Republic of Angola
Ministry of Energy and Waters (MINEA)
National Electricity Transportation Company(RNT)
National Electricity Distribution Company(ENDE)
National Demining Center(CND)

Republic of Angola
Preparatory Survey on the Project for Transmission System Reinforcement in Southern Angola

Final Report
(Pre-release Version)

March 2023

Japan International Cooperation Agency (JICA)
Tokyo Electric Power Services Co., Ltd. (TEPSCO)
Ingerosec Corporation
Oriental Consultants Global Co., Ltd.

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Glossary

Abbreviation	Full name
AfDB	African Development Bank
AAAC	All Aluminium Alloy Conductor
AC	Alternating Current
ACSR	Aluminum Conductors Steel Reinforced
ANAM	Agência Nacional de Acção Contra Minas (Angolan National Agency for Mine Action)
AOA	Angolan Kwanza
ARAP	Abbreviated Resettlement Action Plan
AEWA	The Agreement on the Conservation of African-Eurasian Migratory Waterbirds
AIS	Air Insulated Switchgear
AWG	American Wire Gauge
BOD	Biochemical Oxygen Demand
CBD	Convention on Biological Diversity
CCGT	Combined Cycle Gas Turbines
CED	Comissão Executiva de Desminagem
CMS	The Convention on the Conservation of Migratory Species of Wild Animals
CND	Centro National de Desminagem
CNIDAH	Comissão Nacional Intersectorial de Desminagem e Assistência Humanitária (National Coordination Committee for Demining and Humanitarian Assistance)
CO_2	Carbon Dioxide
COD	Commercial Operation Date
CSPR	Casa de Segurança da Presidência da República (Presidential Guard)
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
DC	Direct Current
DL	Distribution Line
DNAAC	National Directorate for the Environment and Climate Action
DNPAIA	National Directorate for Prevention and Assessment of Environmental Impacts
DFID	Department for International Development
EAS	Extra high strength Aluminum clad Steel
EDS	Every Day Stress
EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
ENDE	Empresa Nacional de Distribuição de Electricidade
EPC	Engineering, Procurement, Construction
FAA	Forças Armadas Angolanas
FS	Feasibility Study
FIRR	Financial Internal Rate of Return
GAMEK	Gabinete de Abinete de Aproveintamento do Médio Kwanza (Central Kwanza River Utilization Authority)
GDP	Gross Domestic Product
GICHD	Geneva International Centre for Humanitarian Demining
GPS	Global Positioning System
GIS	Gas Insulated Switchgear
GT	Gas Turbine
GMh/MWh	Giga/Mega watt hour
IBA	Important Bird and Biodiversity Areas
IDC	Interest During Construction
IEC	International Electrotechnical Commission
IFC	International Finance Corporation
IMAS	International Mine Action Standard
IMF	International Monetary Fund
IMSMA	Information Management System for Mine Action
INAD	Instituto Nacional de Desminagem (National Demining Institute)
INAROEE	Instituto Nacional para Remocao de Objectos e Engenhos Explosivos
INAVIC	National Institute of Civil Aviation (aviation regulator)
INBAC	Instituto Nacional da Biodiversidade e Áreas de Conservação
INBC	Instituto Nacional da Biodiversidade e Conservação (National Institute for Biodiversity Conservation) *Changed its name from INBAC in 2021.
INE	National Statistic Bureau
INGA	Instituto Nacional de Gestão Ambiental
INPC	Instituto Nacional do Património Cultural
IPP	Indigenous Peoples Plan
IWGIA	International Work Group for Indigenous Affairs
IRSEA	Instituto Regulador dos Serviços de Electricidade e de Água
JICA	Japan International Cooperation Agency
JPY	Japanese Yen
KBA	Key Biodiversity Areas
KfW	Kreditanstalt für Wiederaufbau
LFO	Light Fuel Oil

Abbreviation	Full name
LIS	Landmine Impact Survey
LIWV	Lightning Impulse Withstand Voltage
LL-ACSR	Low Loss-Aluminum Conductors Steel Reinforced
LV	Low Voltage
MAG	Mine Advisory Group (Mine Advisory Group (International NGO))
MASFAMU	Ministério da Acção Social, Família e Promoção da Mulher (Ministry of Social Action, Family and Women Promotion)
MCM	M Circular Miles
MCTA	Ministério da Cultura, Tourismo e Ambiente
MINAGRIF	Ministério da Agricultura e Florestas
MINAMB	Ministério do Ambiente (Ministry of the Environment)
MINCULT	Ministério da Cultura (Ministry of Culture)
MINEA	Ministério da Energia e Águas (Ministry of Energy and Water)
MINFIN	Ministry of Finance
MINTRANS	Ministério dos Transportes
MP	Master Plan
NG	Natural Gas
NMAS	National Mine Action Standard
NPA	Norwegian People's Aid (International NGO)
NDP	National Development Plan
NGO	Non-Governmental Organization
NO_2	Nitrogen Dioxide
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
O&M	Operation and Maintenance
OPGW	Optical Fiber Composite Overhead Ground Wire
PGA	Peak Ground Acceleration
PGFA	Polícia de Guarda Fronteira de Angola (Border Guard)
PRODEL	Public Electricity Production Company
RC	Rainforced Concrete
RNT	Rede Nacional de Transporte de Electricidade
ROW	Right of Way (land for power lines)
SAPP	Southern Africa Power Pool
SCADA	Supervisory Control And Data Acquisition
SEEN	Southeast Europe Bird Migration Network
SES	Simplified Environmental Study
SIA	Sistema Integrado do Ambiente
SIWV	Switching Impulse Withstand Voltage
SO_2	Sulfur Dioxide
SOP	Standard Operating Procedures
SS	Substation
TL	Transmission Line
TOR	Terms of Reference
TW	Trapezoid shaped wire
UGDL	Under Groung Distribution Line
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNFPA	United Nations Population Fund
USD/UScents	United States Dollar/United States cents
UTS	Ultimate Tensile Strenght
WHO	World Health Organization
XLPE	Cross - linked Polyethylene

1. Background and Validity of the Project

The Republic of Angola ("Angola") has experienced steady economic growth since the end of the civil war in 2002. Although there was a period of negative GDP growth in 2014 following a sharp drop in oil prices, growth has recovered again, and GDP growth is projected at 2.4% in 2022. In the electric power sector, the installed capacity is planned to increase from 2,120 MW to 8,742 MW by 2025, and the electrification rate is aiming to improve from 30% (national average; less than 9% in rural areas) to 60%.

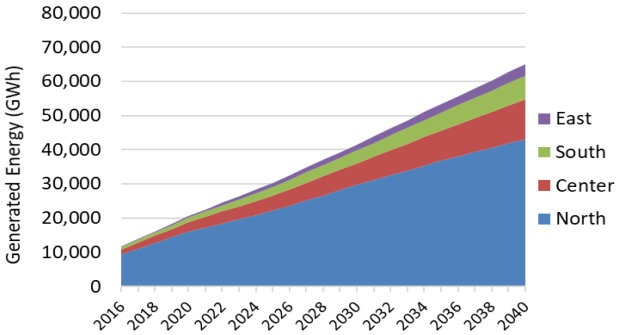


Figure 1.1-1 Peak Demand Forecast by the Electric Power Master Plan (2019)

The power generation facilities in Angola are concentrated in the northern part of the country, where the capital Luanda is located. Therefore, in order to meet the increasing demand in the central and southern regions, it is absolutely indispensable to construct a transmission line that connects the northern grid with the central and southern grid, which are currently separated. It is also identified as a high priority in the Electric Power Master Plan, which is the result of JICA's technical assistance "The Project for Power Development Master Plan in the Republic of Angola" (hereinafter referred to as "MP Study") and is essential for the economic growth of the region.

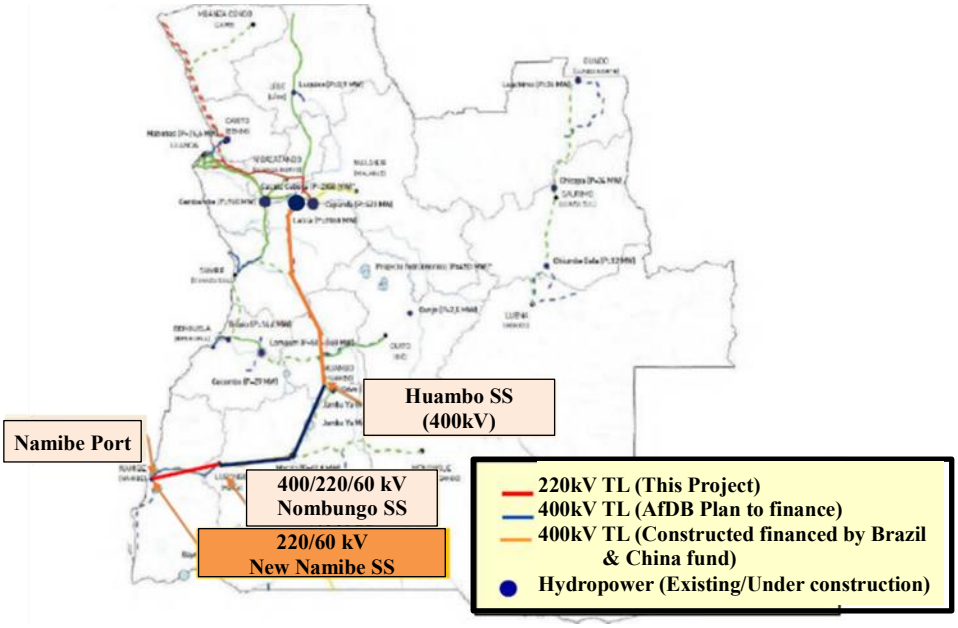


Figure 1.1-2 Location of the Project

Electricity supply for the large demand center in the north, where the capital Luanda is located, is provided through the northern grid, in which large hydroelectric and thermal power stations in the central and northern areas are connected.

The development of a backbone transmission line (400 kV) connecting the mid-northern substations connected to the northern grid to the mid-western city of Huambo, based on the Electricity Master Plan, was funded by Brazil and China and completed in 2020. Also, a development plan for a 400 kV power transmission line between Huambo and Lubango, a city in the southwest of the country, is underway that is funded by the African Development Bank (AfDB), and is expected to be commissioned by the end of 2024. On the other hand, a new 220 kV TL is planned to connect Lubango to the southern part of the country where Namibe Port is located, but currently only a 60 kV DL is available, which is not enough to meet future demand growth.

Southern Angola is rich in mineral resources such as iron ore, and the promotion of logistics efficiency and mineral resource exports through the development of a logistics hub is an important issue. Namibe Port, one of Angola's main ports, is regarded as the starting point of the logistical distribution covering from southern Angola to northern Namibia in the 2013-2017 National Development Plan (hereafter referred to as the NDP). Correspondingly, the Namibe Port Rehabilitation Project was completed in 2019 under the grant aid. Moreover, economic development through the renovation of Namibe and Sacomar ports are being promoted using private funds, thus the necessity for the stable power supply to the region has been increasing more and more. Therefore, the project to construct a power transmission system between Lubango area and Namibe area, which is focused on in this study for the feasibility of Japanese assistance through yen loan, is desirable to be realized sooner following the preceding AfDB-supported new transmission line project between Huambo and Nombungo substations in Lubango area.

1.1. Status of Development Progress and Support from the Other Donors

In the Electric Power Master Plan established in the MP Study, project of 400 kV transmission lines to be developed by 2027, as an improvement of the grid, are listed as shown in the Table 1.1-1. This Angolan power grid is also planned by SAPP to be eventually interconnected with the neighboring country Namibia. Therefore power export through the interconnection with the African power market, and also import during drought seasons are expected. The 400 kV transmission line will also be used as the power line for a new large-scale power station to be developed.

Currently, the development plan in the Table 1.1-1 remains no change although there are some delays such as the completion year of Project Nos. 1~4 was planned in 2020 but completed in this year (2022). In addition, with the exception of Project No. 16, for which construction has begun with AfDB funds, there are construction plans, but the donor has not yet been decided.

Table 1.1-1 List of Projects for 400 kV Transmission Lines

Project#	Year of operation	Area	Voltage (kV)	Starting point	End point	number of circuit	Power Flow (MVA)	Line Length (km)	Remarks
1	2020	**Central**	400	**Lauca**	**Waco kungo**	1	307	177	under construction(China)
2	2020	**Central**	400	**Waco kungo**	**Belem do Huambo**	1	242	174	under construction(China)
3	2020	**Northern**	400	**Cambutas**	**Bita**	1	580	172	under construction(Brazil)
4	2022	**Northern**	400	**Catete**	**Bita**	2	504	54	under construction(Brazil)
5	2025	**Northern**	400	**Cambutas**	**Catete**	1	791	123	Dualization
6	2025	**Northern**	400	**Catete**	**Viana**	1	579	36	Dualization
7	2025	**Northern**	400	**Lauca**	**Capanda elev.**	1	518	41	Dualization
8	2025	**Northern**	400	**Kapary**	**Sambizanga**	2	1130	45	For New Substation
9	2025	**Northern**	400	**Lauca**	**Catete**	2	868	190	Changing Connection Plan
10	2025	**Central**	400	**Lauca**	**Waco kungo**	1	307	177	Dualization
11	2025	**Central**	400	**Waco kungo**	**Belem do Huambo**	1	242	174	Dualization
12	2025	**Central**	400	**Cambutas**	**Gabela**	2	484	131	Pre-FS implemented*
13	2025	**Central**	400	**Gabela**	**Benga**	2	848	25	Pre-FS implemented*
14	2025	**Central**	400	**Benga**	**Nova Biopio**	2	550	200	Pre-FS implemented*
15	2025	**Southern**	400	**Belem do Huambo**	**Caluquembe**	1	606	175	Pre-FS implemented*
16	2025	**Southern**	400	**Caluquembe**	**Lubango2**	1	666	168	Pre-FS implemented*
17	2025	**Southern**	400	**Belem do Huambo**	**Chipindo**	2	264	114	
18	2025	**Southern**	400	**Chipindo**	**Capelongo**	2	190	109	
19	2025	**Southern**	400	**Nova Biopio**	**Quilengues**	2	840	117	Pre-FS implemented*
20	2025	**Southern**	400	**Quilengues**	**Lubango2**	2	772	143	Pre-FS implemented*
21	2025	**Southern**	400	**Lubango2**	**Cahama**	2	450	190	Pre-FS implemented*
22	2025	**Eastern**	400	**Capanda_elev**	**Xa-Muteba**	2	590	266	
23	2025	**Eastern**	400	**Xa-Muteba**	**Saurimo**	2	510	335	under Pre-FS
24	2027	**Southern**	400	**Capelongo**	**Ondjiva**	2	292	312	
25	2027	**Southern**	400	**Cahama**	**Ondjiva**	2	442	175	
26	2027	**Southern**	400	**Cahama**	**Ruacana**	2	409	125	International Interconnection
Total								3,948	

Source: MP Study

In the Angolan power sector, AfDB is the most active donor in the sector and took a leading role in the power sector reforms implemented in 2014. It has recently been involved in technical cooperation related to the electricity distribution sector, with the following four FSs implemented before 2020.

Among them, the 400 kV transmission and substation project between Huambo and Nombungo in the south (Nos. 15 and 16 in Table 1.1) is in progress, with construction expected to start in 2023 and be completed around 2025.

- ✓ Fixed Asset Register Project
- ✓ Technical Loss Reduction Program (2015-2017)
- ✓ Non-technical Loss Reduction Program (initiated in 2017)
- ✓ Transmission Lines Program

The U.S. government, under the direction of the Department of State's Bureau of Energy Resources, is also implementing a technical assistance program from 2016 to 2017, primarily targeting RNT. This included the development of interconnection plans for the northern, central, and southern grids that are not currently interconnected, covering the period 2017-2036. In addition, the U.S. government is also promoting a GT implementation program for voltage stabilization, mainly in the central and southern regions.

1.2. Power Development Plan based on Regional (Northern, Central, and Southern) Characteristics

The Angolan government has been emphasizing the promotion of rural electrification as one of its post-civil war reconstruction measures, and has set an immediate goal of achieving 60% electrification by 2025, etc. In order to realize this policy, the MP Study adopted a plan to expand the scope of electricity supply by building a nationwide 400 kV backbone grid system, which will not only connect several currently separated systems, but also extend the system further, with the aim of quickly increasing the supply to the central and southern regions, where electricity supply is insufficient compared to the northern regions where power stations are concentrated. In addition, the medium- to long-term plan incorporates the sequential construction of large-scale and high-efficiency thermal power stations in the central /southern regions, which require time for site construction and preparation of fuel supply, to achieve a stable supply of electricity on the nationwide scale.

1.3. Status of Power Development Plan

The MP study envisages the future connection of the northern, central, and southern grids and the highly efficient integrated operation of the large power sources planned in various locations such as the Soyo thermal power station currently under construction at the northern end, the 750 MW CCGT of Namibe in the southern grid, and the Caculo Cabasa hydropower station in the central grid. The MP study suggest to establish a unified power grid system and promote electrification as well as realizing the reliable and efficient power grid s utilizing the newly developed high-efficiency power stations such as the 750 MW Namibe CCGT.

Long-term power development plan stated in MP Study is shown in Table 1.3-1. The development of power stations has also been delayed compared to the plan of the MP Study. Among the power stations planned to develop by 2022, the Lauca hydropower station has been completed and the Luachimo hydropower station is expected to complete by the end of 2023, while the development of the other power stations is further delayed. On the other hand, as shown in Table 1.3-2, the construction of a new solar (photovoltaic) power station has been approved and is expected to start operation in the near future.

The RNT has not revised the long-term power development plan since the MP Study established it, while RNT has been checking the status of the development status. In addition, since Angola's peak demand is observed in the evening, the impact of the introduction of solar power stations in the near future on the long-term development plan is negligible. Therefore, for this study, it was assumed that there would be no change in the long-term power supply development plan.

Table 1.3-1 Long-Term Power Development Plan

Year	Power Development Plan				
	Hydro power	CCGT	GT	Wind power	Solar
2017		Soyo1-1 (250)			
2018	Lauca (2070) Lomaun ext. 65	Soyo1-2 (500)			
2019					
2020	Luachimo ext. 34				
2021		Soyo2-1 (375)			
2022		Soyo2-2 (375)	Cacuaco No.1 (125)		
2023					
2024	Caculo Cabaça(2172)		Cacuaco No.2 (125)		
2025			Sambizanga No.1 (125)		
2026	Baynes (300)				
2027		Lobito1-1 (375)	Quileva No.1 (125)		
2028	Quilengue (210)		Quileva No.2 (125)	Beniamin (52)	Benguela (10)
2029		Lobito1-2 (375)		Cacula (88)	Cambongue (10)
2030			Quileva No.3 (125) Soyo-SS No.1 (125)	Chibia (78)	Caraculo (10)
2031		Lobito2-1 (375)		Calenga (84)	Catumbela (10)
2032	Zenzo (950)		Cacuaco No.3 (125) Cacuaco No.4 (125)	Gasto (30)	Lobito (10)
2033			Sambizanga No.2 (125) Quileva No.4 (125) Quileva No.5 (125) Quileva No.6 (125)	Kiwaba Nzoji I (62)	Lubango (10)
2034		Lobito2-2 (375)		Kiwaba Nzoji II(42)	Matala (10)
2035	Genga (900)		Soyo-SS No.2 (125) Cacuaco No.5 (125)	Mussede I (36)	Quipungo (10)
2036		Namibe1-1 (375)		Mussede I (44) Nharea (36)	Techamutete (10)
2037			Cacuaco No.6 (125) Sambizanga No.3 (125) Soyo-SS No.3 (125)	Tombwa (100)	Namacunde (10)
2038	Túmulo Caçador(453)	Namibe1-2 (375)			
2039					
2040	Jamba Ya Oma (79) Jamba Ya Mina (205)	Lobito3-1 (375)			
Plan	7,438MW	4,125MW	2,250MW	652 MW	100 MW

Source: MP Study

Table 1.3-2 Solar power stations approved for development

Name of Power Stations	Installed Capacity (MW)	Expected Commissioning	Status	Developer
Solar Biópio Power Station	145	2022	Under construction	MCA
Solar Baia Farta Power Station	79.5	2022	Under construction	MCA
PV Luena	20.7	2025	Under construction	MCA
PV Saurimo	20.7	2025	Under construction	MCA
PV Caraculo	50	2026	Feasibility studies	ENI/ Sonangol

1.4. Electric Power Supply and Demand in the Southern Region of Angola

1.4.1. Electric Power Supply in Huila Province

Electric power supply to Lubango, the capital of Huila, is provided by the Matala hydroelectric power station (30 MW) located in the northern part of the province, which is connected by a 150 kV transmission line, and two diesel power stations connected to distribution lines (15 kV) located next to and around the 60/15kV Existing Lubango SS. The power system is also connected to the 60/15 kV Existing Namibe SS by an existing 60 kV DL.

The available capacity of the power station has declined significantly, as shown in Table 1.4-1. This is expected due to the aging of the diesel generators themselves.

Table 1.4-1 Available Capacity of Power Station in Huila

Name of power station	Rated Capacity	Available Capacity
Arimba	40 MW	20 MW
Anexa	40 MW	17 MW
Matala	39 MW	26 MW

Source: Hearing from RNT

The system has a supply capacity of approximately 63 MW, but during peak hours the demand increases to 69 MW, resulting in a supply shortage. For this reason, during the peak time four hours a day (18:00-22:00), rotating power outage (2 hours in each area) has been conducted.

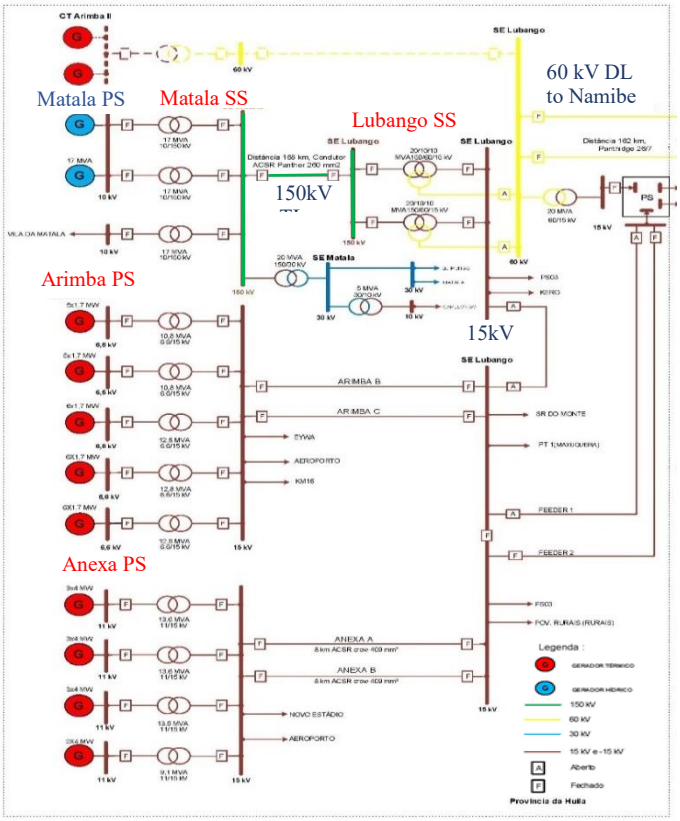


Figure 1.4-1 Electric Power System of Huila Province

Source: Prepared by JICA Survey Team based on RNT data

1.4.2. Electric Power Supply in Namibe Province

The city of Mocamedes, the capital of Namibe Province, is connected to the 150/60 kV Existing Lubango SS by a 162-km long-distance transmission line (60 kV), and electricity is supplied by three diesel power stations installed in the city of Mocamedes.

Previously, a 15 kV transmission line was run to Tombwa, where the fishing industry is thriving, but due to deterioration caused by salt damage, the line was discontinued and is now operated as an independent grid using diesel power generation plant.

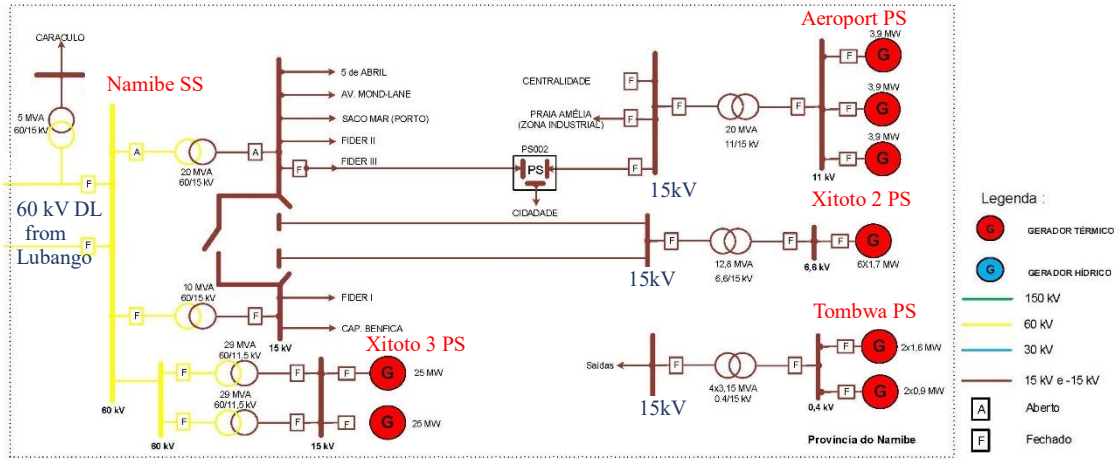


Figure 1.4-2 Electric Power System in Namibe Province

Source: JICA Survey Team, based on RNT data.

The maximum available capacity of power stations in Namibe Province is declining as shown in Table 1.4-2. This is expected to be due to the aging of the power generation equipment. In Tombwa, there are large-scale fishery factories (frozen fish are shipped from the port) near to the port, but the power supply to the factories has been discontinued due to the shortage of power supply capacity caused by the collapse of the transmission line due to salt damage and the subsequent discontinuation of the transmission line. According to the Namibe branch of ENDE, some of the fishery factories are currently operating on their private (diesel) power generation, but due to the high cost of power generation, the scale of the private power generation facilities is small and only about half of the factory facilities are in operation.

Table 1.4-2 Available Capacity of Power Station in Namibe Province

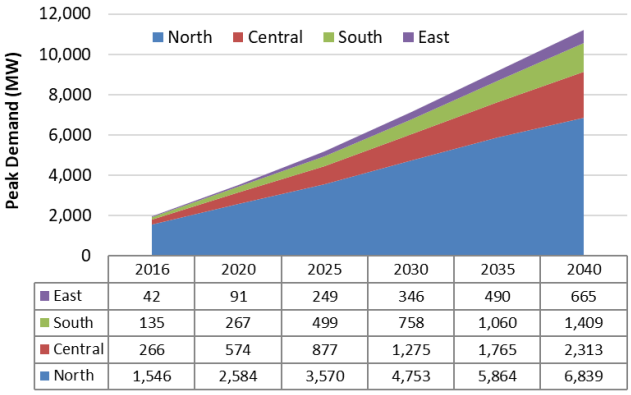
Name of Power station	Rated Capacity	Available Capacity
Xitoto2	11 MW	4 MW
Xitoto 3	56 MW	50MW
Aeroport	11 MW	9 MW
Tombwa	1.5MW	1.2MW

Source: Hearing from RNT

1.5. Electric Power Demand Forecast

1.5.1. Long-Term Demand Forecast of MP Study

Angola's electric Power demand was studied in the MP study and a long-term demand forecast until 2040 was presented. The base year of the study was 2016, and has not been revised for about 6 years since then, making it the most recent long-term demand forecast available at this time. Figure 1.5-1 shows the long-term demand forecast from the MP study (peak demand in the northern, central, and southern eastern regions). The peak demand in Huila and Namibe, which are the target provinces of the “Preparatory Survey on the project for Transmission System Reinforcement in Southern Angola”, is projected as shown in Figure 1.5-2, and is expected to increase steadily in both the Huila and Namibe province.



	2016	2020	2025	2030	2035	2040
East	42	91	249	346	490	665
South	135	267	499	758	1,060	1,409
Central	266	574	877	1,275	1,765	2,313
North	1,546	2,584	3,570	4,753	5,864	6,839

Figure 1.5-1 Long-term demand forecast based on MP Study

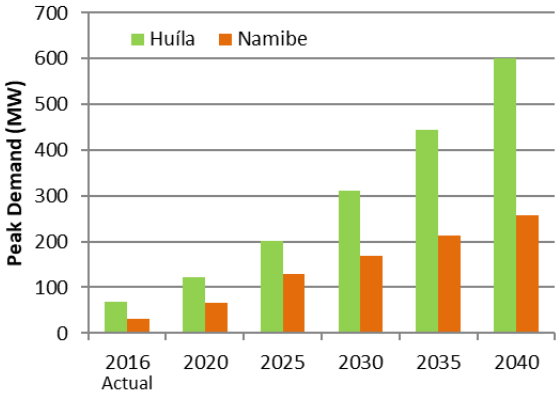


Figure 1.5-2 Peak Demand Forecast for Huila and Namibe Provinces

Source: Prepared by JICA Survey Team

In projecting the peak demand, the forecast of population growth, the electrification plan (government target), and the forecast of commercial and industrial electricity demand were taken into account. The electrification plan is based on the electrification rate for each region as of 2016 (32.3% nationwide), and takes into account that electrification will proceed from areas with high population density to achieve the government target of 60% by 2025, with 66% of the southern region to be electrified by 2040. The commercial and industrial demand forecast is based on the assumption that the commercial and industrial sectors will account for 20% of the maximum electricity demand in 2040. In other words, the forecast incorporates the achievement of the Angolan government's future goals, which is equivalent to the national electricity demand target.

The components of the peak demand forecast for the Huila and Namibe provinces, with commercial and industrial demand extracted from the forecast, are shown in Figure 1.5-3. The percentage of commercial and industrial demand to the peak demand is also shown in Figure 1.5-4. As shown in Figure 1.5-2, the potential demand in Huila is large and is expected to increase rapidly once the power transmission and distribution lines are improved, so the electricity demand is assumed to be about twice that of Namibe. On the other hand, Namibe is projected to exceed Huila in terms of commercial and industrial demand after 2025, and the ratio of commercial and industrial demand to total demand will be higher than 30% after 2025, reaching 40% in 2040.

This reflects the high potential for commercial and industrial demand due to the increasing electrification rate and expanding industrial demand in spite of small population in Namibe Province (see Figure 1.5-4). Specifically, demand for commercial facilities (e.g., fish freezing), which have been shut down due to the lack of a stable power supply, is expected to recover as soon as power supply becomes available.

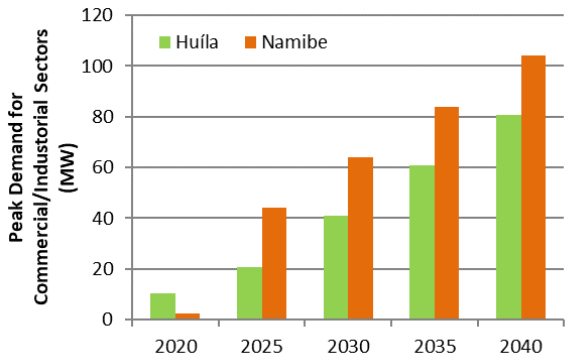


Figure 1.5-3 Peak Demand Forecast for Commerce and Industry in the Huila and Namibe Province

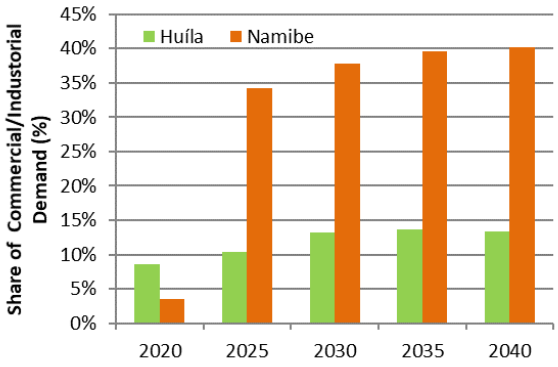


Figure 1.5-4 Share of Peak demand by commercial and industrial demand

1.5.2. Actual Demand in Recent Years

The long-term demand forecast of the MP Study shown in section 1.5.1 was studied based on actual demand up to 2016. Actual demand in 2016-2019 and the demand forecast of the MP Study are shown in Figure 1.5-5. In the figure, RNT's forecast of future peak demand based on the trend of the near-term actual demand is also shown (orange thin dashed line).

The nationwide peak demand in the most recent years since 2016 has only slightly increased due to restrictions of supply and so on, which is lower than the demand forecast in the MP Study. This trend is similar for all provinces in the country, including Huila and Namibe provinces.

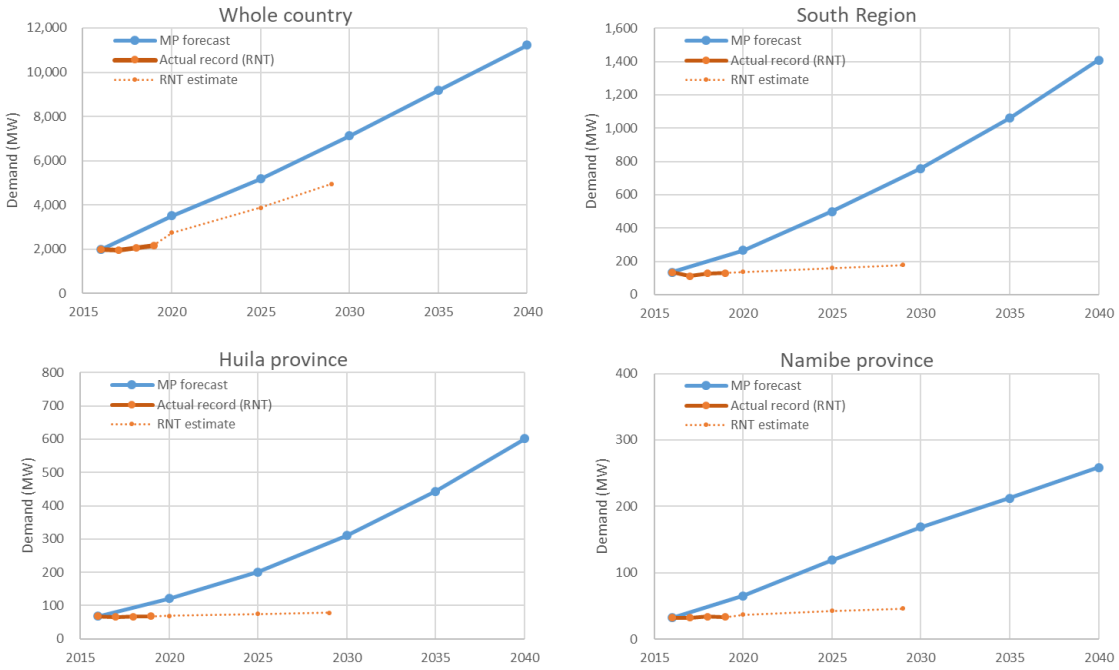


Figure 1.5-5 Peak Demand Forecast, Actual Record and Short-term Forecast by RNT

1.5.3. Demand Forecast

(1) Changes in assumptions since the MP Study

As indicated in section 1.5.1, the demand forecast in the MP Study is a target established including government policy goals, etc. Assumptions have not been changed or updated since the MP Study, as shown below.

1.5.1 As indicated in Section 1.5.1, the demand assumptions in the MP study are targets established by the government, including its policy goals, etc. A review of changes in conditions since the MP study shows no changes or updates to the assumptions, as indicated below.

I. Population growth projection: The "Instituto Nacional de Estatística (INE) Population Projections for Angola (2014 - 2050)," on which the projection was based, has not been updated since then.
II. Electrification Plan: Government targets have not been updated or revised.
III. Commercial and industrial electricity demand forecast: Electricity demand is increasing only slightly, and there are no changes such as launching of new large-scale projects.

Therefore, it can be considered that the long-term demand forecast by the MP Study has not changed its significance as a long-term target value at present.

(2) Potential for Commercial and Industrial Demand in Huila and Namibe Provinces

In order to achieve the increase in the demand forecasted, it is important that steady progress be made in attracting and growing industry hereafter. Therefore, specific large commercial and industrial demand in the Huila and Namibe provinces are investigated.

As shown in 1.5.1, the ratio of commercial and industrial demand to total demand in Namibe Province will be high, exceeding 30% after 2025 and reaching 40% by 2040. Therefore, specific large-lot commercial and industrial demand in the Huilla and Namibe provinces was investigated.

(a) Businesses requesting power supply from RNT

Projects requested to supply electric power to RNT as of January 2020 are listed in Table 1.5-1. In both states, large commercial and industrial demand for electricity is expected, and project plans are being specified. Although the times of requirement are stated in some of these requests, there is no specific information for the start of the projects, therefore, it is assumed that the actual start of service is far in the future.

Table 1.5-1 Power Supply Requests for RNT

Province	District Name	Type of Industry	Scale (MW)	Date of request	Time of Supply
Huila (115 MW in total)	Quipungo	quarrying	2.5	2019	After 2024
	Chibia	ditto	47.5	2019	
	Gambos	ditto	10	2019	
	Jamba	Steel industry	30	Apr. 2019	
			25	Apr. 2019	
Namibe (175 MW in total)	Saco Mar	Steel industry	150	Apr. 2019	After 2026
	Tômbwa	Fisheries industry	25	-	-

(b) Status of Fisheries Business in Tombwa District, Namibe Province

As described in section 1.4.2, the electricity supply to the fishery industry in Tombwa has been suspended due to the shortage of supply power following the decommissioning of the power transmission line, which is a special situation.

Since the high price of fuel used for diesel power generation is a bottleneck, it is assumed that once the power transmission system is restored and the stable power supply, which is less expensive than private power generation, is realized, the operation rate of existing industrial plants would immediately increase and the demand for electricity will rise. This will also create the conditions for further business expansion.

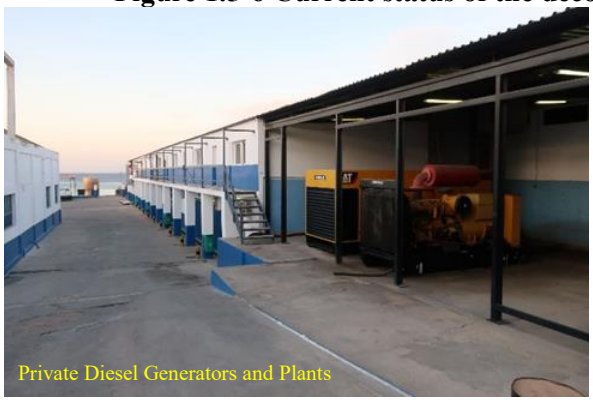
The Tombwa branch of ENDE is eager to extend the transmission line to Tombwa as soon as possible. This is not only for supplying to the existing fishery plants, but also for the expected increase in overall demand including consumer demand.

There used to be a fishery factory in Namibe Port, but many of them have closed down due to aging, and currently only one small-scale fishery factory (frozen fish storage and sales) is in operation, which is smaller in scale than in Tombwa.


Old transmission tower


Abandoned receiving, transforming, and switchgear facilities

Figure 1.5-6 Current status of the decommissioned Namibe - Tombwa TL


Private Diesel Generators and Plants


Wharf adjacent to the factory


Adjacent refrigerated warehouse

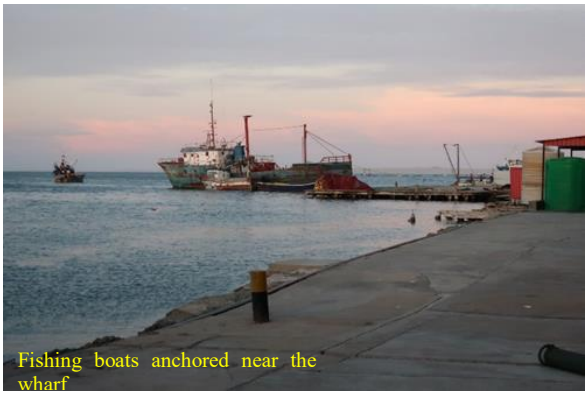

Fishing boats anchored near the wharf

Figure 1.5-7 A view of the fishery factory in Tombwa

(c) Development Plan of Namibe Province

The State Development Plan (2020-2022) is outlined below.

- Fisheries Industry

Namibe sea area has the largest catch in the country (65%), and approximately 40 billion AOA of investment in the fisheries sector was planned for 2013-2017, with 15% of the budget invested in a fisheries inspection station (Bentiaba) and a cold storage warehouse (Tombwa).

The plan will focus on plans to develop aquaculture (marine ranching and fish farming), taking advantage of the climate and ruggedness of the province's coast.

- Water

Currently, 42.7% of households in Namibe Province are supplied with water, and investments in the water supply system are planned to reach the following targets by 2022

Targets; 85% water supply rate in urban areas, 76% in rural areas, 88% operation rate of water supply systems, etc.

- Energy

AfDB's financing of a new 400 kV transmission line between the Huambo SS and the 400/22060 kV Nombungo SS has been approved. In the future, there are plans to construct 400 kV Nombungo – New Namibia TL that will connect to the Baynes hydropower station, which is planned to be constructed along the Cunene River in Cunene Province.

Currently, the 220 kV TL between the 400/220/60 kV Nombungo SS and the 220/60 kV New Namibe SS is planned to be constructed, and a 220 kV TL connection to Tombwa is also being considered for the future.

Namibe is also a very favorable location for renewable energy development, with plans for a 2 MW wind + 3 MW diesel hybrid plant in Tombwa and a 50 MW solar park by Sonangol and ENI (Italy).

(d) Long-term Demand Forecast

As noted in the previous section, commercial and industrial electric power demand in the Huila and Namibe regions is expected to increase further in the future, as shown below.

- The fact that both Huila and Namibe provinces are already in discussions for power supply requests that exceed the size of commercial and industrial demand (81 MW and 104 MW, respectively, in 2040) assumed in the MP Study demand forecasts. (The size of the demand is large, but the timing of the need is likely to be delayed, so it is difficult to revise the demand forecast at this point in time.)
- In Huila Province, there is a large potential demand, which is expected to increase rapidly once power transmission and distribution facilities are in place, and also in Namibe Province, there are specific projects such as a fishery factory in Tombwa area that are expected to increase their demand as soon as power supply is started.

On the other hand, as mentioned above, power supply is currently restricted and supply capacity is inadequate, which is considered one of the reasons for the lack of growth in actual demand, and electricity demand has increased only slightly in recent years. However, the construction of a 220 kV TL between the Lubango and Namibe areas, which will be connected to the central-north grid, is expected to improve supply reliability and increase supply capacity. Therefore, in addition to the potential demand recovery after the completion of the project, the conditions will be in place for the electric power supply range to be expanded and electricity demand to increase through the subsequent extension of distribution lines to un-electrified areas. Therefore, it is expected that electricity demand will increase rapidly after the completion of the project, and there is no material to deny this possibility.

Therefore, the demand forecast from the MP study, which was established as the long-term goal, will be directly appropriated from the MP study as the demand forecast for the period 2025-2040. The long-term peak demand forecasts for the Huila and Namibe provinces are shown in Figure 1.5-8. The annual electricity generation forecast corresponding to this demand assumption is shown in Figure 1.5-9.

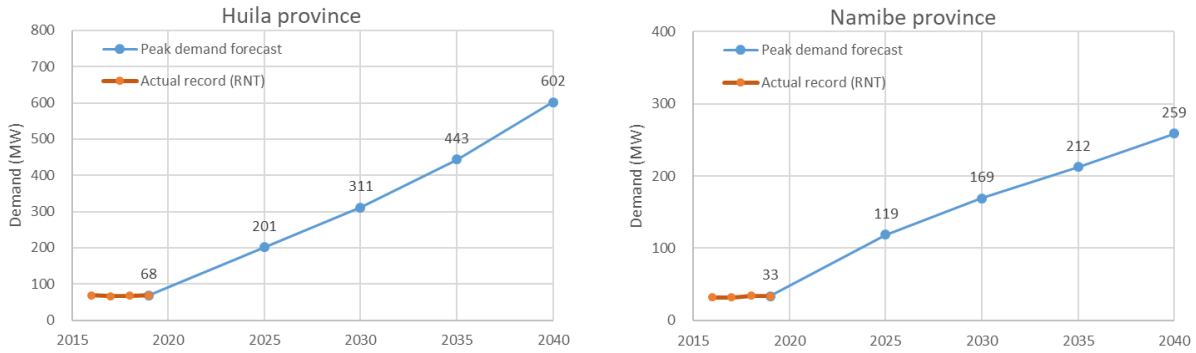


Figure 1.5-8 Long-Term Peak Demand Forecast for Huila and Namibe Provinces

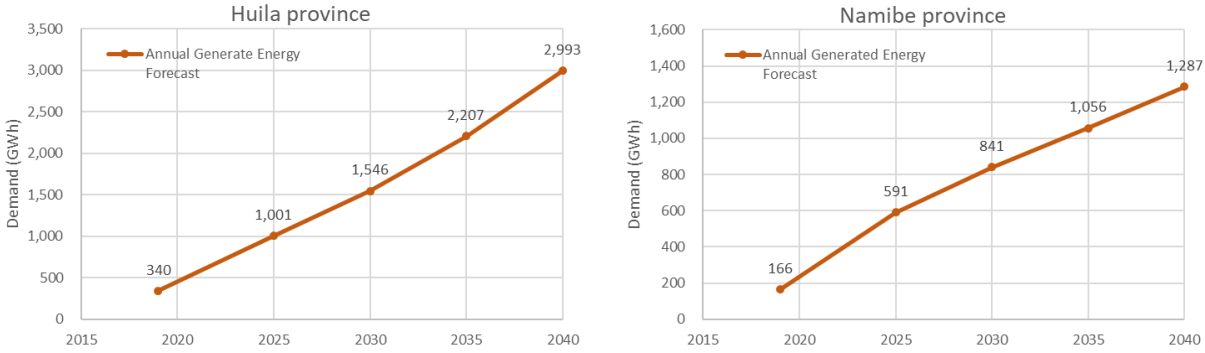


Figure 1.5-9 Annual Electricity Generation for Huila and Namibe Provinces

(3) Latest demand forecast for the Lubango area, Huila province

RNT and ENDE cooperatively established in February 2020 a demand forecast for the Lubango area through 2030, based on the latest electricity demand accumulated from the supply schedules of residential and large customers in the Lubango city area as shown in Table 1.5-2 .

Figure 1.5-10 also shows the above demand forecast, as well as the demand forecast of the Lubango area from the MP Study with an additional blue line. This shows that the latest forecast, which is the high case for 2030, is almost identical to the forecast at the time of the MP Study. Therefore, the demand forecasts for 2035 and 2040 were assumed to be 334 MW and 434 MW, respectively, using the MP Study results after 2030.

According to information from RNT and ENDE, there is a plan to build a large industrial zone (47.5 MW) in the Chibia area, located south of the Lubango, in addition to the demand shown in Table 1.5-2. However, since the timing of development is not clear, RNT and ENDE have not included this in the above demand forecast. Therefore, the size is indicated by red arrows in Figure 1.5-10 for reference.

