(Source: Prepared by Survey Team)

Figure 3-26 Prediction Result of the Maximum Concentration at the Ground Level of SO2 (1 Hour Value)



(Source: Prepared by Survey Team)

Figure 3-27 Prediction Result of the Maximum Concentration at the Ground Level of NO2 (1 Hour Value)



(Source: Prepared by Survey Team)

Figure 3-28 Prediction Result of the Maximum Future Concentration at the Ground Level of particulate matter (PM10) (1 Hour Value)

Table 3-33 Prediction Result of the Maximum Future Concentration at the Ground Level of SO2 (1 Hour Value)

Stability	Wind speed (m/s)	a Maximum concentration at the ground level ($\mu g/m^3$)	Distance for maximum concentration at the ground level (m)	b Present concentration ($\mu g/m^3$)	a+b Maximum future concentration ($\mu g/m^3$)	Mozambique atmospheric environmental quality standard (Decree No.67/2010) ($\mu g/m^3$)	IFC/WB EHS Guidelines (General 2007) ($\mu g/m^3$)
A	1	10.0	1,120	47.5 ~165.1	57.5 – 165.1	800	500 (10 minutes value)
	2	10.3	866		57.8 – 175.4		
B	1	4.2	4,057		51.7 – 169.3		
	2	5.2	2,522		52.7 – 170.3		
	3	5.9	1,912		53.4 – 171		
	4	6.5	1,600		54 – 171.6		
C	1	2.7	9,506		50.2 – 167.8		
	2	3.7	5,460		51.2 – 168.8		
	3	4.4	3,977		51.9 – 169.5		
	4	5.0	3,136		52.5 – 170.1		
D	1	0.5	77,559		48 – 165.6		
	2	1.0	30,579		48.5 – 166.1		
	3	1.5	17,915		49 – 166.6		
	4	1.9	12,298		49.4 – 167		
	6	2.6	8,114		50.1 – 167.7		
	8	3.2	5,794		50.7 – 168.3		
	10	3.7	4,569		5102 – 168.8		

Note: The present concentrations (b) are 19-hour averages conducted at 3 measurement points

(Source: Prepared by Survey Team)

Table 3-34 Prediction Result of the Maximum Future Concentration at the Ground Level of NO2 (1 Hour Value)

Stability	Wind speed (m/s)	a Maximum concentration at the ground level (μg/m³)	Distance for maximum concentration at the ground level (m)	b Present concentration (μg/m³)	a+b Maximum future concentration (μg/m³)	Mozambique atmospheric environmental quality standard (Decree No.67/2010) (μg/m³)	IFC/WB EHS Guidelines (General 2007) (μg/m³)
A	1	9.4	1,120	29.7~69.2	39.1 – 78.6	190	200
	2	9.7	866		39.4 – 78.9		
B	1	4.0	4,057		33.7 – 73.2		
	2	5.0	2,522		34.7 – 74.2		
	3	5.6	1,912		35.3 – 74.8		
	4	6.1	1,600		35.8 – 75.3		
C	1	2.6	9,506		32.3 – 71.8		
	2	3.5	5,460		33.2 – 72.7		
	3	4.2	3,977		33.9 – 73.4		
	4	4.7	3,136		34.4 – 73.9		
D	1	0.5	77,559		30.2 – 69.7		
	2	1.0	30,579		30.7 – 70.2		
	3	1.4	17,915		31.1 – 70.6		
	4	1.8	12,298		31.5 – 71.0		
	6	2.5	8,114		32.2 – 71.7		
	8	3.1	5,794		32.8 – 72.3		
	10	3.6	4,569		33.3 – 72.8		

Note: The present concentrations (b) are 19-hour averages conducted at 3 measurement points

(Source: Prepared by Survey Team)

Table 3-35 Prediction Result of the Maximum Future Concentration at the Ground Level of PM10 (1 Hour Value)

Stability	Wind speed (m/s)	a Maximum concentration at the ground level (μg/m³)	Distance for maximum concentration at the ground level (m)	b Present concentration (μg/m³)	a+b Maximum future concentration (μg/m³)	Mozambique atmospheric environmental quality standard (Decree No.67/2010) (μg/m³)	International standards and standards set in other countries (μg/m³)
A	1	3.1	1,120	83.6~90.0	86.7 – 93.1	-	- (IFC/WB EHS Guidelines) 150 (Brazil) 200 (Japan)
	2	3.2	883		86.8 – 93.2		
B	1	1.3	4,057		84.9 – 91.3		
	2	1.6	2,522		85.2 – 91.6		
	3	1.9	1,912		85.5 – 91.9		
	4	2.0	1,600		85.6 – 92.0		
C	1	0.9	9,506		84.5 – 90.9		
	2	1.2	5,460		84.8 – 91.2		
	3	1.4	3,977		85.0 – 91.4		
	4	1.6	3,136		85.2 – 91.6		
D	1	0.2	77,559		83.8 – 90.2		
	2	0.3	30,579		83.9 – 90.3		
	3	0.5	17,915		84.1 – 90.5		
	4	0.6	12,298		84.2 – 90.6		
	6	0.8	8,114		84.4 – 90.8		
	8	1.0	5,794		84.6 – 91.0		
	10	1.2	4,569		84.8 – 91.2		

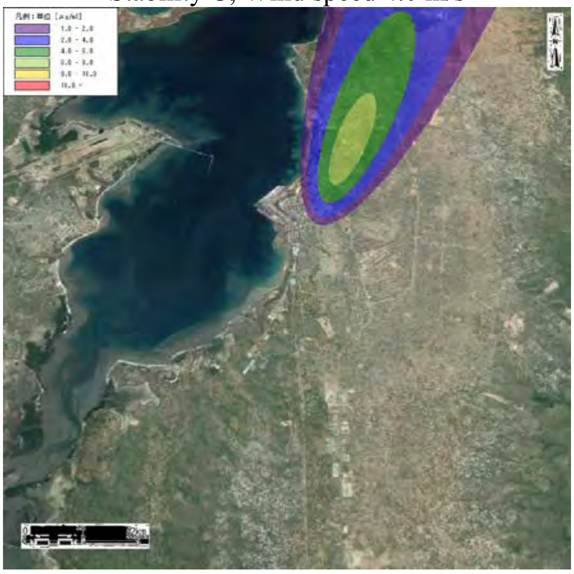
Note: The present concentrations (b) are 19-hour averages conducted at 3 measurement points

(Source: Prepared by Survey Team)

South-west wind
Stability A, Wind speed 2.0m/s

South-south-west wind
Stability B, Wind speed 4.0 m/s

South-south-west wind
Stability C, Wind speed 4.0 m/s



South-west wind
Stability D, Wind speed 10.0 m/s

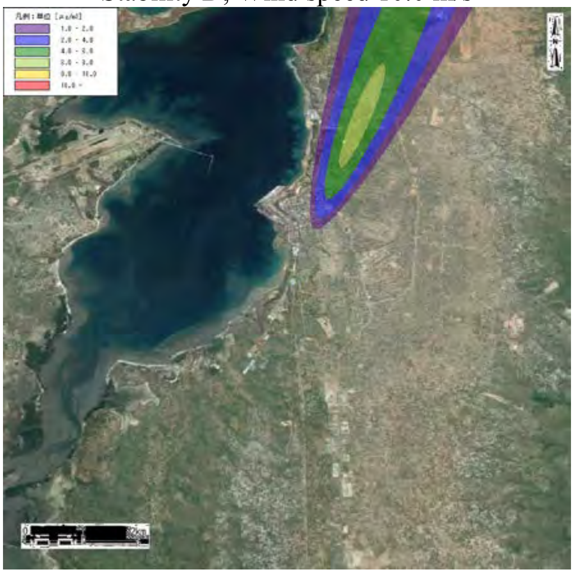
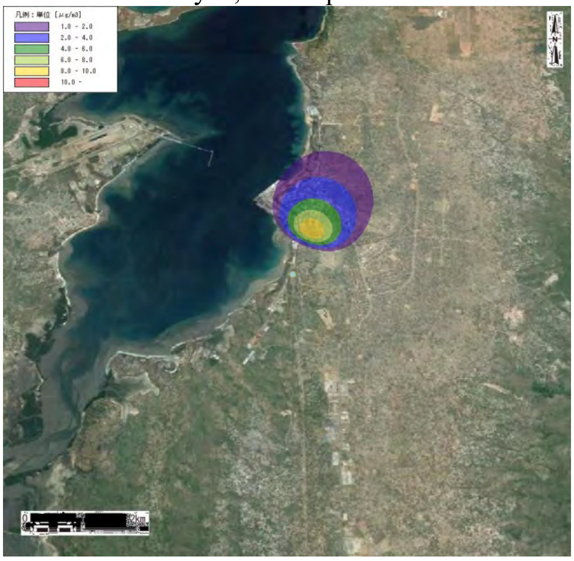


Figure 3-29 Maximum Concentration by each atmospheric stability (1-hour value) (SO2)

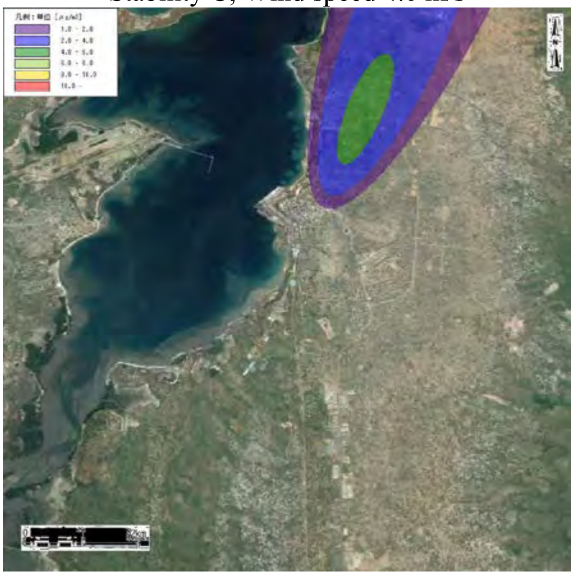
(Source: Prepared by Survey Team using Google Earth)

South-west wind
Stability A, Wind speed 2.0m/s

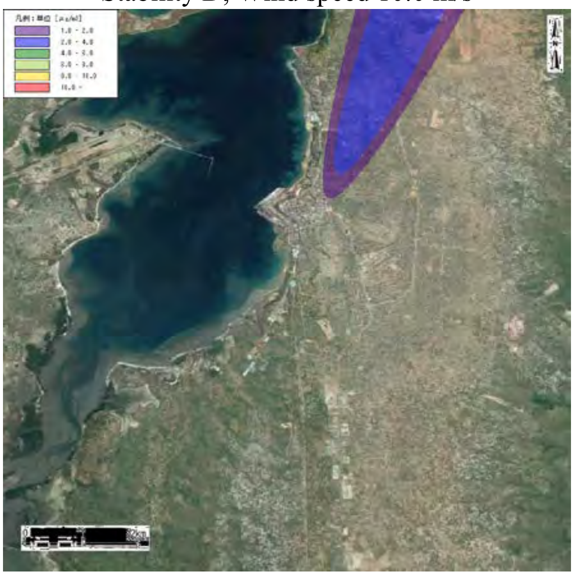


South-south-west wind
Stability B, Wind speed 4.0 m/s

South-south-west wind
Stability C, Wind speed 4.0 m/s

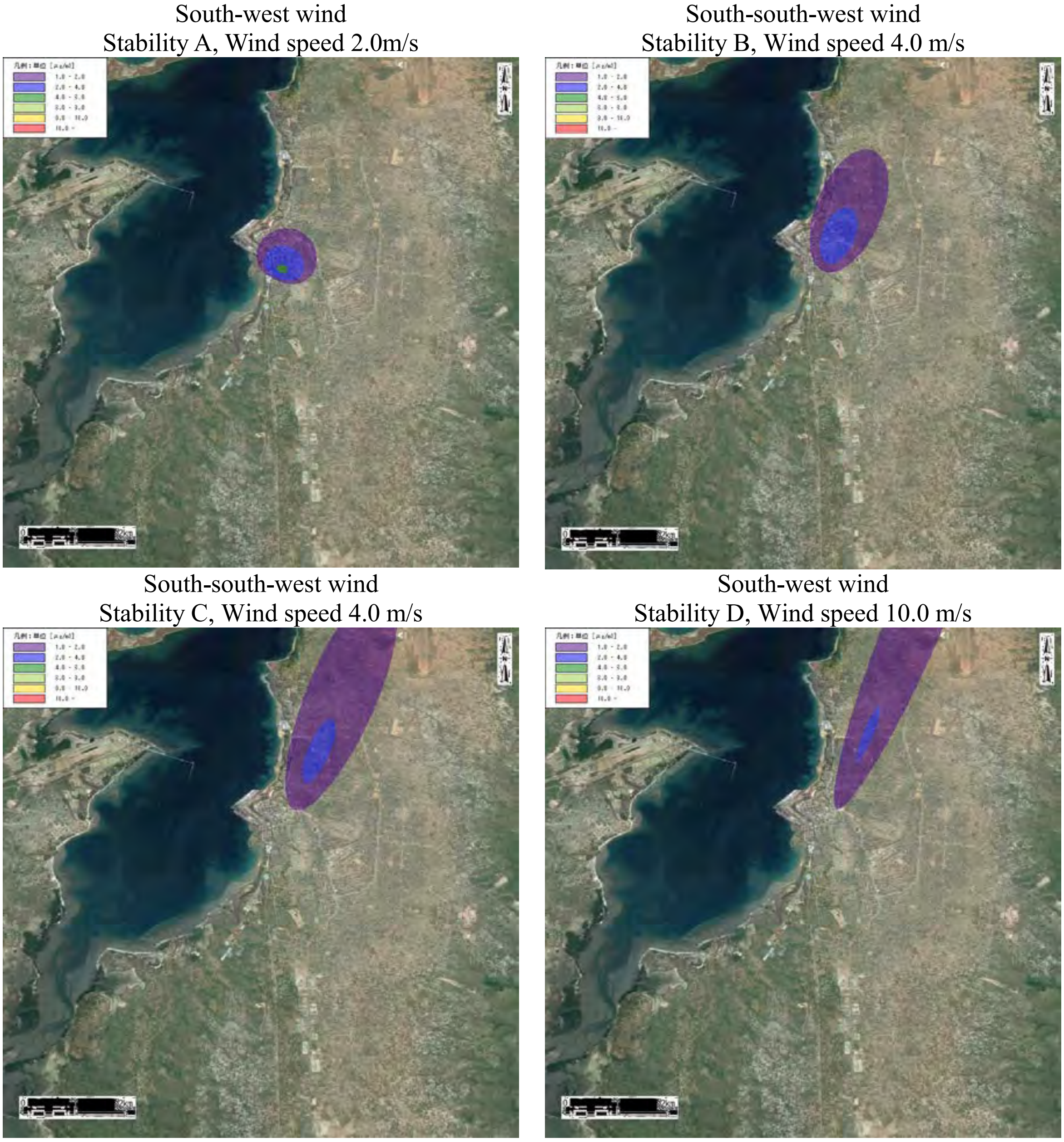


South-west wind
Stability D, Wind speed 10.0 m/s



(Source: Prepared by Survey Team using Google Earth)

Figure 3-30 Maximum Concentration by each atmospheric stability (1-hour value) (NO2)



(Source: Prepared by Survey Team using Google Earth)

Figure 3-31 Maximum Concentration by each atmospheric stability (1-hour value) (PM)

(e) Prediction Results under Inversion Layer

The prediction results of sulfur dioxide, nitrogen dioxide and particulate matter with the presence of an inversion layer are as shown in Table 3-36 and Figure 3-32.

- Sulfur dioxide (SO_2)

  The maximum concentration at the ground level of sulfur dioxide with an inversion layer occurs at 21.5 μg/m3 which corresponds to approximately 2.7% of Mozambique's environmental quality standard and approximately 4.3% of the IFC/WB guidelines (10-minute value).

  According to the IFC/WB Guidelines (General), a single project should not contribute more than 25% of the applicable ambient air quality standards, and compared to this threshold the present project has an extremely low contribution.

  The maximum concentration obtained by adding the present concentration to the predicted value is 197.2 μg/m3, which is sufficiently lower compared with Mozambique's environmental quality standard and the IFC/WB guidelines.

- Nitrogen dioxide (NO_2)

  The maximum concentration at the ground level of nitrogen dioxide with an inversion layer occurs at 20.4 μg/m3 which corresponds to approximately 10.7 % of Mozambique's environmental quality standard and approximately 10.2% of the IFC/WB guidelines.

  According to the IFC/WB Guidelines (General), a single project should not contribute more than 25% of the applicable ambient air quality standards, and compared to this threshold the present project has an extremely low contribution.

  The maximum concentration obtained by adding the present concentration to the predicted value is 89.6 μg/m3, which is sufficiently lower compared with Mozambique's environmental quality standard and the IFC/WB guidelines.

- Particulate matter (PM)

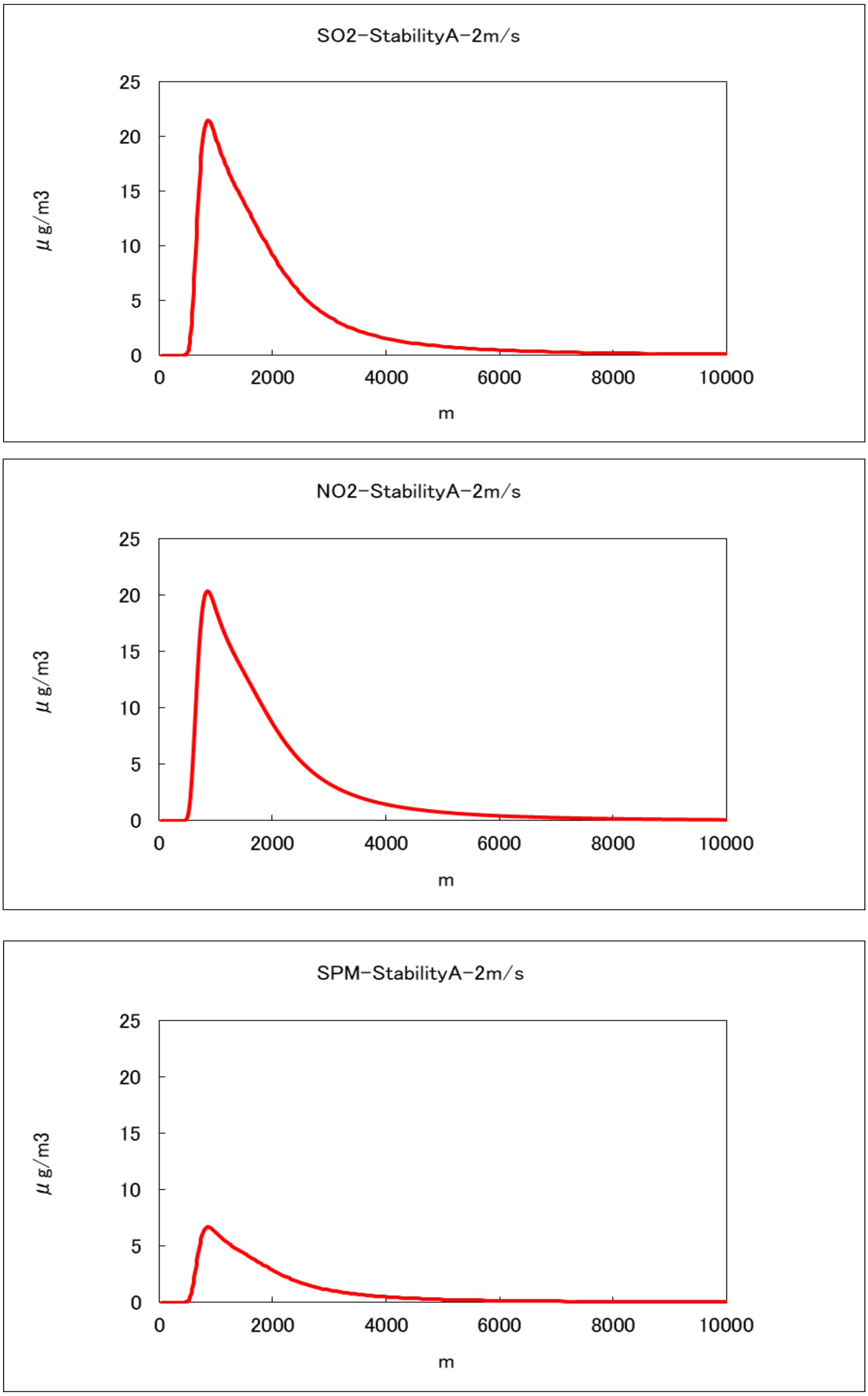
  The maximum concentration at the ground level of nitrogen dioxide with an inversion layer occurs at 6.7 μg/m3 which corresponds to 4.5% and 3.4% of environmental quality standard (PM) of Brazil and Japan, respectively. There is no standard value of PM10 for Mozambique.

  Also, the maximum concentration obtained by adding the present concentration to the predicted value is 96.7 μg/m3, which is sufficiently lower compared with standards set in Brazil and Japan.

Table 3-36 Prediction Result of the Maximum Future Concentration at the Ground Level (1 Hour Value, Atmospheric stability A, Wind speed 2m/s)

Parameter	a Maximum concentration at the ground level ($\mu g/m^3$)	Distance for maximum concentration at the ground level (m)	b Present concentration ($\mu g/m^3$)	a + b Maximum future concentration ($\mu g/m^3$)	Mozambique atmospheric environmental quality standard ($\mu g/m^3$)	International standards and standards set in other countries ($\mu g/m^3$)
SO_2	21.5	866	47.5~165.1	69.0 - 197.1	800	500 (10 mins) (IFC/WB EHS Guidelines)
NO_2	20.4		29.7~69.2	50.1 - 89.6	190	200 (IFC/WB EHS Guidelines)
PM_{10}	6.7		83.6~90.0	90.3 – 96.7	-	- (IFC/WB EHS Guidelines) 150 (Brazil) 200 (Japan)

(Source: Prepared by Survey Team)



(Source: Prepared by Survey Team)

Figure 3-32 Estimated ground level concentration of SO2, NO2 and PM10 with the presence of an inversion layer (1-hour average value)

(2) Water Pollution

In the operation of the power plant, wastewater from the power plant, oil-containing wastewater and domestic sewage will be generated and the potential environmental impact is predicted.

A gas turbine will be installed instead of a steam turbine, and thermal wastewater will not be generated and there will not be intake of cooling water.

In the operation of the power plant, oily drainage wastewater from fuel and around the tank of lubricant, and domestic sewage from office and accommodation for staff will be generated.

Additionally, to reduce the emission of NOx, water treatment (demineralization) system will be needed and wastewater from the system will be generated, if water injection method will be applied. If dry-type low-NOx burner will be applied, water purification system will not be needed; therefore, wastewater will not be generated.

The main items associated with water quality are as follows:

- Oily drainage wastewater from around the tank of lubricant: Oil
- Domestic sewage: Suspended Solids and organic matter
- Wastewater from water treatment (demineralization) system: Suspended Solids, Acid and Alkaline

Oily drainage wastewater will be collected in oil separator/interceptor installed around the fule tanks. Wastewater will be managed and treated appropriately to comply with water quality standards of the IFC/EHS Guideline for thermal power plants (2008). Treated wastewater will be discharged into Nacala Bay.

Domestic wastewater from workers collected in a septic tank. Wastewater will be managed and treated appropriately to comply with water quality standards of the wastewater will be discharged into Nacala Bay.

Wastewater from water treatment (demineralization) system will be treated by neutralization and sedimentation appropriately to comply with IFC/WB EHS guideline standard (Thermal power, 2008) before being discharged into Nacala Bay.

(3) Waste

General waste and hazardous waste will be generated. General waste is sewerage and garbage produced from workers in the power plant. Hazardous wastes are waste oil generated from the operation and maintenance of the facilities and sludge generated through precipitation treatment.

Waste will be collected separately and stored in an appropriate site and method.

Specifically, paper waste and iron scraps will be recycled. Other general wastes will be collected, carried and disposed of by Nacala city.

All of the hazardous waste will be disposed of by a waste management company approved by the government at disposal fields which are permitted by the government in accordance with the relevant legislation.

(4) Soil Contamination

There is a possibility of soil contamination caused by spill of lubricant oil, fuel oil and chemical materials, which will be used for operation of the facilities.

(5) Noise

Noise and vibration impact from the plant operation is predicted. There are residences near the project site, and sufficient consideration must be given to minimize noise impact.

The level of noise resulting from the operation of the major equipment was simulated using the following estimation model.

(a) Noise Level Estimation Model

An estimation of the noise level was made according to .3.7.1(5) (a)

(b) Noise Level Data of Equipment

The noise sources related to the operation of the power plan include air filter, gas turbine, pumps, transformer, duct, etc. as Table 3-37 shows.

Table 3-37 Noise Level and Major Equipment

Equipment	Noise level (dB)
Gas turbine (with enclosures)	97
Gas turbine generator (with enclosures)	87
Intake air duct	87
Intake air filter	94
GT duct (exhaust gas)	87
Main transformer	95
Air compressing equipment	85
Fuel pump	86

(Source: Prepared by Survey Team)

(c) Calculation Conditions

Eight points were selected and used for simulation at the boundary of power plant site and another 5 points in the residential area located near the power plant were also selected for simulation.

The calculation was conducted at the same point as the one in 3.7.1(5) (Figure 3-22).

(d) Results of Simulation

Table 3-38 shows the result of simulating the noise level for each sampling point during the operation of the plant equipment. Table 3-33 shows the noise level distribution.

Noise level generated by power plant operation is 43-58dB (A) at the boundary of the power plant site and 40-48 dB(A) at the residential area.

The future noise levels at all the measuring points of boundary satisfy the IFC/WB guideline value (industrial area, daytime: 70dB (A)).

The current noise level in the residential area already exceeds the IFC / WB EHS guideline values. The future noise level (daytime), which is estimated by adding the contribution of this project to the existing noise level, is expected to be 1 to 2 dBA higher than the current level in residential areas. Therefore, the noise level will comply with the IFC / WB EHS Guidelines (if the current noise level exceeds the guideline value, the future noise level shall not increase by more than 3dBA from the current level by the project contribution).

Actually, the terrain is a steep slope from the eastern boundary of the site to the road, and the altitude of the residential area is more than 15m higher than the site. This means that this terrain is expected to perform the noise level reduction effect similar to the noise-reducing fence and reduce the noise more than 5dB compared to the simulation result.

Table 3-38 Results of the simulation of noise levels in the power plant

Point		Baseline noise level (dBA) (day/night)	Project noise level (dBA)	Future noise level (dBA) (day/night)	IFC/WB EHS General Guideline
Project boundary	No. 1	61/51	43	61/52	昼間：70 夜間：70
	No. 2	61/51	43	61/52	
	No. 3	61/51	53	62/55	
	No. 4	61/51	57	62/58	
	No. 5	61/51	52	62/55	
	No. 6	61/51	55	62/56	
	No. 7	61/51	58	63/59	
	No. 8	61/51	53	62/55	
Residential area	No.9	**61/51**	48	**61/53**	昼間：55 夜間：45
	No.10	**61/51**	43	**61/52**	
	No.11	**61/51**	40	**61/51**	
	No.12	**58/57**	44	**58/57**	
	No.13	**58/57**	42	**58/57**	

(Source: Prepared by Survey Team)

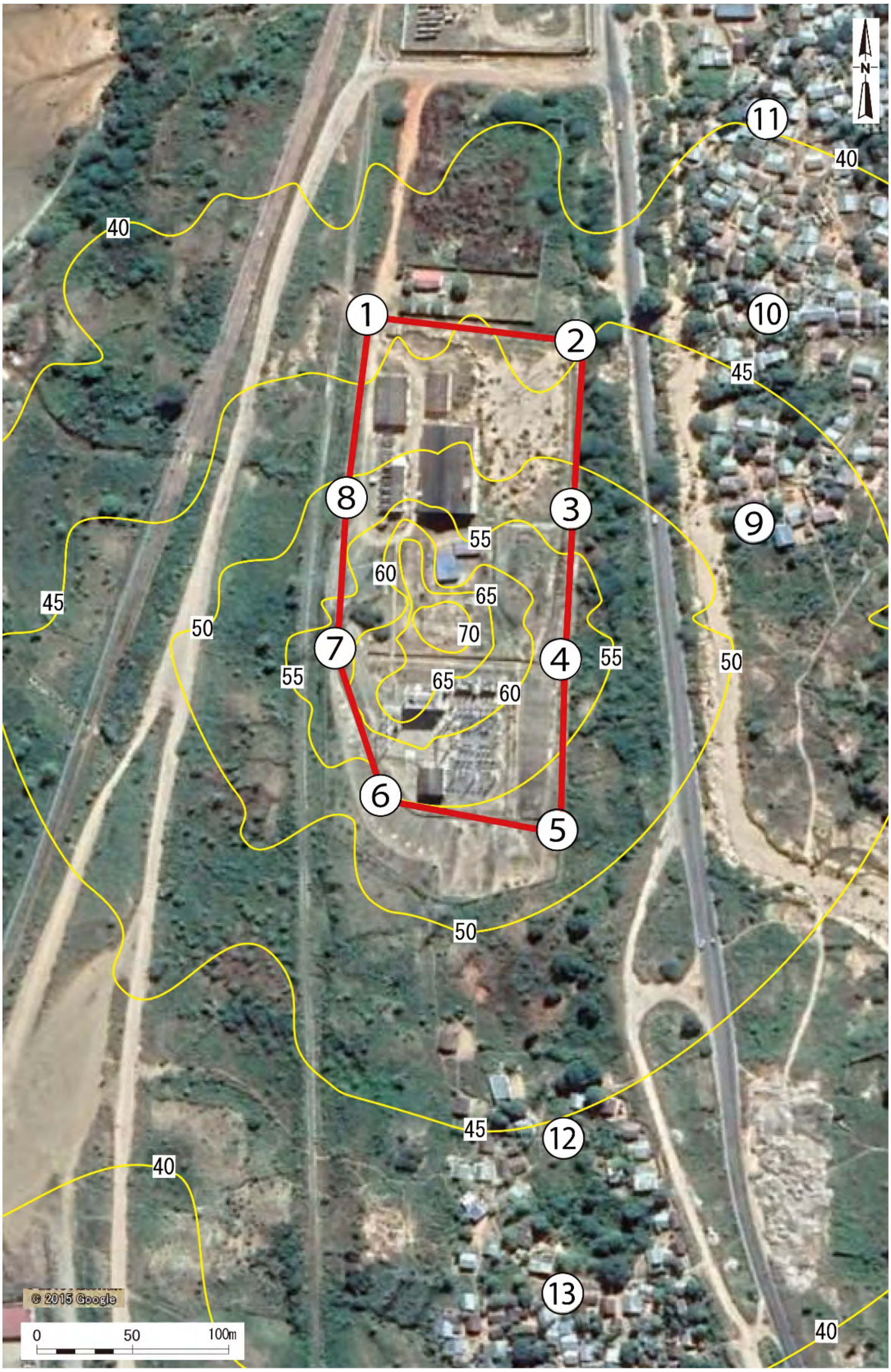


Figure 3-33 Results of Simulating Noise Level from Power Plant (Unit: dBA)

(Source: Prepared by Survey Team using Google Earth)

(6) Vibration

The impact of vibration generated from the operation of the power plant is predicted, but the vibration level is not high. Vibration sources include gas turbine, generator and pumps. They shall be installed on a strong foundation, and therefore significant impact is not predicted.

