CHAPTER 5 DESIGN OF THILAWA SEZ-RELATED INFRASTRUTURE

5.1 New Infrastructure Demands in Thilawa Area Resulting from SEZ Development

According to METI-FS, when the Class A area (about 420 ha) starts operating, about 60,000 new workers will be entering the Thilawa area, 30% (18,000 workers) of whom will be living near Thilawa SEZ. Of these 18,000 workers, 30% are assumed to be living with three family members. Therefore, there will be about 30,000 new residents near Thilawa SEZ. The new infrastructure demands in Thilawa area resulting from the SEZ development are listed in Table 5.1.1 below.

Table 5.1.1 New Infrastructure Demands in Thilawa Area

Infrastructures	SEZ[*1]	New Town Area[*2]	Port[*3]	Total
Electricity（MVA/day）	180	32	100	312
Water（m^3/day）	42,000	2,800	11,100	55,900
Sewerage（m^3/day）	29,400	1,960	7,770	39,130
Solid Waste（ton/day）	930	24	100	1,054

*Sources: [*1] Class A – FS; [*2] METI-FS, infrastructure demand for 18,700 (Electricity 400 kW/ha, Water 150L/cd, Sewerage = Water x 70%, Solid Waste 1.3kg/cd); [*3] Based on the Thilawa Port demand for 4 berths, demand for 37berthsare calculated (x 37/4).*

5.2 Basic Plan to Deal with the New Infrastructure Demands in Thilawa Area

The new infrastructure demands are discussed in the following sections.

(1) Electricity

Currently, Thanlyin Substation can supply an additional capacity of 20 MW. The SEZ, port, and the new town area can utilize this for the time being, but power outages will soon be encountered due to the rapid growth of residential electricity demand.

The Ministry of Electric Power (MOEP) is planning to build a 500 MW power station in Yangon using an independent power producer (IPP). However, Thilawa area will not be expected to retain supply priority because of the growing demand in Yangon City, the insufficient supply of gas, and the lack of reliability in private operations.

As a result, stable supply of power in Thilawa area will be secured only with the construction of a new power station. The concern for the insufficient supply of gas will be managed at the same time.

(2) Water

In the short term, the developers will obtain the water source by themselves and supply water to tenant companies within the SEZ. In the new town area, the water will be supplied by the

township and also from existing wells. In the port area, water will be supplied by the township, Ministry of Construction (MOC), and Ministry of Industry (MOI). All above mentioned scenarios shall be studied and adjusted.

At the moment, there is no big water reservoir near Yangon City or Thilawa area. In the future, public support is needed to develop source of water supply with consideration of consistent development of The Great Yangon area.

(3) Sewerage

Gradual development is required for the sewerage system in line with the water supply development. At the moment, SEZ and port are using individual water treatment plants, and residential housing area need to use septic tanks, but in the future, public support is necessary.

(4) Solid Waste

Solid waste must be managed by the public administration and local institutions as they are managed presently.

(5) Road

In conjunction with the development of Thilawa SEZ and Thilawa Port, traffic volume to the nearby township is predicted to increase. Comfort and driving safety in the existing two-lane road from Thanlyin to Thilawa are major considerations. It is recommended to expand the existing road width.

(6) Other Infrastructure

For rain drainage, prompt action by the public sector is needed to manage the rapidly growing urbanization. For telecommunications, the trunk network telecommunication line is soon to be prepared by the public sector. The demand beyond these public infrastructures will be managed by the private sector if necessary.

5.3 Needs of the Priority Projects

Power supply, Thanlyin to Thilawa Access Road, and water supply are selected as priority public projects. In this project, the power supply and road projects are studied while water supply projects will be studied in other projects.

5.3.1 Power Supply

In recent years, the urban development of Yangon has rapidly moved forward and demand for electricity has increased as more people are using air conditioning and personal computers. On the other hand, expansion or maintenance of electrical supply facilities is not keeping up with the pace of demand.

Under such conditions, maintaining a stable power supply to Thilawa SEZ is expected to be difficult. The already poor power situation may deteriorate further in the coming years. Moreover, the migrant workers ensuing from the SEZ development may put additional strain on the existing infrastructure in the surrounding communities by creating higher demand.

Given this background, for convenience and also for safety reasons (electricity supply for night time lighting), power supply development is listed as a priority public project.

5.3.2 Road

The traffic volume from Thanlyin Bridge to Thilawa SEZ will increase to around 1.5 times the current traffic volume; therefore, traffic congestion during rush hour and safety for other road users (pedestrians, bicycles, motorbikes) shall be considered. Recently, motorbike users are increasing rapidly. Therefore, together with the increase of traffic volume, increase of traffic accidents becomes a serious concern.

With the above background, this Study proposes to expand the road from Thanlyin Bridge to Thilawa SEZ as a priority public project, not only for driving comfort, but also to ensure environmental protection by providing safety for other road users and reducing traffic congestions (CO_2 emissions).

5.4 Power Supply System Plan

5.4.1 Basic Concept

The proposed design standards for power supply system within the area are as follows:

(1) To apply the following regulations and standards corresponding to the:

- Basic Master Plan for Thilawa, August 2012, Ministry of Economy, Trade and Industry of Japan,
- International Electro-technical Commission (IEC),
- Environmental Conservation Law, July 2012, the Republic of the Union of Myanmar,
- Ministry of Electric Power (MOEP) Regulations,
- Yangon City Electric Supply Board (YESB) Technical Standards,
- Japanese Industrial Standards (JIS),
- Other local electrical rules and regulations;

(2) To provide reliable power supply without any power interruptions;

(3) To take adequate measures in line with the local conditions so as to conserve the landscape and water environment, and protect the site from natural disasters such as floods;

(4) To extend the power supply facilities incrementally (such as substations and power plants) in accordance with the power demand forecast of the SEZ; and

(5) To use the national grid of the Myanmar Electric Power Enterprise (MEPE) to secure a stable power supply in the future.

5.4.2 Design Criteria

(1) Voltage of Power Supply System

The system voltages applied to power supply facilities (including transmission, substation, and distribution systems) in relation to Thilawa SEZ are shown as below (also satisfy MEPE's standards).

- 230 kV±10%, three-phase circuit
- 132 kV±10%, three-phase circuit
- 33 kV±10%, three-phase circuit
- 11 kV±10%, three-phase circuit

(2) N-1 Contingency Criteria

Power supply facilities for the SEZ shall maintain N-1 redundancy for all transmission, generation, and major distribution components. The N-1 criteria require that all loads can be restored if any single component fails.

(3) Meteorological Conditions

The meteorological conditions in the following Table 5.4.1 shall be applied for the design of facilities.

Table 5.4.1 Meteorological Conditions

Item	Description
Mean Temperature	27.0 °C
Maximum Temperature	37.6 °C (April)
Minimum Temperature	16.6 °C (January)
Precipitation	2,918 mm
Maximum Wind Speed	42.7 m/s (May, 2008)

Source: Department of Meteorology

(4) Electrical Clearance

The electrical clearance of the facilities shall be designed based on IEC Standards, as follows:

Table 5.4.2 Electrical Clearance

Nominal System Voltage	230 kV	33 kV
Minimum clearance between live metal and earth (mm)	2,100	360
Minimum clearance between live metal(mm)	2,400	360
Minimum safety clearance between ground and the nearest point not at earth potential of an insulator(mm)	2,500	2,500
Minimum safety clearance between ground and the nearest live unscreened conductor (mm) (BS 7354)	4,270	2,740
Minimum insulator creep age distance (at rated voltage between phases) mm/kV	25	25

Source: JICA Study Team

5.4.3 Power Demand Estimation

According to METI-FS, the power load for all the tenants in the whole area of SEZ (2,400 ha including Class A and Class B) is estimated to reach approximately 800 MVA in total.

To focus on the power demand in the Class A area, the annual volume of selling area is predicted at 20 ha/year and assuming the load density at 0.5 MVA/ha, the power demand forecast for Class A area is calculated as shown in Table 5.4.3. For the first year of operation of the SEZ in 2015, approximately 2 MVA is estimated as the initial load. Thereafter, the load is expected to increase by 10 MVA every year, until 2037 when the sale of industrial area of Class A is completed, the load will reach a maximum of 180 MVA.

Table 5.4.3 Power Demand of SEZ (Class A)

Unit: MVA

Year	2015	2017	2019	2021	2023	2025	2027	2029	2031	2033	2035	2037
Load of SEZ (Class-A)	2	12	30	50	70	90	110	130	150	168	178	180

Source: JICA Study Team

At the same time, Thanlyin and Kyauktan are observing rapid economic growth accompanied by rapid population growth as predicted in Table 5.4.4 below.

Table 5.4.4 Predicted Population Growth in Thanlyin and Kyauktan

Township	2011	2018	2020	2025	2030	2035	2040
Thanlyin	181,959	371,076	431,650	597,416	785,881	1,000,154	1,243,770
Kyauktan	48,473	67,171	73,160	89,549	108,183	129,368	153,454

Source: The Project for the Strategic Urban Development Plan of the Greater Yangon.(JICA Study)

The population of Thanlyin is expected to increase by a factor of seven in the next 30 years. For Kyauktan, it is expected to increase by a factor of three. This region's total population is projected to increase sixfold by 2040.

As the population grows, the demand for electricity inevitably increases. Since population in the area where currently power supplied by Thanlyin substation with 100MW capacity, will be increased 6 times, the future capacity requirement is predicted to increase by more than six times (600 MW).

5.4.4 Outline of Power Supply System Plan

Regarding to power supply facilities, the development scenario with consideration of Thilawa area including SEZ is proposed as below:

(1) Stage-1: Supply of 20 MW through 33 kV Double Circuit Distribution Line from Thanlyin Substation

Together with the operation Class A, employment chances for surrounding area will be increased, and power supply to reseidential houses and industrail ara will be expected.

It is required that the initial power supply facilities for SEZ be completed by October 2015 when Class A starts operations. Therefore, as an early countermeasure for possible power supply deficiency, the 33 kV distribution line will be specially extended from Thanlyin substation to Thilawa with power supply 20 MW.

There is an existing 33 kV distribution line from Thanlyin Substation to the 33/11 kV distribution substation in Thilawa, operated by YESB. Since this existing line has already been used to provide public power supply to Thilawa area, a new 33 kV distribution line directly connecting Thanlyin Substation to Thilawa SEZ is needed in order to avoid any interruption in the power supply to the affected public network. This new line is recommended to be designed as a double circuit in order to provide the SEZ with stable power supply under N-1 condition to guarantee at least one circuit operation at all times.

(2) Stage-2: Supply of 50 MW Generated by Dual Fuel Generators

It is doubtful whether Yangon power supply system will be able to supply stable electricity (more than 20 MW) to the SEZ as stipulated in Sub-clause 4.7. However, together with the increase of power demand caused by the population increase in Thilawa SEZ and surrounding area, in order to avoid negative influence on the living environment caused by shortage of electricity, additional power supply facilities is necessary to be set up to meet Thilawa's demand in an early stage. Stage-2 plans to set up 50 MW generators in Thilawa to secure the power for Thilawa area, such as for the port, industries, SEZ, university, residences, etc.

The recommended generators are gas turbine generators applicable for dual fuel generation (natural gas and diesel oil) in consideration of the risk from unstable fuel supply.

A 230 kV single circuit transmission line connecting Thilawa to Thanlyin will also be constructed in order to connect the generators to the national grid via a 230/33 kV substation which will be constructed in Thilawa.

(3) Stage-3: Supply of Additional 168 MW from Thaketa IPP

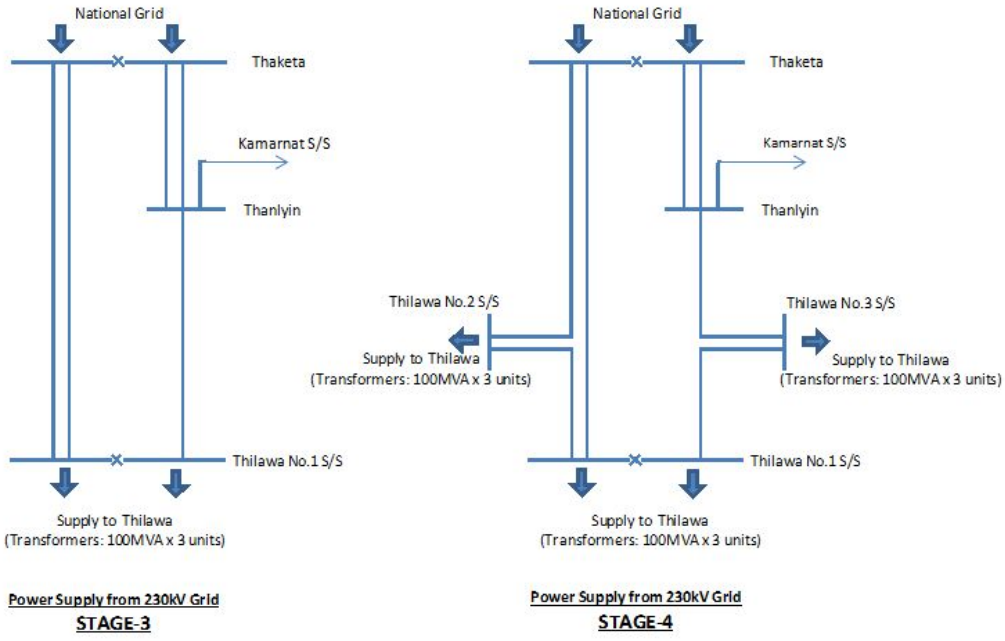
As an alternative choice to secure further power to be supplied to Thilawa, there is an on-going IPP project in Thaketa approximately 20 km north of Thilawa. This IPP project aims to construct a new combined-cycle gas turbine power plant (500 MW) at a site adjacent to Thaketa Power Station. This will be managed by the Busan Korea Biotechnology Co. (BKB) (Korean private company). On this basis, the Thilawa SEZ Supporting Committee has committed to the Study Team in November 2012 that, from 2015,168 MW out of 500 MW generated by the IPP would be fed to Thilawa Substation. However, detailed technical information regarding the IPP project has not been disclosed, and construction seems delayed.

Under the above situation, the additional 168 MW power supply is to be fed from the IPP power station to Thilawa Substation before 2020. The supply capacity will grow to a total of 218 MW (168 MW plus 50 MW) in Stage-3.

(4) Stage-4: Supply of More Than 218 MW from the National Grid

Stage-4 will discuss the scenario of power supply for the demand of more than 218 MW for the public consumers and Thilawa SEZ.

The Thilawa Substation is to prepare three transmission line feeder bays, consisting of two circuits from Thaketa IPP Substation, and one circuit from Thanlyin Substation in Stage-2. Although these transmission lines are capable of transmitting 1,000 MW of power (under N-1 condition), the transformer capacity of Thilawa Substation is designed only at 100 MVA x 3 units. It is recommended that two more substations (100 MW x 3 units x 2 substations) should be constructed at separate locations. The expansion plan of 230 kV transmission lines and grid substations from Stage-3 to Stage-4 is suggested as shown in Figure 5.4.1.



Source: JICA Study Team

Figure 5.4.1 230 kV Transmission System for Thilawa

As a result of the study on power supply scenario, Stage-1 and Stage-2 will be discussed further as priority power supply projects in the subsequent sub-clause.

5.4.5 Priority Power Supply System Plan

(1) Power Distribution System to Tenants in Thilawa SEZ

Before starting the detailed discussion of priority power supply projects for Stage-1 and Stage-2, the planned power distribution system for Class A tenants in Thilawa SEZ is herein discussed. This power distribution system is designed based on 33 kV overhead or underground lines in loop circuits extended from 33 kV switchboards in Thilawa Substation. Eight loop circuits are designed to cover the maximum electric load in the Class A area.

(2) Stage-1: Supply of 20 MW through 33 kV Double Circuit Distribution Line from Thanlyin Substation

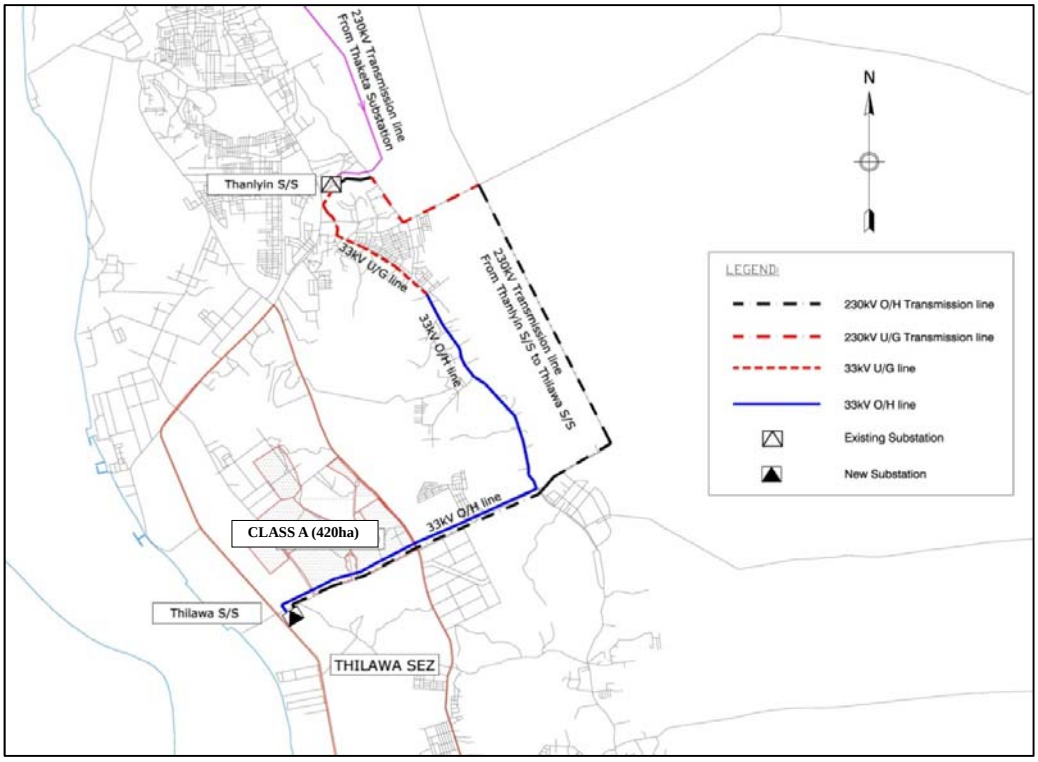
33 kV Double Circuit Distribution Line

The 33 kV distribution line route from the existing Thanlyin Substation to the new Thilawa Substation is indicated in Figure 5.4.2.

The length of the 33 kV distribution line is approximately 13.5 km, consisting of:

- 33 kV underground cable line: 3.7 km
- 33 kV overhead line: 9.8 km

The distribution line for the first 3.7 km from Thanlyin Substation to Thilawa shall be designed as underground line, and then the distribution line will change to an overhead line. The overhead line will continue for approximately 9.8 km up to Thilawa Substation, where it will go underground again to connect to the 33 kV switchboards in Thilawa Substation.

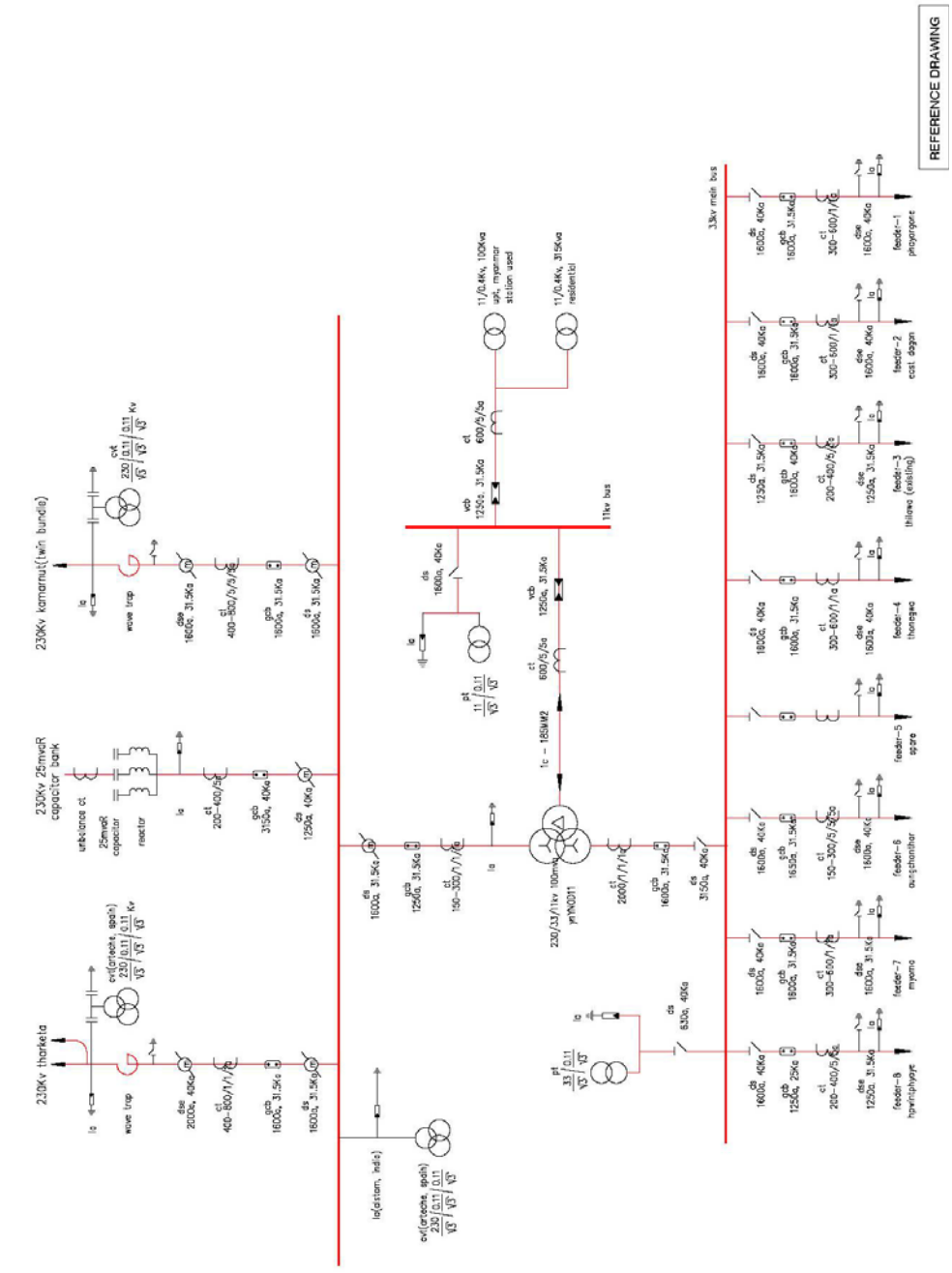


Source: JICA Study Team

Figure 5.4.2 Candidate 33 kV and 230 kV Transmission Line Route to Thilawa Substation

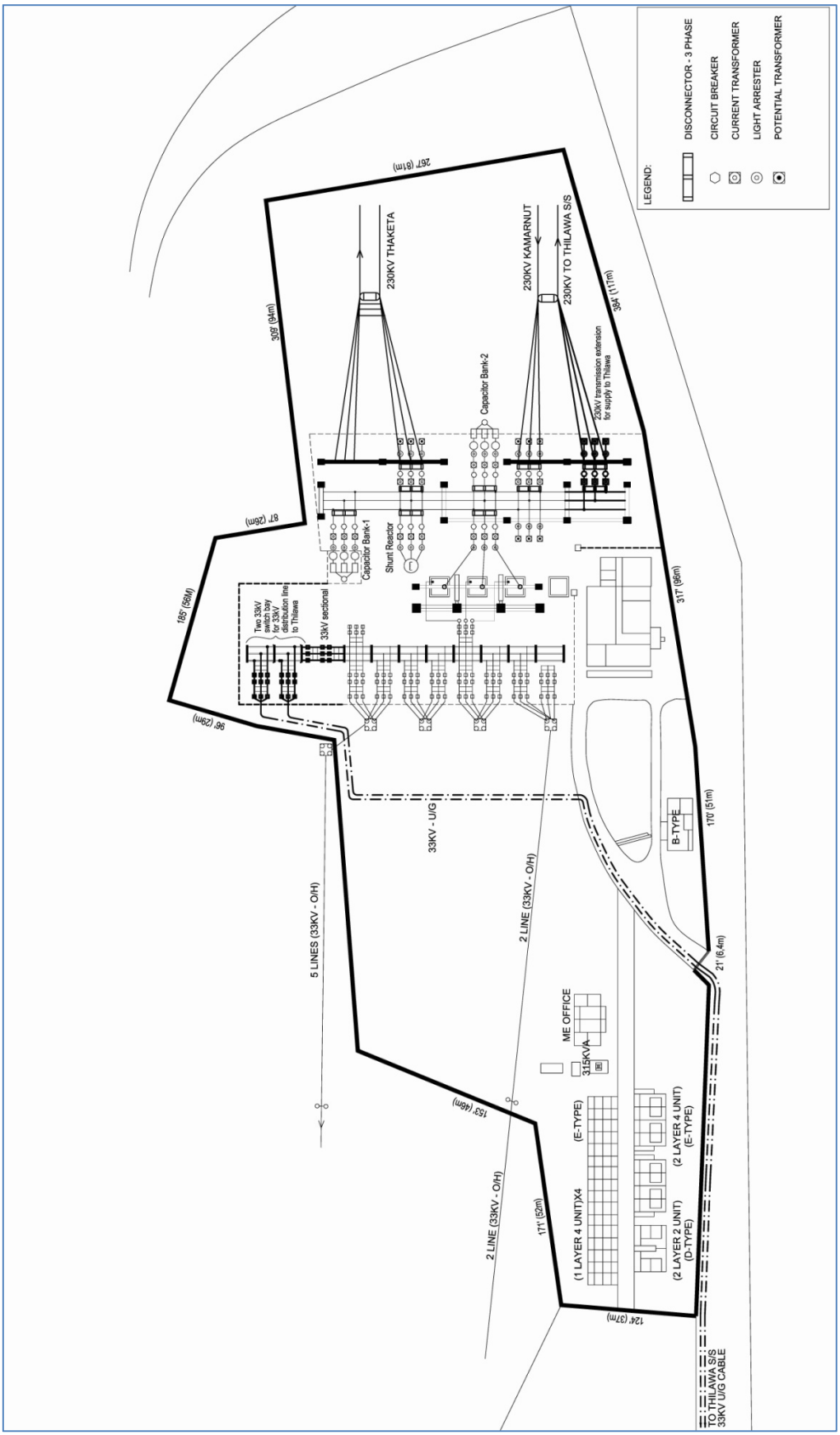
Modification of Thanlyin Substation: 33 kV Switch Bay for Connection of 33 kV Distribution Line

The existing equipment layout of Thanlyin Substation is shown in Figure 5.4.3 and Figure 5.4.4. The 33 kV busbars will be expanded and additional 33 kV switch bay of two outgoing feeders will be installed.



Source: JICA Study Team

Figure 5.4.3 Single Line Diagram of Thanlyin Substation



Source: JICA Study Team

Figure 5.4.4 Equipment Layout of Thanlyin Substation

Construction of 33 kV Bus and Switchgear in Thilawa Substation

For receiving the 33 kV power fed from Thanlyin Substation, 33 kV bus-bars and switchgear will be set up initially in Thilawa Substation. 33kV switchgear will be set in 33kV panel with GIS type double bus-bar and insulated switchgear as indoor type. A control building will also be constructed.

(3) Stage-2: Supply of 50 MW Generated by Dual Fuel Generators

50 MW Dual Fuel Generators

Simple cycle gas turbine generators of more than 50 MW output will be installed in the vicinity of Thilawa Substation. In consideration of the possibility that the natural gas supply volume in Thilawa may be insufficient for power generation, dual fuel (natural gas and diesel oil) type generators will be used.

The generators shall be designed for operation as base load generating units as well as for peak load operation, i.e., applicable to continuous generation for outdoor use. The gas turbine shall be designed and operated using dual fuel with fuel gas (natural gas) as the primary fuel and fuel oil (diesel oil) as the back-up fuel. The fuel supply system shall be designed in such a way that it is possible to change automatically and manually from gas to oil while on load upon sensing a falling gas pressure, or manually from oil to gas while on load.

The power output of gas turbine generators varies depending on ambient temperature, which is generally defined as 15 degrees under ISO condition. Therefore, the gas turbine generators to be installed in such a tropical country as Myanmar will be specified as 55 MW under ISO condition considering an approximately 10% power reduction when the temperature exceeds 30 degrees. Outline specifications for gas turbine generators are summarized in Table 5.4.5. However, it is suggested that these specifications be discussed with MEPE again when the detailed design is carried out before tender stage.

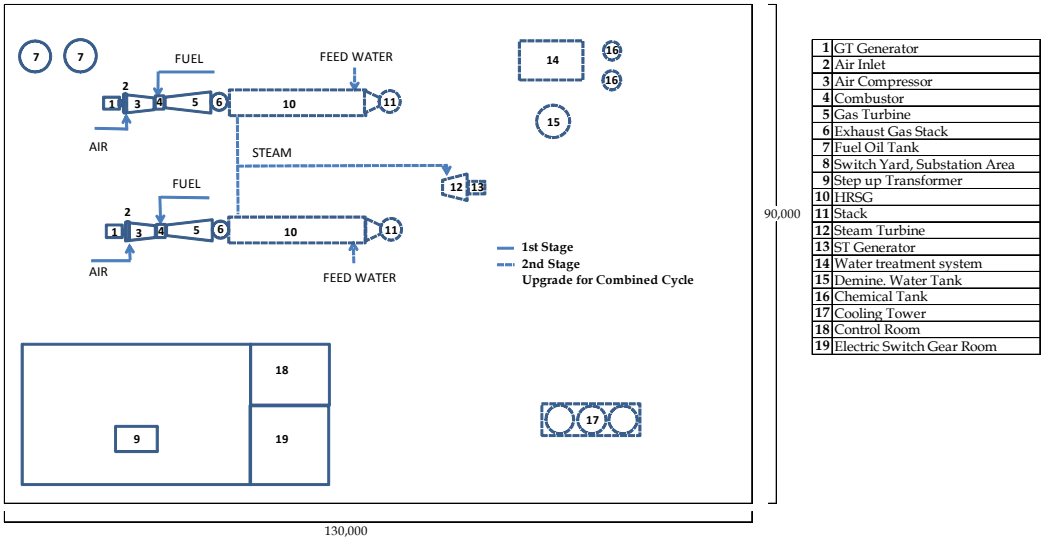
Table 5.4.5 Outline Specifications for Gas Turbine Generators

Item	Specifications	Remarks
Turbine	Simple cycle gas turbine	Possible to be upgraded to combined cycle
Gross Output (at Gen end)	55MW in total (for 2 units)	Under ISO condition Power factor: 0.8
Number of units	2 units	-
Fuel	Diesel oil and natural gas	Dual fuel type
Thermal Efficiency	Not less than 30%	Under ISO condition
Construction Period	First unit : 16 months for completion 18 months for commencement of commercial operation Second unit : 17 months for completion 19 months for commencement of commercial operation	From effective date of contract

Source: JICA Study Team

The gas turbine generators will be equipped with all the necessary facilities for continuous operation, such as the following items:

a.	Simple cycle gas turbine	2 sets
b.	Generator	2 sets
c.	Gas turbine and generator control system	2 sets
d.	Step-up and auxiliary transformers	2 sets
e.	Fuel tank	1 lot (2 turbines)
f.	Demineralizer and water tank	1 lot (2 turbines)
g.	Special tools for maintenance and start-up spare parts	1 lot (2 turbines)
h.	Other peripheral equipment	1 lot



Source: JICA Study Team

Figure 5.4.5 Sample Equipment Layout of Gas Turbine Generation Plant

230 kV Transmission Line from Thilawa Substation to Thanlyin Substation

A single circuit 230 kV transmission line will be constructed between Thilawa Substation and Thanlyin Substation. The candidate transmission line route is indicated in Figure 5.4.2. The transmission line is approximately 15.3 km in line length, and has an overhead line with double conductor ACSR 767 MCM (400 mm^2 x 2) and an underground line with single core XLPE cables having a cross section of 2,000 mm^2. Transmission line capacity is expected at 400 MVA to 500 MVA.