Table 1.5-2 Demand Forecast for Existing/Planned 60 kV Substations in the Lubango city Area through 2030

LOADING OF ENDE - HIGH SCENARIO - YEAR 2022-2030										
Item	SS	2022	2023	2024	2025	2026	2027	2028	2029	2030
1	SE Mapunda	15	17	19	21	23	25	27	29	31
2	SE Quilemba	17	19	21	23	25	27	29	31	33
3	SE Minhota (Edificio Sede)	21	23	24	26	27	28	30	31	33
4	SE Arimba	18	20	22	24	26	28	30	32	34
5	Lubango	20	22	24	26	28	30	32	34	36
5	SE Hoque	4	6	8	10	12	14	16	18	20
6	SE Humpata	10	12	14	16	18	20	22	24	26
7	SE Chibia	4	6	8	10	12	14	16	18	20
Total (MW)		109	125	140	156	171	186	202	217	233

Source: 2020/2 RNT, ENDE

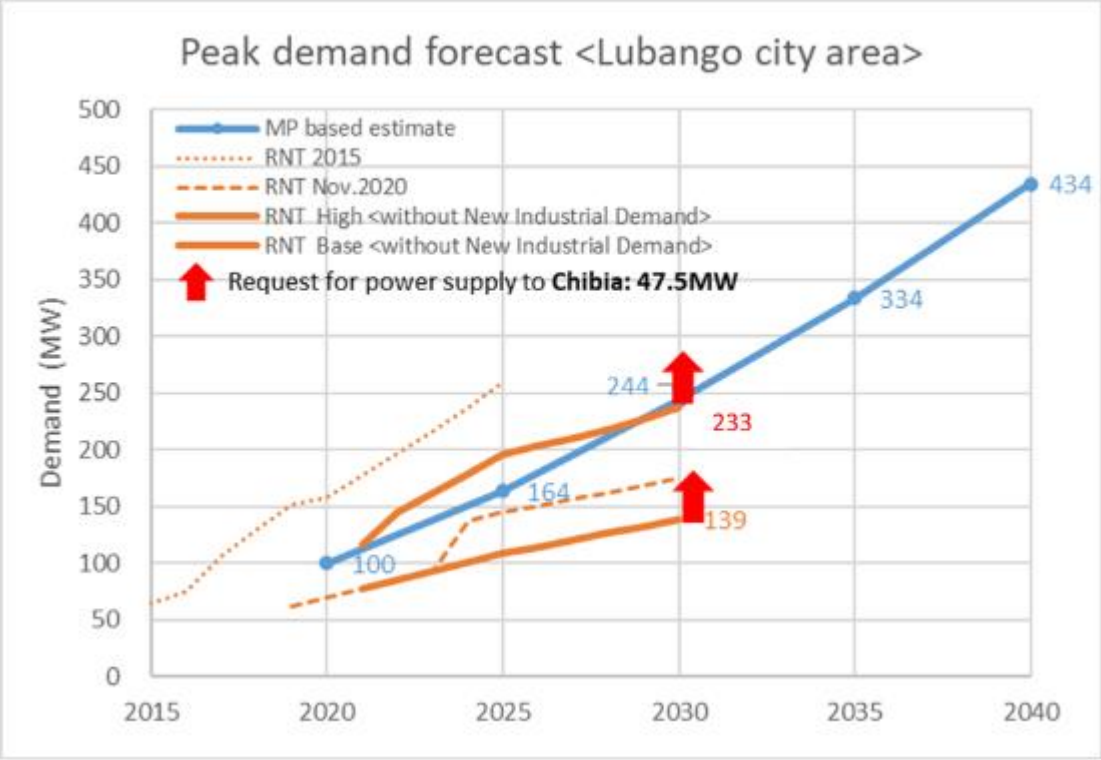


Figure 1.5-10 Comparison of MP Study in the Lubango area with Demand Forecasts by RNT, ENDE

1.6. Positioning of the Project

1.6.1. Scope of the Target Project

This survey was conducted to confirm the validity and affordability of development applying Japanese Yen-loan of the a new 220 kV TL project to supply electricity from Lubango to Namibe, which is based on the MP Study, and also is connected to the national grid through the 400 kV transmission line between Huambo and Lubango that AfDB supported its construction.

As a result of discussions with related organizations, the following works were selected as the scope of the project. The positioning of each project is summarized in this section, and the details of the study and proposals are shown in the following chapters.

Table 1.6-1 Scope of Projects Covered

	Works	Remarks
1.	Newly installed New 220 kV TL between Nombungo and New Namibe	Including connection to the 400/220/60 kV Nombungo SS to be established as a separate project
2.	Newly installed New Namibe SS (220/60 kV)	
3.	Newly installed East Lubango SS (220/60 kV)	
4.	New 60 kV DL between East Lubango and Arimba	Including connection from 60/15 kV Arimba SS to new Arimba 2 PS
5.	Newly installed Arimba SS (60/22kV)	
6.	Procurement of equipment and materials necessary to search for and remove mines and unexploded ordnance in the implementation of the above project	
7.	Consulting services required for project implementation	Including support for training

1.6.2. Necessity of 220 kV Nombungo ～ New Namibe TL and 220/60 kV New Namibe SS

The long-term demand forecast in the MP Study is the latest available at this time. In 2040, the total demand for the 220/60 kV New Namibe SS and the 220/60 kV Tombwa SS is approximately 260 MW. (See Figure 1.6-1)

In addition, the MP study's long-term power development plan, shown in Table 1.6-2, which is the latest available at this time, plans to develop a combined-cycle gas-fired power station with a rated installed capacity of 750 MW in Namibe, which has a good port, in 2040 ("CCGT 750 MW"). At this time, there is no information that the Namibe CCGT750 MW project has been changed, nor is there any information that it is making progress toward.

Angola's power grid is currently divided into three systems: the northern system, the central system, and the southern system, but in the future, Angola plans to interconnect each system and efficiently integrate the operation of large power sources planned in various regions, such as the Soyo thermal power station, which is currently under construction and expansion in the northern end, the 750 MW CCGT in Namibe in the southern system, and the Caculocabasa hydroelectric power station in the central system. The MP has a plan to efficiently operate large power stations and other large power sources planned in various regions in an integrated manner. Based on this concept, the MP study states that the plan is to integrate the Angolan power system by 2025.

Currently, the demand in the Namibe / Tombwa area is supplied by diesel generators. As mentioned above, the MP study proposes to integrate the power system, promote electrification, and operate a new state-of-the-art high-efficiency power station such as the 750 MW Namibe CCGT, in an integrated manner to ensure reliability and efficient operation of the power system. The project proposes a power system that can be operated efficiently while ensuring the reliability of the power system.

Figure 1.6-1 Southern System in Angola

Source: MP Study

Table 1.6-2 Result of Transmission Line Connection Study based on Power Development Plan

Hydropower Plant	(River)	Area	Installed	2017	2018	2020	2025	2030	2035	2040	Transmission Line		
											Voltage	Connected Substation	Distance (km)
<Existing PP (Available Capacity)>	-	-	1,699	1699	1649	1649	1594	1594	1594	1594			
<Development Plan>				931.5	1928	2169	4341	4851	6701	7154			
HPP Lauca	Kwanza	North	2,070	931.5	1863	2070	2070	2070	2070	2070	400kV	Cambutas	224
HPP Caculo Cabaça	Kwanza	North	2,172				2172	2172	2172	2172	400kV	Cambutas	54
HPP Zenzo	Kwanza	North	950						950	950	400kV	Cambutas	41
HPP Túmulo Caçador	Kwanza	North	453							453	220kV	Cambutas	16
HPP Quissonde	Kwanza	North	121								220kV	–	–
HPP Genga ②	Quive	North	900						900	900	400kV	Benga Switch-yard	30
HPP Benga	Quive	North	1,000								400kV	–	–
HPP Quilengue ⑤	Quive	North	210					210	210	210	220kV	Gabera	37
HPP Lomaum Extension	Catumbela	Central	215		65	65	65	65	65	65	220kV	Nova_Biopio	81
HPP Lomaum2	Catumbela	Central	150								220kV	–	–
HPP Baynes (50% Angola)	Cunene	South	300					300	300	300	400kV	Cahama	195
HPP Jamba Ya Oma	Cunene	South	79								220kV	HPP Jamba Ya Mina	37
HPP Jamba Ya Mina	Cunene	South	205								220kV	Matala	86
HPP Luachimo (extention)		East	34			34	34	34	34	34	60kV	Dundo	5
	Candidate Total =		7,154	2631	3577	3818	5935	6445	8295	8748			

Thermal Power Plant <Development Plan>	Type	Area	(MW)	2017	2018	2020	2025	2030	2035	2040	Transmission Line		
											Voltage	Connected Substation	Distance (km)
TPP Soyo 1	CCGT	Zaire	750	250	750	750	750	750	750	750	400kV	Soyo_SS	5
TPP Soyo 2	CCGT	Zaire	750				750	750	750	750	400kV	Soyo_SS	5
TPP Lobito CCGT No.1	CCGT	Benguela	750				375	750	750	750	400kV	Nova_Biopio_SS	23
TPP Lobito CCGT No.2	CCGT	Benguela	750						750	750	400kV	Nova_Biopio_SS	23
TPP Namibe CCGT No.3	CCGT	Namibe	750							750	220kV	Namibe_SS	17
TPP Lobito CCGT No.4	CCGT	Benguela	375							375	400kV	Nova_Biopio_SS	23
TPP Cacuaco GT No.1	GT	Luanda	375				125	250	375	375	220kV	Cacuaco	5
TPP Cacuaco GT No.2	GT	Luanda	375				125	125	250	375	220kV	Cacuaco	5
TPP Boavista GT No.3	GT	Luanda	375				125	125	250	375	220kV	Sambizanga	5
TPP Quileva GT No.4	GT	Benguela	250					125	250	250	220kV	Quileva	1
TPP Quileva GT No.5	GT	Benguela	250					125	250	250	220kV	Quileva	1
TPP Quileva GT No.6	GT	Benguela	250					125	250	250	220kV	Quileva	1
TPP Soyo GT No.7	GT	Zaire	375					125	250	375	400kV	Soyo_SS	5
	Candidate Total =		6,375	250	750	750	2,250	3,250	4,875	6,375			

Source: MP Study

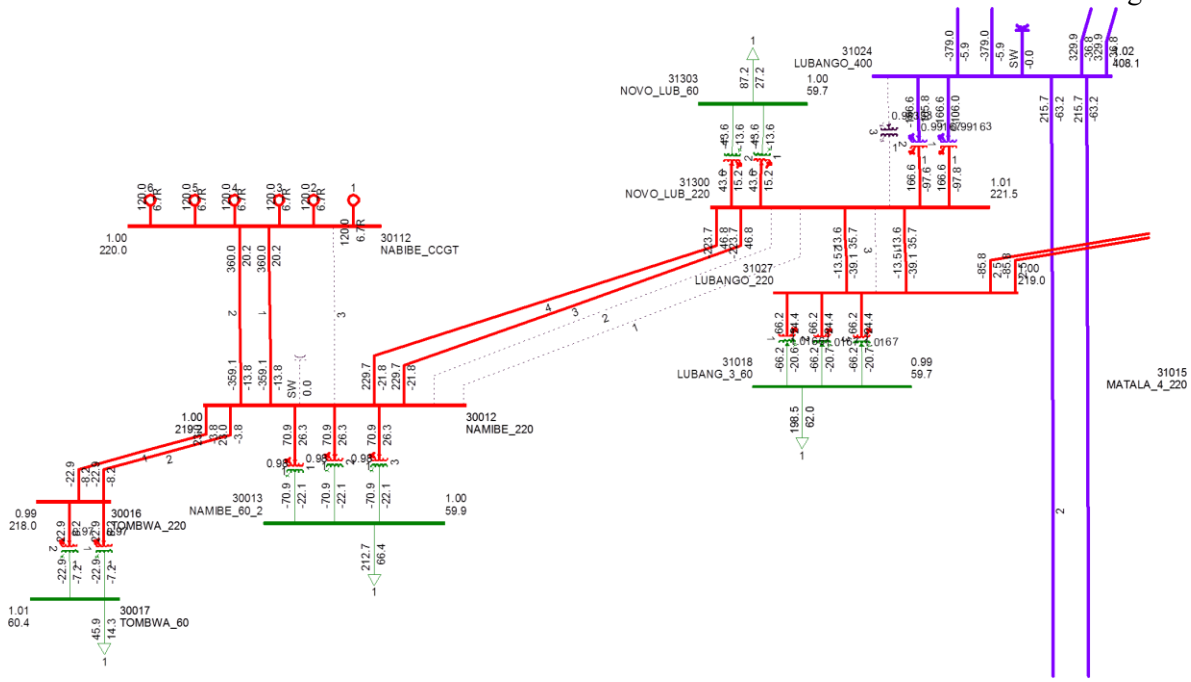


Figure 1.6-2 Peak Power Flow Diagram at 2040 of the new 400/220/60 kV Nombungo - Namibe - Tombwa system

Therefore, in developing a 220 kV transmission system development plan based on the MP study, with 2040 as the target year, it is naturally necessary to consider not only the demand of the 220/60 kV New Namibe SS and the Tombwa SS, but also the Namibe CCGT 750 MW.

Power flow in 2040 based on the MP study is shown in Figure 1.6-2. The power flow between the 400/220/60 kV Nombungo SS and the 220/60 kV New Namibe SS is approximately 460 MW from the 220/60 kV New Namibe SS toward the 400/220/60 kV Nombungo SS. Since Namibe CCGT 750 MW is a state-of-the-art, high-efficiency thermal power station, it is assumed to be expected to operate at full output capacity as a base power source. Accordingly, it is necessary to determine the transmission capacity of the transmission line between the 400/220/60 kV Nombungo SS and the 220/60 kV New Namibe SS, assuming full output operation even in the 2040 at off-peak time. Assuming that the total off-peak demand of the 220/60 kV New Namibe SS and the Tombwa SS is about half of the peak demand, it can be assumed about 130 MW. In this case, the power flow between the 400/220/60 kV Nombungo SS and the 220/60 kV New Namibe SS in the 2040 off-peak time is assumed to be about 600 MW from the 220/60 kV New Namibe SS toward the 400/220/60 kV Nombungo SS.

In order to avoid constraints on the generation of the state-of-the-art highly efficient Namibe 750 MW CCGT, which is expected to operate as a base power supplyer even in the event of N-1 such as a single transmission line outage, the transmission capacity of the 220 kV Nombungo - New Namibe TL should be at least 600 MW.

The 400/220/60 kV Nombungo SS is expected to be newly constructed by around 2025 with AfDB financing.

1.6.3. Necessity of 220/60 kV East Lubango SS and 60 kV Arimba Distribution System

Remote workshops (hereinafter referred to as "WS") with MINEA, RNT, ENDE, and other counterparts in Angola were conducted from November 2020 to February 2021 to discuss the measures to precisely respond to the demand growth in the Huila and Lubango shown in Table 1.5-2 and Figure 1.5-10 above, when the 220 kV transmission system is established between the 400/220/60 kV Nombungo SS and the 220/60 kV New Namibe SS.

The following are the decisions reached during the WS discussions.

(1) Determination of Route of the 220 kV Nombungo – New Namibe TL (Route D)

Four routes were developed, as shown below, and three of them were compared and discussed, excluding route B, which is technically and environmentally difficult.

- Route A : from New Namibe to Nombungo, running parallel to the railroad in the northern region

- Route B: from New Namibe to Nombungo, paralleling National Highway Route100 and passing through the vicinity of a steep slope area (technically and scenically/environmentally difficult)
- Route C: from New Namibe to Nombungo, paralleling the existing 60 kV DL and passing near the 150/60 kV Existing Lubango SS.
- Route D from the middle of route C to Nombungo, bypassing the city of Lubango and passing through an area with no human habitation.

As a result, it was agreed to select route D, which is parallel to the existing 60 kV DL, can effectively utilize the existing patrol route, and avoids the dense Lubango residential area, which has a particularly low social and environmental impact.

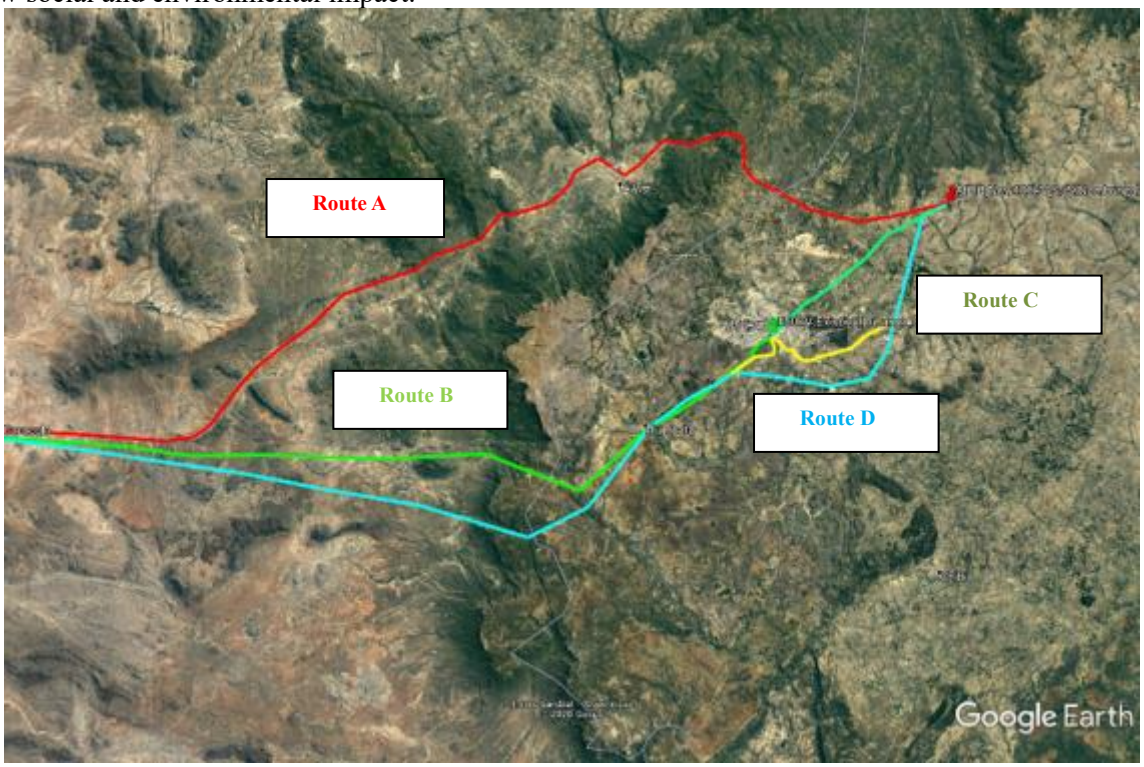


Figure 1.6-3 220 kV Candidate Route for Transmission Line between Nombungo and Namibe

The results of the comparative evaluation of Routes A, C, and D are shown in Table 1.6-2, with scores based on the four factors of technology, economic efficiency, natural environment, and social environment.

The approach to the allocation of overall evaluation points is as follows.

- Previously, technology and economic efficiency were given more weight, but since this project is classified as Environmental Category A by JICA, the weight for the natural environment and social environment were set as the same as other factors (25% for all the four factors).
- For each factor, the importance of each evaluation item was ranked as large, medium, or small, and allocated within 25% of each of the above.

Table 1.6-3 Comparative Evaluation of the Route of Transmission Line

			Plan A+Option 3 Connection with new 220 kV transmission line between SS Nombungo - existing SS Lubango (Trace C). Increase in supply capacity by reinforcing the 60 kV distribution line from SS Nombungo. Extension of the 220 kV transmission line from Route C to SS Lubango.	Plan C+Option 3 Increase in supply capacity by reinforcing the 60 kV distribution line from SS Nombungo. Construction of the new East Lubango SS and installation of new 220/150/60 kV capacity transformers.	Plan D+Option 3 Reinforcement of the 60 kV distribution lines planned by ENDE from Nombungo SS and also for the construction of the new distribution line to Arimba.
Conformity			Technically possible: △	Technically possible: △	Possible: ○
	Critical assumption	Impact on natural parks and reserves	Avoided	Avoided	Avoided
		Compliance with laws and regulations, eg. distance to airports and railways	Possible to avoid	Possible to avoid	Avoided (only in relation to railway crossings)
		Impact on important or large-scale natural/social heritage	Nonexistent	Detour Mt. Leba	Detour Mt. Leba
		** Archaeological heritage is currently being verified			
	Achievement or not of the necessary goals	Transmission to SS (substation) Namibe	Possible	Possible	Possible
		Contribution to improving the stable supply of energy to the municipality of Lubango	Possible	Possible	Possible
		Feasible plan by using existing technology	Possible	Requires advanced technology	Possible
		Prompt and timely delivery to the Matala steelworks	Possible	Possible	Possible
		Completion of the work as planned, without delay	Possible	Possible	Possible
Technical evaluation			Benchmarking possible	Benchmarking possible	Benchmarking possible

Evaluation Item	Items	Degree of effect	Allocation of points	Plan A	Basic score	Final score	Plan C	Basic score	Final score	Plan D	Basic score	Final score
Technical issues	Contribution of stable power supply	High	7.5%	Several TLs will connected to Existing Lubango SS in radial configuration but the system reliability is not high.	2	0.15	Several TLs will connected to Existing Lubango SS in radial configuration but the system reliability is not high.	2	0.15	East LubangoSS can be a power supply base for the Lubango area, replacing the existing Lubango	3	0.225
	Construction period	Medium	5.0%	Around 84 months	1	0.05	Around 84 months	1	0.05	Around 72 months	2	0.1
	Outage due to construction	Medium	5.0%	Outage occurs within short-termed period	2	0.1	Ditto	2	0.1	Ditto	2	0.1
	Risk of delay	High	7.5%	Since difficult upgraded task is necessary at Existing Lubango SS, period will be delay.	1	0.075	There is a high possibility that construction will be delayed due to large-scale relocation compensation and the difficult task of boosting the existing Lubango SS.	1	0.075	None	2	0.15
		Sub total	25%			0.375			0.375			0.575
Economical issues	Construction cost	High	12.5%	321mil $: Many new access roads are necessary in comparison with other Plans.	1	0.125	303mil $; Since it passes through Lubango city area, the difficulty of construction will increase, which will affect the construction cost.	1	0.125	276mil $: Since the Lubango urban area can be avoided, the construction extension will be slightly longer, but it is cheaper than Plan C.	2	0.25
	Compensation cost	Medium	7.5%	0.45mil $	1	0.075	0.48mil $	1	0.075	0.07mil $	2	0.15
	O&M cost	Small	5.0%	0.03mil $/year: Since the route is far from existing 60kV DL and passes through mountainous area, mentenoance effort is difficult.	1	0.05	0.02mil $/year: Parallel to existing transmission lines, maintenance effort is less than Plan A Liaison work such as public accidents prevention will increase in Lubango city area	1	0.05	0.01mil $/year; Since it is relatively parallel to the existing power transmission, maintenance work is about the same as Plan C, but since it does not pass through urban areas, there is almost no external work.	2	0.1
		Sub total	25%			0.25			0.25			0.5
Natural environment	Effects on organisms and ecosystems	High	12.5%	The section of natural vegetation is the longest at approximately 26 km, and there is continuity of natural vegetation with Tundabara IBA, and the impact of the division and loss of vegetation and animal habitats is the greatest.	1	0.125	The section of natural vegetation is approximately 9 km, and the impact of fragmentation and loss of vegetation and animal habitats is relatively small.	2	0.25	The section of natural vegetation is about 10 km, and the impact of fragmentation and loss of vegetation and animal habitats is about the same as Plan C.	2	0.25
	Natural landscape	High	12.5%	Influence of the main road on the scenery in the area with excellent continuity with the natural vegetation of the Tundabara IBA	1	0.125	・There is no obstruction to the scenery from the main road. ・Minimizing the impact on the landscape by passing along the east side of the Christ Statue Hill	2	0.25	Little impact on landscape	3	0.375
		Sub total	25%			0.25			0.5			0.625
Social Environment	Involuntary resettlement	High	7.5%	Almost nothing between Nombungo and Namibe, including temporary relocation during the construction period. Same as PlanC between Nombungo and Lubango	1	0.075	・Potential for permanent relocation of around 200 informal residents ・There is a possibility of temporary relocation during the small-scale construction period	1	0.075	Possibility of temporary relocation during minor construction period	2	0.15
	Ease of land acquisition	Small	2.5%	・Temporary requisition during construction period ・Permanent acquisition of tower base Both are very small.	1	0.025	・Temporary requisition during construction period ・Permanent acquisition of tower base ・Pre-construction removal of informal housing	1	0.025	・Temporary requisition during construction period ・Permanent acquisition of tower base	2	0.05
	Impact on cultural assets	High	7.5%	No effects	3	0.225	It is necessary to select an avoidance route.	2	0.15	Ditto	2	0.15
	Impact on minorities	High	7.5%	The migrate seasonally along the route from Vivara District in Namibe to Humpata District. (Continued investigation required)	2	0.15	Ditto	2	0.15	Ditto	2	0.15
		Sub total	25%			0.475			0.4			0.5
Sum			100%	Score		1.35	Score		1.53	Score		2.20
Evaluation Ranking				The 3rd ranking			The 2nd ranking			The first ranking		

(2) Location of 220/60 kV New Namibe SS (Option 3)

Three candidate locations are nominated for the 220/60 kV New Namibe SS. Option 3 was selected based on the following discussions. (See Chapter 4: Selection of Substation Construction Sites)

- Option 1: Location proposed by RNT was located in a nature reserve
- Option 2: Near location of Option 1 but outside the reserve. However, it was located in the direction of the Namibe Airport and it would take a lot of time to discuss and adjust the height of the tower with the aviation authorities.
- Option 3: located near a port for exporting iron ores, which is advantageous for supplying electricity to customers of the mining port in Sacomar in the future, and RNT agreed to locate the substation at this site. ENDE also agreed that although the site is far from the new distribution substation near the airport that will be built in the future, it would be more advantageous to locate it to the north, considering the future development of the Namibe region and the growth of industrial areas along the rail line and Route 100 in the northern part of the country.

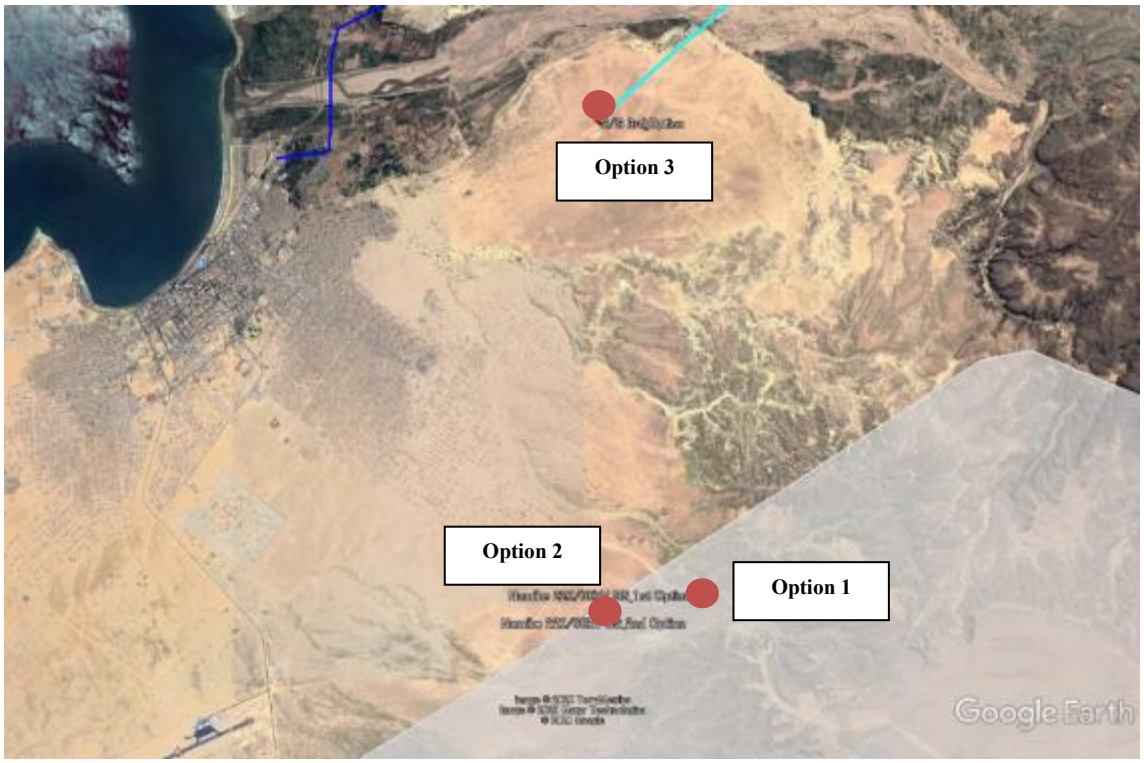


Figure 1.6-4 Candidate locations for 220/60 kV New Namibe SS

(3) Agreement on the need for a 220/60 kV East Lubango SS and selection of a location point

Necessity of a new 220/60 kV East Lubango SS was discussed together with the selection of the transmission line Route D, and positive opinions were expressed by MINEA and RNT.

- The 220/60 kV East Lubango SS would provide 20 MVA to the ENDE's 60/15 kV Arimba SS and 40 MVA to the 60/15 kV Chibia SS to be constructed in the future, for a total of 60 MVA. The 220/60 kV East Lubango SS is considered necessary for the future growth of Lubango area, since the Huila Province has been lacking in power so far. (RNT).
- The new 220/60 kV East Lubango SS will strengthen the southern grid. In particular, a 220 kV transmission system in the Matala area will contribute to the industrialization of the area, and the 60 kV distribution system of Lubango area will be considerably improved. (MINEA)

Therefore, in order to quantitatively verify the need for the 220/60 kV East Lubango SS, RNT and ENDE requested the study team to conduct a Lubango regional power distribution system analysis.

(4) Agreement on future electricity demand forecast for the Lubango area

ENDE and RNT proposed and discussed their respective electricity demand forecasts for the Lubango region, and finally agreed on the results of the electricity demand forecast to 2030, which were discussed and coordinated by RNT and ENDE. (See Table 1.5-2 Demand Forecast for Existing/Planned 60 kV Substations in the Lubango city Area through 2030).

The electricity demand data provided were for the High and Base cases, with the High case demand being almost the same as the Master Plan forecast. (See Figure 1.5-10 Comparison of MP Study in the Lubango area with Demand Forecasts by RNT, ENDE.)

(5) Proposal of optimal power distribution system planning for the Lubango area.

A power system analysis for the Lubango area up to 2030 was conducted based on the power distribution system configuration and power demand forecast for the Lubango area provided by RNT and ENDE (see (4) above).

As a result of the discussions, consensus was made to apply "Plan B" which is the plan to supply power to the Lubango area by constructing the 220/60 kV East Lubango SS and a new 60 kV DL between the 220/60 kV East Lubango SS and the 60/15 kV Arimba SS.

[Plan A]: Supply power to the Lubango area using only the 60 kV DL (the proposal of RNT and ENDE is reflected in the system analysis shown below).

- After 2026, the 60 kV DL between the 400/220/60 kV Nombungo SS and the Quilemba SS will be overloaded under the N-1 criteria, so additional 60 kV double circuit distribution lines is needed to build between the 400/220/60 kV Nombungo SS and the 60/15 kV Arimba SS.
- The addition of 50 MW of industrial zone load to the Chibia SS will not cause an overload, but it is uncertain whether the substation will be able to handle the further increase of demand after 2030.

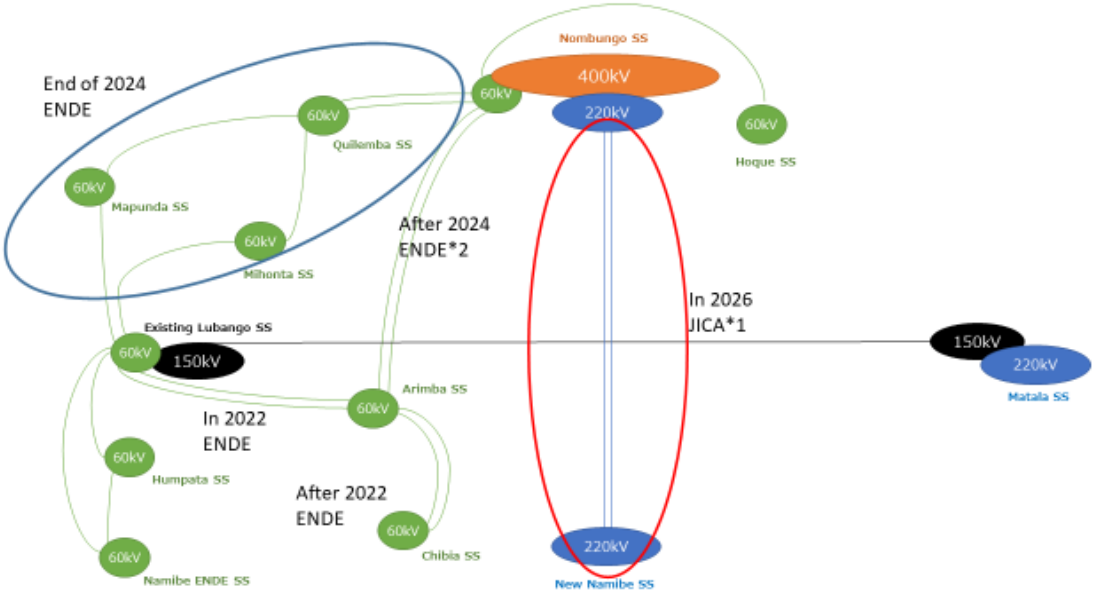


Figure 1.6-5 Distribution Plan for Lubango Area (Plan A)

[Plan B]: Supply power to the Lubango area using the 400/220/60 kV Nombungo SS, the 150/60 kV Existing Lubango SS and 60 kV DL between East Lubango and Arimba to supply power to the Lubango area.

- The addition of a 50 MW load to the Chibia SS will not cause an overload under the N-1 criteria.
- In case of rapid growth of electricity demand in the Lubango area after 2030, the distribution line can be extended around the 220/60 kV East Lubango SS, and the 220 kV TL can be connected between the Matala SS and the 220/60 kV East Lubango SS in the future, etc.

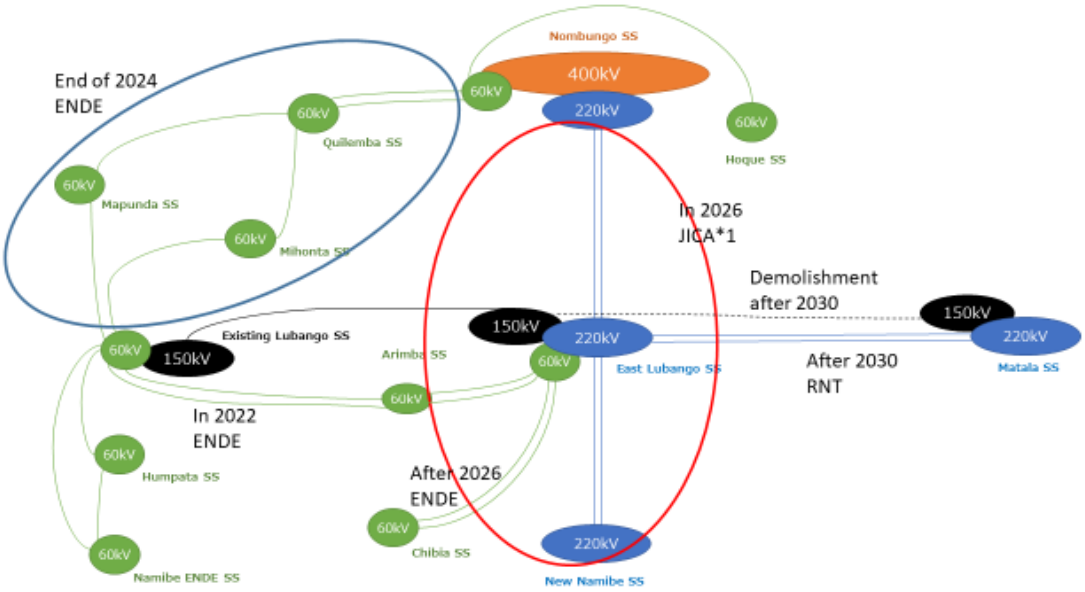


Figure 1.6-6 Distribution Plan for Lubango Area (Plan B)

1.6.4. Determination of the Project Scope

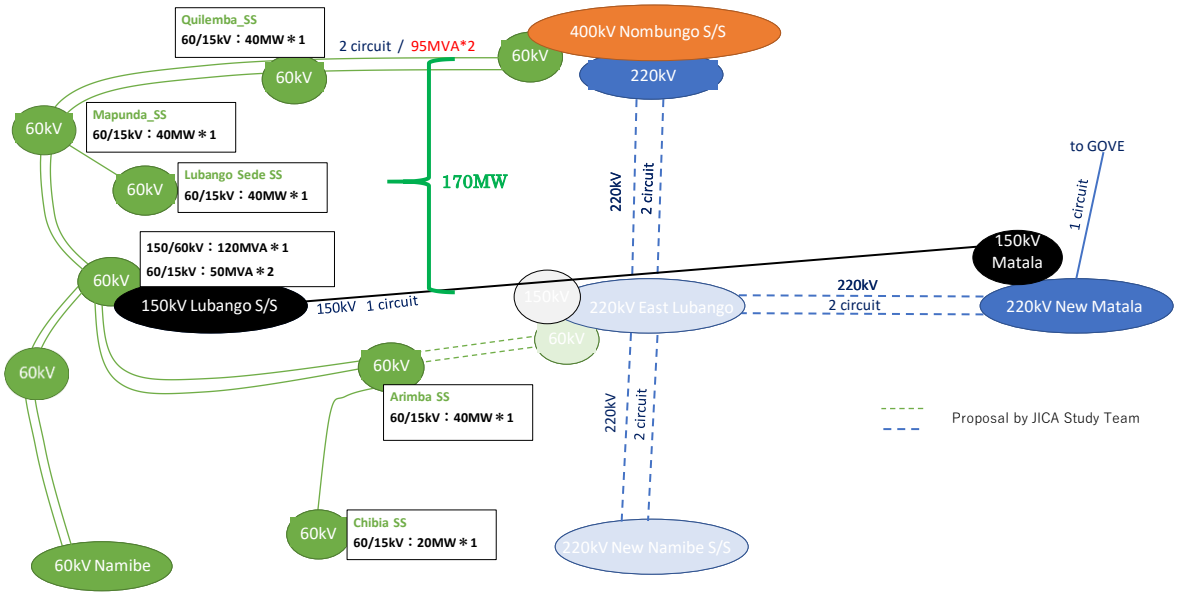


Figure 1.6-7 Southern Angola in 2026 (image of RNT's initial proposal)

In RNT's original proposal, shown in Figure 1.6-7, the supply to the Lubango area was planned on the basis of two substations, the 400/220/60 kV Nombungo SS and the 150/60 kV Existing Lubango SS.

The transmission capacity of the two 60 kV DL at Nombungo and Quilemba was determined to be 95 MVA/cct, but even if the existing 150 kV transmission line at the150/60 kV Existing Lubango SS to the Matala SS is upgraded to a 220 kV line, the power transmitted from the 400/220/60 kV Nombungo SS is expected to exceed 170 MW after 2026 in the case trouble occurs in this line. Therefore, the two 60 kV DL between the Nombungo and Quilemba are expected to be overloaded, requiring the installation of emergency generators in this area to ensure supply reliability in the Lubango area.

This situation is inconsistent with the basic policy of the MP study, which is to efficiently supply power to each region by reinforcing large power stations and the backbone grid transmission network. Therefore, as mentioned above, the construction of the 220/60 kV East Lubango SS and other substations was proposed and discussed at the WS.

As a result, a route that largely bypasses the city of Lubango was selected to avoid the social and environmental impacts of the transmission line route (see Chapter 5), and it was decided to construct the 220/60 kV East Lubango SS on the suburb of Lubango city and supply power from this substation to Lubango city via a 60 kV DL (see 3.1 the results of the power flow analysis for the Lubango area). At the same time of of developing the 220 kV Lubango area - Namibe area transmission line, the 60/15 kV Arimba SS and the 60 kV East Lubango - Arimba distribution line will be constructed. The JICA project outline for the proposed project is as follows.

- 220 kV Nombungo - East Lubango TL
- 220 kV East Lubango - New Namibe TL
- 220/60 kV New Namibe SS
- 220/60 kV East Lubango SS
- 60/15 kV Arimba SS for distribution
- 60 kV East Lubango - Arimba Distribution line

However, the project plan include provides the space for pull in the 220 kV voltage single circuit line from the 150/60 kV Existing Lubango SS to the Matala SS, and as well as a pull-in space for future upgrading of the second 220 kV line, to be double circuit, pull-in to the 220/60 kV East Lubango SS.

Based on the above, the system diagram for southern Angola as of 2026 is shown in Figure 1.6-7 The diagram reflects RNT's plan to boost the existing 150 kV transmission line between the 150/60 kV Existing Lubango SS and the Matala SS after 2026 or to build a new 220 kV TL parallel to the existing transmission line, which will also be connected to the 220/60 kV East Lubango SS.

In addition to the construction of the 220/60 kV East Lubango SS in the middle of the 220 kV transmission system between the 400/220/60 kV Nombungo SS and the 220/60 kV New Namibe SS, the future expansion to a 220 kV system between the 150/60 kV Existing Lubango SS, the 220/60 kV East Lubango SS and the Matala SS, with the 400/220/60 kV Nombungo SS, creating a 60 kV distribution system (including ENDE planned distribution substations of Quilemba, Mapunda, Arimba, Lubango Sedde, and Chibia by 2030) with three 220 kV substations as supply points. This will ensure that this 60 kV distribution system in the Lubango region will have a stable power supply, high supply reliability, and will be able to handle future increases in demand.

On the other hand, even if there is a delay in boosting the 150 kV Existing Lubango - Matala TL to 220 kV or building a new parallel 220 kV TL or pull-in this lines into the 220/60 kV East Lubango SS, the 60 kV distribution system from the 400/220/60 kV Nombungo SS and the 220/60 kV East Lubango SS will be in place. In addition, the 150 kV transmission line from the Matala SS is still in good condition, so no major problems are expected in the foreseeable future.

After the 220/60 kV New Namibe SS is put into operation and power is supplied to the 150/60kV Existing Namibe SS, etc., the 60 kV DL between the Humpata SS and the 150/60kV Existing Namibe SS will be taken out of operation.

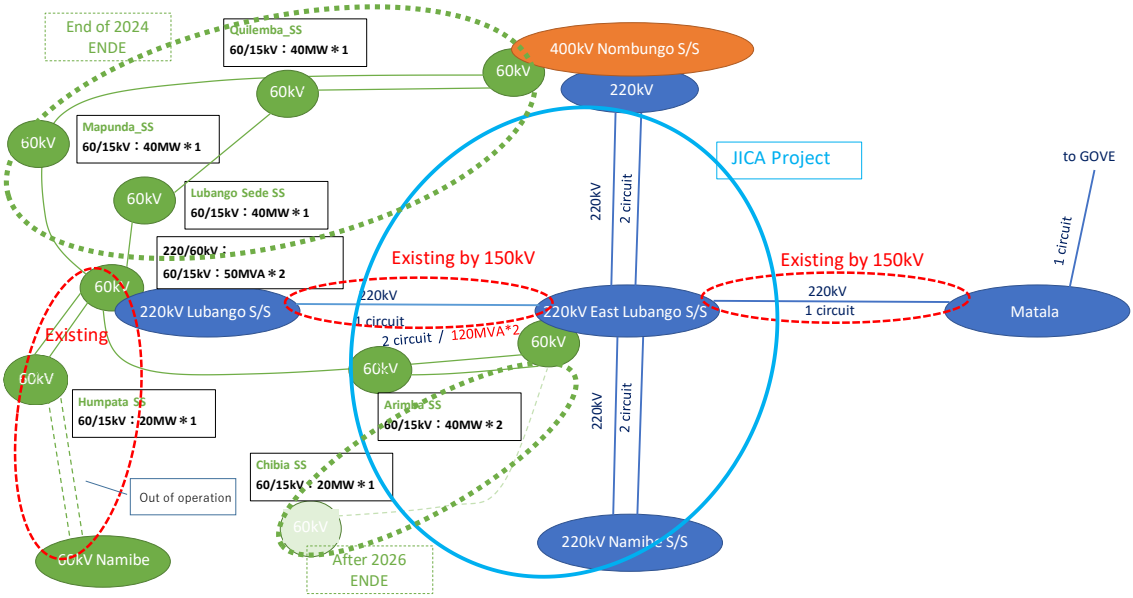


Figure 1.6-8 Southern Angola in 2026 (Lubango - East Lubango - Matala TL 220 kV boost)

1.6.5. Necessity of Exploration and Removal of Mines and Unexploded Ordnance

In Angola, in addition to landmines buried during the civil war, a large number of unexploded ordnance (UXO) remain, and although exploration and clearance of these ordnance is being carried out with the support of several donors, the danger of landmines and UXO is said to still remain. In Namibe Province, Huila Province, which is the target of this project, the landmine contamination rate is considered to be low ([1]). However, mine and UXO exploration has not been conducted in the specific areas to be surveyed and constructed under this project.

In light of this situation, and from the perspective of placing the highest priority on safety when implementing the project, it is unavoidably important to complete the exploration and removal of unexploded mines in the area covered by the project prior to entering the site, and therefore the necessary materials, equipment, and costs are assumed to be carried out and included in this project. The necessary equipment, materials, and expenses shall be included in this project.

[1]See Figure 8.2-1 and Table 8.2-1

2. Outline of the Related Organizations

2.1. Implementation Structure in the Angolan Electric Power Supply System

2.1.1. Implementation Structure in Electric Power Supply System

(1) Outline of Project Implementation Structure

Angola's electric power supply system is overseen by the Ministry of Energy and Water (MINEA), a government administrative agency. Under MINEA, three public corporations, horizontally integrated into power generation (PRODEL), transmission (RNT), and distribution (ENDE), have been organized to monopolize the national power supply system. In addition, an organization specializing in the design and construction of electric power facilities (GAMEK) continues to exist as an affiliate of MINEA.

The organizations involved in the construction and maintenance of the project will be MINEA, RNT, and ENDE, which are outlined below.

(2) MINEA

As an administrative agency, MINEA proposes, formulates, manages, implements, and administers policies in the areas of energy, water, and sanitation. In particular, it aims to establish strategies to ensure sustainable development in water and electricity supply through the rational use of domestic water and energy resources, as well as to plan and promote national policies on electrification.

The organizational structure of MINEA is shown in Figure 2.1-1 shows the organizational structure of MINEA. The Directorate General of Electricity is in charge of the work related to the construction of new electric power facilities, in cooperation with the public corporations concerned, PRODEL, RNT, and ENDE.