(7) Odor

In case domestic waste from the workersthe operation of the power plant is predicted, but the vibration levage will be collected on a periodic basis by Nacala city to ensure that odors are not generated. Therefore, no significant impact is predicted.

(8) Sediment Contamination

Sediment pollution may occur in the case untreated power plant wastewater and domestic wastewater flows into the sea.

Oil-containing water will be treated in oil separator/interceptor installed around the fule tanks, domestic waste water from worker will be treated in a septic tank, and wastewater from water treatment (demineralization) system will be treated by neutralization and sedimentation. This wastewater will be managed and treated appropriately to comply with IFC/WB EHS guideline standard before being discharged into Nacala Bay. Therefore, no significant impact is predicted.

(9) Terrestrial Ecosystem and Rare Species

Power plant will generate air pollution, noise and vibration, etc. that may have impact on the terrestrial ecosystems.

The land around the project site is used for industry, residence and service, and the affected biota is not expected to be significant.

As described in the chapter site is used for industry, residence and service, and the affected biota is not expected to be significant.

(10) Marine Ecosystem and Rare Species

In the operation phase, pollutants discharged from oil-containing water are expected to have impact on marine organisms.

The fish and benthic animals inhabiting Nacala Port are species commonly observed in the surrounding sea, and rare species such as coral reef are not observed.

Oil-containing water and domestic water will be treated before discharge as described in “Water Quality” and no significant impact is predicted.

(11) Local Economy Including Employment and Means of Livelihood

Since the site is a land developed for existing power plant, new land acquisition and resettlement will not occur. Increased purchase of local materials and equipment items, use of local restaurants and catering service will activate local economy. Nacala area is currently being promoted as a special economic zone as well as a port area. Therefore, the power plant construction is expected to largely contribute to the further development of the local economy.

(12) Water Use

In the operation of the power plant, oily drainage wastewater from fuel and around the lubricant tank, and domestic sewage from office and accommodation for staff will be generated and may affect local fishery by water pollution.

Small scale trawl and roll net fishery is conducted on the west side of the project site.

Oil-containing water and domestic water will be treated before discharge as described in “Water Quality” and no significant impact is predicted.

When water injection is implemented as a NOx reduction measure, 120-150m3 per day of water is required. In that case, the required water in this project will be supplied from the Nacala Water Authority (FIPAG). In an interview with FIPAG, it was confirmed that the current water supply capacity is 12,000-15,000m3 per day, and supply volume will be increased to 30,000m3 per day in June 2019 and then to 48,000m3 per day, and that 120-150m3 per day of water can be supplied to the project. The water demand by this project is limited and is not supplied from rivers, but supplied by the Waterworks Bureau. Therefore, no impact on water use by residents due to water intake is expected.

(13) Existing Social Infrastructure and Social Service

In the period of regular maintenance in which larger number of workers are expected, construction of lodging houses, medical treatment facilities, schools, sewer systems and other infrastructure may be necessary.

In Nacala-Porto City, a certain level of social infrastructure is already established, and no significant impact is predicted.

(14) Unfair Distribution of Damage and Benefit

The site is a developed area for the existing power plant and new land acquisition and resettlement will not occur. Unfair distribution of damage and benefits caused by compensation should not occur. If employment of local people and/or outsourcing contracts is done through unfair schemes such as personal connections of the construction company, benefit may be unfairly distributed among local people.

(15) Work Environment Including Labor Safety

In the operation phase, works at a high place or those generating loud noises may cause labor accidents.

(16) Accident

Fire and traffic accidents by operation of facilities and / or vehicles may occur.

(17) Impact across the Borders and on Climatic Change

CO_2 is produced by the project operation, but the output of the power plant is not large. Additionally, with high-efficiency gas turbine, CO_2 generation per kWh is lower than in the conventional power generation system and the cross-boundary pollution and impact on climate change will be insignificant.

3.8 Environmental and Social Impact Assessment Results

The results of environmental and social impact assessment are summarized in Table 3-39.

Table 3-39 Results of Environmental Impact Assessment

No.	Items	Scoping		Assessment Results		Explanations of the Rational Assessment Process
		Preparation and Construction	Operation	Preparation and Construction	Operation	
Pollution Prevention						
1	Air pollution	B-	A-	B-	B-	**Construction period:** - Civil engineering work, such as destruction of the existing facilities and land formation, may cause dust, but the impact should be temporary. When wind speed exceeds about 6 m/s, dust on the ground may be lifted up. The occurrence ratio of wind speed exceeding about 6 m/s around the project site is 10%. - Emission of air pollutants (SOx, NOx, PM) from construction machinery and vehicles may affect air quality of the surrounding site. **Operation period:** - Diesel oil will be used as the fuel at the power plant. SOx, NOx, and PM will be emitted by the operation of gas turbine, causing impact on a broad area. According to the field survey conducted by the Survey Team, it was found that the east side of the proposed power plant site is a high-elevation area; therefore, there is a possibility that a part of the area may have high concentration of pollutants emitted from the stack, depending on the wind direction. The emission concentration of air pollutant in the exhaust gas will meet the emission standard of Mozambique and the standard value of IFC/WB EHS guidelines (Thermal power plant, 2008). - There is an elevated area higher than 130m within 5km of the power plant, but east wind going in that direction is very rare (less than 5% annually) and no prediction shall be necessary. - The maximum concentration at the ground level of pollutants are extremely low compared to the Mozambique's standard and IFC/WB guidelines. - Future concentration obtained by adding the present concentration to the predicted value are sufficiently low as compared with

No.	Items	Scoping: Preparation and Construction	Scoping: Operation	Assessment Results: Preparation and Construction	Assessment Results: Operation	Explanations of the Rational Assessment Process
						Mozambique's standards and the IFC/WB guidelines - Regarding contribution concentration from the power plant, most locations show concentrations below detection limits or close to the limits, so the impact to the region is very low.
2	Water pollution	B-	B-	B-	B-	**Construction period:** - Muddy water generated by precipitation may cause adverse impact on the water quality of the marine area around the project site mainly during the rainy season. A temporary sedimentation pond will be installed around the construction area. Its surface water shall be discharged to the sea after the sedimentation treatment. - Wastewater from the construction site, concrete effluent and oil-containing effluents are generated and may affect the water quality of the surrounding sea. A wastewater treatment system for workers, such as a septic tank and temporary toilet, will be installed in the workers' camp and construction area. Concrete-generated wastewater and oil-containing effluent are treated at a neutralization system and oil separator installed within the construction area, respectively. Treated wastewater is finally sent to the temporary sedimentation pond and discharged into the sea. **Operation period:** - A gas turbine will be installed and thermal wastewater will not be generated. - Oily drainage wastewater from fuel and around the tank of lubricant, and domestic sewage from office will be generated. Oily drainage wastewater will be treated in the oil separator/interceptor installed around the fule tanks and domestic wastewater from workers is treated in the septic tank to comply with Mozambique's standards and IFC/EHS Guideline and treated wastewater will be discharged into Nacala Bay. - To meet the exhaust gas standard for gas turbine in Mozambique, water treatment (demineralization) system will be needed and wastewater from the system will be generated, if water injection method will be applied. If dry-type low-NOx burner will be applied, water treatment (demineralization) system will not be needed; therefore, wastewater will not be generated. Wastewater from water treatment (demineralization) system will be treated by neutralization and sedimentation appropriately to comply with IFC/WB EHS guideline standard (Thermal power, 2008) before being discharged into Nacala Bay.
3	Waste	B-	B-	B-	B-	**Construction period:** - Waste may be generated at decommission of the existing facility such as concrete and metal chips, oil-containing soil and hazardous waste containing asbestos. - Other waste generated from the construction work will include general waste and hazardous waste. **Operation period:** - Hazardous waste is waste oil generated from the operation and maintenance of the facilities and sludge generated through precipitation treatment. - General waste is sewerage and garbage produced from workers in the

No.	Items	Scoping: Preparation and Construction	Scoping: Operation	Assessment Results: Preparation and Construction	Assessment Results: Operation	Explanations of the Rational Assessment Process
						power plant.
4	Soil contamination	B-	B-	B-	B-	**Construction period:** - Soil pollution may possibly be caused by leakages of lubricant collected from construction machinery, fuel oil and chemicals. - Oil and chemicals will be stored at an appropriate storage place equipped with anti-permeation system in the project site. **Operation period:** - Lubrication oil, fuel oil and chemical materials may be spilled and are likely to cause contamination to the soil.
5	Noise and vibration	B-	A-	A-	B-	**Construction period:** - Operation of heavy equipment and trucks will cause noise and vibration impacts. In particular, pile driving and decommissioning of the existing facilities will cause impact from the strong noise and vibration reaching surrounding broader areas. - The current noise level at the residential area is 58～61dBA, excedding the IFC/WB EHS guideline value (daytime:55dB(A)). - In the case with the installation of the noise reducing fences of 5m height, the future noise levels in the daytime were estimated to lie between 62-66 dB(A) in the residential area, which is 1dBA higher than the current noise level. Therefore, the noise level will comply with the IFC / WB EHS Guidelines (if the current noise level exceeds the guideline value, the future noise level shall not increase by more than 3dBA from the current level by the project contribution). - Considering elevated topography in the east of the site, noise level in the residential area 15m higher than the site is expected to be mitigated without noise reduction fence to the similar extent to the case where fence is installed. **Operation period:** - Noise and vibration impact from the plant operation is predicted. There are residences near the project site, and sufficient consideration must be given to minimize noise impact. - The current noise level at the residential area is 58～61dBA in daytime and 51～57 dBA in night time, excedding the IFC/WB EHS guideline value (daytime:55dB(A), nighttime:45dB(A)). - The future noise levels will be between 40-48 dB(A) in daytime and 51-57dB(A) in nighttime in the residential area, which is 1to 2dBA higher than the current noise level. Therefore, the noise level will comply with the IFC / WB EHS Guidelines (if the current noise level exceeds the guideline value, the future noise level shall not increase by more than 3dBA from the current level by the project contribution). Actually, the residential area is 15m higher than the site and, therefore, actual noise level is expected to be lower than the predicted noise level.
6	Land subsidence	D	D	D	D	**Construction and operation period:** - Water will not be drawn from underground.
7	Odor	B-	B-	B-	B-	**Construction and operation period:** - In case domestic waste from the workers is not appropriately treated, it may produce foul odors.

No.	Items	Scoping: Preparation and Construction	Scoping: Operation	Assessment Results: Preparation and Construction	Assessment Results: Operation	Explanations of the Rational Assessment Process
8	Substratum contamination	B-	B-	B-	B-	**Construction and operation period:** - If untreated wastewater is discharged into the sea, sediment contamination may occur. - In construction phase, temporary toilet and septic tanks will be installed in the workers' camp and the management office to treat wastewater. Concrete-generated wastewater and oil-containing effluent are treated at a neutralization system and oil separator, respectively, installed within the construction area. Treated wastewater is finally sent to the temporary septic tank and discharged into the sea. - In operation phase, oil-containing water will be treated in oil separator/interceptor installed around the fule tanks, and domestic wastewater from worker will be treated in a septic tank, and wastewater from water treatment (demineralization) system will be treated by neutralization and sedimentation. This wastewater will be managed and treated appropriately to comply with IFC/WB EHS guideline values before being discharged into Nacala Bay.
Natural environment						
1	Wild life preservation area	D	D	D	D	**Construction and operation period:** - The site is located in Nacala City, and no wildlife preservation area is within or near the area.
2	Terrestrial ecosystems and rare species	B-	B-	B-	B-	**Construction period:** - The site is a developed area for the existing power plant mostly covered with artificial structures. Only limited terrestrial flora and fauna are present including rodents and grasses. These are commonly observed, broadly-inhabiting species and no precious species are observed. Consequently, the direct impact of land alteration will be very limited. - Construction work will generate air pollution, noise and vibrations that are likely to have an impact on the terrestrial ecosystems. However, the site is used for industry, residence and service, so the affected ecosystems are likely to be very few. **Operation period:** - Power plant will generate air pollution, noise and vibration, etc. that may have impact on the terrestrial ecosystems. - Power plant will generate air pollution, noise and vibration, etc. that may have impact on the terrestrial ecosystems. The land around the project site is used for industry, residence and service, and the affected biota is not expected to be significant.
3	Marine ecosystems and rare species	B-	B-	B-	B-	**Construction period:** - Fish and benthic animals in Nacala Port are the species commonly seen in the surrounding area, and rare species such as coral reef are not observed. - Concrete-containing wastewater and oil-containing wastewater are likely to be generated during construction phase and water pollution may cause adverse effects to the marine ecosystem. **Operation period:** - Fish and benthic animals in Nacala Port are the species commonly seen in the surrounding area, and rare species such as coral reef are not observed.

No.	Items	Scoping: Preparation and Construction	Scoping: Operation	Assessment Results: Preparation and Construction	Assessment Results: Operation	Explanations of the Rational Assessment Process
						- A gas turbine will be installed instead of a steam turbine, and thermal wastewater will not be generated and there will be no intake of cooling water. - Pollutants discharged from oil-containing water are expected to have impact on marine organisms.
4	River ecosystem	D	D	D	D	**Construction and operation period:** - The site has no rivers nearby and no wastewater shall be discharged into rivers.
5	River hydrology	D	D	D	D	**Construction and operation period:** - The site has no nearby rivers. Water will not be drawn from rivers.
6	Underground hydrology	D	D	D	D	**Construction and operation period:** - Water will not be drawn from underground.
7	Marine hydrology	D	D	D	D	**Construction period:** - Since no port and harbor facilities will be constructed, there is likely to be no change in flow conditions caused by the structure. **Operation period:** - A gas turbine will be installed. There will be no change in flow conditions in the vicinities of the discharged area due to the cooling water intake and discharge.
8	Topography and geology	D	D	D	D	**Construction period:** - The site is a developed area for the existing power plant and land alteration should be very limited. **Operation period:** - Since no port and harbor facilities will be constructed, there will be no soil erosion caused by the structure.
Social environments						
1	Resettlement and Land acquisition	D	D	D	D	**Construction and operation period:** - The site is a developed area for the existing power plant and new land acquisition and resettlement will not occur.
2	Poor People	D	D	D	D	**Construction and operation period:** - The site is a developed area for the existing power plant and new land acquisition and resettlement will not occur.
3	Ethnic minorities	D	D	D	D	**Construction and operation period:** - The area around the site is not inhabited by ethnic minorities.
4	Local economy including employment and means of livelihood	B+	B+	B+	B+	**Preparation period:** - The site is a developed area for the existing power plant and new land acquisition and resettlement will not occur. **Construction and operation period:** - Employment of local people and purchace of products offered in the local community may contribute to the activation of the local economy. - Use of the services (i.e. restaurant and catering service etc.) is expected to contribute to local economy. - Nacala area is currently being promoted as a special economic zone as well as a port area, and construction materials are easily available. The power plant construction is expected to contribute to the further development of the local economy.
5	Land use and utilization of	D	D	D	D	**Preparation, construction and operation period:** - The site is a developed area for the existing power plant and new land

No.	Items	Scoping: Preparation and Construction	Scoping: Operation	Assessment Results: Preparation and Construction	Assessment Results: Operation	Explanations of the Rational Assessment Process
	local resources					acquisition and resettlement will not occur. Use of land and local resources are not likely to be affected.
6	Water use	B-	B-	B-	B-	**Construction period:** - Muddy water, concrete-containing wastewater and oil-containing wastewater may be generated, and a temporary impact on fishery is predicted. **Operation period:** - In the operation of the power plant, oily drainage wastewater from fuel and around the tank of lubricant, and domestic sewage from office and accommodation for staff will be generated and may affect local fishery by water pollution. Small scale trawl and roll net fishery is conducted on the west side of the project site. - Even when water injection is implemented as a NOx reduction measure, water demand by this project is limited and is not supplied from rivers, but supplied by the Waterworks Bureau. Therefore, no impact on water use by residents due to water intake is expected.
7	Existing social infrastructure and social service	B-	B-	B-	B-	**Construction period:** - In case where inflows of workers are significant, construction of lodging houses, medical treatment facilities, schools, sewer systems and other infrastructure may be necessary. In Nacala City, there is already a certain level of social infrastructure. - Traffic jam caused by increasing traffic is expected during construction. **Operation period:** - Larger number of workers are expected, construction of lodging houses, medical treatment facilities, schools, sewer systems and other infrastructure may be necessary. - In Nacala-Porto City, there is already a certain level of social infrastructure.
8	Social bodies including social capitals and social organizations that make local decisions	D	D	D	D	**Preparation, construction and operation period:** - The site is a developed area for the existing power plant and new land acquisition and resettlement will not occur. Consequently, social bodies including social capitals and local decision-making organization will not be affected.
9	Unfair distribution of damage and benefit	B-	B-	B-	B-	**Preparation, construction and operation period:** - The site is a developed area for the existing power plant and new land acquisition and resettlement will not occur. Unfair distribution of damage and benefits caused by compensation should not occur. - If employment of local people is done through unfair schemes such as personal connection of the construction company, benefits may be unfairly distributed among local people.
10	Conflict of interests within the local area	B-	D	B-	D	**Preparation and construction period:** - The site is a developed area for the existing power plant and new land acquisition and resettlement will not occur. Conflicts of interests within the local area are not predicted. - Inflows of many workers from other parts of Mozambique or foreign countries during construction period may cause conflict with local workers, if the local customs are not followed.

No.	Items	Scoping: Preparation and Construction	Scoping: Operation	Assessment Results: Preparation and Construction	Assessment Results: Operation	Explanations of the Rational Assessment Process
						Operation period: - A small inflow of workers from outside the area is predicted, and conflict with local workers due to difference in customs should not occur.
11	Cultural heritage	D	D	D	D	**Construction and operation period:** - The site is a developed area for the existing power plant and the construction site has no precious historical, cultural, or religious heritage.
12	Landscape	D	D	D	D	**Construction and operation period:** - The site is a developed area for the existing power plant, and since the site has no scenic spots, no impact is expected.
13	Gender	D	D	D	D	**Preparation, construction and operation period:** - The site is a developed area for the existing power plant, and new land acquisition and resettlement will not occur. No particular impact is expected to take place regarding gender.
14	Rights of children	B-	D	B-	D	**Preparation period:** - The site is a developed area for the existing power plant, and new land acquisition and resettlement will not occur. No particular impact is expected to take place to the rights of children **Construction period:** - Child labor may increase on the construction site and may lead to school abandonment. **Operation period:** - No child workers will be employed for simple work during operation.
15	HIV/AIDS and other infectious diseases	B-	D	B-	D	**Construction period:** - The inflow of workers from other parts of Mozambique or foreign countries may induce the spread of infectious diseases. **Operation period:** - A very small inflow of workers is expected, so the spread of infectious disease is not expected.
16	Work environment (including work safety)	B-	B-	B-	B-	**Construction period:** - Workers may have accidents during construction service. **Operation period:** - In the operation phase, works at a high place or generating loud noises may cause labor accidents.
Others						
1	Accidents	B-	B-	B-	B-	**Construction period:** - Traffic accidents may occur during operation of vehicles. **Operation period:** - Fire and traffic accidents by operation of facilities and / or vehicles may occur. -
2	Cross-boundary Impact and Climate Change	D	B-	D	B-	**Construction period:** - Although CO2 will be generated during construction, the impact shall be limited to a temporary period and is highly unlikely to have any impact across the borders and on climatic change. **Operation period:** - CO2 is produced by the project operation, but the output of the power plant is not large. Additionally, with high-efficiency gas turbine, CO2

No.	Items	Scoping		Assessment Results		Explanations of the Rational Assessment Process
		Preparation and Construction	Operation	Preparation and Construction	Operation	
						generation per kWh is lower than in the conventional power generation system and the cross-boundary pollution and impact on climate change will be insignificant.

Note: Categories are classified as follows:
A: There will be a serious impact.
B: There will be a certain impact.
C: The extent of impact will be uncertain. (A further survey will be needed to make the expected impact clear.)
D: Impact will hardly be expected.
+: Positive impact
-: Negative impact

(Source: Prepared by Survey Team)

3.9 Environmental Management Plan

The following environmental management plan is reflected into EIA report prepared for EIA procedure in accordance with Mozambican legislation.

3.9.1 Implementation System

(1) Construction Phase

At the construction phase, the power generation department of EDM shall carefully consider all construction activities with the supervision consultant, and encourage the EPC contractor to fully understand the necessary mitigation measures and implement them.

In this regard, Project Implementation Unit (PIU) shall be organized prior to the start of construction and an expert environmental management administrator in the PIU shall be employed. The unit will discuss and prepare mitigation measures with the supervision consultant and the EPC contractor prior to the start of construction. Furthermore, a large inflow of workers is expected once construction begins.

The PIU shall also function as a grievance organization seeking to understand and address any grievances from local people during the construction phase, and conduct appropriate mitigation measures. The PIU shall improve the understanding of the surrounding community regarding construction details, schedule and mitigation measures, and shall obtain local people's opinions and correct the mitigation measures as appropriate.

In order to confirm the implementation of environmental management and to consider further mitigation measures, the contractor should submit regular reports to the supervisory consultant and the PIU on the implementation status of the management plan.

The administrator of the PIU shall regularly hold explanation sessions with the local community, continuously listen to their grievances, submit reports to JICA and other relevant organizations regarding those grievances, as well as the implementation status of environmental management and environmental monitoring (described hereinafter).

If environmental problems occur due to construction work, the PIU shall confirm the cause with the contractor as soon as possible.

In order to resolve these problems, the administrator of the PIU shall instruct the contractor and consultant regarding necessary measures. If the problem is serious, the power generation department may order the contractor to halt construction work until the problem is resolved.

Figure 3-34 outlines the environmental management and monitoring implementation structure in accordance with the reporting flow during the construction phase.

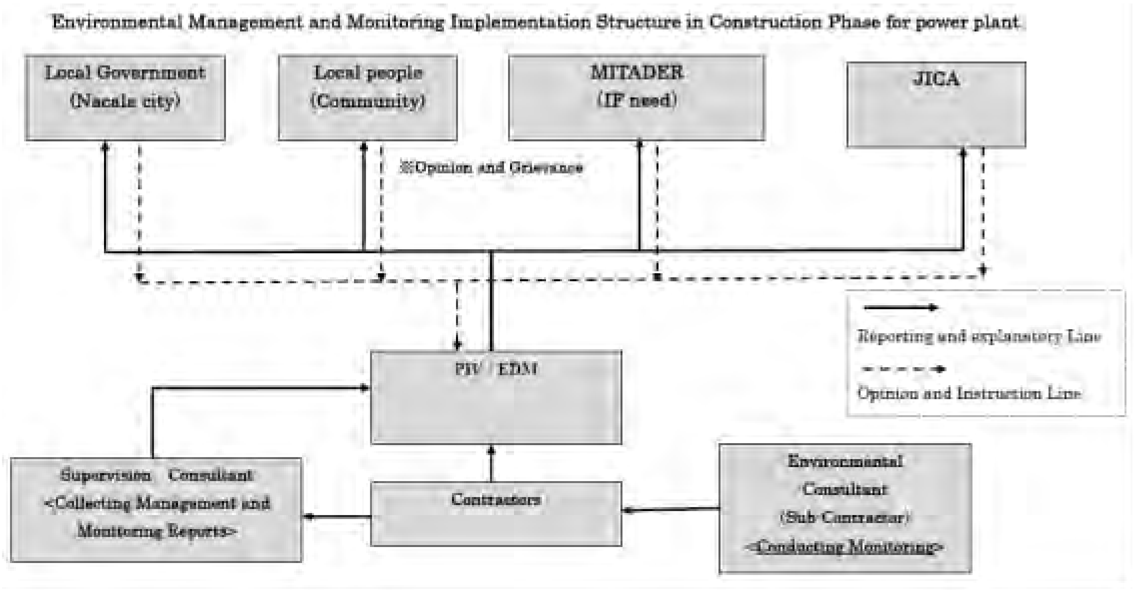


Figure 3-34 Environmental Management Plan and Monitoring Implementation Structure in Construction Phase

(Source: Prepared by Survey Team)

(2) Operation Phase

The EDM and power plant are responsible to develop and implement an environmental management plan that includes mitigation measures. An expert environmental management administrator in the EDM and power plant shall be employed to ensure the environmental management plan is appropriately implemented. The administrator shall encourage the project staffs to familiarize themselves with the environmental management plan prior to the start of plant operation, and shall regularly educate them regarding ongoing matters during the operation phase.

The administrator shall also function as a grievance organization and will strive to understand and address any grievances from the local people during the operation phase, and conduct appropriate mitigation measures.

The basic function of the environmental management plan is to closely cooperate with the local community, and to provide them with sufficient explanations based on positive mitigation measures, which is very important.

The administrator shall report the contents and implementation status of the environmental management plan and environmental monitoring plan described below to the director of the plant and the director of the responsible section, with the director of power plant taking final responsibility. The administrator shall regularly provide explanations to the local community, continuously listen to their grievances, submit reports to JICA and other relevant organizations regarding those grievances, as well as on the implementation status of environmental management and environmental monitoring activities (described hereinafter).

Figure 3-35 outlines the environmental management and monitoring implementation structure in accordance with the reporting flow during the operation phase.

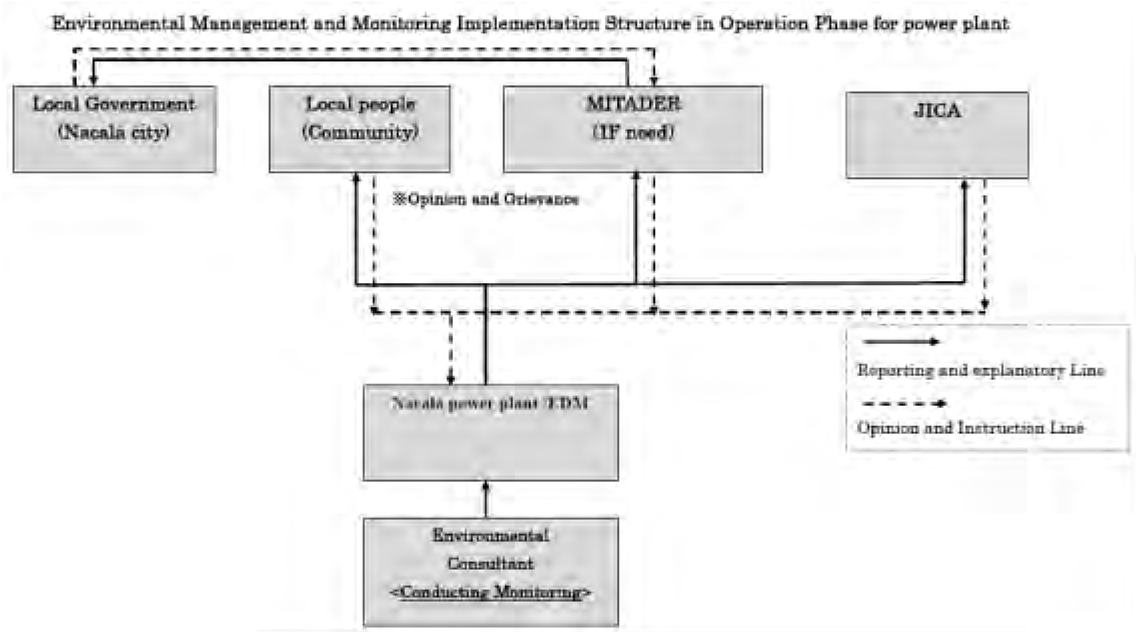


Figure 3-35 Environmental Management Plan and Monitoring Implementation Structure in Operation Phase

(Source: Prepared by Survey Team)

3.9.2 Environmental Management Plan

Table 3-40 describes the environmental impact, mitigation measure, responsible organization and cost for each environmental item in construction and operation phase.