The underground cable line will be applied for a line length of 2.9 km to Thanlyin Substation, whereas the overhead line supported by steel monopoles will be installed in the right of way of public Thanlyin to Thilawa Access Road and/or canal for the rest of the transmission line route to Thilawa Substation (12.4 km in line length).

On the other hand, there were no transmission line projects that utilized steel monopoles or underground cables for 230 kV transmission system in Myanmar in the past. As a consequence

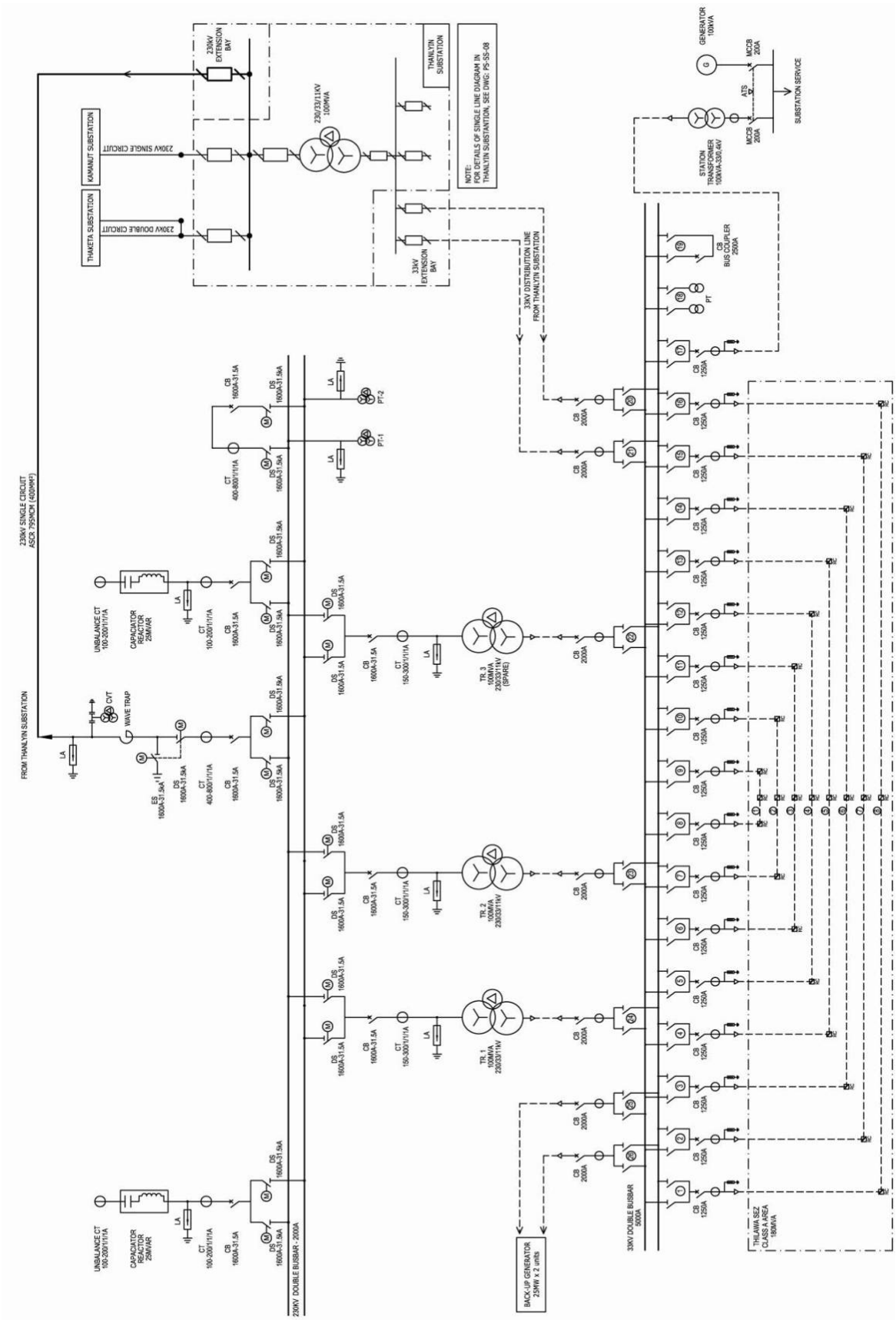
of very high project cost when using steel monopoles and underground cables, it is recommended that the project design be discussed again with the implementing agencies in Myanmar during the detailed design stage in consideration of the two alternatives, namely, steel tower lines and underground cable.

Thilawa 230/33 kV Substation

Thilawa 230/33 kV Substation will be constructed near the premises of Class A area in Thilawa SEZ, and will be equipped with 300 MVA main transformers and a 230 kV transmission line bay for receiving power from Thanlyin Substation. The 33 kV GIS switchboards already set up in Stage-1 will become the secondary circuit to the main transformers in Thilawa Substation. The single line diagram and equipment layout are respectively shown in Figures 5.4.6 and 5.4.7 for reference. The main transformers will be comprised of three units of 100 MVA transformers in consideration of N-1 contingency condition, based on the Class A area needs of 180 MW.

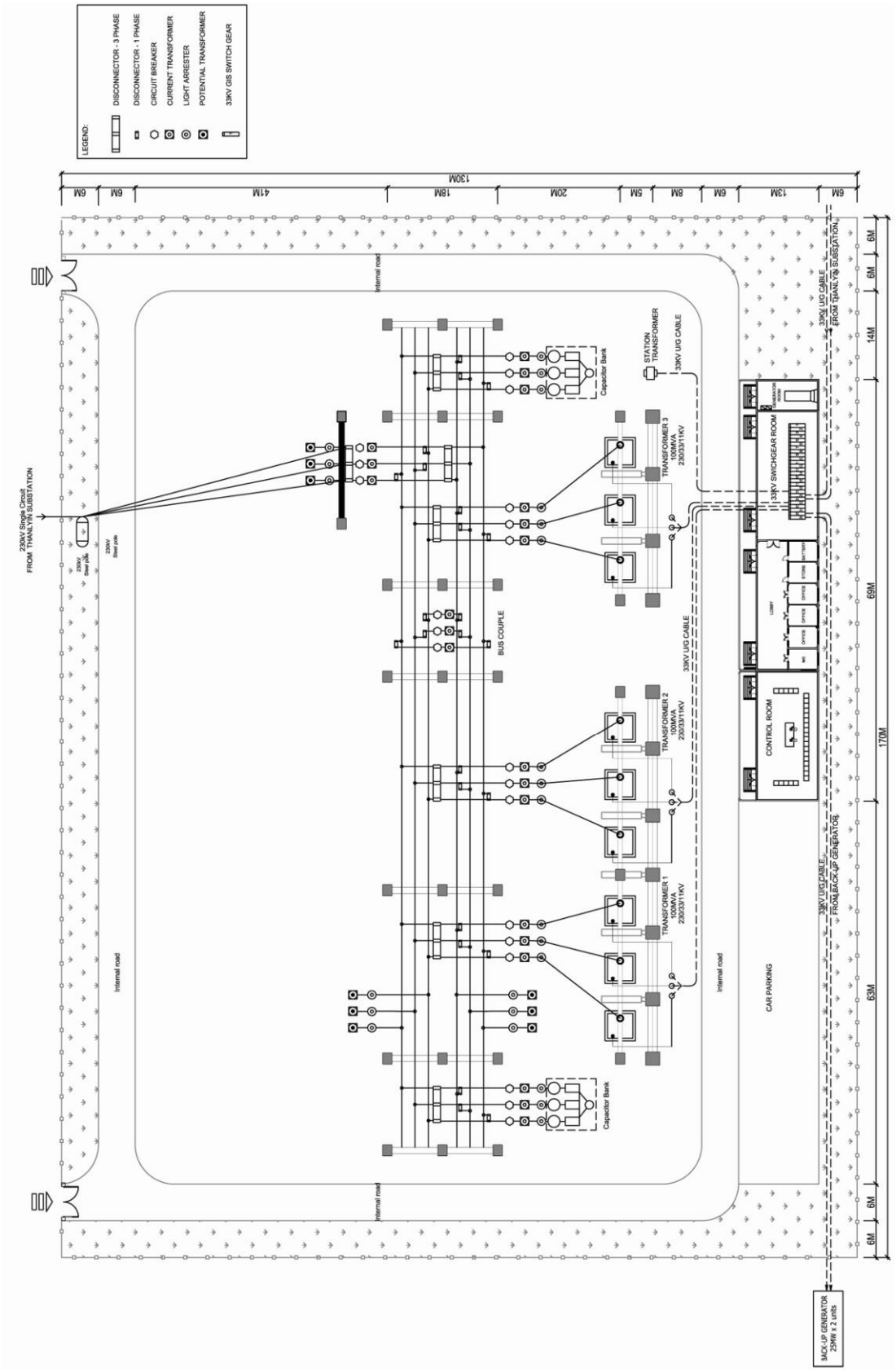
The switchgear for the primary circuit of Thilawa Substation is recommended to be an air-insulated switchgear (AIS) in accordance with MEPE's existing substations in Myanmar.

The empty space for two transmission line bays will be considered in the equipment layout drawing (as shown in Figure 5.4.7) for receiving the power from external power stations in the future.



Source: JICA Study Team

Figure 5.4.6 Single Line Diagram of Thilawa Substation

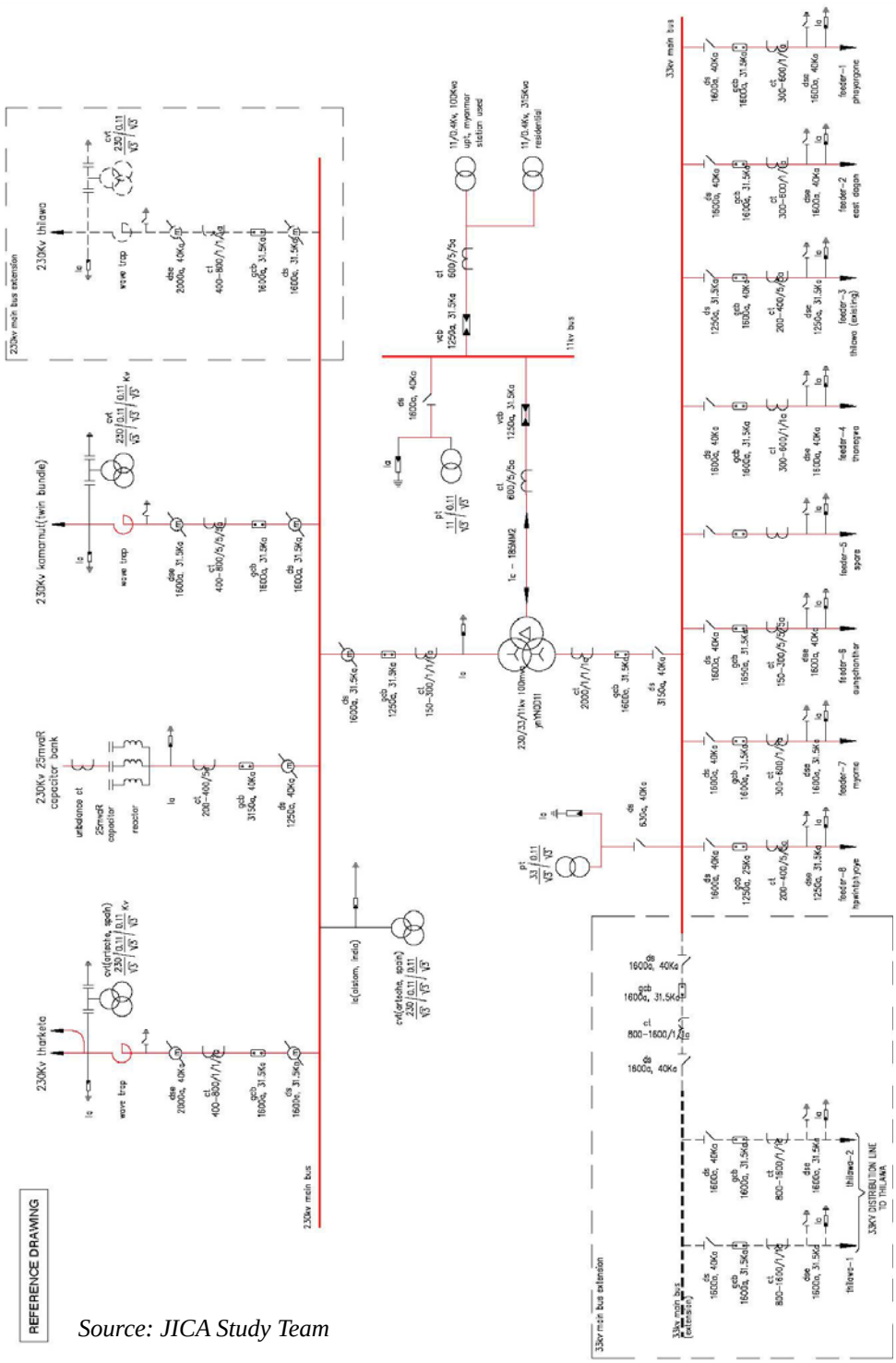


Source: JICA Study Team

Figure 5.4.7 Equipment Layout of Thilawa Substation

Modification of 230 kV Switchyard for Connection of 230 kV Transmission Line in Thanlyin Substation

The existing 230 kV bus conductors will be expanded and an additional 230 kV switch bay to the Thilawa Substation will be installed as shown in Figure 5.4.8. The specification of equipments for 230kV and 33kV feeder bay will be used same as existing equipments.



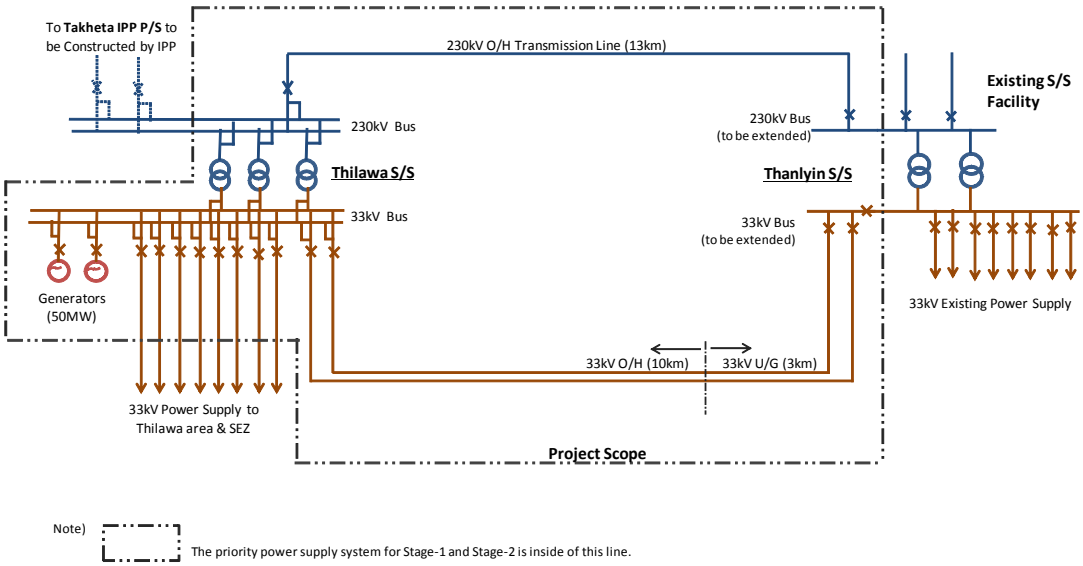
Source: JICA Study Team

Figure 5.4.8 Single Line Diagram of Thanlyin Substation

(33 kV Extension and 230 kV Main Bus)

(4) Conclusion of Priority Power System Plan

The priority power system plan for Thilawa is illustrated in Figure 5.4.9.



Source: JICA Study Team

Figure 5.4.9 Summary of Priority Power Supply System (for Stage-1 and Stage-2)

5.4.6 Fuel Supply for Priority Plan

(1) Dual Fuel Gas Turbine Generator

Dual fuel-type gas turbine generator is adopted to ensure a steady start of power generation. This type makes it possible to start power generation using diesel fuel even when natural gas supply is delayed, and in order to maintain power supply even when there is disruption of natural gas supply. This will result in providing a reliable power supply system to Thilawa SEZ and compensating the additional costs to make a dual fuel system instead of a gas-fired system.

(2) Natural Gas Supply

Natural Gas Requirement

Table 5.4.6 shows the natural gas requirement for the gas turbine generator.

Table 5.4.6 Natural Gas Requirement for Gas Turbine Generator

Item	Requirement
Gas Supply Rate at Maximum Output	・ Gas Supply Rate: 22.8 MMSCFD (for 2 Gas Turbine Generators) @ Gross Output of 56.6 MW (for 2 Gas Turbine Generators)
Gas Property	・ Offshore gas from Yadana Gas Field with components shown in Table 4.7.7 ・ Molecular Weight: 20.5 ・ Higher Heating Value: 733 BTU/SCF ・ Lower Heating Value: 653 BTU/SCF
Gas Supply Pressure	・ 21- 23 bar at Gas Turbine Inlet

Source: JICA Study Team

Further Action Required for Natural Gas Supply

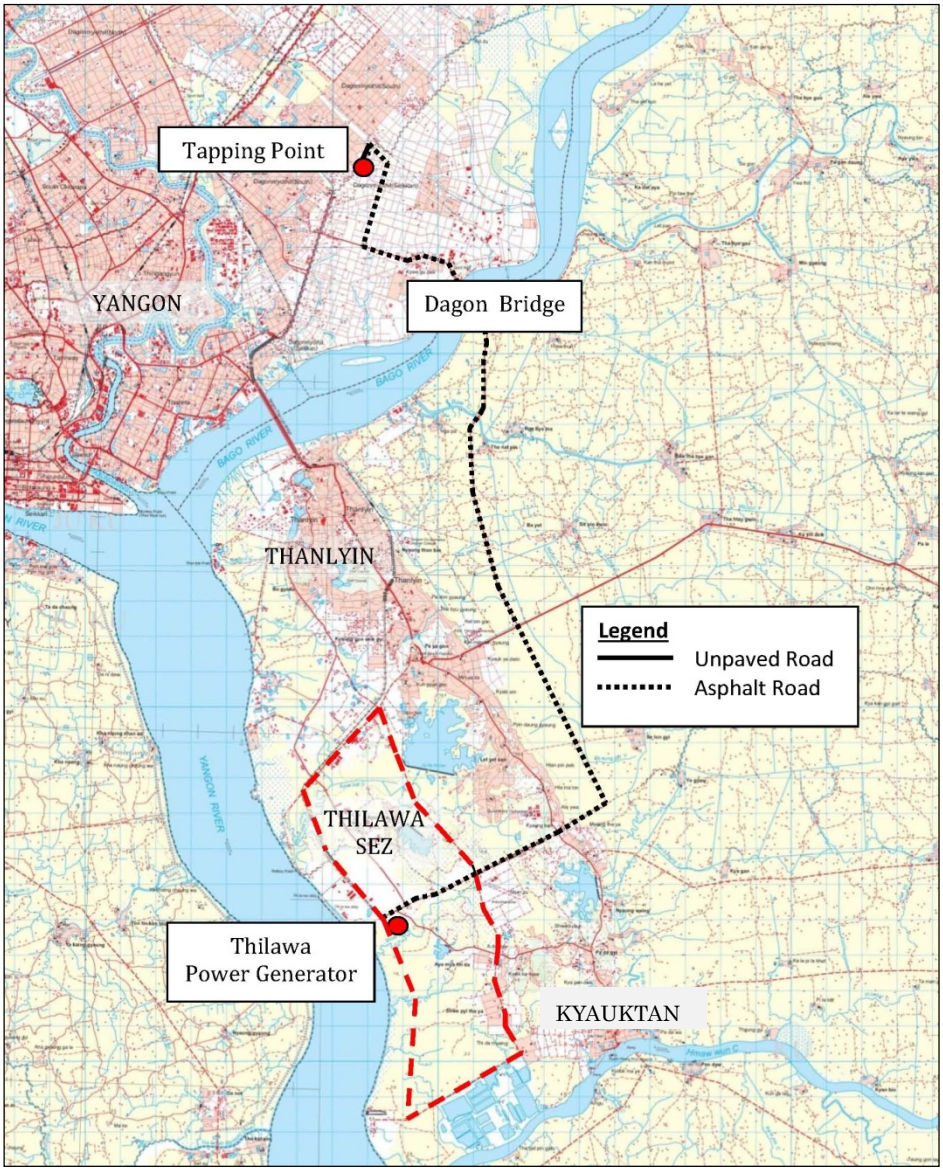
The following issues should be addressed for natural gas supply to the gas turbine generators:

- Natural gas allocation to generator
- Gas pipeline network design
- Share of gas pipeline construction works and cost among beneficiaries
- Detailed design, procurement of equipment and materials, and construction for gas pipeline construction.

A total of 110 MMSCFD offshore gas has been supplied to four gas power stations at Thaketa, Ahlon, Ywama, and Hlawaga in Yangon. According to Myanma Oil and Gas Enterprise (MOGE), an additional 100 MMSCFD of offshore gas will be allocated to fuel the new power plants and existing power plants, which will be upgraded at the end of 2013 by the MOEP.

The MOGE are expected to be responsible for the design, construction, operation and maintenance of domestic pipelines. After the natural gas is allocated, MOGE needs to design the upgrading of the pipeline network including hydraulic analysis and investigate the compressor station and pressure control of the offshore gas pipeline network, considering the operational effect of the upgrading to a number of users.

According to MOGE, it will take charge of the detailed design and construction for pipeline modification for the account of the beneficiary, while the beneficiary should take charge of procurement. On the other hand, a Korean consortium appears to have taken charge of detailed design, procurement, and construction of a part of the pipeline to supply offshore gas to its own 500 MW gas-fired combined cycle power plant at Thaketa. The gas supply pipeline to the SEZ will be connected to the pipeline constructed by the Korean consortium (Figure 5.4.10). It is necessary to demarcate the work and cost among the beneficiaries based on the gas allocation.



Source: JICA Study Team

Figure 5.4.10 Gas Pipeline Route to Thilawa SEZ (Proposal)

(3) Diesel Oil Supply

Diesel Oil Requirement

Table 5.4.7 shows the diesel oil requirement for the gas turbine generator.

Table 5.4.7 Diesel Oil Requirement for Gas Turbine Generator

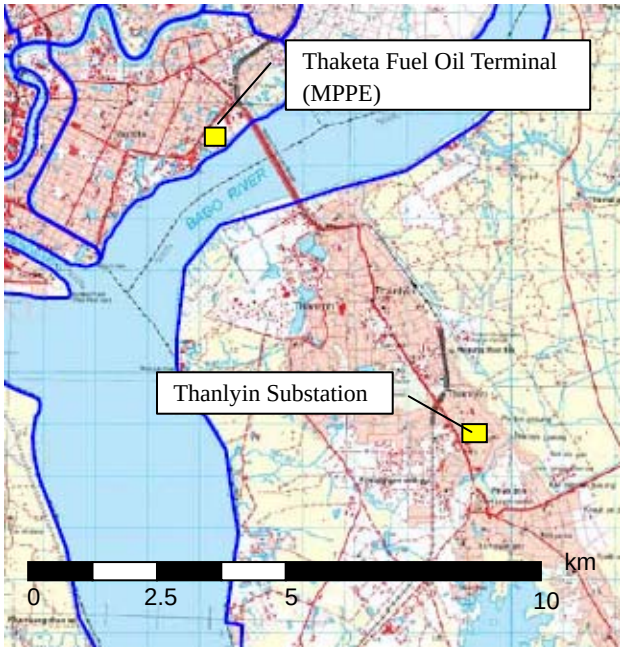
Item	Requirement
Diesel Oil Consumption at Maximum Output	・ Diesel Oil Supply Rate: 88,000 gallons/day (for 2 Gas Turbine Generators) @ Gross Output of 51.5 MW(for 2 Gas Turbine Generators)
Diesel Oil Specification	・ Refer to Table 4.7.8
Diesel Oil Storage Capacity	・ Equivalent to three days' consumption at maximum output
Transportation Method	・ By tanker lorry with a capacity of 1,600 gallons or 3,200 gallons

Source: JICA Study Team

Diesel Oil Supply Plan

It is expected that Myanma Petroleum Products Enterprise (MPPE) will supply diesel oil to MEPE for gas turbine generators. The MPPE sometimes supplied diesel oil to power stations in Yangon when offshore gas is not available.

The MPPE has a fuel oil terminal at Thaketa Township, about 11 km from the gas turbine generators at Thanlyin Township. Diesel oil storage capacity of Thaketa Fuel Oil Terminal is approximately two million gallons which is equivalent to 23 days' consumption.



Source: JICA Study Team

Figure 5.4.11: Location of Thaketa Fuel Terminals

Diesel oil is supplied by using tanker lorry with a capacity of 1,600 gallons or 3,200 gallons. When a maximum of 88,000 gallons of diesel oil is supplied per day, 3,200 gallon tankers will need to deliver 28 times per day.

Procurement of Diesel Oil

According to MPPE, the current price level of diesel oil is USD 4.65 per gallon (MMK 4,000 per gallon) for the government sector as of 01 March 2013. Transportation cost by MPPE's 1,600 gallon tanker lorry is MMK 0.60 per mile per gallon under good road conditions, and MMK 0.64 per mile per gallon under bad road conditions.

Cost comparison between diesel oil and natural gas

Requirement for gas turbine generator:

- 50 MW single gas turbine generator
- Efficiency due to Lower Heating Value (LHV): 34.3%

Requirement for natural gas generator (Refer to Myanmar offshore gas specification):

- Net average calorific value: 713 BTU/SCF
- Lower Heating Value (LHV) : 653BTU/SCF
- Price: USD 12/MMBTU

Requirement for diesel oil:

- Lower Heating Value (LHV): 230,000 BTU/gallon or 12,700 kcal/liter
- Price: USD 4.5/gallon

Power generation cost:

- Power generation cost of natural gas: USD 0.13/kWh

- Power generation cost of diesel oil: USD 0.20/kWh
- Power generation cost of diesel oil is 1.5 times more than power generation cost of natural gas

5.5 Road Plan

5.5.1 Basic concept

Thilawa SEZ access road is the main road which will connect Yangon City and Thilawa SEZ. By evaluating the existing road conditions and future traffic volume, appropriate function and road width shall be designed.

5.5.2 Design Criteria

According to Japanese road design regulations (by Japan Road Association), the target road in this project belongs to city road category No.4 (not including express way and special road for vehicles). The relevant regulations are shown in Table 5.5.1.

Table 5.5.1 Category of Road

	Local	Urban
National Highway and Expressway	Category 1	Category 2
Other Roads	Category 3	Category 4

Source: Japan Road Association

Table 5.5.2 Road in Category 4

	More than 10,000	More than 4,000, less than10,000	More than 500, less than 4,000	More than 500
National road	Grade 1		Grade 2	
Province road	Grade 1	Grade 2	Grade 3	
Urban road	Grade 1	Grade 2	Grade 3	Grade 4

Source: Japan Road Association

Table 5.5.3 Planned Traffic Volume

Category		Geographic	Standard Traffic Volume (Unit/day) One day
Category 4	Grade 1	-	12,000
	Grade 2	-	10,000
	Grade 3	-	9,000

Source: (for the 3 tables above) Japan Road Association, JICA Study Team

5.5.3 Traffic Demand Forecast

(1) Traffic Generating Points

Together with the development of Thilawa SEZ area, the future traffic can be grouped into two categories: (i) Commuter traffic from Thanlyin/Kyauktan area to Thilawa SEZ, and (ii) Cargo traffic from Thilawa SEZ and Thilawa Port.

1) Commuter Transportation

Workers in Thilawa SEZ are assumed to live mainly in Thanlyin, Kyauktan, and Yangon City. Commuter traffic from Yangon and Thanlyin is expected to use the access road from Thanlyin Bridge to Thilawa SEZ. In this area, traffic volume will increase rapidly due to additional commuters going to Thilawa SEZ.

2) Cargo Transport

In terms of cargo traffic, two types are assumed: (a) Material transportation from Thilawa Port to Thilawa SEZ, and (b) Products transported from Thilawa SEZ to Thilawa Port for export. In the future, the products produced in Thilawa SEZ for domestic market will increase due to the increase in individual income in Myanmar including Yangon City. Cargo traffic from Thilawa SEZ to Yangon is predicted to increase gradually.

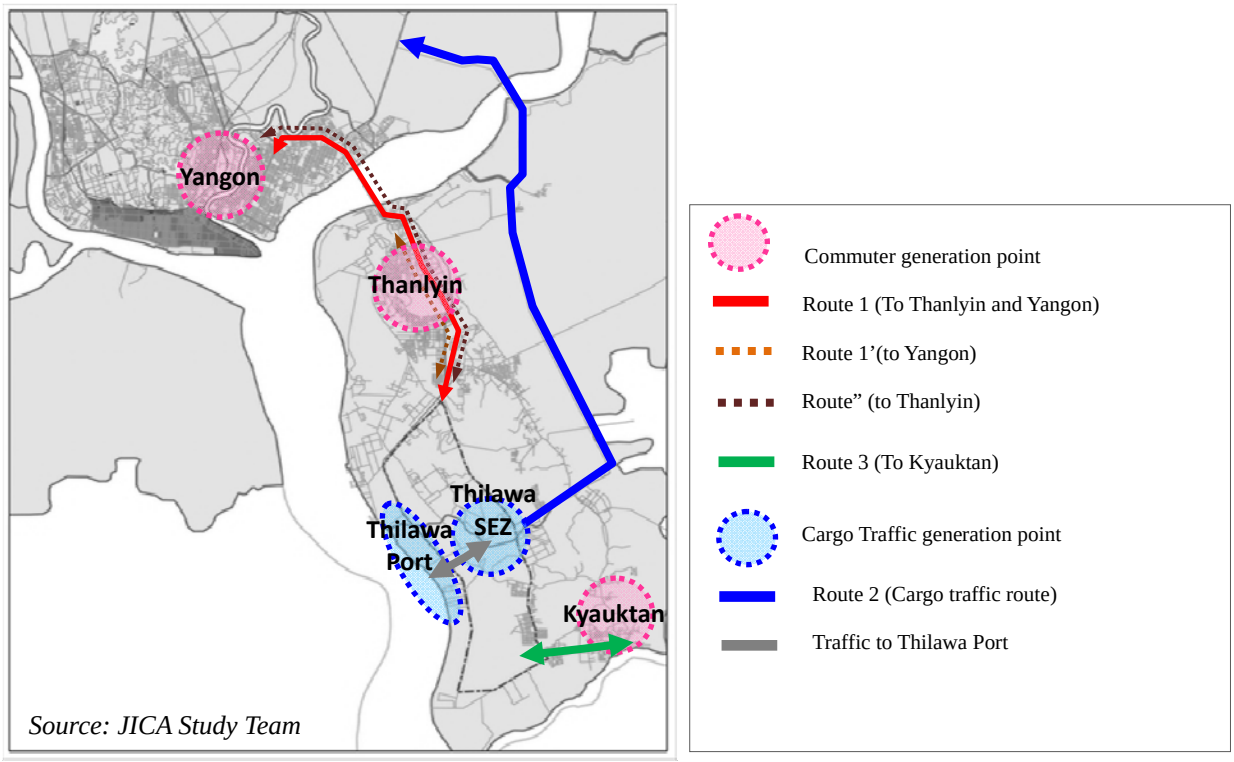


Figure 5.5.1 Traffic Generating Points and Transportation Routes

(2) Assumed Traffic Volume based on Demand Forecast

1) Commuter Transportation

Number of Commuters to Thilawa SEZ

The number of workers commuting to Thilawa SEZ when Thilawa SEZ are fully developed (after year 2040) is assumed at 85,996. The basis for calculation is shown in Table 5.5.4.