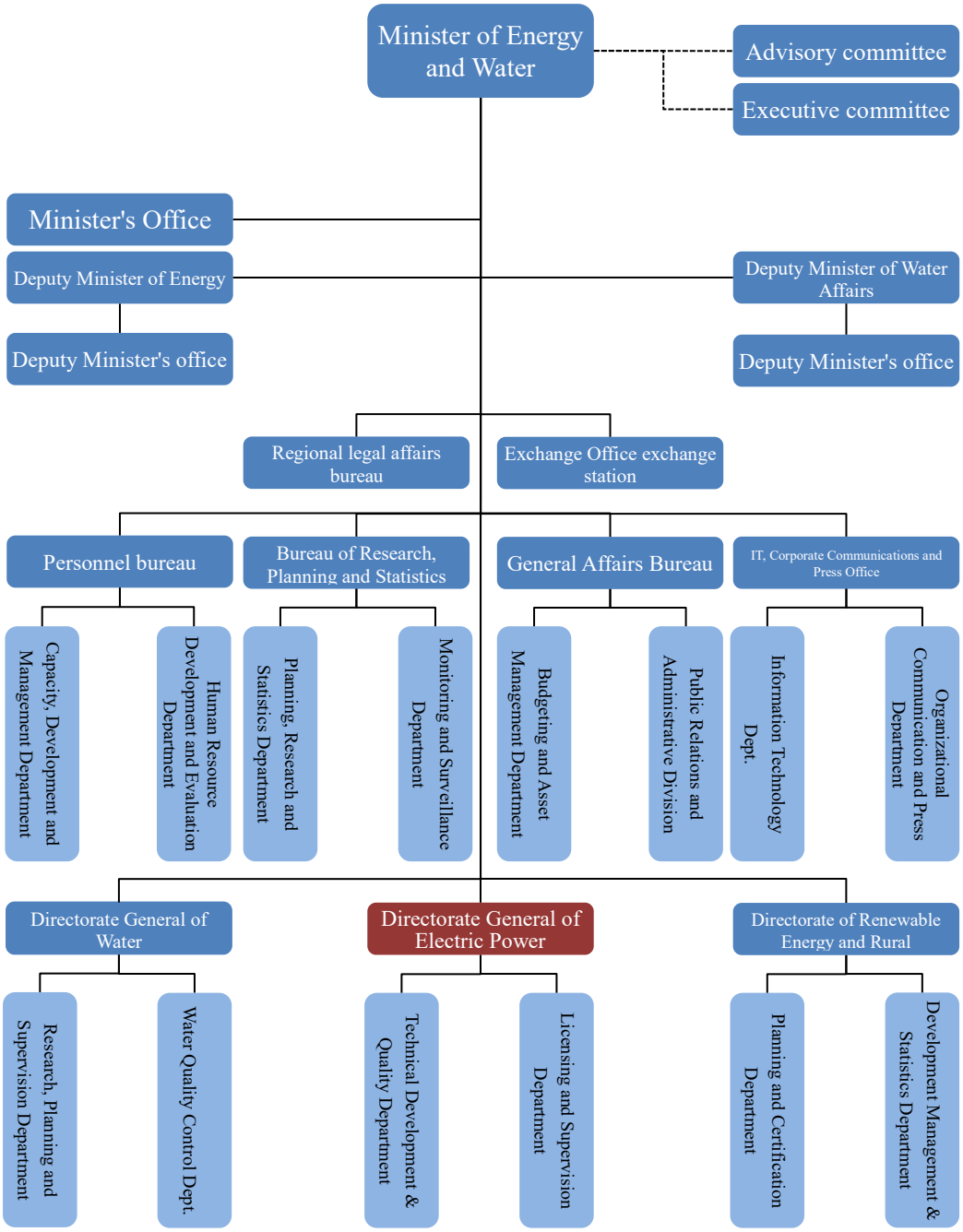


Figure 2.1-1 Organizational Structure of MINEA

Source: MINEA's website (http://www.minea.gv.ao/index.php/pages/sobre-nos-2 accessed November 19, 2021)

(3) RNT

RNT is the public corporation that plays a central role in the electric power supply system, as it is responsible for the planning and management of all transmission and substation facilities, and the feed-in command center is also under RNT's control. The transmission network (with a maximum voltage of 400 kV and transmission voltages of 220 kV, 150 kV, 132 kV, and 110 kV) is managed and operated by RNT.

Figure 2.1-2 shows the organizational structure of RNT. The implementation of new projects will mainly involve the Quality, Safety, Health and Environment Office, Regal Office, Quality Power Systems Planning Department, Engineering and Project Management Department, Assets, Purchasing, and General Services Department, as well as the Regional Development Department which is organized by region.

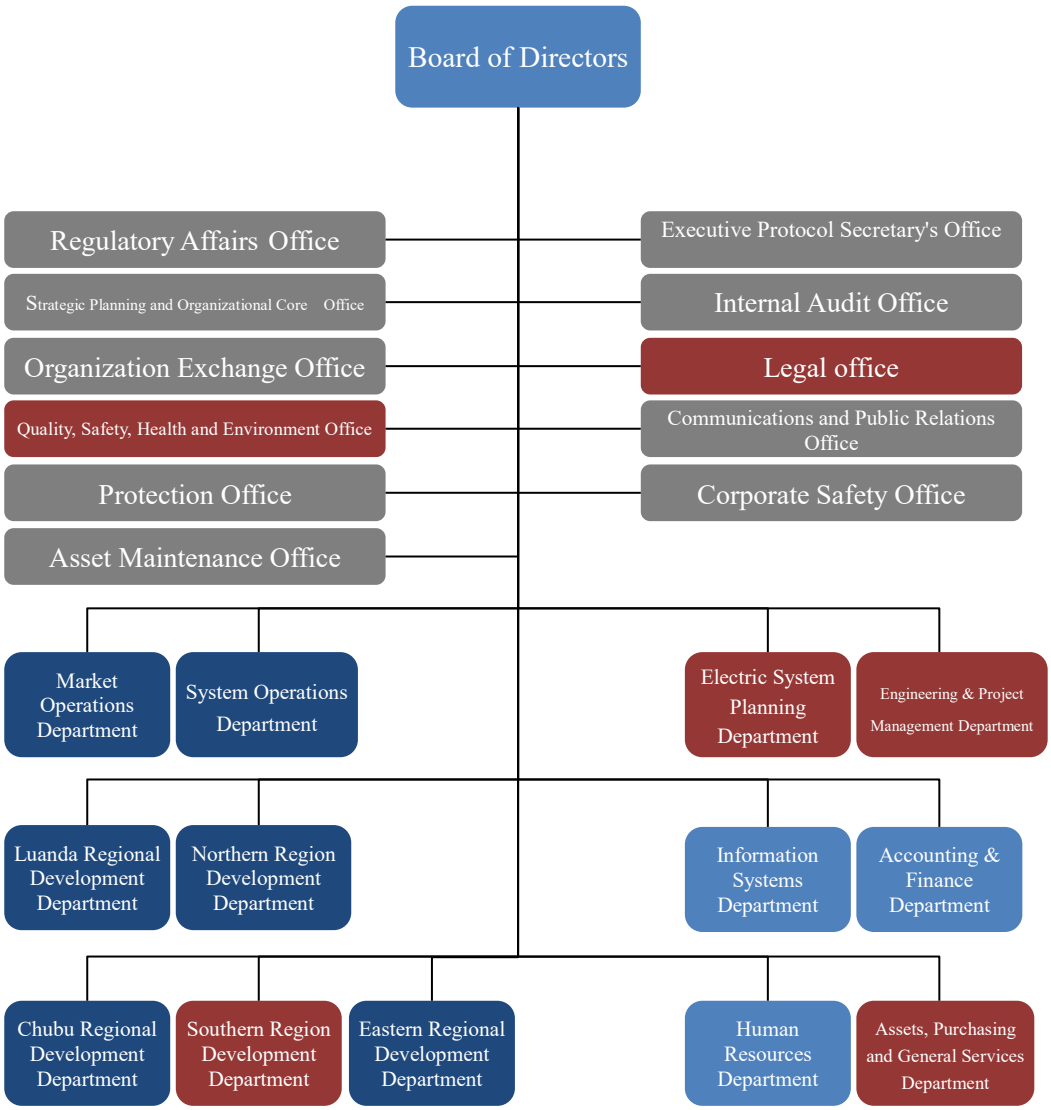


Figure 2.1-2 Organizational Structure of RNT

Source: RNT's website (http://www.rnt.co.ao/pt/a-rnt-ep/estrutura-organica/ accessed November 19, 2021)

(4) ENDE

ENDE is the public corporation responsible for the retail distribution of electricity and manages and operates the distribution facilities (60 kV, 30kV, 15 kV). The organizational structure is shown in Figure 2.1-3 shows the organizational structure of ENDE. The implementation of new power projects mainly involves the Engineering, Project Management, and Construction Division, the Medium and High Voltage Development and Maintenance Division of the Southern Regional Department, and the Supply Chain Department.

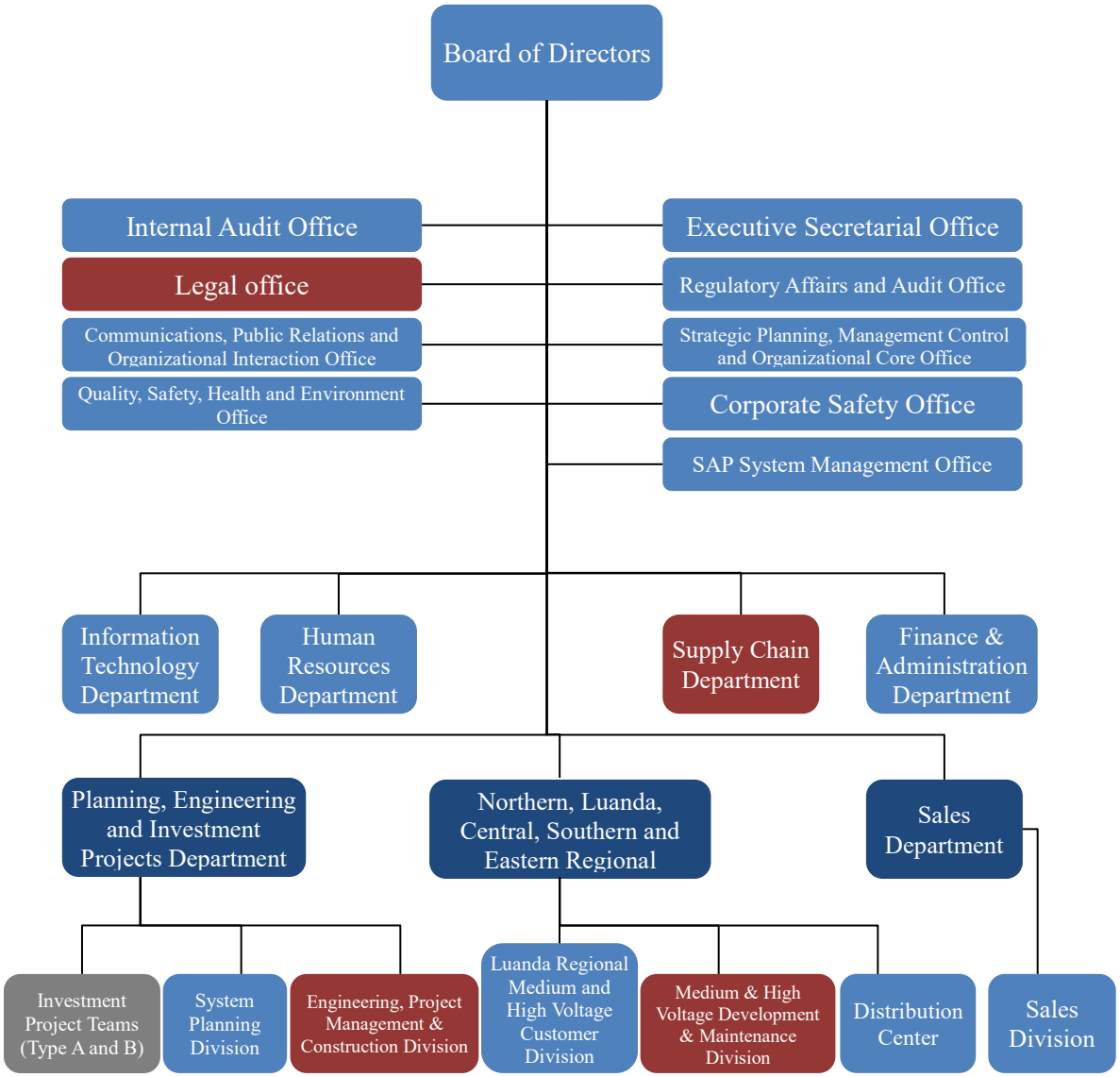


Figure 2.1-3 Organizational Structure of ENDE

Source: ENDE's website (https://ende.co.ao/sobre/estrutura-organica/ accessed November 19, 2021)

2.1.2. Functions of each Electric Power Organization involved in the Project and their Roles

(1) MINEA

The functions and roles of MINEA Directorate involved in this project are shown below.

1) Directorate General of Electricity

- National Electricity Policy General
- Electric power development planning

(2) RNT

The functions and roles of the various RNT department involved in this project are described below.

1) Legal Office

- Contract negotiation support

2) Quality, Safety, Health and Environment Office

- Environmental and Social Impact Management

- Safety management

3) Assets, Purchasing and General Services Department

- Purchasing materials and equipment
- Storage and management of materials and equipment
- Site Acquisition

4) Power Planning System Department

- Medium- to long-term electricity demand forecasting
- Generation and grid planning based on demand forecasts
- System analysis for various power system development planning

5) Engineering and Project Management Department

5-1) Engineering Division

a) Transmission and Substation Study and Project Department

- Management of transmission and substation construction and renovation projects
- Transmission and Substation Project Design Drawing Approval
- Progress management and support for power transmission and substation projects
- Approval and acceptance inspection of transmission and substation project equipment and materials
- Request and coordination of CND implementation of mine exploration and clearance in the area of new transmission and substation project facilities

b) Standardization and Technical Documentation Section

- Standards, criteria, technical specifications operations management
- Promote research, development and innovation projects
- Management of equipment technical information

5-2) Project Management Division

a) Project Financial Management Department

- Project Budget Management
- Assistance in registering new project assets

b) Project Team Support Section

- Project progress and quality control
- Project Risk Management
- Preparation of bid documents, bid evaluation, contract negotiation
- Various equipment testing
- Management of consulting services
- Project Team Staffing and Training

6) Southern Regional Development Department (Huila, Namibe)

a) Transmission Line Branch

- Maintenance of 400 kV, 220 kV, and 132 kV transmission lines

b) Substation Branch

- Maintenance of 400 kV, 220 kV, and 132 kV substations

(3) ENDE

The functions and roles of the various ENDE departments involved in this project are shown below.

1) Legal Office

- Contract negotiation support

2) Supply Chain Office

- Purchasing materials and equipment
- Storage and management of materials and equipment

3) Planning and Engineering, Investment Projects Department

- Planning, design, specification, incoming inspection, and quality control of materials and equipment
- Design Drawing Approval
- Preparation of bid documents, bid evaluation, contract negotiation
- Project progress and quality control
- Project Budget Management
- Various equipment testing
- Project Site Acquisition
- Report on construction progress

- Environmental and Social Impact Assessment

4) Southern Regional Electricity Distribution Department

a) Medium to High Voltage Development & Maintenance Division

- Maintenance of 60 kV, 30 kV and 15 kV distribution lines and substations
- Purchase of materials and equipment necessary for maintenance and management

2.1.3. Power Implementation Department for each Component

(1) RNT

Table 2.1-1 Projected implementing departments for each component of the project

Implementing Department	Legal Office	Quality and Safety Health and Environment Office	Assets & Purchasing General Service Department	Electric Power Planning System Department	Engineering Project Management Department		Southern Region Development Department (Huila/Namibe)	
Department in charge					Engineering	Project Manage	T/L	S/S
Planning and general management				X				
Detailed design					X			
Preparation of bidding documents						X		
Evaluation of bids						X		
Contract negotiation	X					X		
Drawing approval					X			
Material and equipment purchasing management			X		X	X		
Construction management					X	X		
Various tests					X	X		
Completion test					X	X		
Maintenance							X	X
Environmental and Social Impact		X						

Source: JICA Survey Team, based on interviews with RNT

(2) ENDE

Table 2.1-2 Projected Implementing Department for each component of the project

Implementing Department	Legal Office	Supply Chain Department	Engineering Project Management & Construction Department	Southern Regional Department
Detailed design			X	
Preparation of bidding Documents			X	
Evaluation of bids			X	
Contract negotiation	X		X	
Drawing approval			X	
Materials and equipment purchasing management		X	X	
Construction management			X	
Various tests			X	
Completion test			X	
Maintenance				X
Environmental and Social Impact			X	

Source: JICA Survey Team, based on interviews with ENDE

2.1.4. Organizational and Personnel Structure/ Implementing and Maintenance Structure in Electric Power Agencies

(1) RNT

(a) Organizations to maintain and manage facilities

RNT has five regional development headquarters in charge of the maintenance and management of the transmission and substation facilities: Luanda, Northern Region, Central Region, Southern Region, and Eastern Region. The Southern Regional Development Department, which has jurisdiction over the provinces of Huila, Namibe, Cunene, and Cuando Cubango, will be responsible for the maintenance and management of the transmission and substation facilities to be constructed by this project.

The area received by the Southern Regional Development Department is shown in Figure 2.1-4 and the organization chart of the Southern Regional Development Department is shown in Figure 2.1-5 and the number of personnel in each organization is shown in Table 2.1-3.

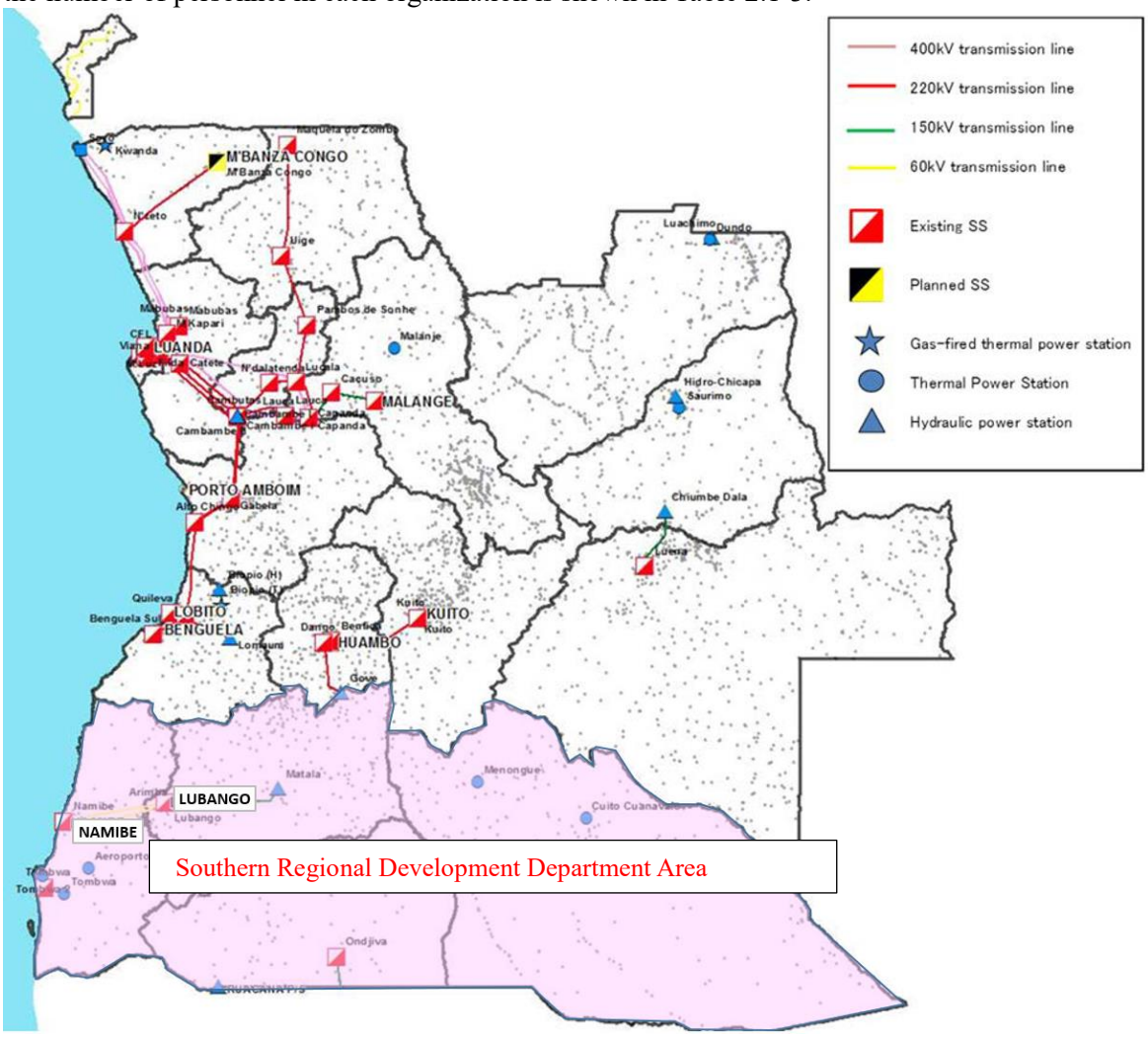


Figure 2.1-4 Southern Regional Development Department Area Map

Source: JICA Survey Team, based on RNT materials

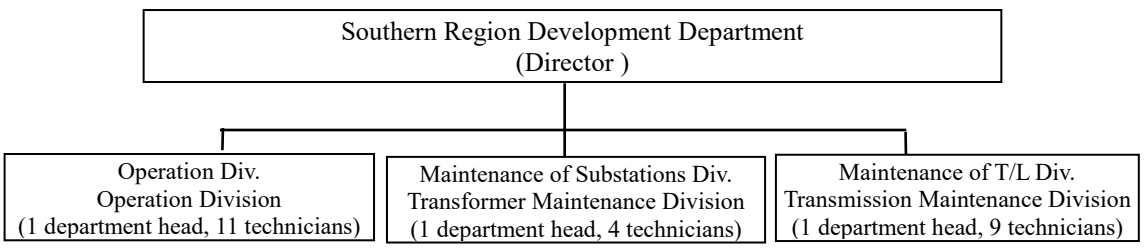


Figure 2.1-5 Organizational Chart of the Southern Region Development Division

Source: JICA Survey Team, based on interviews with RNT

Table 2.1-3 Number of Personnel in Each Organization

Division	Number of personnel	Remarks
Southern Regional Development Division		
Operation Division	12	
Maintenance of Substations Division	5	
Maintenance of Transmission Lines Division	10	
Manned substation		
400 kV Substation	53	9 locations
220 kV Substation	44	22 locations
110-150 kV Substation	30	7 locations

Source: JICA Survey Team, based on interviews with RNT

[Maintenance of substations]

The number of manned substations in RNT by voltage class is 53 for 400 kV substations (9 substations), 44 for 220 kV substations (22 substations), and 30 for 110 to 150 kV substations (7 substations), averaging about 3 persons per substation. Since two new 220 kV substations will be constructed by this project, it is assumed that an increase of approximately 6 personnel will be required for new substations.

[Maintenance of transmission line facilities]

The Maintenance of Transmission Lines Division is responsible for the maintenance of transmission lines in the Southern Regional Development Division, and it has about 10 personnel. The total length of existing transmission lines managed by the Southern Regional Development Division is 225 km, and approximately 200 km of new transmission lines will be constructed by this project.

(b) Facilities Construction Organization

The organization for the construction of this project is the Engineering and Project Management Department. The organizational chart of the Engineering and Project Management Department is shown in Figure 2.1-6.

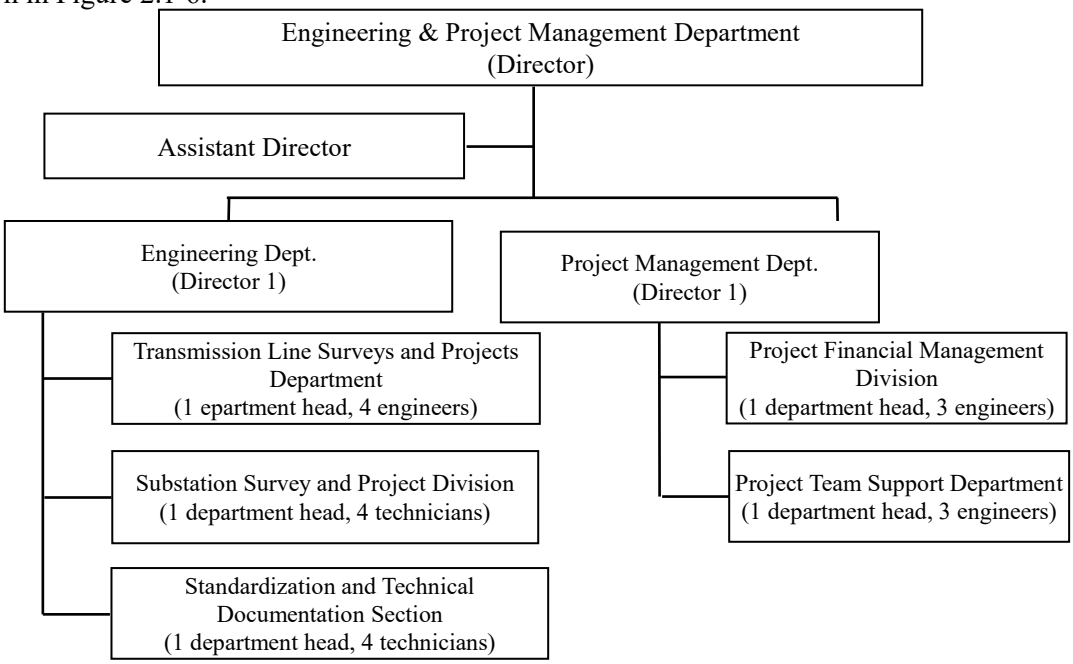


Figure 2.1-6 Organizational Chart of the Engineering and Project Management Department

Source: JICA Survey Team, based on RNT materials

(2) ENDE

(a) Facilities Maintenance and Management Organization

ENDE has the five regional Department (Luanda, Northern Region, Central Region, Southern Region, and Eastern Region) in charge of the maintenance and management of the distribution facilities. The Southern Regional Distribution Department, which has jurisdiction over the provinces of Huila, Namibe, Cunene, and Cuando Cubango, will be responsible for the maintenance and management of

the power distribution facilities to be constructed under by this project. The area served by the Southern Regional Distribution Headquarters is shown in Figure 2.1-4.

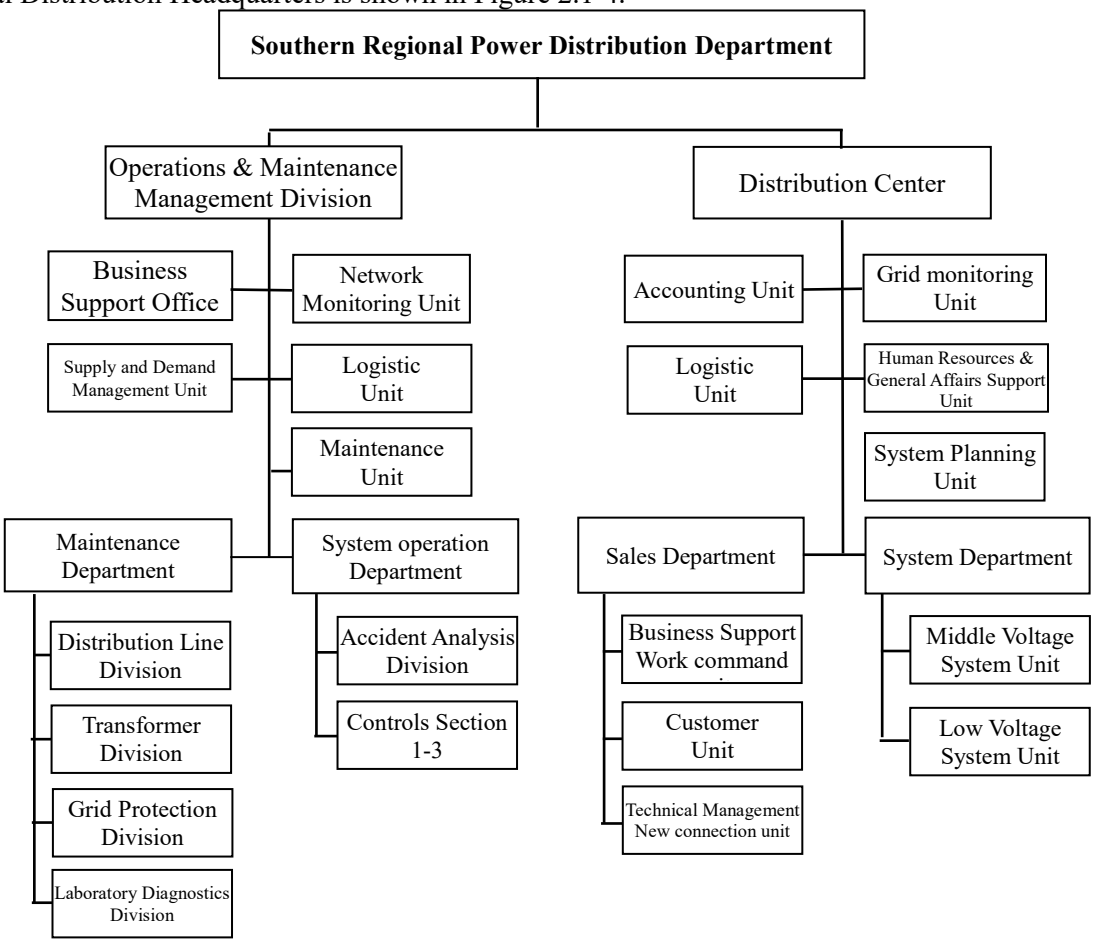


Figure 2.1-7 Organizational Chart of the Southern Regional Electricity Distribution Department

Source: JICA Survey Team, based on ENDE materials

[Maintenance of substations]

The 60 kV substations are manned, and the standard number of personnel at each substation is 7. Since one new 60 kV substation will be constructed as a result of this project, an increase of about 7 personnel will be required for the new substation.

[Maintenance of power distribution lines]

Maintenance of power distribution lines at the Southern Regional Distribution Department is carried out by the Power Distribution Line Section of the Maintenance Department. The total number of personnel in the Southern Area Distribution Department is about 40. The existing distribution lines managed by the Southern Area Distribution Department are estimated to be about 1,000 km, and even if about 10 km of new distribution lines are built by this project, no new personnel in the distribution line section are expected to be required.

(b) Facilities Construction Organization

The organization for the construction of this project is the Planning, Engineering, and Project Investment Department. The organizational chart of the Planning, Engineering, and Project Investment Department is shown below.

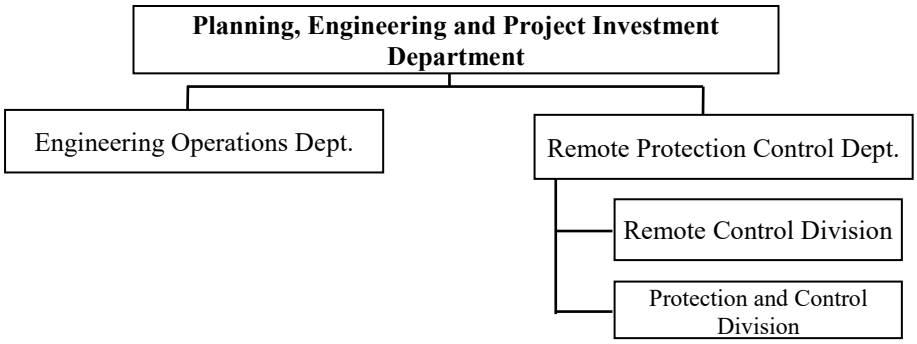


Figure 2.1-8 Organizational Chart of the Planning, Engineering, and Project Investment Department

Source: JICA Survey Team, based on ENDE materials

2.1.5. Operation and Maintenance Costs (O&M Costs)

(1) RNT

The following table shows the actual Operation and Maintenance Costs of transmission and substation facilities for the past three years.

Table 2.1-4 Actual Operation and Maintenance Costs for the past three years

(Unit: 1,000 AOA)

	2018	2019	2020
Maintenance costs (repair, renovation, etc.)	2,916,740	2,796,486	3,339,917
Personnel costs (salary, pension, etc.)	6,405,054	7,820,787	9,959,214

USD 1 = 501 AOA (IMF International Financial Statistics, November 2022)

Source: RNT's annual report

Based on the above results, Operation and Maintenance Costs for the project are estimated.

[Facility maintenance costs]

The average facility maintenance costs are calculated from the facility maintenance costs and facility Installed capacity for the three years 2018-2020 as follows. Note that in this calculation, half of the facility maintenance cost is for transmission facilities and half for substation facilities. In addition, the unit costs per kilometer for transmission facilities and per MVA for substation facilities are calculated, assuming that the unit cost is constant regardless of voltage.

Table 2.1-5 Facility Installed capacity and Unit maintenance costs over the past three years

			Unit	2018	2019	2020
Maintenance costs (repair, renovation, etc.)				2,916,740	2,796,486	3,339,917
Installed capacity	Transmission line	400 kV	km	1523	1924	1924
		220 kV	km	2320	2404	2404
		150 kV	km	190	190	190
		132 kV	km	57	57	57
		110 kV	km	246	291	291
		Total	km	4336	4866	4866
		Unit cost	1,000 AOA /km	336.3	287.3	343.2
	Substation	400 kV	Nos.	8	9	9
		220 kV	Nos.	20	21	22
		150 kV	Nos.	1	1	1
		110 kV	Nos.	1	1	1
		400 kV	MVA	5060	6420	6420
		220 kV	MVA	2255	2855	2885
		150 kV	MVA	50	50	50
		132 kV	MVA	10	10	10
		110 kV	MVA	85.3	95.3	95.3
		Total	MVA	7460.3	9430.3	9460.3
		Unit cost	1,000 AOA /MVA	195.5	148.3	176.5

Source: JICA Survey Team, based on RNT materials

Table 2.1-5 shows that the facility maintenance costs per km of transmission facilities is 343.2*1,000 AOA (in 2020) and the facility maintenance costs per MVA of substation facilities is 176.5*1,000 AOA (in 2020). Since this Project involves the construction of 196 km of transmission facilities and 480 MW of substation facilities (240 MW at the 220/60 kV New Namibe Substation and 240 MW at the 220/60 kV East Lubango Substation), the increase in facility maintenance costs related to the project is expected to be approximately 152 million AOA (approximately 303,000 USD) per year.

[Personnel costs]

Divided by the number of RNT employees 1,125, the annual personnel costs per person would be 8.852 million AOA. As described in Section 2.1.4, the total increase in the number of employees due to this project is about 10 persons, and the increase in personnel costs related to the project is assumed to be about 88.52 million AOA (approximately 177,000 USD) per year.

(2) ENDE

The following table shows the actual Operation and Maintenance Costs of transmission and substation facilities for the past three years.

Table 2.1-6 Actual Operation and Maintenance Costs for the past three years

(Unit: 1,000 AOA)

	2018	2019	2020
Maintenance costs (repair, renovation, etc.)	-	15,934,761	17,943,552
Personnel costs (salary, pension, etc.)	19,519,853	25,473,004	28,647,800

Source: ENDE's annual report

Based on the above results, the Operation and Maintenance Costs for this project are estimated.

[Facility maintenance costs]

Based on the facility maintenance costs and facility installed capacity for the three years 2018-2020, the average facility maintenance costs are calculated as follows. In this calculation, half of the facility maintenance costs are assumed to be for distribution line facilities and half for substation facilities, and the cable portion of the distribution line facility cost is assumed to be approximately five times the overhead line portion. The unit cost per kilometer for the distribution line facilities and unit cost per MVA for the substation facilities are calculated, assuming that the voltage is constant regardless of the voltage.

Table 2.1-7 Facility Installed capacity and Unit maintenance costs over the past three years

			Unit	2018	2019	2020
Maintenance costs (repair, renovation, etc.)			1,000 AOA	-	15,934,761	17,943,552
Installed capacity	Distribution line (OverHead)	60 kV	km	-	1,741.0	1,798.6
		15 to 30 kV	km	-	7,280.0	7,280.4
		Total	km	-	8,769.0	9,079.0
		Unit cost	1,000 AOA /km	-	172.7	169.5
	Distribution line(Cable)	Total	km	-	14,946.5	17,535.4
		Unit cost	1,000 AOA /km	-	888.4	847.7
	Substation	60 kV	Nos.	-	112	131
			MVA	-	5,132	5,355
		15 to 30 kV	Nos.	-	13,221	14,296
			MVA	-	7,240	7,978
		Total	MVA		12,731.6	13,332.7
		Unit cost	1,000 AOA /MVA	-	122.4	115.5

Source: JICA Survey Team, based on ENDE materials

Table 2.1-7 shows that the facility maintenance costs per km of distribution facilities is 169.5*1,000 AOA for overhead lines and 847.7*1,000 AOA for cables (in 2020), and the facility maintenance costs per MVA of substation facilities are 115.5*1,000 AOA (in 2020). Since the project involves the construction of approximately 10 km of overhead lines for distribution line facilities, 0.5 km of cables, and 80 MW of new substation facilities, the increased facility maintenance costs related to this project are expected to be approximately 11.4 million AOA (approximately 22,800 USD) per year.

[Personnel costs]

The personnel costs as of 2020 is 28,648 million AOA, which, divided by the 4,493 personnel in the ENDE, yields an annual personnel costs per person of 6.376 million AOA. As described in Section 2.1.4, the total increase in personnel due to this Project is about 7 persons, and the increase in personnel costs related to the project are assumed to be about 44.63 million AOA (approxomately 89,100 USD) per year.

2.1.6. Financial Status of Implementing Institutions

Undislosed Information.

2.2. Angolan Government's Implementation System for Mine and UXO Countermeasures

Angola's mine and UXO exploration and demining implementation system is shown in Figure 2.2-1. ANAM, as described below, is responsible for coordinating mine countermeasure activities throughout the country, as well as monitoring, implementing a quality control and accrediting of mine exploration and demining organizations. Operators of mine search and demining activities ("operators") are divided into three main categories.

The first is the INAD, the official demining agency, the Forças Armadas Angolanas (FAA), the Casa de Segurança da Presidência da República (CSPR), and Polícia de Guarda Fronteira de Angola (PGFA).These four operators are administrated by the jurisdiction of the Comissão Executiva de Desminagem (CED) which is under the Ministry of Social Action, Family and Women Promotion (Ministério da Acção Social, Família e Promoção da Mulher: MASFAMU).

The second is the Humanitarian Demining Operator, which consists of international and local NGOs.

In addition, all except for four public operators are required to receive a certificate of approval of their activities (Certificado de Acreditação Operacional) from ANAM every year, and in 2021, four international NGOs and five local NGOs have been approved.

Third, there are private demining companies, and in 2021, 12 companies are licensed by CNIDAH (which is current ANAM).[2]

It is noted thatthere are no operators specializing in UXO, including public demining agencies, NGOs, or the private sector.

[2] Hearing from ANAM (March 10, 2022).

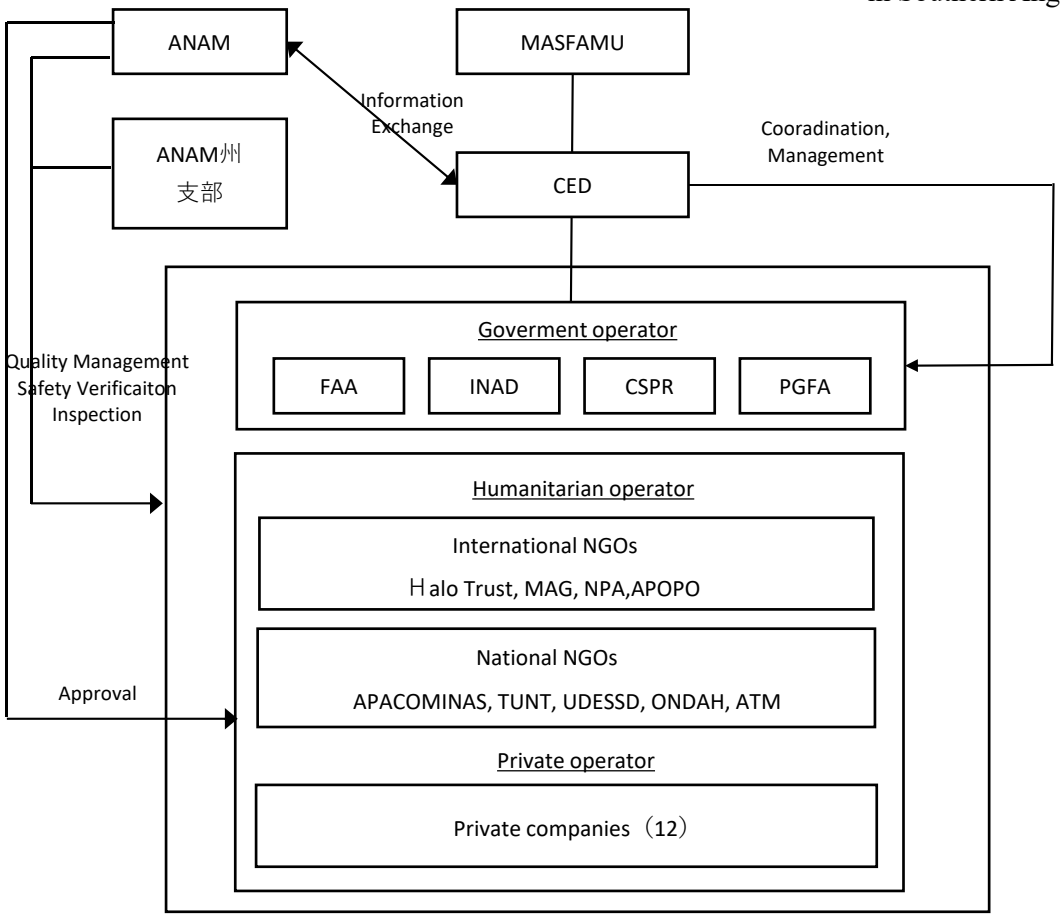


Figure 2.2-1 System of implementation for demining activities (2021)

Note: Humanitarian operators and private operators are the institutions and number of licensed operators in 2021.

Source: Based on interviews with ANAM and relevant organizations

(1) Angolan National Agency for Mine Action (ANAM)

(a) ANAM Overview

ANAM's predecessor is the National Coordination Commission for Demining and Humanitarian Assistance (CNIDAH)[3] , which was established by Presidential Decree in 2001 and whose roles are to formulate policies and regulations for demining activities, coordinate demining activities of public, domestic and foreign private agencies, authorize and manage demining agencies, conduct quality control and quality assurance of demining activities, inspect safety verification inspection after completion of demining activities (including issuance of quality control certificates to certify that the demining hazard has been eliminated by the demining activities[4]), and update and manage the Information Management System for Mine Action (IMSMA), a database of mine contamination status, andsupport victims of mines and unexploded ordnance[5] during the civil war that lasted from 1975 to 2002. Later, in accordance with Presidential Decree No. 172/21 (July 2021), the organization was reorganized in November 2021 into the Angolan National Agency for Mine Action (ANAM), but its role remains unchanged.

After the end of the civil war, support for victims of landmines and unexploded ordnance has been provided by MASFAMU's Disabled People Support Bureau as part of its support for physically and mentally disabled people.

ANAM has chapters in all 18 states, and the Lieutenant Governor of the state government is in a position to oversee the state chapters. In addition to the state chapters, there are a total of eight QA

[3] Decreto Presidencial n.º 54/01 de 14 Setembro

[4] Only if a quality control certificate is not promptly issued by CNIDAH headquarters, a provisional quality control certificate will be issued by the CNIDHA State Branch (heard in Willa.: Dec. 5, 2019).

[5] In 2012, CNIDAH conducted a nationwide survey to identify victims of the 1975-2002 civil war. The survey was conducted in cooperation with village chiefs and others (Interviews at the Wira State Branch of CNIDAH: December 5, 2019).

teams[6] , each with two or three states in a region, that perform quality assurance/quality control ("QA/QC"). The QA teams monitor operator activities during the pre-, intermediate, and completion phases of operations and conduct safety checks after completion of activities. ANAM's organizational chart is shown in Figure 2.2-2.

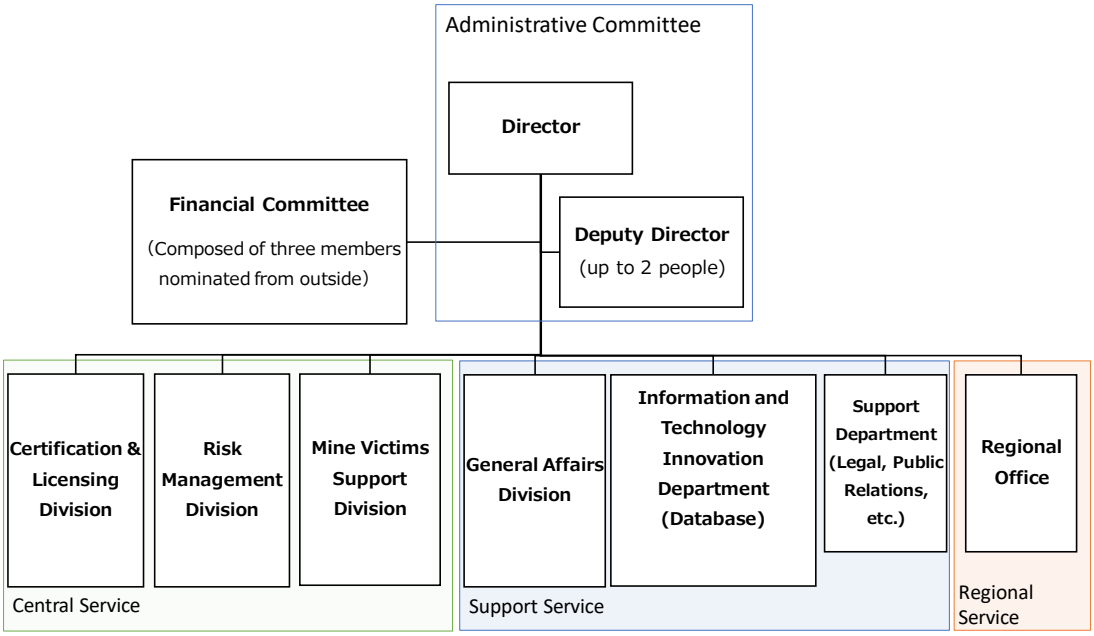


Figure 2.2-2 ANAM Organization Chart

Source: ANAM Organization Order

(b) Overview of ANAM State Chapters in the Willa and Namibe States

ANAM has chapters in Wira and Namibe, where the project area is located. Each branch has one staff member, but QA/QC is handled by the team in charge of the area that includes the above two provinces plus Cunene Province. The QA team has three staff members, but when an increase in staff is necessary due to the scale of a project, support staff are dispatched from other teams to assist. On the other hand, since 2012, ANAM has not been able to renew the equipment and materials necessary for monitoring and safety inspections of mine exploration and demining activities because the budget for these activities has not been secured, with the exception of salaries for staff, and the vehicles necessary for transportation have not been secured resulting in visiting the site in the operator's vehicle. The situation has affected ANAM's activities, as branch staff members use their personal Internet connections to communicate with headquarters. [7]

(2) Commisao Executiva de Deminagem (CED)

(a) CED Overview

The CED was created in 2005 by Presidential Decree[8] as an agency responsible for the four public operators, INAD, FAA, CSPR, and PGFA. Its main task is to coordinate, guide, and manage the effective and efficient activities of the various operators. The CED, as its organization chart is showed in Figure 2.2-3 The MASFAMU Minister stands at the top as coordinator, followed by the FAA General Chief of Staff as deputy coordinator, and under him are the General Police Commander, the FAA Commander, the FAA Chief of Staff Representative, and the CSPR Representative. The central operational group is responsible for the overall planning and management of exploration and demining activities under the jurisdiction of the CED. The Operational room instructs each operator to implement the exploration and demining activity plan and prepares reports and other documents summarizing

[6] The designation " QA Team" is based on an interview at CNIDAH headquarters (February 11, 2020).
[7] Hearings from CNIDAH headquarters and branches (February 11, 2020 and December 5 and 9, 2019)
[8] Despacho Presidencial nº 28/05, de 05 de Dezembro de 2005

each activity. The CED selects and determines the operator best suited for the area and content of the activity, taking into consideration the operator's removal personnel, operational status and structure (existence of a branch in the target province, etc.), and issues instructions to that operator for exploration and removal activities.