Table 3-40 Environmental Management Plan

No.	Potential Impact	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Location	Period	Responsible Institution	**Cost**
Construction									
1	Air pollution	Generation of fine particles from decommissioning work	- Ambient air quality standards (Mozambique) - IFC guideline values for ambient air quality (General 2007)	Prevention of air pollution in the surrounding area	- Anti-dust sheet will be installed to reduce dust generation during decommissioning - Generation of dust due to strong wind will be reduced with periodic watering (dry season)	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
		Exhaust gas from construction machinery and vehicles used for mobilization of equipment			- Conduct periodical maintenance in the construction equipment and vehicles - Distribute construction work within schedule preventing concentration of work in short periods				
		Exhaust gas from construction machinery and vehicles used for mobilization of equipment	—		- Prohibit field burning of waste				
2	Water Pollution	Increase in water turbidity due to rain and soil runoff	- Water quality standards (Mozambique) - IFC/WB EHS guideline values for ambient air quality (General 2007; Thermal 2008)	Prevention of water pollution of the rivers in the lower reaches of the basin	- Installation of provisional rain catchment course and settling tank	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
		Wastewater from concrete			- Installation of a neutralization tank				
		Oily wastewater			- Installation of a provisional oil separator				
		Wastewater from the construction site			- Installation of a septic tank and temporary toilets for the workers				
3	Waste	Waste such as concrete, or sand containing scrap iron and oil and asbestos containing waste	Waste management regulation	Prevention of soil and water pollution, malodors and hygiene issues	- Implement a waste management and disposal plan to be explained to the site workers addressing waste reduction, recycling and inadequate waste disposal - Collection and storage of waste	- Construction area - Villages in the vicinit	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and	Expenses included in contract cost by Contractor

No.	Potential Impact	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Location	Period	Responsible Institution	**Cost**
		General waste generated in the construction phase (packaging, organic, etc.) Hazardous waste generated in the construction phase (exhausted batteries)			separately at an appropriate location in an appropriate manner - Compliance of regulations related to general waste and hazardous waste and transportation and disposal of waste at permitted area	y of the site		Supervision consultants	
4	Soil pollution	Leakage of lubricants, fuels and chemicals collected by construction vehicles and other construction equipment	Hazardous material regulation	Prevent soil pollution in the project site	Conduct the lubricants and oils collection in area where soil permeation does not occur (for example, a concrete layer covered soil)	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
5	Noise and vibration	Noise and vibration caused by construction machinery Noise caused by vehicles used for mobilization of equipment and workers	IFC EHS guideline, noise level values (General 2007)	Reduction of noise level from construction activities	- Using low-noise/low vibration equipment - Perform construction work during daytime, especially piling work - Periodic checks and regular maintenance of construction equipment and vehicles - Optimizing construction schedule - Limit truck speed, especially around residential areas - Periodic checks and regular maintenance of construction equipment and vehicles - Optimizing construction schedule	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
6	Odor	Waste from construction site	Waste management regulation	Prevention of generation of malodors	- Education regarding litter separation and prohibition of illegal dumping - Regarding organic waste, containers with lids will be installed on the site and the waste periodically collected and disposed of by Nacala City waste company	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor

No.	Potential Impact	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Location	Period	Responsible Institution	**Cost**
7	Sediment pollution	Increase in water turbidity due to rain and soil runoff Wastewater from concrete Oily wastewater Wastewater from the construction site	Same as "2) Water Pollution"	Minimize the impact to sediments in the marine ecosystem	Same as "2) Water Pollution"	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
8	Terrestrial ecosystem and rare species	Generation of fine particles from decommissioning work Exhaust gas from construction machinery and vehicles used for mobilization of equipment	Same as "1) Air Pollution"	Same as "1) Air Pollution"	Same as "1) Air Pollution"	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
		Noise and vibration from construction machinery Noise from transportation of workers and supplies	Same as "5) Noise and Vibration"	Same as "5) Noise and Vibration"	Same as "5) Noise and Vibration"				
9	Marine ecosystem and rare species	Increase in water turbidity due to rain and soil runoff Wastewater from concrete Oily wastewater Wastewater from the construction site	Same as "2) Water Pollution"	Minimize the impact to the aquatic ecosystem by preventing water pollution	Same as "2) Water Pollution"	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
10	Local economy including employment and means of livelihood	- Employment for local residents - Local supply and machinery	-	- Activation of the local economy - Increase the standard of living of the local population	- Employ as many local residents as possible - Use the services (i.e., laundry and catering services, etc.) and products offered by the local community	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor

No.	Potential Impact	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Location	Period	Responsible Institution	**Cost**
11	Water use	Increase in water turbidity due to rain and soil runoff Wastewater from concrete Oily wastewater Wastewater from the construction site	Same as "2) Water Pollution"	Minimize the impact to fishery by preventing water pollution	Same as "2) Water Pollution"	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
12	Existing social infrastructure and social service	Sewage treatment, schools, medical facilities, housing due to the increase of working population	-	Impact on the usability of the current infrastructure	- Offer employment to local population as much as possible	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
		Increase in traffic due to the increase in the number of vehicles		Mitigation of traffic	- Investigate and coordinate adequate driving route and schedule through negotiation with the related organizations. - Reduction of the number of vehicle by utilizing buses	Road surrounding the construction area			
13	Unfair distribution of damage and benefit	Employment distribution in the area could be unfair	-	Promote local employment and avoiding a feeling of unfairness within the community	- Present employment opportunities with clearly explained prerequisites	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
14	Conflicts regarding benefits and damage within the region	Conflict between the local population and manpower coming from other regions	-	Cooperation with the local population	- Employ as many local residents as possible - Respect and give education on local habits and traditions - Promote cultural exchange with the local population (for instance, participating in a local event)	Construction area and its surroundings	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor

No.	Potential Impact	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Location	Period	Responsible Institution	**Cost**
15	Children's rights	Potential increase in child labor due to school abandonment	-	Prohibit child labor	- Prohibit labor contracts with minors - Conduct periodical inspections regarding child labor	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
16	Infectious Diseases such as HIV/AIDS	Temporary influx of migrant labor during construction may increase risk of infection	-	Consideration of sanitation of local residents	- Employment of local people as much as possible - Education and training on workers' health care - Deployment of medical facility and staffs - Implementation of periodic medical check-ups	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Education and training: approximately 10.9 million yens (about 100,000USD) Expenses included in contract cost by Contractor
17	Work Conditions (Including Work safety)	Labor accidents involving: - Handling heavy loads - Working at heights - Electric shocks	- Occupational standards established in Mozambique - IFC/WB EHS Guidelines (General 2007)	Labor safety and prevention of health problems	- Prepare a manual for labor accident prevention including safety education and training: - - Provide workers with appropriate protective equipment such as a helmet, safety boots, earplugs, etc. - - Establish clear signs to identify the location of hazardous or toxic material - - Create a "User Manual" for lifting equipment such as cranes	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
18	Accidents	Traffic accidents	-	Prevent traffic accidents	- Investigate adequate traffic rules and timing - Compliance with local traffic rules and promote safe driving	Road surrounding the construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor

No.	Potential Impact	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Location	Period	Responsible Institution	**Cost**
Operation									
1	Air pollution	Emissions of SOx, NOx, PM generated in the gas turbine	- Mozambique's emission standards - IFC/WB EHS guideline emission standard (Thermal 2008) - Mozambique's ambient air quality standards	Prevention of air pollution in the surrounding area	- Introduction of Low NOx combustion technology to reduce the total emission of NO2 - A continuous emission monitoring system (CEMS) will be installed in the duct, and emissions will be compared with international emissions standards and Mozambique's standards	Power plant	During operation	EDM and environmental consultants	CEMS: approximately 30 million yen (about 270,000USD) Expenses included in contract cost by Contractor
2	Water pollution	Oily water	- Mozambique's effluent standards - IFC/WB EHS guideline effluent standard (Thermal, 2008)	Prevention of marine pollution	Wastewater will be collected, and its related neutralization, sedimentation and oil separation/interceptor installed around the fule tanks will be installed. Treated wastewater will be periodically checked against the IFC/WB EHS standards.	Power plant	During operation	EDM and environmental consultants	Expenses included in contract cost by Contractor
		Domestic wastewater	- Mozambique's effluent standards - IFC/WB EHS guideline effluent standard (General 2007)		Wastewater treatment for domestic water will be installed. The treated water will be periodically checked against IFC/WB EHS guideline and Mozambican standard.				
3	Waste	Hazardous waste from wastewater treatment (sludge, oil)	Waste management regulation	Prevention of inadequate waste disposal	- Implement a waste management and disposal plan to be explained to the site workers addressing waste reduction, recycling and inadequate	Power plant	During operation	EDM and environmental consultants	EDM (included in O&M cost)

No.	Potential Impact	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Location	Period	Responsible Institution	**Cost**
		Waste from construction site			waste disposal - Collection and storage of waste separately at an appropriate location in an appropriate manner - Compliance of regulations related to general waste and hazardous waste and transportation and disposal of waste at permitted area				
4	Soil pollution	Leakage of lubricants, fuels and chemicals collected by construction vehicles and other construction equipment	Hazardous material regulation	Prevent soil pollution in the project site	- Conduct the lubricants and oil collection in area where soil permeation does not occur (for examples, a concrete layer covered soil)	Power plant	During operation	EDM and environmental consultants	Expenses included in contract cost by Contractor
5	Noise and vibration	Equipment generating noise	IFC/WB EHS Guidelines noise level standards (General 2007)	Mitigation of noise from the power plant	- Introduction of low noise type or enclosed type equipment - Maintaining equipment by periodical check - Installation of fence or green area for noise reduction, if necessary	Power plant	During operation	EDM and environmental consultants	Expenses included in contract cost by Contractor
		Equipment generating vibration	—	Mitigation of vibration from the power plant	- Introduction of low vibration equipment - Periodical check of equipment - Reduce vibration by employing strict standards				
6	Odor	Waste generated from the construction site	Waste management regulation	Prevention of malodors	- Thourough instructions on the separation and collection of waste and prohibition of illegal dumping. - Regarding organic waste, containers with lids will be installed on the site and the waste periodically collected and disposed of	Power plant	During operation	EDM and environmental consultants	EDM (included in O&M cost)
7	Sediment pollution	Oily water Domestic wastewater	Same as “2) Water Pollution”	Minimize the impact to the sediments in the marine ecosystem by preventing water pollution	Same as “2) Water Pollution”	Power plant	During operation	EDM and environmental consultants	Same as “2) Water Pollution”

No.	Potential Impact	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Location	Period	Responsible Institution	**Cost**
8	Terrestrial ecosystem and rare species	Emissions of SOx, NOx, PM generated in the gas turbine	Same as "1) Air Pollution"	Maintain conditions for the growth of native plants	Same as "1) Air Pollution"	Power plant	During operation	EDM and environmental consultants	Same as "1) Air Pollution" and "5) Noise and vibration".
		Equipment generating noise Equipment generating vibration	Same as "5) Noise and vibration"	Maintain conditions for the growth of native animals	Same as "5) Noise and vibration"				
9	Marine ecosystem and rare species	Plant wastewater Oily water Domestic wastewater	Same as "2) Water Pollution"	Minimize the impact to the marine ecosystem by preventing water pollution	Same as "2) Water Pollution"	Power plant	During operation	EDM and environmental consultants	Same as "2) Water Pollution"
10	Local economy including employment and means of livelihood	- Employment for local residents - Local supply and machinery	-	- Activation of the local economy - Increase the standard of living of the local population	- Employ as many local residents as possible - Use the services (i.e., laundry and catering services, etc.) and products offered by the local community	- Village in the vicinity of the site - Power plant	During operation	EDM and environmental consultants	EDM (included in O&M cost)
11	Water Use	Plant wastewater Oily water Domestic wastewater	Same as "2) Water Pollution"	Minimize the impact to fishery by preventing water pollution	Same as "2) Water Pollution"	Power plant	During operation	EDM and environmental consultants	Same as "2) Water Pollution"
12	Existing social infrastructure and social service	Infrastructure bottlenecks (sewage treatment, schools, medical facilities, housing) due to the increase of working population	-	Reduce infrastructure bottlenecks	Employ as many local residents as possible	Power plant	During operation	EDM and environmental consultants	EDM (included in O&M cost)

No.	Potential Impact	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Location	Period	Responsible Institution	**Cost**
13	Unfair distribution of damage and benefit	Employment distribution in the area could be unfair	-	Promote local employment and avoid a feeling of unfairness within the community	- Present employment opportunities with clearly explained prerequisites	Power plant	During operation	EDM and environmental consultants	EDM (included in O&M cost)
14	Work Conditions (including work safety)	Labor accidents involving: - Handling heavy loads - Working at heights	- Occupational standards established in Mozambique - IFC/WB EHS Guidelines (General 2007)	Labor safety and prevention of health problems	- Prepare a manual for labor accident prevention including safety education and training: - Provide workers with appropriate protective equipment such as a helmet, safety boots, earplugs, etc. - Establish clear signs to identify the location of hazardous or toxic material	Power plant	During operation	EDM and environmental consultants	Facility expenses included in contract cost by Contractor and EDM (included in O&M cost)
15	Accidents	Fire	—	Fire prevention and fire extinguishing	- Implement plan to prevent oil leakages - Installation of fire extinguishers - Installation of fire alarm systems - Establishment of fire brigade and training	Power plant	During operation	EDM and environmental consultants	Facility expenses included in contract cost by Contractor and EDM (included in O&M cost)
		Traffic accidents (prevention through periodic inspections)	—	Prevention of traffic accidents	- Investigate adequate traffic rules and timing - Education to promote safe driving	Road surrounding the site			
16	Transboundary effects and climate change	CO2 emissions	Amount of CO2 emissions	Reduction of CO2 emissions per kW	Utilization of high-efficiency gas turbine	Power plant	During operation	EDM and environmental consultants	Expenses included in contract cost by Contractor

(Source: Prepared by Survey Team)

3.10 Environmental Monitoring

3.10.1 Environmental Monitoring Plan

An Environmental Monitoring Plan will be prepared to provide guidelines for environmental management plan during construction and operation of the power plant.

The environmental components that will be monitored are those that will be negatively affected by the construction activities and are determined that the effectiveness of mitigation measures should be confirmed.

Environmental management is a sustainable way of planning, arranging, supervising, organizing, and developing the environment for the maintenance of the preservation of natural resources and the prevention or reduction of damage to the environment.

Implementation structure for monitoring is also shown in Figure 3-34 and Figure 3-35.

The major environmental impact, monitoring method, responsible organizations, and expenses for each environmental item in the construction and operation phases for the transmission line are listed in Table 3-41.

Table 3-41 Environmental Monitoring Plan

No.	Items	Source of impact	Monitoring parameter	Criteria	Objectives	Methods: Data collection and analysis	Methods: Location	Methods: Period and frequency	Responsible institution	Cost/cost bearing
Construction										
1	Air pollution	Dust generated from demolition of the existing facility and earth work Exhaust gas from construction machinery and vehicle	Air quality of the surrounding area (TSP, PM10, SO2, NO2)	- Mozambican ambient air quality standard - IFC/WB EHS guideline, ambient air quality standard (General 2007)	Confirmation of the mitigation measures of air pollution	Analyzing air quality	3 points: Residential area around the power plant	Twice in period where construction activity becomes maximum	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
2	Water pollution	Wastewater generated from construction activity	Wastewater (TSS, pH, Oil, BOD, Coliforms, etc.)	- Mozambican effluent standards - IFC/WB EHS guideline, ambient air quality standard (General 2007)	Confirmation of the mitigation measure of water pollution	Evaluation of effect of the mitigation measure of water pollution	1 point: discharge point of temporary sediment basin	Every week during rainy season	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
			Seawater where wastewater is discharged (TSS, pH, Oil, BOD, Coliforms, etc.)	- Mozambican sea water quality standards			1 point	Every month in rainy season		
3	Waste	Generation of waste from	Type and volume of waste as well as	Waste management	Confirmation of mitigation	Record of type and	Contractor's office	Continuously	**Implementation**: EPC Contractor and	Expenses included in

No.	Items	Source of impact	Monitoring parameter	Criteria	Objectives	Methods: Data collection and analysis	Methods: Location	Methods: Period and frequency	Responsible institution	Cost/cost bearing
		demolition of the existing facility and construction activity	disposal method	regulation	measures	volume of waste as well as disposal method			Environmental consultants **Supervisor:** EDM and Supervision consultants	contract cost by Contractor
4	Noise and Vibration	Noise from construction machinery and vehicle	Noise level	IFC/WB EHS guideline, noise level standard (General/2007)	Evaluation of effect of the mitigation measures towards noise levels	Measurement using noise level meter	3 points: On the border of the site near the residential areas	Twice in period where construction activity becomes maximum	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
5	Work Environment (Including Work Safety)	Labor accidents	- Handling heavy loads - Working at heights - Electric shock	—	Evaluation of effect of the work safety plan	- Record of accidents	Contractor's office	Continuously	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
Operation										
1	Air pollution	Generation of SOx, NOx, PM from operation of gas turbine	Emission gas (SO_2, NO_2, PM)	- Mozambican emission gas standards - IFC/WB EHS Guidelines (Thermal 2008)	Confirmation of the mitigation measures of air pollution	CEMS (Continuous Emission Monitoring System)	Stack outlet	Continuously	EDM and environmental consultants	- Expenses for CEMS installation (approximately 30 million yen) is included in contract cost by Contractor - Management

No.	Items	Source of impact	Monitoring parameter	Criteria	Objectives	Methods			Responsible institution	Cost/cost bearing
						Data collection and analysis	Location	Period and frequency		
										of CEMS and Measurement is covered by EDM
2	Water pollution	Water discharge from power plant operation	Effluent (TSS, pH, Oil, BOD, Coliforms, etc.)	- Mozambican effluent standards - IFC/WB EHS Guidelines (Thermal 2008)	Confirmation of the mitigation measure of water pollution	Evaluation of effect of the mitigation measure of water pollution	Outlet of discharging point	As necessary	EDM and environmental consultants	EDM
3	Waste	Waste generated from power plant operation	Type and volume of waste as well as disposal method	Waste management regulation	Confirmation of mitigation measures	Record of type and volume of waste as well as disposal method	Power plant	Continuously	EDM	EDM (included in O&M cost)
4	Noise and Vibration	Noise from power plant operation	Noise level	IFC/WB EHS Guidelines (General 2007)	Evaluation of effect of the mitigation measures towards noise levels	Measurement using noise level meter	3 points: On the border of the site near the residential areas	As necessary for the first 3 years	EDM and environmental consultants	EDM (approximately 600,000 yen).
5	Work Environment (Including Work Safety)	Labor accidents	Record of labor accidents - Handling heavy loads - Working at heights - Electric shocks	—	Evaluation of effect of the work safety plan	Record of accidents	Power plant	Continuously	EDM	EDM (included in O&M cost)

(Source: Prepared by Survey Team)

3.10.2 Monitoring Forms

Monitoring forms are shown below.

(1) Construction Phase

(a) Air Quality

Monitoring location: Residential area around the power plant

Relevant lows and guidelines: Ambient Air Quality Standard of Mozambique (Decree No. 67/2010)
IFC/WB EHS General Guidelines (2007)

Monitoring date:

Item	Unit	Baseline	Measured Value (1hr)			National ambient standards (Decree No. 67/2010)	IFC/WB EHS General Guidelines (2007)	Note
			Min	Max	Average			
SO_2	μg/m^3	0～784.4				800 (1 hour) 100 (24 hour)	500 (10 min) 125 (24 hour)	Twice in period where construction activity becomes maximum
NO_2		0～563.4				190 (1 hour) - (24 hour)	200 (1-hour) - (24 hour)	
PM_{10}		16.0～905				- (1 hour) 150 (24 hour)	- (1 hour) 150 (24hour)	

(b) Wastewater from Sedimentation Basin

Monitoring location: Discharge point of temporary sediment basin

Relevant lows and guidelines: Wastewater standard of Mozambique (Decree No. 18/2004)
IFC/WB EHS Guidelines for Thermal Power Plants (2008)

Monitoring date:

Item	Unit	Measured Value	National effluent standards (Decree No. 18/2004)	IFC/WB EHS Guidelines for Thermal Power Plants (2008)
pH	─		6 –9	6 –9
TSS	mg/L		50	50
Oil & Grease	mg/L		10	10
Iron	mg/L		1	1
Zinc	mg/L		1	1
Chromium	mg/L		0.5	0.5
Chlorine residue	mg/L		0.2	0.2
Copper	mg/L		0.5	0.5
Lead	mg/L		—	0.5
Cadmium	mg/L		—	0.1
Mercury	mg/L		—	0.005
Arsenic	mg/L		—	0.5

(c) Seawater Quality

Monitoring location: One point around the discharging point

Relevant lows and guidelines: Ambient Air Quality Standard of Mozambique (Decree No. 67/2010)

Monitoring date:

Parameter	Unit	Baseline	Measured value	National seawater quality standard (Decree No. 67/2010)	Note
Suspended solids (SS)		590		ND	Every month in rainy season
Oil		ND		ND	
Color, foul odor or turbid matter		-		ND	
Artificial coloration		-		ND	
Abrasive deposit		-		ND	
BOD5 at 20℃	mg/L	ND		≤ 5	
COD	mg/L	ND		≤ 6	
pH		7.24-7.31		6.5 －8.5	
Aluminum	mg/L	-		1.5	
Ammonia	mg/L	-		0.4	
Antimony	mg/L	-		0.2	
Arsenic	mg/L	-		0.05	
Barium	mg/L	-		1.0	
Beryllium	mg/L	-		1.5	
Boron	mg/L	-		5.0	
Bromine	mg/L	-		0.1	
Cadmium	mg/L	-		0.005	
Lead	mg/L	-		0.01	
Cyanogen	mg/L	-		0.005	
Chlorine residue	mg/L	-		0.01	
Copper	mg/L	-		0.05	
Total chromium	mg/L	-		0.05	
Tin	mg/L	-		2.0	
Phenol	mg/L	-		0.001	
Dissolved iron	mg/L	-		0.3	
Fluorine	mg/L	-		1.4	
Manganese	mg/L	-		0.1	
Mercury	mg/L	-		0.0001	
Nickel	mg/L	-		0.1	
Nitrate	mg/L	-		10.0	
Nitrite	mg/L	-		1.0	
Silver	mg/L	-		0.005	
Selenium	mg/L	-		0.011	
Surface-activating matter	mg/L	-		0.5	
Sulfur（H2S）	mg/L	-		0.002	
Thallium	mg/L	-		0.1	
Uranium	mg/L	-		0.5	
Zinc	mg/L	-		0.01	

ND: Note detected

(d) Waste

Monitoring location: Contractor's office

Relevant lows and guidelines: Waste management regulation of Mozambique (Decree No. 13/2006)

Monitoring date:

Item	Place of generated waste	Storage amount (Unit: t or kg)	Disposal amount (Unit: t or kg)	Disposal method and place	Remark
					Continuously

(e) Noise

Monitoring location: One point on the site boundary
Two points in the residential area around the power plant

Relevant lows and guidelines: IFC/WB EHS General Guidelines (2007)

Monitoring date:

Location	Baseline	Noise level (Leq)	IFC/WB EHS General Guidelines (2007)	Note
Residential area	41.6 – 67.9		Day: 55 Night: 45	Twice in period where construction activity becomes maximum
Residential area	-		Day: 70 Night: 70	

(f) Working Environment

Monitoring location: Contractor's office

Construction Contents	Inspection Item	Contents	Status	Provision	Remarks
					Continuously

(2) Operation Phase

(a) Emission Gas

Monitoring location: Duct
Relevant lows and guidelines: National Emission Gas Standards (Decree No. 18/2004)
IFC/WB EHS Guidelines for Thermal Power Plants (2008)
Monitoring date:
Fuel (diesel oil or natural gas):

Item	Unit	Measured value		National emission gas standards (Decree No. 18/2004)		IFC/WB EHS Guidelines for Thermal Power Plants (2008)		Note
		Min	Min	Diesel oil	Natural gas	Diesel oil	Natural gas	
NO_X	mg/Nm^3			460	320	152	51	Continuously
SOx	mg/Nm^3			2,000	2,000	-	-	
PM	mg/Nm^3			100	100	50	-	

(b) Wastewater (Only If Wastewater Treatment System is installed)

Monitoring location: Wastewater discharging point
Relevant lows and guidelines: National effluent standards (Decree No. 18/2004)
IFC/WB EHS Guidelines for Thermal Power Plant (2008)
Monitoring date:

Parameter	Unit	Measured value	National effluent standards (Decree No. 18/2004)	IFC/WB EHS Guidelines for Thermal Power Plants (2008)	Note
pH	—		6 –9	6 –9	
TSS	mg/L		50	50	
Oil & Grease	mg/L		10	10	
Iron	mg/L		1	1	
Zinc	mg/L		1	1	
Chromium	mg/L		0.5	0.5	
Chlorine residue	mg/L		0.2	0.2	
Copper	mg/L		0.5	0.5	
Lead	mg/L		—	0.5	
Cadmium	mg/L		—	0.1	
Mercury	mg/L		—	0.005	
Arsenic	mg/L		—	0.5	

(c) Waste

Monitoring location: Power plant

Relevant lows and guidelines: Waste management regulation of Mozambique (Decree No. 13/2006)

Monitoring date:

Item	Place of generated waste	Storage amount (Unit: t or kg)	Disposal amount (Unit: t or kg)	Disposal method and place	Remark
					Continuously

(d) Noise

Monitoring location: One point on the site boundary
Two points in the residential area around the power plant

Relevant lows and guidelines: IFC/WB EHS General Guidelines (2007)

Monitoring date:

Location	Baseline	Noise level (Leq)	IFC/WB EHS General Guidelines (2007)	Note
Residential area	41.6 – 67.9		Day:55 Night: 45	As necessary for the first 3 years
Residential area	-		Day: 70 Night: 70	

(e) Working Environment

Monitoring location: Power Plant

Construction Contents	Inspection Item	Contents	Status	Provision	Remarks
					Continuously

3.11 Stakeholder Meetings

During this Project, which has been categorized as a Category A project in Mozambique's EIA procedures, requests were made for Stakeholder Meetings to be held once during scoping and once during the preparation of EIA report. Also, in this Project, after the acquisition of EIA approval in 2017, a request was made for the production of an Addendum EIA Report along with changes to facility specifications, and, at the same time, a request was made to hold an additional Stakeholder Meeting.

The status and minutes from the Stakeholder Meetings held in this Project are shown below.

3.11.1 Scoping

(1) Objectives

The 1st Stakeholder Meeting is aimed at hearing the opinions and/or comments of stakeholders such as residents and local government officials regarding the project, and understanding their needs, as well as appropriately reflecting those needs into the relevant survey.

(2) Implementation Methodology

The project owner, EDM, hosted the meeting assisted by the local consultant hired by the JICA Study Team.

(3) Notification

A notification was made to the public by local newspaper. Also, the invitation letter was sent to public organizations and private entities as well as residents directly or indirectly affected by this project.

(4) Results

Date: June 8, 2016

Time: 9:15 am to 11:30 am

Venue: Nacala Port City Council

Bazar District

Host: EDM

Participants: Relevant central government officers, Local government officers, private entities, Secretary of the affected residential area (Triangulo district), local residents, etc. A total of 14 participants including 11 men and 3 women.

Agenda

- Registration
- Presentation of Scoping Report
- Presentation of TOR for EIA

- Question and Answer
- Conclusion

At the meeting, a PowerPoint presentation was given to the participants in their mother language (Portuguese), with a full explanation of the project outline, environmental impacts and the mitigation measures to be taken, as well as providing hand-outs of the summary of Scoping and TOR for EIA, to allow the audience to fully understand the project and contribute valuable comments. The main comments raised by the participants and the responses made by EDM are as shown in Table 3-42.

Table 3-42 Main Comments by Participants and Response by EDM at the Meeting (Scoping Phase)

Comments by Participants	Response by EDM
The main issue has to do with the quality of energy, because several large users are affected by frequent changes in voltage. The Nacala district is being transformed into an industrial park, so that it is urgent to ensure the quality of power supply.	The main attention is focused on transmission and distribution projects, including lines and substations. What happens is that the energy from Cahora Bassa loses quality by reaching Nacala, i.e. voltage drop. Thus, the project of constructing emergency electricity generator facility contributes to maintain tension, and hence a better quality of energy.
What is the number of jobs expected in this project?	Many of jobs during the preparation and construction will go to Mozambicans, with priority within Nacala region, but some specialized professions will be occupied by technicians from other regions of the country. The operation of this project requires about 53 workers.
How is the impact of fire evaluated in the EIA?	The EIA deals with health and safety issues of the project operation, as well as mitigation measures to reduce fire risk.
With regard to HIV/AIDS, how will you plan to avoid the increased infection rate?	Prevention measures will be addressed in the EIA. EDM certainly will have an ongoing program of prevention, whose actions will be extended to the crew of the new electricity generator facility, whether possible or effective.

3.11.2 EIA Phase

(1) Objectives

The objective of the Stakeholder Meeting held at the time of producing the EIA report was to gather opinions and comments about the results of the EIA, which had been explained to those related to the Project (residents and local government officers, etc.), and to reflect their comments in the business plan as needed.

(2) Implementation Methodology

The meeting was organized by the Project owner, EDM, with support from the local consultant employed by EDM (same company as the local consultant employed by the JICA survey team)

(3) Notification

Notification that the Stakeholder Meeting was to be held was made in local newspapers. Also, EDM sent written invitations to notify the public organizations, private companies and general residents who will directly or indirectly contribute to, or be affected by, this Project.

(4) Results

Date: November 15, 2017

Time: 9:20 am to 1:30 pm

Venue: Nacala Port City Council

Host: EDM

Participants: A total of 30 people (17 men and 13 women) including relevant central government officers, local government officers, private companies, directors of the residents' association of the affected area (Triangulo district), local residents, etc.

Agenda:

- Reception
- Presentation about EIA procedures
- Presentation about EIA surveys
- Presentation about impacts and the environmental management plan
- Question and answer session
- Conclusion

The explanations given to participants were made in their mother language (Portuguese) based on handouts related to a PowerPoint presentation and summary explanation. Explanations were given with regard to the Project details, environmental impact, and the mitigation measures under consideration so that participants were able to understand and make comments. The main comments raised by the participants and the responses made by EDM are as shown in Table 3-43.

Table 3-43 Main Comments by Participants and Response by EDM at the Meeting (EIA Phase)

Comments by Participants	Response by EDM and environmental consultant
What fuel will be used?	Diesel (gas oil) will be used at the start of operation, but, once natural gas is being supplied from the north, the plan is to use natural gas as fuel.
What kind of cooling system will be used?	We expect to use a cooling process based on air cooling.
Will wastewater include oil or lubricating oil?	Wastewater from the power plant will be analyzed before being discharged into Nacala Bay.
Interpretation should be provided for consultations in the future for participants who do not understand Portuguese.	A translation of the relevant documents and an interpretation of the discussions can be provided for community representatives and Triangulo district chiefs who attend consultations. If any residents have questions about the Project in the future, they will be able to provide the necessary support.

Comments by Participants	Response by EDM and environmental consultant
How will exhaust gases from the turbine be processed?	The details have not been decided at present, but in the F/S, investigations were made into equipping the stack with a filter that absorbs PM and the installation of water-based smoke processing equipment.
Will emergency contingency plan and health and safety plan during operation be produced?	Recommended countermeasures for health and safety during the stages of Project preparation, construction and commencement of full-scale operation are included in the EIA. Also, countermeasures for emergencies such as fires and accidents are included in the environmental management plan, and emergency contingency plan will be produced in the planning stage for the entire Project.
What are the standards for selecting air quality measurement locations?	With consideration for the prevailing northeast and southwest winds, as well as sloping land, measurement locations in the city were selected based on the scope of influence from direct air pollutant dispersion within a radius of 2km from the power plant, and on the basis of population density, the passage of traffic and pollutant activities.
What are the effects on the people of Nacala-Porto from high-level noises and PM10?	It is expected that the effects of noise during operation will include discomfort and sleeplessness. The high concentration of PM10 may have negative health effects, such as eye irritation and respiratory illnesses. In order to mitigate the effects from noise and PM10, mitigation measures and environmental impact management measures will be implemented and monitoring will be carried out.
How has the estimated noise level and air quality been evaluated in terms of impact from the power plant?	Based on the estimate results, it is considered that the total impact will be sufficiently reduced to within domestic and international environmental standards for air pollution and noise by implementing the mitigation measures planned in the environmental management plan.
What is the social responsibility of this Project?	The social responsibility of this Project is to provide a better supply of power while taking measures to mitigate estimated impacts without any negative effects that threaten human health or life.
Is this the end of the consultation, or will it be expanded to more distant communities?	Consultations were conducted in the scoping stage with attendance from Triangulo district chiefs from around the site. In the current consultation, people from more distant communities also attended along with residents of the Triangulo district. Therefore, it is considered that no further meetings are necessary. However, future communications to EDM or the consultant and consultations from relevant people and residents will not be denied. The contact addresses of the relevant persons in charge were published in the documents distributed during the consultations and in the advertisements published in the Notícias paper.

3.11.3 Addendum EIA Phase

(1) Objectives

The objective of the stakeholder meeting held at the time of producing the addendum EIA report was to gather opinions and comments about the results of the Addendum EIA, puuting focuses on the changes from the results of the EIA, which had been explained to those related to the Project (residents and local government officers, etc.), and to reflect their comments in the business plan as needed.

(2) Implementation Methodology

The meeting was organized by the Project owner, EDM, with support from the local consultant employed by JICA survey team.