Table 5.5.4: Number of Commuters to Thilawa SEZ

Site Classification	Area for Land Development (ha)	Total Floor Space Industry: 1F Commercial: 10F	Unit Number of Workers per Unit Area (person/day・ha)	Total Number of Workers (person/day)	Number of Commuters out of SEZ (person/day)
	(1)	(1)'	(2)	(3)=(1)'×(2)	(4)=(3)×S*
Industrial Area	956	956	200	191,200	82,216
Commercial Area	42	420	30	12,600	3,780
Total	*998*	-	-	*203,800*	85,996

Source: JICA Study Team
Note: S = Percentage of commuters outside of Thilawa SEZ (Industrial: 42.6%, Commercial: 30%)
(Source: METI-FS)

Traffic Volume by Commuters

Since most of the commuters to Thilawa SEZ are laborers working in factories, it can be assumed that their main transportation modes will be public transportation or special company-provided transportation (buses or trucks). According to the traffic volume survey (refer to Table 4.2.5), the volume of mini buses (36% of the current total pcu) in the current traffic is much larger than that of heavy buses (17% of the total pcu). Relative to the current public transportation ratio, it is assumed that future traffic volume ratio for mini bus is 35% and 15% for middle-large buses. On the other hand, with the increase in personal income, individual transportation modes are predicted to increase accordingly. Ratio of bicycles (0.2% of the current total pcu) and motorbikes (13% of the current pcu) are assumed to increase to 5% for bicycles, and 30% for motorbikes. In addition, even passenger cars for management level employees (21% of the current total pcu) will increase in the future. However, because the ratio is low among all commuters, it is assumed to be 15% of the future total pcu. Based on the above conditions, the traffic volume forecast is calculated in Table 5.5.5.

Table 5.5.5 Traffic Volume of Commuters to and from SEZ

Vehicle Type	PCU Percentage		Commuters	Number of Users	Vehicle Units	PCU Factor	Traffic Volume of Commuters
	(Current)*	(Assumed)					
			(person)	(person)	(unit)		(PCU/day)
		(1)	(2)=(1)*85,996	(3)	(4)	(5)	(6)=(4)*(5)*2trips/day
Bicycle	0.2%	5%	4,300	1	4,300	0.2	860
Motorbike	13%	30%	25,799	1	25,799	0.5	12,899
Passenger car	21%	15%	12,899	2	6,450	1.0	6,450
Mini bus	36%	35%	30,099	25	1,204	1.0	1,204
Medium-large bus	17%	15%	12,899	40	322	2.0	645
Total		***100%***					***22,058***

Source: JICA Study Team, PCU= Passenger Car Unit、※Based on the survey in 2013.9.

2) Cargo Transportation

According to METI-FS, cargo transportation generated by the production activity in Thilawa SEZ is estimated to be 5,095 trucks/day. According to the study in Thilawa Port, future freight generation from four berths out of 37 berths is calculated to be 1,627 trucks/day. If we assume the same berth development conditions, there will be 15,050 trucks/day from Thilawa port after all berths are developed.

Based on METI-FS, it is assumed that most products from the SEZ will be transported to Thilawa Port because Thilawa SEZ intends to obtain foreign currency through export. Therefore, about 9,955 trucks/day will go to Yangon.

According to the traffic survey, current volume of heavy freight truck is about 883 trucks/day (52.5% of total truck traffic) while light freight truck is about 789 trucks/day (47.5% of total truck traffic). If, in the future, these two types of trucks maintain the same current ratio (50:50), the traffic volume for each type of truck is assumed at 4,978 trucks/day.

3) Traffic Volume Forecast based on the Development of Thilawa SEZ

Commuter Traffic

The destinations of commuter transportation can be separated into the following three routes: Route 1 (to Thanlyin and Yangon), Route 2 (to Dagon Bridge), and Route 3 (to Kyauktan). By using Table 4.2.5, Table 4.2.6 and Table 5.5.5, traffic volume for route 1 can be calculated as shown follows:

- $Q_{total} = Q_{1Y} + Q_{1T} + Q_2 + Q_3$……(i)
  As Shown in table 5.5.5, Q_{total}=22,058 pcu/day
- Current commuter daily traffic = All traffic - (light truck traffic + heavy truck traffic)
  As shown in table 4.2.5, P_1 = 22,878 - (832 + 2,141) = 19,905 pcu/day,
  As shown in table 4.5.6, P_2 = 1,749 – (503 + 76) = 1,170 pcu/day
  Q1 : Q2 = P1 : P2 = 181,300 : 1,170 ≒ 17 : 1 …… (ii)
- Commuters to Thanlyin and Kyauktan will be assigned following the population ratio between two townships.
  $Q_{1T} : Q_3 = T_{1T} : T_3$ ≒ 1.7 : 1.0 ……..(iii)
- Commuters from Thilawa SEZ to Yangon are assumed to be management level employees, or around 1% of the whole labor population.
  Total commuters number * 1% = 85,996 * 0.01 = 860 people
  It is assumed that 2 people using one car and with round trip , so
  Q_{1Y} = 860 pcu /day……(iv)

And

Q i: predicted traffic volume in Route 1 (pcu/day),
i : Name of route (Route 1Y: Route 1 goes to Yangon city, Route 1T: Route 1 goes to Thanlyin)
Pi: Current traffic volume in Route i
Ti : Current population of township i

From formula (ii)、(iii)、(v), $Q_{1T}=1.7Q_3$; $Q_1=17Q_2$; $Q_{1T}=Q_1-Q_{1Y}=17Q_2-860$;
So, $Q_2=(Q_{1T}+860)/17=(1.7Q_3+860)/17$……(vi)
From formula (i)、(iii)、(iv)、(vi), $22,058=860+1.7Q_3+(1.7Q_3+860)/17+Q_3$
So, Q_3≒7,570 pcu/day
From formula (iii), $Q_{1T}=1.7Q_3=1.7*7,570$≒12,870 pcu/day

Based on above calculation method, traffic volume in route 1, $Q_1= Q_{1Y}+Q_{1T}$ = 13,730 pcu/day. Commuter traffic volume in Route 1 (13,730 puc/day) is about 62.25% of the total commuter traffic generated from outside of Thilawa SEZ (22,058 pcu/day). This data will be used in Table 5.5.8.

Cargo Transportation

Due to the weight limitation of the existing Thanlyin Bridge, only light freight trucks are allowed to pass through Route 1. Heavy freight trucks will use Route 2.

Traffic volume of light freight trucks are assumed to be distributed to Route 1 and Route 2 proportionally following current distribution ratio. As shown in table 4.2.5, current daily traffic volume averaged by weekdays and weekends (P_{c1}, P_{c2}) is calculated as: $P_{c1} : P_{c2}$ = (764+832)/2 : (124+76)/2 = 798 : 100 ≒ 9 : 1.

As addressed in Section 5.5.3 (2) 1), estimated generation of light cargo truck is 4,978 trucks / day for one way. Since PCU coefficient = 1, traffic volume of light freight trucks is calculated (Q_{c1}) as: Q_{c1} = 9/10*4,978*2 = **8,960 pcu/day**

Forecast of Traffic Volume

Referring to the above analysis, the increased traffic volume in Route 1 will be 13,730 +8,960 = 22,690 pcu/day (estimated commuter traffic + estimated cargo traffic). If the existing traffic of 20,737 pcu/day (current commuter traffic + current light freight truck) is added, **the total traffic volume in Route 1 will become 43,427 pcu/day.**

5.5.4 Outline of Road Plan

(1) The Project

It is predicted that traffic volume in both Route 1 and Route 2 will increase greatly. It is thought that the need of the congestion reducing of Route 1 is higher than Route 2, since Route 1is mainly used for commuter traffic and Route 2 is mainly used as cargo traffic, off-peak traffic management can be applied to Route 2. Because Route 1 passes through an urban area, road expansion in Route 1 is urgent and necessary to secure safety from traffic accidents caused by increased traffic volume. Since the survey on Thanlyin Bridge and a new bridge next to it is being carried out by another study team, the target area for road expansion is the part of Thanlyin to Thilawa access road located south of Thanlyin Bridge.

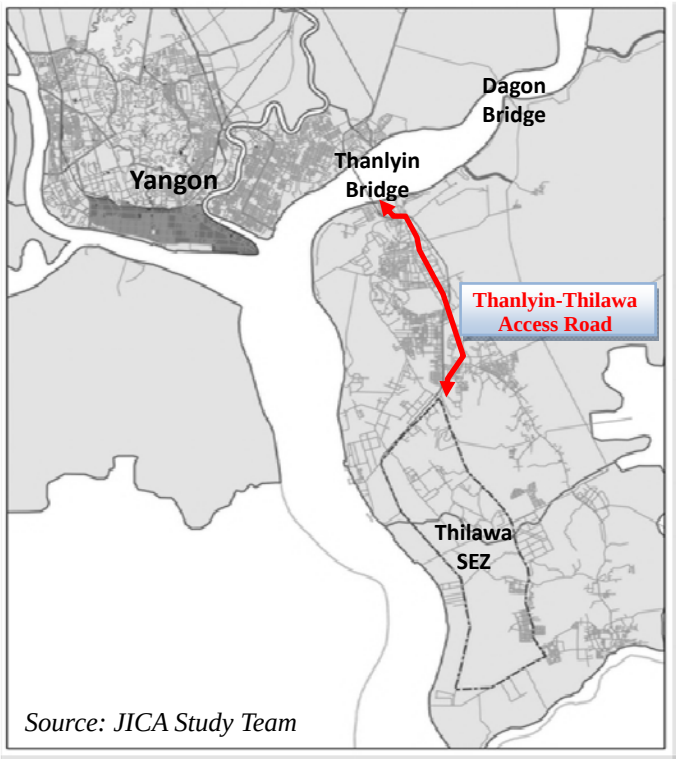


Figure 5.5.2 Access Road to Thilawa SEZ (Thanlyin to Thilawa Access Road)

(2) Development policy

Expansion plan shall utilize the existing road, and make sure the new road alignment should be located inside the MOC ROW. Land acquisition shall be avoided.

(3) Classification of Roads

Road type is classified based on the road design standards of the Japan Road Association, and the parameters are shown in Table 5.5.6.

Table 5.5.6 Classification of Thanlyin to Thilawa Access Road

No	Road Name	Design Speed	Classification	Standard Traffic Volume (one lane)	Standard Traffic Volume (4 lanes)
1	Thanlyin to Thilawa Access Road	60 km/h	4th Class, 1st grade	12,000 vehicles/per day	48,000 units/day

Source: Road Design Standards (Japan Road Association)

As estimated traffic volume for this road is 43,427 pcu/day, four lanes will be used for the Thanlyin to Thilawa SEZ access road.

(4) Summary of Thanlyin to Thilawa Access Road

The summary of Thanlyin to Thilawa Access Road is shown in Table 5.5.7 below.

Table 5.5.7 Summary of Thanlyin to Thilawa Access Road

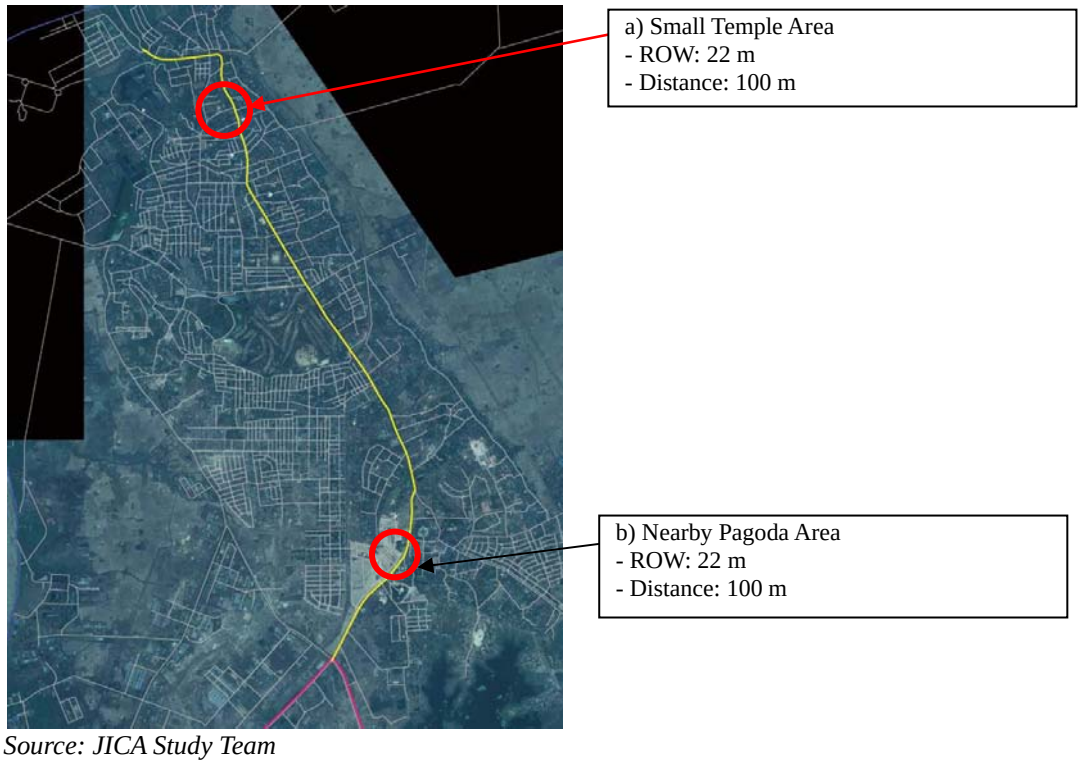
Road	Length	Number of Additional Lane	Width of Lanes	Width of Median	Sidewalk	ROW	Paved Material
Thanlyin to Thilawa Access Road	8,700 m	2 lanes each	16 m	1 m	4 m (both sides)	24.0 m*	Asphalt

Source: JICA Study Team
Note: ROW = Right of Way
** Note: in order to avoid the existing structure, part of ROW is set as 22 m.*

5.5.5 Road Expansion Plan

(1) Proposed Thanlyin to Thilawa Access Road Alignment

The horizontal alignment of the road is basically smooth, except one location with sharp curve. Since there are many existing buildings and structures along the existing road in the town section, in order not to affect the existing temples and pagodas, the center line are basically following the existing road centerline, except in the two locations shown in the map in Figure 5.5.3, where the center line are shifted from the existing road center line and cross sections are reduced to 22 m (reduced utility space).



Source: JICA Study Team

Figure 5.5.3 Main locations of changed road alignment

a. Small Temple Area

The Thanlyin to Thilawa Access Road alignment is adjusted in this area and the ROW is reduced to 22 m in order to avoid existing temple buildings.

Source: JICA Study Team

Figure 5.5.4 Existing Temples and New Alignment in the Small Temple Area

b. Nearby Pagoda Area

Due to fences in both sides of the road, the cross section is set at 22 m for a distance of around 100 m.

Source: JICA Study Team

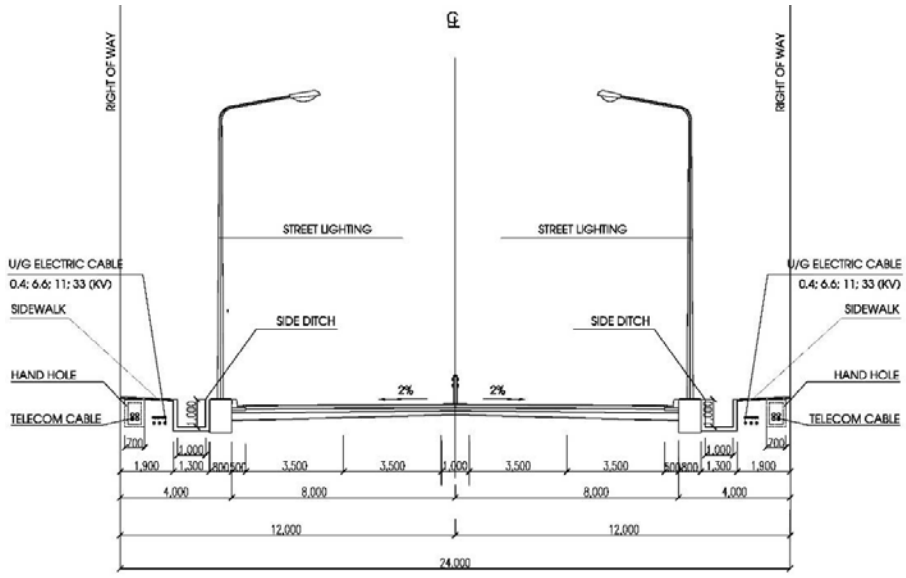
Figure 5.5.5 22 m Cross Section near Pagoda Area

(2) Typical Road Cross Section

The typical road cross section has been designed based on the following conditions:

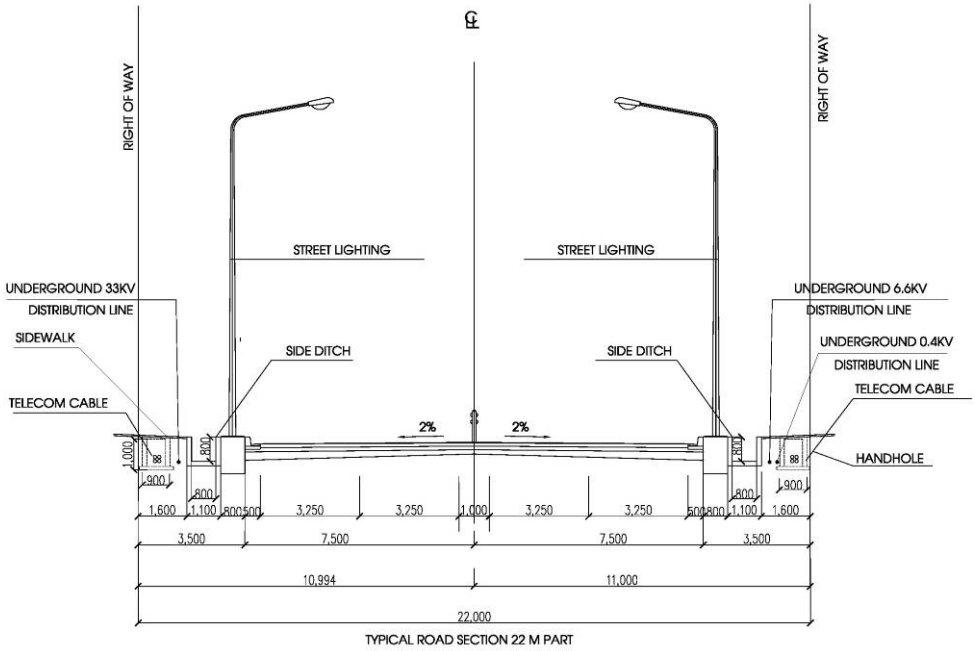
a. Required space for necessary infrastructure is considered (side ditch, street light/traffic signal, power supply, and telecommunication cable).

b. Referring to the result of traffic volume estimation, smooth traffic for commuters using different transportation tools and pedestrian sidewalks are considered during cross section design.



Source: JICA Study Team

Figure 5.5.6 Typical Cross Section of Thanlyin to Thilawa Access Road (24 m)

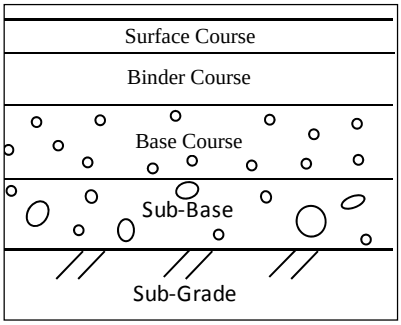


Source: JICA Study Team

Figure 5.5.7 Typical Cross Section of Thanlyin to Thilawa Access Road (22 m)

(3) Pavement Design

Pavement structures were designed in accordance with the images shown in Figure 5.5.8 below.



Source: JICA Study Team

Figure 5.5.8 Pavement Design

Based on the result of the dynamic cone penetration test (DCPT), the thickness of each layer in the asphalt pavement is calculated using the following conditions:

Calculation Conditions：

TA＝3.84 （$N^{0.16}$)/$CBR^{0.3}$

TA: Necessary equivalent thickness of pavement

N：49 kN Tire

CBR：CBR of road bed (Based on DCPT result, CBR=5)

Design life span：15 years

Table 5.5.8 Traffic Volume Forecast

	Weight	Traffic Volume*(unit/day)	Remarks
1.Standard Passenger Car	1.6 t	29,325 pcu/day	Traffic volume is calculated from the pcu of bicycle, motorbike, car, and light vehicle per person
2. Light Vehicles (Freight)	3 t	9,792 pcu/day	Freight transportation
3.Heavy Buses	8 t	2,155 pcu/day	-

Source: JICA Study Team

1. *Passenger car traffic volume = total traffic volume (43,427 pcu/day) - light truck (9,792 units/day)*1 (pcu factor) - heavy bus, 2,155 unit s* 2 (pcu factor) = 29,325 pcu/day*
2. *Traffic volume of light trucks = existing traffic volume, 832 (Table 4.2.5) + forecast traffic volume, 8,960 (refer to 5.5.3, 3)＝ 9,792 unit/day*
3. *Heavy buses = existing heavy buses, 1.955(Table 4.2.5, units) + forecast heavy bus traffic volume, 645 (Table 5.5.5 units) * 62.25% [(5.5.3 3) traffic assignment ratio to Route 1]/2 (pcu factor) = 2,155 units/day*

Based on the above calculation conditions, the necessary equivalent thickness of pavement, TA, is 25.4 cm. The proposed structure of the road pavement is shown in Table 5.5.9.

Table 5.5.9 Proposed Asphalt Pavement

	Structure of Asphalt Pavement (cm)	Convert factor*	TA
Asphalt course	5	1.00	5
Binder course	7	1.00	7
Base course	20	0.35	7

Sub-course	30	0.25	7.5
		Total	26.5 > 25.4 cm

Source: JICA Study Team

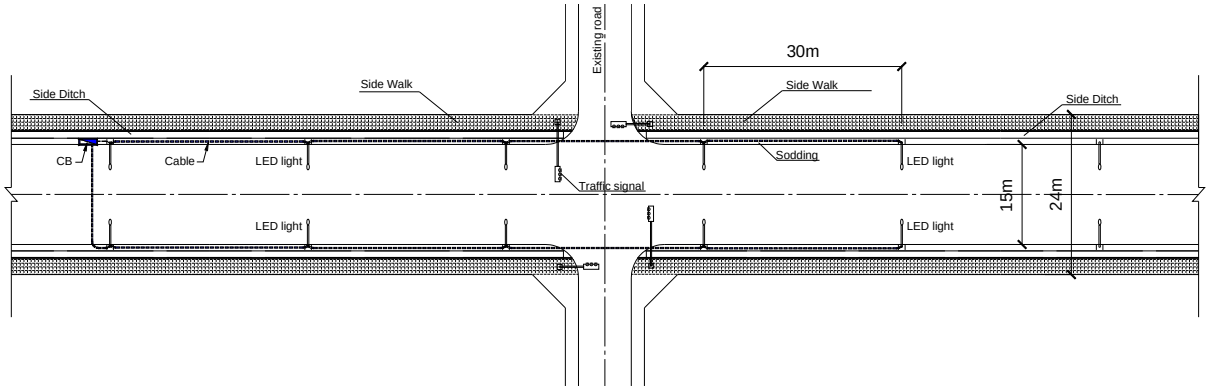
(4) Street Lighting and Traffic Signal

Since relevant authorities are concerned about the expensive electricity fee for street lighting, street lights will be placed only in existing street light locations and intersections. Existing street lights are all located within the new road ROW, therefore all of them need to be removed.

Table 5.5.10 Summary of Street Lighting

Type	Capacity	Height	Distance between Pole
LED	78 W	9 m	30 m

Source: JICA Study Team



Source: JICA Study Team

Figure 5.5.9 Typical Road Plan with Street Lights

The location of new street lighting is shown in Table 5.5.11.

Table 5.5.11 Location of New Street Lighting

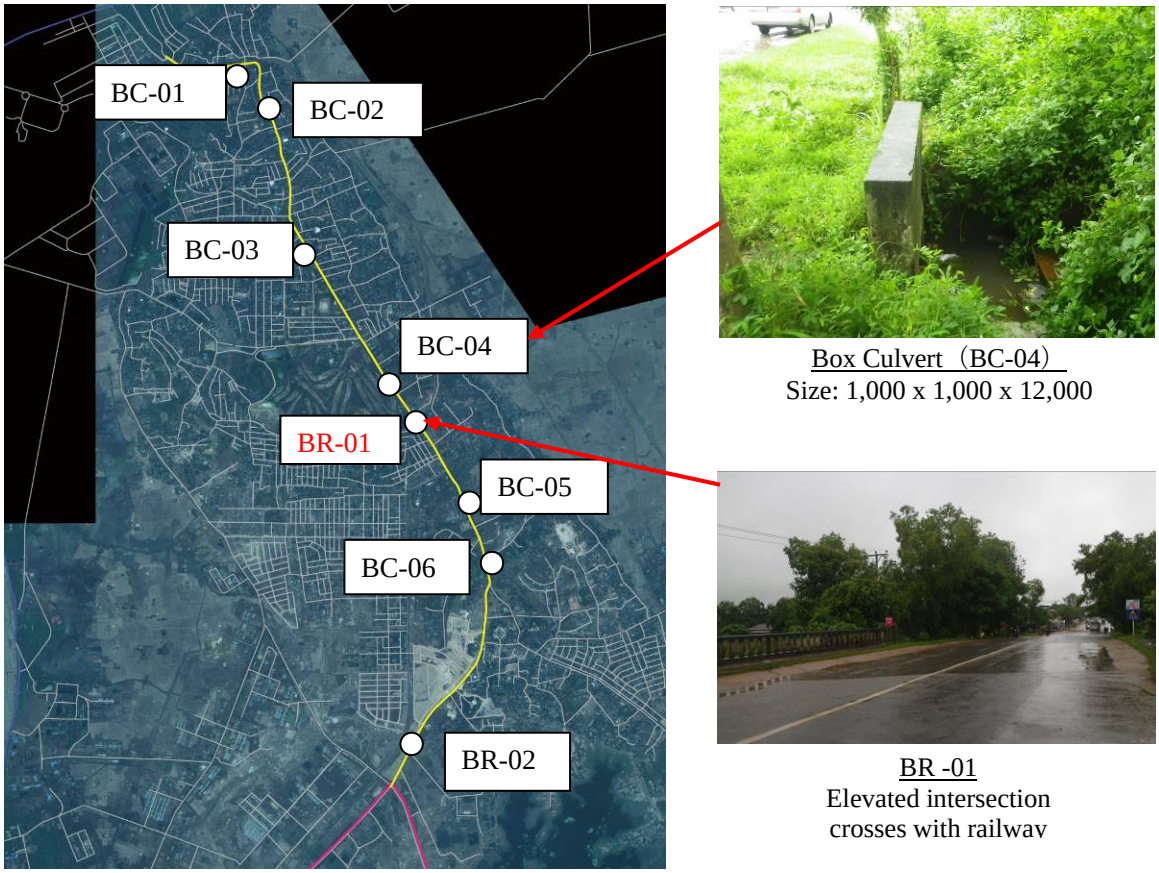
No.	Location	No. of Lamp
1	Thanlyin Bridge Approaches	68
2	Intersection of Kyaik Pagoda Street and U Ba Oh Street	12
3	Intersection of Kyaik Pagoda Street and Nan That Kone Street	24
4	Intersection of Kyaik Pagoda Street and Weizar Street	12
5	Intersection of Kyaik Pagoda Street and Pitautt Street	12
6	Intersection of Kyaik Pagoda Street and Bogyoke Nay Win Street	12
7	Intersection of Kyaik Pagoda Street and Site Pyo Yae Street	12
8	Intersection of Kyaik Pagoda Street and Thama College Street	12
9	Intersection of Kyaik Pagoda Street and Thamadi Street	12
10	Intersection of Kyaik Pagoda Street and Development Street	12
11	Before T-junction of Kyaik Pagoda Street and Thilawa Street	12
12	T-junction of Kyaik Pagoda Street and Thilawa Street	12
13	In front of Kyaeik Khout Pagoda	12
	Total	236

Source: JICA Study Team

In addition, there is one traffic signal in the intersection of Kyaik Khauk Myoma Kanar Road and Pagoda Road which needs to be replaced with a new traffic signal.

(5) Bridges and Box Culverts

The locations of existing bridges and box culverts are shown in Figure 5.5.10 and Figure 5.5.11.



Box Culvert（BC-04）
Size: 1,000 x 1,000 x 12,000

BR -01
Elevated intersection
crosses with railway

Figure 5.5.10 The Locations and Conditions of the Existing Box Culverts and Bridges

BC-01
Size: 1,500 x 1,000 x 15,000

BC-02
Size: 1,500 x 1,500 x 15,000

BC-03
Size: 1,000 x 1,000 x 12,000

BC-05
Size: 2,000 x 2,000 x 12,000

BC-06
Size: 2,000 x 2,000 x 12,000

BR-02
Span length：10.5m

Source: JICA Study Team

Figure 5.5.11 Existing Box Culverts and Bridges

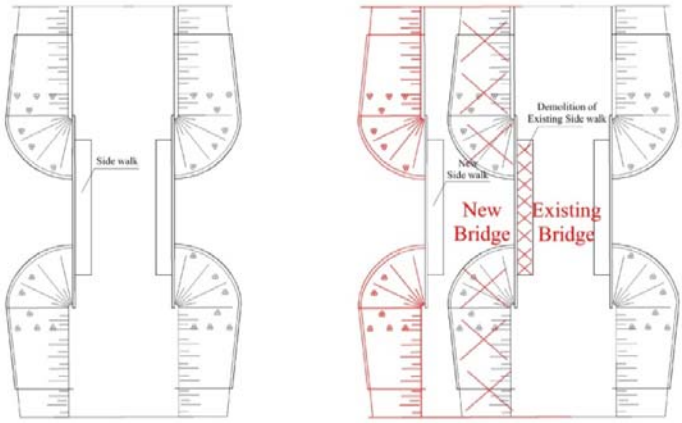
Due to the undesirable condition of existing box culverts and to meet the road width after expansion, the new box culvert size is proposed as shown in Table 5.5.12.

Table 5.5.12 Size of Box Culverts

Name	Size（mm）
BC-01	1,500 x 1,000 x 24,000
BC-02	1,500 x 1,500 x 24,000
BC-03	1,000 x 1,000 x 24,000
BC-04	1,000 x 1,000 x 24,000
BC-05	2,000 x 2,000 x 24,000
BC-06	2,000 x 2,000 x 24,000

Source: JICA Study Team

In addition, Bridge 2 (BR-2) needs to be expanded in line with the road width expansion. Regarding existing Bridge 1, there are already two lanes on each side.