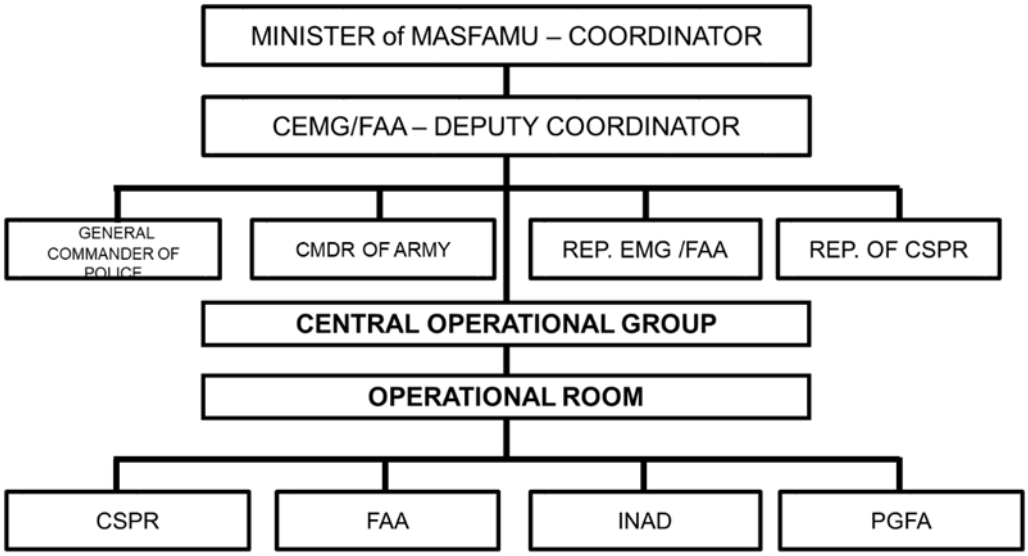


Figure 2.2-3 Organization chart of the CED

Note: CEMG: Chefe do Estado-Maior General (Chief of General Staff), CMDR: Comandante do Exército (Military Commander), REP.EMP : Representante do Estado-Maior General (Chief of Staff Representative)

Source: Prepared by JICA Survey Team based on materials obtained from CED

(b) Personnel and military status of public operators under the administration of the CED

The number of personnel for each operator is shown in Table 2.2-1. FAA personnel are registered with the military. The following table shows the payroll for each agency's personnel.

1. All the 933 INAD personnel are quasi-civil servants who are paid by MASFAMU.
2. All the FAA's 1,567 personnel belong to the national military and paid by them.
3. The 1,199 personnel of the CSPR are composed of veterans and civilians who are paid by the CSPR.
4. All the 196 personnel of the PGFA belong to the National Police and are paid accordingly.

Table 2.2-1 Military and other registers of public operators under CED jurisdiction

	INAD	FAA	CSPR*	PGFA
Number of personnel under CED jurisdiction	933 people	1,567 people	1,199 people	196 people
a) Number of personnel in the main body of the Armed Forces (excluding institutions under the Armed Forces) and active duty military personnel (those with military status who are currently serving in the Armed Forces)	0 person	1,567 people	0 person	0 person
b) Number of personnel in institutions under the military and people with military status but not currently serving in the military.	0 person	0 person	0 person	0 person
c) Number of personnel in the MoD itself or in agencies under the MoD, as well as MoD personnel.	× 0 person	○ 1,567 people	×	×
d) Civilian institutions, including military institutions and people with military status within the institution	×	×	×	×
e) Agencies that come under the military or Ministry of Defense in the event of a contingency (war).	×	○	○**	○

Note: *Composed of veterans and civilians

**Some of the 1,196 will be reservists.

Source: Prepared by JICA Survey Team based on materials obtained from CED and INAD (as of December 2019).

(c) Budget for CED activities and operations

CED's budget and actuals for 2013-2019 are shown in Table 2.2-2. This budget covers the activities and operational costs of mine and UXO countermeasures under the administration of the CED, but the amount allocated to each operator is not disclosed. In addition, personnel costs are not included because, as noted above, they are allocated by MASFAMU or the respective agencies.

Table 2.2-2 shows that, with the exception of 2014, the difference between budgeted and actual results is significant, and in fact, activities and operating expenses are not allocated as budgeted. In terms of the local currency, AOA (Kwanzaa), the actual amount in 2014 was about AOA 7.7 billion, which decreased significantly to about AOA 2.4 billion in 2015 and to about AOA 200 million in 2016; in 2018, it seems to be improving slightly to about AOA 800 million, but in the seven years from 2013 to 2019 the AOA exchange rate against the euro has fallen by a quarter over the past seven years, and given that inflation has averaged 17.5%/year during this period, and that the consumer price index in 2019 is about three times higher than in 2013, the budget is considered to be severely underfunded in real terms as well.

Table 2.2-2 CED's annual operating and activity budget (2013-2019)

Year	Budget (AOA)	Achievements (AOA)	Actual (JPY)
2013	9,454,633,134	5,945,758,779	1,367,524,519
2014	7,760,820,024	7,706,611,502	1,772,520,645
2015	5,799,788,655	2,448,315,838	563,112,643
2016	5,766,337,870	206,617,812	47,522,097
2017	7,637,922,337	218,817,580	50,328,043
2018	5,495,112,123	825,888,933	189,954,455
2019	4,030,233,942	-	-

Note: For reference, the Japanese Yen amount calculated at the same rate for each year of AOA1=JPY0.23 (OANDA rate on December 21, 2019).

Source: Prepared by JICA Survey Team based on information obtained from CED

(3) Forças Armadas Angolanas (FAA)

(a) FAA Overview

The FAA is the national armed forces of Angola and, under the coordination of the CED, conducts mine and UXO exploration and demining activities under the national project[9] (mine and UXO exploration and demining activities are limited to the project area and are different from areal humanitarian demining activities in accordance with the Medium-term Operational Plan, etc.).

(b) Equipment, etc.

The FAA has 20 small Eastern European-made Bozena-5 deminers and five South African-made Casspir armored vehicles for transporting deminers.

The detector (Garrett) used by the FAA as equipment that contributes to the rapidity of search operations is less expensive than the mine detectors (MineLab, Forrester, etc.) used by mine action centers around the world, and the detector is easy to handle, which reduces the handling burden for FAA removal personnel. On the other hand, the detector has the disadvantage of low information processing capability and poor detection performance due to its long frequency wavelength.

(4) Institute Nacional de Deminagem (INAD)

(a) INAD Overview

INAD was established in 2003 as a public operator of a civilian agency, a modification of the Instituto Nacional para Remocao de Objectos e Engenhos Explosivos (INAROEE), which was established in 1995. INAD is under MASFAMU and carries out not only exploration and demining activities for mines and UXOs involved in national projects, but also exploration and clearance activities at the request of communities[10] . The following is a summary of INAD's main activities

[9] Basically, the project is listed in Angola's National Development Plan (Plano de Desenvolvimento Nacional).

[10] Requests from the community are made to INAD through the local government (answers to questionnaires collected from INAD).

- Demining activities, mine avoidance education
- Surveys during demining activities
- Demining activities linked to socio-economic infrastructure development
- Humanitarian Demining Activities
- technical support
- Cooperation with International NGOs

Although INAD's capacity is stipulated to be 2,344, the actual number of personnel is only 881 as of 2021. The organization chart of INAD is shown in Figure 2.2-4. It has branches in all 18 provinces, but the demining teams and the equipment they possess are assigned according to the circumstances of the exploration and demining activities.

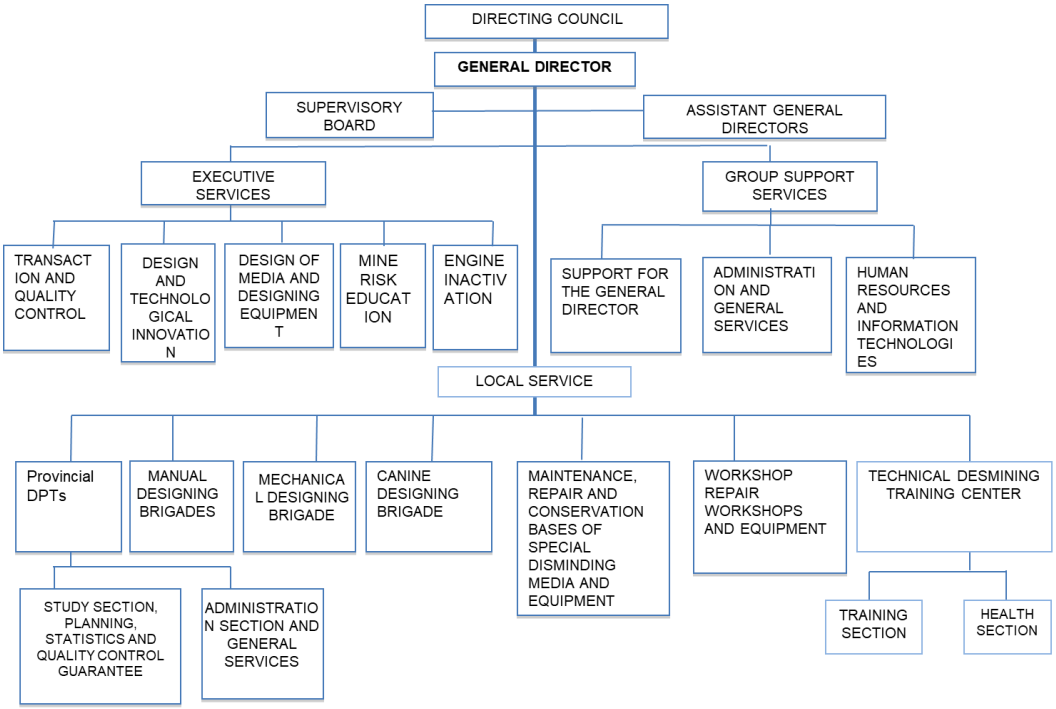


Figure 2.2-4 INAD Organization Chart

Source: Prepared by JICA Survey Team based on materials obtained from INAD.

(b) INAD Labor Costs

INAD's labor costs from 2013 to 2021 are showed in Table 2.2-3.Table 2.2-2 shows that while CED's operating and activity costs have decreased significantly since 2016, INAD's personnel costs have not changed significantly. When per capita personnel costs are calculated based on total personnel costs and the number of staff, they appear to have risen from approximately AOA 738 thousand in 2013 to AOA 1,959 thousand in 2019. However, as previously mentioned, the significant decline in the AOA exchange rate between 2013 and 2019, the rate of inflation increase, and the consumer price index suggest that the budget is underfunded in real terms. As a result, it is assumed that the actual number of employees has been decreasing year by year.There are signs that the situation is improving as the exchange rate and oil prices increase since 2020.

Table 2.2-3 INAD's Total Personnel Costs and Number of Staff (2013-2021)

Year	AOA	JPY	Number of staff
2013	829,461,920	190,776,242	1,123
2014	1,259,892,853	289,775,356	1,107
2015	1,538,584,770	353,874,497	1,078
2016	1,458,481,487	335,450,742	1,000
2017	1,409,444,791	324,172,302	974
2018	1,442,256,598	331,719,018	963
2019	1,827,840,663	420,403,352	933
2020	1,997,560,335	459,438,877	899
2021	1,968,982,066	452,865,875	881

Note: For reference, the Japanese Yen amount calculated at the same rate for each year of AOA1=JPY0.23 (OANDA rate on December 21, 2019).
Salaries exclude income tax and social security.
Source: Prepared by JICA Survey Team based on materials obtained from INAD

(c) INAD's experience in the mine exploration and demining

INAD's record of exploration of mines and UXOs and demining are showed in Table 2.2-4. The area of the exploration and demining hit the record in 2014, when CED activities and operating costs peaked. Since 2015, with the decrease in activity and operation expenses of the CED which is written in Table 2.2-2, the area of exploration and demining have been decreasing, but have been slightly increasing in recent years.

Table 2.2-4 INAD's Mine and UXO Search and Clearance Performance (2013-2021)

	Area (m²)	Road (km)	Transmission line (km)	Mines A/P	Mines A/T	unexploded ordnance	ERW
2013	48,078,014	415.00	-	1,245	58	9,886	73,146
2014	149,768,628	480.27	-	698	59	3,564	79,304
2015	38,109,053	151.73	176.81	597	161	5,417	42,316
2016	83,513,134	45.25	139.39	172	84	11,600	29,245
2017	29,700,746	184.3	114.69	203	183	5,582	28,997
2018	2,780,170	2.60	13.00	138	116	9,665	42,174
2019	3,694,109	12.40	21.00	89	25	3,077	18,012
2020	8,500,352	152	27.00	468	26	3,962	14,073
2021	11,248,330	67	96.00	382	39	7,914	38,246
Total	375,392,536	1,511	588	3,992	751	60,667	365,513

Note: Mines A/P: anti-personnel mines, Mines A/T: anti-tank mines
The
Source. Prepared by JICA Survey Team based on materials obtained from INAD

(5) Establishment of the National Demining Center (CND)

Presidential Decree No. 212/22 (July 2022) created the National Demining Center (Centro Nacional de Desminagem: CND), merging the CED, INAD, and FAA's demining units and the CSPR's demining unit, and bringing it under the administration of the Ministry of National Defense (Ministério da Defesa Nacional e Veteranos da Patria (MINDENVP).

The basic role of CND is to integrate the activities of the CED, INAD, and FAA's demining units, and CSPR's demining unit. Since the CND is currently in a transitional phase of reorganization and will not be fully operational until 2023, this report describes the findings of the former organization.

An organizational chart of CND is shown in Figure 2.2-5.

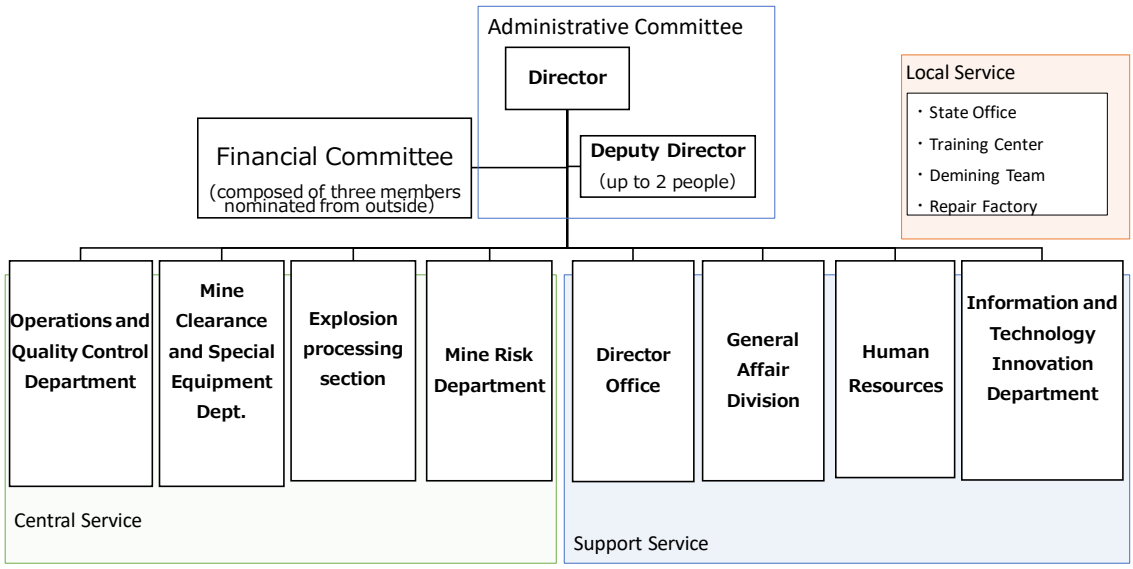


Figure 2.2-5 Organizational Chart of CND

Source: CND Organization Order

In addition, with the establishment of the CND, Angola's mine and UXO exploration and demining implementation system will be in place from 2023, it is expected to be as shown in Figure 2.2-6.

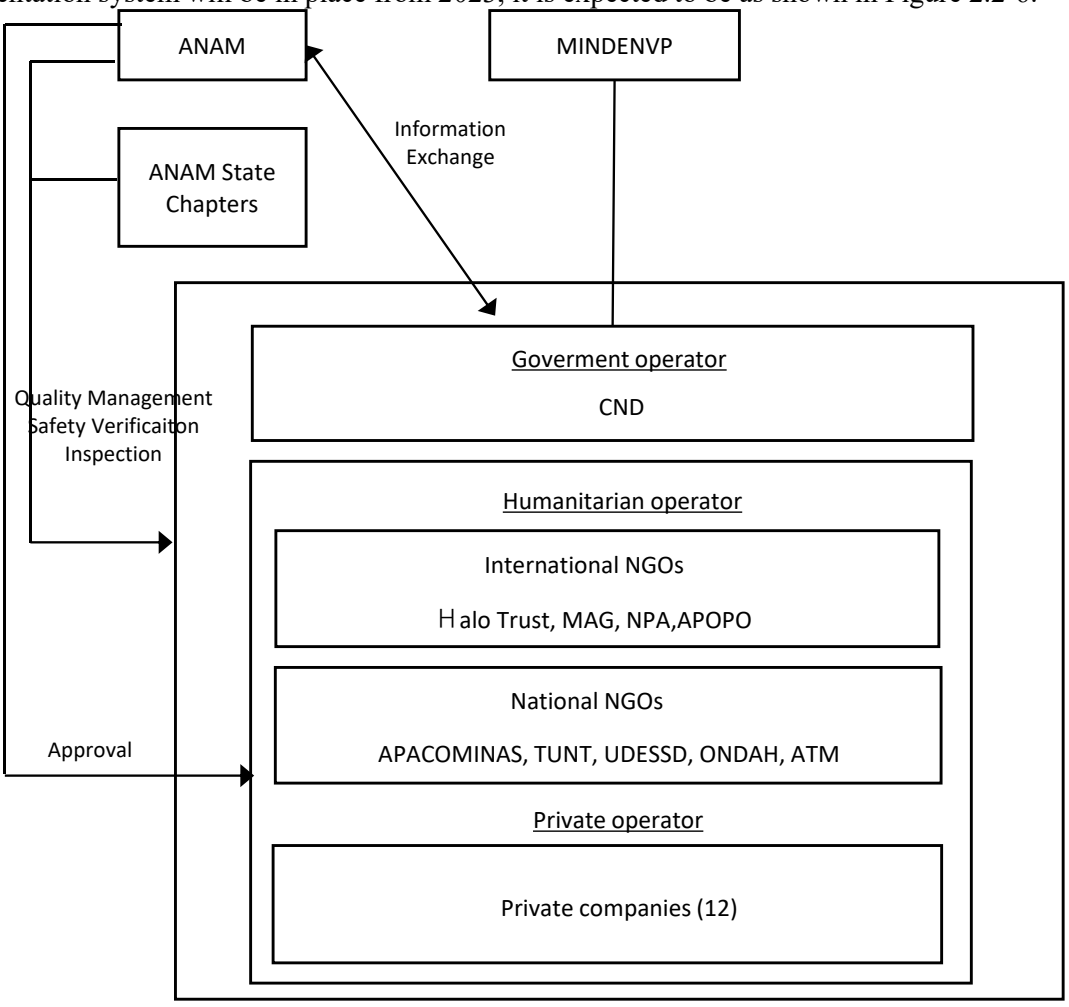


Figure 2.2-6 System for implementation for demining activities (from 2023)

Source: Prepared based on interviews with relevant organizations

3. Power System Analysis

3.1. Power Flow Calculation Results for the Lubango Area

As described in Section 1.6.3, after extensive discussions in the WS, it was decided to add a plan for the construction of the 220/60 kV East Lubango SS and a distribution line between the 220/60 kV East Lubango SS and the 60/15 kV Arimba SS to the project scope in order to provide a stable supply of electricity to the Lubango area.

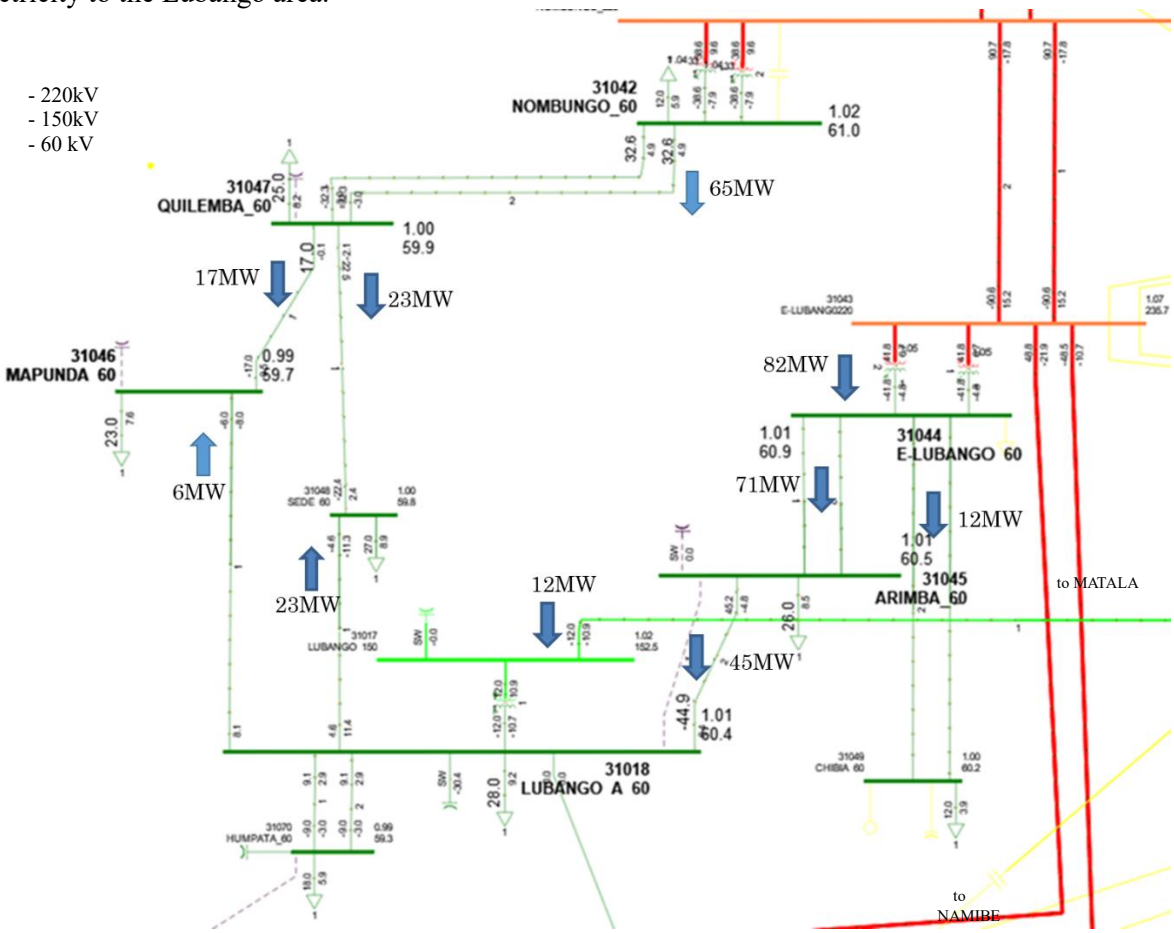


Figure 3.1-1 Power Flow calculation results for the Lubango region (2026)

Figure 3.1-1 shows the results of the power flow calculations for the year 2026.

In the 2026 system in Figure 3.3-1, among the supply lines, the largest current flows between Nombungo - Quilemba, which is the supply line to the Lubango regional distribution system, and the capacity of the 60 kV DL. Therefore, we verified the occurrence of an accident on one of the 60 kV DL between Nombungo and Quilemba as the most severe case of an N-1 accident, and confirmed whether or not an overload occurred. The results are shown in Figure 3.3-1.

By reducing the power supplied from the 400/220/60 kV Nombungo SS to the Lubango regional distribution system and increasing the power supplied from the 220/60 kV East Lubango SS and the Matala SS, there is no overloaded equipment, no deviation from the proper voltage, and no problems.

It has been confirmed that no overload or other problems have occurred on other 60 kV DL and on a single line accident on a 150 kV transmission line.

There is also a plan to boost the existing 150 kV line between Lubango and Matala to 220 kV and bring it to the 220/60 kV East Lubango SS in 2026. Even if the implementation of this plan is delayed, it will not be a problem in terms of power flow and voltage based on the power flow calculation results. On the other hand, if the existing 220 kV line between Lubango and Matala can be brought into boost the existing 150 kV line between Lubango and Matala to 220 kV and bring it to the 220/60 kV East Lubango SS as planned, the reliability of the distribution system in this Lubango area will be improved.

Figure 3.1-2 shows the results of the power flow calculations for the year 2030.

- 220kV
- 60 kV

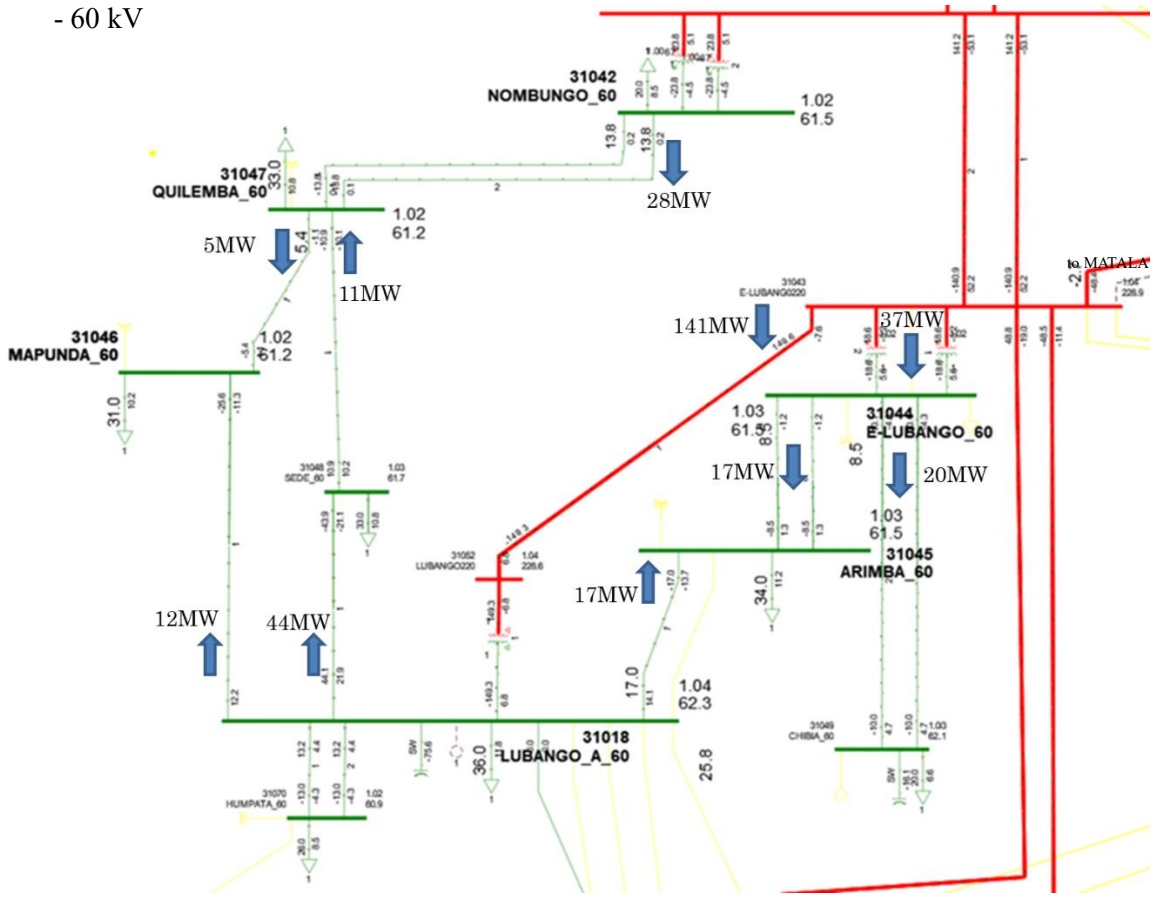


Figure 3.1-2 Power flow calculation results for the Lubango area (2030)

The calculations were performed assuming that in 2030, as planned, the 220 kV TL between the 150/60 kV Existing Lubango SS and the Matala SS will have been pulled into the 220/60 kV East Lubango SS.

With the 150/60 kV Existing Lubango SS and the 220/60 kV East Lubango SS connected by a 220 kV TL, the power flows on the 60 kV DL between Nombungo-Quilemba and the 60 kV DL between East Lubango and Arimba are reduced from the 2026 cross section, and there will be no overloading of equipment and no voltage deviation even in the event of a single line accident on each transmission line. No equipment overloads will occur and no deviation from the proper voltage will occur in the event of a line accident. Thus, supply reliability in this Lubango region is increasing.

In addition, a power system has been established to supply power to the 60 kV distribution system in the Lubango area from three base substations, the 400/220/60 kV Nombungo SS, the 220/60 kV East Lubango SS, and the 150/60 kV Existing Lubango SS with a boosted voltage of 220 kV, which ensures sufficient reliability to cope with increased demand in the Lubango area. Therefore, future increases in demand can be met by strengthening the distribution system from these base substations.

3.2. Fault Current

The three-phase short-circuit currents calculated for the power system in Table 3.2-1 are shown in Figure 3.1-2. In Angola, the rated breaking capacity of 220 kV circuit breakers and 60 kV circuit breakers is 50 kA and 31.5 kA, respectively, which is a level that will not cause any problems in the foreseeable future, even if the power supply and transmission system of the Angolan power system is further expanded.

Table 3.2-1 Three-phase short-circuit currents in the southern region of Angola (2030)

BUS	Three-phase short-circuit current (kA)	BUS	Three-phase short-circuit current (kA)
Nombungo 220kV	4.1	Nombungo 60kV	9.0
EastLubango 220kV	3.8	EastLubango 60kV	9.0
Lubango 220kV	3.4	Arinba 60kV	8.5
Namibe 220kV	2.1	Lubango 60kV	12.4
-	-	Namibe 60kV	4.4

3.3. Identification of Bottlenecks in the Transmission, Substation, and Distribution Network in the Lubango Region and Study of Measures to Address these Bottlenecks

The most severe accident in the 2026 system in Figure 3.3-1 is a one-circuit fault on the 60 kV DL between Nombungo and Quilemba, which is the supply line to the Lubango regional distribution system and carries the largest power flow.

The results of this single line accident are shown in Figure 3.3-1. The power flow on all 60 kV DL were within 95 MVA of the installed capacity, no distribution lines were overloaded, and no deviation from the proper voltage occurred. It is also confirmed that no overloads and no deviation from the proper voltage occurred on the other 60 kV DL and on the 150 kV transmission line during the single line fault.

In addition, the decrease in power supplied from the 400/220/60 kV Nombungo SS to the Lubango regional distribution system, while the increase in power supplied from the 220/60 kV East Lubango SS and the Matala SS, confirmed that there were no overloaded facilities and that there were no problems.

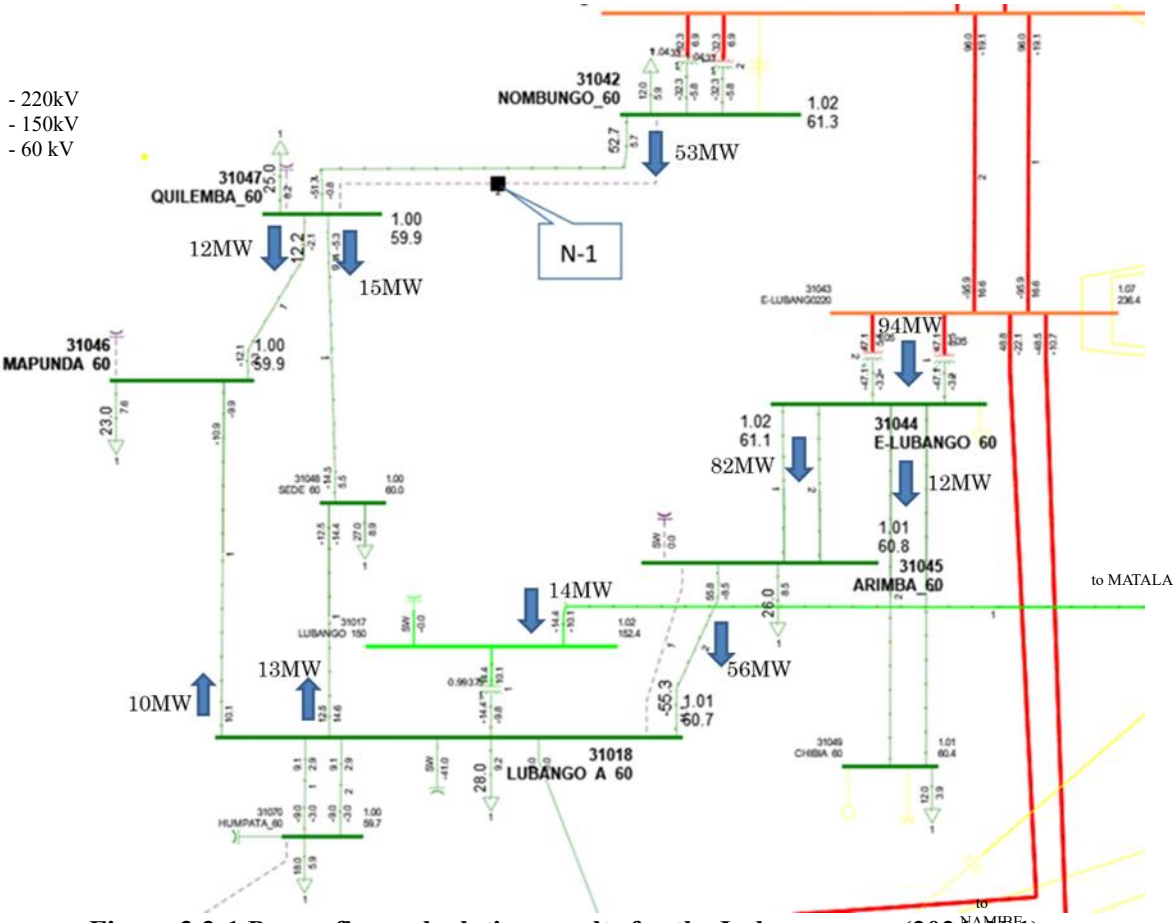


Figure 3.3-1 Power flow calculation results for the Lubango area (2026, N-1)

Figure 3.3-2 shows the results of a single-circuit fault on the 220 kV TL between the 220/60 kV East Lubango SS and the 150/60 kV Existing Lubango SS, which has the largest power flow and is the most severe fault in the Lubango area distribution system in 2030 in Figure 3.1-2.

The 220 kV TL between the 150/60 kV Existing Lubango SS and the 60/15 kV Arimba SS will experience a slight increase in power flow, but no equipment, including this line, will be overloaded and no deviation from the power voltage will occur, ensuring sufficient reliability. It has also been confirmed that no overloading or other problems and no deviation from the voltage occurred during a single line accident on another 60 kV DL.

In addition, since the 60 kV DL between East Lubango and Chibia is long, it is necessary to install phase modifying equipment (as voltage countermeasures in the event of a single line fault) at the Chibia SS in order to meet the increased demand due to the construction of a large-scale industrial zone in the Chibia region.

In 2030, it is planned that the 150/60 kV Existing Lubango SS will be upgraded to a 220 kV substation, bringing the total number of 220 kV substations supplying power to the Lubango area to three. The plan calls for one 220 kV TL between East Lubango and Lubango and one 220/60 kV transformer, but as mentioned above, no major problems are expected in the immediate future. The most likely measures to cope with a further significant increase in demand are to increase the number of transmission lines to two and the number of transformers to two.

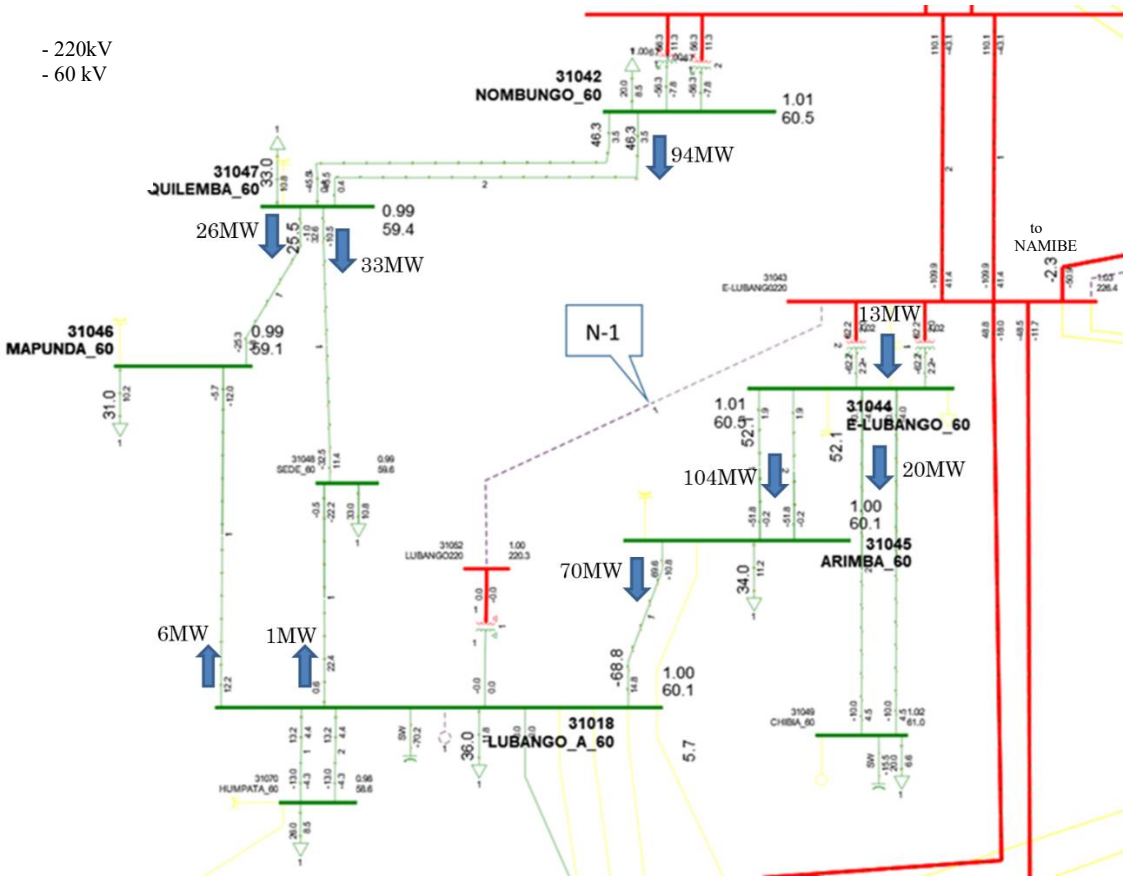


Figure 3.3-2 Power flow calculation results for the Lubango area (2030, N-1)

For the 220 kV TL between Nombungo and the New Namibe, discussions are being conducted in the WS on the assumption that power will be supplied from the 220/60 kV New Namibe SS to the 150/60kV Existing Namibe SS and other Namibe area demand. It has been confirmed that the connection between the station and the Namibe distribution system will coincide with the start of operation of the 220/60 kV New Namibe SS. In 2026 and 2030, demand in the Namibe area will still be small, and the power flow of the 220 kV TL will be small, so the results of the power flow calculations confirm that there will be no particular problems with the stable operation of the power system.

In addition, after the Namibe power station was put into operation, the MP Study verified that there were no equipment overloads or significant voltage drops in the event of a single line accident, etc., and confirmed that there were no particular problems. (See Figure 1.6-2)

However, due to various reasons, including the delay in this study caused mainly by the Corona disaster, it is currently expected that the project will not be operational until 2028. Although the reliability of the power system in the Lubango and Namibe areas will be lower than originally planned during the delay period due to the delayed start-up, even if the start-up is in 2028, the expected effects of the project as shown above will be achieved based on the results of the study for 2030. The project is expected to be completed in 2030.

4. Selection of Substations' Construction Site

4.1. 220/60 kV New Namibe Substation Construction Candidate Site

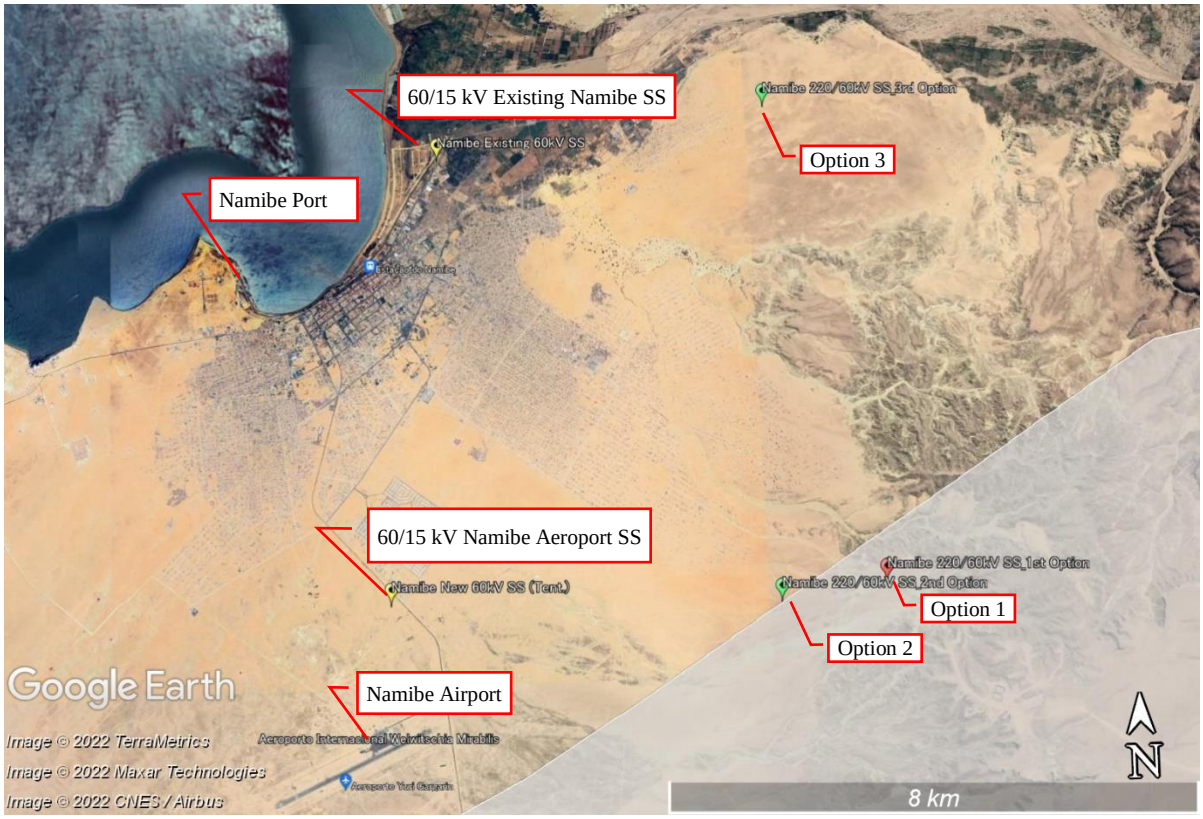


Figure 4.1-1 Candidate sites for construction of the 220/60 kV New Namibe SS (second field survey)

Source: Compiled by JICA Survey Team from Google Earth

At the time of the second field study, there were three options for the 220/60 kV New Namibe SS, which are shown in Figure 4.1-1.

Option 1: Not applicable from an environmental standpoint since it is within the Namibe Partial Protected Area.

Option 2: Outside of Namibe Partial Protected Area, no environmental issues, but the extent of Namibe Airport's airspace restrictions must be confirmed.

Option 3: The distance from Namibe Airport would not be affected by air restrictions and the length of the 220 kV TL could be shortened, but the length of the distribution line to the 60/15 kV New ENDE Namibe SS would be longer, which would require discussions with RNT and ENDE.

In selecting the 220/60 kV New Namibe SS, geological survey, construction and installation, operation and maintenance, and environmental and social considerations for the surrounding area were taken into account.

The geotechnical investigations included excavation in the vicinity of Option 3 as a representative site for the potential substation construction, and confirmed that approximately 3.0 m from the ground surface is a soft layer, but below that is a hard layer (for details, see 5.3 Chapter No. 13 Boring No. SS-4). Based on these results, it is concluded that pile foundations are not required for the 220/60 kV New Namibe SS.

In terms of construction and installation, a survey of the surrounding environment was conducted, and Option 1 and Option 2 fell under the partial protection zone or were in close proximity to the partial protection zone, and because of their proximity to Namibe Airport, the construction of new towers and transmission lines for 220 kV power lines and 60 kV power distribution lines fell under the height restriction, and the possibility of using underground power lines for part of the project was taken into consideration but was concluded to be in effective and avoided. For option 3, it is not subject to the height restriction due to its disntance from the airport, but on the other hand, there is a vertical cliff on

the north side near the river crossing point. Therefore, a site that is a short distance away from the cliff was selected to avoid the risk of landslides at the tower and substation construction site. In addition, a study of the transportation route of the substation equipment from Namibe Port was conducted, and a transportation route was selected with paved road crossing obstructions and unpaved roads (for details, see 7.5.3, and 7.7.2).

In terms of operation and maintenance, RNT stated that it strongly requested an indoor GIS substation and decided on an indoor substation, considering the effects of salt damage and sand dust, but the JICA survey team recommended an outdoor substation, considering the construction cost, future facility planning, and expandability of indoor and outdoor substations.

In terms of environmental and social considerations, sites were selected that avoided the Namibe Partial Protected Area (see Chapter 9). In view of the need to avoid sites within the Namibe Partial Protected Area and the need to consider the unique ecosystem of the desert area, Option 3 was considered because it is the furthest away from the protected area, on the edge of the desert area, and is considered to have the least impact on the ecosystem.

Also later, after discussing the technical aspects at the WS, the decision was made to go with Option 3 area. Comparative results for each option are shown in the table below.

ENDE plans to construct a 60/15 kV New ENDENamibe SS in conjunction with the 220/60 kV New Namibe SS, as shown in the figure below, and the two substations are planned to be interconnected by a 60 kV DL. The construction route of the lower green 60 kV DL is envisioned. The existing 60 kV Namibe substation, on the other hand, is located toward Namibe Bay and is assumed to be the construction route of the upper green distribution line. In addition, the planned extension of the 220 kV TL includes the construction of the Sakomar iron ore export terminal in Namibe Bay, a new 220 kV Sakomar SS in conjunction with the new Namibe CCGT (combined cycle gas turbine power station), and a new 220 kV Tombwa SS in southern Namibe (see Figure 1.6-1) are planned for the new construction of a new substation.