(3) Notification

Notification of the Stakeholder Meeting was made in local newspapers on 9th of September, 2019. Also, EDM sent written invitations to notify the public organizations, private companies and NGOs prior to the meeting.

(4) Results

Date: September 24, 2019

Time: 8:00 am to 12:15 pm

Venue: Oceano Hotel in Nacala

Host: EDM

Participants: A total of 30 people (25 men and 5 women) including relevant central government officers, local government officers, private companies, local residents, etc.

Agenda:

- Presentation of the scope of EIA addendum process and Nacala EPP project
- Public discussion of EIA addendum results
- Conclusion

The explanations given to participants were made in their mother language (Portuguese) based on handouts. An EDM engineer from Nacala was arranged for communication in local language just in case but all the participants were capable to communicate in Portuguese. Explanations focused on changes at the EIA addendum results in the Project details, environmental impact, and the mitigation measures under consideration from the EIA results. The main comments raised by the participants and the responses made by EDM are as shown in Table 3-44.

Table 3-44 Main Comments by Participants and Response by EDM at the Meeting (Addendum EIA Phase)

Comments by Participants	Response by EDM and environmental consultant
Past occurrence of pollution of bay water from spills of fuels and lubricants used in EPP.	As the recognition of past errors allows us to analyze the present state of environmental studies, to envisage how EPP should operate in the future in order to limit environmental impacts. In this context, environmental monitoring, and the full implementation of the Environmental Management Plan, is extremely important, as it allows verification of the impact that is happening, and what additional mitigation measures can be taken, if necessary, thus anticipating the worsening impact.

Comments by Participants	Response by EDM and environmental consultant
Would like to know which company will do the environmental monitoring of the EPP project?	In due course, when the implementation of the Nacala EPP project begins, EDM will select the licensed environmental consultant to carry out environmental monitoring under the terms set forth in the Environmental Impact Assessment decree 54/2015.
What type of material will noise reduction panels be composed of?	The technical specifications of the noise reduction panels will be defined at the EPP executive project.
How can impacts on air quality be mitigated?	The EIA, as well as this Addendum, lists a set of mitigation measures that, when fully implemented, allow the impact to be limited to a low degree of significance. It should be noted that the gas turbine adopted in this project is equipped with a type of low-pollutant emission dry burner. As presented here, pollutant emission values are below both national and international standards.
Where will EPP be set up, and how many families should be resettled?	The EPP will be installed and operated within the substation area and the former EDM thermal power station in the city's port area. Therefore, it will be within the area managed by EDM, so there will be no need for human resettlement or compensation of assets. Inside the area, there is space available for EPP installation.

3.12 Environment Checklist

Table 3-45 shows environment checklist.

Table 3-45 Environment Checklist

Category	Main Check Items	Yes: Y No: N Not Applicable: N/A	Confirmation of Environmental Consideration (Justifications and mitigation measures)
1 Permits and Explanation			
(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process?	Y	EIA reports for this power plant were prepared by local consultants employed during “The Preparatory Survey for Nacala Corridor Transmission & Distribution Network Reinforcement Project” based on the results of that survey.
	(b) Have EIA reports been approved by authorities of the host country's government?	N	EIA reports were submitted to MITADER and approved in April 2017. However, since the Project Outline that was estimated during the preparation of EIA reports, changes were made to the stack height and assumed operation hours, etc. based on this preparatory survey, so MITADER made a request for an Addendum EIA Report to be prepared and for an additional Stakeholder Meeting to be held. It is expected that EDM will submit the addendum EIA report to MITADER after the consultation meeting on 24th of September, 2019 so that MITADER will approve it before Tender Notice.
	(c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied?	N	The conditions for the approval of EIA reports are “the secure implementation of the mitigation measures stated in the EIA report and in the environmental management plan,” and “the payment of the Environmental Permit Tax and acquisition of the Environment Permit.” The project operator will comply with this. The Addendum EIA report is expected to obtain approval before Tender Notice.
	(d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	N	After approval of the EIA reports, an Environment Permit must be obtained after paying the Environment Permit Tax. Before the commencement of this phase of the project, EDM will acquire the Environment Permit.
(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders?	Y	Based on Mozambique’s EIA-related laws, explanations were given to local residents during the scoping stage in June 2016 and during the EIA stage in November 2017. Additionally, the additional Stakeholder Meeting for Addendum EIA was held in September 2019.
	(b) Have the comments from the stakeholders (such as local residents) been reflected to the project design?	Y	The project operator is responding appropriately to the comments received from stakeholders raised during the explanations given to local residents in 2016 and 2017. The project operator will also respond appropriately to the comments received in the additional Stakeholder Meeting that is scheduled to be held in August 2019.

Category	Main Check Items	Yes: Y No: N Not Applicable: N/A	Confirmation of Environmental Consideration (Justifications and mitigation measures)
(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	Y	Investigations were conducted into a no implementation of the project, a new location and the current location, and alternatives for the power generation methods.
2 Pollution Control			
(1) Air Quality	(a-1) Do air pollutants, such as sulfur oxides (SOx), nitrogen oxides (NOx), and soot and dust emitted by the power plant operations comply with the country's emission standards?	Y	SOx, NOx, and PM will be emitted in the operation of this power generation facility which uses diesel as fuel. In terms of low-NOx countermeasures, reduction systems will be used such as dry process low-NOx burners or water injection. The concentration of air pollutants in the emitted gases complies with Mozambique exhaust gas standards and IFC/WB EHS guideline values (Thermal Power Plants, 2008).
	(a-2) Is there a possibility that air pollutants emitted from the project will cause areas that do not comply with the country's ambient air quality standards? Are any mitigating measures taken?	N	There is an area with a high elevation to the east of the power plant, and, depending on the wind direction, it is possible that higher concentration of smoke will come from the plant during certain periods. Within a radius of 5 km of the power plant, there are areas with an elevation of 130 m or more, but westerly winds that blow in that direction are exceedingly rare (less than 5% annually). The maximum ground concentration of pollutants from this Project is much lower than the guideline values from Mozambique or the IFC/WB. Also, in the case that future concentrations are calculated not only from the estimate values but also current concentrations, these future concentrations are sufficiently below than the values in Mozambique environmental standards and IFC/WB guideline values. In most areas, the distribution of the concentration contributing to annual average concentrations from the power plant is within pollutant measurement limitation values or similar values, so the impact on the region is limited.
	(b) In the case of coal-fired power plants, is there a possibility that fugitive dust from the coal piles, coal handling facilities, and dust from the coal ash disposal sites will cause air pollution? Are adequate measures taken to prevent the air pollution?	N/A	This power plant is fueled by diesel and it is not a coal-fired power plant.
(2) Water Quality	(a-1) Do effluents including thermal effluents from the power plant comply with the country's effluent standards?	Y	There is no thermal effluent because this power plant does not have a steam turbine. Wastewater containing fuel oil and oil from around the oil lubricating tank will be emitted, as well as domestic wastewater from office employees, but any wastewater that contains oil will be processed using an oil separator/interceptor installed around the fule tanks and, after processing in a septic tank, domestic wastewater from office employees will be discharged into Nacala Bay after confirming compliance with the values in Mozambique effluent standards and IFC/WB EHS guideline values. As for NOx countermeasures, in the case of using a dry process low-NOx burner, no regenerated wastewater will be produced, but in the case of using water injection, water treatment (demineralization)

Category	Main Check Items	Yes: Y No: N Not Applicable: N/A	Confirmation of Environmental Consideration (Justifications and mitigation measures)
			measures will be required, which will produce regenerated wastewater. In the case that regenerated wastewater is produced, after neutralization and flocculation, it will be drained into Nacala Bay after confirming compliance with Mozambique effluent standards and IFC/WB EHS (Thermal Power Plants, 2008) guideline values.
	(a-2) Is there a possibility that the effluents from the project will cause areas that do not comply with the country's ambient water quality standards or cause any significant temperature rise in the receiving waters?	N	Based on the above countermeasures, it is not thought that there are any areas that do not comply with Mozambique environmental standards.
	(b) In the case of coal-fired power plants, do leachates from the coal piles and coal ash disposal sites comply with the country's effluent standards?	N/A	This power plant is fueled by diesel and it is not a coal-fired power plant.
	(c) Are adequate measures taken to prevent contamination of surface water, soil, groundwater, and seawater by the effluents?	Y	Effluents will be discharged after being processed so as not to contaminate surface waters, soil/underground water and oceans, etc.
(3) Wastes	(a) Are wastes, (such as waste oil, and waste chemical agents), coal ash, and by-product gypsum from flue gas desulfurization generated by the power plant operations properly treated and disposed of in accordance with the country's regulations?	Y	Waste management/disposal plans, including worker training, will be established in order to reduce waste, promote recycling and prevent inappropriate waste disposal. Paper and iron scraps, etc., will be recycled, while other general waste will be collected/transported/disposed by Nacala-Porto City. All hazardous waste will be transported to permitted locations and disposed based on relevant laws. In this case, disposal will be subcontracted to a specialist processing business that has obtained permission.
(4) Noise and Vibration	(a) Do noise and vibrations comply with the country's standards?	Y	The current noise level at the residential area is 58～61dBA in daytime and 51～57 dBA in night time, excedding the IFC/WB EHS guideline value (daytime:55dB(A), nighttime:45dB(A)). The future noise levels will be between 40-48 dB(A) in daytime and 51-57dB(A) in nighttime in the residential area, which is 1to 2dBA higher than the current noise level. Therefore, the noise level will comply with the IFC / WB EHS Guidelines (if the current noise level exceeds the guideline value, the future noise level shall not increase by more than 3dBA from the current level by the project contribution). Actually, the residential area is 15m higher than the location of the gas turbine unit and, therefore, actual noise level is expected to be lower than the predicted noise level. Regarding machinery that produces noise/vibrations, in addition to making it as enclosed as possible, low-noise/low-vibration machinery will be used, and operational management will be carried out by

Category	Main Check Items	Yes: Y No: N Not Applicable: N/A	Confirmation of Environmental Consideration (Justifications and mitigation measures)
			means of regular checks. Also, monitoring will be carried out as necessary during nighttime operation, and afforestation will be carried out on the east side of the power plant if necessary.
(5) Subsidence	(a) In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?	N/A	Underground water will not be extracted.
(6) Odor	(a) Are there any odor sources? Are adequate odor control measures taken?	Y	It is possible that odors will be produced in the case that domestic waste is handled inappropriately. Workers will be given thorough guidance about waste separation and collection, and illegal dumping will be prohibited. Also, raw garbage will be collected and stored in a sealed container in order to prevent odors, which will be transported and disposed of regularly by Nacala-Porto City. The production of odors will be prevented due to the implementation of such control measures.
3 Natural Environment			
(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	N	The project site, which is located in Nacala-Porto city, is not in or near any wildlife protected areas.
(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)?	N	The project site, which is on the site of a full-developed existing power plant, does not encompass primeval forests, tropical rain forests, or ecologically valuable habitats.
	(b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions?	N	Plants and animals including grasses and rodents have been confirmed on the site, but these are generally species that commonly inhabit the surrounding area and no precious plants or animals have been confirmed.
	(c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem?	N/A	The surrounding area is used for manufacturing, residences and services, and there will be no major impact on living things. The fish and benthos living in Nacala Bay are common in the surrounding ocean areas, and there has been no confirmation of precious species, such as coral. For these reasons, it is assumed that there will be no significant impact on ecosystems.
	(d) Is there a possibility that the amount of water (e.g., surface water, groundwater) used by the project will adversely affect aquatic environments, such as rivers? Are	N	There will be no intake of coolant because this power plant does not have a steam turbine.

Category	Main Check Items	Yes: Y No: N Not Applicable: N/A	Confirmation of Environmental Consideration (Justifications and mitigation measures)
	adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?		
	(e) Is there a possibility that discharge of thermal effluents, intake of a large volume of cooling water or discharge of leachates will adversely affect the ecosystem of surrounding water areas?	N	There will be no intake of coolant and no thermal discharge will be implemented because this power plant does not have a steam turbine. Regarding water pollution in the ocean due to drainage from the power plant, there will be little impact on marine organisms as wastewater treatment will be carried out appropriately.
4 Social Environment			
(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement?	N	The project site, which is on the site of a full-developed existing power plant, will not generate new land appropriation or resettlement.
	(b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Are the compensations going to be paid prior to the resettlement? (e) Are the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement?	N/A	Not applicable

Category	Main Check Items	Yes: Y No: N Not Applicable: N/A	Confirmation of Environmental Consideration (Justifications and mitigation measures)
	(h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?		
(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary?	N	The project site, which is on the site of a full-developed existing power plant, will not generate new land appropriation or resettlement.
	(b) Is sufficient infrastructure (e.g., hospitals, schools, and roads) available for the project implementation? If the existing infrastructure is insufficient, are any plans developed to construct new infrastructure or improve the existing infrastructure?	N	Nacala-Porto already has a degree of infrastructure facilities. So as not to affect the use of existing infrastructure facilities, local residents will be employed as workers to the extent possible so as to prevent an influx of workers, etc. from outside the region.
	(c) Is there a possibility that large vehicle traffic for transportation of materials, such as raw materials and products will have impacts on traffic in the surrounding areas, impede the movement of inhabitants, and cause any risks to pedestrians?	Y	It is possible that traffic congestion will arise due to an increase in traffic volume during construction, but the number of vehicles will be reduced to the extent possible by studying appropriate transport routes and transport schedules, and by arranging buses for workers. Also, transport routes and transport schedules will be decided upon discussion with the relevant agencies.
	(d) Is there a possibility that diseases, including infectious diseases, such as HIV, will be brought due to the immigration of workers associated with the project? Are adequate considerations given to public health, if necessary?	Y	It is possible that the influx of workers from other areas during construction, including foreigners, will cause a rise in infectious diseases. In the Nacala region, there are many infectious diseases such as HIV/AIDS, but local residents will be employed to the extent possible so as to avoid the risk of spreading infectious diseases from workers from other areas. Also, training/education will be implemented among workers regarding infectious diseases and health, medical facilities and staff will be deployed, and regular health checks will be implemented.
	(e) Is there a possibility that the amount of water used (e.g., surface water, groundwater) and discharge of thermal	N	Fishing is being carried out on the west side of the power plant using small trawlers and round-haul nets. There will be no intake of coolant and no thermal discharge will be implemented because this power plant does not have a steam turbine.

Category	Main Check Items	Yes: Y No: N Not Applicable: N/A	Confirmation of Environmental Consideration (Justifications and mitigation measures)
	effluents by the project will adversely affect existing water uses and uses of water areas (especially fishery)?		Regarding water pollution in the ocean due to drainage from the power plant, there will be little impact on marine organisms as wastewater treatment will be carried out appropriately. Even when water injection is implemented as a NOx reduction measure, water demand by this project is limited and is not supplied from rivers, but supplied by the Waterworks Bureau. Therefore, no impact on water use by residents due to water intake is expected.
(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	N	There are no historical, cultural, or archeological heritages on the project site, which is located on the site of a full-developed existing power plant.
(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	N	There is no scenic spot on the project site, which is located on the site of a full-developed existing power plant.
(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples?	N/A	The project site, which is located on the site of a full-developed existing power plant, will not generate new land appropriation or resettlement. It was confirmed in the study that the area around the site is not being used by ethnic minorities.
	(b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	N/A	Not applicable
(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project?	Y	The laws of Mozambique regarding workplace safety will be complied with when implementing this Project.
	(b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials?	Y	Safety protection equipment such as helmets, safety boots, earplugs and shock protection gear will be provided. In addition, signs will be put in place on hazardous/toxic storage areas.
	(c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a	Y	Work safety plans will be produced and implemented, including safety training and drills.

Category	Main Check Items	Yes: Y No: N Not Applicable: N/A	Confirmation of Environmental Consideration (Justifications and mitigation measures)
	safety and health program, and safety training (including traffic safety and public health) for workers etc.?		
	(d) Are appropriate measures taken to ensure that security guards involved in the project not violate safety of other individuals involved, or local residents?	Y	Regarding security at the power plant, security guards who have undergone the appropriate training will be deployed so as not to violate the safety of people involved in the project/local residents.
5 Others			
(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)?	Y	Noise/vibrations The construction schedule will be managed, the quantity and scale of construction will be standardized, and a temporary fence will be set up with consideration for the impact on residential areas. Low-noise/low-vibration machinery will be used and operational management will be carried out by means of regular checks. In order to restrain the output of noise, large vehicles used to transport machinery and equipment, etc. will be limited to travelling at as low speeds as possible in residential areas. Also, construction will be carried out during the day to the extent possible, and the dismantling of existing facilities/piling work, in particular, will not be carried out at night. Polluted water Polluted water will be processed by setting up a sedimentation tank, and the clear top liquid will be discharged into the sea. Dust/exhaust gases In the dismantling of existing facilities, the area will be protected by dust scattering prevention sheets and the construction area and roads will be regularly sprinkled with water while checking for dust in the strong winds in the dry season. The emission of air pollutants will be restrained by maintaining construction machinery and vehicles through regular checks. Also, investigations will be conducted on the standardization of the construction schedule to the extent possible, and advance considerations made so that there is no unnecessary convergence during the period in which there are many uses of construction equipment and transport vehicles. Waste Basically, waste management/disposal plans, including worker training, will be established in order to reduce waste, promote recycling and prevent inappropriate waste disposal. Paper and iron scraps, etc., will be recycled, while other general waste will be collected/transported/disposed of by Nacala-Porto City.

Category	Main Check Items	Yes: Y No: N Not Applicable: N/A	Confirmation of Environmental Consideration (Justifications and mitigation measures)
			All hazardous waste will be transported to permitted locations and disposed of based on relevant laws. In this case, disposal will be subcontracted to a specialist processing business that has obtained permission.
	(b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce the impacts?	Y	Plants and animals including grasses and rodents have been confirmed on the project site, which is located on the site of an existing fully-developed power plant, but these are generally species that commonly inhabit the surrounding area and no precious plants or animals have been found, so there is almost no direct impact due to the transformation. Air pollutants, noise and vibrations, etc. during construction may have an impact on the growth of plants and the behavior of animals in the area, so necessary countermeasures against air pollutants and noise/vibrations will be taken.
	(c) If construction activities adversely affect the social environment, are adequate measures considered to reduce the impacts?	Y	It is possible that traffic congestion will arise due to an increase in traffic volume during construction, but the number of vehicles will be reduced to the extent possible by studying appropriate transport routes and transport schedules, and by arranging buses for workers. Also, transport routes and transport schedules will be decided upon discussion with the relevant agencies.
(2) Accident Prevention Measures	(a) In the case of coal-fired power plants, are adequate measures planned to prevent spontaneous combustion at the coal piles (e.g., sprinkler systems)?	N/A	The power plant will use diesel as fuel; it is not a coal-fired power plant.
(3) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts?	Y	The project operator will develop and implement a monitoring plan regarding environment items that are considered to have an impact.
	(b) What are the items, methods and frequencies of the monitoring program?	Y	The main items, methods and frequencies are planned as follows. Air pollution ・During construction - SO_2、NO_2 and PM10 will be measured twice during peak construction periods in three residential areas near the power plant ・During operation Continuous observation of SOx, NOx and PM from the duct Water pollution ・During construction - Weekly measurement of TSS, pH, Oil, BOD and number of coliform bacilli, etc., during the rainy season from the spout of the temporary settlement tank

Category	Main Check Items	Yes: Y No: N Not Applicable: N/A	Confirmation of Environmental Consideration (Justifications and mitigation measures)
			・During operation - Measurement of TSS, pH, Oil, BOD and number of coliform bacilli, etc., from drain outlet will be carried out as necessary. Noise ・During construction - The noise level will be measured twice during peak construction periods in three residential areas near the power plant ・During operation - Measurement of the noise level in three residential areas near the power plant will be carried out as necessary.
	(c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)?	Y	The project operator will establish appropriate monitoring systems for organizations, personnel, materials and budgets, etc., as well as their continuity, during both construction and operation.
	(d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	Y	The project operator will regularly make reports to relevant agencies such as JICA and MITADER regarding the implementation status of environmental management plans and environment monitoring.
6 Note			
Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Power Transmission and Distribution Lines checklist should also be checked (e.g., projects including installation of electric transmission lines and/or electric distribution facilities).	N/A	The generated electricity will be supplied to existing nearby substations.
	(b) Where necessary, pertinent items described in the Ports and Harbors checklist should also be checked (e.g., projects including construction of port and harbor facilities).	N/A	Harbor facilities will not be built.
Reference to	(a) If necessary, the impacts to	N	Although the operation of the power plant will produce CO_2, there is no large-scale output from the

Category	Main Check Items	Yes: Y No: N Not Applicable: N/A	Confirmation of Environmental Consideration (Justifications and mitigation measures)
Checklist of Other Sectors	transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, and global warming).		power plant and CO_2 output per kWh will be limited by constructing a high-efficiency gas turbine. For this reason, there will be almost no impact on transboundary issues or climate change.

Chapter 4 Project Evaluation

4.1 Preconditions

(1) Undertakings by GOM

It is essential that all works agreed to be undertaken by GOM is executed without delay for the smooth implementation of the project. EDM is to allocate the budget and organize the capable staffs for such works.

4.2 Necessary Inputs by the Recipient Country

In order to accomplish and sustain the effectiveness of the project, the EDM is to ensure the following issues:

1) Coopearation with JICA for Project implementation
2) Legal Process
3) Support of Tax exemtion on Personal Income Tax(IRPS), Corporate Income Tax(IRPC) of contractor
4) Pre-application to Tax autholities for VAT, and Substitute payment by CERT process
5) Assignment of adequate and capable operation staff
6) Allocate the budget necessary to operate and maintain the project equipment.

4.3 Important Assumptions

(1) Continuous economic development of the Nacala corridor area

In order to accomplish and sustain the project effectiveness, sustainable economic growth in the Nacala corridor area is essential.

The realization and sustenance of the effect of this project will require that the economic growth in the Nacala Corridor Area will continue and the power demand in the area will not decrease in future.

(2) Continuous fuel supply

Continuous fuel supply will be essential for the stable and reliable operation of the emergency power plant. The plant is planned to be operated with petroleum-based fuel (paraffin or diesel). Mozambique totally depends on imports for the supply of paraffin and diesel. Therefore, it will be necessary to ensure continuous and stable fuel supply by eliminating all risks.

4.4 Project Evaluation

4.4.1 Relevance

(1) Beneficiary of the Project

The completion of the project will encourage the electrification ofNacala corridor area and contribute to the reduction of poverty in this area.

(2) Consistency with the Middle and Long Term Development Plan

As described in the section 3-3, this project composes one of the important projects in Master Plan. Subsequent to the completion of this project, other development projects should be planned in order to achieve the goal of the middle and long term development plan.

The Government of Mozambique has requested to the Government of Japan its assistance to the Project for Construction of Nacala Emergency Power Plant in order to ensure the stable power supply to the Central and Northern Power Grids.

(3) Consistency with the Japanese Government Strategy and Policy

Japanese government support to Mozambique is primarily focused on 1) stimulation of regional and local development (especially corridor development along Nacala and Maputo corridors), 2) human development, and 3) disaster management and climate change.

The execution of this project consists with the objective of “stimulation of regional and local development along Nacala corridor”.

(4) Measure for operation and maintenance

The technology required for the operation and maintenance of gas turbine power plants was transferred to the Mozambican side in the “Maputo Gas Fired Combined Cycle Power Plant Development” implemented in the past, and Long Term Service Agreement (LTSA) also was appplied in the “Maputo Gas Fired Combined Cycle Power Plant Development”. These experiences in the past project are expected to be utilized in this project. Additionally, on comparison between power sales price and power generation cost, any budget for the LTSA is estimated to be raised.

(5) Correspondence for Emergency

Emergency of the project is prioritized, by the follloing reasons..

- Actualized shortage trend of power supply capacity form the viewpoint of Power demand banance
- After leasing barges from private companies, EDM has been supplying power with the provision of fuel for power generation, from grant aid cooperation from the Government of Japan. However, this provision is coming to the final stage.

4.4.2 Effectiveness

The following quantitative and qualitative effects are expected as outputs of the Project.

(1) Quantitative Effects

The project is expected to achieve the quantitative effectiveness as shown in Table 4-1.

Table 4-1 Quantitative Effectiveness Index

Index	Base Value (2018)	Target Value（2023*） *3 years after the completion
Net Output at sending end （MW）（at 31℃）	N.A	30MW
Annual Power Generation（MWh）(Note1)	N.A	54,750MWh
Availability（%） (Note2)	N.A	20.8%

Note-1 30MW x 5 hr/day x 365 = 54,750MWh

Note-2 5hr/24hr x100 = 20.8%

(2) Qualitative Effects

Construction of Nacala Emergency Power Plant can encourage the economic development and the improvement of living standards in this area by improvement of credibility of power supply for Nacala area.

Appendices

1. Member of the Survey Team

Name	Organization	Expert	Remark
Mr.Daisuke Iijima	JICA	Team Leader	1st Survey
Mr.Tsunenari Soyama	JICA	Cooperation Planning, Team Leader	1st & 3rd Survey
Mr.Kazuhiko Akamine	TEPSCO	Chief Consultant / Power plant equipment	
Mr.Hitoshi Furukoshi	TEPSCO	Power Plant operation planning / Fuel Planning	
Mr.Masanobu Kaminaga	TEPSCO	Power Demand forecast/ Power system analysis	1st &2nd Survey
Mr.Ryota Takahashi	TEPSCO	Transmission/System protection	1st Survey
Mr.Naohisa Inoue	TEPSCO	Material and Equipment planning	1st &2nd Survey
Mr.Tadashi Inoue	TEPSCO	Construction and Installation planning (Mechanical)	1st &2nd Survey
Ms.Mizuki Kitagawa	JANUS	Environmental and Social Consderation	2nd Survey
Mr.Kazutora Kono	OCG	Cost estimation / Construction and Installation planning (Civil & Architect)	1st Survey

2. Survey Schedule

1st Survey

Date		Mr.D.Iijima	Mr.T.Soyama	Mr.K.Akamine	Mr.H.Furukoshi	Mr.M.Kaminaga	Mr.R.Takahashi	Mr.N.Inoue	Mr.T.Inoue	Mr.K.Kono
		JICA	JICA	TEPSCO	TEPSCO	TEPSCO	TEPSCO	TEPSCO	TEPSCO	OCG
2019/4/17	Wed		Tokyo → Maputo							
2019/4/18	Thu		Meeting with JICA Maputo offfice / Meeting with EDM							
2019/4/19	Fri		Meeting with EDM							
2019/4/20	Sat	Internal Meeting								
2019/4/21	Sun	Plant survey at Maputo GTCC								
2019/4/22	Mon	Maputo → Nampla, Visit Nampla central substation Nampla → Nacala , Site Survey in Nacala substation								
2019/4/23	Tue	Meeting with Nacala PETROMOC Oil Base Terminal / City water supply (FIPAG) Site Survey in Nacala Substation, Nacala → Nampla								
2019/4/24	Wed	Nampla → Maputo								
2019/4/25	Thu	Meeting with EDM								
2019/4/26	Fri	Meeting with EDM , Meeting with JICA Maputo office								
2019/4/27	Sat	Maputo → Tokyo								

2nd Survey

Date		Mr.K.Akamine	Mr.N.Inoue	Mr.T.Inoue	Ms.M.Kitagawa	Mr.H.Furukoshi	Mr.M.Kaminaga
		TEPSCO	TEPSCO	TEPSCO	JANUS	TEPSCO	TEPSCO
2019/5/18	Sat	Tokyo → Maputo					Tokyo → Maputo
2019/5/19	Sun					Tokyo → Maputo	
2019/5/20	Mon	Meeting with JICA Maputo office / Meeting with EDM				Meeting with EDM	JIMeeting with JICA Maputo office / Meeting with EDM
2019/5/21	Tue	Meeting with EDM					
2019/5/22	Wed	Meeting with EDM					
2019/5/23	Thu	Meeting with EDM / Meeting with PETROMOC, Meeting with MIREME					
2019/5/24	Fri	Meeting with EDM / Meeting with JICA Maputo office					Maputo → Tokyo
2019/5/25	Sat	Maputo → Tokyo					

3rd Survey

Date		Tsunenari Soyama	Kazuhiko Akamine	Hitoshi Furukoshi
		JICA	TEPSCO	TEPSCO
2019/9/1	Sun	Tokyo → Maputo		
2019/9/2	Mon	Meeting with JICA Office		
2019/9/3	Tue	Meeting with EDM		
2019/9/4	Wed	Meeting with EDM		
2019/9/5	Thu	Meeting with EDM (Environmental)		
		Meeting with JICA Office		
2019/9/6-8	Fri	Maputo → Tokyo		

3. List of Parties Concerned in the Recipient Country

1st Survey

Meeting Attendance from EDM

4/18/2018 KOMAttendant at CTM

Name	Company	Title
1. Mr.Narendra Gulab	EDM	Director of Generation
2. Mr.Joao Paulo Fernandes	EDM	Directorate of Generation, Head of Technical support
3.Mr.Firmino Licumba	EDM	Head of Power Plant of South Region, Dir. Of Generation
4. Mr.Leopoldo Khadyhale	EDM	Directorate of Renewable Energy & Energy efficiency
5. Mr.Manuel Anselmo	EDM	Directorate of Distribution
6. Mr.Dolcidio Chimbuinhe	EDM	System Operator, Directorate of Operation System Engineer
7. Mr.Sebastiao Ngugulo	EDM	Electrical Engineer,Directorate of System planning &Engineering
8. Mr.Ivan Rangane	EDM	Directorate of Generation, Mechanical Engineer
9. Ms.Hiroko Tanaka	EDM	Directorate of Generation, Liaison officer

4/22-23/2019 Nampla/Nacala Area

At Napra central substation

1.Mr.Felisberto Ussitome	EDM	Director of North Transmission
2. Mr.Stiven Ferro	EDM	Head of Dept. of North Substations
3. Mr.Stelio Leitao	EDM	Head of Dept. of Central Region Power Plants

Atendant from EDM HQ

Name	Company	Title
1. Mr.Narendra Gulab	EDM	Director of Generation
2. Mr.Joao Paulo Fernandes	EDM	Directorate of Generation, Head of Technical support
7. Mr.Sebastiao Ngugulo	EDM	Electrical Engineer,Directorate of System planning &Engineering
9. Ms.Hiroko Tanaka	EDM	Directorate of Generation, Liaison officer

4/24-26/2019 EDM Meeting at CTM

Name	Company	Title
1. Mr.Narendra Gulab	EDM	Director of Generation
2. Mr.Joao Paulo Fernandes	EDM	Directorate of Generation, Head of Technical support
3.Mr.Firmino Licumba	EDM	Head of Power Plant of South Region, Dir. Of Generation
4. Mr.Leopoldo Khadyhale	EDM	Directorate of Renewable Energy & Energy efficiency
6. Mr.Dolcidio Chimbuinhe	EDM	System Operator, Directorate of Operation System Engineer
7. Mr.Sebastiao Ngugulo	EDM	Electrical Engineer,Directorate of System planning &Engineering
8. Mr.Ivan Rangane	EDM	Directorate of Generation, Mechanical Engineer
9. Ms.Hiroko Tanaka	EDM	Directorate of Generation, Liaison officer
10. Mr.Stelio Leitao	EDM	Head of Dept. of Central Region Power Plants (*出張)

Additionnaly,

PETROMOC　Mr. Frank Panguene（Nacala Oil Storage terminal, Head of Nacala office）

FIPAG(Nacala City Waterworks Bureau)　Mr. Jose Chiure（Head of Nacala office）、Mr. Adeliano Bata（Water tretment）, Mr. Orlando Antonio（Water Supply system）

＊FIPAG;　“Fundo de Investmento e Pathmonio de Abasterimento de Agua”

2nd Survey

Name	Company	Title
1. Mr. Narendra Gulab	EDM	Director of Generation
2. Mr. Joao Paulo Fernandes	EDM	Directorate of Generation, Head of Technical support
3. Mr. Leopoldo Khadyhale	EDM	Directorate of Renewable Energy & Energy efficiency
4. Mr. Dolcidio Chimbuinhe	EDM	System Operator, Directorate of Operation System Engineer
5. Mr. Sebastiao Ngugulo	EDM	Electrical Engineer, Directorate of System Planning & Engineering
6. Mr. Ivan Rangane	EDM	Directorate of Generation, Mechanical Engineer
7. Ms. Hiroko Tanaka	EDM	Directorate of Generation, Liaison officer
8. Mr. Felisberto Paulino	EDM	Electrical Engineer/Transmission
9. Mr. Alberto Mondlate Junior	EDM	Electrical Engineer/Transmission
10. Mr. Adriano Mandlane	EDM	Electrical Engineer/Transmission
11. Mr. Aderito Sibumbe	EDM	Electronic Engineer, Protection Sector, Transmission
12. Ms. Aissa Naimo	EDM	Environmental Engineer
13. Dr. Fernando L. Ribeiro	BioGlobal	Managing Director

3rd Survey

Name	Company	Title
1. Mr.Narendra Gulab	EDM	Director of Generation
2. Mr.Joao Paulo Fernandes	EDM	Directorate of Generation, Head of Technical support
3. Mr.Dolcidio Chimbuinhe	EDM	System Operator, Directorate of Operation System Engineer
4. Mr.Sebastiao Ngugulo	EDM	Electrical Engineer,Directorate of System planning &Engineering
5. Mr.Ivan Rangane	EDM	Directorate of Generation, Mechanical Engineer
6. Ms.Hiroko Tanaka	EDM	Directorate of Generation, Liaison officer
7.Ms. Aissa Naimo	EDM	Environmental Engineer
8.Dr. Fernando L. Ribeiro	BioGlobal	Managing Director

4. Minures of Discussions (M/D)

Minutes of Discussions
on the Preparatory Survey for the Project for
the Project for Construction of Nacala Emergency Power Plant,
Republic of Mozambique
(Explanation on Draft Preparatory Survey Report)

With reference to the minutes of discussions signed between Electricidade de Moçambique, E.P. (hereinafter reffered as "EDM") and the Japan International Cooperation Agency (hereinafter referred to as "JICA") on 26th April, 2019 and in response to the request from the Government of Mozambique (hereinafter referred to as " Mozambique ") dated 28th January, 2016 and 10th Feburuary, 2016, 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 for Construction of Nacala Emergency Power Plant (hereinafter referred to as "the Project").