Source: JICA Study Team

Figure 5.5.12 Expansion Plan for BR-2 (Expand 12 m to West Side)

(6) Power Supply Facilities

During the development of Thilawa SEZ, the power distribution system is maintained by YESB, and the power plants/substations are maintained by MOEP. After discussion with the above related authorities regarding land use and landscape, all overhead power supply lines inside the new road ROW will be relocated underground. The quantity for removing existing overhead power cable and quantity for installation of power cable are shown as follows:

Table 5.5.13 Summary of Power Supply Works

No.	Type of Power Distribution Line	Total Line Length(km)
(1)	Removal of O/H line	
1)	35 kV O/H line	14.90
2)	11 kV O/H line	2.10
3)	6.6 kV O/H line	19.90
4)	0.4 kV O/H line	8.90
(2)	Installation of U/G cable	
1)	35 kV U/G cable	14.50
2)	11 kV U/G cable	2.05
3)	6.6 kV U/G cable	19.40
4)	0.4 kV U/G cable	8.50

Source: JICA Study Team

Since the transformers shown in Table 5.5.14 were installed at the shoulder of the current road, they need to be relocated to the buffer area after the road expansion. (MOC-owned ROW is wider than the new ROW; buffer zone means the space between the two ROWs.)

Table 5.5.14 Summary of Existing Transformers

No.	Name of Transformer	No. of Transformer	Voltage	Capacity
1	Thaut Taw Kwin (1+2)	2	6.6/0.4 kV	2 x 315 kVA
2	Ah Mu Htan	1	6.6/0.4 kV	1 x 500 kVA
3	Yone Taw Kwat	1	6.6/0.4 kV	1 x 500 kVA
4	Aung Chan Thar (3)	1	6.6/0.4 kV	1 x 500 kVA

Source: JICA Study Team

(7) Plan of Telecommunications System

Inside of expansion road ROW, there are two types of Telecommunications system:

a. Underground telecommunications cable system (depth is about 0.6 m, distance to the existing buildings is about 1.0m)
b. Overhead telecommunications cable system

Due to the lack of detailed location map of underground telecommunications cable, it is difficult to show the location of underground telecommunications cable in the current stage. After discussion with MPT-Yangon Division, it was agreed that during the construction stage, the actual location of the underground cable would be confirmed together with the contractor before construction works.

When installing underground telecommunications cables, high-density polyethylene (HDPE) pipe will be used for protection. Four HDPE pipes will be installed on each side of the road in anticipation of future demand and other similar scale projects. In addition, hand holes are designed at every 50 m interval for maintenance and future installation purposes.

Table 5.5.15 Summary of Telecommunications Cable Works

No.	Type of Telecom Cable	Total Line Length(km)
(1)	Demolition of O/H line	
1)	Telecom cable	2.2
(2)	Installation of U/G cable	
1)	Copper telecom cable 100 x 2 x 0.4	8.7
2)	Copper telecom cable 300 x 2 x 0.4	1.3
3)	Fiber optic cable	18.8
4)	Installation of HDPE 130/100	68.0

Source: JICA Study Team

CHAPTER 6 ENVIRONMENTAL AND SOCIAL CONSIDERATION

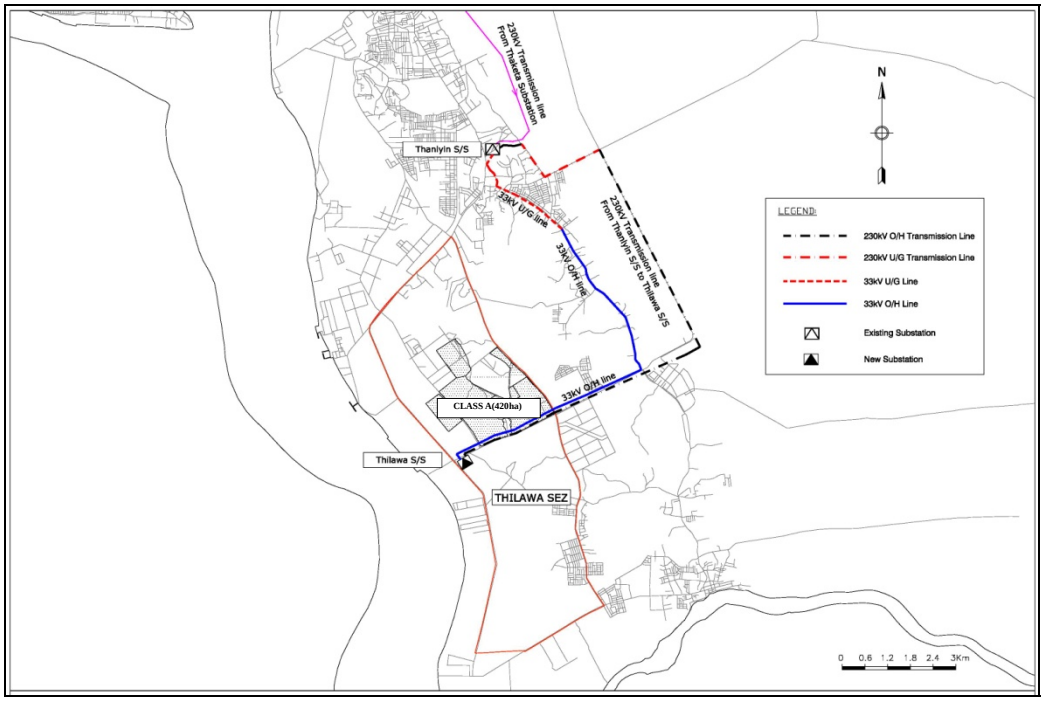
In the Survey, environment and social considerations were examined on two projects listed below. These are proposed to be implemented as public work projects by the Myanmar government.

1. Power Supply Facilities Upgrading Project (hereafter called "the Power Supply Project")
2. Road Expansion Project between Thanlyin Bridge and Thilawa SEZ (hereafter called "the Road Expansion Project")

6.1 Power Supply Project

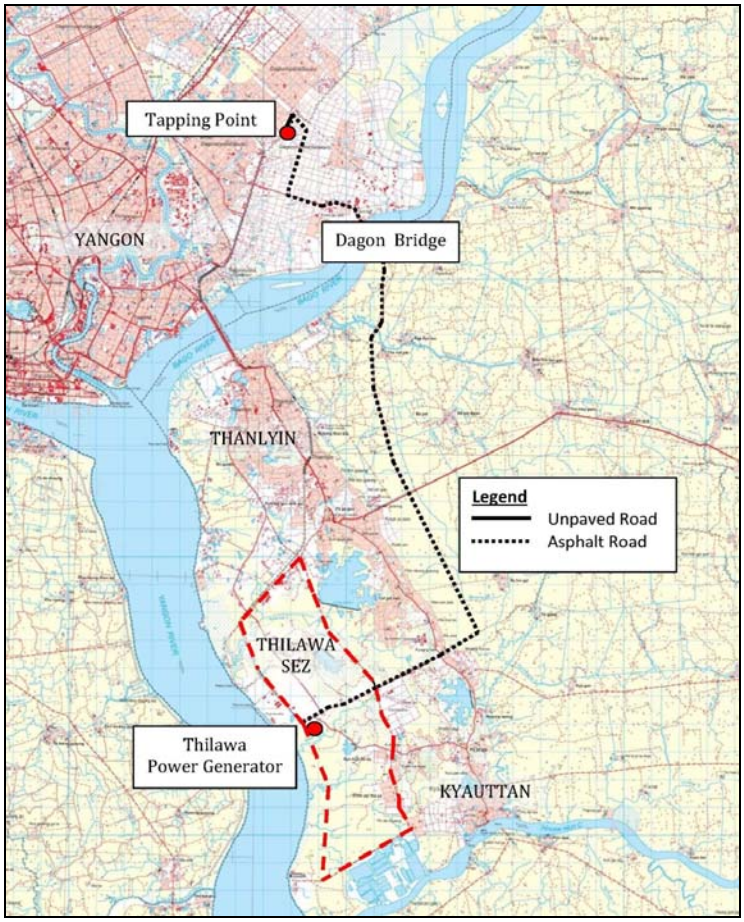
6.1.1 Location of Power Supply Project

Locations of the gas turbine generator, substation, 230 kV transmission line, and 33 kV distribution line of the Power Supply Project are mapped in Figure 6.1.1, while the alignment of the gas pipeline is shown in Figure 6.1.2.



Source: JICA Study Team

Figure 6.1.1 Location Map of the Power Supply Project (Gas Turbine Generator, Substation, 230 kV Transmission Line, and 33 kV Distribution Line)



Source: JICA Study Team

Figure 6.1.2 Location Map of the Power Supply Project (Gas Pipeline Alignment)

6.1.2 Current Situation of Surrounding Environment of the Subject Area

A satellite image and landscape photographs around the planned site for the gas turbine generators and substation are shown in Figures 6.1.3 to 6.1.5, respectively. The planned site and surrounding areas are widely covered by grasslands and morass as shown in the photographs.

Figure 6.1.3 Satellite Image around the Planned Site
Source: JICA Study Team, Note: The area is 350 m (from east to north) and 400 m . The northern direction points upward

Figure 6.1.4 Photograph of the North Side

Figure 6.1.5 Photograph of the South Side

Source: JICA Study Team

6.1.3 Alternative Study

(1) Components of Gas Turbine Generators and Substation

In the Power Supply Project, the 230kV Thilawa substation and gas turbine generators with 50 MW capacities (total area: approx. 10 ha) are planned to be constructed. Regarding the selection of location for the 230 kV substation, since the government have already finished land acquisition of the planned site which is located in the center of Thilawa SEZ, and it is a suitable location as a base to distribute electricity to the whole area with high efficiency, an alternative study is unnecessary to be conducted since there is no competitive location to install the substation other than the planned site.

For gas turbine generators, since it is essential to be set adjacent to the substation, two alternative candidates were considered: i) Case A, where the area is within the premises of the existing Thanlyin Substation and adjacent area, and ii) Case B where the area is adjacent to the Thilawa Electric Power Substation in the SEZ, as shown in Table 6.1.1. Case A was weighed against Case B based on technical and financial aspects as well as from the viewpoint of environmental and social considerations. As a result, Case B, where the proposed area is adjacent to the Thilawa Electric Power Substation in the SEZ, has been concluded as the optimum option as shown in Table 6.1.2.

Table 6.1.1: Candidates for the Alternative Plan of Power Supply Facilities

(Gas turbine power plant and substation)

Project	At the Existing Thanlyin Substation (Case A)	At the Thilawa SEZ (Case B)
Gas turbine generator	Construction inside the site of the existing Thanlyin Substation	Construction inside Thilawa SEZ
Substation	Construction inside Thilawa SEZ	

Source: JICA Study Team

Table 6.1.2 Comparison of Alternatives Plans for the Power Supply Project (Gas Turbine Generators)

Alternatives	Case A：In the existing Thanlyin Electric Power Substation site	Case B：In the site of Thilawa SEZ
General	Construction within the premises of the existing Thanlyin Substation	Construction in the Thilawa SEZ.
Technical aspect	There are six 33 kV underground power distribution lines under the planned site inside the existing Thanlyin Substation. The construction work will be necessary to divert the lines outside of the site and reset it, because the lines will become an obstruction at the time when the new gas turbine generators will be set up. It is necessary to consider the cost to purchase new underground lines with the laying operation and remove the present lines. Construction with power suspension will be necessary though it will last for a short time. Earthwork and land leveling will also be necessary for some parts of the planned site.	There are few technical issues due to the flat site and no obstruction around.
Economic aspect	The power transmission loss will be bigger than Case B due to its long distance of approximately 13 km from Thilawa area including villages, college, port, and SEZ, which is the main supply destination.	There is almost no electricity transmission loss unlike Case A because the facility site is inside the supply destination area.
Environmental consideration aspect	Noise would be an issue due to its short distance of 10 m from the border of the electric generation facility site to the closest residence.	Noise would not be a significant issue because there is a distance of 100 m from the border of the generator site and the closest residential area and forest zone would be set with a 16 m buffer zone around the site.
Social consideration aspect	The planned site for the power facility is located in the area of the existing Thanlyin Substation and a vacant lot adjacent to it. There is neither a residence nor activity of livelihood in the area.	The site is inside a government property. There are no residences and activities of livelihood in the planned area.
Location Map	 Source: JICA Study Team **Case A：In the Existing Thanlyin Electric Power Substation Site**	 Source: JICA Study Team **Case B：In the Thilawa SEZ**
Evaluation	Although it is closer to the main fuel supply area, technical difficulties, electric transmission loss, and environmental impacts are assumed.	Although it is far from the main fuel supply area compared to Case A, it is not so crucial with a pipeline fuel supply. Construction will have fewer issues, and electric transmission loss will not be so significant. Environmental impacts to be assumed are less in Case B. Therefore, Case B will be adopted.

Source: JICA Study Team

(2) 230 kV Transmission Line and 33 kV Distribution Line

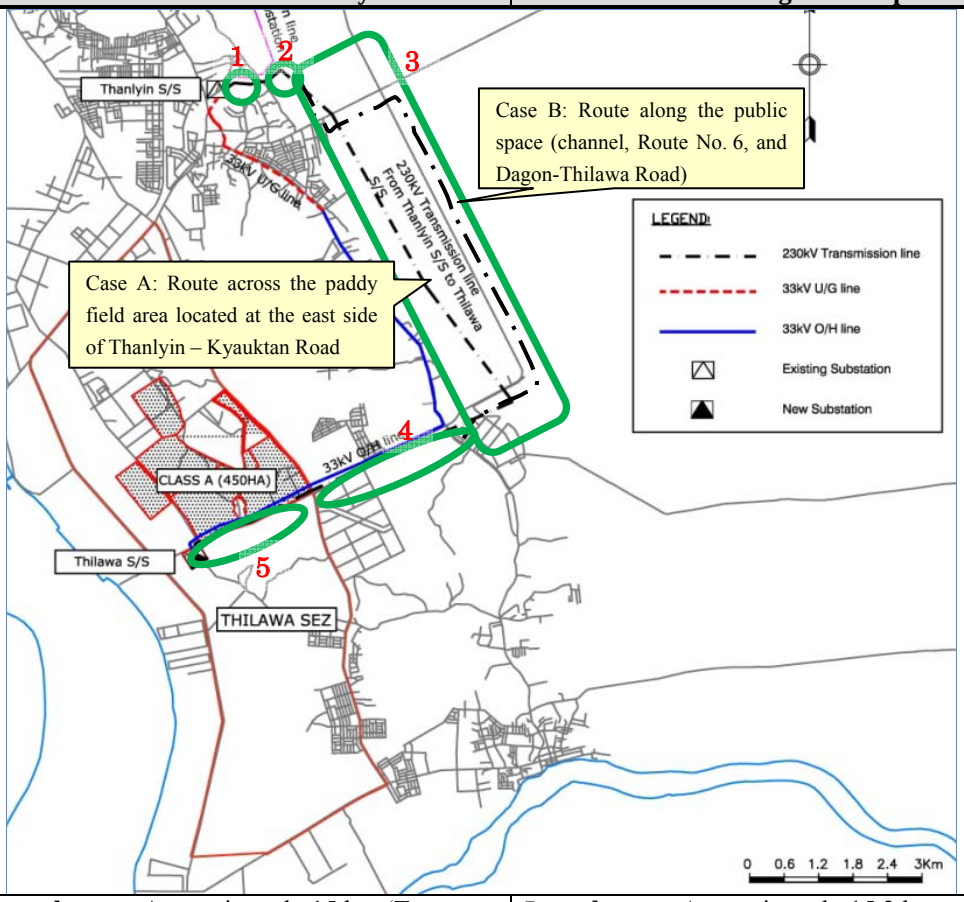
There are two components for the transmission line and distribution line construction in the Power Supply Project, i.e., one is the construction of a 230 kV transmission line from Thanlyin Substation to Thilawa Substation, while the other is the construction of a 33 kV distribution line from Thanlyin Substation to Thilawa Substation. With respect to the 33 kV distribution line, the line will be planned to run along and the hard shoulder of the road and will be set underground in crowded areas occupied by houses and vendors. Therefore no serious environmental and social impacts are assumed. Furthermore, it will be possible to adjust the positions of distribution line poles and change the alternative route. In this connection, an alternative study for 33 kV distribution line was not examined.

On the other hand, regarding the 230 kV transmission line from Thanlyin Substation to Thilawa Substation, a part of the transmission line which is from the existing Tower No. 1 to Tower No. 5 has been constructed already by MEPE. Thus, the transmission line is targeted to be constructed from the existing Tower No. 5 to Thilawa Substation. There are two alternatives as shown in Table 6.1.3: the route of Case A which is laid across more than half of the paddy field area, and the route of Case B which is laid mostly along the road and channel. An alternative study was examined by comparing the two cases regarding environmental consideration, technical aspect, and cost.

As a result of the study, Case A adopted the tower type to support the transmission line. The tower is easy to construct and its costs is lower compared with Case B. However, it is necessary to acquire the lands to build the towers before the start of construction as well as to secure at a certain period an agreement with the land owner on the compensation. Besides, this is a risk that may cause delay of the project completion because it is necessary to acquire land at the beginning when the transmission route alignment is changed after the start of construction. On the other hand, Case B requires higher construction cost compared with Case A, but there is no need to acquire lands because the route will use the premises of public facilities (road and channel). Thus, risk of delaying the project completion will be minimized. As a result of the alternative study, Case B is selected as shown in Table 6.1.3 because it is necessary to take precedence to supply electric power to the surrounding area as soon as possible. But Case A has a big advantage on the cost aspect. Therefore, it is recommended that an alternative study will be examined again in the detailed design stage.

Table 6.1.3 Comparison of Alternative Plans for Power Supply Project (230 kV Transmission Line)

Alternatives	Case A: Route Across Paddy Field	Case B: Route Along Public Space
Project Description	Construction of one circuit transmission line from Thanlyin Substation to Thilawa Substation. More than half of the transmission routes are across the paddy field area located at the east side of Thanlyin–Kyauktan Road.	Construction of one circuit transmission line from Thanlyin Substation to Thilawa Substation. Most of the routes of the transmission lines are laid along the public facilities such as channel, Route No. 6, and Dagon-Thilawa Road.
Route	Section 1: From Thanlyin Substation to Tower No. 1– No. 5 (use of existing transmission line, same route between Class A and Class B)	
	Section 2: - Construction of two new towers for the existing transmission line to Kamarnut instead of the existing Tower No. 6 and modification of the route. - Use of Tower No.6 for the transmission line to Thilawa,	Section 2: - Construction of cable head for connection between overhead and underground transmission lines within ROW around the existing Tower No. 5.
	Section 3: - Construction of towers in the paddy field area.	Section 3: - Construction of underground transmission line to Dagon-Thilawa Road (2.9 km; 1.3 km along the channel, 1.6 km along route No. 6), - Construction of cable head for connection between overhead and underground transmission lines within ROW of Dagon-Thilawa Road, then construction of steel monopole along the road.
	Section 4: - Changing direction to southwest bound for Thilawa SEZ - Construction of steel monopole along Dagon-Thilawa Road (same route between Class A and Class B)	
	Section 5: - Construction of towers for four circuits along the channel in Class B of Thilawa SEZ with consideration of future power supply.	Section 5: - Construction of steel monopole for single circuit along Dagon-Thilawa Road same as Section 4. - Construction of one transmission tower inside of Thilawa Substation site.

Alternatives	Case A: Route Across Paddy Field	Case B: Route Along Public Space
Route Map		
Technical Aspect	**Length:** Approximately 15 km (Towers: 12 km, steel monopoles 3 km) **No. of towers:** 34 **No. of steel monopoles:** 16 **Construction method:** Necessary to secure spaces for access road from the existing road for towers to be constructed temporary in the paddy field area **Normal span of towers:** 350 m **Area of land for a tower:** 15 m x 15 m=225 m^2 **Normal span of steel monopoles**: 150-200 m **Area of land for a pole**: 5 m x 5 m=25 m^2 * All these items will be reviewed in the detailed design stage	**Length:** Approximately 15.3 km (steel monopoles 12.4 km, underground 2.9 km) **No. of tower:** 1 (only inside the substation site) **No. of steel monopoles:** 63 (200m span case) **Construction Method:** Easy to construct steel monopole compared with Case A due to the use of existing road area, need to construct 2.9 km underground transmission line. **Normal span of steel monopoles:** 150-200 m **Area of land for a pole:** 5 m x 5 m=25 m^2 **Diameter of transmission line in the underground:** Approximately 2,000 mm^2 as a single core **Size of conduit line in the underground**: 0.2 m diameter at 1.2 m depth from the ground with earthwork of 1.5 m width x 1.6 m depth. * All these items will be reviewed in the detailed design stage.
Economic Aspect	**Cost:** - Lower total cost of towers/monopoles compared with Case B because a tower is a standard production and can be procured in Myanmar - Lower construction cost of	**Cost:** - 5.3 times of the total construction cost higher than Case B because high cost materials and construction method such as steel

Alternatives	Case A: Route Across Paddy Field	Case B: Route Along Public Space
	transmission line due to short length, - Land acquisition cost will be assumed. **Duration:** - Same as construction period - Delay of construction might be assumed because it is necessary to secure a certain time to negotiate with the land owner about compensation in case of land acquisition and a deal breaker issue may come up.	monopole and underground transmission line will be adopted. **Duration:** - Same as construction period - No delay of construction as there will be no land acquisition issue.
Environmental Consideration	No difference between Case A and Case B.	
Social Consideration	No resettlement will be assumed but land acquisition of approximately 20 paddy fields and some areas in Section 4 will be assumed.	No land acquisition and resettlement will be assumed.
Evaluation	Case A has an advantage on the cost aspect compared with Case B but necessary to conduct land acquisition. Furthermore, delay of construction might be assumed especially a deal breaker issue may arise.	Case B has a disadvantage on the cost aspect compared with Case A but has an advantage on the social consideration component such as unnecessary land acquisition. Furthermore, no delay of construction due to land acquisition will be assumed. In this connection, Case B is selected as a priority plan.

Source: JICA Study Team

(3) Gas Pipeline

As shown in Figure 6.1.2, the connection point of existing gas pipeline (valve station) is located at approximately 5 km north from the Dagon Bridge. Thus, a route passing through the existing road from the valve station to the Dagon Bridge (See Figure 6.1.6), the Dagon Bridge itself, and Dagon-Thilawa Road to the gas turbine generator in Thilawa SEZ is the most feasible alignment for the gas pipeline because of a relatively short distance, most cost efficient, and less impacts on the environmental and social aspects. In this connection, an alternative study for selection of gas pipeline route was not examined.

On the other hand, there are two options to pass the Bago River, i.e., attaching gas pipeline to the Dagon Bridge (Case A) and construction of a new bridge of single purpose for gas pipeline (Case B). Alternative comparison between Cases A and B has been conducted based on technical and financial aspects, as well as from the viewpoint of environmental and social considerations. As a result, Case A, that is attaching gas pipeline to the Dagon Bridge, has been considered to be better, as shown in Table 6.1.4.

Source: JICA Study Team

Figure 6.1.6 Dagon Bridge Proposed to be Used for Gas Pipeline

Table 6.1.4 Comparison of Alternative Plans for Power Supply Project (Gas Pipeline)

Alternatives	Case A: Attaching Gas Pipeline to the Dagon Bridge	Case B: Construction of a New Bridge of Single Purpose for Gas Pipeline
Project Description	Attaching gas pipeline to the Dagon Bridge by installation of a temporary stage (bracket).	Construction of a new bridge of single purpose for gas pipeline passing the Bago River.
Technical Aspect	Possible for many local contractors in Myanmar to implement the construction.	Possible for some contractors to implement the construction which have advanced technology for construction of new bridge over a big river.
Economic Aspect	Construction cost is lower than Case B because the components of construction are only for installation of a temporary stage (bracket) and attachment of gas pipeline. In addition, duration of construction will be shorter than Case B.	Construction cost is higher than Case A because the necessity to construct the new bridge including design works. In addition, the duration of construction works will be longer than Case B.
Environmental Consideration	No particular environmental impact will arise.	River water quality shall be considered due to the dredging of river bed by the construction of pier.
Social Consideration	Traffic congestion will temporary be created as half lane in some parts will be occupied for securing the construction space.	It is necessary to consider avoiding interference with navigation of the ship's course on the river.
Evaluation	Although it is necessary to consider social aspect, Case A has advantages on the technical, cost, and environmental aspects compared with Case B. In this connection, Case A is selected as the priority plan.	Compared with Case A, Case B has disadvantages on the technical, cost, and environmental aspects.

Source: JICA Study Team

6.1.4 Scoping

Below are the proposed components of the priority infrastructure development projects. These facilities are subject to consider Environmental and Social Considerations.

(1) Short term (targeted to be completed in 2015): 33 kV distribution line from Thanlyin Substation

a. 33 kV distribution line
b. Rehabilitation of Thanlyin Substation (Set up switches for 33kV line)
c. 33 kV switch gear of new Thilawa Substation

(2) Medium term (targeted to be completed in 2018): Thilawa Substation and gas turbine generator

d. 230/33 kV Thilawa Substation
e. Gas turbine generator
f. 230 kV transmission line
g. Rehabilitation of Thanlyin Substation (Set up switches for 230kV line)
h. Gas pipeline

Each environmental impact varies depending on the characteristic or feature of each project for electric power generation, electric energy transformation, and electric power transmission and distribution. Regarding items for impact evaluation (draft scoping), components of target projects have been reclassified as Table 6.1.5 in order to clarify environmental impacts better. Evaluation of pollution control measure, natural environment, and social environment are classified from A to D based on the JICA Guidelines for Environmental and Social Considerations.

Table 6.1.5 Reclassification of Components of Target Projects for Impact Evaluation

Project classification to determine items for impact evaluation (draft scoping)	Target Project
Electric power generation	e. Gas turbine generator
Gas pipeline	h. Gas pipeline
Transformation of electric energy	d. Thilawa Substation (230/33 kV)
Transmission and distribution of electric power.	a. Distribution line (33 kV) b. Thanlyin Substation（rehabilitation） c. 33 kV switch of new Thilawa Substation
	f. 230 kV transmission line g. Thanlyin Substation（rehabilitation）

Source: JICA Study Team

(1) Power Supply Project (Gas Turbine Generator)

Table 6.1.6 shows the results of the scoping on the Power Supply Project.

Table 6.1.6 Results of Scoping on Power Supply Project (Gas Turbine Generator)

Category	Scoping Item	Evaluation		Reasons for Evaluation
		Before / During Construction (BC/DC)	Operation Stage (OS)	
Pollution	Air	B-	B-	**DC:** Gas emission from construction equipment, dust arising from construction activities, and air pollution due to traffic congestion are anticipated. **OS:** Because of gas emission from the operation of power supply facilities, concentration of polluted air may elevate.
	Water	B-	B-	**DC:** Muddy water flowing towards the rivers from bare land in the construction site, and drainage from construction bunkhouses may deteriorate water quality. **OS:** Water pollution including thermal discharge would be caused by the operation of power generation facilities.
	Solid Waste	B-	B-	**DC:** Solid wastes from cuttings and removal of manufactured articles are anticipated. **OS:** Wastes like smoke dust and sludge are assumed to be emitted from the operation of electrical power generator.
	Soil Contamination	D	D	**DC:** The planned site lies on pasture and agricultural lands. Therefore, land contamination is not assumed. **OS:** No activities causing soil pollution are anticipated.
	Noise / Vibration	C	B-	**DC:** Noise and vibration from operation of construction machinery and on-site vehicles are anticipated. **OS:** Operation of machineries in the power generation facilities and carrying materials in and out may cause noise and vibration.
	Subsidence	D	D	Excavation work and intake of underground water that cause subsidence are not anticipated.
	Odor	D	D	**DC:** Construction causing odor is not anticipated. **OS:** Small impact by odor is assumed. Though ammonium is to be used in denitration process for the operation of electrical generation facility, the

Category	Scoping Item	Evaluation		Reasons for Evaluation
		Before / During Construction (BC/DC)	Operation Stage (OS)	
				amount of it is small.
	Sedimentation	D	D	**DC:** Impact of sedimentation is not expected because gas turbine will be used for electricity generation and water intake facility with dredging work is not necessary. **OS:** No significant impact is anticipated.
Natural Environment	Natural Preserve	D	D	No natural preserves exist in and around the project site.
	Biota	D	D	Impact on biofacies is not assumed. Areas around the site are pasture and agricultural lands, while rare and precious species of animals and plants have not been identified.
	Ecosystem	D	C	Impact on inland ecosystems is not assumed. Substantial change (e.g., habitat disjuncture) caused by the construction of the electrical generation facility is not expected. On the other hand, impact on aquatic ecosystems of rivers due to heated effluent is assumed.
	Hydrology	D	D	Because the project does not change water current and riverbed and does not include structure development such as tunnels, impacts on hydrology are not anticipated.
	Topography/ Geography	D	D	Because the project does not require a massive boring or excavation, no significant impact is anticipated.
Social	Involuntary Resettlement	D	D	Because there are no residences inside the project site, no resettlement is anticipated.
	Poor	B+	B+	**DC:** Job opportunities and commercial activities may be enhanced by construction works that lead the poor to increase their earnings. **OS:** By operation of power generation facilities, customers, surrounding stores, and restaurants may be increased and economical activities may be enhanced that may lead the poor to increase their earnings.
	Indigenous and Ethnic Minority	D	D	No indigenous and ethnic minority groups reside in and around the site.
	Local economy such as Employment and Livelihood	B+	A+/B-	**DC:** Locals will have job opportunities and the regional economy will be boosted. Other local resources and food will be procured on site. **OS：** The local economy and employment will be boosted with the operation of the power supply facilities. On the other hand, it is assumed that impact due to the heated effluent from electrical generation facilities on fishery in the area will cause loss of livelihood.
	Land Use and Local Resources	D	D	There is no threat that could damage land use and local resources.
	Water Use	D	B-	**DC：** No threats on the use of water from this construction. **OS:** The thermal discharge from the power plant may impact the fishing industry.
	Existing Infrastructure	D	D	No impacts on existing social infrastructures and services.

Category	Scoping Item	Evaluation		Reasons for Evaluation
		Before / During Construction (BC/DC)	Operation Stage (OS)	
	and Services			
	Social structure such as Provincial Government	D	D	No impacts on existing social structures.
	Uneven Distribution of Harm and Benefit	D	D	The power generated from this power plant will not be consumed only in the SEZ, but will also be distributed to other districts. There will be no uneven distribution of harm and benefit.
	Conflicts of Interest within the Region	D	D	There will be no conflicts of interest within the region.
	Cultural Heritage	D	D	Because there is no cultural heritage at the site, negative impact is not anticipated.
	Landscape	D	D	Impact on landscape is not expected because there are no important landscapes and viewpoints to be considered around the project area.
	Gender	D	D	Negative impact on gender is not anticipated.
	Children's Right	D	D	Negative impact on children's right is not anticipated.
	Risks of Infectious Diseases such as AIDS/HIV	B-	D	**DC:** There may be risks of infectious disease due to the influx of workers. **OS:** Because there is no large change in traffic volume from the increase in inflow into the site from different regions, impacts on infectious disease are not anticipated.
	Working Environment	B-	B-	**DC:** It is necessary to consider occupational safety and health during construction. Also, accidents to third parties are anticipated. **OS:** Working environment may be deteriorated because workers may have to work in dangerous and loud areas when the plant is operating.
Others	Accident	B-	B-	**DC:** It is necessary to consider the possibility of accidents during construction. **OS:** Careful attentions are needed because there will be some dangerous works during plant operation.
	Global Warming	D	B-	**DC:** No significant impact to climate change. **OS:** The exhaust gases from the plant at the time of operation may contribute to climate change.