Figure 4.1-2 Location of the 220/60 kV New Namibe SS and the surrounding new and old 60 kV Namibe substations

Source: Compiled by JICA Survey Team from Google Earth

Table 4.1-1 Comparison table of potential sites for the 220/60 kV New Namibe SS

Business Segment				Option 1 New 220 kV substation on unused land in a partially protected area			Option 2 New 220 kV substation on unused land adjacent to a partially protected area			Option 3 New 220 kV substation on unused land away from the partially protected area		
				Official Development Assistance Loan	ENDE	Future	Official Development Assistance Loan	ENDE	Future	Official Development Assistance Loan	ENDE	Future
	New 220 kV TL (From Nombungo to New Namibe)			✓			✓			✓		
	New 220/60 kV New Namibe SS			✓			✓			✓		
	Extension of 60 kV DL	ENDE plan	New 60 kV DL from Namibe to New ENDE		✓			✓			✓	
			Construction of new 60 kV substation		✓			✓			✓	
			Connection to existing 60 kV substation		✓			✓			✓	
	Extension of power lines (220 or 150 kV)	RNT plan	High-voltage power supply to steel industries (new transmission line)			✓			✓			✓
			Same as above (new substation / existing substation decommissioned)		(✓)	✓		(✓)	✓		(✓)	✓
			Extension of transmission lines to Tombwa and others			✓			✓			✓
	Total cost (ODA Loan + ENDE + future)			Good			Good			Excellent		
Technical evaluation	Technical Advantages and Challenges			[Poor] Technically possible location, but is not permitted due to being inside the partially protected area. [Good] Because of its proximity to the ocean, measures to prevent salt damage are essential.			[Good] The area surrounding the candidate site is a large area of unused land, and although technically feasible to locate, the proximity to Namibe Airport makes it essential that the plan avoids the regulation conditions (avoidable but undesirable). [Good] Adjacent to a partially protected area, power lines may pass through the park. (Conditions to avoid) [Good] Because of its proximity to the ocean, measures to prevent salt damage are essential.			[Excellent] The area surrounding the candidate site is a vast area of unused land, technically feasible to locate and free of obstacles. [Excellent] The 220 kV TL extension is short. It is also closer than other options for future extension of the transmission line to Sacomar, which is economically advantageous. [Good] Distribution lines will be longer due to the distance from the new substation planned by ENDE. [Good] Located in unutilized land, new roads need to be built to transport heavy cargo (can be used as a future entry road). [Good] Because of its proximity to the ocean, measures to prevent salt damage are essential.		
	Conditions and measures to realize stable supply			Countermeasures not possible			1) Detailed route planning and facility design selection that avoids low contact with the separation and other conditions required by Namibe Airport. 2) Measures against salt damage			1) Coordination and consultation with relevant agencies is required to align RNT and ENDE plans. 2) Measures against salt damage		
Compatibility	**Technical evaluation of feasibility**			**Technically possible [Good].**			**Technically possible [Good]**			**Possible [Excellent]**		
Technical assessment				**Not Acceptable**			**While feasible. Higher risk compared to Option 3**			**Most desirable**		

The candidate site (Option 3) for the 220/60 kV New Namibe SS option are shown in the following figure.

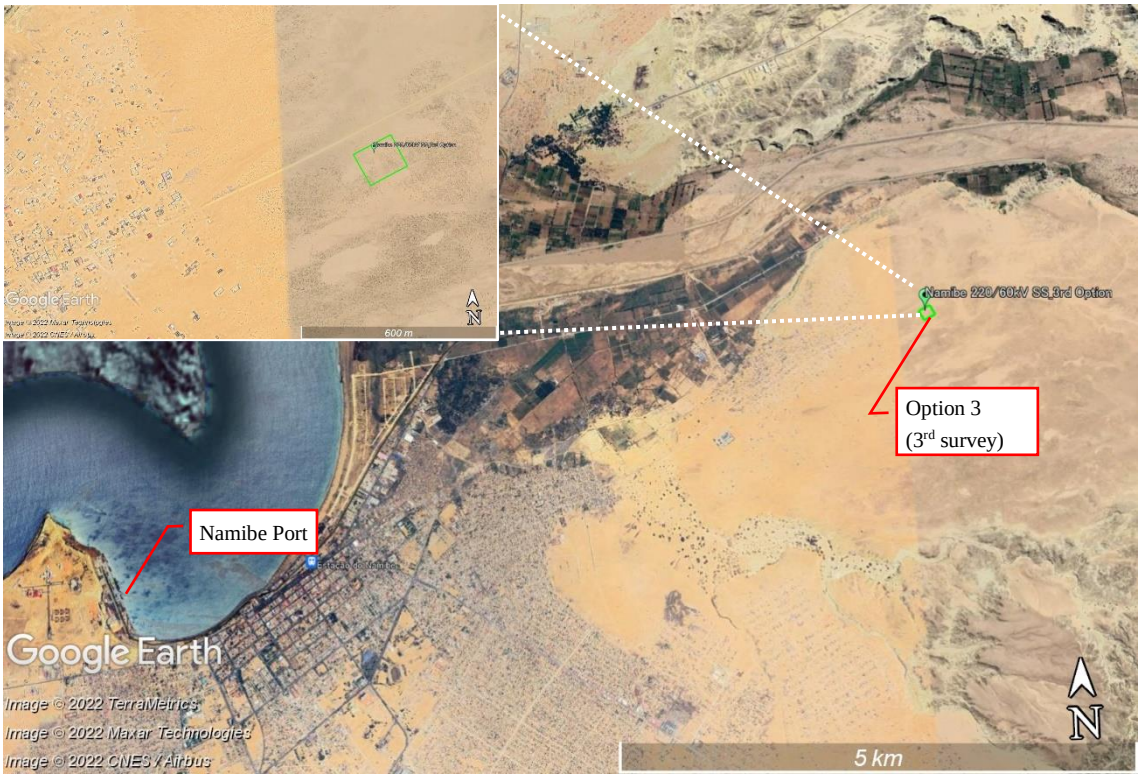


Figure 4.1-3 Potential sites for construction of 220/60kV New Namibe SS

Source: Compiled by JICA Survey Team from Google Earth

4.2. 220/60 kV East Lubango Substation Proposed Construction Site

During the WS discussions, the distribution plan and demand forecast for the Lubango area was confirmed and it is found that the 60 kV DL from the 400/220/60 kV Nombungo SS alone is not sufficient to supply the Lubango area's electricity distribution demand. In particular, a fault on the 60 kV DL from the 400/220/60 kV Nombungo SS would be a major supply disruption, leading the the necessity to construct a new 60 kV DL route. Therefore, in order to provide a stable supply of electricity to the Lubango area, the construction of the East Lubango Substation was added to the scope of the JICA project, and in addition to the 400/220/60 kV Nombungo Substation in the north, it was made to be the supply base for the 60 kV DL in the south.

The selection assumptions for the candidate sites for the 220/60 kV East Lubango SS are as follows

- Avoid overcrowded areas and minimize the impact on private homes.
- The project shall be located at the intersection of the 220 kV TL from the 400/220/60 kV Nombungo SS to the 220/60 kV New Namibe SS and the 150 kV (to be boosted to 220 kV in the future) transmission line from Matala to the 150/60 kV Existing Lubango substation.

This is because (1) the 220/60 kV East Lubango SS will be located in the middle of the 220 kV TL from the 400/220/60 kV Nombungo SS to the 220/60 kV New Namibe SS, and (2) there are plans to boost the voltage from the existing 150 kV transmission line to the 220 kV line, and this 220 kV TL will be pulled into the 220/60 kV East Lubango SS. The site at the intersection near the existing 150 kV was considered.

Therefore, the following are the potential sites for the 220/60 kV East Lubango SS as a result of the third field survey and discussions with RNT.

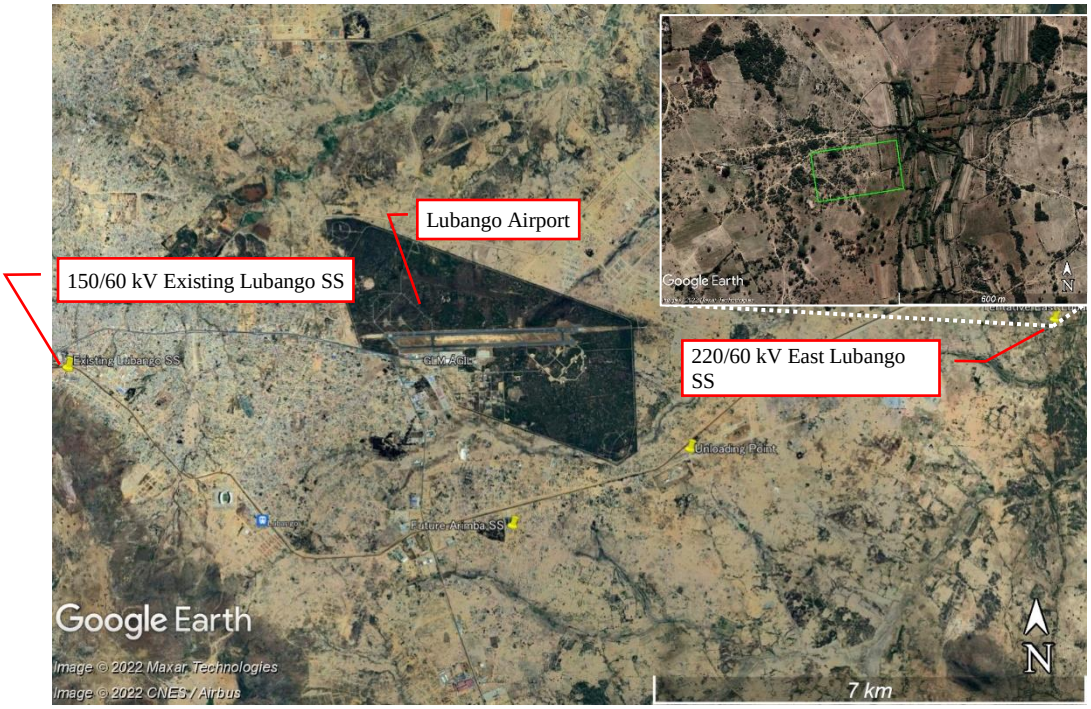


Figure 4.2-1 Potential sites for the construction of the 220/60 kV East Lubango SS

Source: Compiled by JICA Survey Team from Google Earth

In selecting the 220/60 kV East Lubango SS, we considered geological survey, construction and installation, operation and maintenance, and environmental and social considerations for the surrounding area.

The geotechnical investigation included excavation in the vicinity of the proposed substation, which revealed a slightly softer layer at approximately 14.0 m from the ground surface, but a harder layer below that (for details 5.3 Chapter No. 11, Boring No. SS-2). Based on these results, it is concluded that a pile foundation for the 220/60 kV East Lubango SS is not required.

In terms of construction and installation, a vacant lot on the south side of the existing 150 kV TL was selected as the substation construction site. During equipment transport, a transmission line shutdown will be required due to the distance above ground of the existing transmission line and the lack of sufficient isolation distance between the incoming equipment on trailers. The substation equipment was transported from the port of Namibe in the Atlantic Ocean to Lubango, Huila, inland by the Moçâmedes Railroad, and from the rail unloading point near the substation, the transportation route was selected by trailer (for details, see 7.5.4, and7.7.2).

In terms of operation and maintenance, since no special environmental measures are required, an outdoor air-insulated switchgear (AIS) was adopted to allow for future facility planning and expansion in the Lubango area.

In terms of environmental and social considerations, a survey of the surrounding environment was conducted and the site were selected that avoided existing private homes and churches (See Chapter 9.4).

4.3. Proposed Site for Construction of the 60/15 kV Arimba Substation

In selecting the 60/15 kV Arimba SS, the following factors were taken into account: geological survey, construction and installation, maintenance and operation, and environmental and social considerations for the surrounding area.

The geotechnical investigation included excavation in the vicinity of the proposed substation, which revealed a slightly softer layer at approximately 14.0 m from the ground surface, but a harder layer below that (for details 5.3 Chapter No. 12, Boring No. SS-3). Based on these results, it is concluded that a pile foundation for the 60/15 kV Arimba SS is not required.

In terms of construction and installation, the site adjacent to the south side of the existing Arimba1 PS was selected as the construction site for the distribution substation. The substation equipment was

transported from the port of Namibe by the Moçâmedes railroad, and from the railroad unloading point in the vicinity of the substation, a trailer haul route was selected (see details in7.5.5, and7.7.2).

In terms of operation and maintenance, since no special environmental measures are required, an outdoor air-insulated switchgear (AIS) was adopted to allow for future 15 kV distribution line facility planning and expansion in the Lubango area.

In terms of environmental and social considerations, a survey of the surrounding environment was conducted and the route of the 60 kV DL was studied (see 7.3 and 9.4).

During the WS discussions, the distribution plan and demand forecast for the Lubango area were confirmed, and there were concerns about overloading due to insufficient distribution capacity of the 60 kV DL. Therefore, it was found essential to strengthen the distribution lines in anticipation of future demand growth, and the construction of the 60/15 kV Arimba SS was added to the scope of the JICA project to ensure a stable supply of electricity to the Lubango region.

The proposed location of the 60/15 kV Arimba SS is shown in the following figure. The 60/15 kV Arimba SS has been located and walled around the perimeter as per the ENDE plan.

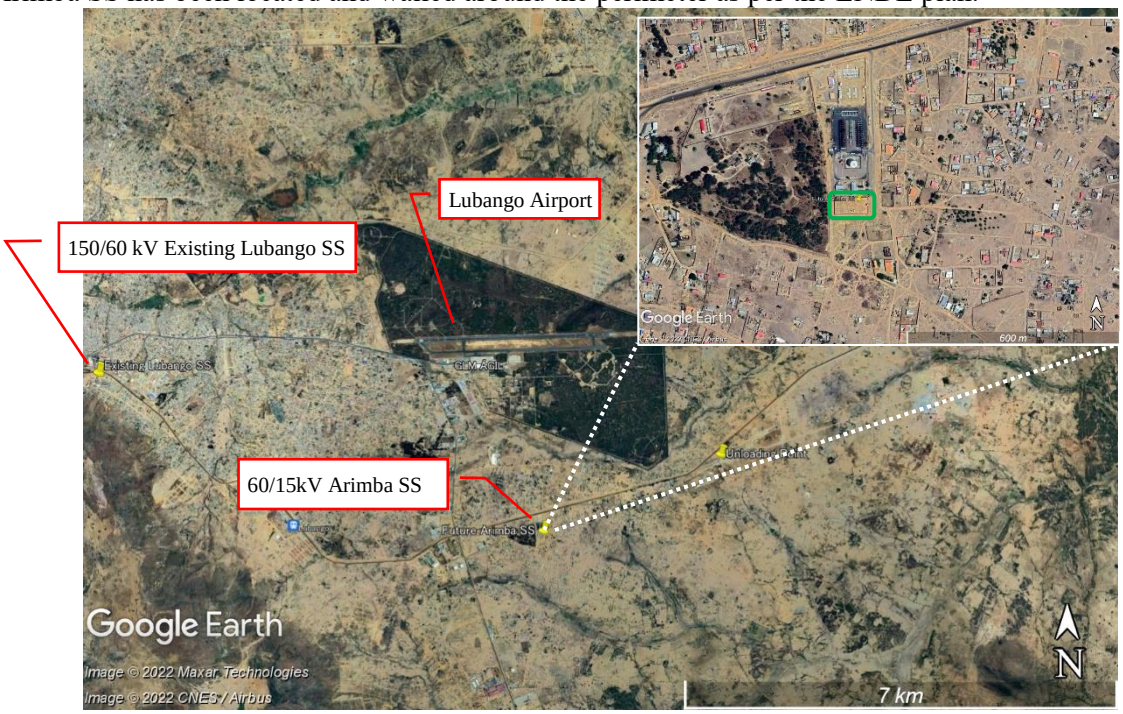


Figure 4.3-1 Potential sites for the construction of the 60/15 kV Arimba SS

Source: Compiled by JICA Survey Team from Google Earth

5. Selection of Transmission Line Route

5.1. Transmission Line Route Selection

Route surveys and, if necessary, surveying and geological studies shall be conducted, and from the results, a finalized transmission line route map shall be prepared after consultation with RNT.

The focus of the transmission line route survey: The following properties in general and in Angola in particular, including airports, nature reserves (including equivalent areas), large rivers, etc., that need to be considered when constructing transmission lines are identified in advance, and multiple routes that avoid these properties are studied on the desk. In order to conduct efficient and effective field surveys, accurate route maps will be prepared using the latest map data from Google Earth Pro and other sources, and will be effectively utilized during the field surveys.

Table 5.1-1 Properties of Interest in Preliminary Studies for Transmission Line Construction

Needs to be considered property	National parks, etc.: avoid passage due to environmental and social considerations Airports: Consideration for building restrictions on air routes due to the nearby Lubango and Namibe airports. Large rivers: Identify large rivers that may be long, and if there are vessels to navigate, consider the clearance for navigation and the flood zone of the river. Special high-voltage transmission lines: Clearance considerations with existing transmission lines Major roads: Consideration for road width, road appurtenances, the ground level above the road, traffic volume, etc. Railroads: Consideration for track width, track ancillary equipment (communication lines, etc.), height above ground, and measures to prevent falling wires. Housing and Dwelling: Crossing avoided due to reduction in residential relocation targets Schools: avoiding passage due to environmental and social considerations Religious facilities and cemeteries: Avoid passing through due to environmental and social considerations Local community facilities: Avoid passing through due to environmental and social considerations Chimneys: Avoid chimneys that emit soot and smoke to prevent electrical accidents and wire corrosion.
Properties requiring confirmation for power line construction	Steep mountainous areas: Visual inspection and, if possible, a geological survey to confirm the condition of steep areas that may be affected by construction. Salt and dust damage areas: Confirmation or hearing of damage to existing facilities in areas close to the coast or in desert areas (to study corrosion countermeasures) Roads: Consideration given to access during construction, whether temporary paths are required, and maintenance after construction

Overhead transmission line route survey method: The survey is conducted using the aforementioned topographic maps and satellite images to narrow down the points of interest, such as river crossings, near villages, and points of heavy angles, etc. The route survey is basically surveyed by vehicle, and the latitude and longitude of the points along the route are confirmed using GPS. The optimal crossing method was studied and evaluated, paying particular attention to obstructions, and the presence or absence of residences, private facilities, rare flora and fauna, protected forests, national parks, and important cultural facilities along the route was checked to the extent possible, while also considering the required separation of buildings and other structures in accordance with facility standards.

The above-focused points will be checked by transmission line experts, natural environment experts and social environment experts. However, the areas that may be contaminated by mines was visually checked from nearby roads, as safety cannot be confirmed.

5.2. Transmission Line Rout

The following is a schematic diagram of the entire survey. The 440/220/60 kVNombungo SS, the starting point, is located approximately 30 km northeast of Lubango City, the 220/60 kV East Lubango

SS is located approximately 20 km east of Lubango City, and the 220/60 kV New Namibe SS, the terminal point, is located approximately 140 km west of Lubango City and 8 km northeast of Mocamedes City.

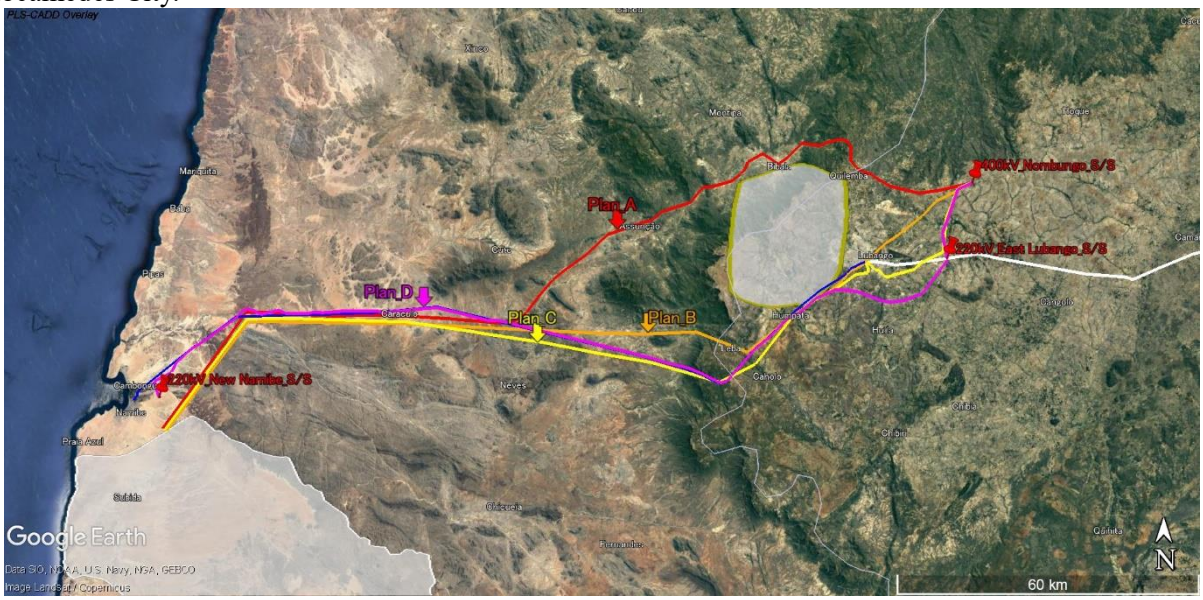


Figure 5.2-1 Overall View of 220 kV TL Route

Source: Compiled by JICA Survey Team by Google Earth

The following is for each lines in Figure 5.2-1:

- ✓ Red route - Plan A (basically a route adjacent to the railroad)
- ✓ Orange route - Plan B (shortest route through the vicinity of the 150/60 kV Existing Lubango SS)
- ✓ Yellow route - Plan C (avoiding downtown Lubango and passing near the 150/60 kV Existing Lubango SS)
- ✓ Peach route - Plan D (avoiding downtown Lubango, route via the 220/60 kV East Lubango SS)
- ✓ Blue route - Existing 60 kV DL
- ✓ White route - Existing 150 kV TL

These four routes are candidates along railroads or major roads that are already developed, while avoiding natural parks, protected areas, and critical habitat areas (IBAs). In addition to the presence or absence of ROW-related issues, there are three main points to consider on the transmission line routes

- ➢ Points passing through the vicinity of IBAs (Tundabala, Namibe Protected Area)
- ➢ Consideration of a route in the cliff area that descends about 1200m in elevation in about 8km.
- ➢ Study of two 500-800m river crossing locations in Namibe Province.

The current status of the proposed transmission line route will be confirmed through a site visit, and the most appropriate transmission line route will be selected. The selection will be based on a multifaceted evaluation from the following perspectives

- ➢ Topographical and geological aspects: Less affected by natural disasters
- ➢ Economy: Low project costs
- ➢ Environmental impact aspects: little impact on the natural environment, little urban lapse
- ➢ Construction and maintainability: Close to roads, easy to construct and maintain, no relocation in the near future

◆ Plan A (red route): Nombungo - Bibala - New Namibe route about 194 km

The route starts from the 400/220/60 kV Nombungo SS and goes through the highlands in the northern part of the Lubango urban area, follows by 2,000-meter mountains along roads or railroads, and then through steppe climate areas with vegetation of shrubs and desert areas. No structures, roads, or railroads were found to be obstructions. The mountainous areas have no access roads, and although they are as close as possible to existing roads, they require extensive construction and maintenance

access roads because they must pass through areas with steep valleys and ridges. Although there are few dwellings in the area, the construction cost is inferior to Plan D because of the poor workability in the mountainous area and the need for many access roads, and the construction and maintenance costs are also inferior to those of Plan D.

◆ Plan B (Orange route): Nombungo - near the 150/60 kV Existing Lubango SS - Humpata – 220/60 kV New Namibe SS route about 185 km

The transitional area starts from the 400/220/60 kV Nombungo SS, in the eastern part of the Lubango urban area, where there is vegetation with shrubs, and then passes through the urban area in the center of Lubango City to the vicinity of the 150/60 kV Existing Lubango SS. The transitional area in the center of Lubango City is a densely urbanized area with a high concentration of houses and stores. After that, the route bypasses the symbolic statue at the top of the mountain, passes through the cultivated area of the Humpata region and the steep mountainous area of scenic Mt. Leba, and runs parallel to the road or the existing 60 kV DL.

Although this route has the shortest transmission line length, it is less feasible than the other route proposals because it involves large-scale resettlement as it passes through a densely urbanized area, and it is difficult to construct on the steep slope of Mt. Leba.

◆ Plan C (yellow route): Nombungo – near the 150/60 kV Existing Lubango SS - Humpata – 220/60 kV New Namibe SS route approx. 197 km

The route starts from the 400/220/60 kV Nombungo SS, in an area with scrub vegetation in the eastern part of downtown Lubango, and then continues along the railroad in Lubango City to the vicinity of the 150/60 kV Existing Lubango SS, where there are areas of densely populated housing. After that, the route bypasses the symbolic statue at the top of the mountain and follows the road or the existing 60 kV DL through the cultivated area in the Humpata region. The route then passes through the steep valleys of the Burco area, and passes through the same steppe-climate and desert areas as in Plan A. Except for the steep mountainous areas in the Burco area, the area is flat and has relatively good access to the existing road.

This route has some residential areas and other areas that may be affected by relocation. Construction costs are more costly than Plans A and D. In addition, construction and maintainability are inferior to those of Plan D.

◆ Plan D (Peach Route): Nombungo – 220/60 kV East Lubango SS - Humpata – 220/60 kV New Namibe SS route about 196 km

After repeated remote workshops between our team, RNT and ENDE to discuss demand assumptions and facility plans for the Lubango area, it was decided that it would be beneficial to construct the 220/60 kV East Lubango SS to ensure a stable supply in the Lubango area. The location of the 220/60 kV East Lubango SS is advantageous in terms of facility formation because there is a plan to convert the 150 kV existing TL to 220 kV, and the intersection of the project's transmission line and the existing 150 kV TL is advantageous.

The route starts from the 440/220/60 kV Nombungo SS and passes through the shrubby area in the eastern part of the Lubango urban area, then passes through the 220/60 kV East Lubango SS, and then passes through the southern part of the Lubango urban area avoiding the dense residential area that is an issue in Plan C. It then passes through the cultivated area in the Humpata area and steep valley in the Burco area along the existing 60 kV DL. After that, the line will basically follow the main road for the advantage of construction and maintenance. The cost of construction, ease of construction and maintenance of the project is better than other plans.

After evaluating and comparing these four routes, we decided on Plan D, which is superior in terms of construction and maintenance and also takes into consideration the natural environment, because it contributes greatly to the formation of facilities for a stable supply in the Lubango area, avoids areas with dense housing, and has good access to the construction site because it passes along a major road. The project team decided on Plan D, which is easy to construct and maintain and also takes into account the natural environment.

Table 5.2-1 Comparative Evaluation of proposed Routes for 220 kV TL

	Plan A		Plan B		Plan C		Plan D	
Line length	194 km	◯	185 km	◎	197 km	△	196 km	○
Main crossing point	National road : 2 Railroad : 3 Large rivers : 2 Existing transmission line : 1	△	National road : 1 Railroad : 1 Large rivers : 2 Existing transmission line : 1	○	National road : 1 Railroad : 1 Large rivers : 2 Existing transmission line : 1	○	National Road : 7 Railroad : 3 Large rivers : 2 Existing transmission lines : 4	△
Facility Formation	Not contributing to stable supply in the Lubango region.	×	Contributes to stable supply in the Lubango area, but is limited by the site of the 150/60 kV Existing Lubango SS.	△	Contributes to stable supply in the Lubango area, but is limited by the site of the 150/60 kV Existing Lubango SS.	△	Very effective for stable supply in the Lubango region	◎
Construction costs	The cost is higher than Plan D because it passes through mountainous areas and steep slopes in the north, and because of the construction cost of the main body and the development of the access road.	○	Although the line length is the shortest, it passes through a dense residential area, is expected to be difficult to construct in the steep terrain of Mount Leba, and is more expensive than Plans A and C.	×	Access road for the existing 60 kV DL can be utilized, but is more expensive than Plan D because the line is the longest and passes through densely populated residential areas.	△	Lowest cost due to the low maintenance of access roads, as access roads can be utilized for the existing 60 kV DL and are often along major roads without passing through dense residential areas.	◎
Workability	In the northern mountainous areas, there are no access roads from the existing roads, so the construction will be all new, and the process is expected to be longer than in Plan D.	○	The construction is more difficult than Plan C, considering the passage through the dense residential area in the city of Lubango and the difficulty of construction in the steep area of Mt. Leba.	×	Construction is more difficult than Plans A and D because of the dense residential area in the city of Lubango.	△	The construction workability is the best compared to other plans due to the proximity and parallel to the existing 60 kV DL and the existing road.	◎
Maintainability	Longer distance between mountainous areas in the north, and maintenance of access roads, etc., is less than that of Plan D.	○	The area near Mt. Leba is steep and its maintainability is inferior to other plans. There are also concerns about public disasters caused by the passage of urban areas, and measures to prevent such disasters will increase.	×	Public hazards due to urban transit are a concern, and measures to prevent such hazards are increasing.	△	Many sections are in close proximity to or parallel to existing 60 kV DL and existing roads, so access roads can be shared and maintenance is easy.	◎
Natural Environmental Aspects*	The construction is expected to have a significant impact on birds because it will avoid the Tundabala area, which is an	×	Passing through a highly developed area south of the Tundavala area, an important habitat for birds, reduces the impact on birds, but	×	Parallel to the existing 60 kV DL will avoid impacts to the Mt. Leba landscape. In addition, it is possible to reduce	○	Similar to Plan C, but rerouting around Humpata and bypassing the dense residential areas of Lubango would reduce the impact as it	◎

	important habitat for birds, but will pass through an area of high natural degree of continuity to the north.		significantly impacts Mount Leyva, which has high natural and cultural landscape value		vegetation cutting for the construction of access roads and material storage areas, division and disappearance of animal habitats, and illegal cutting of trees due to easier access to forests.		would take distance from the Tundabala area.	
Social Environmental Aspects*	Since the line will not pass through dense residential areas such as downtown Lubango, it is expected to have little impact on the resettlement of residents, etc.	◎	As it passes through a dense residential area, it is expected to have a significant impact on resettlement, etc.	×	Resettlement and other impacts are expected in the vicinity of the 150/60 kV Existing Lubango SS.	△	Since the line will not pass through dense residential areas such as urban areas, it is expected to have little impact on the relocation of residents, etc.	◎
Comprehensive evaluation	△		×		△		◎	

* Details of the environmental assessment are described in section 9.4.3.

Source: Prepared by JICA Survey Team

5.3. Topographic and Geological Survey

(1) Topography and ground conditions

The 220 kV TL planned for this project is approximately 196 km from 400/220/60 kV Nombungo substation to 220/60 kV New Namibe SS via 220/60 kV East Lubango SS. The approximately 18 km from Nombungo to East Lubango is a bushland with low trees, and is a wilderness of gently undulating terrain with few villages in the vicinity. However, in an area about 10 km from the 400/220/60 kV Nombungo SS, a swamp spreads out and the surrounding area is farmland. From the standpoint of environmental conservation, a route was selected that avoided the swampy area as much as possible. However, a detailed survey of the topography and geological conditions of the area was necessary to determine the optimal route, tower locations, and appropriate foundation design.

From the 220/60 kV East Lubango SS, the number of villages gradually increases, and after passing through the agricultural lands in the Humpata area, a steep cliff is reached at a point of about 49 km, and about 9 km crosses the rocky Burco area. From there, a flat desert area continues for 120 km to the 220/60 kV New Namibe SS, but near the 220/60 kV New Namibe SS, the transmission line crosses two canyons where water flows only during the rainy season. Because of the steep slope of the long section there, it is necessary to carefully consider the design of the conductor, towers, foundations, etc., and to pay sufficient attention to construction and safety.

The project also included the construction of a new 60 kV DL from the 220/60 kV East Lubango SS to the 60/15 kV Arimba SS, a distance of approximately 10 km. It was investigated and considered to find the route that avoid existing structures and keep required clearances from an existing 150 kV transmission line and a railroad which are passing parallel and adjacent to the distribution line. Based on a comprehensive evaluation of site workability and economic feasibility, the route parallel and adjacent to the existing 150 kV transmission line and the railroad was selected as the first candidate. The topography is flat and the geological conditions are dense and stable.

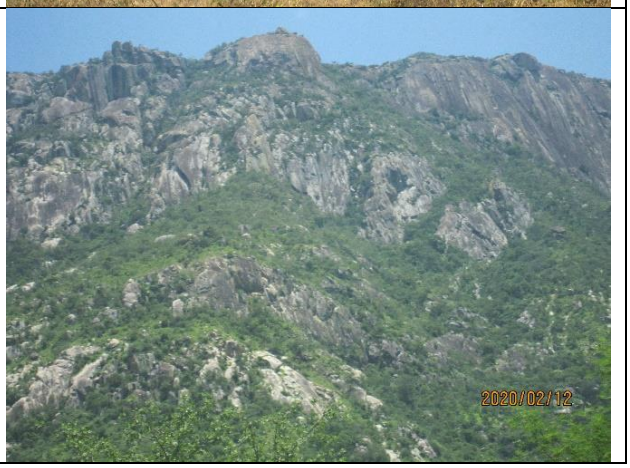
The geology of the Lubango region is formed on stable granitic ground known as Angola Kraton, with dense, hard rocks found in many places. In the Burco area, steep cliffs up to 1,500 m in height have been formed due to ground subsidence, exposing the hard bedrock on the surface.

From the Burco area below the cliff to the 220/60 kV New Namibe SS, there is an area of desert, with scattered exposed sandstone-like bedrock. The area in the valley near the 220/60 kV New Namibe substation is under agricultural cultivation, so it is important to observe changes in the water level.

Before starting construction, a detailed geological survey should be conducted to confirm the strength of the geology, water table, and depth to bedrock in order to better understand the topographical and geological changes and reflect them in the foundation design.

An overview of the investigated area is shown in Table 5.3-1.

Table 5.3-1 Survey Area Overview

Location	General View	Photo
400/220/60 kV Nombungo SS (Expected construction site)	Facing the main road Shrubland wilderness	
Swampy area about 12 km from 400/220/60 kV Nombungo SS.	Agricultural land extends to the south of the swamp	
Approx. 1,500 meters high precipitous cliff	Considering landscape, the transmission line route should be selected away from arterial road with as gentle a slope as possible.	

Namibe region	Sandy soil desert area	
Valley near the 220/60 kV New Namibe SS	Agriculture is to be engaged and water levels during rainy season should be considered for foundation design.	

Source: Photographs of the second and third rounds of the JICA survey mission

(2) Geological survey conducted

In the Lubango region, especially in the Burco area, where bedrock layers are exposed, it is necessary to adopt the special foundations such as anchor foundations that are suitable to bedrock in addition to the inverted T-shaped direct foundations for normal soil conditions, and, because the Namibe region is a desert area, inverse T-shaped direct foundations are to be mainly adopted at a stable depth after carefully checking the strength of the soil. In order to shorten the construction period, it is also recommendable to consider the use of auger foundations, which are easier to construct in compacted sandy soils.

In order to get an overview of how the geologic strata has changed along the entire route, boring with standard penetration tests and soil sampling were conducted at the following 13 locations to investigate the geological composition of the ground.

No.	Facility	District	Boring No.	Coodinate		Place
				Latitude	Longitude	
1	220kV T/L	Lubango	Bor_220-1	14° 52'39"S	13° 39'15"E	Nombungo S/S - East Lubango S/S
2		Unpata	Bor_220-2	14° 59'46"S	13° 31'57"E	East Lubango S/S - Bruco
3		Bruco	Bor_220-3	14° 59'44"S	13° 25'23"E	Near Cliff
4		Bruco	Bor_220-4	15° 5'13"S	13° 18'33"E	Near Cliff
5		Namibe	Bor_220-5	15° 1'45"S	12° 43'57"E	Bruco - Namibe S/S
6		Namibe	Bor_220-6	15° 1'43"S	12° 21'18"E	Top of Valley in Namibe
7		Namibe	Bor_220-7	15° 4'27"S	12° 17'22"E	Top of Valley in Namibe
8		Namibe	Bor_220-8	15° 9'8"S	12° 12'14"E	Near Riverbed of Valley in Namibe
9	Substation	Lubango	Bor_SS-1	14° 47'25"S	13° 42'32"E	Nombungo S/S
10		East Lubango	Bor_SS-2	14° 55'26"S	13° 39'47"E	East Lubango S/S
11		Arimba	Bor_SS-3	14° 57'14"S	13° 34'49"E	Arimba S/S
12		Namibe	Bor_SS-4	15° 10'12"S	12° 12'36"E	Namibe S/S
13	60kV D/L	namibe	Bor_60-1	14° 56'43"S	13° 36'10"E	East Lubango S/S - Arimba S/S

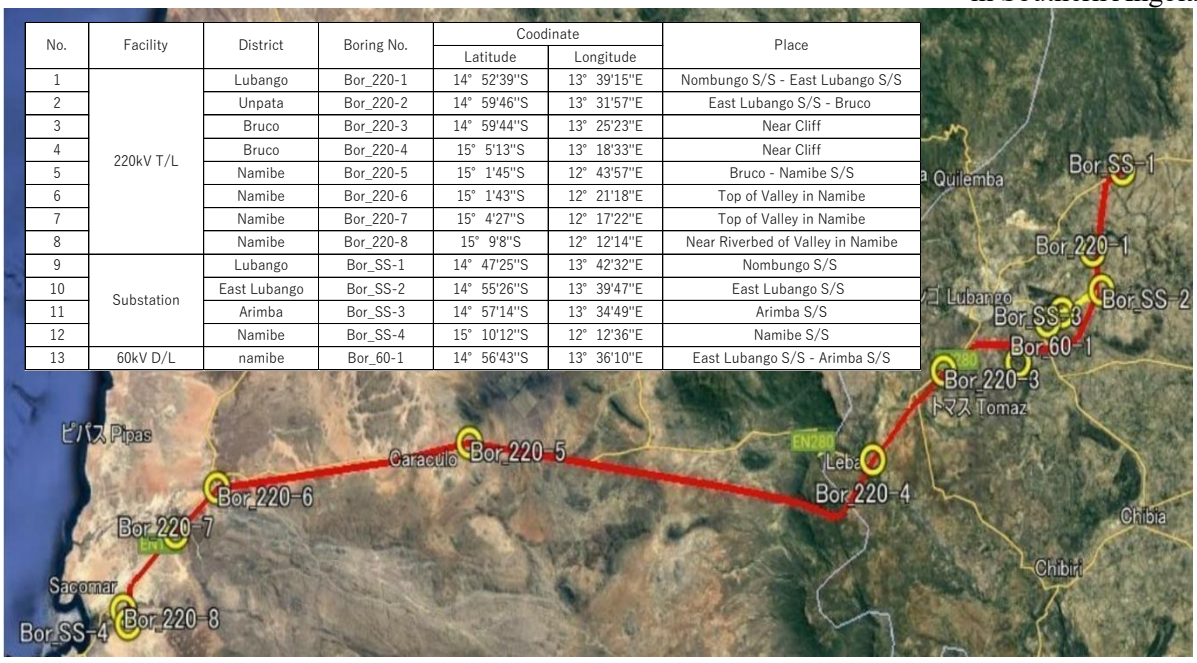


Figure 5.3-1 Geological Survey Boring Locations

Source: JICA Survey Team by Google Earth

220 kV TL

No. 1 Boring No. 220-1 (near swamp)

From the ground surface to about 2.0 m deep, compact sandy silt was found, but a loose layer of density appears beneath it, which increases in density with depth and becomes a compact silty sand layer from about 10.0 m. Bedrock and water level were not detected.

No. 2 Boring No. 220-2 (Humpata area)

From the ground surface to about 8.0 m deep, the soil condition is somewhat soft, with a dense, compacted silt and clay mixed sandy layer below. Bedrock and water level were not detected.

No. 3 Boring No. 220-3 (near cliff area)

Hard, dense sandstone and mudstone, a type of sedimentary rock, are exposed on the ground surface.

No. 4 Boring No. 220-4 (Burco area under the cliff)

About 50 cm of the ground surface is covered by clayey silt, but beneath this is hard sandstone and mudstone.

No. 5 Boring No. 220-5 (Namibe Desert)

A sandy layer with silt and clay is formed from the ground surface. From the ground surface to about 2.0 m is a loose soft layer of sandy soil, but below that to about 12.0 m is a tight layer. Bedrock and water level were not detected.

No. 6 Boring No. 220-6 (north side near the top of the canyon)

A layer of clayey silt covered the area from the ground surface to about 50 cm, below which gravel and crushed limestone of various grain sizes followed. Bedrock and water level were not detected.

No. 7 Boring No. 220-7 (south side near the top of the canyon)

Gravel and limestone crumbles of various sizes followed from the ground surface. Bedrock and water level were not detected.

No. 8 Boring No. 220-8 (near canyon riverbed)

A silty sand layer is formed from the ground surface. Up to about 5.0 m, the layer is soft with loose density, but below that, a well-compacted layer extends to about 15.0 m. The water level was detected at a depth of about 6 m. The annual water level displacement should be observed and reflected in the foundation design.

Substations

No. 9 Boring No. SS-1 (proposed 400/220/60 kV Nombungo SS)

From the ground surface to about 7.5 m, a slightly compacted clay and sand mixed silt layer continues, with a very hard granite formation below. No water level was detected.

No. 10 Boring No. SS-2 (near proposed 220/60 kV East Lubango SS)

A compact sandy silt layer extends from the ground surface to about 2.0 m. Below that is a very dense compact silt and clay-mixed sandy layer continues to about 14.0 m. Bedrock and water level were not detected.

No. 11 Boring No. SS-3 (near proposed 60/15 kV Arimba SS)

A slightly dense loose silty sand layer extends from the ground surface to about 14.0 m, followed by a densely compacted silty sand layer. Bedrock and water level were not detected.

No. 12 Boring No. SS-4 (near proposed 220/60 kV New Namibe SS)

A sandy silt layer is formed from the ground surface. Approximately 3.0 m from the ground surface is a soft layer with loose density, but below that is a tight layer with density down to about 12.0 m. Bedrock and water level were not detected.

60 kV DL

No.13 Boring No. 60-1 (Arimba District)

A loose, soft clayey silt layer of loose density extends from the ground surface to about 8.0 m, below which is a densely compacted silt and clay-mixed sand layer to about 14.0 m. Bedrock and water level were not detected.

6. Selection of Distribution Line Routes

6.1. Distribution Line Route Selection

The basic concept is the same as for 5.1 the selection of transmission line routes.

6.2. Distribution Line Route

A general overview of the survey is shown below. The entire area is flat, with the 220/60 kV East Lubango SS, the starting point, located approximately 15 km east of Lubango City, and the 60/15 kV New Arimba SS, the terminus, and located approximately 8 km east of Lubango City.

In addition, the Arimba2 PS (planned) will be connected to the 60/15 kV Arimba SS by a 60 kV underground distribution line.

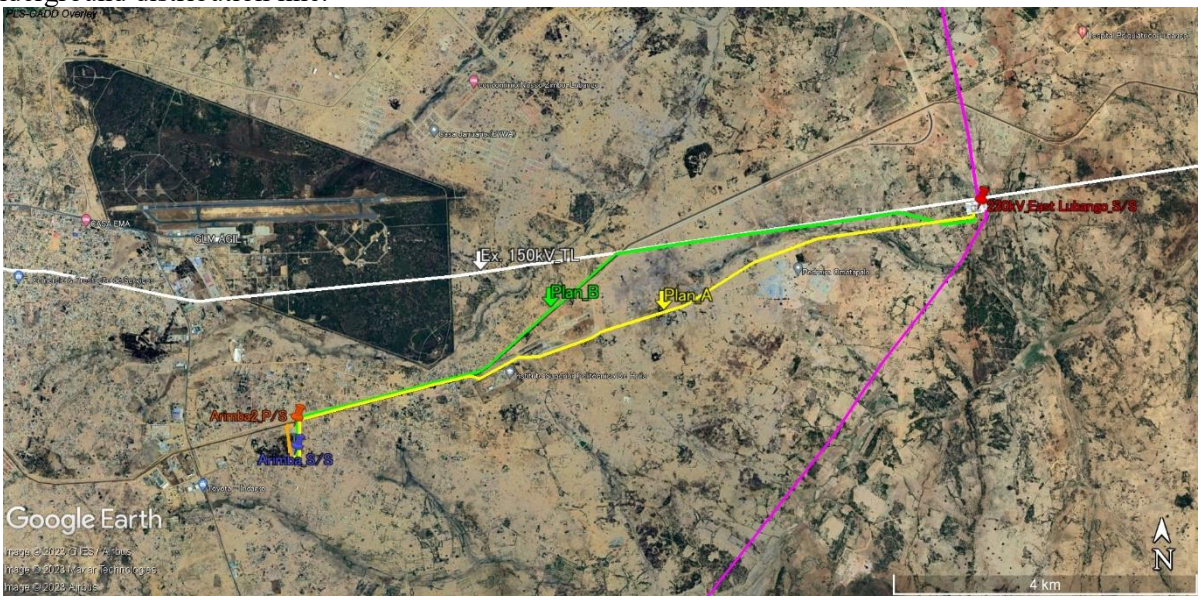


Figure 6.2-1 Overall View of Distribution Line Route

Source: Compiled by JICA Survey Team from Google Earth

The following is for each lines in Figure 6.2-1:

- ✓ Yellow route - Plan A (shortest route avoiding buildings, etc.)
- ✓ Green route - Plan B (route parallel and adjacent to existing 150 kV transmission line and railroad)
- ✓ Orange route - 60 kV underground distribution line route of the project
- ✓ Pink route - 220 kV TL route of the project
- ✓ White route - Existing 150 kV transmission line route

The current conditions of these two routes will be confirmed through on-site inspections, and the optimal distribution line route will be selected. The selection was based on a multifaceted evaluation from the following perspectives

- ➢ Economy: Low project costs
- ➢ Environmental impact: Little impact on the natural environment, little impact on dwellings, etc.
- ➢ Construction and maintainability: Close to roads, easy construction, no major maintenance problems, no relocation in the near future

◆ Plan A (yellow route): East Lubango - New Arimba approx. 10.0 km

The area is basically flat, starting from the 220/60 kV East Lubango SS, and the surrounding area is vegetated with shrubs and bushes. The route passes near the village of the 220/60 kV East Lubango SS and near the quarry plant, then along the road, crossing the railroad and running parallel to it. Near the

Arimba PS, the line crosses the railroad again to reach the 60/15 kV Arimba SS. Although structures, roads and railroads are present, the distribution line can be passed. Access roads are required in some parts, but the ease of construction and maintenance is slightly less than in Plan B, but not to the extent that it is problematic.

◆ Plan B (green route): East Lubango - New Arimba approx. 10.3 km

The transit area is basically flat, starting from the220/60 kV East Lubango SS, and the surrounding area is vegetated with shrubs and bushes. First, immediately after the 220-60 kV East Lubango SS is ran out, the route avoids the village and runs parallel to the existing 150 kV transmission line, and then crosses the railroad and runs parallel to it. It crosses the railroad again near the Arimba PS and continues to the 60/15 kV Arimba SS. Although structures, roads and railroads are present, the distribution line can be passed. The ROW can be shared with the existing 150 kV transmission line, and access from the existing road is good, so both construction and maintenance are better than in Plan A.

After conducting a field survey of the two routes and discussing and comparing the evaluations with ENDE and RNT, it was decided to give first priority to Plan B, which was judged to reduce the impact of clearing of vegetation and fragmentation or loss of animal habitat for construction of access roads and material storage areas, and illegal cutting of trees due to easier access into the forest by paralleling the existing 150 kV transmission line, have less impact on residences, and be superior in terms of construction and maintainability.