As a result of the discussions, both sides agreed on the main items described in the attached sheets.

Maputo, 4th September, 2019

早山恒成	Carlos Alberto Yum
Mr. Tsunenari Soyama	Mr. Carlos Alberto Yum
Leader	Executive Board Member
Preparatory Survey Team	Electricidade de Moçambique, E.P.
Japan International Cooperation Agency	(EDM)
Japan	Mozambique

ATTACHEMENT

1. Objective of the Project

   The objective of the Project is to achieve the stable power supply by installation of power plant , thereby contributing to economic development of Mozambique.

2. Title of the Preparatory Survey

   Both sides confirmed the title of the Preparatory Survey as "the Preparatory Survey for the Project for Construction of Nacala Emergency Power Plant".

3. Project site

   Both sides confirmed that the site of the Project is in Nacala, which is shown in Annex 1.

4. Responsible authority for the Project

   Both sides confirmed the authorities responsible for the Project are as follows:

   4-1. The EDM will be the executing agency for the Project (hereinafter referred to as "the Executing Agency"). 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.

   4-2. The line ministry of the Executing Agency is the Ministerio dos Recursos Minerais e Energia (MIREME). The MIREME shall be responsible for supervising the Executing Agency on behalf of the Government of Mozambique.

5. Contents of the Draft Report

   After the explanation of the contents of the Draft Report by the Team, the Mozambique side agreed to its contents. JICA will finalize the Preparatory Survey Report based on the confirmed items. The report will be sent to the Mozambique side around October 2019.

6. Cost estimate

   Both sides confirmed that the cost estimate explained by the Team is provisional and will be examined further by the Government of Japan for its approval.

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 Mozambique 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 Mozambique side agreed to take necessary measures according to the procedures.

9. Timeline for the project implementation
The Team explained to the Mozambique 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 Mozambique side will be responsible for the achievement of agreed key indicators targeted in year 2025 and shall monitor the progress for Ex-Post Evaluation based on those indicators.

[Quantitative indicators]

Index	Base Value (2018)	Target Value (2025*) *3 years after the completion
Net Output at seding end (MW) (at 31℃)	N.A	30
Annual Power Generation (MWh) (Note1)	N.A	54,750
Availability (%) (Note2)	N.A	20.8

Note1: 30MW x 5 hr/day x 365=54,750MWh

Note2: 5hr/24hr x 100 =20.8%

[Qualitative indicators]

Construction of Nacala Emergency Power Plant can encourage the economic development and the improvement of living standards in this area by improvement of credibility of power supply for Nacala area.

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 Mozambique 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, refund of internal taxes and other fiscal levies as stipulated in (2) During the Project Implementation , Items NO.4 & 5 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 EDM during the implementation stage of the Project.

The Mozambique 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

15-1 General Issues

15-1-1 Environmental Guidelines and Environmental Category

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 B because the Project is neither located in a sensitive area, nor has its sensitive characteristics, further nor falls into sensitive sectors under the Guidelines, and its potential adverse impacts on the environment are not likely to be significant.

15-1-2 Environmental Checklist

The environmental and social considerations including major impacts and mitigation measures for the Project are summarized in the Environmental Checklist attached as Annex 7. Both sides confirmed that in case of major modification of the content of the Environmental Checklist, the Mozambique side shall submit the modified version to JICA in a timely manner.

15-2 Environmental Issues

15-2-1 Addendum Environmental Impact Assessment (EIA) and Environmental License

Both sides confirmed the Addendum EIA report will be approved by Ministry for Land, Environment and Rural Development (MITADER) and, following the approval, the Environmental License will be also obtained from MITADER by Notice of Bidding Document(s).

15-2-2 Environmental Management Plan and Environmental Monitoring Plan

Both sides confirmed Environmental Management Plan (EMP) and Environmental Monitoring Plan (EMoP) of the Project is as Annex 8, respectively. Both side agreed that environmental mitigation measures and monitoring shall be conducted based on the EMP and EMoP, which may be updated during the detailed design stage.

15-2-3 Other specific environmental issues which need to be confirmed/agreed between the parties.

Both sides confirmed that the Mozambique side will hold a public consultation under the support of JICA Study Team in September 2019 and, at the same time, Mozambique side will host a site visit by MITADER to obtain the approval of Addendum EIA report.

15-3 Environmental and Social Monitoring

15-3-1 Environmental and Social Monitoring

Both sides agreed that the Mozambique side will submit results of environmental and social monitoring to JICA with PMR by using the monitoring form attached as Annex 9. The timing of submission of the monitoring form is described in Annex 5.

15-3-2 Information Disclosure of Monitoring Results

Both sides confirmed that the Mozambique side will disclose results of environmental and social monitoring to local stakeholders through their website / in their field offices.

The Mozambique side agreed JICA will disclose results of environmental and social monitoring submitted by the Mozambique side as the monitoring forms attached as Annex 9 on its website.

16. Other Relevant Issues

16-1. 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.

16-2. Tax refund

JICA side explained that tax etc. in Mozambique shall be refunded on Japanese Grant Aid project as described in Annex 3. JICA requested EDM to provide equivalent amount of tax refund in case Mozambique does not ensure to provide the tax refund. Mozambique side understood the policy of Japanese Grant Aid and agreed to do so.

16-3. Schedule of implementation

Mozambique side requested to shorten the project period in order to operate the power plant as soon as possible. JICA agreed to make an effort to promote the project by close communication of both sides.

【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 Mozambique】

【Annex 6 Project Monitoring Report (template) 】

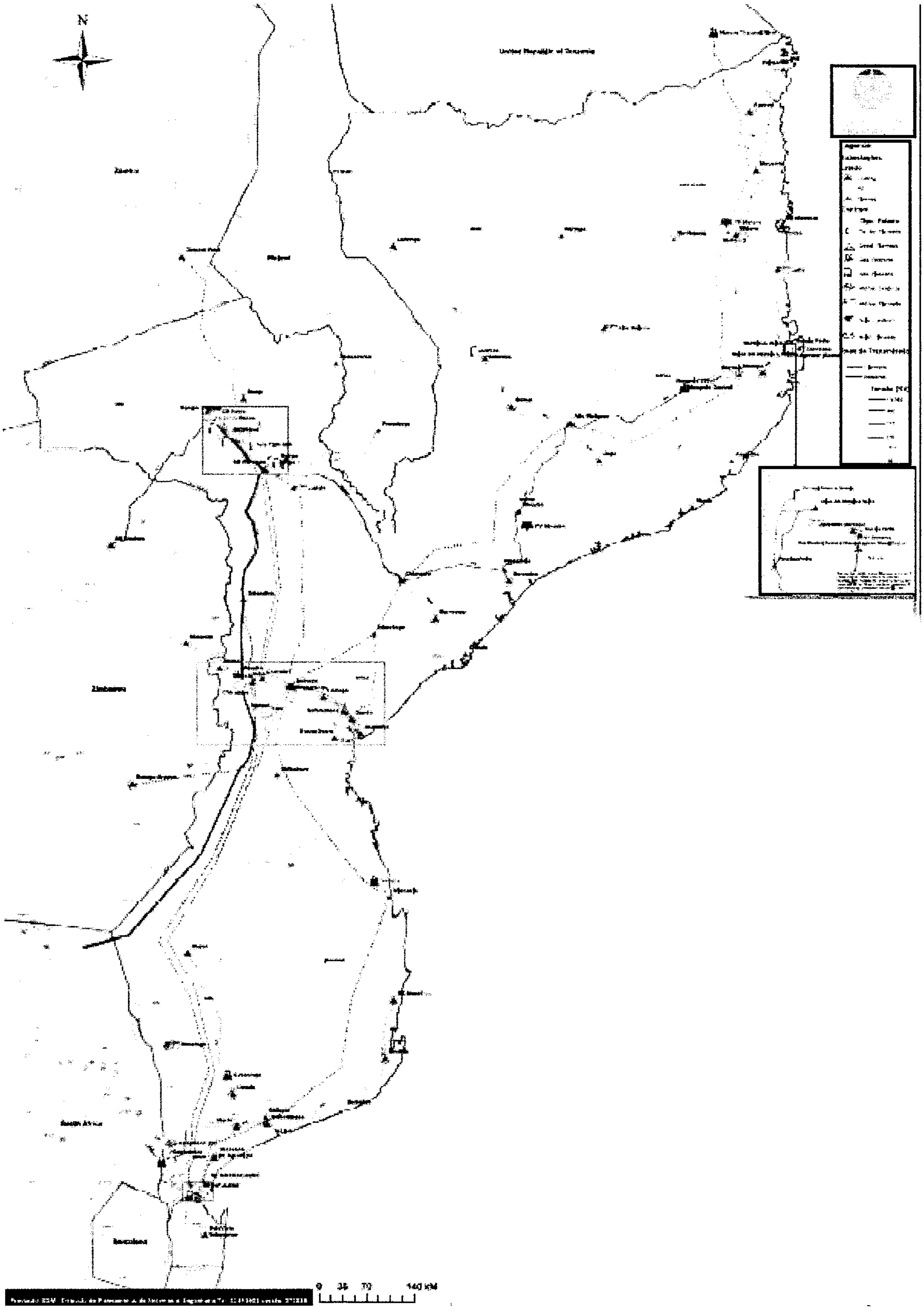
【Annex 7 Environmental Check List】

【Annex 8 Environmental Management Plan/Environmental Monitoring Plan】

【Annex 9 Environmental and Social Monitoring Form】

【Annex 10 Project Cost Estimation】

【Annex 1 Project Site】



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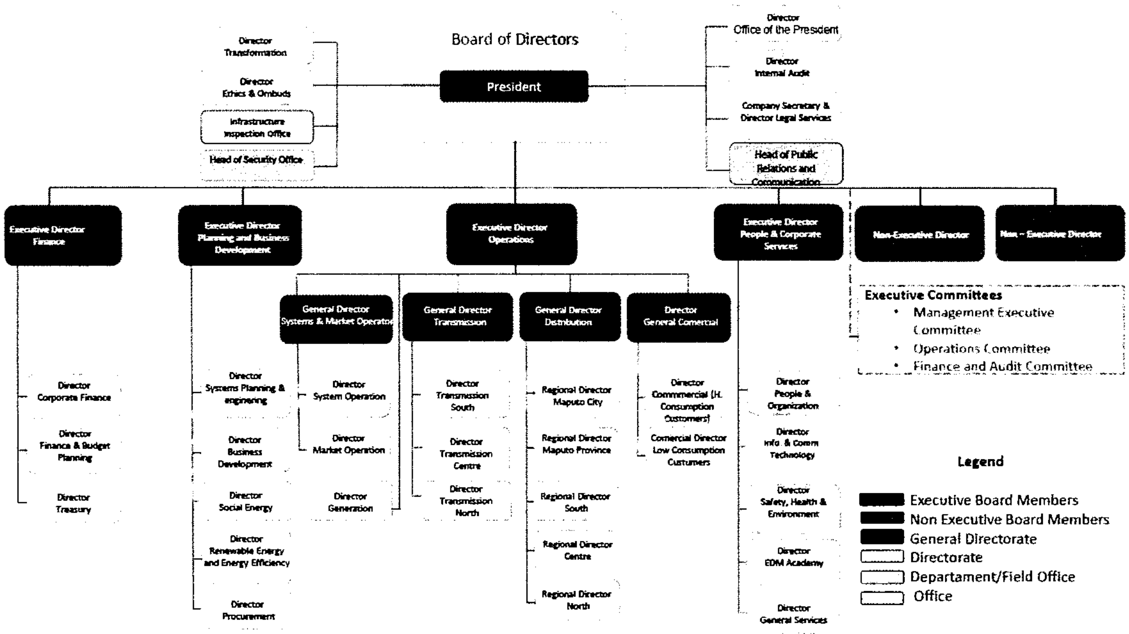
【Annex 2 Organization Chart】



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【Annex 3 Japanese Grant】

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.

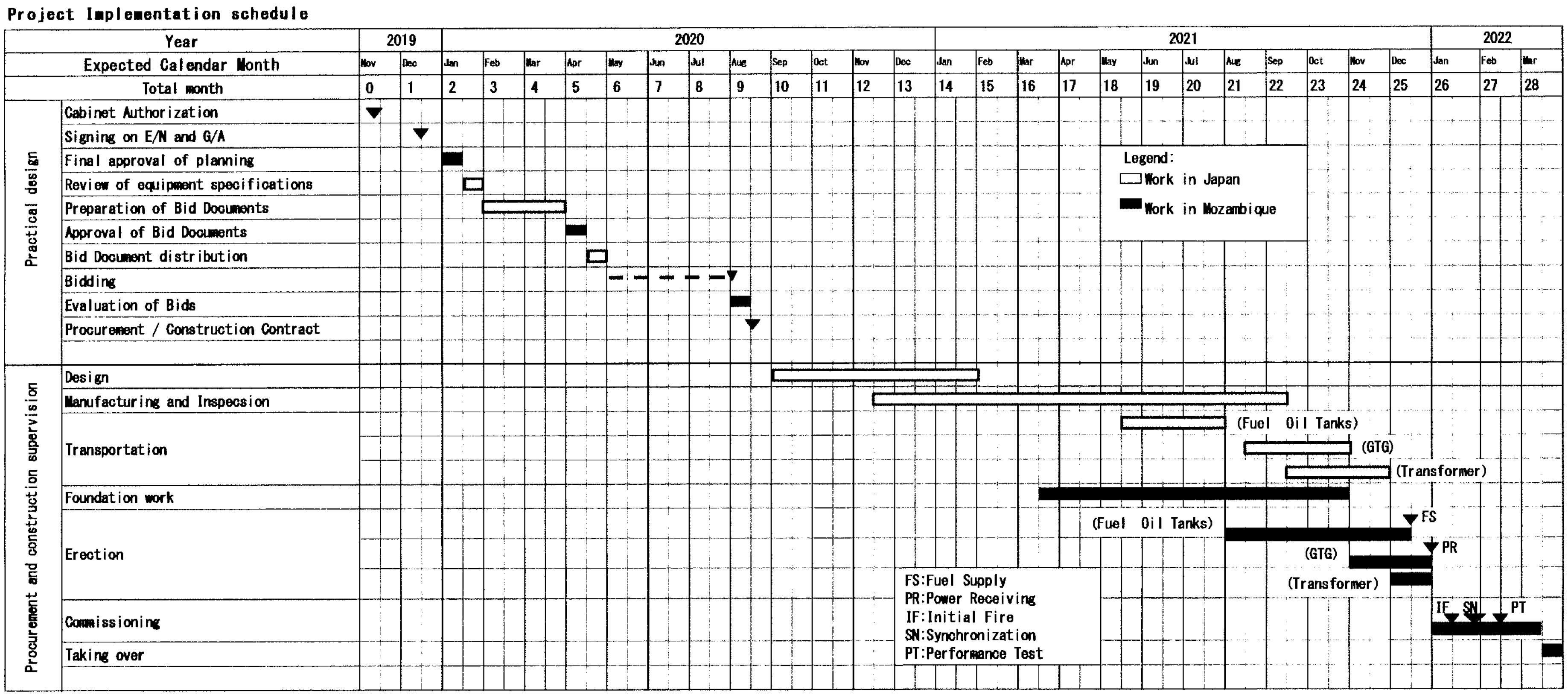
3) Proper Use

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 Project Implementation Schedule】



【Annex 5 Major Undertakings to be taken by the Government of Mozambique】

Specific obligations of the Government of Mozambique which will not be funded with the Grant

(1) Before the Tender

NO	Items	Deadline	In charge	Estimated Cost (1000 US$)	Ref.
1	To open bank account (B/A)	within 1 month after the signing of the G/A	EDM	-	
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)	EDM	-	
3	To obtain the approval of Addendum EIA (Conditions of approval should be fulfilled, if any), obtain Environmental License and secure the necessary budget for implementation including the tax.	before notice of the bidding document(s)	EDM	91.4	
4	To secure and clear the lands (5,490m^2 for emergency power plant, 1,890m^2 for substation facilities.)	before notice of the bidding document(s)	EDM	70.3	
5	To obtain the planning, zoning, building permit	before notice of the bidding document(s)	EDM	-	
6	leveling and reclaiming the sites (9,260m^2 for emergency power plant), and access roads for tank trucks	before notice of the bidding document(s)	EDM	34.9	
7	To submit Project Monitoring Report (with the result of Detail Design)	before preparation of bidding documents(s)	EDM	-	

(2) During the Project Implementation

NO	Items	Deadline	In charge	Estimated Cost (1000US$)	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)	EDM	-	
2	To bear the following commissions to a bank in Japan for the banking services based upon the B/A		EDM	46.2	
	1) Advising commission of A/P	within 1 month after the signing of the contract(s)	EDM		
	2) Payment commission for A/P	every payment	EDM		
3	To ensure prompt unloading and customs clearance at ports of disembarkation in recipient country and to assist the Supplier(s) with internal transportation therein (Mozambique communication network fee)	during the Project	EDM	238.6	
4	To accord Japanese nationals and/or physical persons of third countries (main contractors, subcontractors, supplies and consultants) 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.	during the Project	EDM	-	

	The Recipient implements this project in accordance with Regulation of the Mechanisms and Procedures of Employment of foreign Workers stipulated in article 12 "Investment Projects" on the decree No. 37/2016, August 31, 2016. Working status for the Project shall be preceded as a contract for the investment Project approved by the Recipient Government stipulated in Article 12 on the decree No. 37/2016, August 31, 2016. The possible number of Japanese nationals and/or physical persons of third countries are 22 persons while the number of persons of Recipient country is 15. If the above number of Japanese nationals and/or physical persons of third countries exceed than the Project shall apply for Working Permit Authorization Regime stipulated in article 16, 17, 18 and 19 on the decree No. 37/2016, August 31, 2016.				
5	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 borne by its designated authority without using the Grant	during the Project	EDM	-	
6	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project	during the Project	EDM	13.9	
7	1) To submit Project Monitoring Report after each work under the contract(s) such as shipping, hand over, installation and operational training	every month	EDM	-	
	2) To submit Project Monitoring Report (final)	within one month after signing of Certificate of Completion for the works under the contract(s)	EDM	-	
8	To submit a report concerning completion of the Project	within six months after completion of the Project	EDM		
9	To provide facilities for the temporary road of the project sites	before start of the construction	EDM		
11	To take necessary measure for safety construction - traffic control - public notifications Securing safety for personnel involved in the Project	during the construction			
12	To implement Environmental Management Plan (EMP) and Environmental Monitoring Plan (EMoP)	during the construction	EDM		
13	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	EDM		
14	Refund equivalents of Personal Income Tax(IRPS), Corporate Income Tax(IRPC)	during the construction	EDM	TBD*	

*The amount for Item 14 to be determined during the project implementation.

(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		-	
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	for three years after the Project		-	

	significant negative impacts on the environment are found. The extension of environmental monitoring will be decided based on the agreement between EDM and JICA.				
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 3) Routine check/Periodic inspection	After completion of the construction	EDM	-	

Table- Work Allocation between Japan and Mozambique

No.	Work Items	Japan	Mozambique
1.	Preparation work		
1-1)	Securement of construction site (access roads, temporary storage place for materials, supplies and equipment, office for construction works, parking space)		○
1-2)	Installation of temporary storage places for materials, supplies and equipment and office for construction works	○	
2)	Road surface leveling works for unpaved road running to the Nacala Substation		○
3)	Land improvement and surface leveling of the construction site		○
	1) Measures against inflow of cray and sand from the east side of the Nacala Substation (as needed)		(○)
	2) Removal works for remaining foundations at the former power plant (as needed)		(○)
	3) Removal of existing containers that were temporarily set up		○
4)	Step up transformer and switchgear for protection/control panel		
	1) Removal of existing transformer maintenance building		○
	2) Reinforcement of existing cable trenches		○
	3) Removal of the old control panels located in the existing control room		○
	4)Install the new control and protection panel, connection to the OPS of the gas turbine power plant	○	
5)	Supply of water and installation of a sewerage system (drainage) for operators (as needed)		(○)
6-1)	Preparation of power supply points (connection points in the existing substation) for construction works within the construction area and supply of power (including tariff)		○
6-2)	Installation of facilities to supply power needed for construction works within the construction area (from the connecting points)	○	
7-1)	Preparation of water supply points (connection points in the existing substation) for the construction area and supply of water (including water fee)		○
7-2)	Installation of water supply facilities within the construction area (from the connecting points)	○	
8-1)	Construction of fences and gates at the Nacala Substation (as needed)		○

No.	Work Items	Japan	Mozambique
8-2)	Installation of temporary fences and gates for the emergency power plant construction area	○	
9)	Advance procedures necessary for applying VAT mechanism and exemption of import customs duties. Advance procedures necessary for refunding Prsonal Income Tax(IRPS) and Corporate Income Tax(IRPC)		○
10)	Procedures for acquiring licenses/approvals necessary for the commencement of construction works		○
11)	Acquisition of EIA license prior to the commencement of construction works		○
2.	Emergency power plant facilities installation work		
1)	Installation of equipment, commissioning/test-run, guidance/instruction for initial operation and full-scale operation	○	
	1) Gas Turbine Power Generation Unit (gas turbine, generator, electric equipment and control system)	○	
	2) Fuel oil tanks (fuel tanks and receiver pumps)	○	
	3) Substation facility (transformer, switchgear and protection/control system)	○	
	4) Water treatment facilities (demineralization and wastewater treatment) (as needed)	(○)	
2)	Foundation works for equipment and pile driving (as needed)	○	
3)	Improvement of access roads for transportation of heavy equipments etc.		○
4)	Maintenance and improvement of access roads for such as tank trucks after the construction of the emergency power plant is completed		○
5)	Maintenance and improvement of the area surrounding the equipment within the construction area (external structures, crushed stones, etc.) (as needed)		(○)
6)	Installation of water supply pipes from the water distributing pipe to the construction area (as needed)		(○)
7)	Until equipment handover		
	1) Power blackout within the area where construction will be carried out for the project in order to install 110kV switchgears (including removal of the bus wire and bypassing works)		○
	2) Works to connect to 110kV transmission line		○
	3) Travel costs and hotel and living expenses if attendance at the on-site inspections at the manufacturer's factory is necessary		○
	4) Costs to procure fuel oil and service water (as needed) for the test-run period		○
	5) Securement of a temporary office for the consultant		○
	6) Securement of operation and maintenance personnel for the power plant		○
8)	Operation and maintenance (after equipment handover)		
	1) Procurement of fuel oil and service water (as needed)		○
	2) Personnel costs (operation and maintenance personnel)		○
	3) Maintenance costs (LTSA, etc.)		○

Annex 5

No.	Work Items	Japan	Mozambique
3.	Common items		
1)	Marine transportation from the country where equipment was procured to Mozambique	○	
2)	Works to be implemented for tax exemption and customs clearance at the port of discharge		○
3)	Inland transportation from the port of discharge to the project site	○	
4)	Tax exemption procedures concerning the project implementation		○
5)	Provision of benefits to those concerned on the Japanese side engaged in equipment procurement and facilities construction including benefits related to immigration formalities and tax exemption		○
6)	Implementation of appropriate operation and maintenance after the introduction of equipment and facilities		○
7)	Cost sharing for items not included in the grant aid project (to be borne by the Mozambican government) that may arise during procurement and construction works		○

( ): As needed

【Annex 6 Project Monitoring Report (template) 】

Project Monitoring Report
on
Project Name
Grant Agreement No. XXXXXXX

20XX, Month

Organizational Information

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

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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).

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(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(<u>Confidential until the Bidding</u>)

Components			Cost (Million Yen)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original1),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).

2-8 Gender Mainstreaming

- Plan, Progress and impact on gender related activities during project implementation.
- This item should be filled in if the project is categorized by JICA as 'Gender Equality Project', 'Project Targeting Women' (GIP: Gender Informed Principle), or 'Gender Integrated Projects' (GIS: Gender Informed Significant).

Original gender related activities	Actual gender related activities, issues and Countermeasure(s)
(at the time of original design)	*(PMR)*

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

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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.

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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)

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)
-
-
-

Annex 6
Attachment 6

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%)	

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【Annex 7 Environmental Check List】

Category	Main Check Items	Yes: Y No: N Not Applicable: N/A	Confirmation of Environmental Consideration (Justifications and mitigation measures)
1 Permits and Explanation			
(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process?	Y	EIA reports for this power plant were prepared by local consultants employed during "The Preparatory Survey for Nacala Corridor Transmission & Distribution Network Reinforcement Project" based on the results of that survey.
	(b) Have EIA reports been approved by authorities of the host country's government?	N	EIA reports were submitted to MITADER and approved in April 2017. However, since the Project Outline that was estimated during the preparation of EIA reports, changes were made to the stack height and assumed operation hours, etc. based on this preparatory survey, so MITADER made a request for an Addendum EIA Report to be prepared and for an additional Stakeholder Meeting to be held. It is expected that approval will be acquired for the Addendum EIA report in September after submission to MITADER following the additional Stakeholder Meeting that will be held in August 2019.
	(c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied?	N	The conditions for the approval of EIA reports are "the secure implementation of the mitigation measures stated in the EIA report and in the environmental management plan," and "the payment of the Environmental Permit Tax and acquisition of the Environment Permit." The project operator will comply with this. The Addendum EIA report is expected to obtain approval by September 2019.
	(d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	N	After approval of the EIA reports, an Environment Permit must be obtained after paying the Environment Permit Tax. Before the commencement of this phase of the project, EDM will acquire the Environment Permit.
(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders?	Y	Based on Mozambique's EIA-related laws, explanations were given to local residents during the scoping stage in June 2016 and during the EIA stage in November 2017. In August 2019, an additional Stakeholder Meeting is scheduled to be held based on the details of the Addendum EIA report.
	(b) Have the comments from the stakeholders (such as local residents)	Y	The project operator is responding appropriately to the comments received from stakeholders raised during the explanations given to local residents in 2016 and 2017.