Source: JICA Study Team

Evaluation: A-: Significant negative impact A+: Significant positive impact
B-: Some negative impact B+: Some positive impact
C: Impacts are not clear, need further investigation
D: No impacts or impacts are negligible, no further study required
* The scoping items are selected in reference with the new JICA Guidelines for Environmental and Social Considerations

(2) Gas Pipeline

Table 6.1.7 Results of Scoping on Power Supply Facilities Upgrading Project (Gas Pipeline)

Category	Scoping Item	Evaluation		Reasons for Evaluation
		Before / During Construction (BC/DC)	Operation Stage (OS)	
Pollution	Air	B-	D	**DC:** Gas emission from construction equipment, dust arising from construction activities, and air pollution due to traffic congestion are anticipated. **OS:** Emissions of air pollutants from gas pipeline operation are not anticipated.
	Water	B-	D	**DC:** Muddy water flowing towards the rivers from bare land in the construction site may deteriorate water quality. **OS:** Water pollution from gas pipeline operation is not anticipated.
	Solid Waste	B-	D	**DC:** Solid wastes from cuttings and removal of manufactured articles are anticipated. **OS:** Emission of solid waste from gas pipeline operation is not anticipated.
	Soil Contamination	D	D	**DC:** The planned site lies on pasture and agricultural lands. Therefore, land contamination is not assumed. **OS:** No activities causing soil pollution are anticipated.
	Noise / Vibration	B-	D	**DC:** Noise and vibration from operation of construction machinery and on-site vehicles are anticipated. **OS:** Noise and vibration from gas pipeline operation are not anticipated.
	Subsidence	D	D	Excavation work and intake of underground water that may cause subsidence are not anticipated.
	Odor	D	D	**DC:** Construction causing odor is not anticipated. **OS:** Operation causing odor is not anticipated.
	Sedimentation	D	D	No significant impact on sedimentation is anticipated.
Natural Environment	Natural Preserve	D	D	No natural preserves exist in and around the project site.
	Biota	D	D	Impact on biofacies is not assumed. Areas around the site are pasture and agricultural lands, while rare and precious species of animals and plants have not been identified.
	Ecosystem	D	D	Impact on inland ecosystems is not assumed. Substantial change (i.e., habitat disjuncture) by the construction of the gas pipeline is not expected.
	Hydrology	D	D	Because the project does not change water current and riverbed and does not include any structure development such as tunnels, impacts on hydrology are not anticipated.
	Topography / Geography	D	D	Because the project does not require a massive boring or excavation, no significant impact is anticipated.
Social	Involuntary Resettlement	D	D	Because there are no residences inside the project site, no resettlement is anticipated.
	Poor	B+	D	**DC:** Job opportunities and commercial activities may be enhanced by construction works that may

Category	Scoping Item	Evaluation		Reasons for Evaluation
		Before / During Construction (BC/DC)	Operation Stage (OS)	
				lead the poor to increase their earnings. **OS:** No positive or negative impact to the poor is anticipated from the gas pipeline operation.
	Indigenous and Ethnic Minority	D	D	No indigenous and ethnic minority groups reside in and around the site.
	Local Economy such as Employment and Livelihood	B+	A+	**DC:** Locals will have job opportunities and the regional economy will be boosted. Other local resources and food will be procured on site. **OS :** The local economy and employment will be boosted by the operation of the gas pipeline together with the operation of the power supply facilities.
	Land Use and Local Resources	D	D	There is no threat that could damage land use and local resources.
	Water Use	D	D	No threats on the use of water from this construction.
	Existing Infrastructure and Services	D	D	No impacts on existing social infrastructures and services.
	Social Structure such as Provincial Government	D	D	No impacts on existing social structures.
	Uneven Distribution of Harm and Benefit	D	D	The power generated from the gas turbine generator will be distributed to districts other than Thilawa SEZ. There will be no uneven distribution of harm and benefit.
	Conflicts of Interest within the Region	D	D	There will be no conflicts of interest within the region.
	Cultural Heritage	D	D	Because there is no cultural heritage found within the site, negative impact is not anticipated.
	Landscape	D	D	Impact on landscape is not expected because there are no important landscapes and viewpoints to be considered around the project area.
	Gender	D	D	Negative impact on gender is not anticipated.
	Children's Right	D	D	Negative impact on children's right is not anticipated.
	Risks of Infectious Disease such as AIDS/HIV	B-	B-	**DC:** There may be risks of infectious disease due to the influx of workers. **OS:** Because there is no large change in traffic volume from the increase in inflow into the site from different regions, impacts on infectious disease are not anticipated.
	Working Environment	B-	B-	**DC:** It is necessary to consider occupational safety and health during construction. Also, accidents to third parties are anticipated. **OS:** Working environment may be deteriorated because workers may have to work in dangerous and loud areas when the plant is operating.
Others	Accident	B-	D	**DC:** It is necessary to consider the possibility of accidents during construction. **OS:** Careful attentions are needed because there

Category	Scoping Item	Evaluation		Reasons for Evaluation
		Before / During Construction (BC/DC)	Operation Stage (OS)	
				will be some dangerous works during operation.
	Global Warming	D	D	No significant impact to climate change.

Source: JICA Study Team

Evaluation: A-: Significant negative impact A+: Significant positive impact
B-: Some negative impact B+: Some positive impact
C: Impacts are not clear, need further investigation
D: No impacts or impacts are negligible, no further study required
* The scoping items are selected in reference with the new JICA Guidelines for Environmental and Social Considerations

(3) Power Supply Project (Substation)

Table 6.1.8 Results of Scoping on Power Supply Facilities Upgrading Project (Substation)

Category	Scoping Item	Evaluation		Reasons for Evaluation
		Before/ During Construction (BC/DC)	Operation Stage (OS)	
Pollution	Air	B-	D	**DC:** Gas emission from construction equipment, dust arising from construction activities, and air pollution due to traffic congestion are anticipated. **OS:** No discharge of air polluting substances from the substation operation.
	Water	B-	D	**DC:** Muddy water flowing towards the rivers from bare land in the construction site may deteriorate water quality. **OS:** No deterioration of water quality due to the water discharge from the substation is anticipated.
	Solid Waste	B-	D	**DC:** Solid wastes from cuttings and removal of manufactured articles are anticipated. **OS:** There will be no solid waste generated from the substation that would require special treatment.
	Soil Contamination	D	D	No activities causing soil pollution are anticipated.
	Noise/Vibration	B-	D-	**DC:** Noise and vibration from the operation of construction machineries and on-site vehicles are anticipated. **OS:** There are no machineries in the substation which may cause noise and vibration to the surrounding area.
	Subsidence	D	D	Excavation work and underground water intake that may cause subsidence are not anticipated.
	Odor	D	D	**DC:** Construction causing odor is not anticipated. **OS:** There are no activities in the substation which may cause odor.
	Sedimentation	D	D	No significant impact is anticipated.
Natural Environment	Natural Preserve	D	D	No natural preserves exist in and around the project site.
	Biota	D	D	Impact on biofacies is not assumed. Areas around the site are pasture and agricultural lands, while rare and precious species of animals and plants have not been identified.
	Ecosystem	D	D	The construction of the substation will not damage any ecosystem and will not cause any habitat fragmentation.
	Hydrology	D	D	Because the project does not change water current and

Category	Scoping Item	Evaluation		Reasons for Evaluation
		Before/ During Construction (BC/DC)	Operation Stage (OS)	
				riverbed, impacts on hydrology are not anticipated.
	Topography, Geography	D	D	Because the project does not require a massive boring or excavation, no significant impact is anticipated.
Social	Involuntary Settlement	D	D	Because there are no residences inside the project site, no resettlement is anticipated.
	Poor	B+	D	**DC:** Job opportunities and commercial activities may be enhanced by construction works that may lead the poor to increase their earnings. **OS:** There will be no impacts to the poverty level at the time of operation.
	Indigenous and Ethnic Minority	D	D	No indigenous and ethnic minority groups reside inside and around the site.
	Local Economy such as Employment and Livelihood	B+	B+	**DC:** The regional economy will be boosted. There will be job opportunities for locals. Other local resources and food will be procured on site. **OS:** The local economy and employment will be boosted, combined with the operation of the substation and the power supply facilities.
	Land Use and Local Resources	D	D	There will be no threat that could harm or damage land use and local resources.
	Water Use	D	D	The project works will not affect the fishing and agricultural industries in the surrounding area.
	Existing Infrastructures and Services	D	D	No impacts on existing social infrastructures and services.
	Social Structure such as Provincial Government	D	D	No impacts on existing social structures.
	Uneven Distribution of Harm and Benefit	D	D	The power generated in this power plant will be consumed only in the SEZ, but also to other districts outside. There will be no uneven distribution of harm and benefit.
	Conflicts of Interest within the Region	D	D	There will be no conflicts of interest within the region regarding the construction of the substation.
	Cultural Heritage	D	D	Because there is no cultural heritage within the site, negative impact is not anticipated.
	Landscape	D	D	Impact on landscape is not expected because there are no important landscapes and viewpoints to be considered around the project area.
	Gender	D	D	Negative impact on gender is not anticipated.
	Children's Right	D	D	Negative impact on children's right is not anticipated.
	Risks of Infectious Disease such as AIDS/HIV	B-	D	**DC:** There may be risks of infectious disease by influx of workers. **OS:** Because there is no large change in traffic volume from the increase in inflow into the site from different regions, impacts on infectious disease are not anticipated.
	Working Environment	B-	B-	**DC:** It is necessary to consider occupational safety and health during construction. Also, accidents to third parties are anticipated. **OS:** Working environment may be deteriorated because workers may have to work in dangerous areas during

Category	Scoping Item	Evaluation		Reasons for Evaluation
		Before/ During Construction (BC/DC)	Operation Stage (OS)	
				plant operation.
Others	Accident	B-	B-	**DC:** It is necessary to consider the possibility of accidents occurring during construction. **OS:** Careful attentions are needed because there will be some dangerous works during plant operation.
	Global Warming	D	D	No significant impact to climate change.

Source: JICA Study Team

Evaluation: A-: Significant negative impact A+: Significant positive impact
B-: Some negative impact B+: Some positive impact
C: Impacts are not clear, need further investigation
D: No impacts or impacts are negligible, no further study required
* The scoping items are selected in reference with the new JICA Guidelines for Environmental and Social Considerations

(4) Power Supply Project (Power Transmission and Distribution Line)

Table 6.1.9 Results of Scoping on Power Supply Project (Transmission and Distribution Line)

Category	Scoping Item	Evaluation		Reasons for Evaluation
		Before/During Construction (BC/DC)	Operation Stage (OS)	
Pollution	Air	B-	D	**DC:** Emission from construction equipment, dust arising from construction activities, and air pollution due to traffic congestion are anticipated. **OS:** No discharge of air polluting substances from power transmission and distribution line facilities.
	Water	D	D	**DC:** There is not much excavation required and the inflow of muddy water is not expected. Thus, the water quality will deteriorate. **OS:** The operation of the power transmission and distribution line facilities will not deteriorate the water quality.
	Solid Waste	B-	D	**DC:** Solid wastes coming from cuttings and removal of manufactured articles are not anticipated. **OS:** There will be no solid waste generated from the power transmission and distribution line facilities that would require specific treatment.
	Soil Contamination	D	D	**DC:** The planned site lies on pasture and agricultural lands. Therefore, land contamination is not assumed. **OS:** No activities causing soil pollution are anticipated.
	Noise/Vibration	B-	D	**DC:** Noise and vibration from the operation of construction machinery and on-site vehicles are anticipated. **OS:** There are no machineries in the power transmission and distribution line facilities that would cause noise and vibration to the surrounding areas.
	Subsidence	D	D	Excavation work and groundwater intake are not anticipated to cause subsidence.
	Odor	D	D	**DC:** Construction causing odor is not anticipated. **OS:** There are no activities in the power transmission and distribution line facilities that would affect odor.

Category	Scoping Item	Evaluation		Reasons for Evaluation
		Before/During Construction (BC/DC)	Operation Stage (OS)	
	Sedimentation	D	D	No significant impact is anticipated.
Natural Environment	Natural Preserve	D	D	No natural preserves exist in and around the project site.
	Biota	D	D	Impact on biofacies is not assumed. Areas around the site are pasture and agricultural lands, while rare and precious species of animals and plants have not been identified.
	Ecosystem	D	D	The construction of the power transmission and distribution line facilities is not expected to damage the ecosystem and cause any habitat fragmentation.
	Hydrology	D	D	Because the project will not change to water current and riverbed, impacts on hydrology are not anticipated.
	Topography/ Geography	D	D	Because the project does not require massive boring or excavation, no significant impact is anticipated.
Social Environment	Involuntary Settlement	D	D	Because there are no residences inside the project site, no resettlement is anticipated.
	Poor	B+	D	**DC:** Job opportunities and commercial activities may be enhanced by construction works that would lead the poor to increase their earnings. **OS:** No negative nor positive impacts to the poverty level at the time of operation are expected.
	Indigenous and Ethnic Minority Group	D	D	No indigenous and ethnic minority groups reside in and around the site.
	Local Economy such as Employment and Livelihood	B+/C	A+	**DC:** The regional economy will be boosted. There will be job opportunities for locals. Other local resources and food will be procured on site. On the other hand, it is necessary to check the impacts on livelihood such as land under the transmission line. **OS:** The local economy and employment will be boosted, combined with the operation of the substation and power supply facilities.
	Land Use and Local Resources	D	D	There is no threat that could harm or damage land use and local resources.
	Water Use	D	D	No impacts on the fishing and agricultural industries in the surrounding area.
	Existing Infrastructures and Services	D	D	No impacts on existing social infrastructures and services.
	Social Structure such as Provincial Government	D	D	No impacts on existing social structures.
	Uneven Distribution of Harm and Benefit	D	D	Power generated in this power plant will not only be consumed in the SEZ but will also be distributed to other districts. There will be no uneven distribution of harm and benefit.
	Conflicts of Interest within the Region	D	D	There will be no conflicts of interests within the region with regard to the construction of power transmission and distribution line facilities.
	Cultural Heritage	D	D	Because there is no cultural heritage at the site, negative impact is not anticipated.
	Landscape	D	D	Impact on landscape is not expected because there are

Category	Scoping Item	Evaluation		Reasons for Evaluation
		Before/During Construction (BC/DC)	Operation Stage (OS)	
				no important landscapes and viewpoints to be considered around the project area.
	Gender	D	D	Negative impact on gender is not anticipated.
	Children's Right	D	D	Negative impact on children's right is not anticipated.
	Risks of Infectious Disease such as AIDS/HIV	B-	B-	**DC:** There may be risks of infectious disease by the influx of workers. **OS:** Because there is no large change in traffic volume from the increase in inflow into the site from different regions, impacts on infectious disease are not anticipated.
	Working Environment	B-	B-	**DC:** It is necessary to consider occupational safety and health during construction. Also, accidents to third parties are anticipated. **OS:** Working environment may be deteriorated because workers may have to work in dangerous areas during plant operation.
Others	Accident	B-	D	**DC:** It is necessary to consider the possibility of accidents occurring during construction. **OS:** Careful attentions are needed because there would be some dangerous works during plant operation.
	Global Warming	D	D	No significant impact to climate change.

Source: JICA Study Team

Evaluation: A-: Significant negative impact A+: Significant positive impact
B-: Some negative impact B+: Some positive impact
C: Impacts are not clear, need further investigation
D: No Impacts or Impacts are negligible, no further study required
* The scoping items are selected in reference with the new JICA Guidelines for Environmental and Social Considerations

6.1.5 TOR for Environmental and Social Considerations

The survey item and evaluation methods for items identified as A, B, and C by scoping as TOR for the environmental and social consideration are shown in Table 6.1.10.

Table 6.1.10 TOR for the Power Supply Facilities Upgrading Project

Category	Item	Survey Item	Survey Method
Pollution	Air	i. Construction traffic route. ii. Target of preservation such as residents along the construction traffic route. iii. Target of preservation such as residents around the planned site for construction. iv. General description of construction and project.	i. Prehension of general contents of construction which are assumed to cause impacts on air quality. ii. Prehension of general contents of the project which are assumed to cause impacts on air quality. iii. Prediction of evaluation based on past incidents.
	Water	i. Rivers around the planned site for construction. ii. General description of construction and project.	i. Prehension of general contents of construction which are assumed to cause impact on water quality. ii. Prehension of general contents of project which are assumed to cause impact on water quality.

Category	Item	Survey Item	Survey Method
			iii. Prediction of evaluation based on past incidents.
	Waste	i. Land use and topography around the planned site. ii. General description of construction and project.	i. Confirmation of methods of application and treatment of construction wastes/dirt. ii. Prehension of waste as operation.
	Noise and Vibration	i. Construction traffic route. ii. Target of preservation such as residents along the construction traffic route. iii. Target of preservation such as residents around the planned site for construction. iv. General description of construction and project.	i. Prehension of general contents of construction which may cause noise. ii. Prehension of general contents of the project which may cause noise. iii. Prediction of evaluation based on past incidents.
Social Environment	Local Economy such as Employment and Livelihood	i. Land use and topography around the planned site.	i. Confirmation of the current situation by satellite image and field survey.
	Water Use	i. Prehension of general contents of the project.	i. Prehension of general contents of the project which are assumed to affect water use.
	Risks of Infectious Disease such as AIDS/HIV	i. Prehension of general contents of the project (scale of construction workers).	i. Prehension of impacts and countermeasures based on past cases.
	Working Environment (including Work Safety)	i. Safety measures for the working environment.	i. Prehension of impacts and countermeasures based on past cases.
Others	Accident	i. Safety measures for the working environment. ii. Prehension of general contents of the project.	i. Prehension of impacts and countermeasures based on past cases.
	Climate Change	i. Prehension of general contents of the project.	i. Prehension of general contents of the project which are assumed to accelerate greenhouse gas effects.

Source: JICA Study Team

6.1.6 Initial Environmental Examination (IEE)

The following are the results of IEE on the potential impacts identified using scoping:

(1) Gas Turbine Generator

Table 6.1.11 Results of IEE on Power Supply Facilities Upgrading Project (Gas Turbine Generator)

Category	Scoping Item	Evaluation at Scoping		Evaluation by IEE		Reasons for Evaluation
		BC/ DC	OS	BC/DC	OS	
Pollution	Air	B-	B-	B-	B-	**DC:** Dust and gas emissions from construction works and transportation of construction vehicles are anticipated. However, this is a temporary matter and the impact may be limited. **OS:** Because the electric facility is small and it uses gas turbine, the impact is thought to be limited.

Category	Scoping Item	Evaluation at Scoping		Evaluation by IEE		Reasons for Evaluation
		BC/ DC	OS	BC/DC	OS	
	Water	B-	B-	B-	B-	**DC:** Muddy water flowing towards the rivers from bare lands of the construction site as well as drainage from construction bunkhouses may deteriorate water quality. However, this is a temporary matter and the impact may be limited. **OS:** Impact by thermal effluent is estimated to be small because the scale of a gas turbine is small. Thermal effluent will be circulated as much as possible.
	Solid Waste	B-	B-	B-	B-	**DC:** Impact of wastes generated by construction work is estimated to be small, though wastes from excavation works and structure removal were estimated. Fill dirt will be utilized for embankment, wastes from structures removal works will be sorted out to be reused as much as possible, while the rest will be treated at disposal fields. **OS:** Impact of wastes from construction work is estimated to be small due to minimal sludge and smoke from gas turbine, as well as the periodical appropriate recovery and treatment.
	Noise / Vibration	B-	B-	B-	B-	**DC:** Noise and vibration impacts are estimated to be small due to more than enough distance from the construction site to the residential areas. Noise and vibration from the transportation of construction vehicle are anticipated. However, this is a temporary matter and the impact may be limited. **OS:** Noise and vibration impacts are estimated to be small as there is more than enough distance from the generating facilities to residential areas.
Social Environment	Poor	B+	B+	B+	B+	**DC:** Employment of residents and the poor living in the area as construction workers is expected to contribute in vitalizing the regional economy and increasing the income of the poor. **OS:** Operation of facility is expected to contribute in vitalizing the regional economy and increasing the income of the poor.
	Local Economy such as Employmen t and Livelihood	B+	A+/ B-	B+	A+/ B-	**DC:** Employment of community people in the area as construction workers and procurement of fuel and food for workers from the area are expected to contribute in vitalizing the regional economy and increasing the income of the poor. **OS:** Operation of facility is expected to contribute in vitalizing the regional economy and increasing the income of the poor. On the other hand, the impact of heated effluent to fisheries in the area is assumed. However, impact is estimated to be small because the scale of a gas turbine is small, and thermal effluent will be circulated as much as possible.
	Water Use	D	B-	D	B-	**OS:** The impact of heated effluent to fisheries in the area is assumed. However, the impact is estimated to be small because the scale of a gas turbine is small, and thermal effluent will be circulated as much as possible.
	Risks of Infectious Disease such as AIDS/HIV	B-	D	B-	D	**DC:** Large-scale construction work is not planned. However, the spread of infectious diseases is estimated by the inflow of construction workers from outside of the community.

Category	Scoping Item	Evaluation at Scoping		Evaluation by IEE		Reasons for Evaluation
		BC/ DC	OS	BC/DC	OS	
	Working Environment	B-	D	B-	B-	Impacts on the working condition will be anticipated due to dealing with high voltage, high places, and other dangerous working conditions.
Others	Accident	B-	B-	B-	B-	Accidents will be anticipated as the work will deal with high voltage, high places, and other dangerous working conditions,.
	Global Warming	D	B-	D	B-	In this project, the power generation facility is small so the impact to global warming is assumed to be limited.

Source: JICA Study Team

Evaluation: A-: Significant negative impact A+: Significant positive impact
B-: Some negative impact B+: Some positive impact
C: Impacts are not clear, need further investigation
D: No impacts or impacts are negligible, no further study required

Note) BC: Before Construction, DC: During Construction, OS: Operation Stage
* The scoping items are selected in reference with the new JICA Guidelines for Environmental and Social Considerations

(2) Gas Pipeline

Table 6.1.12 Results of IEE on Power Supply Facilities Upgrading Project (Gas Pipeline)

Category	Scoping Item	Evaluation at Scoping		Evaluation by IEE		Reasons for Evaluation
		BC/DC	OS	BC/DC	OS	
Pollution	Air	B-	D	B-	D	**DC:** Dust and gas emission from construction work and transportation of construction vehicle are anticipated. However, this is only temporary and the impact may be limited.
	Water	B-	D	B-	D	**DC:** Muddy water flowing towards the rivers from bare lands in the construction site may deteriorate water quality. However, this is only temporary and the impact may be limited.
	Solid Waste	B-	D	B-	D	**DC:** Impact of construction wastes is estimated to be small, although wastes from excavation works and structures removal were estimated. Fill dirt may be utilized for embankment, waste from structure removal works will be sorted out to be reused as much as possible, while the rest will be treated at disposal fields.
	Noise / Vibration	B-	D	B-	D	**DC:** Noise and vibration from the transportation of construction vehicles are anticipated. However, this is only temporary and the impact may be limited.
Social Environment	Poor	B+	D	B+	D	**DC:** Employment of local residents and the poor in the area as construction workers is expected to contribute in vitalizing the regional economy and increase the income of the poor.
	Local Economy such as Employment and Livelihood	B+	D	B+	D	**DC:** Employment of local community as construction workers and procurement of fuel and food for workers from the area are expected in vitalizing the regional economy and increasing the income of the poor.

Category	Scoping Item	Evaluation at Scoping		Evaluation by IEE		Reasons for Evaluation
		BC/DC	OS	BC/DC	OS	
	Risks of Infectious Disease such as AIDS/HIV	B-	D	B-	D	**DC:** A large-scale construction work is not planned. However, spread of infectious diseases is estimated by the inflow of construction workers from outside of the community.
	Working Environment	B-	B-	B-	B-	Accidents will be anticipated due to dealing with heavy machines and working under dangerous working conditions.
Others	Accident	B-	B-	B-	B-	Accidents will be anticipated due to dealing with heavy machines and working under dangerous working conditions.

Source: JICA Study Team

Evaluation: A-: Significant negative impact A+: Significant positive impact
B-: Some negative impact B+: Some positive impact
C: Impacts are not clear, need further investigation
D: No impacts or impacts are negligible, no further study required
Note) BC: Before Construction, DC: During Construction, OS: Operation Stage
* The scoping items are selected in reference with the new JICA Guidelines for Environmental and Social Considerations

(3) Substation (230/33 kV Thilawa Substation)

Table 6.1.13 Results of IEE on Power Supply Facilities Upgrading Project (Substation)

Category	Scoping Item	Evaluation at Scoping		Evaluation by IEE		Reasons for Evaluation
		BC/DC	OS	BC/DC	OS	
Pollution	Air	B-	D	B-	D	**DC:** Dust and gas emissions from construction work and transportation of construction vehicle are anticipated. However, this is only temporary and the impact may be limited.
	Water	B-	D	B-	D	**DC:** Muddy water flowing towards the river from bare lands of the construction site may deteriorate water quality. However, this is only temporary and the impact may be limited.
	Solid Waste	B-	D	B-	D	**DC:** Impact of wastes from construction work is estimated to be small, though wastes from the removal excavated soil and structures are estimated. Fill dirt will be utilized for embankment, waste from structure removal works will be sorted out to be reused as much as possible, while the rest will be treated at disposal fields.
	Noise / Vibration	B-	D	B-	D	**DC:** Noise and vibration impacts are estimated to be small as there is more than enough distance from the construction site to the local residents. Noise and vibration from transportation of construction vehicles are anticipated. However, this is only temporary and the impact may be limited.
Social Environment	Poor	B+	D	B+	D	**DC:** Employment of local residents and the poor in the area as construction workers is expected to contribute in vitalizing the regional economy and increasing the income of the poor.

Category	Scoping Item	Evaluation at Scoping		Evaluation by IEE		Reasons for Evaluation
		BC/DC	OS	BC/DC	OS	
	Local Economy such as Employment and Livelihood	B+	B+	B+	B+	**DC:** Employment of local communities in the area as construction worker and procurement of fuel and food for workers from the area are expected to contribute in vitalizing the regional economy and increase the income of the poor. **OS:** In combination with the operation of power supply, it is expected to contribute in vitalizing the regional economy and increasing the income of the poor.
	Risks of Infectious Disease such as AIDS/HIV	B-	D	B-	D	**DC:** A large-scale construction work is not planned. However, the spread of infectious diseases is estimated by the influx of construction workers from outside of the community.
	Working Environment	B-	B-	B-	B-	Impacts on the working condition will be anticipated due to dealing with high voltage, and other dangerous working conditions.
Others	Accident	B-	B-	B-	B-	Accidents will be anticipated due to dealing with high voltage, and other dangerous working conditions.

Source: JICA Study Team

Evaluation: A-: Significant negative impact A+: Significant positive impact
B-: Some negative impact B+: Some positive impact
C: Impacts are not clear, need further investigation
D: No impacts or impacts are negligible, no further study required

Note) BC: Before Construction, DC: During Construction, OS: Operation Stage
* The scoping items are selected in reference with the new JICA Guidelines for Environmental and Social Considerations

(4) Electric power transmission and distribution line

Table 6.1.14 Results of IEE on the Power Supply Facilities Upgrading Project (Transmission and Distribution Line)

Category	Scoping Item	Evaluation at Scoping		Evaluation by IEE		Reason for evaluation
		BC/ DC	OS	BC/ DC	OS	
Pollution	Air	B-	D	B-	D	**DC:** Dust and gas emissions from construction works and transportation of construction vehicles are anticipated. However, this is only temporary and the impact may be limited.
	Water	B-	D	B-	D	**DC:** Muddy water flowing towards the rivers from bare lands of the construction site and drainage from construction bunkhouses may deteriorate water quality. However, this is only temporary and the impact may be limited.
	Solid Waste	B-	D	B-	D	**DC:** Impact of construction wastes is estimated to be small, though wastes from excavation and structure removal works are estimated. Fill dirt will be utilized for embankment, wastes from structure removal work will be sorted out to be reused as much as possible, while the rest will be treated in the disposal field.
	Noise / Vibration	B-	D	B-	D	**DC:** Noise and vibration from construction work and transportation of construction vehicles are anticipated. However, this is only temporary and the impact may be limited.
Social Environment	Poor	B+	D	B+	D	**DC:** Employment of local residents and the poor in the area as construction workers is expected to contribute in vitalizing the regional economy and increasing the income of the poor.

Category	Scoping Item	Evaluation at Scoping		Evaluation by IEE		Reason for evaluation
		BC/ DC	OS	BC/ DC	OS	
	Local Economy such as Employment and Livelihood	B+/ C	D	B+	D	**DC:** Employment of local residents in the area as construction workers and procurement of fuel and food for workers from the area are expected to contribute in vitalizing the regional economy and increasing the income of the poor. No impact on livelihood under transmission lines because the alignment of transmission and distribution lines are within public spaces, such as existing roads and channels. **OS:** In combination with the operation of power supply, it is expected to contribute in vitalizing the regional economy and increasing the income of the poor.
	Risks of Infectious Disease such as AIDS/HIV	B-	D	B-	D	**DC:** A large-scale construction work is not planned. However, spread of infectious diseases is estimated by influx of construction workers from outside of the community.
	Working Environment	B-	B-	B-	B-	Impacts will be anticipated due to dealing with high voltage, high places, and dangerous working conditions.
Others	Accident	B-	B-	B-	B-	Accidents will be anticipated due to dealing with high voltage, high places, and dangerous working conditions.

Source: JICA Study Team

Evaluation: A-: Significant negative impact A+: Significant positive impact
B-: Some negative impact B+: Some positive impact
C: Impacts are not clear, need further investigation
D: No impacts or impacts are negligible, no further study required

Note) BC: Before Construction, DC: During Construction, OS: Operation Stage
* The scoping items are selected in reference with the new JICA Guidelines for Environmental and Social Considerations

6.1.7 Mitigation and Cost of Mitigation Implementation

Mitigation measures were identified for the categories evaluated as A, B, or C according to the results of the impact assessment. Mitigation measures and their implementation costs in the construction and operation stages are shown in Table 6.1.15 and Table 6.1.16, respectively. The cost of mitigation measures will be calculated during the detailed design stage, and the only items of expenditure are mentioned in this stage.