Table 6.2-1 Comparative Evaluation of proposed Routes for 60 kV DL

	Plan A	Plan B		
Line length	10.0 km	◎	10.3 km	○
Main Crossing point	Railroad : 2	○	Railroad : 2	○
Construction costs	Slightly higher than Plan B	○	More advantageous than Plan A because it has fewer angle points than Plan A and avoids settlements.	◎
Workability	It is along the existing road except for a portion near the 220/60 kV East Lubango SS. There is no ROW sharing with the existing 150 kV transmission line.	○	Except for the area near the 220/60 kV East Lubango SS, it is along existing roads and railroads, and can also share ROW in close proximity to and parallel with some existing 150 kV transmission lines.	◎
Maintainability	Dust impact is foreseen due to the proximity to the quarry. In addition, the maintenance access road needs to be improved more than Plan B.	○	Many areas parallel to existing 150 kV transmission lines and roads, and access roads, etc. can be shared.	◎
Natural Environmental Aspects*	Due to the high development and low natural level of the area, tree cutting is expected to be limited to the vicinity of the 220/60 kV East Lubango SS.	○	Because the area is highly developed and low natural, tree removal would be limited to the vicinity of the 220/60 kV East Lubango SS. Running parallel to the existing 150 kV transmission line will reduce vegetation cutting for the construction of access roads and material storage areas, fragmentation and loss of animal habitats, and illegal cutting of trees due to easier access to forests.	◎
Social and Environmental Aspects*	The impact is limited because it does not pass through a dense residential area, but it is in close proximity to a settlement in the vicinity of the 220/60 kV East Lubango SS, and there is a crushing plant nearby.	△	The impact is limited because it avoids settlements in the vicinity of the 220/60 kV East Lubango SS and does not pass through densely populated residential areas.	◎
Comprehensive Evaluation	○		◎	

* Details of the environmental aspects of the evaluation are described in 9.4.3.

Source: Prepared by JICA Survey Team

◆ Route of 60 kV underground distribution line (orange route): from the 60/15 kV Arimba SS to the Arimba 2 PS approx. 0.5 km

The passing of the underground distribution line area is basically a flat dirt road, starting from the 60/15 kV Arimba SS, and the surrounding area is an area where residences and electric power facilities exist.

First, immediately after running out from the west side of the 60/15 kV Arimba SS, it passes directly under the unpaved road and reaches the planned new Arimba 2 PS. No obstacles on the ground were found. In addition, as for the underground buried objects, a ground check was carried out at the site, and no large excavation traces could be confirmed (see Figure 6.2-2). Access from the existing road is good, so there are no problems with both workability and maintainability.

Figure 6.2-2 Local Conditions of the 60 kV Underground Distribution Line Route (Orange Line)

Figure 6.2-3 Overall View of 60 kV Underground Distribution Line Route

Source: Compiled by JICA Survey Team from Google Earth

7. Oveall Design of Transmission, Distribution and Substation Facilities

7.1. Power System Diagram

The power system diagram of southern Angola in 2026 is shown in Figure 7.1-1 and Figure 7.1-2.

According to RNT, a new 220 kV TL will be installed parallel to the existing 150 kV transmission line between the 150/60 kV Existing Lubango SS and the Matala SS in 2026, and plans are being made to connect it to the 220/60 kV East Lubango SS too.

The power system diagram with the 220 kV TL completed is shown in Figure 7.1-1. The power system diagram in which the 220 kV TL has not been completed is shoen in Figure 7.1-2.

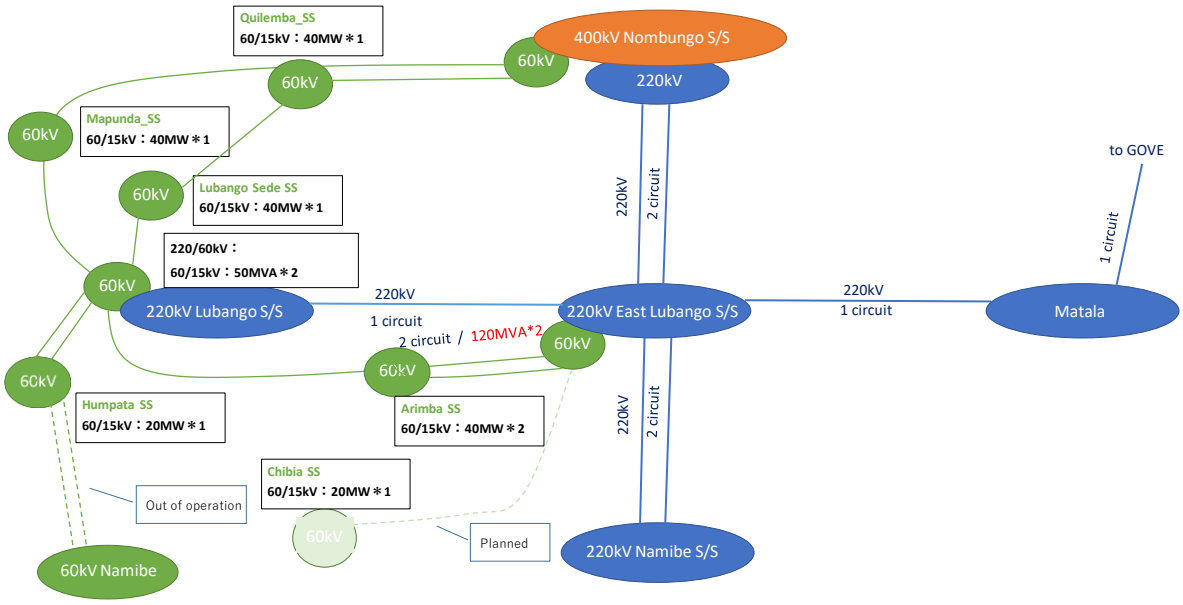


Figure 7.1-1 Southern Angola in 2026 (220 kV Lubango - East Lubango - Matala transmission line)

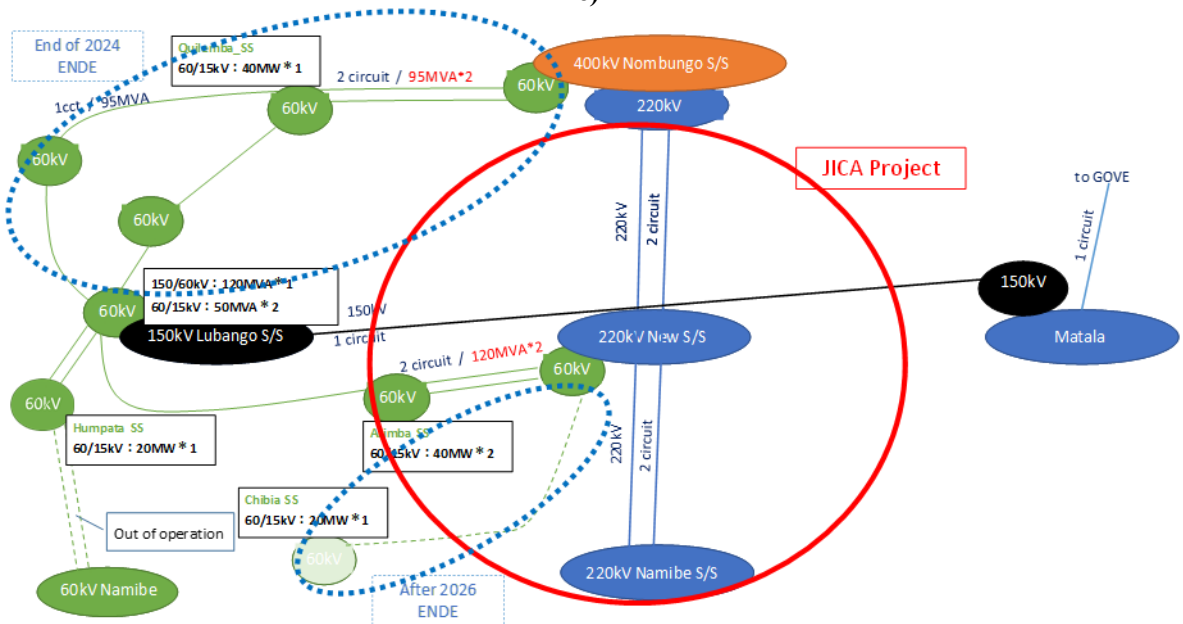


Figure 7.1-2 Southern Angola in 2026 (150 kV Lubango - Matala TL)

The project targets the area in the red circle in Figure 7.1-2 is as follows.

- New 220 kV TL (196 km between 400/220/60 kV Nombungo SS and 220/60 kV New Namibe SS)

- Two new substations (220/60 kV New Namibe SS and 220/60 kV East Lubango SS)
- New 60 kV DL (10 km between 220/60 kV East Lubango SS and 60/15 kV Arimba SS)
- Construction of one new substation for power distribution (60/15 kV Arimba SS)

The blue dashed oval in Figure 7.1-2 is the future plan by ENDE.

This project will establish a new 220 kV TL connecting the 400/220/60 kV Nombungo SS, the 220/60 kV East Lubango SS and the 220/60 kV New Namibe SS, thereby securing a power supply source for the Lubango area and the Namibe area.

In addition, the existing two 60 kV DL that connect the 150/60 kV Existing Lubango SS, the Humpata SS, and the 60/15 kV Existing ENDE Namibe SS are long-distance and aging facilities. Therefore in the discussion of WS, on the condition that the 2 lines are pulled in the Humpata SS, we are proposing to stop the operation of the existing 60 kV DL between the Humpata SS and the 60/15 kV Existing ENDE Namibe SS, which is indicated by the dashed line.

7.2. 220 kV Transmission Line

7.2.1. Overview of 220 kV Transmission Line Route

The new 220 kV TL route is shown in Figure 7.2-1. The route is shown as a pink-colored line.

The route between the 400/220/60 kV Nombungo SS and the 200/60 kV New Namibe SS is a two-circuit overhead transmission line with a total length of 196 km via the 220/60 kV East Lubango SS.

The Lubango area, the starting point of the project, is located at an elevation of 1,500 m or higher and is relatively flat with a distribution of shrubs. The Humpata area is a cultivated area with scattered dwellings at an elevation of 2,000 m. Then, it passes parallel to the existing 60 kV DL through the steep cliffs and valleys of the Burco area. Thereafter, the route follows the desert area parallel to the existing 60 kV line or the main road and ends at the 220/60 kV New Namibe SS.

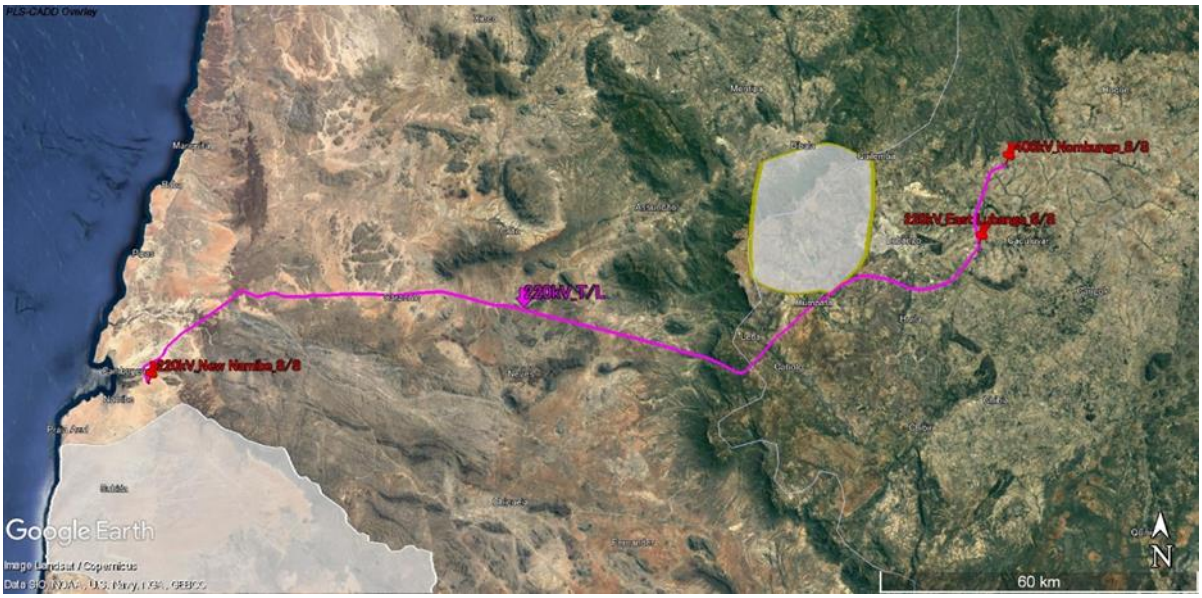


Figure 7.2-1 Overall View of 220 kV TL Route

Source: Compiled by JICA Survey Team from Google Earth

7.2.2. Design Condition

The outline design conditions are as follows. The various conditions have been established from European standards (EN50341-1 2012), IEC standards, etc., although priority was given to the MINEA design specifications.

(1) Atmospheric temperature

Maximum air temperature	40 ºC
Minimum air temperature	0 ºC
Maximum wind speed temperature	20 ºC
EDS (Every Day Stress) air temperature	25 ºC

(2) Conductor temperature

Maximum conductor temperature 85 ºC
Minimum conductor temperature 0 ºC

(3) Design wind speed

The design wind speeds are divided into two zones, Zone A and Zone B, which are 30 m/s and 33 m/s, respectively. Since the transmission line of this project is positioned as an important power supply line, the following value for Zone B is adopted after discussing it with RNT.

Maximum 10-minute average wind speed 33 m/s

(4) Standard wind pressure

The above wind speed is the wind speed at a height of 10 m above the ground and is multiplied by the following equation to calculate the reference wind pressure depending on the height of the transmission line.

$$q_h = 0.5 \times \rho \times 33^2 \times \left(\frac{h}{10}\right)^{0.4} N/m^2$$

Table 7.2-1 Standard Wind Pressure

ρ is the air density at an air temperature of 20°C and an air pressure of 1,013 hPa,

h[m].	0	10	20	25	30	35	40	45	50	55
q_h[Pa]	870	870	870	946	1,017	1,082	1,142	1,197	1,248	1,297

which is 1.205 kg/m^3

(5) Design wind pressure

Tower 2,660 Pa (H=50 m A+0.0 type steel tower height)
Conductor 910 Pa (H=35 m A+0.0 type medium phase position)
Ground wire 1,090 Pa (H=55 m A+0.0 type ground line position)
Insulator 2,020 Pa (H=40 m A+0.0 type mid-phase position)

(6) Worst-case conditions and EDS conditions

Table 7.2-2 Conductor

Condition	Temperature	Wind pressure	Tension
The worst	20 ºC	910 Pa	40.0% UTS
Normal	25 ºC	windless	22.0% UTS

Table 7.2-3 Ground Wire

Condition	Temperature	Wind pressure	Tension
The worst	20 ºC	1,090 Pa	40.0% UTS
Normal	25 ºC	windless	22.0% UTS

*UTS: Ultimate Tensile Strength

(7) Pollution level (according to IEC standard)

Reflecting the information from RNT that there is actual damage to facilities caused by sea salt and sand dust, and the request to set up a pollution classification, the following classification is shown below.

The area from the 400/220/60 kV Nombungo SS to the front of the steep area in the Buruco district is designated as Medium (green line) because it is not affected much by sea salt and dust, the area from the Buruco district to the 220/60 kV New Namibe SS is designated as Very Heavy (red line) because of the effects of sea salt and dust, and the area between the above two districts is designated as Heavy (orange line).

400/220/60 kV Nombungo SS - Steep area in Burco dist. (apx. 67 km)	Medium (20 mm/kV)
Valleys and cliffs of steep land in the Burco area (about 9 km)	Heavy (25 mm/kV)
Burco District Steep to 220/60 kV New Namibe SS (apx. 120 km)	Very Heavy (31 mm/kV)

Figure 7.2-2 Pollution Level Diagram

Source: Compiled by JICA Survey Team from Google Earth

(8) Elevation of elapsed place

The site has passed between 20 m and 2,000 m above sea level.

(9) Insulation design voltage

Maximum operating voltage (Us)	245 kV
Lightning impulse withstand voltage (LIWV)	950 kV
Switching impulse withstand voltage (SIWV)	Not considered (because the maximum voltage is less than 245 kV)

(10) Insulation distance

Although the MINEA specifications list the insulation distance at an elevation of 1,500 m, the elevation correction will be implemented for this project, since the project will pass through an elevation of about 2,000 m.

Table 7.2-4 Insulation Distance

Voltage Type	Elevation				Remarks
	1,500 m		2,000 m		
	Earth	Phase	Earth	Phase	
Lightning impulse	1.76 m	2.02 m	1.81 m	2.06 m	
Switching Impulse	not take into account		Same as on the left.		Maximum voltage is less than 245 kV.
Power frequency	0.44 m	0.71 m	0.46 m	0.74 m	

(11) Safety factor

The various minimum safety ratios applicable to transmission facilities are as follows

(a) Tower
- Worst-case condition: 2.0 % of member yield strength
- In the event of wire breakage: 1.5 relative to the yield strength of the member (worst-case condition + 1 ground wire or 1 phase breakage)

(b) Conductors / Ground wires
- Worst-case conditions: 2.5 (40% UTS) relative to UTS (Ultimate Tensile Strength)
- EDS condition: 4.5 (22%UTS) relative to UTS at the support point

(c) Insulators
- 2.5 to RUS (Rated Ultimate Strength) at the maximum working tension at the support point

(d) Tower foundation
- 2.0 for worst-case conditions
- 1.5 for disconnection conditions

(12) Transposition

When the line length of the transmission line is generally 100 km or longer, the reactance and capacitance of the three phases of the transmission line become unbalanced, affecting the operation of the protective relays. In order to maintain this balance, it is necessary to place two transposition towers (devices) between the 220/60 kV East Lubango SS and the 220/60 kV New Namibe SS.

The line length of the project is approximately 196 km, but because the line passes through the 220/60 kV East Lubango SS, it is necessary to apply this transposition system to the approximately 176 km section between the East Lubango and New Namibe substations. The transposition towers are to be located where the transmission line is divided into three sections of approximately the same length, as shown in Figure 7.2-3.

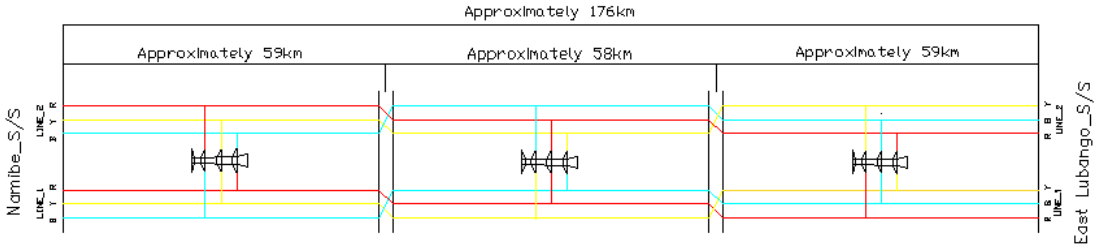


Figure 7.2-3 Schematic Diagram of Transpositions

7.2.3. Conductor and Ground Wire Design

(1) Conductor and ground wire types

Figure 7.2-4 shows the assumed power flow assumed by the 2018 MP. On this basis, Figure 7.2-5 shows the generation capacity of the Namibe-Tombwa wind power project as confirmed by the WS and field consultations, as well as the assumed tidal currents for the Namibe district during low demand. The demand assumption for the Namibe area is based on the maximum case of thermal and wind power generation at N-1 of the transmission line, without considering any curtailment. On the other hand, since the assumed demand in the Namibe area fluctuates during the year and on a daily basis, the low demand in the Namibe area was considered in the selection of the transmission line so that the power flow of the transmission line would be the maximum, as shown below.

Based on information from the 2018 Master Plan, the minimum monthly maximum power in the southern region is 91% of the maximum and the minimum daily load variation is about 50% of the maximum. Therefore, these coefficients are taken into account in the assumed demand for the Namibe area as follows.

260 MW x 0.91 x 0.5 = 118 MW ≈ 100 MW (rounded down to be on the safe side)

The selection of the conductor size shall be determined by the power flow of 720 MW.

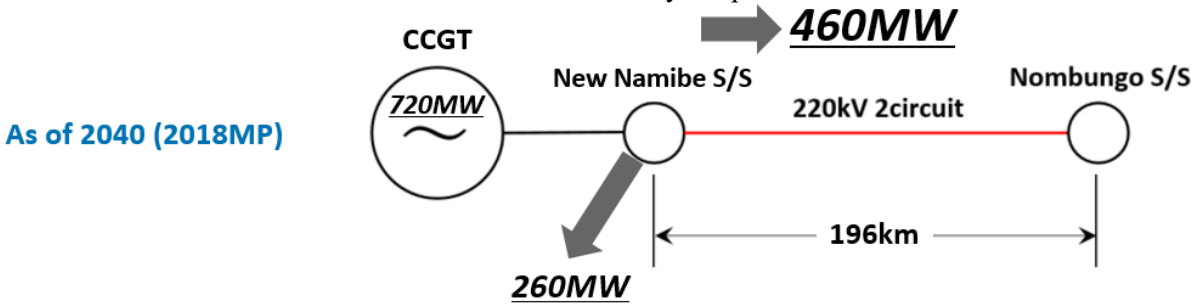


Figure 7.2-4 2040 Assumed Load Flow by 2018 MP

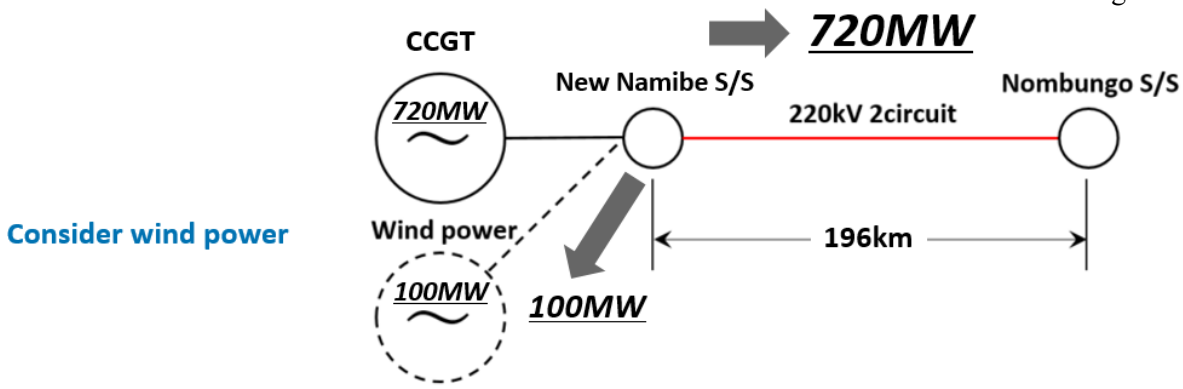


Figure 7.2-5 Assumed Power Flow in 2040 Considering Wind Power and Low Demand in the Namibe Area

The phase current I at a single circuit accident is calculated by the above assumed power flow as follows.

$$720MW \leq \sqrt{3} \times 220kV \times I \times 0.85$$
$$I \geq 2{,}223 \ \ A/phase$$

Here, 0.85 is the power factor, which was determined in consultation with Angola.

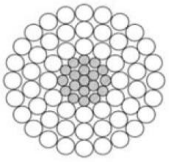
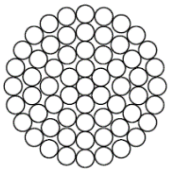
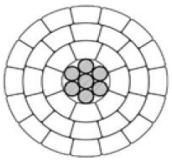
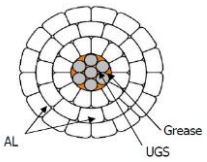
The allowable current capacity of the selected conductor was then calculated based on the following conditions of the MINEA specification.

- Ambient air temperature 40 °C
- Maximum conductor temperature 85 °C
- Wind speed 0.6 m/s
- Solar radiation 0.1 W/cm^2
- Absorption coefficient on conductor surface 0.5
- Conductor surface emissivity 0.6

The calculation results show that the required current capacity is 2,223 A/phase. Therefore, when selecting a conductor with a current capacity of 1,112 A or more in a single conductor, the allowable current of steel-core aluminum stranded conductor (ACSR) 1272MCM (Pheasant) is about 1,140 A so the two-bundle system of this wire was used as the selection standard. In Angola, an all-aluminum conductor (AAAC) is used as a standard wire, so the size of 732 mm2, which is equivalent to this current capacity, is used as a comparison target.

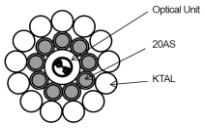
However, since the 220 kV TL under consideration is for transmitting electric power from the power station and large power generation will always flow in the future, we recommend the application of low-loss conductor LL-ACSR/SA 728 mm^2 or LL-ACSR/UGS 724 mm^2, which have equivalent allowable current and weight (ACSR only) and about 13%-15% lower DC resistance compared to ACSR Pheasant and AAAC 732 mm^2, thereby significantly reducing transmission losses. The ground wire shall be two strips, one OPGW 159 mm^2 and one 20SA 19/2.906 (equivalent to 19 No 9 AWG in Angolan standard). Technical specifications for wire and ground wire are as follows

Table 7.2-5 Technical Specifications of Conductors

Conductor type	ACSR 1272 MCM (Pheasant)	AAAC 732 mm²	LL-ACSR/SA 728 mm²	LL-ACSR/UGS 724mm²
Conductor composition (Number/diameter)	Al: 54/3.899 mm St: 19/2.339 mm	61/3.91-AAL	16/TW*1 - AL 12/TW - AL 8/TW - AL 7/3.25 - 14EAS*2	16/TW-AL 12/TW-AL 12/TW-AL 7/3.01(UGS)
Outer diameter	35.09 mm	35.2 mm	33.05 mm	33.0 mm
Aluminum sectional area	644.5 mm²	732.6 mm²	727.5 mm²	723.7 mm²
Total cross-sectional area	726.4 mm²	732.6 mm²	785.6 mm	776.5 mm²
Unit mass	2,434 kg/km	2,020 kg/km	2,434 kg/km	2,429 kg/km
Minimum Tensile Strength	194.1 kN	230.6 kN	194.1 kN	195.0 kN
Modulus of elasticity	77.9 GPa	54.0 GPa	69.8 GPa	71.6 GPa
Coefficient of linear expansion	19.6 x 10^{-6} /°C	23.0 x 10^{-6} /°C	21.0 x 10^{-6} /°C	20.7 x 10^{-6} /°C
DC Resistance at 20°C	0.04501 Ω/km	0.0458 Ω/km	0.0392 ohm/km	0.0400Ω/km
Cross-sectional view				

*1 TW: Trapezoid shaped wire
*2 14EAS: Extra high strength aluminum clad steel with 14%IACS conductivity

Table 7.2-6 Technical Specifications of Ground Wires

Type	OPGW159 mm²	20SA 19/2.906	19 No 9 AWG
Wire composition (Number of strands / Diameter)	AA: 13/3.95mm SA: 9/3.3 mm SUS: 1/6.50 mm	20SA: 19/2.906 mm	AW 19/2.91 mm
Outer diameter	21.0 mm	14.53 mm	14.5 mm
Total cross-sectional area	231.42 mm²	126.1 mm²	126.1 mm²
Unit mass	1,028 kg/km	842.0 kg/km	841.3 kg/km
Minimum Tensile Strength	130.3 kN	152.5 kN	152.4 kN
Modulus of elasticity	93.6 GPa	158.9 GPa	160.0 GPa
Coefficient of linear expansion	17.6 x 10^{-6} /°C	13.0 x 10^{-6} /°C	12.6 x 10^{-6} /°C
DC Resistance at 20°C	0.147 Ω/km (including OP unit)	0.6821 ohm/km	0.6821 ohm/km
Number of optical fibers	24	-	-
Cross-sectional view			

(2) Standard Span Length

The standard span length shall be 400 m.

(3) Maximum Working Tension and EDS Tension

The safety factor is met under the maximum working tension and EDS conditions for both wire and ground wire as shown below.

The tension of the ground wire should be set so that the ground wire slack is less than 85% of the conductor slack at standard span lengths under EDS conditions. This is to avoid reverse sparking from the ground wire to the wire in the event of a lightning strike to the ground wire.

The tension of the ground wire varies depending on the type of wire, so the value has a wide range, but there is no problem with the safety factor.

Table 7.2-7 Maximum Working Tension and EDS Tension of Conductors and Ground Wires

Conductor and ground wire type	Minimum Tensile Strength	Tension		Safety factor
AAAC 732 mm²	230.6 kN	Max. working tension	78.0 kN	2.95 > 2.5
		EDS tension	48.6 kN	4.74 > 4.5
LL-ACSR/SA 728 mm²	194.1 kN	Max. working tension	65.0 kN	2.98 > 2.5
		EDS tension	41.3 kN	4.69 > 4.5
LL-ACSR/USG 724mm²	195.0 kN	Max. working tension	65.0 kN	3.00 > 2.5
		EDS tension	41.2 kN	4.70 > 4.5
OPGW159 mm²	130.3 kN	Max. working tension	47.0 - 42.0 kN	2.77 - 3.10 > 2.5
		EDS tension	28.6 - 21.3 kN	4.55 - 6.11 > 4.5
20SA 19/2.906	152.5 kN	Max. working tension	37.0 - 32.0 kN	4.12 - 4.77 > 2.5
		EDS tension	24.5 - 17.1 kN	6.22 - 8.91 > 4.5
19 No 9 AWG	152.4 kN	Max. working tension	37.0 - 32.0 kN	4.11 - 4.76 > 2.5
		EDS tension	24.5 - 17.1 kN	6.22 - 8.91 > 4.5

LL-ACSR/SA 728mm^2 and LL-ACSR/UGS 724mm^2 are judged to have equivalent specifications, and LL-ACSR/SA 728mm^2 is used in the following study.

(4) Right of Way (ROW)

The ROW of the 220 kV TL shall be 22.5 m from the center to both sides (total 22.5 m x 2 = 45.0 m).

7.2.4. Insulation Design

The elevations of the project range from 20 m to 2,000 m, and the insulation distances for each elevation are shown below. Since the difference in insulation distances for each elevation is slight, the value for the elevation of 2,000 m is adopted and used for the insulator design and tower clearance design.

Table 7.2-8 Insulation Distance

Voltage Type	Elevation					
	1,000 m		1,500 m		2,000 m	
	Earth	Phase	Earth	Phase	Earth	Phase
Lightning impulse	1.72 m	1.98 m	1.76 m	2.02 m	1.81 m	2.06 m
Switching Impulse	not take into account		not take into account		not take into account	
Power frequency	0.43 m	0.69 m	0.44 m	0.71 m	0.46 m	0.74 m

7.2.5. Insulator Design

(1) Mechanical Strength of Insulator set and Insulator

For the insulators to be used in Angola, the MINEA specifications state that insulators and insulator sets with a strong series of 160kN should be used, and it should be confirmed that the prescribed safety factor (2.5) is satisfied with the RUS at the maximum working tension in a standard 400m span.

Although the maximum working tension varies depending on the conductor applied, strength studies for AAAC732mm^2 and LL-ACSR/SA728mm^2 are in Table 7.2-9 and Table 7.2-10.

Table 7.2-9 Strength Study of Insulator Set and Insulator

Device type		Device tension	Mechanical strength of a device	Safety factor	Judgment
AAAC 732 mm² 2 bundles Conductor	Tension	156 kN (78 kN x 2)	320 kN (160 kN x 2 series)	2.05 < 2.5	NG
			420 kN	2.69 > 2.5	OK

			(210 kN x 2 series)		
	Suspension	93.6 kN (78 kN x 2 x 0.6)	160 kN (160 kN x 1 series)	1.70 < 2.5	NG
			210 kN (210 kN x 1 series)	2.20 < 2.5	NG
			320 kN (160 kN x 2 series)	3.41 > 2.5	OK

In the case of AAAC732mm^2, 210kN series double insulator sets and insulators shall be adopted for the tension-type equipment, and 160kN series double insulator sets and insulators shall be adopted for the suspension-type equipment.

Table 7.2-10 Strength Study of Insulator Set and Insulator

Device type		Device tension	Mechanical strength of a device	Safety factor	Judgment
LL-ACSR/SA 728mm^2 2 bundles Conductor	Tension	130 kN (65 kN x 2)	160 kN (160 kN x 1 series)	1.23 < 2.5	NG
			210 kN (210 kN x 1 series)	1.61 < 2.5	NG
			320 kN (160 kN x 2 series)	2.46 < 2.5	NG
			420 kN (210 kN x 2 series)	3.23 > 2.5	OK
	Suspension	78.0 kN (65 kN x 2 x 0.6)	160 kN (160 kN x 1 series)	2.05 < 2.5	NG
			210 kN (210 kN x 1 series)	2.69 > 2.5	OK

In the case of LL-ACSR/SA728mm^2, 210kN series double insulator sets and insulators shall be shall for the tension-type equipment, and 210kN series single insulator sets and insulators shall be adopted for the suspension-type equipment.

As a result of the above strength study, in the case of the LL-ACSR/SA728mm^2 conductor to be used this time, the 160kN strength series insulators and insulator sets do not satisfy the required strength, so 210kN strength series insulator sets and insulators are required.

(2) Insulator Type and Size

The Angolan side has confirmed its intention to use polymer insulators for the entire 220 kV TL of the project in order to unify the specifications since polymer insulator is used for the existing 220 kV TL near the coast in the Luanda area. The polymer insulators will be adopted for the 220 kV TL of this project.

The reason for the unification of the specifications of “Very Heavy” is the possibility of expanding the heavy pollution category in the future and the unification of specifications for the same lines.

As for the replacement cycle of polymer insulators, Angola adopted it for the first time in 2009, and up to now, there has been no problem and no trouble has been confirmed. Therefore, the Angola side

considers that the replacement of polymer insulators will require further observation, and the Angola side intends to adopt polymer insulators in this project as well.

As a result of the strength study in the previous section, it is judged appropriate to adopt an imposed breakdown load of 210kN per series. The creepage distance is shown below, assuming that the pollution classification is Very Heavy (31 mm/kV) in the IEC standard.

$$Creepage\ \ distance：31mm/kV \times 245kV = 7{,}595mm\ \ or\ \ more$$

Table 7.2-11 Applicable Insulators by Pollution Level

Pollution Level	Creepage distance	Electromechanical Failing Load	Applicable section
Very Heavy	7,595 mm or more	210 kN / series*1	Nombungo Substation - New Namibe Substation

*1 Based on the results of the study in the previous section

Figure 7.2-6 shows an example of a “Very Heavy” with an Electromechanical failing load of 210 kN.

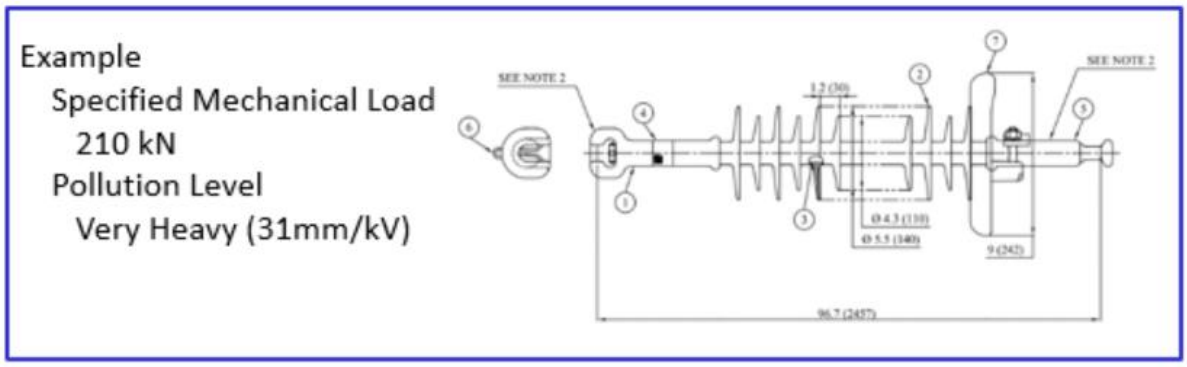


Figure 7.2-6 Example of an Polymer Insulator

Source: NGK

Manufacturers of polymer insulators to be supplied for this project shall comply with the following standards as minimum requirements

- The manufacturer’s molding method shall be the one piece molding without any rubber-to-rubber joint in any parts of rubber housing. In case of other molding methods such as sheath and shed or injection molding, the manufacturer shall prove that their molding method will not cause deterioration triggered at joint (s) of polymer housing.
- The manufacturer shall submit design test report which proves their silicone rubber is resistive to deteriorations caused by nitric acid.

7.2.6. Separation of Electric Conductors from Other works

The most severe conditions for ground clearance of conductors and separation from structures of conductors, etc., are when the conductor temperature reaches 85°C with no wind. 220 kV TL are required the following minimum ground clearance and distance from obstructions.

Table 7.2-12 Separation Distances from Ground and Obstacles

Object	Separation distance
Earth	12.0 m
Trees	5.0 m
Structure	6.0 m
Road	12.0 m
Electric railroad	15.0 m
Non-electrified railroad	12.0 m
Other overhead lines	5.0 m
Other obstacles	5.0 m

7.2.7. Tower Shape

(1) Electrical Clearance

Table 7.2-13 Conductor Runout Angle and Insulation Clearance

		Normal condition	Abnormal condition	Worst condition
Wind speed		0 to 10 m/s	10 to 20 m/s	20 to 33 m/s
Lateral swing angle of suspension (A)		0 to 10 degree	10 to 30 degree	30 to 60 degree
Lateral vibration angle of tensile strength device (without support) (B)		0 to 5 degree	5 to 15 degree	15 to 40 degree
Lateral vibration angle of tensile strength device (with support) (C, D, E, T)		0 to 15 degree	N/A	N/A
Minimum Clearance	**Suspension**	2,250 mm	1,510 mm	460 mm
	Tension device	2,050 mm	1,510 mm	460 mm

(2) Length of suspension device and jumper depth of tension and support device system

The lengths of the suspension system and the jumper depths of the tension-type device and the support-type device are as follows

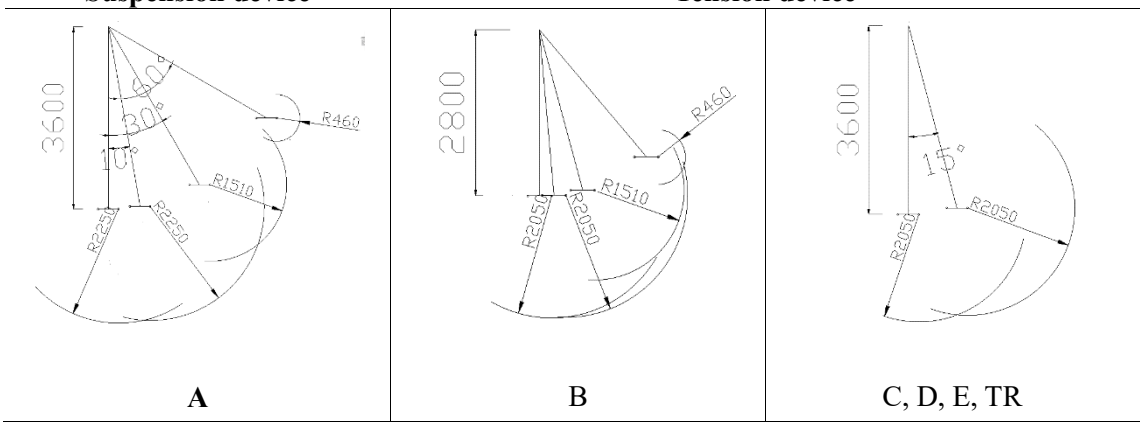
Table 7.2-14 Length of Suspension Device and Jumper Depth of Tension and Support Device

External device type	Breakdown	Device length
Suspension-type device length	2600mm x 1 piece + 990mm (fitting length) + 10mm (margin)	3,600mm
Tension-type device length	2,600mm x 1 piece + 1,315mm (fitting length) + 35mm (margin)	3,950mm
Depth of jumper device (Type B)	2600mm (size of jumper) + 100mm (influence of suspended material) + 100mm (margin)	2,800mm
Support-type device length (C, D, E, TR type)	2600mm x 1 piece + 990mm (fitting length) + 10mm (margin)	3,600mm

(3) Electrical clearance diagram

The electrical clearance diagram for the suspension-type, the tension-type and jumper device is shown below.

Suspension device **Tension device**



A B C, D, E, TR

Figure 7.2-7 Clearance Diagram

(4) Type of towers

(a) Type A

Applicable to suspension towers with straight sections and suspension-type device with horizontal angles up to 3 degrees.

(b) Type B

Applicable to tension towers with a tension-type device up to a horizontal angle of 20 degrees.

(c) Type C

Applicable to tension towers with a tension-type device and jumper support device with horizontal angles from 21 to 40 degrees.

(d) Type D

Applicable to tension towers with a tension-type device and jumper support device with horizontal angles from 41 to 60 degrees.

(e) Type E

It is applied to tension strain device towers with a tension-type device and jumper support device for pulling down conductors with horizontal angles of up to 40 degrees.

(f) Type TR

Applicable for tension-type towers with a tension-type device and jumper support device with a horizontal angle of up to 20 degrees.

Table 7.2-15 Tower Type and Application Conditions

Type	Location of use	Angle range [degrees]	Device type
A	straight line	0 - 3	suspension
B	angle	0 - 20	tension
C	angle	21 - 40	tension
D	angle	41 - 60	tension
E	detention	0 - 40	tension
TR	transposition	0 - 20	tension

(5) Design span length

The following wind span and weight span shall apply

Table 7.2-16 Design Span Length

Tower type	Wind Span [m].	Weight Span [m].
A	500	600
B	500	600
C	500	600
D	500	600
E	250	300
TR	500	600

(6) Maximum sag and standard height from ground to lowest arm

Conductor temperature: 85 °C
Wind speed: no wind
Standard Span length: 400 m
Maximum working tension: 63,000 N

Table 7.2-17 Maximum Sag and Typical Tower Height

	Suspension type	Tension type
Maximum sag	14.2 m	14.2 m
Length of insulators	3.6 m	- m
Ground clearance	12.0 m	12.0 m
Height from ground to lowest arm	> 29.8 m	>26.2 m

(7) Tower Shape

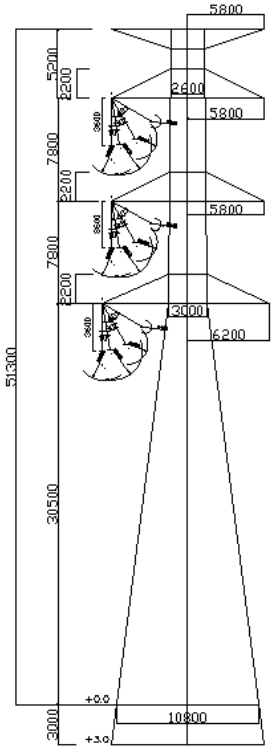


Figure 7.2-8 Type A Tower

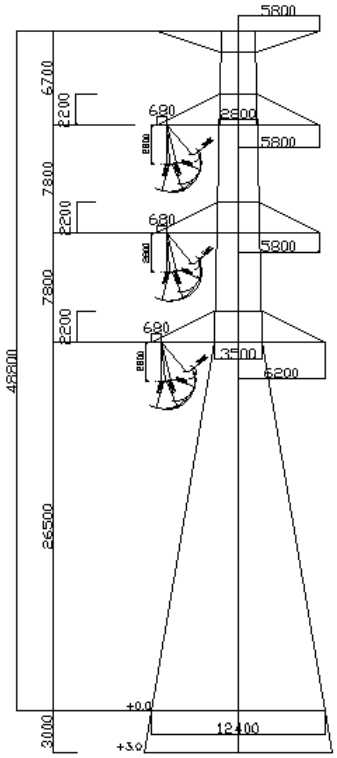


Figure 7.2-9 Type B, C and D

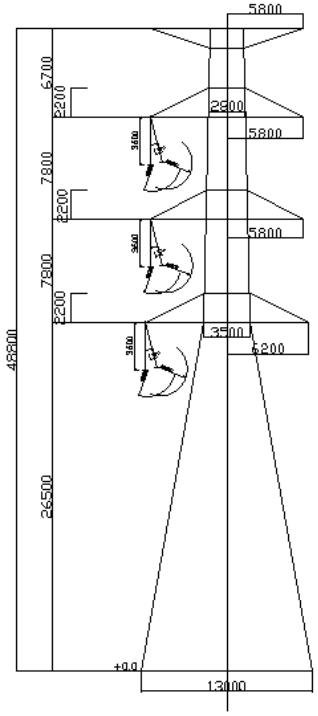


Figure 7.2-10 Type E Tower

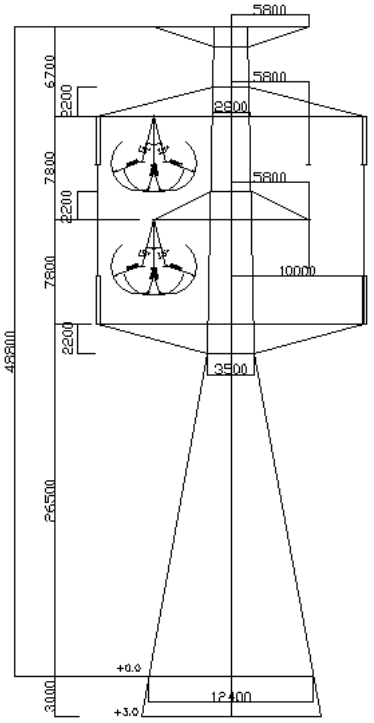


Figure 7.2-11 Type TR Tower

(8) Approximate tower weights for each tower type

Approximate tower weights for each tower type are as follows

Table 7.2-18 Estimated Tower Weight

Leg Joint [m].	Weight of tower per unit [ton]					
	A	**B**	**C**	**D**	**E**	**TR**
+0.0	27	35	41	47	50	35
+3.0	30	37	45	50	-	37

7.2.8. Foundation Shape

(1) Approximate tower foundation loads

The approximate foundation loads of normal condition for each tower type with a tower joint length of +0.0 m are as follows

Table 7.2-19 Tower Foundation Load

Tower Type	Compressive force [kN]	Pulling force [kN]
A	753	524
B	1,025	737
C	1,451	1,133
D	1,851	1,506
E	2,205	1,829
TR	1,025	737

(2) Assumed foundation and approximate dimensions

The following inverted-T, auger, or rock anchor type foundations are assumed.