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Category	Main Check Items	Yes: Y No: N Not Applicable: N/A	Confirmation of Environmental Consideration (Justifications and mitigation measures)
	been reflected to the project design?		The project operator will also respond appropriately to the comments received in the additional Stakeholder Meeting that is scheduled to be held in August 2019.
(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	Y	Investigations were conducted into a no implementation of the project, a new location and the current location, and alternatives for the power generation methods.
2 Pollution Control			
(1) Air Quality	(a-1) Do air pollutants, such as sulfur oxides (SOx), nitrogen oxides (NOx), and soot and dust emitted by the power plant operations comply with the country's emission standards?	Y	SOx, NOx, and PM will be emitted in the operation of this power generation facility which uses diesel as fuel. In terms of low-NOx countermeasures, reduction systems will be used such as dry process low-NOx burners or water injection. The concentration of air pollutants in the emitted gases complies with Mozambique exhaust gas standards and IFC/WB EHS guideline values (Thermal Power Plants, 2008).
	(a-2) Is there a possibility that air pollutants emitted from the project will cause areas that do not comply with the country's ambient air quality standards? Are any mitigating measures taken?	N	There is an area with a high elevation to the east of the power plant, and, depending on the wind direction, it is possible that higher concentration of smoke will come from the plant during certain periods. Within a radius of 5 km of the power plant, there are areas with an elevation of 130 m or more, but westerly winds that blow in that direction are exceedingly rare (less than 5% annually). The maximum ground concentration of pollutants from this Project is much lower than the guideline values from Mozambique or the IFC/WB. Also, in the case that future concentrations are calculated not only from the estimate values but also current concentrations, these future concentrations are sufficiently below than the values in Mozambique environmental standards and IFC/WB guideline values. In most areas, the distribution of the concentration contributing to annual average concentrations from the power plant is within pollutant measurement limitation values or similar values, so the impact on the region is limited.
	(b) In the case of coal-fired power plants, is there a possibility that fugitive dust from the coal piles, coal handling facilities, and dust from the coal ash disposal sites will cause air pollution? Are adequate measures taken to prevent the air pollution?	N/A	This power plant is fueled by diesel and it is not a coal-fired power plant.
(2) Water Quality	(a-1) Do effluents including thermal effluents from the power plant comply with the country's effluent standards?	Y	There is no thermal effluent because this power plant does not have a steam turbine. Wastewater containing fuel oil and oil from around the oil lubricating tank will be emitted, as well as domestic wastewater from office employees, but any wastewater that contains oil will be

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Category	Main Check Items	Yes: Y No: N Not Applicable: N/A	Confirmation of Environmental Consideration (Justifications and mitigation measures)
			processed using an oil separator/interceptor installed around the fuel tanks and, after processing in a septic tank, domestic wastewater from office employees will be discharged into Nacala Bay after confirming compliance with the values in Mozambique effluent standards and IFC/WB EHS guideline values. As for NOx countermeasures, in the case of using a dry process low-NOx burner, no regenerated wastewater will be produced, but in the case of using water injection, water treatment (demineralization) measures will be required, which will produce regenerated wastewater. In the case that regenerated wastewater is produced, after neutralization and flocculation, it will be drained into Nacala Bay after confirming compliance with Mozambique effluent standards and IFC/WB EHS (Thermal Power Plants, 2008) guideline values.
	(a-2) Is there a possibility that the effluents from the project will cause areas that do not comply with the country's ambient water quality standards or cause any significant temperature rise in the receiving waters?	N	Based on the above countermeasures, it is not thought that there are any areas that do not comply with Mozambique environmental standards.
	(b) In the case of coal-fired power plants, do leachates from the coal piles and coal ash disposal sites comply with the country's effluent standards?	N/A	This power plant is fueled by diesel and it is not a coal-fired power plant.
	(c) Are adequate measures taken to prevent contamination of surface water, soil, groundwater, and seawater by the effluents?	Y	Effluents will be discharged after being processed so as not to contaminate surface waters, soil/underground water and oceans, etc.
(3) Wastes	(a) Are wastes, (such as waste oil, and waste chemical agents), coal ash, and by-product gypsum from flue gas desulfurization generated by the power plant operations properly treated and disposed of in accordance with the country's regulations?	Y	Waste management/disposal plans, including worker training, will be established in order to reduce waste, promote recycling and prevent inappropriate waste disposal. Paper and iron scraps, etc., will be recycled, while other general waste will be collected/transported/disposed by Nacala-Porto City. All hazardous waste will be transported to permitted locations and disposed based on relevant laws. In this case, disposal will be subcontracted to a specialist processing business that has obtained permission.
(4) Noise and	(a) Do noise and vibrations comply with	Y	The current noise level at the residential area is 58~61dBA in daytime and 51~57 dBA in night

Category	Main Check Items	Yes: Y No: N Not Applicable: N/A	Confirmation of Environmental Consideration (Justifications and mitigation measures)
Vibration	the country's standards?		time, excedding the IFC/WB EHS guideline value (daytime:55dB(A), nighttime:45dB(A)). The future noise levels will be between 40-48 dB(A) in daytime and 51-57dB(A) in nighttime in the residential area, which is 1to 2dBA higher than the current noise level. Therefore, the noise level will comply with the IFC / WB EHS Guidelines (if the current noise level exceeds the guideline value, the future noise level shall not increase by more than 3dBA from the current level by the project contribution). Actually, the residential area is 15m higher than the location of the gas turbine unit and, therefore, actual noise level is expected to be lower than the predicted noise level. Regarding machinery that produces noise/vibrations, in addition to making it as enclosed as possible, low-noise/low-vibration machinery will be used, and operational management will be carried out by means of regular checks. Also, monitoring will be carried out as necessary during nighttime operation, and afforestation will be carried out on the east side of the power plant if necessary.
(5) Subsidence	(a) In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?	N/A	Underground water will not be extracted.
(6) Odor	(a) Are there any odor sources? Are adequate odor control measures taken?	Y	It is possible that odors will be produced in the case that domestic waste is handled inappropriately. Workers will be given thorough guidance about waste separation and collection, and illegal dumping will be prohibited. Also, raw garbage will be collected and stored in a sealed container in order to prevent odors, which will be transported and disposed of regularly by Nacala-Porto City. The production of odors will be prevented due to the implementation of such control measures.
3 Natural Environment			
(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	N	The project site, which is located in Nacala-Porto city, is not in or near any wildlife protected areas.
(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g.,	N	The project site, which is on the site of a full-developed existing power plant, does not encompass primeval forests, tropical rain forests, or ecologically valuable habitats.

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Category	Main Check Items	Yes: Y No: N Not Applicable: N/A	Confirmation of Environmental Consideration (Justifications and mitigation measures)
	coral reefs, mangroves, or tidal flats)?		
	(b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions?	N	Plants and animals including grasses and rodents have been confirmed on the site, but these are generally species that commonly inhabit the surrounding area and no precious plants or animals have been confirmed.
	(c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem?	N/A	The surrounding area is used for manufacturing, residences and services, and there will be no major impact on living things. The fish and benthos living in Nacala Bay are common in the surrounding ocean areas, and there has been no confirmation of precious species, such as coral. For these reasons, it is assumed that there will be no significant impact on ecosystems.
	(d) Is there a possibility that the amount of water (e.g., surface water, groundwater) used by the project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?	N	There will be no intake of coolant because this power plant does not have a steam turbine.
	(e) Is there a possibility that discharge of thermal effluents, intake of a large volume of cooling water or discharge of leachates will adversely affect the ecosystem of surrounding water areas?	N	There will be no intake of coolant and no thermal discharge will be implemented because this power plant does not have a steam turbine. Regarding water pollution in the ocean due to drainage from the power plant, there will be little impact on marine organisms as wastewater treatment will be carried out appropriately.
4 Social Environment			
(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement?	N	The project site, which is on the site of a full-developed existing power plant, will not generate new land appropriation or resettlement.
	(b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement?	N/A	Not applicable

Category	Main Check Items	Yes: Y No: N Not Applicable: N/A	Confirmation of Environmental Consideration (Justifications and mitigation measures)
	(c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Are the compensations going to be paid prior to the resettlement? (e) Are the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?		
(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary?	N	The project site, which is on the site of a full-developed existing power plant, will not generate new land appropriation or resettlement.
	(b) Is sufficient infrastructure (e.g., hospitals, schools, and roads) available for the project implementation? If the	N	Nacala-Porto already has a degree of infrastructure facilities. So as not to affect the use of existing infrastructure facilities, local residents will be employed as workers to the extent possible so as to prevent an influx of workers, etc. from outside the region.

Category	Main Check Items	Yes: Y No: N Not Applicable: N/A	Confirmation of Environmental Consideration (Justifications and mitigation measures)
	existing infrastructure is insufficient, are any plans developed to construct new infrastructure or improve the existing infrastructure?		
	(c) Is there a possibility that large vehicle traffic for transportation of materials, such as raw materials and products will have impacts on traffic in the surrounding areas, impede the movement of inhabitants, and cause any risks to pedestrians?	Y	It is possible that traffic congestion will arise due to an increase in traffic volume during construction, but the number of vehicles will be reduced to the extent possible by studying appropriate transport routes and transport schedules, and by arranging buses for workers. Also, transport routes and transport schedules will be decided upon discussion with the relevant agencies.
	(d) Is there a possibility that diseases, including infectious diseases, such as HIV, will be brought due to the immigration of workers associated with the project? Are adequate considerations given to public health, if necessary?	Y	It is possible that the influx of workers from other areas during construction, including foreigners, will cause a rise in infectious diseases. In the Nacala region, there are many infectious diseases such as HIV/AIDS, but local residents will be employed to the extent possible so as to avoid the risk of spreading infectious diseases from workers from other areas. Also, training/education will be implemented among workers regarding infectious diseases and health, medical facilities and staff will be deployed, and regular health checks will be implemented.
	(e) Is there a possibility that the amount of water used (e.g., surface water, groundwater) and discharge of thermal effluents by the project will adversely affect existing water uses and uses of water areas (especially fishery)?	N	Fishing is being carried out on the west side of the power plant using small trawlers and round-haul nets. There will be no intake of coolant and no thermal discharge will be implemented because this power plant does not have a steam turbine. Regarding water pollution in the ocean due to drainage from the power plant, there will be little impact on marine organisms as wastewater treatment will be carried out appropriately. Even when water injection is implemented as a NOx reduction measure, water demand by this project is limited and is not supplied from rivers, but supplied by the Waterworks Bureau. Therefore, no impact on water use by residents due to water intake is expected.
(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	N	There are no historical, cultural, or archeological heritages on the project site, which is located on the site of a full-developed existing power plant.

Category	Main Check Items	Yes: Y No: N Not Applicable: N/A	Confirmation of Environmental Consideration (Justifications and mitigation measures)
(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	N	There is no scenic spot on the project site, which is located on the site of a full-developed existing power plant.
(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples?	N/A	The project site, which is located on the site of a full-developed existing power plant, will not generate new land appropriation or resettlement. It was confirmed in the study that the area around the site is not being used by ethnic minorities.
	(b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	N/A	Not applicable
(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project?	Y	The laws of Mozambique regarding workplace safety will be complied with when implementing this Project.
	(b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials?	Y	Safety protection equipment such as helmets, safety boots, earplugs and shock protection gear will be provided. In addition, signs will be put in place on hazardous/toxic storage areas.
	(c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.?	Y	Work safety plans will be produced and implemented, including safety training and drills.
	(d) Are appropriate measures taken to ensure that security guards involved in the project not violate safety of other	Y	Regarding security at the power plant, security guards who have undergone the appropriate training will be deployed so as not to violate the safety of people involved in the project/local residents.

Category	Main Check Items	Yes: Y No: N Not Applicable: N/A	Confirmation of Environmental Consideration (Justifications and mitigation measures)
	individuals involved, or local residents?		
5 Others			
(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)?	Y	Noise/vibrations The construction schedule will be managed, the quantity and scale of construction will be standardized, and a temporary fence will be set up with consideration for the impact on residential areas. Low-noise/low-vibration machinery will be used and operational management will be carried out by means of regular checks. In order to restrain the output of noise, large vehicles used to transport machinery and equipment, etc. will be limited to travelling at as low speeds as possible in residential areas. Also, construction will be carried out during the day to the extent possible, and the dismantling of existing facilities/piling work, in particular, will not be carried out at night. Polluted water Polluted water will be processed by setting up a sedimentation tank, and the clear top liquid will be discharged into the sea. Dust/exhaust gases In the dismantling of existing facilities, the area will be protected by dust scattering prevention sheets and the construction area and roads will be regularly sprinkled with water while checking for dust in the strong winds in the dry season. The emission of air pollutants will be restrained by maintaining construction machinery and vehicles through regular checks. Also, investigations will be conducted on the standardization of the construction schedule to the extent possible, and advance considerations made so that there is no unnecessary convergence during the period in which there are many uses of construction equipment and transport vehicles. Waste Basically, waste management/disposal plans, including worker training, will be established in order to reduce waste, promote recycling and prevent inappropriate waste disposal. Paper and iron scraps, etc., will be recycled, while other general waste will be collected/transported/disposed of by Nacala-Porto City. All hazardous waste will be transported to permitted locations and disposed of based on relevant laws. In this case, disposal will be subcontracted to a specialist processing business

Category	Main Check Items	Yes: Y No: N Not Applicable: N/A	Confirmation of Environmental Consideration (Justifications and mitigation measures)
			that has obtained permission.
	(b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce the impacts?	Y	Plants and animals including grasses and rodents have been confirmed on the project site, which is located on the site of an existing fully-developed power plant, but these are generally species that commonly inhabit the surrounding area and no precious plants or animals have been found, so there is almost no direct impact due to the transformation. Air pollutants, noise and vibrations, etc. during construction may have an impact on the growth of plants and the behavior of animals in the area, so necessary countermeasures against air pollutants and noise/vibrations will be taken.
	(c) If construction activities adversely affect the social environment, are adequate measures considered to reduce the impacts?	Y	It is possible that traffic congestion will arise due to an increase in traffic volume during construction, but the number of vehicles will be reduced to the extent possible by studying appropriate transport routes and transport schedules, and by arranging buses for workers. Also, transport routes and transport schedules will be decided upon discussion with the relevant agencies.
(2) Accident Prevention Measures	(a) In the case of coal-fired power plants, are adequate measures planned to prevent spontaneous combustion at the coal piles (e.g., sprinkler systems)?	N/A	The power plant will use diesel as fuel; it is not a coal-fired power plant.
(3) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts?	Y	The project operator will develop and implement a monitoring plan regarding environment items that are considered to have an impact.
	(b) What are the items, methods and frequencies of the monitoring program?	Y	The main items, methods and frequencies are planned as follows. Air pollution ・During construction - SO_2, NO_2 and PM10 will be measured twice during peak construction periods in three residential areas near the power plant ・During operation Continuous observation of SOx, NOx and PM from the duct Water pollution ・During construction - Weekly measurement of TSS, pH, Oil, BOD and number of coliform bacilli, etc., during the rainy season from the spout of the temporary settlement tank

Category	Main Check Items	Yes: Y No: N Not Applicable: N/A	Confirmation of Environmental Consideration (Justifications and mitigation measures)
			・During operation - Measurement of TSS, pH, Oil, BOD and number of coliform bacilli, etc., from drain outlet will be carried out as necessary. Noise ・During construction -The noise level will be measured twice during peak construction periods in three residential areas near the power plant ・During operation -Measurement of the noise level in three residential areas near the power plant will be carried out as necessary.
	(c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)?	Y	The project operator will establish appropriate monitoring systems for organizations, personnel, materials and budgets, etc., as well as their continuity, during both construction and operation.
	(d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	Y	The project operator will regularly make reports to relevant agencies such as JICA and MITADER regarding the implementation status of environmental management plans and environment monitoring.
6 Note			
Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Power Transmission and Distribution Lines checklist should also be checked (e.g., projects including installation of electric transmission lines and/or electric distribution facilities).	N/A	The generated electricity will be supplied to existing nearby substations.
	(b) Where necessary, pertinent items described in the Ports and Harbors checklist should also be checked (e.g., projects including construction of port and harbor facilities).	N/A	Harbor facilities will not be built.
Reference to	(a) If necessary, the impacts to	N	Although the operation of the power plant will produce CO_2, there is no large-scale output from

Category	Main Check Items	Yes: Y No: N Not Applicable: N/A	Confirmation of Environmental Consideration (Justifications and mitigation measures)
Checklist of Other Sectors	transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, and global warming).		the power plant and CO_2 output per kWh will be limited by constructing a high-efficiency gas turbine. For this reason, there will be almost no impact on transboundary issues or climate change.

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【Annex 8 Environmental Management Plan/Environmental Monitoring Plan】

(1) Environmental Management Plan

No.	Potential Impact	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Location	Period	Responsible Institution	**Cost**
Construction									
1	Air pollution	Generation of fine particles from decommissioning work	- Ambient air quality standards (Mozambique) - IFC guideline values for ambient air quality (General 2007)	Prevention of air pollution in the surrounding area	- Anti-dust sheet will be installed to reduce dust generation during decommissioning - Generation of dust due to strong wind will be reduced with periodic watering (dry season)	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
		Exhaust gas from construction machinery and vehicles used for mobilization of equipment			- Conduct periodical maintenance in the construction equipment and vehicles - Distribute construction work within schedule preventing concentration of work in short periods				
		Exhaust gas from construction machinery and vehicles used for mobilization of equipment	—		- Prohibit field burning of waste				
2	Water Pollution	Increase in water turbidity due to rain and soil runoff	- Water quality standards (Mozambique) - IFC/WB EHS guideline values for	Prevention of water pollution of the rivers in the lower reaches of the basin	- Installation of provisional rain catchment course and settling tank	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and	Expenses included in contract cost by Contractor
		Wastewater from concrete			- Installation of a neutralization tank				
		Oily wastewater			- Installation of a provisional oil separator				

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No.	Potential Impact	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Location	Period	Responsible Institution	**Cost**
		Wastewater from the construction site	ambient air quality (General 2007; Thermal 2008)		- Installation of a septic tank and temporary toilets for the workers			Supervision consultants	
3	Waste	Waste such as concrete, or sand containing scrap iron and oil and asbestos containing waste General waste generated in the construction phase (packaging, organic, etc.) Hazardous waste generated in the construction phase (exhausted batteries)	Waste management regulation	Prevention of soil and water pollution, malodors and hygiene issues	- Implement a waste management and disposal plan to be explained to the site workers addressing waste reduction, recycling and inadequate waste disposal - Collection and storage of waste separately at an appropriate location in an appropriate manner - Compliance of regulations related to general waste and hazardous waste and transportation and disposal of waste at permitted area	- Construction area - Villages in the vicinity of the site	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
4	Soil pollution	Leakage of lubricants, fuels and chemicals collected by construction vehicles and other construction equipment	Hazardous material regulation	Prevent soil pollution in the project site	Conduct the lubricants and oils collection in area where soil permeation does not occur (for example, a concrete layer covered soil)	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor

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No.	Potential Impact	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Location	Period	Responsible Institution	**Cost**
5	Noise and vibration	Noise and vibration caused by construction machinery	IFC EHS guideline, noise level values (General 2007)	Reduction of noise level from construction activities	- Using low-noise/low vibration equipment - Perform construction work during daytime, especially piling work - Periodic checks and regular maintenance of construction equipment and vehicles - Optimizing construction schedule	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
		Noise caused by vehicles used for mobilization of equipment and workers			- Limit truck speed, especially around residential areas - Periodic checks and regular maintenance of construction equipment and vehicles - Optimizing construction schedule				
6	Odor	Waste from construction site	Waste management regulation	Prevention of generation of malodors	- Education regarding litter separation and prohibition of illegal dumping - Regarding organic waste, containers with lids will be installed on the site and the waste periodically collected and disposed of by Nacala City waste company	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
7	Sediment pollution	Increase in water turbidity due to rain and soil runoff Wastewater from concrete Oily wastewater Wastewater from the construction site	Same as "2) Water Pollution"	Minimize the impact to sediments in the marine ecosystem	Same as "2) Water Pollution"	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor

No.	Potential Impact	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Location	Period	Responsible Institution	**Cost**
8	Terrestrial ecosystem and rare species	Generation of fine particles from decommissioning work	Same as "1) Air Pollution"	Same as "1) Air Pollution"	Same as "1) Air Pollution"	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
		Exhaust gas from construction machinery and vehicles used for mobilization of equipment							
		Noise and vibration from construction machinery	Same as "5) Noise and Vibration"	Same as "5) Noise and Vibration"	Same as "5) Noise and Vibration"				
		Noise from transportation of workers and supplies							
9	Marine ecosystem and rare species	Increase in water turbidity due to rain and soil runoff	Same as "2) Water Pollution"	Minimize the impact to the aquatic ecosystem by preventing water pollution	Same as "2) Water Pollution"	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
		Wastewater from concrete							
		Oily wastewater							
		Wastewater from the construction site							

No.	Potential Impact	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Location	Period	Responsible Institution	**Cost**
10	Local economy including employment and means of livelihood	- Employment for local residents - Local supply and machinery	-	- Activation of the local economy - Increase the standard of living of the local population	- Employ as many local residents as possible - Use the services (i.e., laundry and catering services, etc.) and products offered by the local community	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
11	Water use	Increase in water turbidity due to rain and soil runoff Wastewater from concrete Oily wastewater Wastewater from the construction site	Same as "2) Water Pollution"	Minimize the impact to fishery by preventing water pollution	Same as "2) Water Pollution"	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
12	Existing social infrastructure and social service	Sewage treatment, schools, medical facilities, housing due to the increase of working population	-	Impact on the usability of the current infrastructure	- Offer employment to local population as much as possible	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor**: EDM and Supervision consultants	Expenses included in contract cost by Contractor
		Increase in traffic due to the increase in the number of vehicles		Mitigation of traffic	- Investigate and coordinate adequate driving route and schedule through negotiation with the related organizations. - Reduction of the number of vehicle by utilizing buses	Road surrounding the construction area			

No.	Potential Impact	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Location	Period	Responsible Institution	**Cost**
13	Unfair distribution of damage and benefit	Employment distribution in the area could be unfair	-	Promote local employment and avoiding a feeling of unfairness within the community	- Present employment opportunities with clearly explained prerequisites	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
14	Conflicts regarding benefits and damage within the region	Conflict between the local population and manpower coming from other regions	-	Cooperation with the local population	- Employ as many local residents as possible - Respect and give education on local habits and traditions - Promote cultural exchange with the local population (for instance, participating in a local event)	Construction area and its surroundings	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
15	Children's rights	Potential increase in child labor due to school abandonment	-	Prohibit child labor	- Prohibit labor contracts with minors - Conduct periodical inspections regarding child labor	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor

No.	Potential Impact	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Location	Period	Responsible Institution	**Cost**
16	Infectious Diseases such as HIV/AIDS	Temporary influx of migrant labor during construction may increase risk of infection	-	Consideration of sanitation of local residents	- Employment of local people as much as possible - Education and training on workers' health care - Deployment of medical facility and staffs - Implementation of periodic medical check-ups	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Education and training: approximately 10.9 million yens (about 100,000USD) Expenses included in contract cost by Contractor
17	Work Conditions (Including Work safety)	Labor accidents involving: - Handling heavy loads - Working at heights - Electric shocks	- Occupational standards established in Mozambique - IFC/WB EHS Guidelines (General 2007)	Labor safety and prevention of health problems	- Prepare a manual for labor accident prevention including safety education and training: - - Provide workers with appropriate protective equipment such as a helmet, safety boots, earplugs, etc. - - Establish clear signs to identify the location of hazardous or toxic material - - Create a "User Manual" for lifting equipment such as cranes	Construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
18	Accidents	Traffic accidents	-	Prevent traffic accidents	- Investigate adequate traffic rules and timing - Compliance with local traffic rules and promote safe driving	Road surrounding the construction area	During construction	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor

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No.	Potential Impact	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Location	Period	Responsible Institution	**Cost**
Operation									
1	Air pollution	Emissions of SOx, NOx, PM generated in the gas turbine	- Mozambique's emission standards - IFC/WB EHS guideline emission standard (Thermal 2008) - Mozambique's ambient air quality standards	Prevention of air pollution in the surrounding area	- Introduction of Low NOx combustion technology to reduce the total emission of NO2 - A continuous emission monitoring system (CEMS) will be installed in the duct, and emissions will be compared with international emissions standards and Mozambique's standards	Power plant	During operation	EDM and environmental consultants	CEMS: approximately 30 million yen (about 270,000USD) Expenses included in contract cost by Contractor
2	Water pollution	Oily water	- Mozambique's effluent standards - IFC/WB EHS guideline effluent standard (Thermal, 2008)	Prevention of marine pollution	Wastewater will be collected, and its related neutralization, sedimentation and oil separator/interceptor will be installed around the fuel tanks. Treated wastewater will be periodically checked against the IFC/WB EHS standards.	Power plant	During operation	EDM and environmental consultants	Expenses included in contract cost by Contractor
		Domestic wastewater	- Mozambique's effluent standards - IFC/WB EHS guideline effluent standard (General 2007)		Wastewater treatment for domestic water will be installed. The treated water will be periodically checked against IFC/WB EHS guideline and Mozambican standard.				

No.	Potential Impact	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Location	Period	Responsible Institution	**Cost**
3	Waste	Hazardous waste from wastewater treatment (sludge, oil)	Waste management regulation	Prevention of inadequate waste disposal	- Implement a waste management and disposal plan to be explained to the site workers addressing waste reduction, recycling and inadequate waste disposal - Collection and storage of waste separately at an appropriate location in an appropriate manner - Compliance of regulations related to general waste and hazardous waste and transportation and disposal of waste at permitted area	Power plant	During operation	EDM and environmental consultants	Operation management expenses by EDM (included in O&M cost)
		Waste from construction site							
4	Soil pollution	Leakage of lubricants, fuels and chemicals collected by construction vehicles and other construction equipment	Hazardous material regulation	Prevent soil pollution in the project site	- Conduct the lubricants and oil collection in area where soil permeation does not occur (for examples, a concrete layer covered soil)	Power plant	During operation	EDM and environmental consultants	Expenses included in contract cost by Contractor
5	Noise and vibration	Equipment generating noise	IFC/WB EHS Guidelines noise level standards (General 2007)	Mitigation of noise from the power plant	- Introduction of low noise type or enclosed type equipment - Maintaining equipment by periodical check - Installation of fence or green area for noise reduction, if necessary	Power plant	During operation	EDM and environmental consultants	Expenses included in contract cost by Contractor
		Equipment generating vibration	—	Mitigation of vibration from the power plant	- Introduction of low vibration equipment - Periodical check of equipment - Reduce vibration by employing strict standards				

No.	Potential Impact	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Location	Period	Responsible Institution	**Cost**
6	Odor	Waste generated from the construction site	Waste management regulation	Prevention of malodors	- Thourough instructions on the separation and collection of waste and prohibition of illegal dumping. - Regarding organic waste, containers with lids will be installed on the site and the waste periodically collected and disposed of	Power plant	During operation	EDM and environmental consultants	Operation manageme nt expenses by EDM (included in O&M cost)
7	Sediment pollution	Oily water Domestic wastewater	Same as "2) Water Pollution"	Minimize the impact to the sediments in the marine ecosystem by preventing water pollution	Same as "2) Water Pollution"	Power plant	During operation	EDM and environmental consultants	Same as "2) Water Pollution"
8	Terrestrial ecosystem and rare species	Emissions of SOx, NOx, PM generated in the gas turbine	Same as "1) Air Pollution"	Maintain conditions for the growth of native plants	Same as "1) Air Pollution"	Power plant	During operation	EDM and environmental consultants	Same as "1) Air Pollution" and "5) Noise and vibration".
		Equipment generating noise Equipment generating vibration	Same as "5) Noise and vibration"	Maintain conditions for the growth of native animals	Same as "5) Noise and vibration"				
9	Marine ecosystem and rare species	Plant wastewater Oily water Domestic wastewater	Same as "2) Water Pollution"	Minimize the impact to the marine ecosystem by preventing water pollution	Same as "2) Water Pollution"	Power plant	During operation	EDM and environmental consultants	Same as "2) Water Pollution"

No.	Potential Impact	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Location	Period	Responsible Institution	**Cost**
10	Local economy including employment and means of livelihood	- Employment for local residents - Local supply and machinery	-	- Activation of the local economy - Increase the standard of living of the local population	- Employ as many local residents as possible - Use the services (i.e., laundry and catering services, etc.) and products offered by the local community	- Village in the vicinity of the site - Power plant	During operation	EDM and environmental consultants	EDM (included in O&M cost)
11	Water Use	Plant wastewater Oily water Domestic wastewater	Same as "2) Water Pollution"	Minimize the impact to fishery by preventing water pollution	Same as "2) Water Pollution"	Power plant	During operation	EDM and environmental consultants	Same as "2) Water Pollution"
12	Existing social infrastructure and social service	Infrastructure bottlenecks (sewage treatment, schools, medical facilities, housing) due to the increase of working population	-	Reduce infrastructure bottlenecks	Employ as many local residents as possible	Power plant	During operation	EDM and environmental consultants	EDM (included in O&M cost)
13	Unfair distribution of damage and benefit	Employment distribution in the area could be unfair	-	Promote local employment and avoid a feeling of unfairness within the community	- Present employment opportunities with clearly explained prerequisites	Power plant	During operation	EDM and environmental consultants	EDM (included in O&M cost)

No.	Potential Impact	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Location	Period	Responsible Institution	**Cost**
14	Work Conditions (including work safety)	Labor accidents involving: - Handling heavy loads - Working at heights	- Occupational standards established in Mozambique - IFC/WB EHS Guidelines (General 2007)	Labor safety and prevention of health problems	- Prepare a manual for labor accident prevention including safety education and training: - Provide workers with appropriate protective equipment such as a helmet, safety boots, earplugs, etc. - Establish clear signs to identify the location of hazardous or toxic material	Power plant	During operation	EDM and environmental consultants	Facility expenses included in contract cost by Contractor and EDM (included in O&M cost)
15	Accidents	Fire	—	Fire prevention and fire extinguishing	- Implement plan to prevent oil leakages - Installation of fire extinguishers - Installation of fire alarm systems - Establishment of fire brigade and training	Power plant	During operation	EDM and environmental consultants	Facility expenses included in contract cost by Contractor and EDM (included in O&M cost)
		Traffic accidents (prevention through periodic inspections)	—	Prevention of traffic accidents	- Investigate adequate traffic rules and timing - Education to promote safe driving	Road surrounding the site			
16	Transboundary effects and climate change	CO_2 emissions	Amount of CO_2 emissions	Reduction of CO_2 emissions per kW	Utilization of high-efficiency gas turbine	Power plant	During operation	EDM and environmental consultants	Expenses included in contract cost by Contractor

(2) Environmental Monitoring Plan

No.	Items	Source of impact	Monitoring parameter	Criteria	Objectives	Methods			Responsible institution	Cost/cost bearing
						Data collection and analysis	Location	Period and frequency		
Construction										

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No.	Items	Source of impact	Monitoring parameter	Criteria	Objectives	Methods			Responsible institution	Cost/cost bearing
						Data collection and analysis	Location	Period and frequency		
1	Air pollution	Dust generated from demolition of the existing facility and earth work Exhaust gas from construction machinery and vehicle	Air quality of the surrounding area (TSP, PM10, SO2, NO2)	- Mozambican ambient air quality standard - IFC/WB EHS guideline, ambient air quality standard (General 2007)	Confirmation of the mitigation measures of air pollution	Analyzing air quality	3 points: Residential area around the power plant	Twice in period where construction activity becomes maximum	**Implementation**: EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
2	Water pollution	Wastewater generated from construction activity	Wastewater (TSS, pH, Oil, BOD, Coliforms, etc.)	- Mozambican effluent standards - IFC/WB EHS guideline, ambient air quality standard (General 2007)	Confirmation of the mitigation measure of water pollution	Evaluation of effect of the mitigation measure of water pollution	1 point: discharge point of temporary sediment basin	Every week during rainy season	**Implementation**: EPC Contractor and Environmental consultants **Supervisor**: EDM and Supervision consultants	Expenses included in contract cost by Contractor
			Seawater where wastewater is discharged (TSS, pH, Oil, BOD, Coliforms, etc.)	- Mozambican sea water quality standards			1 point	Every month in rainy season		
3	Waste	Generation of waste from demolition	Type and volume of waste as well as disposal method	Waste management regulation	Confirmation of mitigation measures	Record of type and volume of waste as well	Contractor's office	Continuously	**Implementation**: EPC Contractor and	Expenses included in contract cost by Contractor

No.	Items	Source of impact	Monitoring parameter	Criteria	Objectives	Methods			Responsible institution	Cost/cost bearing
						Data collection and analysis	Location	Period and frequency		
		of the existing facility and construction activity				as disposal method			Environmental consultants **Supervisor:** EDM and Supervision consultants	
4	Noise and Vibration	Noise from construction machinery and vehicle	Noise level	IFC/WB EHS guideline, noise level standard (General/2007)	Evaluation of effect of the mitigation measures towards noise levels	Measurement using noise level meter	3 points: On the border of the site near the residential areas	Twice in period where construction activity becomes maximum	**Implementation:** EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
5	Work Environment (Including Work Safety)	Labor accidents	- Handling heavy loads - Working at heights - Electric shock	—	Evaluation of effect of the work safety plan	- Record of accidents	Contractor's office	Continuously	**Implementation:** EPC Contractor and Environmental consultants **Supervisor:** EDM and Supervision consultants	Expenses included in contract cost by Contractor
Operation										

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No.	Items	Source of impact	Monitoring parameter	Criteria	Objectives	Methods: Data collection and analysis	Methods: Location	Methods: Period and frequency	Responsible institution	Cost/cost bearing
1	Air pollution	Generation of SOx, NOx, PM from operation of gas turbine	Emission gas (SO_2, NO_2, PM)	- Mozambican emission gas standards - IFC/WB EHS Guidelines (Thermal 2008)	Confirmation of the mitigation measures of air pollution	CEMS (Continuous Emission Monitoring System)	Stack outlet	Continuously	EDM and environmental consultants	- Expenses for CEMS installation (approximately 30 million yen) is included in contract cost by Contractor - Management of CEMS and Measurement is covered by EDM
2	Water pollution	Water discharge from power plant operation	Effluent (TSS, pH, Oil, BOD, Coliforms, etc.)	- Mozambican effluent standards - IFC/WB EHS Guidelines (Thermal 2008)	Confirmation of the mitigation measure of water pollution	Evaluation of effect of the mitigation measure of water pollution	Outlet of discharging point	As necessary	EDM and environmental consultants	EDM (included in O&M cost)
3	Waste	Waste generated from power plant operation	Type and volume of waste as well as disposal method	Waste management regulation	Confirmation of mitigation measures	Record of type and volume of waste as well as disposal method	Power plant	Continuously	EDM	EDM (included in O&M cost)
4	Noise and Vibration	Noise from power plant operation	Noise level	IFC/WB EHS Guidelines (General 2007)	Evaluation of effect of the	Measurement using noise level meter	3 points: On the border of the site	As necessary for the first 3	EDM and environmental consultants	EDM (approximately 600,000 yen).