(1) Before/During Construction

Table 6.1.15 Mitigation Measures and Implementation Costs for the Power Supply Facilities Upgrading Project (Before and During Construction)

Category	Item	Stage	Subject	Mitigation Measure	Implementing Administrator (Cost Burdening Organization)	Responsible Institution	Item of Expenditure
Pollution	Air	During Construction	-Power Generation -Power Transformation -Transmission and Distribution	Sprinkle water around the preservation area, such as the residence, as well as prohibiting idling.	Contractor	MEPE/ MOGE/ YESB	-Water supply cost -Vehicle operating cost

Category	Item	Stage	Subject	Mitigation Measure	Implementing Administrator (Cost Burdening Organization)	Responsible Institution	Item of Expenditure
	Water	During Construction	-Power Generation -Power Transformation -Transmission and Distribution	-Installation of sheet on bare lands. -Sand basin (only when wide bare lands exist). -Simple drainage for construction of bunkhouses.	Contractor	MEPE/ MOGE/ YESB	-Equipment installation cost
	Solid Waste	During Construction	-Power Generation -Power Transformation -Transmission and Distribution	-Utilization of construction soil occurrence. -Appropriate disposal of removed work piece.	Contractor	MEPE/ MOGE/ YESB	-Transportation cost -Solid waste disposal cost
	Noise / Vibration	During Construction	-Power Generation -Power Transformation -Transmission and Distribution	-Installation of soundproof sheet (neighboring preservation areas such as residences), observing maximum driving speed, advance notice of operations and restriction of time period, etc.	Contractor	MEPE/ MOGE/ YESB	-Equipment installation cost
Social Environment	Risks of Infectious Disease such as AIDS/HIV	During Construction	-Power Generation -Power Transformation -Transmission and Distribution	-Thorough education and training for laborers.	Contractor	MEPE/ MOGE/ YESB	-Cost of education and training
	Working Environment	During Construction	-Power Generation -Power Transformation -Transmission and Distribution	-Thorough education and training of laborers -Distribution of safety equipment (helmet, gloves, earplug, mask etc.), and prevention of accidents involving third party such as installation of fence.	Contractor	MEPE/ MOGE/ YESB	-Equipment purchase cost -Education cost - Installation cost for safety facilities
Others	Accident	During Construction	-Power Generation -Power Transformation -Transmission and Distribution	-Thorough education and training activities of laborers. -Distribution of safety equipment (helmet, gloves, earplug, mask etc.), and prevention of accidents involving third party such as installation of fence.	Contractor	MEPE/ MOGE/ YESB	-Equipment purchase cost -Education cost -Installation cost for safety facilities

Source: JICA Study Team

(2) Operation Stage

Table 6.1.16 Mitigation Measures and Implementation Costs on the Power Supply Facilities Upgrading Project (Operation Stage)

Category	Item	Stage	Subject	Mitigation Measure	Implementing Administrator (Cost Burdening Organization)	Responsible Organization	Item of Expenditure
Pollution Countermeasure	Air	Operation Stage	Power Generation	Installation of equipment to prevent air pollution such as NOx.	Project Contractor/Power Plant Operator	MEPE	-Cost for facility installation -maintenance and operation cost
	Water	OS	Power Generation	Development of off-site facilities on thermal discharge (as necessary).	Project Contractor/ Power Plant Operator	MEPE	-Installation cost for facilities -Maintenance and operation cost
	Solid Waste	OS	Power Generation	Regular collection and disposal of sludge, soot, etc.	Power Plant Operator	Power Plant Operator	-Transportation charge -Disposal cost
	Noise / Vibration	OS	Power Generation	Installation of soundproof equipment.	Project Contractor/ Power Plant Operator	MEPE	-Installation cost for facilities
Social Environment	Water Use	OS	Power Generation	Installation of cooling facility.	Project Contractor/ Power Plant Operator	Power Plant Operator	-Installation cost for facilities -Maintenance and operation cost
	Working Environment	OS	-Power Generation -Power Transformation -Transmission and Distribution	-Thorough education and training of laborers. . -Distribution of safety equipment (helmet, gloves, earplug, mask etc.), and prevention of accidents involving third party such as installation of fence.	Power Plant Operator/ Substation Operator/ Manager of Transmission and Distribution/ MOGE	Power Plant Operator/ MOGE	-Equipment purchase cost -Education cost -Installation cost for facilities
Others	Accident	OS	-Power Generation -Power Transformation -Transmission and Distribution	-Thorough education and training for laborers -Distribution of safety equipment (helmet, gloves, earplug, mask etc.), and prevention of accidents involving third party such as installation of fence	Power plant/ Substation/ Manager of transmission and distribution/ MOGE	Power Plant Operator/ MOGE	-Equipment purchase cost -Education cost -Installation cost for facilities
	Global Warming	OS	Power Generation	Operation management of burning temperature etc.	Project Contractor/ Power Plant Operator/ MOGE	MEPE	-Installation cost for facilities -Maintenance and operation cost

Source: JICA Study Team

6.1.8 Monitoring Plan and the Proposed Monitoring Form

Concerning about the items of impacts during the construction and operation stages, the current monitoring items, frequencies, spots, and responsible organizations are shown in Table 6.1.17. The MEPE, YESB, and MOGE are among the planned responsible institutions for the concerned items. The proposed monitoring form is shown in the appendix.

Table 6.1.17 Monitoring Plan of Power Supply Facilities Upgrading Project

Survey item	Item	Spot	Frequency	Responsible Institution
[During Construction]				
Common	Monitoring of mitigation measures	-	Once per month	Project Contractor
Air	Fine particles	Around the proposed construction site (one location for each project component)	During Construction: Once every three months (peak period)	Project Contractor
Water	Water temperature, pH, SS, DO, BOD, number of colitis germ legions (domestic sewage)	Accommodation/ bunkhouses for construction workers		Project Contractor
Solid Waste	Amount of solid waste	Entirety	Once per month	Project Contractor
Noise / Vibration	Noise/vibration level	Preservation area such as residences around the proposed construction site	During Construction: Once every three months (peak period)	Project Contractor
		One or two locations at the preservation site such as residences along the route for on-site vehicles	During Construction: Once (peak period)	Project Contractor
Risks of Infectious Disease such as AIDS/HIV	Prehension of infectious disease	Construction site	Once per month	Project Contractor
Working Environment	Prehension of occupational safety and health conditions	Construction site	Once per month	Project Contractor
Accident	Existence of accident	Construction site	As required	Project Contractor
[Operation Stage]				
Common	Monitoring of mitigation measures	-	Once every three months (three years after operation stage)	-Power plant Operator -Substation Operator -Manager of Transmission and Distribution
Air	NOx, SPM,and CO	Outlet of gas emissions from power generating facility, around the spot of maximum ground concentration	Once every three months (three years after operation stage)	Substation Operator
Water	Water temperature (coolant) Water temperature, pH, SS,	Coolant, discharging spot of domestic sewage and	Coolant: Regular observation	Substation Operator

Survey item	Item	Spot	Frequency	Responsible Institution
	DO, BOD, number of colitis germ legions (domestic sewage)	surrounding water area	Domestic sewage: Once every three months (one year after operation stage)	
Solid Waste	Disposal condition of sludge, soot, etc.	Inside power generating facilities	During maintenance	Substation Operator
Noise / Vibration	Noise level	Preservation area such as residence around the power plant site	Once every three months (one year after operation stage)	Substation Operator
Water Use	Water temperature (outlet of coolant)	An outlet of coolant	Regular observation	Substation Operator
Working Environment	Prehension of occupational safety and health conditions	Work site	Once per month	-Power Plant Operator -Substation Operator -Manager of Transmission and Distribution
Accident	Existence of accident	Work site	As required	-Power Plant Operator -Substation Operator -Manager of Transmission and Distribution
Global Warming	Amount of fuel use and electrical power generation	Inside power generating facilities	Once per month	Substation

Source: JICA Study Team

6.1.9 Stakeholders Meeting

Stakeholders meeting has not been conducted on the Project.

6.1.10 Corresponding Issues of Environmental and Social Considerations on the Project Promotion of the Power Supply Project

(1) Environmental Impact Assessment Procedures

In July 2013, the environmental impact assessment (EIA) is not required because no EIA exists in Myanmar. On the other hand, as the Ministry of Environmental Conservation and Forestry (MOECF) is drafting the EIA procedures to serve as the EIA regulation in Myanmar, an official EIA process may be required should the procedure be issued earlier than the detailed design stage. According to the draft EIA procedure, only the environmental management plan (EMP) will be required and approved by MOECF to a project in the stage of operation, pre-construction, or construction.

Should the Power Supply Project require EIA procedures, it is possible to consider that this Project is under the “project at pre-construction stage”, and only the approval of EMP by

MOECF is required because the result of the environmental and social considerations has already been summarized based on the results of this Study.

However, necessary required documents to be submitted in accordance with the EIA procedures will be judged by MOECF. Therefore, it is better for MEPE (as the Project Proponent) to confirm with MOECF about the necessity of EIA procedures at the timing of definition of specification for transmission line and substation during detailed design.

(2) Implementation of Environmental and Social Considerations in Accordance with the Maturity of the Plan

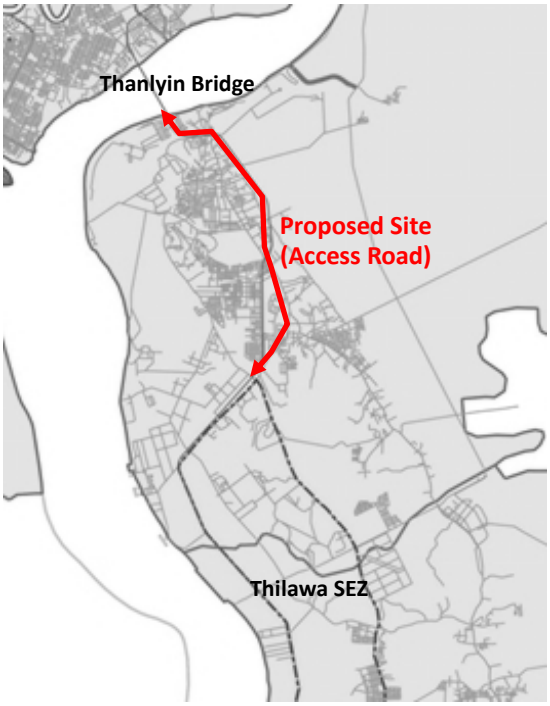
It is desirable to implement a detailed investigation on the following elements which may cause environmental impacts on the Project at the timing of definition of specification for the transmission line, power plant and substation during the detailed design:

- Impact assessment on air quality, noise, and water quality, mitigation and development of a more detailed monitoring plan.

6.2 Road Expansion Project between Thanlyin Bridge and Thilawa SEZ

6.2.1 Positional Relation of the Relevant Project

The location map of the road expansion project between Thanlyin Bridge and Thilawa SEZ and its related facilities is shown in Figure 6.2.1. The outline of this project is as shown in Chapter 5 (length of road 8.7 km, design speed 50km/h and expansion of carriageway to 2 lanes in each direction).



Source: JICA Study Team

Figure 6.2.1 Location Map of the Site of Road Expansion

6.2.2 Current Situation of Surrounding Environment of the Subject Area

Photographs around the subject area are shown in Figures 6.2.2 to 6.2.3. Small street vendors exist within a few meters of the buffer zone around Access Road

Figure 6.2.2 North Side of Access Road

Figure 6.2.3 South Side of Access Road

Source: JICA Study Team

6.2.3 Comparative Review of Alternative Plans

The comparison of the four alternative cases, including "without the project", of the Road Expansion Project between Thanlyin Bridge and Thilawa SEZ is shown in Figure 6.2.4. As a candidate route of the road expansion, the following cases were examined:

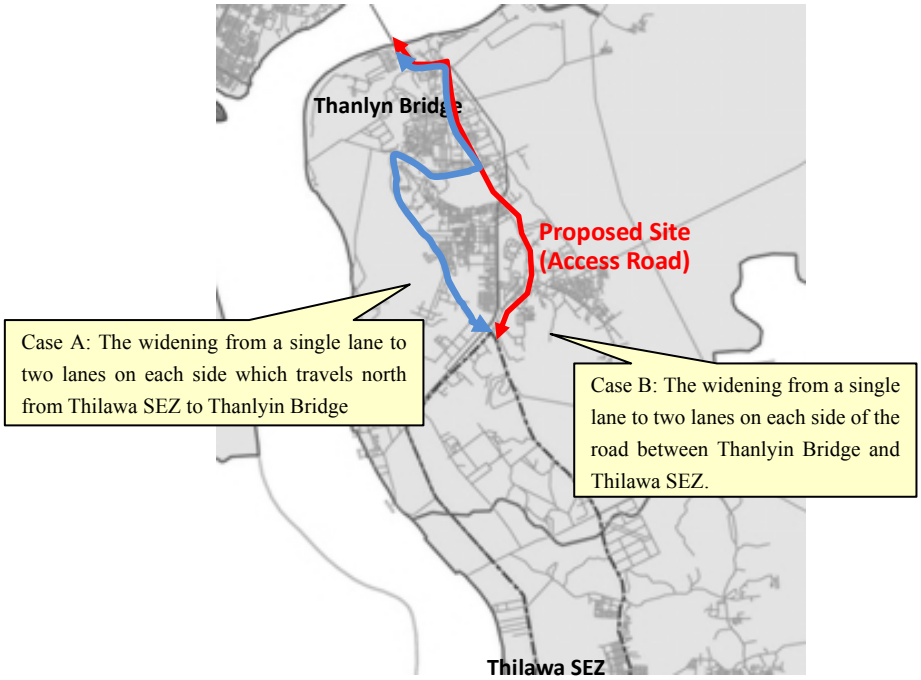
Case 0 : Without the project

Case A : The widening from a single lane to two lanes on each side of the road that travels northward from Thilawa SEZ to Thanlyin Bridge

Case B-1 : The widening from a single lane to two lanes on each side of the road between Thanlyin Bridge and Thilawa SEZ Road, and relocating the power distribution line

Case B-2 : The widening from a single lane to two lanes on each side of the road between Thanlyin Bridge and Thilawa SEZ Road, and realigning the power distribution line underground.

As a result, Case B-2 has been considered as the best case as shown Table 6.2.1.



Source: JICA Study Team

Figure 6.2.4 Road Expansion Project **Candidate** Cases

Table 6.2.1 Comparison of the Alternatives Plans for Road Expansion Project between Thanlyin Bridge and Thilawa SEZ

Alternative Plan	Case 0 : Without the Project	Case A : Widening from single lane to two lanes on each side of the road that travels northward from Thilawa SEZ to Thanlyin Bridge.	Case B : Widening of the road between Thanlyin Bridge and Thilawa SEZ).	
			Case B-1 : Expansion of road and relocation of the distribution line.	Case B-2 : Expansion of road and burying of the distribution line.
General	Corresponds to the increasing traffic volume in the project site with the existing roads between Dagon and Thilawa SEZ and between Thanlyin Bridge and Thilawa SEZ.	Corresponds to the increasing traffic volume in the project site with widening from a single lane to two lanes on each side of the road that travels northward from Thilawa SEZ area to Thanlyin Bridge.	Corresponds to the increasing traffic volume in the project site with road widening between Thanlyin Bridge and Thilawa SEZ as well as relocating the power distribution line.	Corresponds to the increasing traffic volume of the project site with road widening between Thanlyin Bridge and Thilawa SEZ while burying the power distribution line under the sidewalk.
Length	-	9.8 km	8.7 km	8.7 km
Technical Aspect	-	There is no technical issue because the area is almost flat. However, land acquisition will be required for the planned expansion to two lanes on each side of the road (including sidewalk).	The site for the planned four-lane road including sidewalk has been ensured. The existing road has not been paved but ground leveling has already been done. Since the area does not require cut and fill earthworks, there are no significant issues from the technical aspects.	Road part is the same as Case B-1. However, it is necessary to confirm whether any related structure exists underground at the time of burying the power distribution line under the sidewalk. Relocation of structures may be necessary in some cases.
Economic Aspect, Construction Cost and Period	No construction cost will be required. However, opportunities for some benefits such as improvement of traffic safety and congestion might be lost.	Additional costs for land acquisition and resettlement will be required. Moreover, it is assumed that resettlement work might become major cause of delay construction work because resettlement takes a lot of time.	- It is assumed that the construction cost itself will be cheaper than Case A by laying the sidewalk and road on the leveled area. - The cost will increase in order to relocate the power distribution line and acquire the land for it. In addition, it is assumed that resettlement might become a major cause of delay in construction because resettlement takes a lot of time.	- Road part is the same as Case B-1. However, the cost might increase because of underground installation of the distribution line. - On the other hand, since land acquisition and resettlement will not occur, no additional costs will be incurred. In addition, the risk of construction delay will also be reduced.
Economic Aspect,	Road between Thanlyin	Road safety may be improved as	Road safety is expected to be improved as the road expansion project will	

Alternative Plan	Case 0 : Without the Project	Case A : Widening from single lane to two lanes on each side of the road that travels northward from Thilawa SEZ to Thanlyin Bridge.	Case B : Widening of the road between Thanlyin Bridge and Thilawa SEZ).	
			Case B-1 : Expansion of road and relocation of the distribution line.	Case B-2 : Expansion of road and burying of the distribution line.
Required Time, Safety	Bridge and Thilawa SEZ is a major arterial road for local residents, merchants, harbor workers, and visitors visiting the pagodas. The road is constantly congested under the current traffic volume. As a matter of fact, constant crowdedness due to busy traffic and lack of driving etiquette cause dangers for both drivers and pedestrians. In the future, should the traffic volume increase in Thilawa area, the degradation of the congested road might increase the travel time to central Yangon. The increasing traffic volume might also hamper road safety.	the expansion project will separate the sidewalk and the roadway.	separate the sidewalk and the roadway.	
Environmental Consideration Aspect	- The increase in exhaust gas causes more air pollution due to traffic congestion that is worsened by the increase in traffic volume congestion on existing roads.	The impact of air pollution, noise, and vibration will be minimized more than Case B because the traffic volume of the project might be broadly distributed into three roads: Thanlyin-Thilawa Road, Dagon-Thilawa Road, and the northward road .	The impact on air pollution, noise, and vibration in Cases B-1 and B-2 may be larger than Case A because the traffic volume will concentrate on the road between Thanlyin Bridge and Thilawa SEZ after the operation phase.	
Social Consideration Aspect	No land acquisition and resettlement will occur, thus there will be no negative	Large-scale resettlement will occur because land acquisition will be required for within the	Although less than Case A, land acquisition and resettlement will occur because the relocation of the	The plan can minimize social impact of the project because land acquisition and resettlement will not occur due to

Alternative Plan	Case 0 : Without the Project	Case A : Widening from single lane to two lanes on each side of the road that travels northward from Thilawa SEZ to Thanlyin Bridge.	Case B : Widening of the road between Thanlyin Bridge and Thilawa SEZ).	
			Case B-1 : Expansion of road and relocation of the distribution line.	Case B-2 : Expansion of road and burying of the distribution line.
	impact.	3.6 km zone of the whole road zone (9.8 km).	power distribution line under to road expansion project might cause issues.	the underground installation of the power distribution line.
General Evaluation	- Opportunities for benefits such as improvement of traffic safety and congestion would be lost. In addition, influence of air pollution caused by the exhaust gas will increase. Therefore, Case 0 has not been adopted.	Compared with Case B from the aspect of environmental consideration, the impact of air pollution, noise, and vibration will be smaller. However, the need for a large-scale resettlement and a possible low economic efficiency (construction costs versus period) in comparison with Case B are assumed. Therefore, this Case A has not been adopted.	- Compared with Case A, the economic efficiency is rather high. From the aspect of environmental consideration, the impact of air pollution, noise. However, the impact can be minimized by adopting the necessary mitigation measures. - Case B-1 has not been adopted because the relocation of the power distribution line requires land acquisition and resettlement.	- Compared with Case A, the economic efficiency is rather high. From the aspect of environmental consideration, the impact of air pollution, noise, and vibration will be larger than Case A. However, the impact can be minimized by adopting the necessary mitigation measures. - Compared with Case B-1, construction costs associated with underground installation of power distribution lines will be incurred. However, land acquisition and resettlement can be avoided. - Therefore, Case B-2 has been adopted.

Source: JICA Study Team

6.2.4 Scoping

Table 6.22 enumerates the potential evidences and the degrees of impacts, which could arise at the time of project implementation for the road expansion between Thanlyin Bridge and Thilawa SEZ. The evaluation is based on the JICA Guidelines for Environmental and Social Considerations, where the impacts on pollution, natural environment, and social environment are graded from A to D.

Table 6.2.2 Results of Scoping on the Road Expansion Project between Thanlyin and Thilawa SEZ

Category	Scoping Item	Evaluation		Reasons for Evaluation
		Before / During Construction (BC/DC)	Operation Stage(OS)	
Pollution	Air Quality	B-	B-	**DC:** Emissions from construction equipment, dust arising from construction activities, and air pollutants due to traffic congestion are anticipated. **OS:** Air pollution impacts will be anticipated because of increase in traffic volume and speed.
	Water Quality	B-	D	**DC:** Muddy water flowing into the rivers from bare lands in the construction site may deteriorate water quality. **OS:** Facilities for parking or service areas, which may discharge wastewater, are not constructed. Also, it is not anticipated that road may cause water pollution to the rivers, channels, and water sources in the surrounding area.
	Solid Waste	B-	D	**DC:** Generation of construction wastes from excavation and structure removal works are anticipated. **OS:** Impact on solid waste is not anticipated because there are no constructions of parking or service areas.
	Soil Contamination	C	D	**DC:** It is necessary to confirm the current status of soil contamination in the project area. **OS:** No activities causing soil contamination are anticipated.
	Noise / Vibration	B-	B-	**DC:** Noise and vibration from the operation of construction machinery and on-site vehicles are anticipated. **OS:** Noise and vibration impacts will be anticipated because of the increase in traffic volume and speed.
	Subsidence	D	D	Excavation work and extraction of groundwater that may cause subsidence are not anticipated.
	Offensive Odor	B-	D	**DC:** Offensive odor by the asphalt laying is assumed. **OS:** Facilities or activities generating odor are not anticipated.
	Sedimentation	D	D	Activities that cause sediment quality deterioration such as installation of bridge piers in rivers are not anticipated.
Natural Environment	Natural Preserve	D	D	No natural preserves exist within and around the project site.
	Flora/Fauna	C	D	The project site lies on grasslands and farmlands, and bounded by hedgerows, while the construction area is limited. Thus, significant impact to the ecosystem of important animals and valuable plant species is not anticipated. On the other hand, it is necessary to confirm if valuable species will be included among the hedgerow

Category	Scoping Item	Evaluation		Reasons for Evaluation
		Before / During Construction (BC/DC)	Operation Stage(OS)	
				trees to be logged.
	Ecosystem	D	D	Because the project is rehabilitation and widening of an existing road, no significant impact is anticipated.
	Hydrology	D	D	Because the project does not make changes to water current and riverbed, and does not include structure development such as tunnels, impacts on hydrology are not anticipated.
	Topography / Geography	D	D	Because the project is rehabilitation and widening of an existing road without involving large excavation works, impact is not anticipated.
Social Environment	Involuntary Resettlement	D	D	Because the right-of-way is already secured, no resettlement is anticipated.
	Poor	B+	B+	**DC:** Job opportunities and commercial activities may be enhanced by construction works that would help increase the earnings of the poor. **OS:** By operation of the widened road, customers to surrounding stores and restaurants may be increased while economical activities may be enhanced that would help increase the earnings of the poor.
	Indigenous and Ethnic Minority	D	D	No indigenous and ethnic minority groups are within and around the site.
	Local Economy such as Employment and Livelihood	B+/B-	B+	**DC:** There will be job opportunities for the locals, which can boost the regional economy. Moreover, other local resources and food will be procured on site. On the other hand, there is a possibility that the small street vendors in the project area may lose opportunities on livelihood due to loss of space for their commercial activities. **OS:** The local economy and employment will be boosted with the improvement of the transportation condition.
	Land Use and Local Resources	D	D	Because the project is rehabilitation and widening of an existing road, the right-of-way has been acquired beforehand. Thus, no significant impact on land use and use of local resources is anticipated.
	Water Use	D	D	Because the project is rehabilitation and widening of an existing road, the right-of-way has already been acquired beforehand. Thus, no significant impact on water use is anticipated.
	Existing Infrastructure and Services	B-	A+	**DC:** Traffic congestion during construction is anticipated and may be inconvenient to the local people. **OS:** Because of the increase in traffic volume and travel speed, increase in traffic accident is anticipated around the site where houses, schools, medical facilities, etc. are situated. However, traffic accident may be reduced by the separation of pedestrians and vehicles. There will be a positive impact on the use of space along the road because power lines will be installed underground.
	Social Structure such as Provincial Government	D	D	Because the project is rehabilitation and widening of an existing road, no significant impact on social structure is anticipated.
	Uneven Distribution of Harm and	D	D	Because the project is rehabilitation and widening of an existing public road, no uneven distribution of harm and benefit is anticipated.

Category	Scoping Item	Evaluation		Reasons for Evaluation
		Before / During Construction (BC/DC)	Operation Stage(OS)	
	Benefit			
	Conflicts of Interest within the Region	D	D	Because the project is rehabilitation and widening of an existing road, conflict of interest within the region is not anticipated.
	Cultural Heritage	D	D	Because the project is rehabilitation and widening of an existing road and the land has been acquired beforehand, there might be no change in existing land and no impact to cultural heritage.
	Landscape	D	D	There is no road structure such as elevated road that may obstruct the landscape.
	Gender	D	D	No negative impact on gender is anticipated.
	Children's Right	D	D	No negative impact on children's right is anticipated.
	Risks of Infectious Disease such as AIDS/HIV	B-	D	**DC:** Although construction works are large in scale, there may be risks of infectious disease due to the influx of workers. **OS:** Because there will be no significant change in traffic volume raising the inflow into the site from different regions, impact on infectious disease is not anticipated.
	Working Environment	B-	D	**DC:** It is necessary to consider occupational safety and health during construction. Also, accidents involving third parties are anticipated. **OS:** There will be no significant negative impacts to laborers during the operation stage.
Others	Accident	B-	B+	**DC:** It is necessary to consider the possible occurrences of accidents during construction. **OS:** Pedestrian safety may be improved and traffic accidents may be reduced by the separation of pedestrians and vehicles by the road expansion.
	Global Warming	D	D	No significant impact is anticipated because the project is expansion of an existing road, thus, construction area is limited. In addition, the project will not include large-scale deforestation that may directly cause global warming.

Source: JICA Study Team

Evaluation: A-: Significant negative impact A+: Significant positive impact
B-: Some negative impact B+: Some positive impact
C: Impacts are not clear, need further investigation
D: No impacts or impacts are negligible, no further study required
* The scoping items are selected in reference with the new JICA Guidelines for Environmental and Social Considerations

6.2.5 TOR for Environmental and Social Considerations

The survey items and evaluation methods for the items identified as A, B, and C by scoping as TOR for environmental and social considerations are shown in Table 6.2.3.

Table 6.2.3 TOR for the Road Expansion Project between Thanlyin Bridge and Thilawa SEZ

Category	Item	Study Item	Study Method
Pollution	Air Quality	1. Subject to preservation along the route such as residences and hospitals. 2. Road structure and traffic volume. 3. Roadside air quality (twice at one location) and ambient air quality (twice at one location) Measurement items: NO_2,SO_2, CO, TSP, and PM10.	1. Prehension of general contents of the project which is assumed to cause impact on air quality. 2. Prehension of factors affecting aerial environment (background concentration, road structure, traffic volume, and travel speed), and prediction of evaluation based on past incidents.
	Water Quality	1. Rivers around the planned construction site (twice at three locations). Measurement items : 16 parameters for natural and living environment parameters and 21 parameters for health impact parameters (toxic substances) 2. General description of the construction and project.	1. Prehension of contents for construction which are assumed to cause impacts on water, and qualitative prediction of evaluation based on past incidents.
	Soil Contamination	1.Soil contamination survey (once at two locations) Measurement items : Heavy metals and 11 other parameters	1.Confirmation of method of managing construction soil (in case of the occurrence of contaminated soil which exceed the standards in Japan and other countries).
	Solid Waste	1. Land use and topography around the planned site. 2. General description of the construction and project.	1. Confirmation of method of application and treatment of construction solid waste.
	Noise/Vibration	1. Distribution of sensitive targets along the route such as residences. 2. Road structure, traffic volume, and travel speed. 3. Traffic noise (twice at three locations during weekdays and holidays). Measurement items :L_{Aeq}	1. Prehension of general contents of construction which can cause noise. 2. Prehension of factors affecting aerial environment (road structure, traffic volume, and travel speed), prediction of evaluation based on past incidents.
	Offensive Odor	1. Subject of preservation on the route. 2. General description of the construction and project.	1. Prehension of work types and preservation areas that may cause offensive odor. 2. Qualitative prediction of evaluation considering mitigation measures.
Natural Environment	Flora and Fauna	1.Road tree survey (numbers and species).	1. Prehension of levels may affect flora and fauna (such as identifying valuable species along road trees to be logged)
Social Environment	Local Economy such as Employment and Livelihood	1. Distribution of vendors in the project area.	1. Prehension of degree of impacts on livelihood loss.
	Existing Infrastructure and Services	1. General contents of the project.	1. Prehension of areas that may affect transportation on existing lanes due to construction work 2. Qualitative prediction of evaluation considered with mitigation measures.

Category	Item	Study Item	Study Method
	Risks of Infectious Disease such as AIDS/HIV	1. General contents of the project (scale of construction workers).	1. Prehension of impact and countermeasure based on past cases.
	Working Environment	1. Safety measure of working environment.	1. Prehension of impact and countermeasure based on past cases.
Others	Accident	1. Safety measure of working environment. 2. General contents of the project.	1. Prehension of impact and countermeasure based on past cases.

Source: JICA Study Team

6.2.6 Baseline Survey

Among items on environmental and social impacts as shown in Table 6.2.3, the JICA Study Team implemented baseline survey on air quality, water quality, soil, noise, flora (tree inventory survey), and local economy such as employment and livelihood (distribution of vendors along the right-of-way) to grasp the current situation in detail and to reflect the evaluation results of impact assessment. The results of the baseline survey are summarized below:

(1) Outline of Baseline Survey

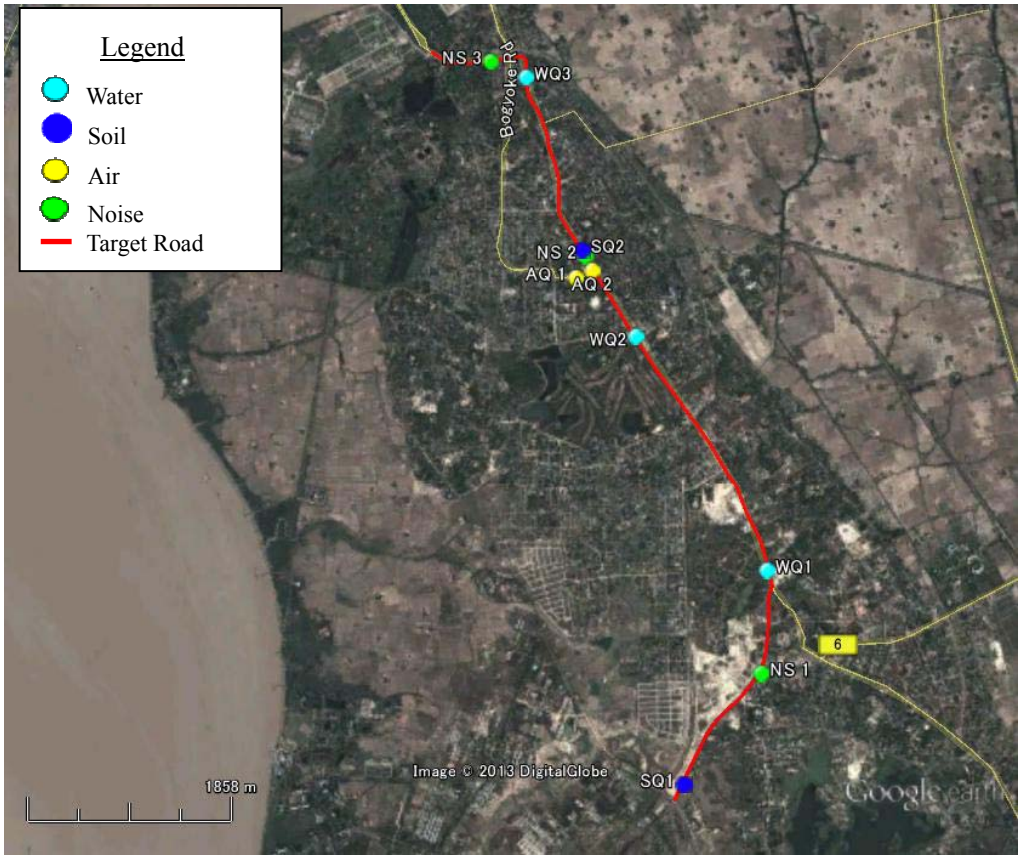
The summary of environmental survey is shown in Table 6.2.4, and locations where the survey was conducted are shown in Figure 6.2.5.