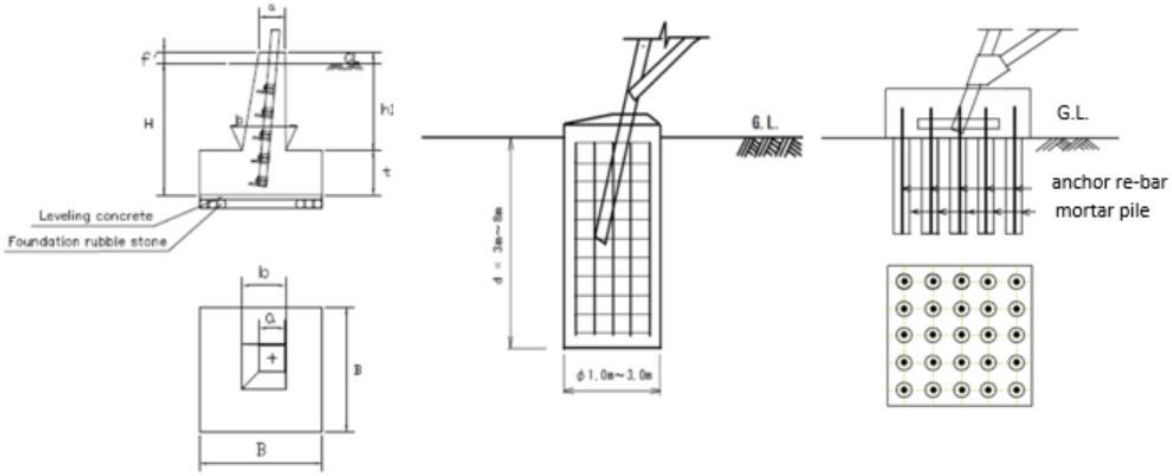


Figure 7.2-12 Assumed Foundation Diagram

7.2.9. Quantity of Transmission Line Equipment Materials

(1) Number of towers and total tower weight

The expected number of towers and total tower weight for the 220 kV TL facility are as follows

Table 7.2-20 Number of Towers and Total Tower Weight

Tower Type	Leg joint [m]	Weight [ton]	Number of towers [unit]	Gross weight [ton]
A: Suspension	0.0	27	359	9,693
(Horizontal angle: 0 - 3 degrees)	+3.0	30	40	1,200
subtotal			**399**	**10,893**
B: Tension	0.0	35	27	945
(Horizontal angle: 3 - 20 degree)	+3.0	37	3	111
subtotal			**30**	**1,056**
C: Tension	0.0	41	27	1,107
(Horizontal angle: 20 - 40 degree)	+3.0	45	3	135
subtotal			**30**	**1,242**
D: Tension	0.0	47	27	1,269
(Horizontal angle: 40 - 60 degrees)	+3.0	50	3	150
subtotal			**30**	**1,419**
E: Retention	0.0	50	4	200
(Horizontal angle: 0 - 40 deg.)				
subtotal			**4**	**200**
TR: Transposition	0.0	35	2	70
(Horizontal angle: 0 - 20 degree)				
subtotal			**2**	**70**
Total amount			**495**	**14,880**

(2) Total length of conductors and ground wires

For the overall conductor and overhead ground wire length, the number of conductors in the conductor and the ground wire is multiplied by the number of circuits and the total route length, and a margin of 1.05 is considered for slack and overhead wire work. For OPGW, the margin for pulling down the line is also estimated.

Table 7.2-21 Lengths of Conductors and Ground Wires

Conductor / Ground Wire Type	Number of conductors	Number of phases	Number of circuit	Line length [km]	Total length [km]
LL-ACSR/SA 728 or LL-ACSR/UGS 724	2	3	2	196.0	2,470
OPGW159 mm²	1	-	1	196.0	211
20SA 9/2.906	1	-	1	196.0	206

(3) Number of insulator sets and insulators

The number of polymer insulators and the number of insulator sets are as follows

Table 7.2-22 Number of Insulator Sets and Insulators

Insulator type	Applicable area	Tower Type	Number of series of 1-phase [Pcs]	1 series of quantity [Pcs]	Number of Pcs per Tower [Pcs]	Number of towers [units]	Subtotal of serial numbers [Pcs].	Subtotal of the number of insulators [Pcs].
Polymer insulator	Suspension	A	1	1	6	399	2,394	2,394
	Supporting	C,D	1	1	3	63	189	189
		E	1	2	3	4	12	24
		TR	1	2	6	2	12	24
	Tension	B,C,D,TR	2	1	12	92	1,104	2,208
		E (Substation side)	1	1	6	4	24	24
		E (Line side)	2	1	6	4	24	48
					Total amount		**3,759**	**4,911**

(4) Spare parts

Spare parts will need to be provided for the maintenance of the transmission line after the completion of the project. The individual items and quantities will be determined during the detailed design phase of the project, but the major items envisaged are standard steel towers, conductors, ground wires, overhead line fittings, insulators and insulator coupling fittings, etc.

Based on the results of other projects, the JICA survey team estimated that the spare parts for this project would be approximately 5% of the total material cost of the transmission facilities.

7.3. 60kV Distribution Line

7.3.1. Overview of 60kV Distribution Line Route

The area is basically flat, and the area around the 220/60 kV East Lubango SS is vegetated with shrubs and trees. First, the route avoids the settlement near the 220/60 kV East Lubango Substation and runs parallel to the existing 150 kV transmission line, and then crosses the railroad and runs parallel to it. It crosses the railroad again near the 60/15 kV Arimba SS to reach the 60/15 kV new Arimba SS. See Figure 7.3-1.

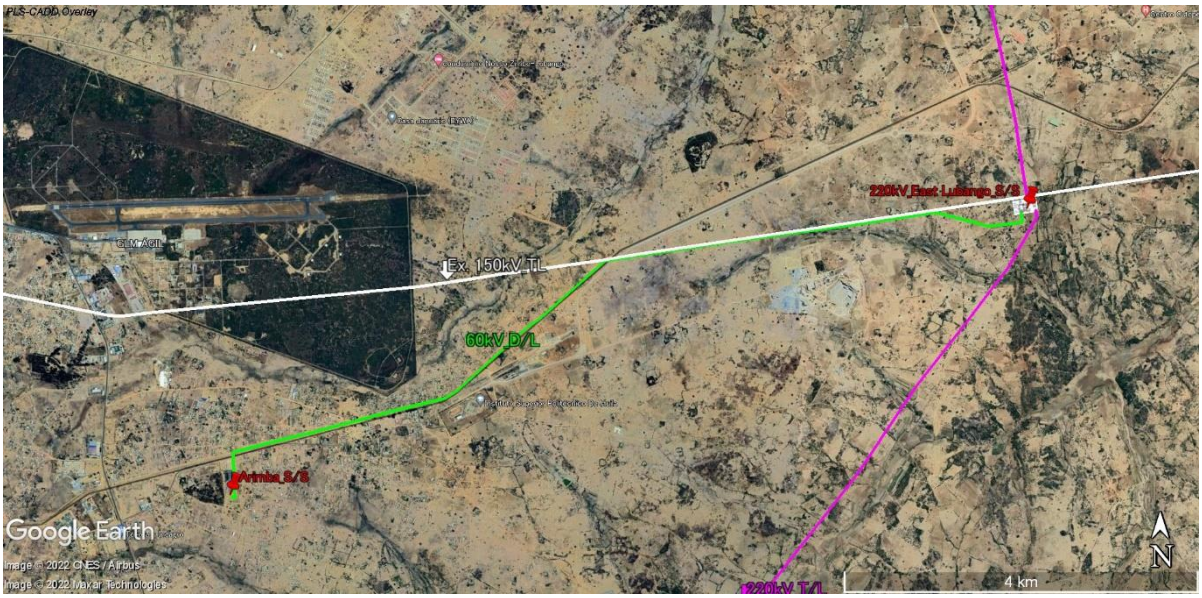


Figure 7.3-1 60 kV Overhead Distribution Line Route Diagram

Source: Compiled by JICA Survey Team from Google Earth

7.3.2. Design Condition

The outline design conditions are as follows. The various conditions have been set from MINEA's design specification, European Standard (EN50341-1 2012) and IEC standards.

(1) Atmospheric temperature

Maximum air temperature	40 ºC
Minimum air temperature	0 ºC
Maximum wind speed air temperature	20 ºC
EDS air temperature	25 ºC

(2) Conductor temperature

Maximum conductor temperature	85 ºC
Minimum conductor temperature	0 ºC

(3) Design wind speed

The design wind speeds are divided into two zones, Zone A and Zone B, which are 30 m/s and 33 m/s, respectively. Since the transmission line of this project is positioned as an important power supply line, the following value for Zone A is adopted after discussing it with ENDE.

Maximum 10-minute average wind speed 30 m/s

(4) Standard wind pressure

The above wind speed is the wind speed at a height of 10 m above the ground, and is multiplied by the following equation to calculate the reference wind pressure depending on the height of the distribution line.

$$q_h = 0.5 \times \rho \times 30^2 \times \left(\frac{h}{10}\right)^{0.4} N/m^2$$

Table 7.3-1 Standard Wind Pressure

h[m].	0	10	20	25	30	35	40	45	50	55
q_h[Pa]	720	720	720	782	841	895	944	989	1,032	1,072

ρ is the air density at an air temperature of 20°C and an air pressure of 1,013 hPa, which is 1.205 kg/m .[3]

(5) Design wind pressure

Steel tower	1,800 Pa (H=30 m A+0.0 type steel tower height)
Conductor	660 Pa (H=25 m A+0.0 type medium phase position)
Ground wire	710 Pa (H=30 m A+0.0 type ground line position)
Insulator	1,380 Pa (H=25 m A+0.0 type mid-phase position)

(6) Worst-case conditions and EDS (Every Day Stress) conditions

Table 7.3-2 Conductor

Condition	Temperature	Wind pressure	Tension
The worst	20 ºC	660 Pa	40.0% UTS
Normal	25 ºC	windless	20.0% UTS

Table 7.3-3 Ground Wire

Condition	Temperature	Wind pressure	Tension
The worst	20 ºC	710 Pa	40.0% UTS
Normal	25 ºC	windless	20.0% UTS

*UTS: Ultimate Tensile Strength

(7) Pollution level (according to IEC standard)

The area is considered to be Medium because it is hardly affected by sea salt and sand dust.

Medium (20 mm/kV)

(8) Elevation of elapsed place

The elevation near the 60/15 kV Arimba SS is about 1,700 m above sea level, and the land is basically flat.

(9) Insulation design voltage

Maximum operating voltage (Us)	72.5 kV
Lightning impulse withstand voltage (LIWV)	325 kV
Switching impulse withstand voltage (SIWV)	Not considered (because maximum voltage is less than 245 kV)

(10) Insulation distance

The MINEA specification lists insulation distances at an elevation of 1,500 m.

In this project, the elevation is about 1,700 m, but the elevation correction is not implemented and the value of 1,500 m is applied.

Table 7.3-4 Insulation Distance

Voltage Type	Elevation 1,500 m		Remarks
	Earth	Phase	
Lightning impulse	0.62m	0.72 m	
Switching Impulse	not take into account		Maximum voltage is less than 245 kV.
Power frequency	0.15m	0.24 m	

(11) Safety factor

The various minimum safety ratios applicable to transmission facilities are as follows

(a) Tower

- Worst-case condition: 2.0 % of member yield strength
- In the event of wire breakage: 1.5 relative to the yield strength of the member (worst-case condition + 1 ground wire or 1 phase breakage)

(b) Conductors / Ground wires

- Worst-case conditions: 2.5 (40% UTS) relative to UTS (Ultimate Tensile Strength)

- EDS condition: 4.5 (22%UTS) relative to UTS at the support point

(c) Insulators

- 2.5 to RUS (Rated Ultimate Strength) at the maximum working tension at the support point

(d) Tower foundation

- 2.0 for worst-case conditions
- 1.5 for disconnection conditions

7.3.3. Conductor and Ground Wire Design

(1) Types of conductors and ground wires

The schematic configuration of the distribution system in the Lubango area as shown in FFigure 7.3-2 was agreed upon in the discussion in Angola and in the WS. The current capacity is calculated and the wire size is selected based on the agreed schematic configuration of the distribution system assumed for the Lubango area, as shown in Figure 7.3-2.

- ✓ The maximum transmission capacity of the 60 kV DL between the 150/60 kV Existing Lubango SS and Arimba PS is 80 MW, so the maximum assumed power flow is 80 MW
- ✓ For the power transmitted between the 60/15 kV Arimba SS and the Arimba PS, the power generation at the Arimba PS is assumed to be 0 MW, and the maximum assumed power flow is 80 MW as above.
- ✓ The assumed maximum load of the 60/15 kV Arimba SS is 40 MW (power factor is set to 0.8 according to Angola's specification), assuming the operation of one transformer (50 MVA) at all times.
- ✓ Based on the above, the total power to be transmitted on the project's 60 kV DL between the 220/60 kV East Lubango SS and the 60/15 kV Arimba SS is assumed to be 120 MW (80 MW + 40 MW).

Therefore, the maximum transmission capacity required for the distribution lines of the project is 80 MW + 40 MW = 120 MW/cct during N-1 accident, and the current corresponding to this 120 MW is calculated to be about 1,443 A/phase. In selecting the conductors, 2-bundles AAAC Yew conductor is selected, which is used as standard in Angola and are close to this capacity. Since the line length is short (about 10 km), low-loss conductor is not expected to be effective, so this conductor is used. For the ground wire, OPGW 70mm^2 is applied, and the technical specifications of the conductor and ground wire are as follows.

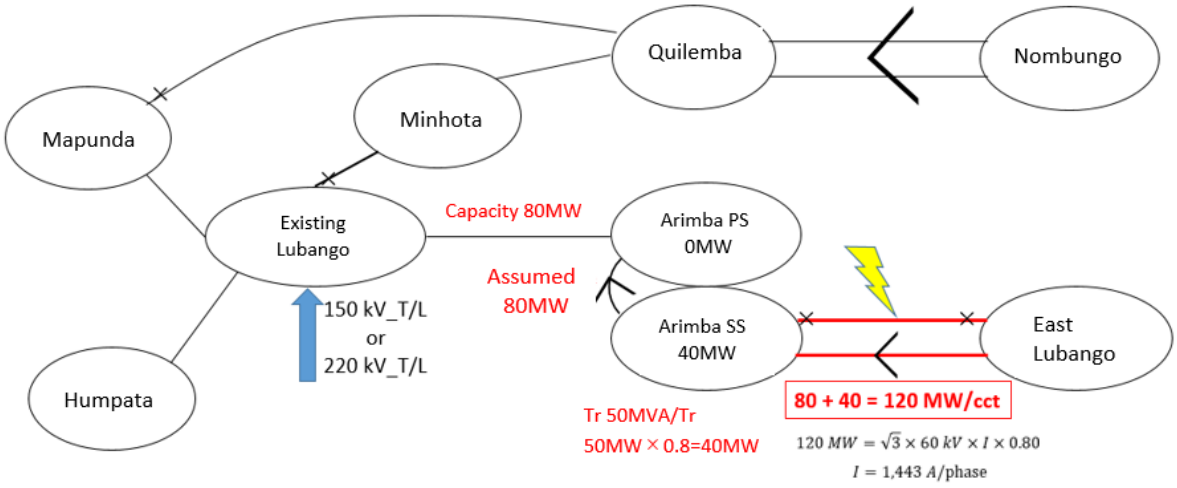


Figure 7.3-2 Capacity Study of the 60 kV Distribution System in the Lubango Area and the New 60 kV DL

Table 7.3-5 Technical Specifications of Conductors

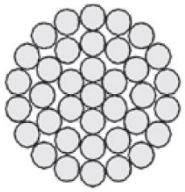
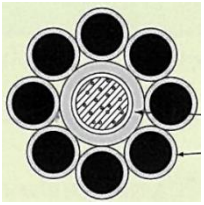
Conductor type	AAAC Yew
Conductor composition (Number/diameter)	AAL:37/4.06
Outer diameter	28.42mm
Aluminum sectional area	479.01mm^2
Total cross-sectional area	479.01 mm
Unit mass	1,294 kg/km
Minimum Tensile Strength	141.3 kN
Modulus of elasticity	57.0 GPa
Coefficient of linear expansion	23.0 x 10^{-6} /°C
DC Resistance at 20°C	0.0693 ohm/km
Allowable current at 85°C	896 A / conductor
Number of conductors	2
Cross-sectional view	

Table 7.3-6 Technical Specifications of Ground Wire

Type	OPGW 70mm^2
Wire composition (Number of strands / Diameter)	8/3.30-20SA 1-5.2-OP
Outer diameter	11.8 mm
Total cross-sectional area	81.62 mm^2
Unit mass	505.8 kg/km
Minimum Tensile Strength	83.9 kN
Modulus of elasticity	147.0 GPa
Coefficient of linear expansion	13.4 x 10^{-6} /°C
DC Resistance at 20°C	0.844 Ω/km
Cross-sectional view	

(2) Standard Span length

The standard span length shall be 300 m.

(3) Maximum Working Tension and EDS Tension

The safety factor is met under the maximum working tension and EDS conditions for both wire and ground wire as shown below.

The tension of the ground wire should be set so that the slack of the ground wire is less than 85% of the conductor slack at standard spacing under EDS conditions. This is to avoid reverse sparking from the ground wire to the conductor in the event of a lightning strike on the ground wire.

Table 7.3-7 Maximum Working Tension and EDS Tension

Conductor and ground wire type	Minimum Tensile Strength	Tension		Safety factor
AAAC Yew	141.3 kN	Max. working tension	52.0 kN	2.71> 2.5
		EDS tension	30.8 kN	4.58 > 4.5
OPGW 70mm^2	83.9 kN	Max. working tension	23.0 kN	3.64 > 2.5
		EDS tension	14.2 kN	5.90 > 4.5

(4) Right of Way (ROW)

The ROW of the 60 kV DL shall be 12.0 m from the center to both sides (total 12.0 m x 2 = 24.0 m).

7.3.4. Insulator Design

(1) Insulator type and size

For insulators applied to distribution lines, ball-and-socket porcelain standard suspension insulators in accordance with IEC 60305 shall be applied, and 160 kN strength insulators shall be applied to suspension towers and tension towers. The technical specifications of the insulators are as follows.

Table 7.3-8 Technical Specifications of the Insulator

Electromechanical Failing Load	160 kN
IEC Designation	U160BS
Shell Diameter	280 mm
Unit Spacing	146 mm
Nominal Creepage Distance	315 mm
Ball & Socket Coupling	20 mm

(2) Method of determining the number of insulators

The method of determining the number of insulators per series is as follows.

[Pollution design].

- Pollution Classification:
  Medium: Creepage distance 20mm/kV
- Maximum operating voltage, Us:72.5 kV
- Required creepage distance of the surface of insulators:
  Medium: 72.5kV × 20 mm/kV = 1,450 mm
- The number of pieces you need per series:
  Creepage distance per unit of U160BS is 370 mm
  Medium: 1,450 mm ÷ 315 mm = 4.6 ≃ 5 pcs / series

[Lightning impulse withstand voltage (LIWV)

- Max. voltage Us = 72.5kV
  According to MINEA specifications, the lightning impulse withstand voltage for a transmission voltage of 72.5 kV is 325 kV, and the required arc horn spacing is at least 620 mm. The arc horn efficiency (Z/Zo) should be 80%.
- The number of consecutive hits:
  U160BS : 620 mm ÷ 0.80 ÷ 146 mm = 5.3 ≃ 6 pcs / series

[Switching impulse withstand voltage (SIWV)

Not considered according to IEC60071-1-2006 because the maximum voltage is less than 245 kV.

[Number of pieces per set]

Table 7.3-9 Number of Pieces

Types of insulator	Pollution level	Number of pieces per set			
		Pollution design	Lightning impulse withstand voltage	Switching impulse withstand voltage	Number of units adopted
U160BS	Medium	5	6	-	**6**

(3) Strength of insulator sets and insulators

The insulator sets for suspension towers shall be single or double insulator sets, and the insulator sets for tension towers shall be double insulator sets. The tension tower insulators shall meet the specified safety factor (2.5) for the RUS at the maximum working tension in a standard span of 300 m, as follows.

Table 7.3-10 Strength of Insulator Sets and Insulator

Conductor type	Max. working tension (Span length: 300m)	Device type	Safety factor
AAAC Yew 2 bundles	104.0kN (52.0kN × 2)	Double tension device 320kN (160kN × 2)	3.07 > 2.5
	62.4kN (52.0kN × 0.6 × 2)	Single suspension system 160kN (160kN × 2)	2.56 > 2.5

7.3.5. Separation of Electric Conductors from Other Works

The most severe conditions for ground clearance of conductors and separation from structures of conductors, etc., are when the conductor temperature reaches 85°C with no wind. 60 kV DL are required the following minimum ground clearance and distance from obstructions.

Table 7.3-11 Separation Distances from Ground and Obstacles

Object	Separation Distance
Earth	8.5 m
Trees	4.0 m
Structure	4.0 m
Road	9.5 m
Electric railroad	13.5 m
Non-electrified railroad	9.5 m
Other overhead lines	3.5 m
Other obstacles	3.5 m

7.3.6. Tower Shape

(1) Electrical Clearance

Table 7.3-12 Conductot Runout Angle and Insulation Clearance

		Normal condition	Abnormal condition	Worst condition
Wind speed		0 to 10 m/s	10 to 20 m/s	20 to 33 m/s
Lateral swing angle of suspension (A)		0 to 10 degree	10 to 30 degree	30 to 60 degree
Lateral vibration angle of tensile strength device (without support) (B)		0 to 5 degree	5 to 15 degree	15 to 40 degree
Lateral vibration angle of tensile strength device (with support) (C, D, E, T)		0 to 15 degree	N/A	N/A
Minimum Clearance	Suspension device	900 mm	620 mm	200 mm
	Tension device	740 mm	620 mm	200 mm

(2) Length of suspension device and jumper depth of tension and support device

The lengths of the suspension device and the jumper depths of the tension device and the support device are as follows

Table 7.3-13 Length of Suspension Device and Jumper Depth of Tension and Support Device

Device type	Breakdown	Device length
Suspension device length (U120B)	146mm x 6pcs + 615mm (metal fitting length) + 19mm (margin)	1,510mm
Tension device length (U120B)	146mm x 6 pieces + 1,225mm (fitting length) + 99mm (margin)	2,200mm
Depth of jumper device (Type B)	1,200mm (size of jumper) + 100mm (influence of suspended material) + 100mm (margin)	1,400mm
support device length (Type C, D, E)	146mm x 6pcs + 615mm (metal fitting length) + 19mm (margin)	1,510mm

(3) Electrical clearance diagram

The electrical clearance diagram for the suspension-type, the tension-type and jumper device is shown below.

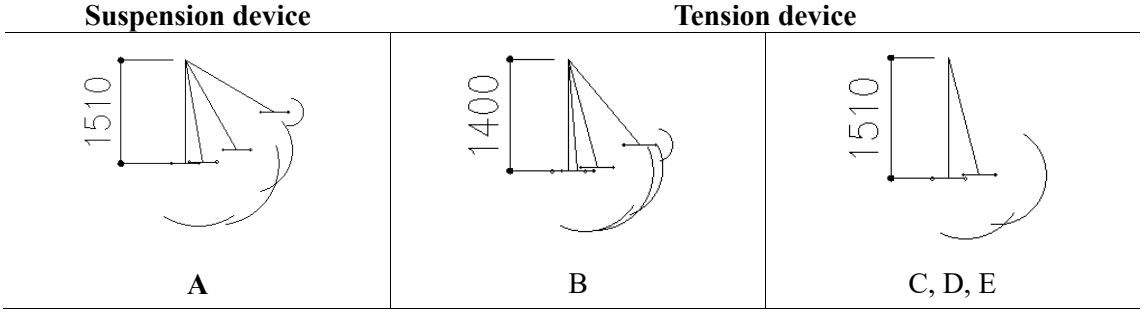


Figure 7.3-3 Clearance Diagram

(4) Tower type

(a) Type A

Applicable to suspension tower with straight sections and suspension-type devices with horizontal angles up to 3 degrees.

(b) Type B

Applicable to tension towers with a tension-type devices up to a horizontal angle of 20 degrees.

(c) Type C

Applicable to tension towers with a tension-type devices and jumper support girder with horizontal angles from 21 to 40 degrees.

(d) Type D

Applicable to tension towers with a tension-type device and jumper support devices with horizontal angles from 41 to 60 degrees.

(e) Type DR

Applicable to tension steel towers with a 90-degree horizontal angle of tension-type device and jumper support device.

(f) Type E

It is applied to tension strain towers with a tension-type device and jumper support device for pulling down wires with horizontal angles of up to 40 degrees.

Table 7.3-14 Tower Type and Applicable Condition

Type	Location of use	Angle range [degrees]	Device type
A	straight line	0 - 3	Suspension
B	angle	0 - 20	Tension
C	angle	21 - 40	Tension
D	angle	41 - 60	Tension
DR	angle	90	Tension
E	dead-end	0 - 40	Tension

(5) Design span length

The following wind span lengths and weight span length shall apply

Table 7.3-15 Design Span Length

Type	Wind Span [m]	Weight Span [m]
A	350	400
B	350	400
C	350	400
D	350	400
DR	350	400
E	200	300

(6) Maximum sag and standard height from ground to lowest arm

Conductor temperature:	85 °C
Wind speed:	no wind
Span length:	300 m
Maximum working tension:	52,000N

Table 7.3-16 Maximum Sag and Typical Tower Height

	Suspension type	Tension type
Maximum Sag	7.4 m	7.4 m
Insulator length	1.6 m	- m
Ground clearance	8.5 m	8.5 m
Height from ground to lowest arm	>17.5 m	>15.9 m

(7) Tower Shape

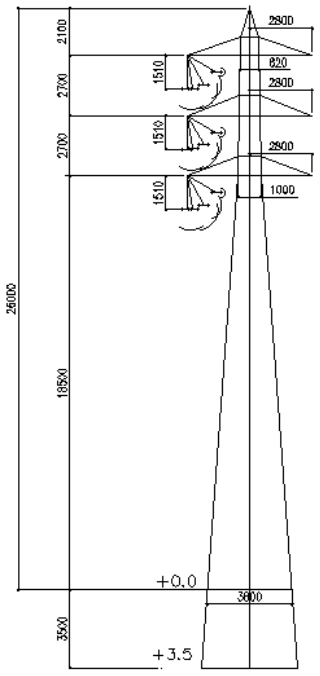


Figure 7.3-4 Type A Tower

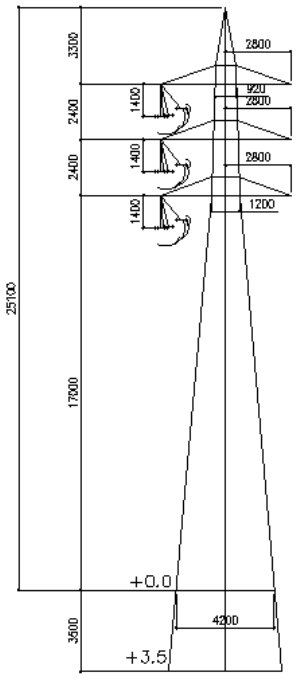


Figure 7.3-5 Type B Tower

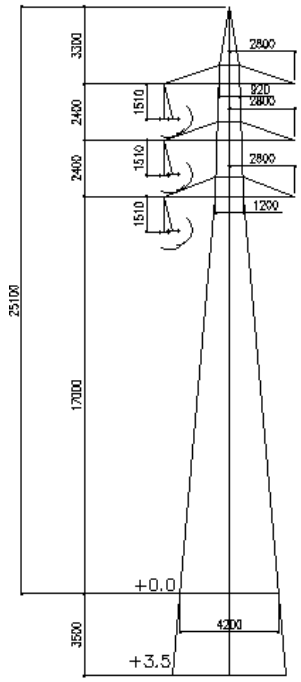


Figure 7.3-6 Type B, C, D, DR, and E Towers

(8) Approximate tower weight for each tower type

Estimated tower weights for each tower type are as follows

Table 7.3-17 Estimated Tower Weight

Leg Joint [m].	Weight of tower per unit [ton]					
	A	B	C	D	DR	E
+0.0	6	8	11	13	15	13
+3.5	7	9	12	15	17	-

7.3.7. Foundation Shape

Estimated tower foundation load:

The specifications and shape of the distribution line foundations need to be determined in the detailed design based on the results of detailed geological investigations at each tower location prior to construction. The inverted T-shape foundation, which is a common foundation for distribution lines, is mainly used. The constant foundation loads for each tower type with a tower joint length of +0.0 m are as follows

Table 7.3-18 Tower Foundation Load

Type	Compressive force [kN]	Pulling force [kN]
A	424	361
B	700	642
C	1,073	988
D	1,316	1,219
DR	1,492	1,381
E	1,316	1,219

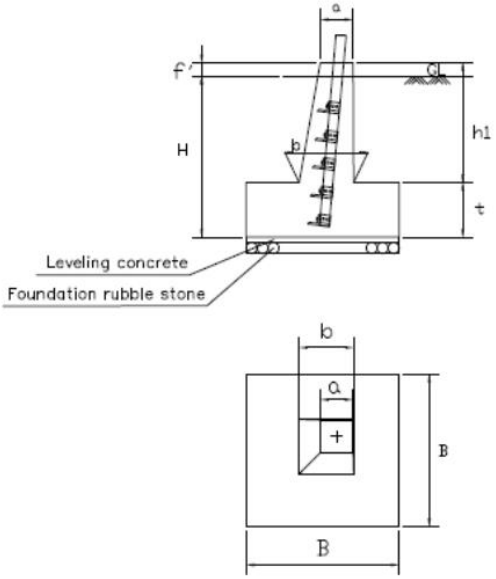


Figure 7.3-7 Assumed Foundation Diagram

7.3.8. Quantity of Distribution Line Equipment Materials

(1) Number of towers and total tower weight

The number of towers and total tower weight of the subject distribution facilities are as follows

Table 7.3-19 Number of Towers and Total Tower Weight

Type	Leg Joints [m]	Weight [ton]	Number of towers [unit]	Gross weight [ton]
A: Suspension	0.0	6	22	132
(Horizontal angle: 0 - 3 degrees)	+3.0	7	2	14
subtotal			**24**	**146**
B: Tension	0.0	8	4	32
(Horizontal angle: 3 - 20 degree)	+3.0	9	1	9
subtotal			**5**	**41**
C: Tension	0.0	11	1	11
(Horizontal angle: 20 - 40 degree)	+3.0	12	0	0.0
subtotal			**1**	**11**
D: Tension	0.0	13	1	13
(Horizontal angle: 40 - 60 degrees)	+3.0	15	0	0.0
subtotal			**1**	**13**
DR: Retention	0.0	15	2	30
(Horizontal angle: 60 - 90 degrees)	+3.0	17	1	17
subtotal			**3**	**47**
E: Retention	0.0	13	2	26
(Horizontal angle: 0 - 40 degree)				
subtotal			**2**	**26**
Total amount			**36**	**284**

(2) Total length of conductors and ground wires

The overall length of the conductors and ground wires are determined by multiplying the number of conductors and circuits in the conductors and ground wires by the total length of the route, plus a margin of 1.10 for sag and overhead line work and OPGW for its drawdown lines (50 m x 4 locations = 200 m).

Table 7.3-20 Lengths of Conductors and Ground Wires

Conductor / Ground Type	Number of conductors	Number of phases	Number of circuits	Line length [km]	Total length [km]
AAAC Yew	2	3	2	10.0	132.0
OPGW 70 mm²	1	-	1	10.0	11.2

(3) Number of insulator sets and insulators

The number of insulators and the number of insulator devices are as follows

Table 7.3-21 Number of Insulator Sets and Insulators

Insulator type	Applicable area	Pollution Level	Device Type	Number of pieces per phase [pcs]	Number of Pcs per unit [set]	Number of towers [units]	Total number of sets [sets]	Total number of insulators [pcs]
U160BS	chin up	Medium	single	6	6	24	144	864
	supporting stone	Medium	single	6	2	6	12	72
	tension	Medium	double	12	12	10	120	1,440
	detention	Medium	double	12	6	2	12	144
			single	6	6	2	12	72
						Total amount		**2,592**

(4) Spare parts

Spare parts will need to be provided for maintenance of the transmission line after completion of the project. The individual items and quantities will be determined during the detailed design phase of the project, but the major items envisaged are standard towers, wires, ground wires, overhead line fittings, insulators and insulator coupling fittings, etc.

Based on the results of other projects, the JICA survey team estimated that the spare parts for this project would be approximately 5% of the total material cost of the transmission facilities.

7.4. Underground Distribution Line

7.4.1. Overview of Underground Distribution Line

Overview of the underground distribution line route Figure 7.4-1. The orange line route in Figure 7.4-1 is the planned underground distribution line. The route is basically flat and runs directly under an unpaved road from the 60/15 kV Arimba SS to the Arimba2 PS. The length of the line is approximately 500 m.

The scope of construction shall be under the jurisdiction of the ENDE and shall extend from the cable head of the 60/15 kV Arimba SS to the cable head of the Arimba2 PS and the jumper lines connecting to PRODEL's facilities. Since the Arimba2 PS is under the jurisdiction of PRODEL, the cable head trestle for connecting the underground line and the connection point of the jumper line must be secured by PRODEL.

Figure 7.4-1 Route Diagram of 60 kV Underground Distribution Line

Source: Compiled by JICA Survey Team from Google Earth

7.4.2. Design Condition

In the basic design, various design conditions were set as follows, referring to MINEA specifications and other documents.

(1) Basic conditions

The basic design conditions are as follows

- ✓ Rated voltage: 60 (kV)
- ✓ Maximum system voltage: 72.5 (kV)
- ✓ LIWV: 325 (kV)
- ✓ Ambient air temperature: 40 deg. C (Max), 0 deg. C (Min), 25 deg. C (Ave.)
- ✓ Pollution level: Middle (20 mm/kV)
- ✓ Power factor: 0.8
- ✓ Transmission capacity: 80MW (963A @power factor 0.8)
- ✓ Short circuit capacity: 31.5 kA (3s)
- ✓ Number of circuits: 1 cct
- ✓ Maximum ground temperature: 40 deg. C (at depth 1.0m from GL)
- ✓ Thermal resistivity of soil: 3.0 K*m/W

(2) Construction conditions

- ✓ Section to be constructed: 500m long over the line between the Arimba2 PS and the 60/15 kV Arimba SS
- ✓ Installation route Unpaved public road between the Arimba2 PS and the 60/15 kV Arimba SS (roadway width: approx. 10.0 m)

7.4.3. Construction Method

Because the number of lines is one and the width of the road is relatively wide (approximately 10.0 m), the direct burial method was chosen to allow greater freedom of separation between phases when installing the cables.

For direct burial, since the cable is buried under the roadway, it is placed in a concrete trough with a lid to protect it from the weight, vibration, and impact of passing vehicles.

The flat stacking method was selected for the cable arrangement, considering the quality and ease of construction work at the site. A standard cross-section is shown in Figure 7.4-2.

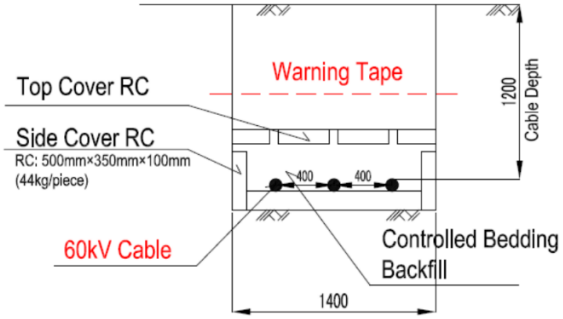


Figure 7.4-2 Cross-Section of Direct Burial Method

7.4.4. Underground Distribution Line Cable Specifications

In designing the cable, the cable specification for the 60 kV cable was set to be a 66 kV class cable, which is equivalent to the IEC standard in terms of maximum working voltage, etc. Since the maximum working voltage for both 60 kV and 66 kV is 72.5 kV, it was judged that there would be no problem. Cross-linked polyethylene (XLPE) was selected as the insulator because of its high maintainability, and a water shield layer was selected to ensure stable and trouble-free power transmission over the long term.

7.4.5. Cable Transmission Capacity

(1) Normal allowable current

Cable conductor sizes were selected based on the basic design conditions, cable cross-section, and cable specifications to meet the required transmission capacity of 80 MW (963 A). Table 7.4-1 shows the cable specifications applied for the calculation. The calculation conditions are shown in Table 7.4-2.

Table 7.4-1 Cable Specifications

Nominal cross section	mm2	1600	2000	Remarks
dc	mm	48.2	53.8	diameter of conductor
Di	mm	72.2	77.8	external diameter of the insulation (excluding screen)
t1	mm	10	10	thickness of insulation between conductor and sheath
ts	mm	1.2	1.2	thickness of sheath (metallic screen)
Ds	mm	79.2	84.8	external diameter of sheath
t3	mm	4.5	5	thickness of serving
R0	ohm/m	1.13E-05	9.00E-06	d.c. current resistance of conductor at 20°C (IEC60228)
De	mm	88.2	94.8	external diameter of one cable

Table 7.4-2 Normal Allowable Current Calculation Conditions

Item	Unit	Description
Rated Voltage	kV	60
Frequency	HZ	50
conductor	-	copper
Number of conductors (n)	-	1
Cable sheath	-	copper wires
Cable formation	-	flat
Relative permittivity of insulation (ε)	-	2.5
Loss factor of insulation (tanδ)	-	0.001
Coefficient for skin effect (ks)	-	0.435
Coefficient for proximity effect (kp)	-	0.37
Loss in the sheath (λ1)	-	0
Power Factor	-	0.8
Bonding system	-	single pointed bonded

As a result of the calculation under the above conditions, it is possible to transmit 963 A of allowable current at all times with a cable conductor size of 2000 mm2. The calculation results are shown in Table 7.4-3.

Table 7.4-3 Required Transmission Capacity Calculation Results

1) 1600mm^2

Item		Unit	Description
Conductor D.C. resistance at 20 deg. C	1600mm2	Ω/km	0.0113
Thermal resistance	Insulattion (T1)	K.m/W	0.1933
	Armour (T2)	K.m/W	-
	Outer sheath (T3)	K.m/W	0.06
	External (T4)	K.m/W	3.745
Dielectric loss/phase		W/m	0.1296
Required current/capacity		A/MW	963/80
Permissible current		A	894

2) 2000mm^2

Item		Unit	Description
Conductor D.C. resistance at 20 deg. C	2000mm2	Ω/km	0.009
Thermal resistance	Insulattion (T1)	K.m/W	0.1761
	Armour (T2)	K.m/W	-
	Outer sheath (T3)	K.m/W	0.0621
	External (T4)	K.m/W	3.7105
Dielectric loss/phase		W/m	0.1419
Required current/capacity		A/MW	963/80
Permissible current		A	990

7.4.6. Salt Damage Design

The Arimba2 PS and the 60/15 kV Arimba SS are air-terminated, so the available insulator specifications for the cable air-terminating connections were considered based on the pollution level. Since the local pollution level is Medium (20 mm/kV), the required creepage distance is 838 mm. The required creepage distance for general-purpose insulators is shown in Table 7.4-4.

Table 7.4-4 Results of Checking Creepage Distance

Insulator type	Creepage distance (mm)	Required creepage distance (mm)	judgment
LS cable air-terminated connections	2500	838	acceptable

From the above, it is not necessary to apply insulators of special specifications. Figure 7.4-3 shows an example of a girders arrangement for an air-terminated connection.

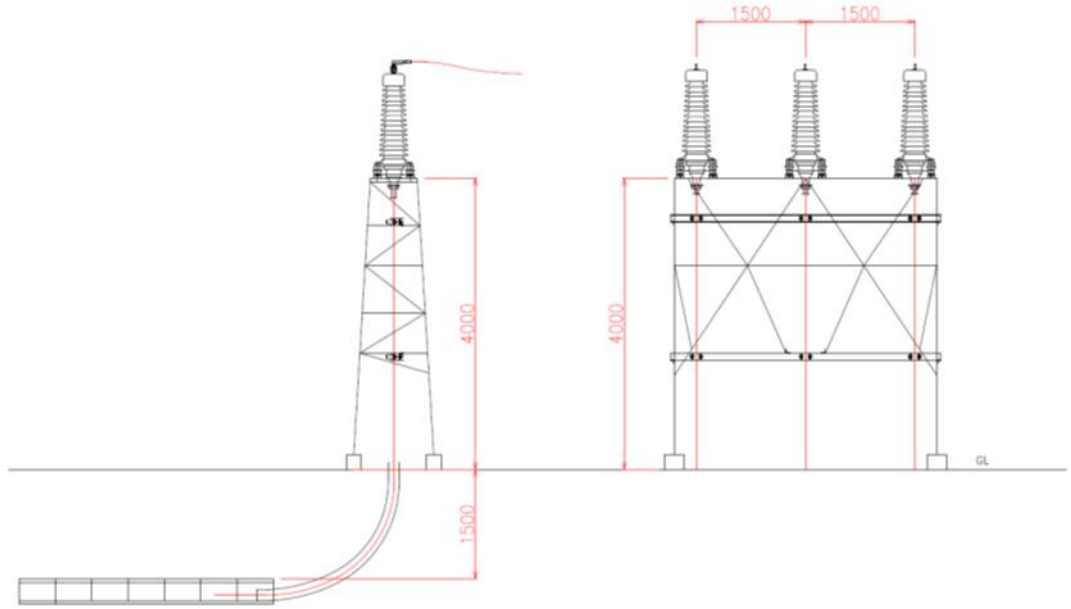


Figure 7.4-3 Example of Air-Terminated Connection Trestle Layout

7.5. Substation Facilities

7.5.1. Namibe Region Overview

Electric power facilities in the Namibe region are located near the Atlantic coast, so they must be protected from salt damage compared to inland areas. At the same time, the proximity to the desert also requires dust control measures.

7.5.2. Lubango Region Overview

The Lubango area is a general area with a high altitude, and the distance of railroad transportation of substation equipment from the port of Namibe to Lubango is about 200 km. The power facilities need to pay attention to the difference in atmospheric pressure because of the high altitude of approximately 1,700 meters.

7.5.3. Around 220/60 kV New Namibe Substation Area

220/60 kV New Namibe SS area is in an environment that requires salt and dust protection measures. This substation will be introduced with the gas-insulated switchgear (GIS), which is more expensive than the air-insulated switchgear (AIS), but has advantages in reliability and future expansion, and concealment of the energized sections, which will reduce land acquisition, site development, and maintenance costs. Therefore, 220 kV GIS and 60 kV GIS will be adopted based on the equipment configuration, construction cost, maintenance, and environment.

The surrounding conditions of the 220/60 kV New Namibe SS are shown in the following figure. There are no land or topographical challenges. The site for the substation is located on a cliff where the 220 kV TL from Lubango crosses the river, and the site was selected away from the cliff to ensure that there is no flooding from the river and to avoid cliff collapse and to secure a site for the transmission line tower. The geology is loose fine sandy soil, and it is expected that compaction and other measures will be necessary to stabilize the soil. The soil does not appear to be hard. It was confirmed that approximately 3.0 m from the ground surface is a soft layer, but below this is a hard layer. Specific figures will be clarified once geological survey has already been conducted at each of the proposed substation sites (for details, see 5.3 Chapter No. 13 Boring No. SS-4). However, if more detailed geological data is required for the actual foundation design for the main construction, additional geological investigations will be required.

(Tentative coordinates: 15°10'15.19 "S 12°12'36.88 "E)

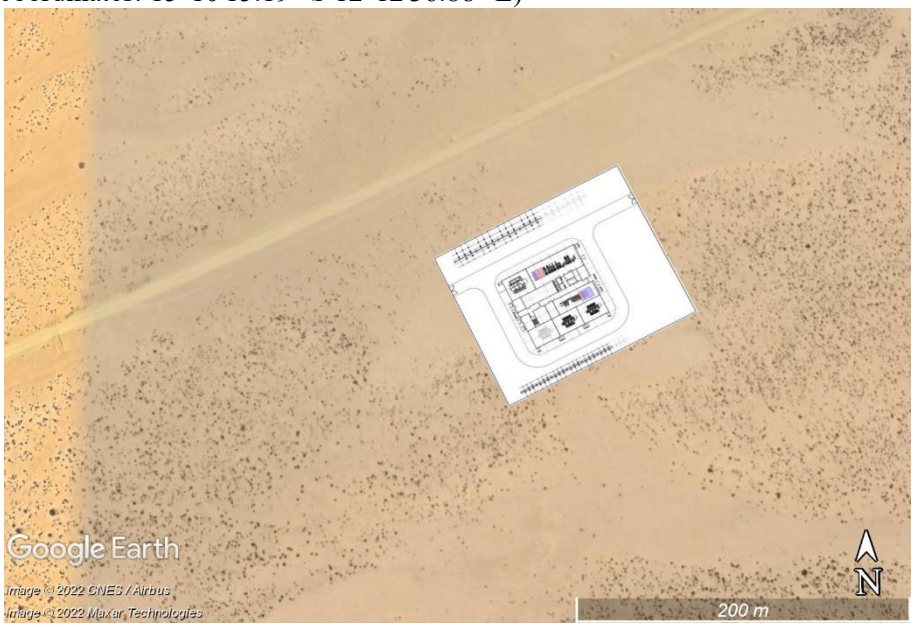


Figure 7.5-1 Situation around 220/60 kV Namibe SS

Source: Compiled by JICA Survey Team from Google Earth

7.5.4. Around 220/60 kV East Lubango Substation Area

The 220/60 kV East Lubango SS is located in the highlands of Lubango area and avoids densely populated areas with large enough perimeter for the facilities. The substaion will be applied the air-insulated switchgear (AIS). In consultation with RNT, it was decided to reserve the necessary space in consideration of future expansion plans. The site for the substation is located to the south of the existing 150 kV transmission line, and was selected based on the policy of avoiding existing buildings such as churches and private houses to secure the necessary site area.

(Tentative coordinates: 14°55'29.1 "S 13°39'49.4 "E)

Figure 7.5-2 Situation around the 220/60 kV East Lubango SS

Source: Compiled by JICA Survey Team from Google Earth

7.5.5. Around 60/15 kV Arimba Substation Area

The 60/15 kV Arimba SS was in the construction plan of ENDE, and the request for additional scope of 60/15 kV Arimba SS from the Angolan side was considered in the WS discussions. The candidate site was determined in the WS, and it was confirmed in the third field survey. Perimeter walls were already in place around the site.

The satellite photo shown in the figure below was identified as the potential site for the 60/15 kV Arimba SS. Since the direction of the 220/60 kV East Lubango SS from the 60/15 kV Arimba SS would be east-northeast (upper right side), the direction of the 60 kV DL feeders was discussed.

First, the north side of the substation site (upper side of the photo) is used as the site for the adjacent Arimba PS. This makes it difficult to run a 60 kV DL from the north while maintaining a separation distance from the transmission tower. Therefore, we considered pulling in the 60 kV DL from the three other directions rather than the north side.

At first, the proposal was to draw 60 kV DL from the west (left) side of the substation site in the short side direction. However, it was found from the dimensional measurements of satellite photos that the distance in the short side direction was insufficient considering the number of 60 kV DL to be drawn (8 feeders in total including the two feeders for Transformars) and the approximately 7 m separation distance required for each line. Therefore, the JICA survey team had considered the possibility of extending the substation site to the south (lower side) to provide sufficient distance in the west direction of the site to receive power. However, during the third field survey, it is confirmed that a large site development would be required for the southward extension due to the already existing perimeter walls and the uneven terrain on the south side.

Therefore, the JICA Survey team considered changing the direction of the 60 kV DL pull in from the west side to the south side to fit within the limited area of the existing perimeter walls. In addition, the pullout of the 15 kV distribution line will be in the upper left direction for the Quilemba and 150/60 kV Existing Lubango SS, and in the upper right direction for the 220/60 kV East Lubango SS.

In addition, the military land to the west of the substation was confirmed to be available for a ROW of 50 m (25 m each side) of 60 kV DL.