No.	Items	Source of impact	Monitoring parameter	Criteria	Objectives	Methods			Responsible institution	Cost/cost bearing
						Data collection and analysis	Location	Period and frequency		
					mitigation measures towards noise levels		near the residential areas	years		
5	Work Environment (Including Work Safety)	Labor accidents	Record of labor accidents - Handling heavy loads - Working at heights - Electric shocks	—	Evaluation of effect of the work safety plan	Record of accidents	Power plant	Continuously	EDM	EDM (included in O&M cost)

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【Annex 9 Environmental and Social Monitoring Form】

Construction Phase

Air Quality

Monitoring location: Residential area around the power plant

Relevant lows and guidelines: Ambient Air Quality Standard of Mozambique (Decree No. 67/2010)

IFC/WB EHS General Guidelines (2007)

Monitoring date:

Item	Unit	Baseline	Measured Value (1hr)			National ambient standards (Decree No. 67/2010)	IFC/WB EHS General Guidelines (2007)	Note
			Min	Max	Average			
SO_2	μg/m³	0～784.4				800 (1 hour) 100 (24 hour)	500 (10 min) 125 (24 hour)	Twice in period where construction activity becomes maximum
NO_2		0～563.4				190 (1 hour) - (24 hour)	200 (1-hour) - (24 hour)	
PM_{10}		16.0～905				- (1 hour) 150 (24 hour)	- (1 hour) 150 (24hour)	

Wastewater from Sedimentation Basin

Monitoring location: Discharge point of temporary sediment basin

Relevant lows and guidelines: Wastewater standard of Mozambique (Decree No. 18/2004)

IFC/WB EHS Guidelines for Thermal Power Plants (2008)

Monitoring date:

Item	Unit	Measured Value	National effluent standards (Decree No. 18/2004)	IFC/WB EHS Guidelines for Thermal Power Plants (2008)
pH	—		6 –9	6 –9
TSS	mg/L		50	50
Oil & Grease	mg/L		10	10
Iron	mg/L		1	1
Zinc	mg/L		1	1
Chromium	mg/L		0.5	0.5
Chlorine residue	mg/L		0.2	0.2
Copper	mg/L		0.5	0.5
Lead	mg/L		—	0.5
Cadmium	mg/L		—	0.1
Mercury	mg/L		—	0.005
Arsenic	mg/L		—	0.5

Seawater Quality

Monitoring location: One point around the discharging point

Relevant lows and guidelines: Ambient Air Quality Standard of Mozambique (Decree No. 67/2010)

Monitoring date:

Parameter	Unit	Baseline	Measured value	National seawater quality standard (Decree No. 67/2010)	Note
Suspended solids (SS)		590		ND	Every month in rainy season
Oil		ND		ND	
Color, foul odor or turbid matter		-		ND	
Artificial coloration		-		ND	
Abrasive deposit		-		ND	
BOD5 at 20°C	mg/L	ND		≤ 5	
COD	mg/L	ND		≤ 6	
pH		7.24-7.31		6.5 —8.5	
Aluminum	mg/L	-		1.5	
Ammonia	mg/L	-		0.4	
Antimony	mg/L	-		0.2	
Arsenic	mg/L	-		0.05	
Barium	mg/L	-		1.0	
Beryllium	mg/L	-		1.5	
Boron	mg/L	-		5.0	
Bromine	mg/L	-		0.1	
Cadmium	mg/L	-		0.005	
Lead	mg/L	-		0.01	
Cyanogen	mg/L	-		0.005	
Chlorine residue	mg/L	-		0.01	
Copper	mg/L	-		0.05	
Total chromium	mg/L	-		0.05	
Tin	mg/L	-		2.0	
Phenol	mg/L	-		0.001	
Dissolved iron	mg/L	-		0.3	
Fluorine	mg/L	-		1.4	
Manganese	mg/L	-		0.1	
Mercury	mg/L	-		0.0001	
Nickel	mg/L	-		0.1	
Nitrate	mg/L	-		10.0	
Nitrite	mg/L	-		1.0	
Silver	mg/L	-		0.005	
Selenium	mg/L	-		0.011	
Surface-activating matter	mg/L	-		0.5	
Sulfur (H2S)	mg/L	-		0.002	
Thallium	mg/L	-		0.1	
Uranium	mg/L	-		0.5	
Zinc	mg/L	-		0.01	

ND: Note detected

Waste

Monitoring location: Contractor's office

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Relevant lows and guidelines: Waste management regulation of Mozambique (Decree No. 13/2006)

Monitoring date:

Item	Place of generated waste	Storage amount (Unit: t or kg)	Disposal amount (Unit: t or kg)	Disposal method and place	Remark
					Continuously

Noise

Monitoring location: One point on the site boundary

Two points in the residential area around the power plant

Relevant lows and guidelines: IFC/WB EHS General Guidelines (2007)

Monitoring date:

Location	Baseline	Noise level (Leq)	IFC/WB EHS General Guidelines (2007)	Note
Residential area	41.6 – 67.9		Day: 55 Night: 45	Twice in period where construction activity becomes maximum
Residential area	-		Day: 70 Night: 70	

Working Environment

Monitoring location: Contractor's office

Construction Contents	Inspection Item	Contents	Status	Provision	Remarks
					Continuously

Operation Phase

Emission Gas

Monitoring location: Duct

Relevant lows and guidelines: National Emission Gas Standards (Decree No. 18/2004)

IFC/WB EHS Guidelines for Thermal Power Plants (2008)

Monitoring date:

Fuel (diesel oil or natural gas):

Item	Unit	Measured value		National emission gas standards (Decree No. 18/2004)		IFC/WB EHS Guidelines for Thermal Power Plants (2008)		Note
		Min	Min	Diesel oil	Natural gas	Diesel oil	Natural gas	
NOx	mg/Nm^3			460	320	152	51	Continuously
SOx	mg/Nm^3			2,000	2,000	-	-	
PM	mg/Nm^3			100	100	50	-	

Wastewater (Only If Wastewater Treatment System is installed)

Monitoring location: Wastewater discharging point

Relevant lows and guidelines: National effluent standards (Decree No. 18/2004)

IFC/WB EHS Guidelines for Thermal Power Plant (2008)

Monitoring date:

Parameter	Unit	Measured value	National effluent standards (Decree No. 18/2004)	IFC/WB EHS Guidelines for Thermal Power Plants (2008)	Note
pH	–		6 –9	6 –9	
TSS	mg/L		50	50	
Oil & Grease	mg/L		10	10	
Iron	mg/L		1	1	
Zinc	mg/L		1	1	
Chromium	mg/L		0.5	0.5	
Chlorine residue	mg/L		0.2	0.2	
Copper	mg/L		0.5	0.5	
Lead	mg/L		—	0.5	
Cadmium	mg/L		—	0.1	
Mercury	mg/L		—	0.005	
Arsenic	mg/L		—	0.5	

Waste

Monitoring location: Power plant

Relevant lows and guidelines: Waste management regulation of Mozambique (Decree No. 13/2006)

Monitoring date:

Item	Place of generated waste	Storage amount (Unit: t or kg)	Disposal amount (Unit: t or kg)	Disposal method and place	Remark
					Continuously

Noise

Monitoring location: One point on the site boundary

Two points in the residential area around the power plant

Relevant lows and guidelines: IFC/WB EHS General Guidelines (2007)

Monitoring date:

Location	Baseline	Noise level (Leq)	IFC/WB EHS General Guidelines (2007)	Note
Residential area	41.6 – 67.9		Day:55 Night: 45	As necessary for the first 3 years
Residential area	-		Day: 70 Night: 70	

Working Environment

Monitoring location: Power Plant

Construction Contents	Inspection Item	Contents	Status	Provision	Remarks
					Continuously

【Annex 10 Project Cost Estimation】

Not to be disclosed until the construction/procurement contractor agreement is approved.

5. Reference

Reference-1 Status of rainwater drainage facility in Nacala substation

Reference-2 Topographical survey results on Nacala substation

Reference-3 Ground study results (extract) on Nacala substation

Reference-4 Specifications of fuel oil for Nacala substation gas turbine

Reference-5 Specifications of tap water quality of Nacala substation

Reference-6 Drainage standards (thermal power plant) of Nacala substation

Reference-7 Access routes from Nacala Bay to the project site

Reference-8 Status of sediment inflow to Nacala substation

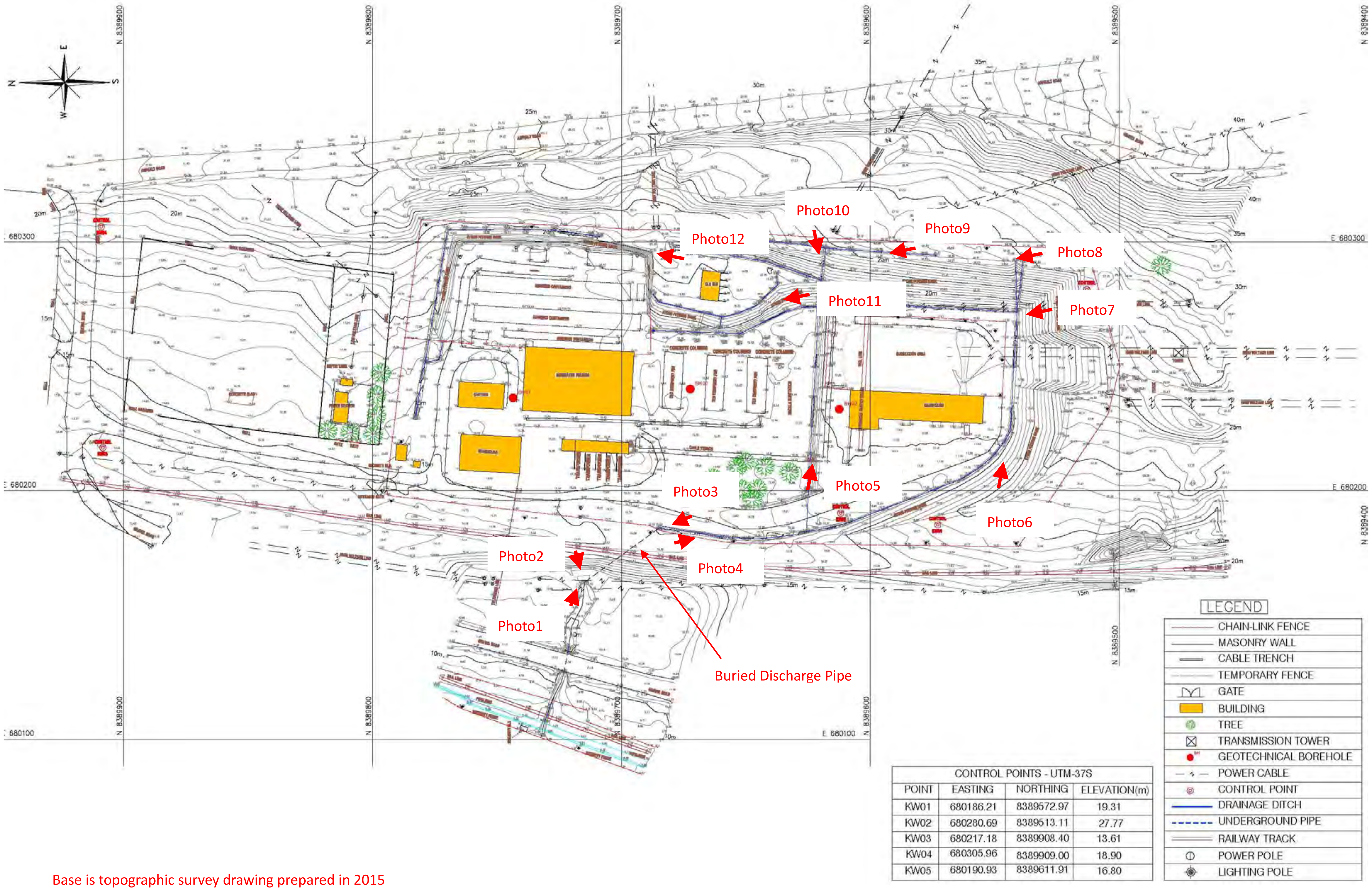
Reference-1: Existing Storm Water Drainage System in the Nacala Substation

On 25th April 2019, the existing storm water drainage system in the Nacala substation was investigated. Storm water is collected by drainage channels sufficiently arranged in the substation, and discharged to the sea through buried discharge pipe from west side of the substation.
EDM stated that the substation has never been flooded due to heavy rains and cyclones in the past. Therefore, it is considered that the existing storm water drainage system is functioning well.

However, it was found that drainage channel located at eastern edge of the substation was damaged due to the heavy rain occurred in 2018.

Currently no soil is flowed into the area where new emergency power plant is planned, however, this soil erosion problem needs to be promptly resolved by local related authorities.

Existing Storm Water Drainage System in the Nacala Substation



CONTROL POINTS - UTM-37S			
POINT	EASTING	NORTHING	ELEVATION(m)
KW01	680186.21	8389572.97	19.31
KW02	680280.69	8389513.11	27.77
KW03	680217.18	8389908.40	13.61
KW04	680305.96	8389909.00	18.90
KW05	680190.93	8389611.91	16.80

Base is topographic survey drawing prepared in 2015

Photo1: Discharge point of buried discharge pipe

Photo2: Drainage channel from buried discharge pipe to the sea

Photo 3: Drainage pipe at west side of the substation

※Storm water collected by drainage channels in the substation is drained into the sea from this point.

Photo4: Drainage channel at west side of the substation

Photo 5: Drainage channel at north side of the existing substation equipment

Photo 6: Drainage channel at south side of the existing substation equipment

Photo 7: Drainage channel at east side of the existing substation equipment

Photo 8: Drainage channel at eastern edge of the substation

Photo 9: Drainage channel at eastern edge of the substation

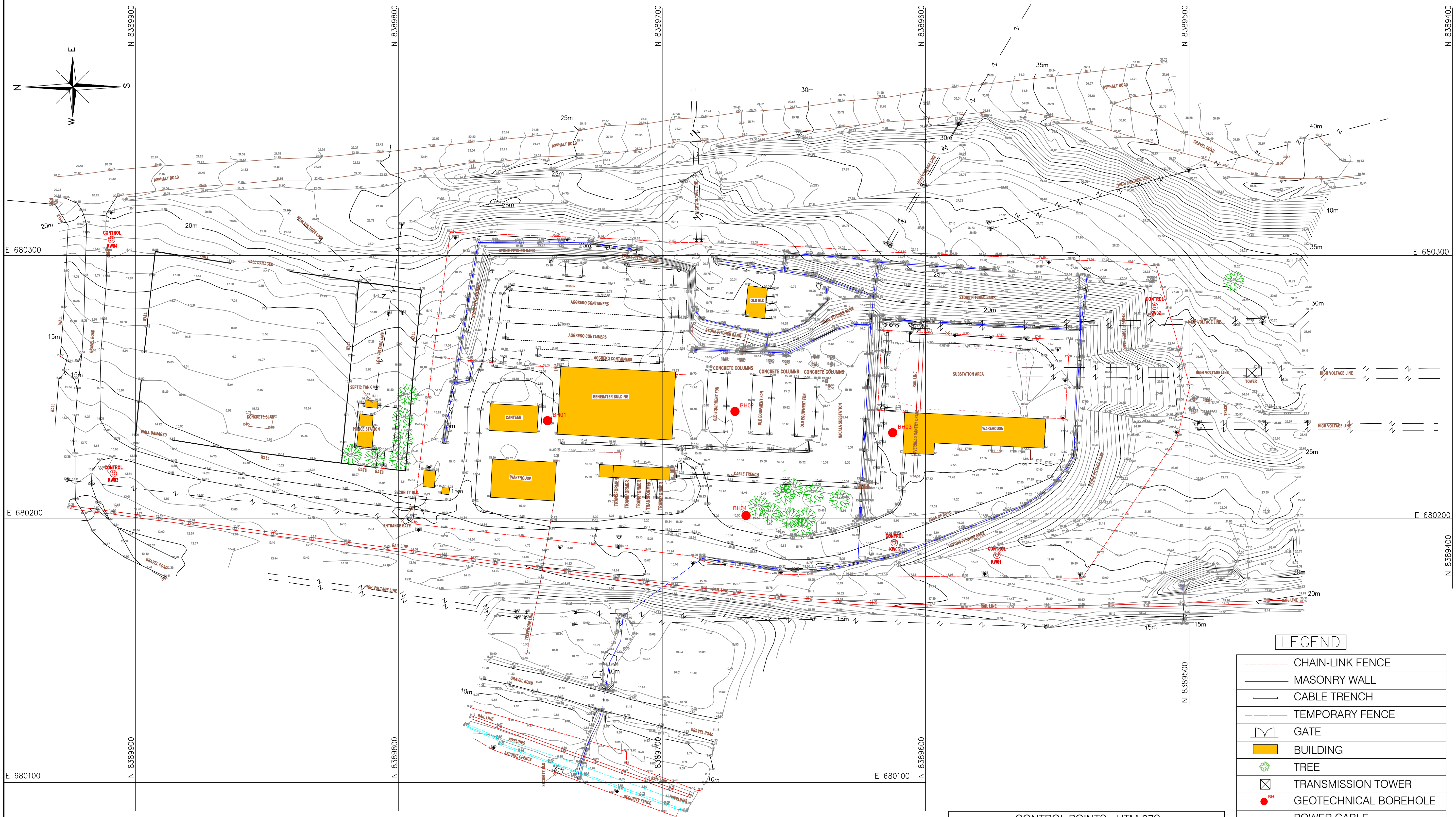
Photo 10: Drainage channel at north side of the substation equipment

Photo 11: Drainage channel at eastern edge of the substation

Photo 12: Drainage channel at eastern edge of the substation

* There is no damage to the channel, however, there are some soils flowed into the channel.

Reference-2: Topographic Survey of the Nacala Substation



LEGEND

	CHAIN-LINK FENCE
	MASONRY WALL
	CABLE TRENCH
	TEMPORARY FENCE
	GATE
	BUILDING
	TREE
	TRANSMISSION TOWER
BH	GEOTECHNICAL BOREHOLE
	POWER CABLE
	CONTROL POINT
	DRAINAGE DITCH
	UNDERGROUND PIPE
	RAILWAY TRACK
	POWER POLE
	LIGHTING POLE

CONTROL POINTS - UTM-37S

POINT	EASTING	NORTHING	ELEVATION(m)
KW01	680186.21	8389572.97	19.31
KW02	680280.69	8389513.11	27.77
KW03	680217.18	8389908.40	13.61
KW04	680305.96	8389909.00	18.90
KW05	680190.93	8389611.91	16.80

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REV	DATE	DESCRIPTION

DATE	JUNE 2015
DESIGNED	Kevin Walsh
DRAWING	Kevin Walsh
CALCULATED	----
APROVED	JWM

CLIENT	ORIENTAL CONSULTANTS GLOBAL Co., Ltd.
PROJECT	PREPARATORY SURVEY ON NACALA CORRIDOR TRANSMISSION & DISTRIBUTION NETWORK REINFORCEMENT PROJECT

DRAWING	P605-NS-01
PROJECT Nº	P605
SUBJECT	TOPOGRAPHIC SURVEY - NACALA SUBSTATION
SCALE	1:1000 / A2

1/1

PREPARATORY SURVEY ON NACALA CORRIDOR TRANSMISSION & DISTRIBUTION NETWORK REINFORCEMENT PROJECT IN THE REPUBLIC OF MOZAMBIQUE

GEOTECHNICAL SURVEY REPORT

FINAL REPORT

PREPARED FOR

Oriental Consultants Global

PREPARED BY

tecnica ENGENHEIROS CONSULTORES LDA.

October 2015

Contents

Preparatory Survey on Nacala Corridor Transmission & Distribution Network Reinforcement Project

GEOTECHNICAL SURVEY REPORT

1. Introduction

Oriental Consultants Global Co, Ltd has appointed TÉCNICA Engenheiros Consultores, Lda to perform geotechnical survey for the Preparatory Survey on Nacala Corridor Transmission & Distribution Network Reinforcement Project. The scope of works of this assignment refers to geotechnical investigation of four site locations through borehole drilling. In total seven boreholes were expected namely:

- Nacala substation (4 boreholes)
- Monapo substation (1 borehole)
- Nampula central substation (1 borehole)
- Nampula 220 substation (1 borehole)

The purpose of these services is to provide information on the site conditions such as:

- Geomorphology;
- Subsurface soil and rock condition;
- Ground water levels;

And to propose geotechnical engineering recommendations relative to:

- Geotechnical design parameters
- Foundations
- Excavations
- Slope protection
- Reuse of soils

2. Methodology for the field investigation

2.1 Location of boreholes

The location of boreholes was set out by the topographic survey team, on the client's indicated positions. Horizontal coordinates are connected to the UTM National Grid System, Moznet. The elevations are referred to the mean sea level.

2.2 Borehole drilling

Borehole was done by rotary drill using self-propelled drill rigs.

2.3 Ground water levels

Ground water levels were recorded during and after the drilling.

2.4 Recovery of samples and cores

2.4.1 SPT tests and sampling

SPT tests were done at every 1,0m as specified. Samples were collected and taken to laboratory for testing.

2.4.2 Undisturbed samples

Undisturbed samples were taken using Shelby tubes at 5.00 m interval and at change in strata as specified. The top ends of tubes were sealed with wax and the tubes covered by aluminium film and wrapped in plastic bags. Samples were taken to laboratory for testing.

2.4.3 Disturbed samples and cores

Disturbed samples and cores were collected and stored in log boxes. Boxes were labelled and photographs taken for testimonials. Field logging was performed.

2.5 Photographic records

A comprehensive photographic record of the used proceedings for boring and sampling is presented in Appendix 1.

Through ought the drilling process photographs of boxes, SPT samples and log boxes were taken for testimonials. The representative photographs are presented with the respective logs of each site.

3. Geomorphology of the sites

As described in section 1 above, the geotechnical survey was performed in the cities of Nacala Porto, Monapo and Nampula. In this section we will present the geomorphology of each city area.

3.1 Geomorphology of Nacala

The geology of the Nacala region can be subdivided into four blocks namely (1) the Marrupa + Ocua block in the NW corner, (2) the coastal block comprising the sediments and volcanics deposited during and after Gondwana breakup, (3) the Monapo Complex, a crudely circular structural klippen in the central SE part of the map and (4) the Nampula Complex which underlies the remaining areas. The Nampula Complex comprises the Mocuba Suite, the Culicui Suite, the Mamala Gneiss, the Molocue Group and Rapale Gneiss.

The region under study belongs to coastal cover rocks containing the ~178Ma old Angoche Andesites at the base followed by Mesozoic to Cenozoic age sediments comprising interlayered siltstones, mudstones, sandstones, calcarenites and limestones. These sediments have been deposited under conditions of numerous transgressions and regressions of sea levels. The relatively linear western contact of the Mesozoic to Cenozoic deposits implies a faulted margin implying they have probably been deposited in a rifted setting. It is uncertain whether the floor rocks beneath the Mesozoic rocks comprise continental basement or sea-floor basalts.

Figure 1. Geological map of Nacala area

The area under study is characterized by sediments (Qst). Mangroves become established in permanently saturated and anaerobic estuarine alluvium rich in silt and clay, terrestrial and marine organic matter and shells. Bacterial action on shells results in breakdown and release of calcareous components and ions, which saturate the exchange complex on clays, reducing the uptake of sodium by the substrate. The dark color of mangroves is due to the organic content, and to reduction of ferric iron compounds to hydrated ferrous sulphides. The tangled mass of mangrove roots and pneumatophores reduce current strength and encourage settling of suspended fines from water, resulting in accretion of the mangrove community substrate and progradation of the shoreline. The tidal interface within estuaries creates greater species zonation patterns extending many kilometres up low gradient rivers (Spalding et al.1997). Detailed maps of the geomorphology of Nacala area are presented in Appendix 2.

4. Logging results

The logging will be presented individually for each site.

4.1 Nacala Substation site

As described above, four boreholes were drilled at Nacala Substation. The site location layout along with the positioning of the boreholes and respective logs summary are presented in subsections bellow whereas the detailed logs and respective testimonial photographs are presented in Appendix 3.

Initially TÉCNICA appointed Geodrill to perform the works at Nacala Substation who started drilling on the 3rd of June 2015. However, Geodrill's drilling rig faced constant breaks and work was abandoned the day after. As alternative Geocontrole was then appointed, which started drilling on the 15th of June 2015 and finished on the 25th of June 2015.

4.1.1 Site location

The Nacala substation is located in the city of Nacala Port, on the eastern shore of the Nacala Bay, 3km away from the city center. The site location layout is shown in the following figure 4. Coordinates of the positioning of boreholes are presented in subsection 4.1.2.

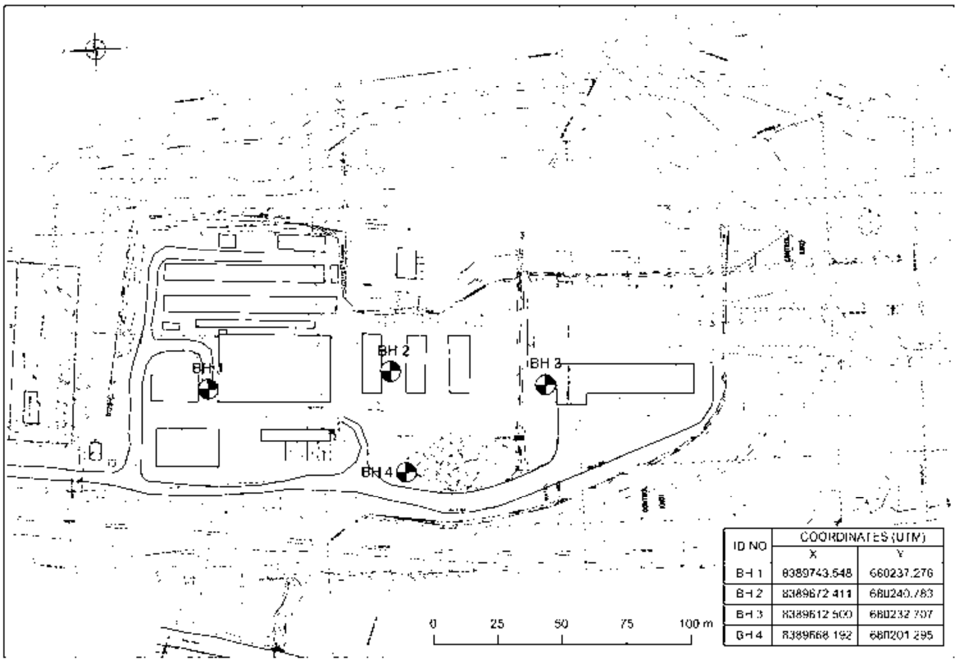

Figure 4. Location of Nacala substation and layout of boreholes

4.1.2 Drilling results

A summary of the drilling results for the four boreholes along with relevant information on positioning, ground water levels, period of drilling and others is presented in the following table 1. As referred to above, borehole logs along with testimonial photographs for the Nacala substation site are presented in Appendix 3.

Table 1 - Summary of Drilling Results for Nacala Substation

Boreholes	Coordinates (UTM)		Elevation (m)	Boxes	Drilling Rock (m)	Drilling Soil (m)	Total Depth (m)	Case Depth (m)	Number of SPT	Number of Shelby	Watel Level (m)	Inclination (C°)	Found Rock (m)	Performing date	
	x	y												Start	Finish
BH1	8389743.548	680237.276	15.36	5	12.60	7.40	20.00	13.00	7	1	2.00	90°	7.40	25-Jun	26-Jun
BH2	8389672.411	680240.783	15.53	5	12.00	8.00	20.00	10.00	8	1	2.20	90°	8.00	15-Jun	18-Jun
BH3	8389612.500	680232.707	17.69	5	14.40	5.60	20.00	15.00	5	1	3.45	90°	5.60	22-Jun	24-Jun
BH4	8389668.192	680201.295	15.58	5	8.70	11.30	20.00	9.00	9	2	4.00	90°	11.30	19-Jun	22-Jun
TOTAL for the site				**20**	**47.70**	**32.30**	**80.00**	**47.00**	**29**	**5**					

5. Laboratory testing

5.1 Descriptive explanation

In compliance with the Contract Terms of Reference the following laboratory tests were performed:

a) Physical properties (for disturbed and undisturbed samples)

- Moisture content
- Specific gravity
- Sieve analysis
- Atterberg Limits

b) Mechanical properties (for undisturbed samples)

- Triaxial Tests, to evaluate the Angle of internal friction ϕ and cohesion, Cu

Tests were performed under ASTM.