Table 6.2.4 Summary of Environmental and Socioeconomic Survey

Air Quality	Parameter	1) Nitrogen dioxide (NO_2), 2) Sulfur dioxide (SO_2), 3) Carbon monoxide (CO),5) Total Suspended Particles (TSP) 5) PM10,
	Period	Twice within one week
	Location	Two points in residential area, and along the road
Water Quality	Parameter	Total: 37 Parameters; A. 16 Parameters for Natural and Living Environment Parameters: 1) Temperature (water and atmosphere), 2) Flow rate, 3) Odor, 4) Color, 5) Electrical Conductivity, 6) pH, 7) BOD_5, 8) SS, 9) DO, 10) Total Coliform, 11) COD, 12) Total Nitrogen, 13) Total Phosphorous, 14) Total Organic Compounds, 15) Turbidity, 16) Hardness B. 21 Parameters for Health Impact Parameters [Toxic Substances]: 1) Mercury (Hg), 2) Lead (Pb), 3) Cadmium (Cd), 4) Hexavalent chromium (Cr(VI)), 5) Copper (Cu), 6) Zinc (Zn), 7) Nickel (Ni), 8) Manganese (Mn), 9) Iron (Fe), 10) Tin (Sn), 11) Cyanide (CN), 12) Oil and grease, 13) Sulfide, 14) Sulfate, 15) Fluoride, 16) Nitrites (NO_2-N) 17) Nitrates (NO_3-N), 18) Ammonium nitrogen (NH_4-N), 19) Arsenic (As), 20) Trivalent chromium (Cr(III)), 21) organic phosphorous
	Frequency	Twice (middle of August and beginning of September)
	Location	Three locations (small creeks and water channel along the target road)
Soil Quality	Parameter	Total 11 parameters; 1) pH, 2) Arsenic (As), 3) Lead (Pb), 4) Cadmium (Cd), 5) Copper (Cu), 6) Zinc (Zn), 7) Manganese (Mn), 8) Iron (Fe), 9) Mercury (Hg), 10) Chromium (Cr), 11) Nickel (Ni)
	Period	Once
	Location	Two samples (no paved areas)
Traffic Volume	Parameter	Volume of traffic and traveling velocity of vehicles
	Period	24 hours survey for weekday and weekend
	Location	Three locations: (i) near Thilawa SEZ, (ii) near Thanlyin Bridge, and (iii) representative point around the middle of the target road.
Noise Level	Parameter	LAeq (A-weighted loudness equivalent)

	Period	24 hours survey for both weekday and weekend
	Location	Same with the Traffic Volume Survey
Tree Inventory Survey	Item	Interviews and field observation
	Area	Project site
	Period	Whole survey period
Living and Livelihood (Street Vendors along the Target Road)	Item	Number of project-affected households (PAHs)
	Area	Project site
	Period	Whole survey period

Source: JICA Study Team



Source: JICA Study Team

Figure 6.2.5 Locations of Environmental Baseline Survey

(2) Air Quality

The results of air quality analysis are summarized in Table 6.2.5. Air quality level of all parameters fell below the standards in Japan and Thailand.

Table 6.2.5 Results of Air Quality Survey

Parameter	(Unit)	Results(Average)				Environmental Standard (Japan or Thailand)
		AQ 1		AQ 2		
		End of August 2013	Middle of September 2013	End of August 2013	Middle of September 2013	
Sulfur Dioxide (SO_2)	ppm	0.02	0.01	0.02	0.02	0.04 (Japan)
Carbon Monoxide (CO)	ppm	0.32	0.39	0.39	0.30	10 (Japan)
Nitrogen Dioxide (NO_2)	ppm	0.02	0.01	0.03	0.03	0.06 (Japan)
Total Suspended Particle (TSP)	mg/m^3	0.05	0.04	0.09	0.19	0.33 (Thailand)
Particle Matter 10 (PM10)	mg/m^3	0.05	0.03	0.05	0.10	0.12 (Thailand)

Source: JICA Study Team

(3) Water Quality

Table 6.2.6 shows the results of water quality analysis at all sampling points at a given time. Only suspended solids and mercury slightly exceeded the water quality standard in Japan and Vietnam. Results of suspended solids exceeded the environmental standards due to the quality of the existing unpaved roads. As for mercury, there are three possibilities to exceed environmental standards: 1) natural origin, 2) derived from industrial wastewater, and 3) acquisition of excessive analysis value due to unstable quality control and quality assurance of the laboratory. However, it is assumed that the possibility of getting high concentrations of mercury is caused by unstable quality control and quality of the laboratory based on the following reasons:

a. High concentration of mercury due to the natural origin: Under (4) soil quality, as mentioned below, the concentration of mercury in the soil is far lower than the environmental standard. Therefore, the natural origin of the sample is not the cause of high concentration of mercury.
b. High concentration of mercury due to the industrial wastewater: Only residential areas and forests exist around the site. Therefore, industrial wastewater is not the cause of high concentration of mercury.
c. High concentration of mercury due to the unstable quality control and quality assurance of the laboratories: Local consultants, mostly having doctoral and masters degrees, have many experiences implementing international projects. However, there are no regulations on quality control and quality assurance of laboratories in Myanmar. Therefore, it is possible that the laboratory was the cause of high concentration of mercury.

Table 6.2.6 Results of Water Quality (WQ 1, WQ-2, WQ-3)

No.	Parameter	WQ1		WQ2		WQ3		Unit	Environmental Standard	
		2013/8/22	2013/9/5	2013/8/22	2013/9/5	2013/8/22	2013/9/5		Japan[1)]	Vietnam[2)]
Natural and living environment parameters										
1	Temperature (water and atmosphere)	28.6/ 30.0	27.5/ 32.0	27.3/ 30.0	27.5/ 32.0	28.0/ 30.0	27.6/ 32.0	^oC	-	-
2	Flow rate	0.5	0.4	0.2	0.1	0.3	0.2	m^3/s	-	-
3	Odor	ND	ND	ND	ND	ND	ND	-	-	-
4	Color	25	10	25	5	8	30	TCU	-	-
5	Electrical Conductivity	29	34	54	61	266	300	µS/cm	-	-
6	pH	9.1	9	9.1	8.9	8.9	9.0	-	6.0~8.5	5.5～9
7	BOD_5	1.5	2.5	2	2	2	2	mg/L	8	15
8	SS	109	704	182	680	320	435	mg/L	100	50
9	DO	4.19	4.4	2.2	2.3	2.62	2.7	mg/L	≥2	≥4
10	Total coliform	1.8×10^3	7.1×10^3	9×10^2	2.4×10^3	$2x\ 10^3$	3.4×10^3	MPN/ 100mL	-	7,500
11	COD	5.52	6.12	3.84	5.15	7.7	2.6	mg/L	5	30
12	Total nitrogen	9.4	9.2	5.9	6.1	9.1	9.3	mg/L	-	-
13	Total phosphorous	0.6	0.4	0.4	0.5	ND	ND	mg/L	-	-
14	Total organic compounds	1	1	3.7	3.8	1.2	1.3	mg/L	-	-
15	Turbidity	20.2	30.6	22.9	43.7	6.7	10.3	FNU	-	-
16	Hardness	20	52	20	14	320	14	mg/L	-	-
Health impact parameters [toxic substances]										
1	Mercury (Hg)	0.0014	0.0011	0.0017	0.0081	0.0019	0.0013	mg/L	0.0005	0.001
2	Lead (Pb)	0.0059	0.0045	0.0063	0.0071	0.0048	0.0038	mg/L	0.05	0.05
3	Cadmium (Cd)	0.0002	0.0004	0.0002	0.0009	ND	0.0007	mg/L	0.01	0.01
4	Hexavalent chromium (Cr(VI))	0.05	ND	0.2	0.12	ND	ND	mg/L	0.04	0.04
5	Copper (Cu)	ND	ND	ND	ND	ND	ND	mg/L	-	0.5
6	Zinc (Zn)	ND	ND	ND	ND	ND	ND	mg/L	-	1.5
7	Nickel (Ni)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/L	-	0.1
8	Manganese (Mn)	ND	0.2	0.8	ND	0.7	0.2	mg/L	0.2	-
9	Iron (Fe)	5	0.001	3	0.005	1	3	mg/L	-	1.5
10	Ti n(Sn)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.01	mg/L	-	-
11	Cyanide (CN)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/L	ND	0.02
12	Oil and grease	<1	<1	<1	<1	<1	<1	mg/L	-	0.1
13	Sulfide	ND	ND	ND	ND	ND	ND	mg/L	-	-
14	Sulfate	62	60	60	61	60	60	mg/L	-	-
15	Fluoride	ND	ND	ND	ND	ND	ND	mg/L	0.8	1.5
16	Nitrates (NO_3-N)	5	6.1	ND	ND	2	3	mg/L	10	10
17	Nitrites (NO_2-N)	3	2	2	3	6	5	mg/L		0.04
18	Ammonium nitrogen (NH_4-N)	ND	ND	ND	ND	ND	ND	mg/L	-	0.5
19	Arsenic (As),	0.0043	0.0052	0.009	0.0081	0.0073	0.0062	mg/L	0.01	0.05
20	Trivalent chromium (Cr(III))	ND	ND	ND	ND	ND	ND	mg/L	-	0.5
21	Organic phosphorous	ND	ND	ND	ND	ND	ND	mg/L	-	-

Note 1) Applies the environment conservation standard related to living environment (D-Agricultural use), health impact standard and guidelines.

2) Applies the agricultural use standard QCVN 08:2008/BTNMT (B1 Irrigation use).

Source: JICA Study Team

(4) Soil

The result of soil quality analysis was summarized in Table 6.2.7. Soil concentration of all parameters fall below the standards in Japan, Vietnam, and Thailand.

Table 6.2.7 Soil Quality Analysis Results

No.	Parameter	SQ-1	SQ-2	Unit	Environmental Standard[1)]
1	pH	6.5	6.7	-	-
2	Arsenic (As)	ND	ND	mg/kg	150 (Japan)
3	Lead (Pb)	110	115	mg/kg	150 (Japan)
4	Cadmium (Cd)	0.022	0.025	mg/kg	150 (Japan)
5	Copper (Cu)	100	105	mg/kg	125 (Japan)
6	Zinc (Zn)	90	105	mg/kg	200-300 (Vietnam)
7	Manganese (Mn)	15	10	mg/kg	1,800-32,000 (Thailand)
8	Iron (Fe)	7850	7950	mg/kg	-
9	Mercury (Hg)	0.009	0.008	mg/kg	15 (Japan)
10	Chromium (Cr)	20	18	mg/kg	250 (Japan)
11	Nickel (Ni)	10	15	mg/kg	1,600-41,000 (Thailand)

Note 1) Basically, the Japanese standards were adopted. If Japanese standards are not available, then Thai and Vietnamese standards were adopted.

Source: JICA Study Team

(5) Noise

Noise levels (LAeq) during the survey period were summarized in Table 6.2.8. All noise levels fall below the request limit for road noise in Japan (residential area, semi-residential area with two lanes road).

Table 6.2.8 A-weighted Loudness Equivalent (LAeq) Level

Parameter	Results (dB)						Request Limit for Road Noise in Japan (residential area, semi- residential area with two lanes road)
	N 1		N 2		N 3		
	Weekend	Weekdays	Weekend	Weekdays	Weekend	Weekdays	
Daytime (6 a.m. – 10 p.m.)	65.0	64.0	61.0	62.	63.8	63.7	75 dB
Night time (10 p.m. – 6 a.m.)	59.0	56.0	54.0	56.0	60.2	50.8	70 dB

Source: JICA Study Team

(6) Flora (Tree Inventory Survey)

There are about 800 trees encountered on both sides of the road within the boundary of the target road. Most of the species are *Acacia auriculiformis A. Cunn.*, *Tectona grandis, Delonix regia, Eucalyptus albens Benth, Terminalia catappa L.,* and *Bauhinia monandra*. It was confirmed that the abovementioned species are not listed under the International Union for Conservation of Nature (IUCN) Red List.

Table 6.2.9 Results of Tree Inventory Survey

No.	Species of Trees	Left Side from Thilawa Area to Yangon	Right Side from Thilawa Area to Yangon	Total
1	*Acacia auriculiformis A. Cunn.*	130	159	289
2	*Aquilaria agallocha*	1		1
3	*Artocarpus heterophyllus Lam.*	1		1
4	*Azadirachta indica A. Juss.*	1	9	10
5	*Bambusa tuldoides*		3	3
6	*Bauhinia monandra*	21	6	27
7	*Buteafrodosa/Butea monosperma*	7		7
8	*Cassia fistula*		3	3
9	*Cassia siamea*	21		21
10	*Ceiba pentendra*		2	2
11	*Chukrasia tabularis*	2		2
12	*Delonix regia*	67	13	80
13	*Erythrina sp.*		1	1
14	*Eucalyptus albens Benth.*	2	52	54
15	*Ficus glomerata/Ficus racemosa*	5		5
16	*Ficus rumphii Blume*	5	3	8
17	*Lagerstroemia reginae*	3		3
18	*Mangifera indica*	3	1	4
19	*Mesua ferrea*	2		2
20	*Mimusops elengi L.*	6	8	14
21	*Morinda angustifolia*	1		1
22	*Moringa oleifera*	1		1
23	*Plumeria rubra*	1		1
24	*Polyathia longifolia (Lam.) Benth.& Hook.f.*	13	10	23
25	*Psidium guajava L.*		1	1
26	*Pterocarpus macrocarpus*	4	1	5
27	*Samanea saman (Jacq.) Merr.*	13	3	16
28	*Swietenia macrophylla*	2		2
29	*Tectona grandis*	104	64	168
30	*Terminalia catappa L.*	16	21	37
31	*Ziziphus jujuba Lam.*	1	2	3
Total		**433**	**362**	**795**

Source: JICA Study Team

(7) Local Economy such as Employment and Livelihood (Street Vendors along the Target Road)

From the results of the field survey, all facilities inside the boundaries of the target road were classified into four types, as shown in Figure 6.2.6.

1. Mobile Vendors with Carts

2. Vendors with Easy Transition

3. Vendors with Easy Reassembly

4. Vendors with Fixed Assets

Source: JICA Study Team

Figure 6.2.6 Four Types of Vendors along the Target Road

Table 6.2.10 shows the four classified project related facilities (vendors, shops, etc.) which are found along the target road. Most of vendors have easy transition and operate with carts.

Table 6.2.10 Vendors along of the Target Road

Types of Vendors	Total
1. Mobile vendors operating with carts	24
2. Vendors with easily transition	36
3. Vendors with easily reassembled structures	8
4. Vendors with fixed assets	4
Total Numbers of Facilities	**72**

Source: JICA Study Team

6.2.7 Initial Environmental Examination

The initial environmental examination (IEE) on the Road Expansion Project between Thanlyin Bridge and Thilawa SEZ are predicted and evaluated based on the project description, results of baseline survey, and set target level. Table 6.2.11 shows the results of IEE on the potential impacts identified as A, B, and C by scoping.

Table 6.2.11 Results of IEE on Road Expansion Project between Thanlyin Bridge and Thilawa SEZ

Category	Item	Evaluation at Scoping		Evaluation by IEE		Reasons for Evaluation
		BC/DC	OS	BC/DC	OS	
Pollution	Air Quality	B-	B-	B-	B-	**DC:** Emission from construction equipment and dust arising from construction activities are anticipated. However, this is only temporary and the impact may be limited. **OS:** Due to the increase in traffic volume, density of air pollutants from vehicles will increase. However, the impact might not be significant because the project site is located in the suburbs and the background

Category	Item	Evaluation at Scoping		Evaluation by IEE		Reasons for Evaluation
		BC/DC	OS	BC/DC	OS	
						atmospheric density is not so high.
	Water	B-	D	B-	D	**DC:** Muddy water flowing into the rivers from bare land in the construction site may deteriorate water quality. However, this is only temporary and and the impact may be limited.
	Soil Contamination	C	D	D	D	**DC:** Based on the baseline survey result, soil contamination including natural contamination inside the project area was not confirmed. Thus, soil contamination resulting from construction works will not arise.
	Solid Waste	B-	D	B-	D	**DC:** Solid waste is generated from cutting and scrapping of land and materials. The soil excavated during construction will be used for banking, while the scrap materials will be recycled as much as possible. Residual wastes will be treated at designated facilities. Thus, environmental impact from solid waste is anticipated to be minimal.
	Noise / Vibration	B-	B-	B-	B-	**DC:** Noise and vibration caused by construction machineries and vehicles are estimated. However, this is only temporary and the impact may be limited. **OS:** Noise and vibration are estimated to intensify due to the increase in traffic volume and speed. However, it will be below the Japanese noise and vibration standards for major roads of four lanes and above in residential and commercial areas (Noise: 75 dB in daytime and 70 dB at night; Vibration: 70 dB in daytime and 65 dB at night) at least ten years after start of operation. Therefore, impact is estimated to be minimal.
	Offensive Odor	B-	D	B-	D	**DC:** Offensive odor coming from asphalt laying is expected. However, this is only temporary and the impact may be limited.
Natural Environment	Flora and Fauna	C	D	B-	D	**DC:** Impact to animals and plants is estimated to be minimal because the project site is located on grasslands and farmlands, and bounded by hedgerows, while construction area is limited. Valuable species on hedgerow trees that will be logged were not confirmed. Thus, the impact is estimated to be minimal.
Social Environment	Poor	B+	B+	B+	B+	**DC:** Employment of local residents and the poor in the area as construction workers is expected to contribute in vitalizing the regional economy and increasing the income of the poor. **OS:** Increase in the amount of traffic is expected to contribute to the increase in the amount of customers of shops and restaurant, which will help vitalize the

Category	Item	Evaluation at Scoping		Evaluation by IEE		Reasons for Evaluation
		BC/DC	OS	BC/DC	OS	
						regional economy and increase the income of the poor.
	Local Economy such as Employment and Livelihood	B+/B-	B+	B+/B-	B+	**BC/DC:** Employment of local residents as construction workers and procurement of fuel and food for workers from the area are expected to contribute in vitalizing the regional economy and increasing the income of the poor. On the other hand, there are small street vendors within the project site and it is assumed that their livelihood will be temporarily disrupted. However, impact might be minimal because relocation for the business inside the project site will be secured and supported by MOC as necessary. **OS:** Revitalization of economic activity by the improvement of traffic environment is expected.
	Existing Infrastructure and Services	B-	A+	B-	A+	**DC:** Traffic congestion during construction is anticipated. **OS:** Increase in travel speed and traffic accidents are concerned. On the other hand, traffic accidents are expected to be reduced due to the separation of pedestrians and vehicles. Also, some spaces can be utilized because the existing electrical cables along the road will be buried to underground.
	Landscape	D	D	D	A+	**OS:** Landscape along the road will be improved because the distribution line will be installed underground.
	Risks of Infectious Disease such as AIDS/HIV	B-	D	B-	D	**DC:** Risks of infectious diseases are expected with a fixed probability. Preventive measures against infectious diseases shall be considered.
	Working Environment	B-	D	B-	D	**DC:** Construction will involve works under dangerous conditions such as use of heavy equipment. Thus, working conditions and safety measures shall be considered.
Others	Accident	B-	B+	B-	B+	**DC:** Construction will include works under dangerous conditions such as such as use of heavy equipment. Thus, measures against accident shall be considered. Furthermore, as construction is near an existing road, measures against accidents involving third parties shall be also considered. **OS:** Pedestrian safety will be improved and traffic accident will decrease due to the separation of car and pedestrian by widening the present road.

Source: JICA Study Team

Evaluation: A-: Significant negative impact A+: Significant positive impact
B-: Some negative impact B+: Some positive impact
C: Impacts are not clear, need further investigation
D: No impacts or impacts are negligible, no further study required

Note) BC: Before Construction, DC: During Construction, OS: Operation Stage

***** The scoping items are selected in reference with the JICA New Guideline for Environmental and Social Considerations

6.2.8 Mitigation and Cost of Mitigation Implementation

Categories were evaluated as A, B, or C according to the results of the impact assessment. Mitigation measures and their implementations costs during the construction and operation stages are shown in Table 6.2.12 and Table 6.2.13. The cost of mitigation measures will be calculated during the detailed design stage, and only the items that will incur expenses are mentioned in this stage. The impact of the road expansion project between Thanlyin and Thilawa SEZ on the environmental and social environment is small by considering the mitigation measures as shown in the IEE evaluation results of Section 6.2.6.

(1) Before and During Construction

Table 6.2.12 Environmental Management Plan on the Road Expansion Project between Thanlyin and Thilawa SEZ (Before and During Construction)

Category	Item	Stage	Mitigation	Implementing Organization	Responsible Organization	Cost
Pollution	Air Quality	During Construction (DC)	- Sprinkle water around the preservation area such as residences - Prohibition of idling	Contractor	MOC	Water Supply, Vehicle Operation Fee
	Water Quality	DC	- Installation of sheet on bare lands (near rivers and channels)	Contractor	MOC	Installation Fee
	Solid Waste	DC	- Utilization of construction soil - Appropriate disposal of removed material	Contractor	MOC	Disposal Fee, Transportation Fee, Waste Management Fee
	Noise / Vibration	DC	- Observance of maximum travel speed - Advanced notice of operations - Restriction of time to implement constriction activities	Contractor	MOC	Training Fee
	Offensive odor	DC	- Consideration of where to produce the asphalt (set away from sensitive areas such as residences, religious places)	Contractor	MOC	To be determined at the Detailed Design Stage
Social Environment	Local Economy such as Employment and Livelihood	Before Construction (BC)	- Support to the relocation of vendors which are located in project area	MOC	MOC	Relocation Fee (Labor Cost)
	Existing Infrastructures and Services	DC	- Implementation of construction to avoid traffic congestion during peak day and peak hours	Contractor	MOC	To be determined at the Detailed Design Stage
	Risks of Infectious Disease such as AIDS/HIV	DC	- Thorough education and training of laborers	Contractor	MOC	Training Fee
	Working Environment	DC	- Thorough education and training of laborers	Contractor	MOC	Equipment Purchase,

Category	Item	Stage	Mitigation	Implementing Organization	Responsible Organization	Cost
			- Distribution of safe equipment - Prevention of accidents involving third parties by installation of fences, etc.			Training Fee, Installation Fee
Others	Accident	DC	- Thorough education and training of laborers - Distribution of safety equipment - Prevention of accidents involving third parties by installation of fences, etc.	Contractor	MOC	Equipment Purchase, Training Fee, Installation Fee

Source: JICA Study Team

(2) Operating Stage

Table 6.2.13 Environmental Management on the Road Expansion Project Between Thanlyin and Thilawa SEZ (Operating Stage)

Category	Item	Stage	Mitigation	Implementing Organization	Responsible Organization	Cost
Pollution	Air Quality	Operation Stage (OS)	- Enforcement of parked vehicles that may cause traffic congestion	MOC/Police	MOC	Enforcement Fee
	Noise / Vibration	OS	- Enforcement of parked vehicle that may cause traffic congestion	MOC/Police	MOC	Enforcement Fee
			- Implementation of traffic volume, noise, and vibration surveys	MOC	MOC	Survey Fee
			- Installation of soundproof walls near sensitive areas (such as hospitals and religious places) that require silence (to be considered in accordance with the increase of traffic volume)	MOC	MOC	Installation Fee (According to the future demand)
Natural Environment	Flora and Fauna	OS	- Security of green areas	Contractor / MOC	MOC	Green Area Installation Fee
Social Environment	Existing Infrastructures and Services	OS	- Installation of 1) sidewalks, 2) center median, 3) street lamps, and 4) traffic signals	Contractor	MOC	Installation Fee
	Landscape	OS	- Installation of underground distribution line	Contractor /MOC/YESB	MOC/YESB	Construction Cost
Others	Accident	OS	- Installation of 1) sidewalks, 2) center median, 3) street lamps, and 4) traffic signals	Contractor	MOC	Installation Fee

Source: JICA Study Team

6.2.9 Monitoring Plan and the Proposed Monitoring Form

Concerning the items of impacts for both before and during construction stage, and operation stage, the current monitoring items, frequency, spot and responsible organization are shown in

Table 6.2.14. The MOC, which is the responsible institution, is planned to be a report destination. The monitoring form is prepared.

Table 6.2.14 Monitoring Plan of the Road Expansion Project between Thanlyin and Thilawa SEZ

Survey item	Item	Location	Frequency	Responsible Organization	Approx. Cost
[Before Construction]					
Support of Loss of Livelihood	Monitoring of relocation progress of vendors in the road expansion project area	Vendors in the project site	Occasionally	MOC	Including routine work of staff
[During Construction]					
Common	- Monitoring of mitigation measures	-	Once a month	Contractor	Including General Expenditure (USD 8,403,898)
Air	- Record of water sprinkling	Roadside (around sensitive areas)	Once every three months	Contractor	Ditto
Water	- Record of sheet installation to prevent mudflow and rainfall	Near rivers and channels	Once every three months	Contractor	Ditto
Solid Waste	- Record of waste generated (number and receiving place)	Overall the road	Once every three months	Contractor	Ditto
Noise / Vibration	- Complaints from residents	Overall the road	Once every three months	Contractor	Ditto
Offensive Odor	- Complaints from residents	Construction site	Once every three months	Contractor	Ditto
Existing Infrastructures and Services.	- Prehension of traffic congestion	Construction site	Once every three months	Contractor	Ditto
Risks of Infectious Disease such as AIDS/HIV	- Prehension of events on infectious diseases	Construction site	Once every three months	Contractor	Ditto
Working Environment	- Prehension of occupational safety and health conditions	Construction site	Once every three months	Contractor	Ditto
Accident	- Accident records	Construction site	Occasionally	Contractor	Ditto
[Operation Stage]					
Common	- Monitoring of mitigation measures	-	Once every three months	MOC	Including routine work of staff
Air Pollution	- SO_2, NO_2, CO, TSP, PM10	Roadside (around sensitive area)	Once every three years	MOC	USD 2,000/test
Noise / Vibration	- Traffic volume, noise and vibration levels	Roadside (around sensitive area)	Once every three years	MOC	USD 3,500-/test
Flora and Fauna	- Condition of greening area	Roadside	Once a year	MOC	Including routine work of staff
Accident	- Existence of accident	Roadside	Occasionally	MOC	Including routine work of staff

Source: JICA Study Team

6.2.10 Implementation System and Mitigation Measures for Monitoring Plan

As for the implementation of the environmental monitoring and mitigation plan, the project contractor and MOC will become the main implementing and responsible institutions. Mitigation measures and implementation system for monitoring before construction, during construction, and during operation are shown in Table 6.2.15.

Table 6.2.15 Implementation System for Environmental Monitoring Plan and Mitigation Measures

Phase	Institution	Factor	Implementation System	Responsible Person
Before Construction	MOC	- Implementation of mitigation measures and environmental monitoring (relocation of vendors which are located in the project expansion area)	To nominate a staff-in-charge of environmental and social considerations as an additional task in PMU (one staff from the Public Works under MOC)	Director of PMU
During Construction （including part of mitigation measures of operation phase）	Contractor	- Implementation of mitigation measures and environmental monitoring	To add the environmental and social considerations to the mandate of a section in construction office (one staff)	The director of construction office and section chief who is in charge of environmental and social considerations
	Consultant	- Supervision on the implementation of mitigation measures and environmental monitoring by a contractor - Preparation of regular monitoring report	To send one environmental and social expert who will supervise the consultant at a fixed interval	Staff in charge of environmental and social consideration field
	MOC	- Approval of mitigation measures and environmental monitoring - Submission of regular monitoring report to MOECAF and JICA	To nominate a staff who is in charge of environmental and social considerations as an additional task in PMU (one staff from Public Works under MOC)	Director of PMU
Operation	MOC	- Implementation of mitigation measures and environmental monitoring - Submission of regular monitoring report to MOECAF and JICA	To nominate a staff who is in charge of environmental and social considerations as an additional task in Operation and Maintenance Organization (one staff from Public Works under MOC)	Chief Engineer of the Road Section, Public Works, MOC

Source: JICA Study Team

6.2.11 Stakeholders Meeting

(1) Outline of Stakeholders Meeting

In the Project, no resettlement will be anticipated because the alignment of the road was modified by avoiding the existing houses along the road. On the other hand, it is necessary to reassemble or relocate some vendors and shops within the Project area to the outside. Thus,

stakeholders meetings were organized by MOC. The stakeholders meetings were held twice as one-on-one meeting and focus group discussion. The outline of the stakeholders meetings is shown in Table 6.2.16.

Table 6.2.16 Outline of Stakeholders Meetings

No.		Agenda	Period
1	One-on-one Meeting	1. To introduce the Project description 2. To explain individual compensation policy 3. To collect the opinions of project affected persons (PAPs) and reflect their opinions on compensation, if any. 4. Hearing for the general information of PAPs and their income status	20th September 2013
2	Stakeholders Meeting	1. To introduce the Project description 2. To explain over all compensation policies 3. To collect the opinions of project affected persons (PAPs)	22nd September 2013

Source: JICA Study Team

(2) Summary of One-on-one Meeting

One-on-one meeting was held during the whole day of 20th September 2013. There were 72 facilities/vendors identified by the field survey as mentioned in Section 6.2.6. MOC selected to have one-on-one meetings with total of 12 vendors whose facilities are necessary to be relocated. The discussion was held at the location of each vendor, which were attended by the PAH, the engineer of MOC/PW, and local consultant of the JICA Study Team. The main agenda of the meeting are as follows:

1. Introduction of the Project description,
2. Explanation of support (relocation and reassembly) by MOC,
3. Feedback from PAHs, and
4. Interview with PAHs about general information and income.

Thorough the one-on-one meeting, it was confirmed that vendors agreed with relocating and reassembling their shops during project implementation.

(3) Summary of Stakeholders Meeting

The stakeholders meeting was held on 22nd September 2013 at the Department of Construction Office in Thanlyin Township. In addition with the aforementioned 12 vendors, MOC also invited representatives from concerned wards and villages, as well as representatives of Thanlyin Township. In the meeting, MOC and local consultant of the JICA Study Team explained not only social considerations on relocation and reassembly but also the results of baseline survey, expected mitigation measures, and monitoring plan as shown below. The participants of each stakeholders meeting are shown in Table 6.2.17.

1. Introduction of the Project outline (Project description, results of baseline survey, expected mitigation measures, and monitoring plan),
2. Explanation of support (relocation and reassembly) by MOC, and

3. Feedback from PAHs and representatives from concerned wards and villages.

As a results of the meeting, representative from Township and villages presented their positive feedback to the project, and offered to cooperate with the Project to MOC during construction.