As far as the Triaxial tests are concern it was not possible to recover undisturbed samples of some boreholes due to the type of material. For instance, in Nampula Central, the sample at 5.0-5.4m was of coarse cohesion-less soil as can be seen in figure 8 bellow.

Figure 8. Undisturbed sample of Nampula Central at 5.0m

In Nampula 220 site, Shelby samples at 5.0m and at 15.0m could not be recovered. In the first the material had a little clay content; and in the later the material was very stiff. The following figures 9 and 10 show both cases.

Figure 9. Undisturbed sample at 5.0m in NPL Central

Figure 10. Undisturbed sample at 15.0m in Nampula Central

We also found that Shelby samples of Nacala boreholes were of very stiff material that could be disturbed during the extraction process.

5.2 Synthetic results

Laboratory test results for each borehole were summarised onto tables enabling the visualisation of the ground properties as an all. These tables are presented in Appendix 7.

5.3 Engineering analysis

The engineering analysis of test results for each site and borehole in particular was performed based on test results along with supporting information from the literature. In the case of SPT test results, BS 5930 establishes following relationship between N-value and the relative density of a soil:

Table 5. Relationship between N-value and relative density of a soil.

N-Value (blows/300mm of penetration)	Relative density
Below 4	Very loose
4-10	Loose
10-30	Medium – dense
30-50	Dense
Over 50	Very Dense

Soils were classified under ASTM D2487-06, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

Especial attention was paid to the interpretation of Atterberg limits in order to evaluate clay soils. Burmister developed a useful tool for identification of composite clay soils, on the basis of overall plasticity, which is presented in table 6 bellow.

Table 6. Identification of composite clay soils on Basis of Overall Plasticity

Degree of Overall Plasticity	PI	Identification (Burmister System)
Nonplastic	0	SILT
Slight	1-5	Clayey Silt
Low	5-10	SILT and CLAY
Medium	10-20	CLAY and SILT
High	20-40	Silty CLAY
Very high	≥40	CLAY

An important parameter to evaluate in cohesive soils is the linear shrinkage which a way for identification of expansive soils. Table 7 bellow shows the relationship between linear shrinkage and expansive rating.

Table 7. Relationship between linear shrinkage and expansive rating

Category	Linear Shrinkage (%m/m)	Expansive Rating
Low	0-12	Non critical
Medium	12-17	Marginal
High	17-22	Critical
Very High	> 22	Very critical

The Engineering analysis of the laboratory test results is presented in the following sub sections.

5.3.1 Nacala substation site

a) Borehole BH1

Water level was found at 2.0m deep.

The top layer of 1.0 m thickness is made of loose clayey mixed sands with medium plasticity (PI = 12.4)

From 1.0 m deep there is a sand clayey formation varying in relative density: the top meter is still loose with low plasticity, followed by a strata of 2.0 m of medium – dense composition, the final 3.5 m of this formation is very dense. Both medium dense and very dense layers have medium plasticity. Soils in this borehole do not show shrinkage troubles.

Weathered sandstone was found from 7.5 m to the end of the borehole at 20.0m deep.

b) Borehole BH2

Water level was found at 3.0m deep.

The top layer of 1.0 m thickness is made of loose clayey mixed sands of low plasticity.

From 1.0 m till 11.5 m deep there is sand clayey of medium plasticity. As far as relative density is concern, this formation is loose for about 3 m thickness, followed by 3m of medium dense material and other by 4.5 m of very dense soil. Similarly to BH1 soils in this borehole do not show shrinkage troubles.

Weathered sandstone was found from 11.5 m deep to the end of the borehole at 20.0 m.

c) Borehole BH3

Water level was found at 1.0m deep.

The top layer of 1.0 m thickness is made of very dense clayey mixed sands of medium plasticity suggesting that this layer was compacted.

From 1.0m deep down to 8.0 m there is a sand clayey formation also of medium plasticity. As far as relative density is concern, this formation is medium dense in the top 1.0m, followed by 6m of very dense strata. Similarly to BH1 and BH2 soils in this borehole do not show shrinkage troubles.

Weathered sandstone was found from 8.0 m deep to the end of the borehole at 20.0m.

d) Borehole BH4

Water level was found at 2.0 m deep.

The top layer of 1.0 m thickness is made of loose clayey mixed sands of medium plasticity. The following layer is of about 4.0 m thickness of sand clayey with low to medium plasticity, varying in relative density: the first half is loose whereas the bottom half is medium dense.

From 5.0 m deep there is a clay formation of 6m of high plasticity. As far as relative density is concern, the top 2.0 m of this formation is dense, followed by 4.0m of very dense strata.

Despite the fact that there is clay of high plasticity, available results of linear shrinkage do not reach critical values; therefore the expansive rating for this clay is still marginal for building construction purpose.

Weathered sandstone was found from 11.0 m deep to the end of the borehole at 20.0m.

6. Geotechnical interpretation

6.1 Design parameters

Unfortunately, mechanical tests on undisturbed samples did not offer reliable results of internal friction and cohesion, apart from the ones for Nampula 220 site on which the results seems to be correct. For this reason, design parameters had to relay on correlation formulas that take into account N values of SPT tests as described in detail in the following sub section 6.2. Engineering recommendations for foundations.

6.2 Recommendations for foundations.

6.2.1 Introduction

This recommendation is issued in the framework of the sub-contract between Oriental Consultants Global from Japan and Técnica-Engenheiros Consultores from Mozambique, for Geotechnical and Topographic Survey for Preparatory Survey on Nacala Corridor Transmission & Distribution Network.

6.2.2 Nacala substation site

Available information:

- Logs of Boreholes BH1, BH2, BH3 and BH4
- Information on Soil Testing on undisturbed samples issued by Geocontrole.

On the expected loading

The information provided is that at this site a power station will be built. The foundations will carry “heavy dynamic loads”. No quantification is available both in terms of static and dynamic load and their characteristics at this stage.

Additionally there will be other foundations to be built in the Nacala Central Area. The loads and foundation types are shown in the Appendix 9.

Brief Characterization of the Site

On the base of the logs and the test results available it is possible to conclude the following:

a) The groundwater level was at about 2 m below ground level, when drilling took place. In the rainy season it is expected that the groundwater level rises even further
b) In geological terms the site is a sedimentary formation and the sequence of layers is basically:

- Up to 1,0 m of fill – sandy material
- A layer of thickness varying from about 7.5m to 11 m of soil. These soils are typical of a deposition in a marine environment and were identified as SC, ML and CH – therefore it is concluded that the formation is heterogeneous in terms of grain-size and plasticity

c) The analysis of SPT-values indicates that the soil strength increases with depth. With the exception of BH3, the mark of 60 blows per 30 cm or less at depths ranging from 6m in BH1 to 8m in BH2 and BH4. In BH3 already at depth 1.5 m the N_{SPT} = 60.

d) Below the soils there is a layer of weathered, fractured, fine grained sandstone starting from a depth of 7.5 m in BH1 to 11.0 m in BH4.

Recommendation on foundation type

Due to the high groundwater level, the heterogeneity of the soil layers both in terms of composition and strength on one side and the fact that one of the foundations will carry heavy dynamic loads on the other side, a shallow foundation is not recommended.

Instead it is suggested to build a raft foundation on piles. It is further suggested to take the piles up to the sandstone layer and the penetration length in the sandstone to be in the order of 3 times the diameter of the pile.

If a 620 mm bored cast in situ concrete pile is used it is considered that the skin friction will be neglected in these soils. The pile will then be of the type "end bearing"

The layer where the pile will be supported shows a SPT "N-Value" of about 60. Therefore from Fig. 1 of Appendix 8, the equivalent qc will be 24 MPa. A factor of 10 will be used to obtain the base resistance

$q_{allowable} = q_c /10 = 2.4$ MPa.

The cross section area of the pile is 0.3017 m2. Therefore the static load on the pile should not exceed 2.4 x 0.3017 = 0.724 KN.

As the skin friction of the pile was not taken into consideration and the depth of penetration (3 x pile diameter) in the load bearing layer was not accounted for, the final resistance of the 620 mm pile will be higher. The effects of the dynamic load on the pile (or piles) will not cause overstressing neither of the pile nor of the load bearing layer if the dynamic factor is in the order of 1.3.

The smaller static loads can be transferred to the soil by means of shallow foundations. It is suggested to take the foundations structures to a depth of 2.0 m.

A safe bearing capacity of 120 kPa is acceptable, in general. If the buildings or structures are not sensitive to differential settlement the safe bearing capacity could be increased to 150 KPa. Under these loads, the long term settlement of the structures will not exceed 30 mm.

For reference, see the Appendix 8, Fig.2, that correlates SPT "N-value" with the allowable bearing pressures. This chart was initially developed for sands, being the 25 mm the limiting settlement. In the present case, soils show cohesion that increases the bearing capacity.

6.3 Recommendations on excavations

These recommendations are meant to provide guidelines for excavation works on each site. In general any excavation works should take into account factors that interfere with the stability of the slopes, which include:

- The type of soil or rock;
- The ground water level;
- The length of time on which the excavation is required to remain open;
- The permissible degree of risk of slipping.

In regards the type of soil, two major groups should be considered as far as excavation is concern: cohesive soils and cohesionless soils. In both cases the presence of ground water is determinant for the stability of the slopes.

Tomlinson describes that an open excavation in normally consolidated clay soil will stand vertically without support provided that the height of the face does not exceed the critical height. The following theoretical critical heights for clays of various consistencies were considered:

Table 8. Critical heights for clays

	Very Soft	Soft	Firm
Cohesion (KN/m2)	0-17.5	17.5-35.0	35.0-70.0
Critical height (m)	4	4-8	8-18

In general, due to safety measures, unsupported vertical faces of open excavations are only allowed up to 1.5m deep.

The presence of ground water will affect negatively the slope of excavations, as some clays tend to slid as a result of removal of lateral pressure by excavation.

In the case of cohesionless soils they can stand at slopes equal to their natural angle of repose. Dense sands can have 1:1 slopes, however loose sands may stand on 1:2 slopes.

Attention shall also be paid to rocks, which might not stand on vertical slopes especially on unsound rocks.

6.3.1 Nacala substation site

The presence of ground water at high level in Nacala substation site is a major challenge for the excavation on the soil strata. Open excavation shall only be performed at soft slopes, which would affect the size of the excavation as going deep.

6.4 Recommendations on reuse of soils

The intention of these recommendations is to provide guidelines on the destiny of soils resulting from the excavations.

6.4.1 Nacala substation site

As described before, Nacala substation is characterized by cohesion soils, which do not offer major trouble during the construction as far as shrinkage is concerns. However, soils were classified as being within the range of marginal to critical expansive rating, therefore we do not recommend the reuse of sand clayey soils on the site.

We would recommend the use of excavated soils from Nacala substation to be given to the Municipality to cover dumping sites.

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CERTIFICATE OF QUALITY

Client	IMOPETRO
Product	GASOIL 50 PPM
Sample Origin	SAMCOL SHORE TANK 401 AFTER 1ST DISCHARGE MT ZHUJIANG

Sampling Method	ASTM D4057	Sample Number	02/2018/445
Date Sampled	28/02/2019	Time Sampled	10:35H
Date Tested	29/03/2019	Time Tested	11:40H
Batch Number	N/A	Order Number	COA 0129
Weather Condition	CLEAR	Client Reference	5.17 01 18.5°
Intertek Job No.	MZ-01150 00000052 2019		

TEST DESCRIPTION	METHOD	SPECIFICATION	RESULT
Appearance	Visual	Bright and Clear	Bright and Clear
Ash, %mm	ASTM D482	Max 0.01	*0.000
Cetane Index	ASTM D976	Min 45.0	54.5
Cloud Point, °C	ASTM D2500	Max 2	*2
Copper Corrosion, 3hrs @100 °C	ASTM D130	Max 1	1a
Density @ 20 °C, Kg/l	ASTM D1298	Min 0.8150 – Max 0.8470	0.8304
Density @ 15 °C, Kg/l	ASTM D1298	Report	0.8339
DISTILLATION (°C)			
90% Recovered	ASTM D86	Report	335.5
95% Recovered		Max 360	351.0
FBP		Report	359.0
Electrical Conductivity @ 27.8C, pS/m	ASTM D2624	Min 100	121
Flash Point (°C)	ASTM D93	Min 60	74.0
Ramsbottom on 10% Dist Residue	ASTM D524	0.2 Max	*0.05
Kinematic Viscosity@40°C, cSt	ASTM D445	Min 2.200- Max 4.500	3.614
Total Acidity, mgKOH/g	ASTM D974	Max 0.08	*0.05
Sulphur, mg/kg	ASTM D4294	Max 50	*11
Water Content, mg/kg	ASTM 6304	Max 200	20.4

The above product meet clients' specifications.

*Tests outsourced to Intertek Maputo Laboratory.

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Assurance Testing Inspection Certification
Laboratory Supervisor
Cargo & Analytical Assessment
Date 29 03 2019

MZ120-0007239

Analysis Report: BE19-00103.001

Date: 21/Jun/2019
EDM - ELECTRECIDADE DE MOCAMBIQUE, EP
AV. AGOSTINHO NETO, NR. 70
MAPUTO - MOZAMBIQUE

The results shown in this test report specifically refer to the sample(s) tested as received unless otherwise stated. All tests have been performed using the latest revision of the methods indicated, unless specifically marked otherwise on the report. Precision parameters apply in the determination of the below results. Users of analytical results, when establishing conformance with commercial or regulatory requirements should note the full provisions of ASTM D3244, IP 367 and ISO 4259 in that context, the default confidence level of petroleum testing having been set at the 95% confidence level. Your attention is specifically drawn to Sections 7.3.6., 7.3.7 and 7.3.8 of ASTM D3244. With respect to the UOP methods listed in the report below the user is referred to the method and the statement within it specifying that the precision statements were determined using UOP Method 999.

CLIENT ORDER NUMBER :	Ref: 67/DG/19	SGS ORDER NO.:	3004330
CLIENT ID :	Sample #: 1112/06/2019		
LOCATION :	Petromoc Terminal, Nacala	PRODUCT DESCRIPTION :	Gasoil - 50ppm
SAMPLE SOURCE :	Shore Tank	SOURCE ID :	TK 42 - Quality Control
SAMPLE TYPE :	Composite	SAMPLE BY :	SGS
SAMPLED :	10/Jun/2019	RECEIVED :	13/Jun/2019
ANALYSED :	21/Jun/2019	COMPLETED :	21/Jun/2019
SAMPLE COMMENT :	**Sample condition: Good 1x5L Can**		
REPORT COMMENT :	**Details of the Uncertainty of Measurement are available upon request. *Subcontracted to another SGS - ISO 17025 Laboratory**		

PROPERTY	METHOD	RESULT	UNITS	MIN	MAX
Flash Point by PMCC	ASTM D93	67.5	°C	60	--
Distillation of Petroleum Products at Atmospheric ~~Pressure~~ Temperature	ASTM D86				
90 % Recovered at		345.3	°C	--	--
95 % Recovered at		356.3	°C	--	360
Final boiling point (FBP)		363.3	°C	--	--
Copper Strip corrosion (3h / 100°C {212°F})	ASTM D130	1a	Rating	--	Class 1
Kinematic Viscosity at 40°C	ASTM D445	3.648	mm²/s	2.2	4.5
Sulfur Content	ASTM D5453	5.7	mg/kg	--	50
***Pour Point**	ASTM D97	-9	°C	--	--
***Ash from Petroleum Products**	ASTM D482				
Ash		<0.001	% (m/m)	--	0.01
***Carbon Residue (on 10 % Distillation Residue)**	ASTM D4530	<0.1	% (m/m)	--	0.2
***Elements by ICP**	ASTM D7111				
Calcium as Ca		<0.1	mg/kg	--	--
Copper as Cu		<0.1	mg/kg	--	--
Lead as Pb		<0.1	mg/kg	--	--
Lithium as Li		<0.1	mg/kg	--	--
Potassium as K		<0.1	mg/kg	--	--
Sodium as Na		<0.1	mg/kg	--	--
Vanadium as V		<0.1	mg/kg	--	--
Zinc as Zn		<0.1	mg/kg	--	--
***Total Contamination**	EN 12662:2014	<12	mg/kg	--	24
***Asphaltenes**	ASTM D6560	<0.50	%wt	--	--
-Calorific Value, nett	ASTM D240	42.980	MJ/kg	--	--
***Water Separability at 25°C**	ASTM D1401				
Emulsion time to 3 mL emulsion, 25°C		5	minutes	--	--
Amount of oil Layer after testing		42	mL	--	--
Amount of water Layer after testing		38	mL	--	--

REPORTED BY

SARIFO DONDO
Lab Supervisor

SGS Moçambique, Lda | SGS Beira Laboratory - Estrada Nacional No. 6, Vaz, Beira, Mozambique Tel: +258 23 302104 / 302256

Analysis Report: BE19-00103.001

Date: 21/Jun/2019
EDM - ELECTRECIDADE DE MOCAMBIQUE, EP
AV. AGOSTINHO NETO, NR. 70
MAPUTO

CLIENT ORDER NUMBER :	Ref: 67/DG/19	SGS ORDER NO.:	3004330
CLIENT ID :	Sample #: 1112/06/2019		
LOCATION :	Petromoc Terminal, Nacala	PRODUCT DESCRIPTION :	Gasoil - 50ppm
SAMPLE SOURCE :	Shore Tank	SOURCE ID :	TK 42 - Quality Control
SAMPLE TYPE :	Composite	SAMPLE BY :	SGS
SAMPLED :	10/Jun/2019	RECEIVED :	13/Jun/2019
ANALYSED :	21/Jun/2019	COMPLETED :	21/Jun/2019
SAMPLE COMMENT :	Sample condition: Good 1x5L Can		
REPORT COMMENT :	Details of the Uncertainty of Measurement are available upon request.		

PROPERTY	METHOD	RESULT UNITS	MIN	MAX
Amount of emulsion Layer after testing		0 mL	--	--
*Hydrogen	ASTM D5291	13.8 % wt	--	--

** End of Analytical Results **

REPORTED BY

SARIFO DONDO
Lab Supervisor
21062019145100000006193

LABORATORY OGC SGS SGS MOÇAMBIQUE LDA

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CERTIFICATE OF QUALITY

Client	IMOPETRO
Product	JET-A1 JET-A1
Sample Origin	PETROMOC SHORE TANK 22 AFTER DISCHARGE MT ALPINE MAYA

Sampling Method	ASTM D4057	**Sample Number**	12/2018/062
Date Sampled	10/12/2018	**Time Sampled**	08:30H
Date Tested	28/12/2018	**Time Tested**	15:10H
Batch Number	LON/68/22	**Order Number**	COA 0496
Weather Condition	CLEAR	**Client Reference**	5.17.01.18.3°
Intertek Job No.	MZ-01150-00000040-2018		

TEST DESCRIPTION	METHOD	SPECIFICATION	RESULT
Appearance	Visual	Clear, bright and visually free from solid matter and undissolved water at normal temperature	Clear, bright and visually free from solid matter and undissolved water at normal temperature
Flash Point, ºC	IP 170	Min 38.0	39.5 39.5
Electrical Conductivity, pSm@26.5ºC	ASTM D 2624	50 - 600	291 291
Density @20 ºC, kg/l	ASTM D 1298	Min 0.771 – 0.836 Max	0.7809 0.7809
Density @15 ºC, kg/m³	ASTM D 1298	Min 775.0 – 840.0 Max	784.6 784.6
Density @20 ºC, kg/l-TOP	ASTM D 1298	Min 0.771 – 0.836 Max	0.7811 0.7811
Density @20 ºC, kg/l-MID	ASTM D 1298	Min 0.771 – 0.836 Max	0.7811 0.7811
Density @20 ºC, kg/l-BOT	ASTM D 1298	Min 0.771 – 0.836 Max	0.7811 0.7811
Total Acidity, mgKOH/g	ASTM D 3242	0.015 Max	*0.005 *0.005
Copper Corrosion (2Hrs@100 ºC)	ASTM D130	1 Max	1a 1a
DISTILLATION (°C) IBP -10% V@ ºC -50% V@ ºC -90% V@°C -FBP °C -Residue %V -Loss %V	ASTM D 86	 Report 205 Max Report Report 300 Max 1.5 Max 1.5 Max	 150.5 150.5 158.5 158.5 178.5 178.5 223.5 223.5 242.5 242.5 1.0 1.0 1.0 1.0
Smoke Point, mm	ASTM D 1322	25 Min	26 26
Aromatics, %vol	ASTM D 1319	22.0 Max	*15.5 *15.5
Freezing Point, ºC	ASTM D 2386	-47 Max	-58.0 -58.0
Existent Gum, mg/100ml	ASTM D 381	7 Max	4.5 4.5
Net Heat of Combustion of Aviation Fuels, MJ/Kg	ASTM D 3338	42.80 Min	43.40 43.40
Doctor Test	ASTM D4952	Negative	Negative

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Date 28/12/18

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Terminal da Petromoc.
Email:antonio.baptista@intertek.com

CERTIFICATE OF QUALITY

Client	IMOPETRO
Product	JET-A1 JET-A1
Sample Origin	PETROMOC SHORE TANK 22 AFTER DISCHARGE MT ALPINE MAYA

Sampling Method	ASTM D4057	**Sample Number**	12/2018/062
Date Sampled	10/12/2018	**Time Sampled**	08:30H
Date Tested	28/12/2018	**Time Tested**	15:10H
Batch Number	LON/68/22	**Order Number**	COA 0496
Weather Condition	CLEAR	**Client Reference**	5.17.01.18.3°
Intertek Job No.	MZ-01150-00000040-2018		

TEST DESCRIPTION	METHOD	SPECIFICATION	RESULT
Sulphur, % mass	ASTM D2622	0.3 Max	*0.008 *0.08
Thermal Stability (JFTOT)	ASTM D 3241		
-Filter Press Diff		25 Max	0.1 0.1
-Tube Deposit Rate		<3	1 1
-Test Temperature		260 Min	260.1 260.1
Fuel with Static Dissipator, additive (MSEP)	ASTM D 3948	70 Min	99 99
Saybolt Color	ASTM D 6045	Report	+30 +30

"It is certified that the samples have been tested using the Test Methods Stated and the Batch represented by the samples conforms with DEF STAN 91-091 Issue 9 and AFQRJOS Checklist Issue 29"

The above product meets client specifications.

***Tests outsourced to Intertek Maputo Laboratory.**

Laboratory Technician

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Reference 5_Specification of City water at Nacala substation site
ナカラ変電所水道水水質仕様

Resultados das analises realizadas de 08 a 12/04/2019 sobre a Qualidade de Água nos vários pontos de Amostragem

Analyzed Parameters Parâmetros Analisados	Unit Unidad	Number of analysis undertaken Nº. Análises Realizadas	Raw Water Água bruta Minimum Valor mín	 Maximum Valor máx	Treated Water Água tratada Minimum Valor mín	 Maximum Valor máx	Distributed Water Água distribuída Minimum Valor mín	 Maximum Valor máx	受水端水 Água da rede Minimum Valor mín	 Maximum Valor máx	飲用スタンダード Padrões de potabilidade Potability Standards VMA	Analysis insatisfactory Analises Não conformes Analysis Analises	 Occurrence / observation Ponto de ocorrência
水道 Temperatura	°C	51	26.5	30.5	26.6	30.6	26.9	28.5	26.9	28.1	-	-	
Ph	-	51	7.2	7.6	7.2	7.4	7.2	7.4	7.2	7.4	6.5-8.5	-	
Sabor / taste	-	11	0	0	0	0	0	0	0	0	insipida	-	
大腸菌糞便 Fecal Coliforms Col. fecais	mg/l	4	0	0	0	0	-	-	0	0	Ausente	0	
Conductivity Condutividade	µs/cm	11	366	1155	312	421	301	323	296	309	2000	0	
大腸菌合計 Total coliforms Col. totais	mg/l	2	0	0	0	0	-	-	0	0	Ausente	0	
Turbidity Turvação	NTU	51	0.25	4.18	0.93	3.47	2.14	3.29	3.26	3.55	5	0	
残存塩素 Total Residual Chlorine Cloro Residual	mg/l	38	-	-	1.0	1.5	0.2	0.2	0.2	0.2	0.2-2	0	
外観 colour Cor aparente	uz	51	0	0	0	0	0	0	0	0	15	-	
アルカリ度 Alcalinity Alcalinidade	mg/l	11	65	90		70	80	50	30	40	250	-	
odour Cheiro	-	51	0	0	0	0	0	0	0	0	Inodoro	-	

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Nacala, 15 de Abril de 2019

Table Effluent Guidelines (IFC/WB EHS Guidelines (Thermal Power Plants))

Parameter	Unit	Decree No. 18/2004 of Mozambique	Effluent guidelines
pH	－	6-9	6 –9
TSS	mg/L	50	50
Oil & Grease	mg/L	10	10
Iron	mg/L	1	1
Zinc	mg/L	1	1
Chromium-Total	mg/L	0.5	0.5
Total residual chlorine	mg/L	0.2	0.2
Copper	mg/L	0.5	0.5
Lead	mg/L	-	0.5
Cadmium	mg/L	-	0.1
Mercury	mg/L	-	0.005
Arsenic	mg/L	-	0.5
Temperature increase by thermal discharge from cooling system		3 degree Celsius or below (at the edge of mixing zone, not at the discharge point)	Elevated temperature areas due to discharge of once-through cooling water (e.g., 1 Celsius above, 2 Celsius above, 3 Celsius above ambient water temperature) should be minimized by adjusting intake and outfall design through the project specific EA depending on the sensitive aquatic ecosystems around the discharge point.

(Source: Decree 18/2004, IFC-World Bank Group Environment Health and Safety (EHS) Guideline (Thermal Power Plants), 2008)

Inland Transportation Route from Nacala Port to the Project Site

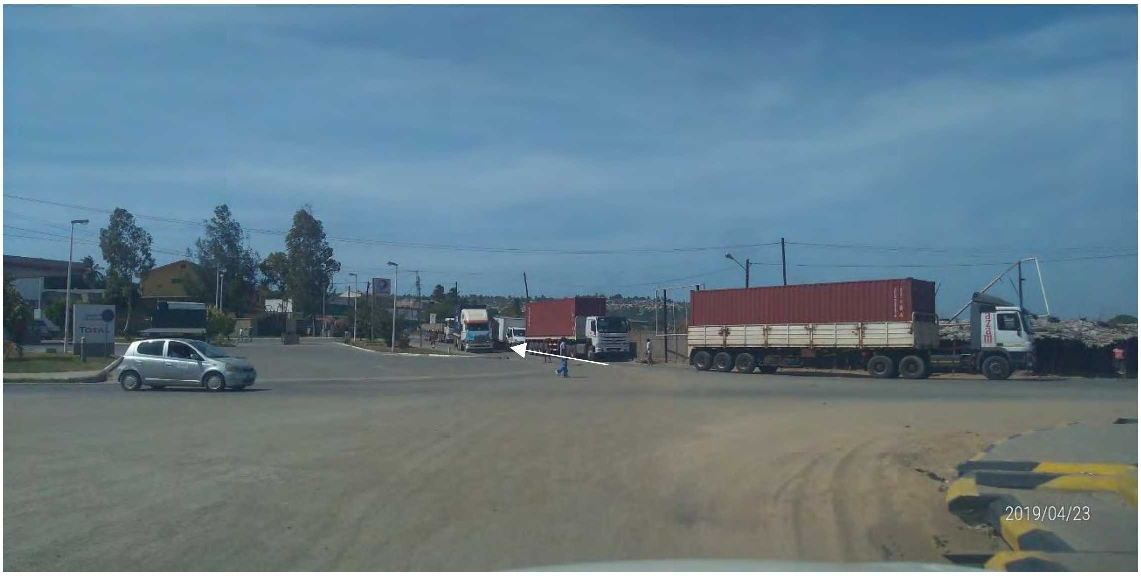
Nacala Port Entrance Gate (height limit 5.5m)

Paved road from Nacala Port to the Roundabout

Low voltage power distribution line 1 (between Nacala Port and the Roundabout)

Low voltage power distribution line 2 (between Nacala Port and the Roundabout)

Low voltage power distribution line 3 (In front of the Roundabout)



Low voltage power distribution line 4 (At the entrance of the paved road to the site)

Pave road to the site with a gentle slope

Low voltage power distribution line 5 (At the paved road to the site)

Low voltage power distribution line 6 (At the paved road to the site)

Low voltage power distribution line 7 (At the paved road to the site)

There are some low voltage power distribution lines crossing the inland transportation route, however, these lines will not disturb the transportation of heavy equipment.

Pave road to the site with a gentle slope

Entrance to the site from the paved road

Unpaved road at north side of the site 1 (surface is uneven and rough)

Unpaved road at north side of the site 2 (surface is uneven and rough)

Uneven and rough surface of this unpaved road can be leveled and reinforced by laying gravels and compacting.

Approach road to the site (unpaved but not so rough)

Access road from the gate to the project area (almost flat with old gravel pavement)

As a result of these investigations, it is considered that the inland transportation of heavy equipment from Nacala Port to the project site is feasible.

Reference-8: Soils Flown into the Substation due to the Heavy Rain

As shown in photos on following pages, due to the heavy rain occurred in 2018, a lot of fine sandy soil was eroded and flown out from the higher land at the east side of the Nacala substation, and flown into the free space at east side of the old generator building from north-east corner of the premises. It was reported that the road at east side of the substation was filled by soil, and traffic was blocked at the time of the said heavy rain.

EDM asked some treatment against this soil erosion problem to be included in the scope of the Project. However, even if some kind of retaining wall is constructed along the substation, soil which will be eroded by the heavy rain in future will be flown into lower lands adjacent to the substation, and it will not be a fundamental solution on this issue.

Therefore, this soil erosion problem should be comprehensivly resolved by means of flood prevention works in the region by the related local authorities in Mozambique, and it should not be included in the scope of the Project.


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Photo D
Photo B
Photo C
Photo F
Photo E
Photo A
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Plenty of soil was flown into the free space at east side of the old generator building. Its thickness almost reaches human height.

Road at east side of the substation of which level is higher than the substation. Fine sandy soil eroded and flown out from the higher land at east side of this road flown into the substation.

EDM laid sandbags as an emergency measure, however, they are now damaged most probably by UV light and it needs to be restored.

There is a drainage channel at east side of the road, however, it is filled by soil and seems not functioning.

Other than the soil massively flown into the substation from north-east corner of the premises, it was found that some soil was flown into inside of the substation from the net fence at east side boundary. It did not affect the substation, however, there is a possibility that the situation would get worse in future. Therefore, early action to take some sort of counter measure is recommended.