Table 6.2.17 Summary of Attendances of Focus Group Meeting

No.	Organization	Number of Attendance
1	Vendor	11
2	General Administrative Office, Thanlyin Township	1
3	Administrative Office, Aung Chan Thar Ward, Thanlyin	1
4	Administrative Office, Payagone Ward, Thanlyin	1
5	Administrative Office, Bauk Htaw Dwin Ward, Thanlyin	1
6	Administrative Office, Oak Pho Su Ward, Thanlyin	1
7	Kyauk Khauk Pagoda Administrative Board	2
8	Southern District Development Zone	4
9	West of Kyeik Khauk Pagoda, Payagon Village	4
10	Ministry of Construction, Naypyitaw	1
11	Ministry of Construction, Thanlyin Township	9
12	Local Staff of JICA Survey Team	1
13	Resource and Environment Myanmar	6
Total		**43**

Source: JICA Study Team

CHAPTER 7 MEASURES TO ACCELERATE PROJECT IMPLEMENTATION

7.1 Major Premises for Project Implementation

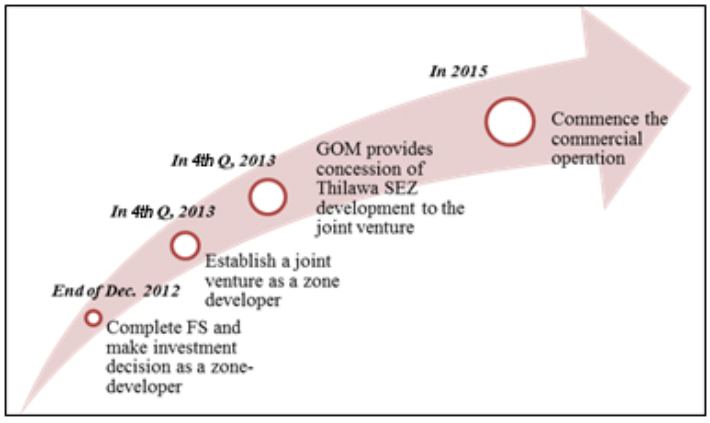
(1) Basic Concept of Thilawa SEZ Development

Developers of Japan and Myanmar will establish a joint venture (JV) as zone developers of Thilawa SEZ to develop on-site infrastructure and facilities inside the SEZ. The Government of Myanmar (GOM) is assumed to develop supporting off-site infrastructures. GOM will provide a concession for the JV on the development of Thilawa SEZ. In order to execute the development, appropriate methods to finance each supporting infrastructure will be decided by GOM.

(2) Time Frame

According to the Memorandum on the Cooperation for the Development of The Thilawa SEZ(Dec.21/2013) between the Government of Japan (GOJ) and GOM, it is expected that the SEZ shall be developed in accordance with the following time frame (also shown in Figure 7.1.1):

a. Investors of Japan and Myanmar will complete their feasibility studies and make their investment decision as zone developers by the end of 2012;
b. Based on their decisions, the investors will establish a JV as a zone developer of Thilawa SEZ in the fourth quarter of 2013;
c. The GOM will provide a concession for the JV for the development of Thilawa SEZ in the fourth quarter of 2013;
d. Commercial operations of Thilawa SEZ will commence in 2015; and
e. The JV will decide the sizes and sites of the Class A and Class B areas in the SEZ based on METI-FS and F/S for Thilawa SEZ Class A Development. The Class A are will be developed with priority.



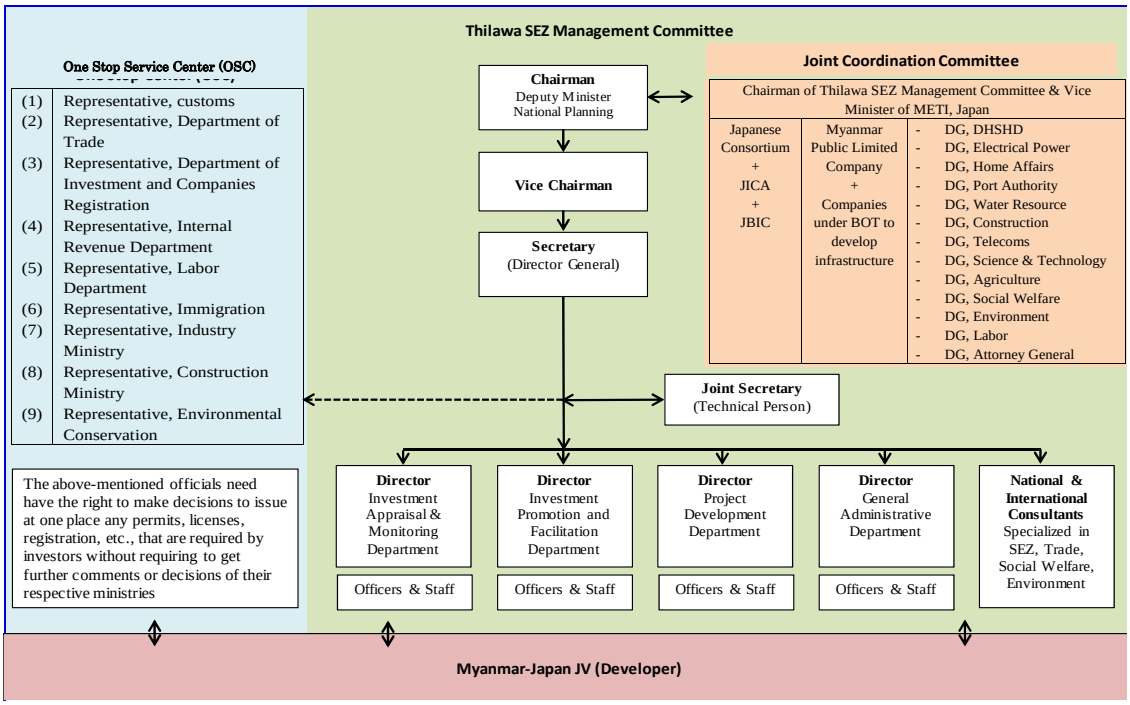
Source: METI-FS

Figure 7.1.1: Time Frame of Thilawa SEZ

7.2 Organizational Development for Thilawa SEZ

(1) Organization Structure of Thilawa SEZ Development Project

The organizational structure for the SEZ development project was designed in order to ensure its expeditious development and attractive investment climate. The organizational structure should have the following four key components: Thilawa SEZ Management Committee, Joint Coordination Committee, Myanmar-Japan JV (Developer), and One-stop Service Center (OSC). These components should have cooperation among each other, as shown in Figure 7.2.1.



Source: Thilawa SEZ Management Committee

Figure 7.2.1: Organization Structure of Thilawa SEZ Management Committee

(2) Thilawa SEZ Management Committee

The Thilawa SEZ Management Committee will set up office inside Thilawa SEZ, and managers and staff will work there. The committee will be chaired by the Deputy Minister of the Ministry of National Planning and Economic Development. The ministry's vice chairman and secretary (or director general) shall also support the chairman.

Under the top management, the management committee will have the following departments: Investment Appraisal and Monitoring Department, Investment Promotion and Facilitation Department, Project Development Department, and General Administrative Department. National and international consultants specializing in SEZ, trade, social welfare, environment, etc. will also be employed under these departments.

(3) Joint Coordination Committee

The Government of Japan (GOJ) and GOM shall cooperate in advancing the development of the Thilawa SEZ. Both governments shall establish a joint coordination committee which will monitor, coordinate, and facilitate the development of the SEZ.

The committee will be co-chaired by the Vice Minister for International Affairs from the Ministry of Economy, Trade and Industry (METI) of Japan, and the Chairman of the Thilawa SEZ Management Committee of Myanmar. Members of the committee from the GOJ will include a Japanese consortium, JICA, and JBIC. On the other hand, the Myanmar Listed Company, companies under BOT infrastructure development, and director generals from relevant ministries will be the members from GOM. The Joint Coordination Committee members are listed in Table 7.2.1.

Table 7.2.1: Members of the Joint Coordination Committee

Chairman of Thilawa SEZ Management Committee and Vice Minister of METI, Japan		
Japanese Consortium + JICA + JBIC	Myanmar Public Limited Company + Companies under BOT infrastructure development	DG, DHSHD DG, Electrical Power DG, Home Affairs DG, Port Authority DG, Water Resource DG, Construction DG, Telecoms DG, Science and Technology DG, Agriculture DG, Social Welfare DG, Environment DG, Labor DG, Attorney General

Source: Thilawa SEZ Management Committee

(4) Myanmar-Japan JV (Zone Developer)

A Myanmar-Japan JV as zone developer is underway with the preparation for its establishment lead by a Japanese consortium. The terms and conditions of the JV are discussed between the two countries. The zone developer will be responsible for implementing the development of the project, as well as for the operation and maintenance (O&M) of Thilawa SEZ.

(5) One-stop Service Center (OSC)

The OSC will be set up at Thilawa SEZ to issue any permit, license, registration, etc. that will be required from the investors in Thilawa SEZ. The OSC officials, as listed in Table 7.2.2, will work together at OSC. The OSC will have the right to make decisions without the need to get further comments or decisions from their respective ministries.

Table 7.2.2: Members of the OSC

	Member
(1)	Representative, Customs
(2)	Representative, Department of Trade
(3)	Representative, Department of Investment and Companies Registration
(4)	Representative, Internal Revenue Department
(5)	Representative, Labor Department
(6)	Representative, Immigration
(7)	Representative, Industry Ministry
(8)	Representative, Construction Ministry
(9)	Representative, Environmental Conservation

Source: Thilawa SEZ Management Committee

7.3 Institutional Measures

(1) Policy and Legal System for Investment Promotion

Industrial Policy

Industrial policy is important for the rapid and sustainable long-term development of the industrial sector in Myanmar. It contributes significantly to the increase of gross domestic product (GDP) and the balance of payments, resulting to higher labor income and higher living standards. The industrial policy of Myanmar has been drafted by the Industrial Development Committee (IDC) chaired by the Union Minister at the President's Office. However, the policy has not been finalized and disclosed yet.

Revised Law on Foreign Investment

Myanmar is opening up to other countries and attracting foreign investors. To attract foreign investment, Myanmar revised its related laws, relaxing the rules and regulations, and speeding up the incorporation process. An amendment to the Foreign Investment Law was issued on 2 November 2012.

Revised Law on Special Economic Zone

The Law on Special Economic Zone is the legal basis for the development of Thilawa SEZ as well as of other SEZs in Myanmar. The Revised Law on Special Economic Zone has been drafted but amendments are still required. The draft is preferable to be examined from the viewpoint of investors so as to make the law practical. The revised law needs to be finalized and promulgated as soon as possible.

(2) Institutional Measures to Accelerate the Project

Investment Promotion Activity

It is necessary to organize various business seminars and missions in Myanmar in order to introduce the business climate and investment opportunities to Japanese investors in cooperation with GOM, Japanese government-related organizations such as the Japan External Trade Organization (JETRO), ASEAN Japan Center (AJC), and the Organization for Small and

Medium Enterprises and Regional Innovation of Japan (SME Support of Japan). The Thilawa SEZ development projects will be introduced to Japanese investors at such seminars and missions. Japanese investors are expected to express high interest in Thilawa SEZ through these investment promotion activities. Such activities for investment promotion need to be organized repeatedly.

One-stop Service Center

It currently takes months to issue permits, licenses, or registration to foreign investors in Myanmar. It is necessary to establish an OSC in Thilawa SEZ to make these processes transparent, smooth, and efficient. The Revised Law on Special Economic Zone is required to stipulate the process of issuing permits, licenses, and registration at the OSC. The revised law shall also stipulate the maximum number of days to issue certificates.

Improvement of Worker Quality

After the commencement of the commercial operations of Thilawa SEZ in 2015, investors who will employ large numbers of workers and managers would gradually grow. Employers are expected to educate and train their own employees as needed. Also, vocational education and training of workers would be needed to meet the employment requirements. Public vocational training schools are recommended to be established inside Thilawa SEZ, with the participation of foreign investors, in order to develop a practical training program which can provide system of employment promotion for neighborhood residents and priority employment for graduates of the schools.

7.4 Proposal on Off-site Priority Infrastructure Development

(1) Priority Infrastructure Development Projects

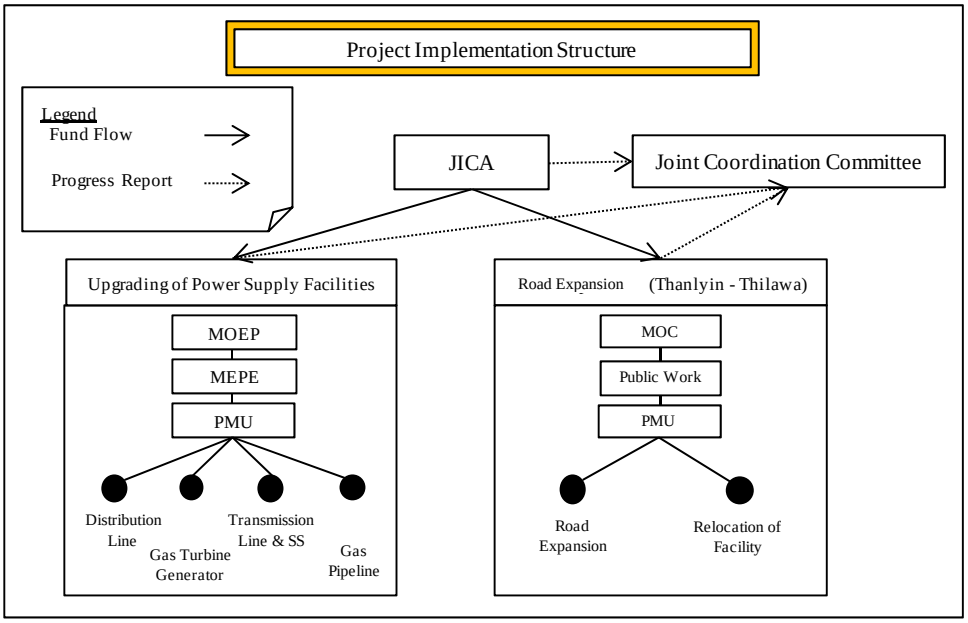
The GOM will develop supporting off-site infrastructures that will be located outside the SEZ. Such infrastructures have been planned in this Study as described earlier in Chapter 5. The following supporting infrastructure projects are proposed to be implemented under the public works:

- Power Supply Facilities Upgrading Project, and
- Road Expansion Project between Thanlyin Bridge and Thilawa SEZ.

As for water supply, a new water purification plant under the Yangon City Development Committee is being planned and studied by the JICA Study Team to improve the water supply, sewerage, and drainage systems in Yangon City. In addition to this, a project on solid waste disposal is also being studied.

(2) Proposed Project Implementation Structure

The priority projects for power supply and road expansion will be implemented on a sector-by-sector basis as shown in Figure 7.4.1. The progress of project implementation would be reported to the Joint Coordination Committee by JICA and the executing agencies of individual sectors.



Source: JICA Study Team

Figure 7.4.1: Proposed Project Implementation Structure

(3) Proposed Establishment of PMU

Principles of Operation of PMU

As presented in Figure 7.4.1, the establishment of a project management unit (PMU) is proposed to assist the executing agency in implementing the projects. The PMU shall maintain the following principles:

- Observe the provisions of Myanmar's laws and other international agreements to be signed with JICA,
- Justify issues under competence to the executing agency
- Manage and efficiently use project resources and avoid the loss and waste of these resources, and
- Adopt measures to prevent and combat corruption.

Functions and Tasks of PMU

The PMU will assist the executing agency in implementing projects through several tasks, as shown in Table 7.4.1 below.

Table 7.4.1: Functions and Tasks of PMU

Functions and Tasks	Description
1. Planning	To elaborate an overall plan and detailed annual plans on project implementation such as disbursement plan, spending plan, and bidding plan. The plan will specify the resources to be used, implementation schedules, completion deadlines, quality targets and criteria for acceptance of results of each project activity, to be used as the basis for monitoring and evaluation.
2. Management of preparation for project implementation	For managing the preparation for project implementation, PMU must comply with current regulations on the management of work investment and construction while taking into consideration the number of requirements (evacuation and resettlement of inhabitants, ground clearance, environmental impact assessment, and social impact assessment) on the basis of international agreements signed with JICA.
3. Bidding and contract management	To perform bidding tasks assigned by the executing agency in accordance with JICA's bidding guidelines.
	To manage the performance of obligations specified in the contracts signed between authorized persons and contractors (in terms of work progress, volume and quality, labor safety, and environmental sanitation).
	To monitor, supervise, and evaluate activities and performance results of contractors.
4. Financial and asset management, and disbursement	To perform financial and asset management, and carry out procedures for disbursement in accordance with JICA's guidelines.
5. Administration, information provision, and coordination	To perform general administration work for PMU.
	To provide accurate and correct information for law enforcement, oversight, inspection and auditing agencies, JICA, the mass media, and concerned individuals within the scope of its assigned tasks and responsibilities, except for information restricted by law to the public.
	To act as the coordinator of the executing agency and agencies participating in project implementation on relevant issues in the course of project implementation.
6. Monitoring, evaluation, and reporting of project implementation	To organize the monitoring and assessment of project implementation, including hiring consultants to make evaluations, as well as coordinating with JICA in evaluating projects.
	To submit periodical and occasional reports on project implementation to the executing agency so that it can send reports to the Joint Coordination Committee for Thilawa SEZ development.
7. Handover and financial settlement of projects	To prepare conditions for the executing agency to hand over completed projects to recipients for operation.
	To make reports on completion and financial settlement of projects.

Source: JICA Study Team

7.5 Proposed Organization for Priority Projects

(1) Power Supply Facilities Upgrading Project

Executing Agency

Ministry of Electric Power (MOEP)

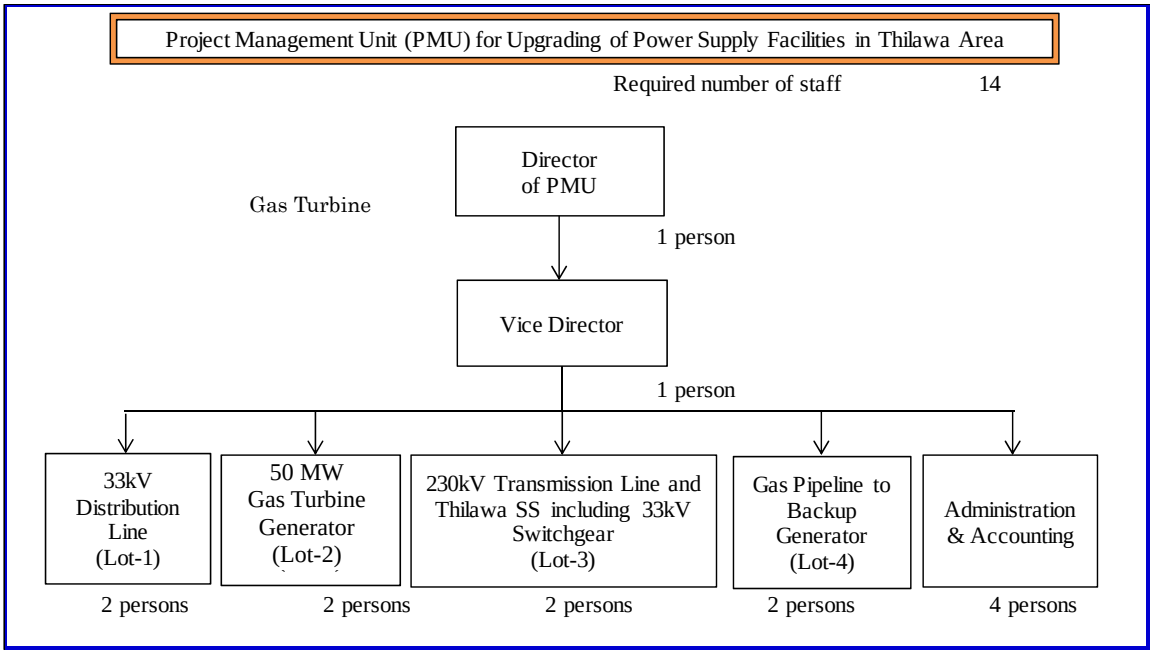
Project Objective

The project aims to improve and upgrade the existing power supply facilities by installing 33 kV distribution lines between Thanlyin and Thilawa, new gas turbine generators, a transmission line, Thilawa Substation, and gas pipeline in order to achieve stable power supply to Thilawa.

Organization for Project Implementation

In implementing the project, a PMU is expected to be set up under the Yangon Electricity Supply Board (YESB).

Figure 7.5.1 shows the recommended organizational chart of the PMU. Under the supervision of the PMU director and vice director, eight engineers will be assigned to the different power supply facilities. There will be two engineers assigned each to the distribution line (Lot-1), 50 MW gas turbine generator (Lot-2), the 230 kV transmission line and Thilawa Substation including the 33 kV switchgear (Lot-3), and gas pipeline (Lot-4). Four officials or staff will also be assigned for administrative and accounting work. The total number of PMU staff to be deployed is 14.



Source: JICA Study Team

Figure 7.5.1: PMU for Power Supply Facilities Upgrading Project

Organization for O&M

a. Transmission and Distribution Lines

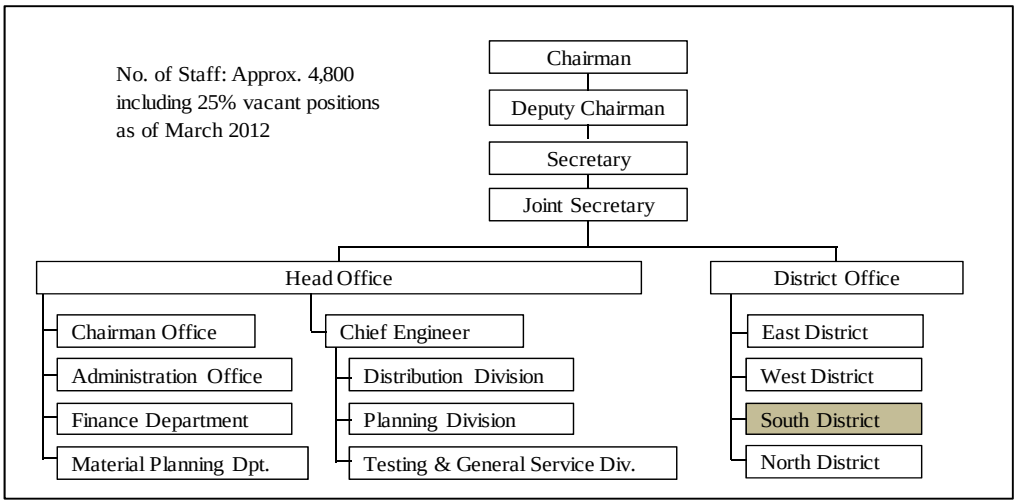
The O&M for the newly installed transmission line and Thilawa substation, including the 33 kV switch gear, will be undertaken by the existing Myanmar Electric Power Enterprise (MEPE) staff at Thanlyin Substation. Whereas, the existing YESB staff at the South District Office will take charge of the new distribution lines.

Table 7.5.1 shows the staff assignment at Thanlyin Substation, and Figure 7.5.2 shows the YESB organizational chart.

Table 7.5.1: Staff Assignment of MEPE at Thanlyin Substation

No	Position	Maximum Allowable Number of Staff (A)	Existing Number of Staff (B)	Vacant Position (A) - (B)
1	Chief Engineer	1	1	-
2	Assistant Engineer	3	1	2
3	Electrical Expert (1)	1	1	-
4	Junior Engineer (2)	5	4	1
5	Electrical Expert (2)	2	2	-
6	Senior Clerk	1	1	-
7	Electrical Expert (3)	2	2	-
8	Accountant (3)	1	1	-
9	Junior Engineer	1	1	-
10	Accountant (4)	1	1	-
11	Store Keeper (4)	1	1	-
12	Junior Typist	1	1	-
13	Electrical Expert (4)	4	1	3
14	Driver (4)	1	1	-
15	Electrical Expert (5)	4	1	3
16	Driver (5)	1	0	1
17	Security (5)	1	0	1
18	General Staff	8	2	6
19	Helper	1	0	1
20	Guard	1	1	-
	Total	**41**	**23**	**18**

Source: Thanlyin Main Substation



Source: Yangon Electricity Supply Board

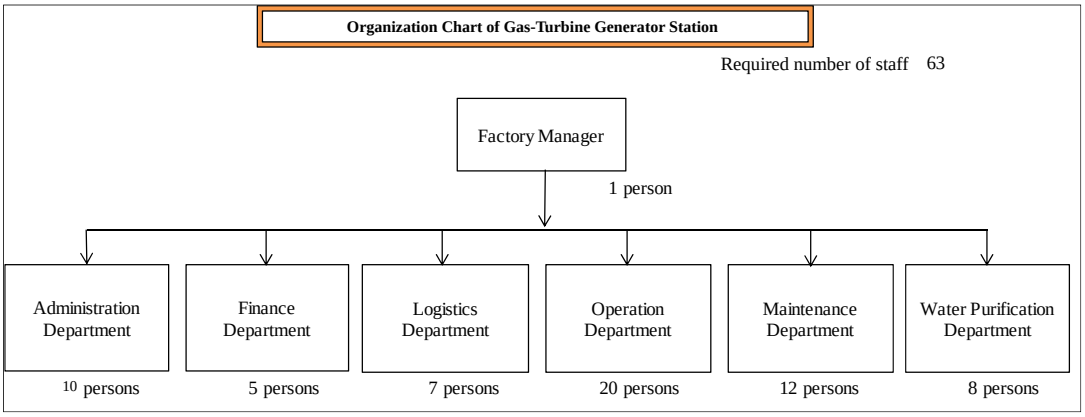
Figure 7.5.2: Organizational Chart of YESB

b. Gas Turbine Generator

A new organization is needed for the O&M of the gas turbine generator station. Figure 7.5.3 shows the organizational chart of the gas turbine generator station proposed by the JICA Study Team using the organizational chart of the Ywama Gas Turbine Station as reference. The total number of staff assigned to the gas turbine generator was estimated at 63. This is less than the 109 staff at the Ywama Gas Turbine Station considering the difference in number of equipment

and configuration between the simple cycle gas turbine of the gas turbine generator station and the combined cycle gas turbine of the Ywama Gas Turbine Station.

It is expected that the operation department shall operate two groups of gas turbine generators in the work system with three shift operation, as handled by four groups.

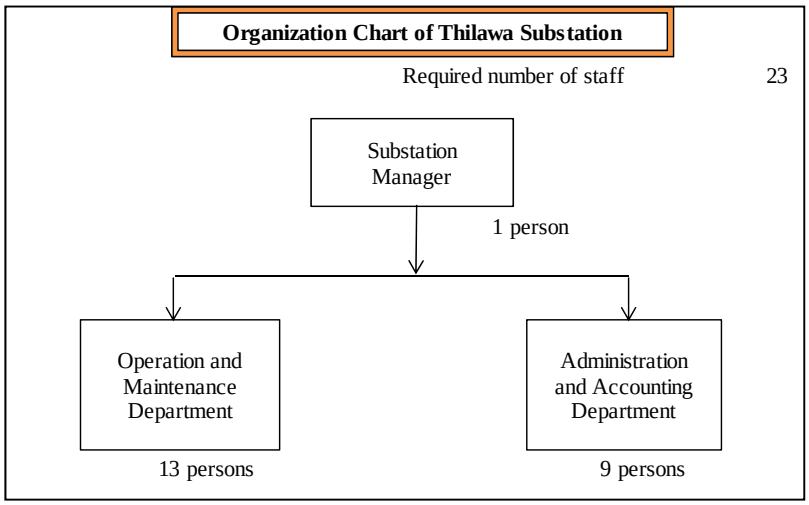


Source: JICA Study Team

Figure 7.5.3: Organizational Chart for the O&M of the Gas Turbine Generator Station

c. Substation in Thilawa SEZ

A new organization is needed for the O&M of the new substation in Thilawa SEZ. Figure 7.5.4 shows the organizational chart of the Thilawa Substation proposed by the JICA Study Team using the organizational chart of the existing Thanlyin Substation as reference. The total number of staff required to operate the station was estimated at 23.



Source: JICA Study Team

Figure 7.5.4: Organizational Chart for the O&M of the Substation in Thilawa SEZ

d. Gas Pipeline

The MOEP will hand over the completed gas pipeline for gas turbine generator to the Myanma Oil and Gas Enterprise (MOGE), which is under the Ministry of Energy (MOE), for operation.

(2) Thanlyin-Thilawa Road Expansion Project

Executing Agency

Ministry of Construction (MOC)

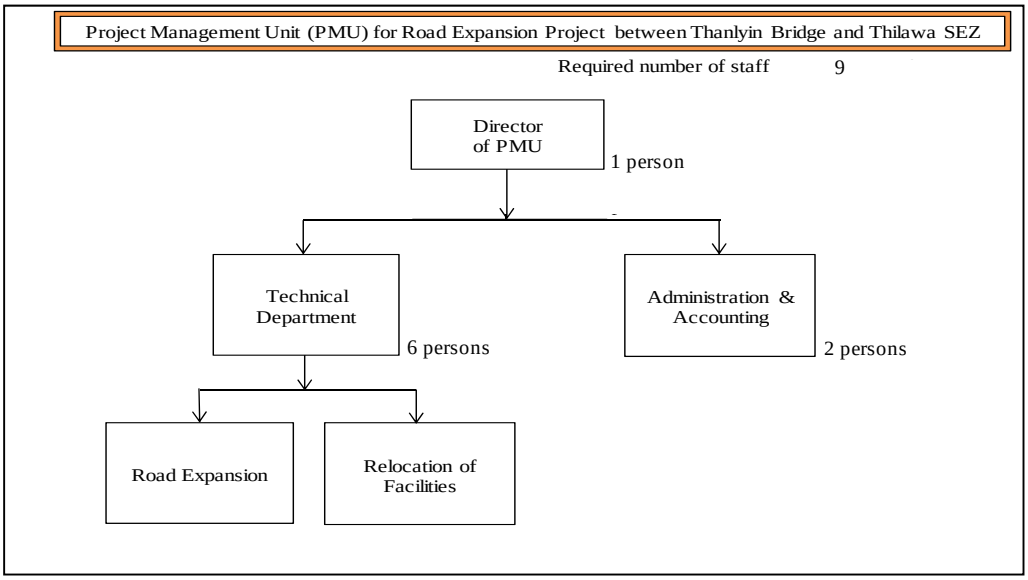
Project Objective

The project is aimed at expanding the road between Thanlyin Bridge and Thilawa SEZ. The project is also aimed at relocating facilities along the road so as to improve transportation between Yangon and Thilawa SEZ.

Organization for Project Implementation

For implementing the project, a PMU is expected to be set up at MOC.

Figure 7.5.5 shows the proposed organizational chart of the PMU. Under the supervision of the PMU director and vice director, six engineers will be assigned for road expansion and facilities relocation, while two persons for administrative and accounting work. The total number of PMU staff to be deployed is 9.

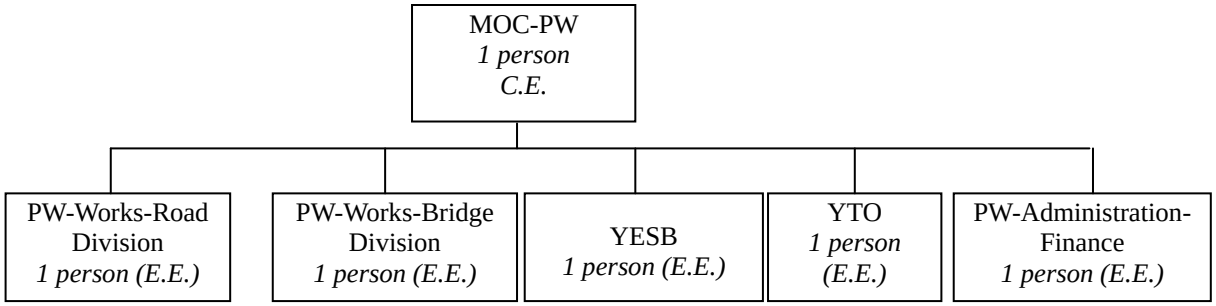


Source: JICA Study Team

Figure 7.5.5: PMU for the Thanlyin-Thilawa Road Expansion Project

Organization for O&M

After completing the road construction, MOC will be responsible for the O&M of the expanded road. Meanwhile, MOC will hand over the relocated facilities to the original organization in charge so that they can carry out the O&M of the facilities.



C.E. Chief Engineer
E.E. Executive Engineer
Source: JICA Study Team

Figure 7.5.6: Thanlyin to Thilawa Access Road O&M Organizational Chart