(Tentative coordinates: 14°57'14.2 "S 13°34'49.3 "E)

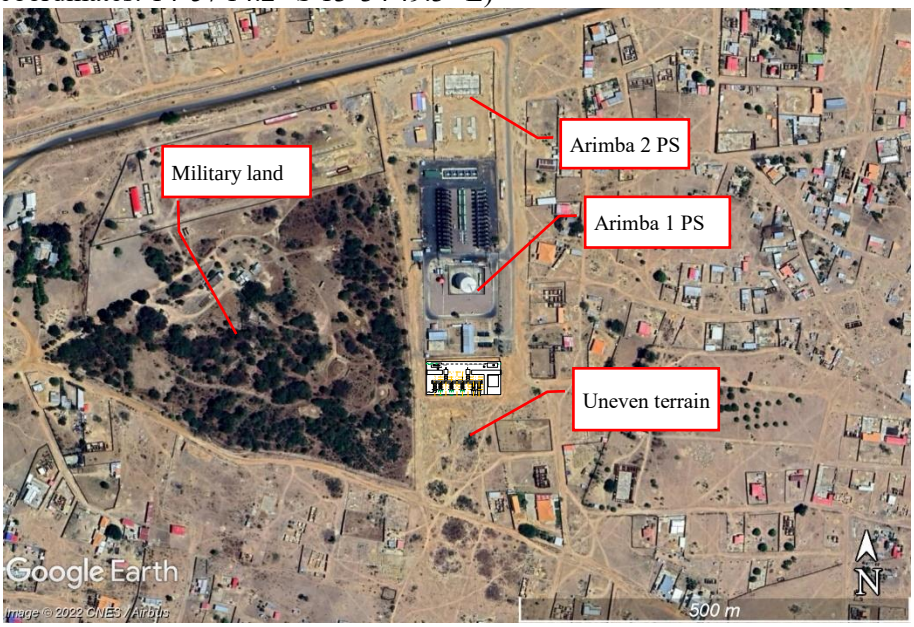


Figure 7.5-3 Situation around 60/15 kV Arimba SS

Source: Compiled by JICA Survey Team from Google Earth

7.5.6. Substation Design Concepts, Criteria, and Design Conditions

(1) General Concept

The following items are typically considered in substation design.

- Daily operation and maintenance are performed safely and reliably.
- Wiring should be simplified as much as possible under conditions that maximize the performance of the equipment.
- In the event of an accident, the scope of its impact can be minimized, and operations such as load switching can be performed promptly.
- Space for future equipment expansion to accommodate future increases in demand. (i.e., to provide space for future expansion and renovation work).
- It is technically appropriate and economically justifiable. (The insulation distance, etc. between phases and to ground of the equipment shall be sufficiently secured at the substation site in accordance with technical standards, and the equipment specifications such as current-carrying capacity, etc. shall be met.)

(a) Main transformer

The main transformer to be installed in the substation shall be an oil-filled transformer with on-load tap changeover (OLTC). The 220/60/15 kV transformers shall be Y-Y-Δ wired, and the 60/15 kV transformers shall be Y-△ wired. The cooling system shall be oil-in-air cooled (ONAN) or oil-in-air cooled (ONAF).

(b) Transmission and Distribution Line Protection Relay

The method of protection for 220 kV and 60 kV DL within Angola shall be as follows

<u>220 kV power line protection *1</u>

- Main protection: Differential protection relay (87)
- Backup Protection: Distance protection relay (21)

<u>60 kV DL protection *2</u>

- Main protection: Differential protection relay (87)
- Backup Protection: Distance protection relay (21)

*1 Transmission line protection at the 400/220/60 kV Nombungo SS is outside the scope of this project, as it will be implemented by the AfDB project.

*2 Distribution line protection between 20/60 kV East Lubango SS and 60/15 kV Arimba SS will be installed by RNT contractors at the East Lubango end and by ENDE contractors at the Arimba end due to the different packages.

(c) Control and monitoring equipment

Currently, each region has a Regional Control Center (RCC), and there is a plan to collect information on the entire regional electric grid at the RCC. There is a guideline that the equipment to collect information at RCCs should be constructed in accordance with IEC 61850. Therefore, after fully confirming the intentions and plans of the Angolan government, the equipment configuration of the substation to be developed in this project is based on the assumption that the Substation Automation System (SAS) will be constructed in accordance with IEC 61850, As shown in the figure below, IEC 61850 is applied at the Bay Level and Station Level, and the higher levels are applied by the protocol from the Angolan standard or IEC 60870.

Note that the Digital Fault Recorder (DFR) function is included in the SAS of each substation.

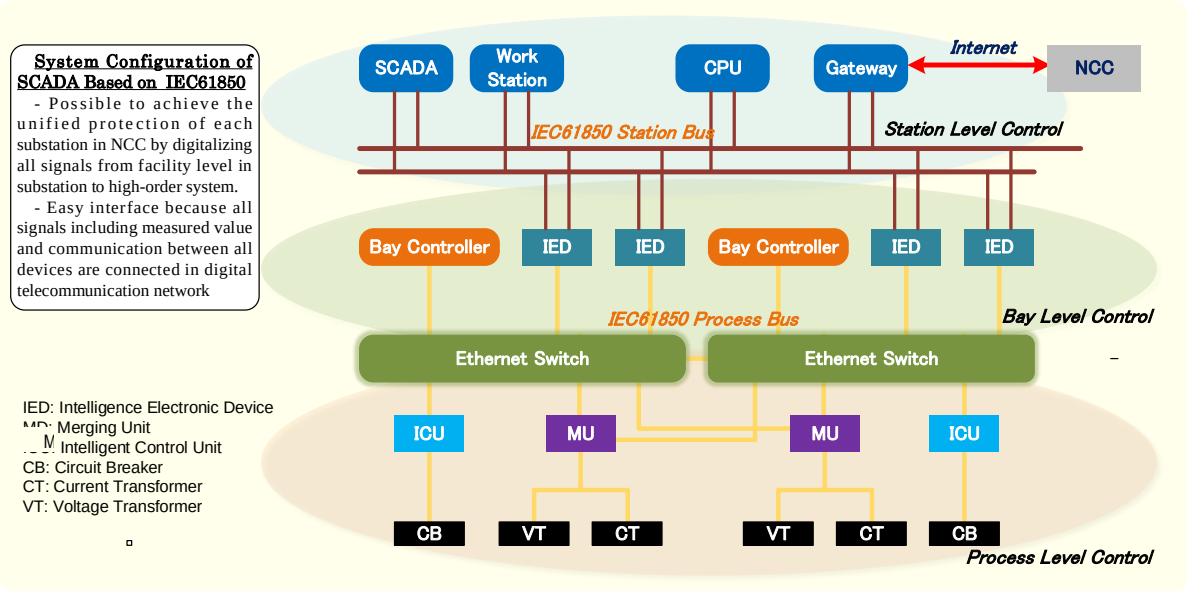


Figure 7.5-4 Equipment configuration of a substation according to the IEC 61850 standard

Source: JICA Survey Team

(d) Communication system

Substations in Angola employ optical communication systems using OPGW and PLC systems using transmission lines. Therefore, in this project, the first priority is to install an optical communication system using OPGW, and if necessary, to consider the installation of PLC as an alternative to OPGW. If a PLC were to be installed, two Line Traps would be required for each substation terminal and each transmission line, and they would be installed at the same location as the CVT (PT) or the stanchion tower, but since this would not be a significant addition in terms of cost, it is not expected in the cost estimation.

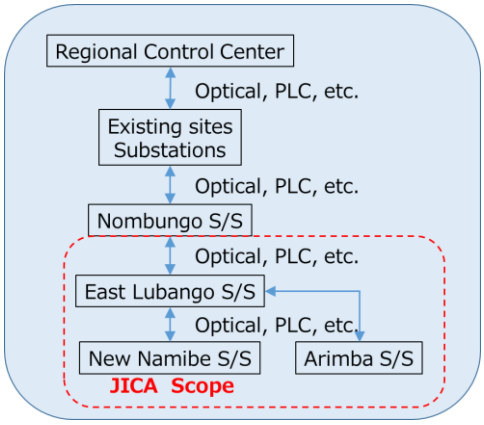


Figure 7.5-5 Anticipated Communication Configuration Diagram

Source: JICA Survey Team

(e) Concept of Environmental Measures

When constructing new or additional substations, the following necessary measures should be taken to prevent any impact on the surrounding residents.

Noise control measures: Implement measures to ensure that noise from the substation is kept below a reasonable level.

Vibration countermeasures: Implement measures to ensure that the vibration of the substation is below the generally recognized standard value.

Environmental harmony: We will pay sufficient attention to the protection and harmony of the natural environment of the surrounding area and the preservation of the living environment, including sunlight, beautification, and radio interference, and we will work in harmony with the local community.

(2) Design standard

The design standards for substation facilities in Angola are based on the ET-N (Equipment and Facilities Technical Specification) of MINEA. This ET-N was prepared based on the International Electrotechnical Commission (IEC), an international standard, and its contents generally satisfy the IEC specifications. International manufacturers of substation equipment, including the three Japanese heavy electric power companies, can design in accordance with the IEC, and the adoption of the ET-N is not expected to impede the competitiveness of international competitive bidding.

The specifications for Angola's facilities basically apply ET-N. In cases where the values differ between ET-N and IEC, the appropriate standard will be adopted through consultation, taking care not to impede the competitiveness of international competitive bidding. As a result, IEC, the international standard, may be adopted depending on the situation.

- IEC 60044-1 Instrument transformers - Part 1: Current transformers
- IEC 60044-1 Instrument transformers - Part 5: Capacitor voltage transformers
- IEC 60071 Insulation coordination
- IEC 60076 Power transformers
- IEC 60099-4 Surge arresters - Part 4: Metal-oxide surge arresters without gaps for a.c. systems
- IEC 60265-2 High-voltage switches - Part 2: High-voltage switches for rated voltage of 52 kV and above
- IEC 60694 Common specifications for high-voltage switchgear and control gear standards
- IEC 61850 Communication networks and systems in substations
- IEC 62271-100 High-voltage switchgear and control gear - Part 100: High-voltage alternative-current circuit breakers
- IEC 62271-102 High-voltage switchgear and control gear - Part 102: Alternative-current disconnectors and earthing switches
- IEC 62271-203 High-voltage switchgear and control gear - Part 203: Gas-insulated metal-enclosed switchgear for rated voltage above 52 kV

If IEC standards are not applicable, international standards such as ANSI, ASTM, BS, JIS, and JEM may be considered.

The resistance of the grounding system shall be designed in accordance with the American Institute of Electrical and Electronics Engineers standard IEEE 80.

(3) Design condition

Based on the technical specification ET-N of MINEA (ET-N-008-Ed.1, ET-N-014-Ed.2, ET-N-101-Ed.1) and the design conditions of 220/60 kV New Namibe SS prepared by MINEA (Construction of 220/60 kV New Namibe SS, MD-SB-NM 220, April 2018), the design conditions for the project are established as follows

(a) Weather conditions

The weather conditions for the substation facilities are shown in the table below. Regarding the salt pollution level, since the proposed 220/60 kV New Namibe SS construction site is close to the coast, the pollution status of the existing equipment will be checked and the pollution level upgrade will be considered.

Table 7.5-1 Weather conditions

Item	220/60 kV Namibe SS	220/60 kV East Lubango SS	60/15 kV Arimba SS
Maxi temp	50 ºC	30 ºC	30 ºC
Min temp	0 ºC	0 ºC	0 ºC
Avg temp	< 40 ºC	< 30 ºC	< 30 ºC
Maxi wind sp	33 m/s	-	-
Contamination	Very Heavy 31 mm/kV	Medium 20 mm/kV	Medium 20 mm/kV
Altitude	170 m	1700 m	1700 m

Source: Construction of substation 220/60 kV Namibe, MD-SB-NM220, MINEA

(b) Equipment Common Specifications

The following table shows common specifications for equipment in substation equpmet. In addition, the current specifications are based on the Chapter 3 The following table shows the power flow results of the system analysis based on the future plan in Chapter 3, as well as the specifications for the bus-bar short-circuit currents of the existing substations.

Table 7.5-2 Current Specifications

Rated voltage	Rated current	Rated short-time withstand current (RMS)	Rated short-time withstand current (Wave height)
220 kV	3150 A	50 kA (3 sec)	125 kA
60 kV	2500 A	31.5 kA (3 sec)	80 kA
15 kV	2500A	25kA (1 sec)	63 kA

Table 7.5-3 Voltage Specifications

Rated voltage	Maximum voltage	Short-time commercial frequency withstand voltage (50 Hz, 1 min)	Lightning impulse withstand voltage
220 kV	245 kV	460 kV 395 kV (switchgear)	1050 kV 950 kV (switchgear)
60 kV	72.5 kV	140 kV	325 kV
15 kV	24 kV	50 kV	125 kV

Table 7.5-4 Minimum Separation Distance

Maximum voltage	Phase-to-phase	Phase-to-ground
245 kV	2400 mm	2100 mm
72.5 kV	630 mm	720 mm
24 kV	480 mm	540 mm

Table 7.5-5 Others

Item	220/60 kV Namibe SS	220/60 kV East Lubango SS	60/15 kV Arimba SS
Phases	3		
Frequency	50 Hz		
Neutral grounding method	Direct grounding (220 kV, 60 kV)	Direct grounding (220 kV, 60 kV)	Direct grounding (60 kV)

Source: Construction of substation 220/60 kV Namibe, MD-SB-NM220, MINEA

7.5.7. Seismic Impact Assessment

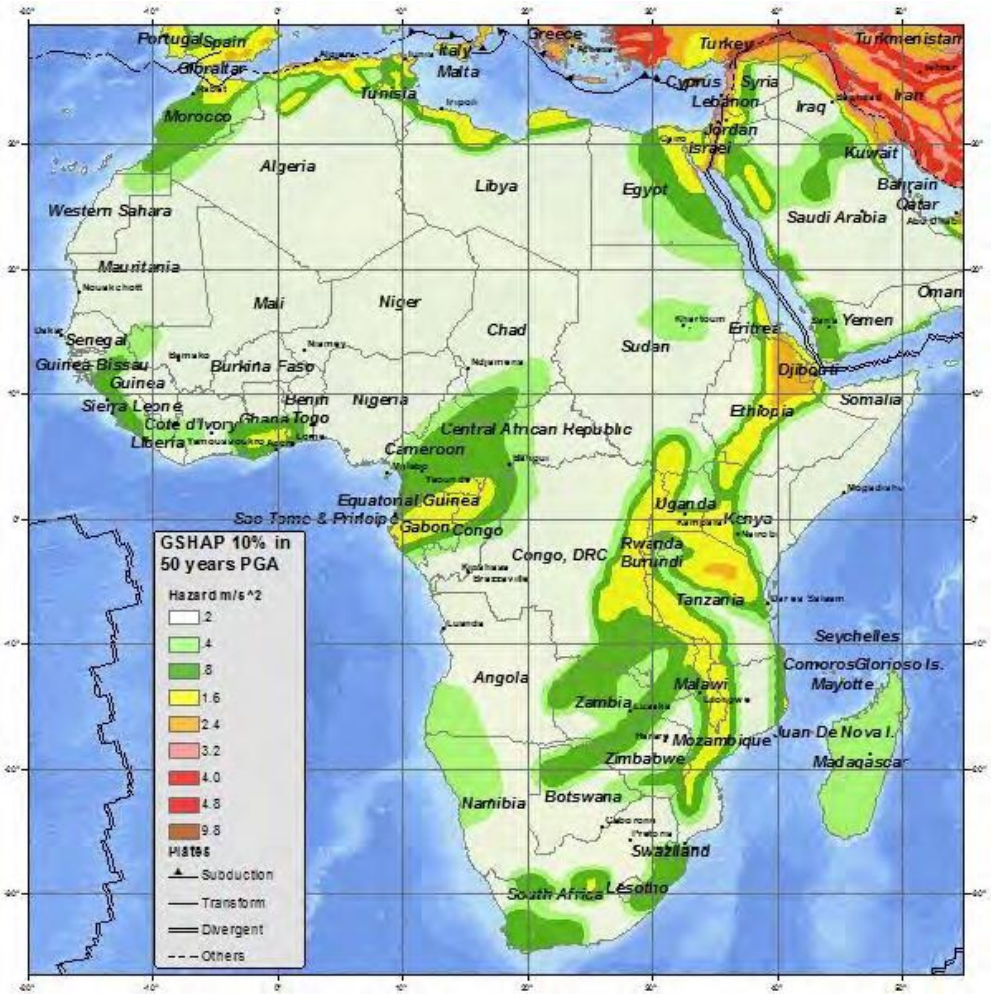


Figure 7.5-6 Seismic risk map of Africa (PGA: Peak Ground Acceleration)

Source: United States Geological Survey

According to the seismic risk map shown above, the seismic acceleration in the Namibe region of southern Angola is 0.4 m/s2 or 40 gal in terms of maximum surface acceleration (PGA). This is a relatively small value to be considered in equipment design and is not a problematic level.

7.5.8. Design Policy

220/60 kV New Namibe SS for RNT's power transmission substation and will be applied with indoor GIS type. RNT has requested an indoor substation, including transformers, considering the effects of salt damage and sand dust. On the other hand, the outdoor substation allows the use of heavy equipment during construction, which makes it easier to construct transformer and GIS expansions and shortens the construction period, and the outdoor substation building is smaller than the indoor substation building, which reduces building construction costs. The JICA survey team has proposed an outdoor substation, but has not been able to obtain the RNT's agreement. An indoor substation would require three transformers (including on additional one for future use) and a GIS building, which would require a larger building than an outdoor substation, resulting in higher substation construction costs and a longer construction period. In addition, for future additions of 220 kV TL and 60 kV DL, it will be necessary to secure a building and site that takes into account the increase in feeders connected to the GIS. In the case of large equipment replacement that requires space for temporary equipment installation for indoor equipment, the outdoor site should be secured. Specifically, when replacing transformers and GIS, after removing the existing equipment, the new equipment that are temporarily placed in the vacant space on the lower right side of Figure 7.5-9 will be moved to the installation location.

During the survey trip, RNT informed the JICA survey team that "the 220/60 kV New Namibe SS has been officially decided as an indoor GIS substation," so RNT and ENDE asked to check the

operation status of aged outdoor GIS at power stations and substations in salt-affected areas in the TEPCO service area and GIS equipment manufacturer factories to encourage the change from indoor to outdoor substations. The visits to the Higashi Ogishima Thermal PS, Minami-Kawasaki Substation, and Kawasaki Substation in the Tokyo Bay area confirmed the operation of outdoor transformers, outdoor GIS, outdoor shunt reactors, etc. in salt-affected areas, and although Angola's understanding was obtained regarding the operation of aged outdoor equipment in Japan, RNT's policy remains unchanged for indoor GIS substations. However, the indoor substation that takes in outside air through the ventilation louvers, which has been adopted in Angola, is not desirable in a sand and dust district because it directly takes in outside air. Based on the results of the underground substation at the new Toyosu substation, we considered the removal effect of sand and dust by dust filters and the forced ventilation and temperature rise control by intake and exhaust fans. As a result of considering the effects, it was decided to adopt an indoor GIS substation with forced ventilation by fans.

The 220/60 kV East Lubango SS will use outdoor AIS. Sufficient substation site area is available near the intersection of the existing 150 kV transmission line and the new 220 kV TL, allowing for future expansion of 220 kV TL (RNT) and 60 kV DL (ENDE).

The 60/15 kV Arimba SS is an ENDE outdoor distribution substation and will employ AIS. All facilities under 60 kV at the 60/15 kV Arimba SS will be under the jurisdiction of ENDE (both 60 kV DL and 15 kV distribution lines will be under the jurisdiction of ENDE). On the other hand, since the Arimba 1 SS is under the jurisdiction of PRODEL, the Arimba 2 SS is also assumed to be under the jurisdiction of PRODEL. The 60 kV bus bar connection between the Arimba 2 PS and the substation is requested by RNT, and the bus bar connection is assumed to be under the jurisdiction of ENDE by adopting underground cables. However, RNT avoided giving a clear answer for the demarcation point between ENDE and PRODEL. Therefore, based on the general concept of the construction demarcation point, the JICA survey team assumed the bus bar connection point of the Arimba 2 PS as the responsible demarcation point. Specifically, the scope of construction of ENDE is assumed to be up to the 60 kV cable head of the Arimba 2 PS, while the overhead line connection between the cable head and the bus bar and the related switchgear are considered as power station equipment and are considered as PRODEL's scope of construction. In addition, securing the underground cable burial route is required for both ENDE and PRODEL.

The basic design took into account as much as possible the existence of multiple agencies involved, including RNT, ENDE, and PRODEL, as well as the construction of the 400/220/60 kV Nombungo SS and plans for future lines for the preceding AfDB project. In particular, when the Angolan side confirmed the plans for future transmission and distribution lines, lines with a high degree of certainty were marked as "Reserve" and the related equipment was implemented, while lines with a low degree of certainty (at the conceptual stage) were marked as "Future" and the equipment was not implemented. The responsibility demarcation points and the scope of construction will also be clarified through discussions with the Angolan side, and the data will ultimately contribute to the detailed study.

7.5.9. Overview Design

(1) 220/60 kV New Namibe SS

The single line diagram and draft layout diagram for the 220/60 kV New Namibe SS are shown below. The red in the diagrams distinguish the equipment to be installed and the black in the diagrams distinguish the equipment space for future use. Equipment for future use must be installed by RNT: 8 x 220 kV feeders (including 4 transmission feeders, bus coupler, 2 transformers, 1 shunt reactor, and excluding Tombwa’s 2 future feeders and 1 future transformer feeder), 1 x 220 kV shunt reactor, 1 x 220/60 kV transformer (excluding one transformer for future use), and 9 60 kV feeders (including 4 distribution feeders, 2 power station interconnection feeders, 1 bus cupler, and 2 transformer feeders, and excluding 1 distribution feeder for future use and 1 transformer feeder for future use). Although the MP has information on the new Namibe thermal power station, the specific construction plan is unknown, so it is not considered as a 220 kV future-use feeder.

Both 220 kV and 60 kV busbars will be applied a double busbar GIS system to prevent salt damage and dust damage. Each transformer having a capacity of 120 MVA and the two units having a total capacity of 240 MVA. Two (2) interconnection feeders from the existing Xitoto 3 PS are connected to the 60 kV busbar. Even if Units 1 and 2 of the existing Xitoto 3 PS on were to shut down simultaneously, resulting in a simultaneous loss of 60 kV output from that power station, the system is capable of

supplying the loads of two distribution substations (the 60/15 kV Existing ENDE Namibe SS and the 60/15 kV New ENDE Namibe SS) with up to 80 MVA (two 60/15 kV transformers of 40 MVA) and 60 MVA (two 60/15 kV transformers of 30 MVA) respectively, supplied from two 220/60 kV transformers.

The capacity of the 220 kV shunt reactor was set at 30 MVAR. There are two ways to consider the shunt reactor capacity of a new 220 kV TL: either the results of calculations under the most severe conditions (light load cross-section), or 100 % compensation of the transmission line. The capacity of the 220 kV shunt reactor was determined based on the concept of 100 % compensating of the transmission line.The capacity is 30 MVAR/cct, which doubles to 60 MVAR for the two lines. Here, if half of the capacity is generally installed at both ends (Namibe and Nombungo substation ends), half of the capacity at the Namibe end would be 30 MVAR. Considering the small amount of 220 kV TL charge to Tombwa, the increase in load at Namibe and Tombwa, the new Namibe thermal power station, and other future demand growth and power supply development, the actual required compensation capacity is considered sufficient because it will lessen in the future when demand increase. In other words, this study was based on the latter of the most severe conditions and considered the safety side.

In addition, on the 400/220/60 kV Nombungo SS side, shunt reactor installation should be considered for 400 kV transmission line compensation on the upper system, and if the 400 kV voltage at Nombungo is within the specified value, the 400 kV/220 kV transformer at Nombungo can be expected to necessarily suppress the 220 kV bus line voltage as well. In other words, the reactive power adjustment of the 220 kV TL at the 400/220/60 kV Nombungo SS will not be implemented at 220 kV, but will be implemented by the reactive power adjustment of the upper system's 400 kV.

Therefore, we considered that 30MVAR is a good reactive power value on the 220/60 kV New Namibe SS side, considering re-transmission conditions based on the span length of the 220 kV TL. Ultimately, we believe that the cost of capital investment should be reduced by determining an appropriate reactive power capacity (30 MVAR or lower), taking into account the results of system analysis of voltage and reactive power control, etc. in the detailed study.

The 220 kV feeders will be a two-circuit 220 kV TL between the 220/60 kV East Lubango SS and 220/60 kV New Namibe SS, which will be newly constructed under the project, and will connect two lines for transformers, one line for shunt reactors, and a bus line connection. A reserve line (Reserve) will also be implemented for future connection of two 220 kV TL for Sakomar. In addition, although GIS will not be implemented, space will be reserved for the installation of 220 kV GIS for the No. 3 transformer and 2 lines for Tombwa as future lines (Future).

The 60 kV feeders will be two lines from the Xitoto 3 PS, two lines from the 60/15 kV Exisitng Namibe SS, two lines from the 60/15 kV New Namibe SS, two lines for transformers, bus coupler, and two spare lines (Future-No. 3Tr, 60 kV 1 line). For the 60/15 kV Exisitng Namibe SS feeder and the 60/15 kV New Namibe SS feeder, it is assumed that the 60 kV 1 feederwill be put into operation first according to Angolan practice. However, in order to maximize the effect of this project, it is necessary to connect two lines together to ensure a high level of reliability, so a second 60 kV GIS feeder will be implemented (Existing Namibe 2L and a reserve line for New ENDE Namibe 2L).

In anticipation of future demand growth, the capacity of the two existing transformers is set at 120 MVA, but there are plans by RNT to add a third transformer. Therefore, in consideration of RNT's requirements, a new foundation for 120 MVA needs to be built in the space where the additional transformer will be installed. In addition, one 220 kVGIS line and one 60 kVGIS line for the transformer will also need to be added to accommodate the third transformer due to increased demand. According to the 2040 peak cross-sectional power flow diagram in Section 2.2 in Figure 1.6-2, the peak load on the 60 kV side of the 220/60 kV New Namibe SS is 223 MVA (212.7 MW, 66.4 MVAR), and considering N-1 criteria, three 120 MVA transformer capacity units are required, in which case N-1 criteria (two transformers) would be 240 MVA.

Figure 1.6-2 shows the peak cross-sectional power flow diagram in 2040 for the 220/60 kV New Namibe SS 213 MW (82.2%) and Tombwa 46 MW (17.8%), when referring only to active power. On the other hand, Figure 1.6-8 shows the demand in Namibe is as follows: 2025: 119 MW, 2040: 259 MW, which makes sense as of 2040.

In 2025, the 220/60 kV New Namibe SS is about 98 MW (= 119 MW x 0.822), so considering N-1 criteria, two transformer capacities of 120 MVA are required, in which case N-1 criteria (one transformer) is 120 MVA, which is sufficient capacity.

In 2030, the 220/60 kV New Namibe SS is about 139 MW (= 169 MW x 0.822), so three 120 MVA transformer capacity units are required, which is 240MVA when considering N-1 critera (two transformers).

Since the 220 kV TL to Tombwa needs to be two lines to ensure higher reliability as shown in the MP, two GIS spaces are reserved as future feeders so that the 220 kV GIS lines can be expanded according to RNT's plan to expand the Tombwa transmission line. The 220 kV TL to Tombwa is described as "Future" because the construction date of the 220 kV TL to Tombwa is not clear, and two GIS lines for Tombwa will not be implemented in this project.

As for the 60 kV DL connecting the 60/15 kV Existing Namibe SS and the 60/15 kV New Namibe SS, according to Angolan practice, it is assumed that one line will be commencement of operation first, but in order to maximize the effect of the project, it is necessary to have two lines that ensure a high level of reliability, so a pulling ready feeders (Existing Namibe 1L (COD) and 2L (Reserve), New ENDE Namibe (COD) and 2L (Reserve) are implemented.

The 60 kV and 15 kV distribution system diagram at the completion of the project is shown below. A total of six 60 kV DL will be connected from the 220/60 kV New Namibe SS to the 60/15 kV Existing Namibe SS, the 60/15 kV New Namibe SS and the Xitoto 3 PS, each with two 60 kV lines.

Figure 7.5-7 shows the 60 kV system diagram for the future connection to the 220/60 kV New Namibe substation in the Namibe region.

(1) The construction of the 60 kV power interconnection line from the Xitoto 3 PS to the 220/60 kV New Namibe SS will be financed by MINEA and constructed, operated and maintained by ENDE.

(2) The 60/15 kV Existing Namibe SS is planned to be completely renewed by ENDE with funding from KfW in Germany. This renewal of the 60/15 kV Existing Namibe SS is planned to replace the 60 kVAIS with a 60 kVGIS on the adjacent land, install two more 40 MVA transformers and relocate the existing 60 kV and 15 kV distribution lines. In addition, MINEA will finance the construction of a 60 kV DL from the 220/60 kV New Namibe SS to the 60/15 kV Existing Namibe SS, and ENDE will construct, operate and maintain the line.

(3) Financing for the construction of the 60/15 kV Namibe Airport SS (New ENDE Namibe (Aeroport)) and the 60 kV DL from the 220/60 kV New Namibe SS to the 60/15 kV Namibe Airport SS will be provided by MINEA, implemented by MINEA and constructed, operated and maintained by ENDE.

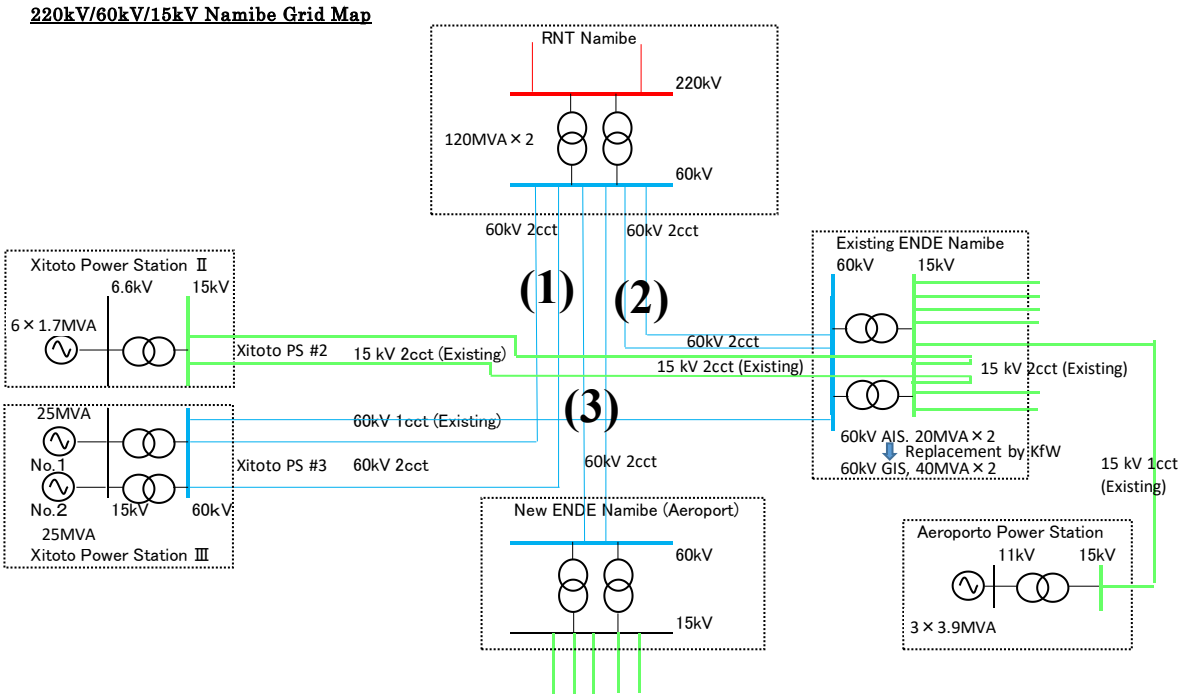


Figure 7.5-7 220 kV/60 kV/15 kV grid map of the Namibe region (at completion of the project)

Source: ENDE

A route map was obtained from ENDE for the construction of the 60 kV DL to be implemented by ENDE in conjunction with the project. Existing 60 kV DL route (a) from Xitoto PS III to the 60/15 kV

Existing Namibe SS is shown as black line; route (b) from 220/60 kV New Namibe SS (RNT Namibe) to 60/15 kV Existing Namibe SS, and the 60 kV DL construction route (c) from the 220/60 kV New Namibe SS to the 60/15 kV Namibe Airport SS (New ENDE Namibe (Aeroport)) are shown as white lines in Figure 7.5-8.

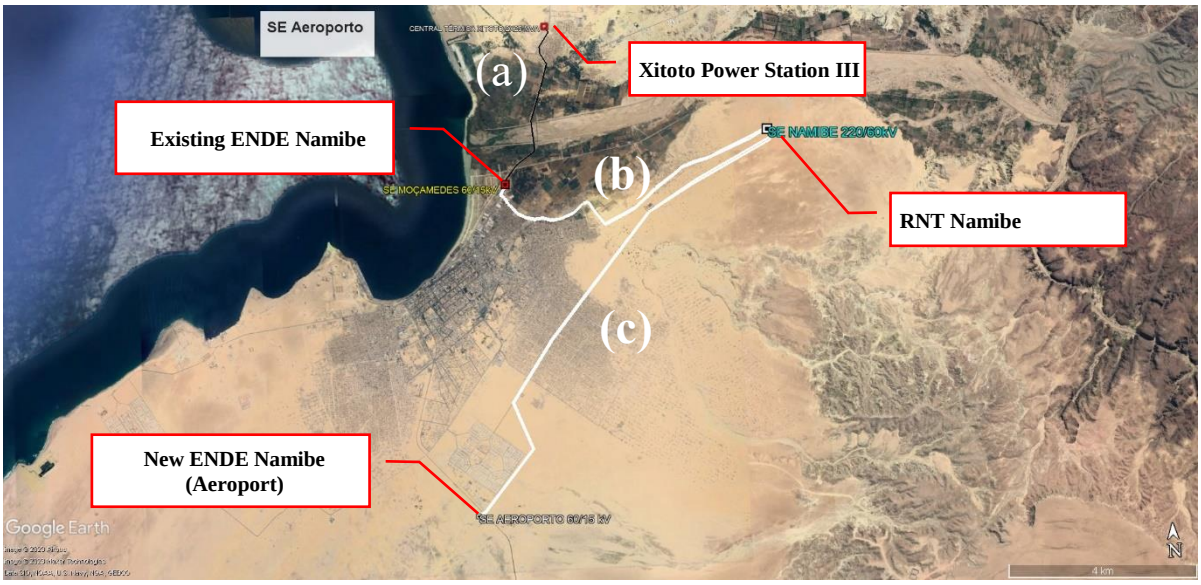


Figure 7.5-8 Route map of the 60 kV DL in Namibe area (not covered by the project, planned and implemented by ENDE).

Source: ENDE

The table below shows the specifications of the 60 kV DL to be constructed by ENDE in conjunction with the project. (1) (= (a) + (b)) from the Xitoto PS III to the 220/60 kV New Namibe SS, (2) (= (b)) from the 220/60 kV New Namibe SS to the 60/15 kV Existing Namibe SS and (3) (= (c)) from the 220/60 kV New Namibe SS to the 60/15 kV Namibe Airport SS. All three lines will be constructed by ENDE with MINEA funding. Considering N-1 for the operation of two 60 kV DL, 80 MW can be transmitted on one line and distribution line overloads can be avoided.

In addition, the total renewal of the associated 60/15 kV Existing Namibe SS will be carried out by ENDE using KfW funds, while the construction of the new 60/15 kV Namibe Airport SS will be planned and implemented by ENDE using MINEA funds. All Angolan side projects related to the project are planned to be implemented by 2025, so it is essential that the Angolan side related projects are urgently developed.

Table 7.5-6 60 kV DL specifications (not covered by the project, ENDE plan implementation)

Route (1)

From	Xitoto Power Station III
To	RNT Namibe
Route	(a) + (b)
Length	11km
Voltage	60kV
Number of circuit	2
Transmission capacity/cct	85MW
Size os conductor	Yew 479mm2
Number of conductor (s)	1
Ownershup/responsibility	ENDE
Fund	MINEA and ENDE
COD	By 2025
Autorization/Aproved by	MINEA

Route (2)

From	RNT Namibe
To	Exisiting ENDE Namibe
Route	(b)
Length	7km
Voltage	60kV
Number of circuit	2
Transmission capacity/cct	85MW
Size of conductor	Yew 479mm2
Number of conductor (s)	1
Ownershup/responsibility	ENDE
Fund	MINEA and ENDE
COD	By 2025
Autorization/Aproved by	MINEA

Route (3)

From	RNT Namibe
To	New ENDE Namibe (Aeroport)
Route	(c)
Length	11km
Voltage	60kV
Number of circuit	2
Transmission capacity/cct	85MW
Size of conductor	Yew 479mm2
Number of conductor (s)	1
Ownershup/responsibility	ENDE
Fund	MINEA and ENDE
COD	By 2025
Autorization/Aproved by	MINEA

Reignforcement of 60/15kV Exsiting Namibe S/S (No discussion with ENDE)

Capacity of transformer	80 MVA
Number of transformer(s)	2 units
Type of substation	Indoor GIS
Ownership/ Responsibility	ENDE
Fund	KfW
COD	By 2025
Autorization/Approved by	MINEA

New ENDE Namibe (Aeroport)

Transformer capacity	40MVA(Tr:20MVAx2), Indoor GIS
Ownership/ Responsibility	ENDE
Fund	MINEA and ENDE
COD	By 2025
Autorization/Approved by	MINEA

Note: “Route lines” are shown in Figure 7.5-8
Source: ENDE

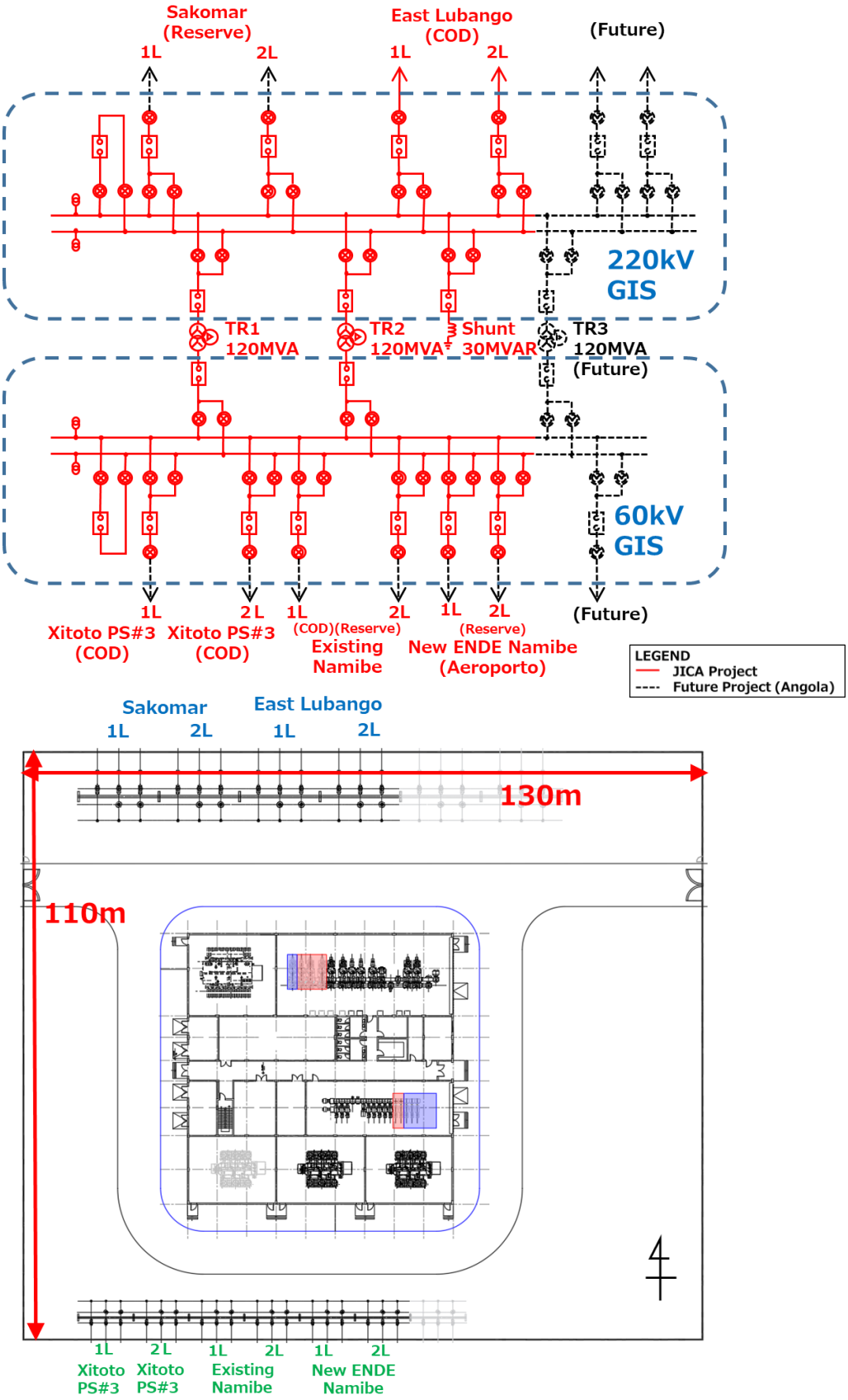


Figure 7.5-9 Single line wiring diagram and draft layout of Namibe substation

Source: JICA Survey Team

Table 7.5-7 220/60 kV New Namibe SS Main Equipment List

No.	Name of equipment	Technical specification	Unit	Qty.
1	**Transformers and Shunt Reactor**			
1-1	Main Transformer TR1, TR2	220/60/15 kV, 120 MVA	unit	2
1-2	Auxiliary Transformer #1, #2	15/0.4kV, 400 kVA	unit	2
1-3	Shunt Reactor	220 kV, 30MVAR	unit	1
2	**220 kV switchgear (GIS)**			
2-1	220 kV Transformer bay #1, #2	3150A, 50 kA	Bay	2
2-2	220 kV Shunt Reactor bay	3150A, 50 kA	Bay	1
2-3	220 kV TL bay (East Lubango 1L, 2L)	3150A, 50 kA	Bay	2
2-4	220 kV TL bay (Sakomar 1L, 2L)	3150A, 50 kA	Bay	2
2-5	220 kV Bus coupler bay	3150A, 50 kA	Bay	1
3	**60 kV switchgear (GIS)**			
3-1	60 kV Transformer bay #1, #2	2500A, 31.5 kA	Bay	2
3-2	60 kV Generation line bay (Xitoto PS #3 1L, #3 2L)	2500A, 31.5 kA	Bay	2
3-3	60 kV DL bay (Exisiting Namibe 1L, 2L)	2500A, 31.5 kA	Bay	2
3-3	60 kV DL bay (New ENDE Namibe 1L, 2L)	2500A, 31.5 kA	Bay	2
3-4	60 kV Bus coupler bay	2500A, 31.5 kA	Bay	1
4	**Control panels, protective relays, etc.**			
4-1	Control Panel (220 kV)		Panel	8
4-2	Control Panel (60 kV)		Panel	9
4-3	Protection Relay (220/60 kV Transformer)		Panel	2
4-4	Protection Relay (220 kV Shunt Reactor)		Panel	1
4-5	Protection Relay (220 kV Generation & Transmission line)		Panel	4
4-6	Protection Relay (220 kV Bus Protection)		Panel	1
4-7	Protection Relay (60 kV DL)		Panel	6
4-8	Protection Relay (60 kV Bus Protection)		Panel	1
4-9	SAS		set	1
4-10	SCADA system		set	1
4-11	RTU (for communication connection)		set	1
4-12	Optic fiber communication system		set	1
4-13	DC Charger, battery		set	1
4-14	LV AC Distribution system		set	1
4-15	Firefighting Equipment		set	1
4-16	Forced Air Ventilation and Filter		set	1

Source: JICA Survey Team

Table 7.5-8 220/60 kV New Namibe SS Construction Classification

No.	Line name	Equipment Installation (GIS etc.)	Conductor Connection (TL/DL etc.)	Demarcation point
1	**220 kV TL**			
1-1	East Lubango 1L, 2L	JICA Project	JICA Project	-
1-2	Sakomar 1L, 2L (Reserve)	JICA Project	RNT	Cable Head / Gantry
1-3	(Future) 1L, 2L	RNT	RNT	-
2	**60 kV Generation & Transmission line**			
	60 kV underground cables from 60 kV GIS to 60 kV Gantry	JICA Project	—	—
2-1	Xitoto PS #3 1L, #3 2L (Reserve)	JICA Project	PRODEL	Cable Head / Gantry
2-2	Existing Namibe 1L, 2L (Reserve)	JICA Project	ENDE	Cable Head / Gantry
2-3	New ENDE Namibe 1L, 2L (Reserve)	JICA Project	ENDE	Cable Head / Gantry
2-4	(Future)	RNT	ENDE	-
3	**220/60 kV Transformer**			
3-1	Transformer TR1, TR2	JICA Project	JICA Project	-
3-2	Transformer TR3 (Future)	RNT	RNT	-
4	**220 kV Shr**			
4-1	Shunt Reactor	JICA Project	JICA Project	-

Source: JICA Survey Team

(2) 220/60kV East Lubango SS

The single line diagram diagram and draft layout diagram for the 220/60 kV East Lubango SS is shown below, which consists of 9 x 220 kV feeders (6 transmission, bus coupler and 2 transformers), 2 x 220/60 kV transformers and 5 x 60 kV feeders (including 2 distribution, bus coupler and 2 transformers).

In the candidate sites with sufficient area, 220 kV AIS and 60 kV AIS shall be adopted. 220 kV and 60 kV systems shall both apply the double bus-bar system.

The 220 kV feeders include two transmission lines each between the new 400/220/60 kV Nombungo and 220/60 kV East Lubango substations and between the East Lubango and Namibe substations to be built under the project, and to two feeders for transformers and bus coupler. In addition, one line will be installed to connect the 150/60 kV Existing Lubango substation and the 220 kV line (planned to replace the former 150 kV line) for Matala. In addition, 220 kV line space for the Existing Lubango substation 2L and Matala 2L will be reserved for future use.

Two 220/60 kV transformers with a capacity of 120 MVA will be installed, along with the space for the addition of a third transformer in the future.

Figure 1.5-10 shows the MP study for the Lubango region, the results are 164 MW in 2025, 244 MW in 2030, 334 MW in 2035, and 434 MW in 2040. In the grid analysis with the 400 kV Nombungo substation in operation, the results are according to Figure 3.1-1, power flow calculation results for the Lubango region in 2026, and Figure 3.1-2, power flow calculation results for the Lubango region in 2030, also confirm that the substation will not be overloaded.

The 60 kV feeders shall be two transmission lines for the new East Lubango - Arimba distribution line, two feeders for transformers, and a bus coupler to be built under the project. If connections other than the two distribution lines to the 60/15 kV Arimba SS are implemented, resulting in a capacity of 120 MVA, a third transformer addition will be required to account for N-1 craiteria.

When the 220/60 kV East Lubango SS is commissioned, the 220 kV TL connecting the Matala SS and the 60/15 kV Existing Lubango SS is planned to be operated as a single line diagram. In order to ensure higher reliability, it is necessary to have two circuit, so space is reserved for additional feeders according to the expansion plan.

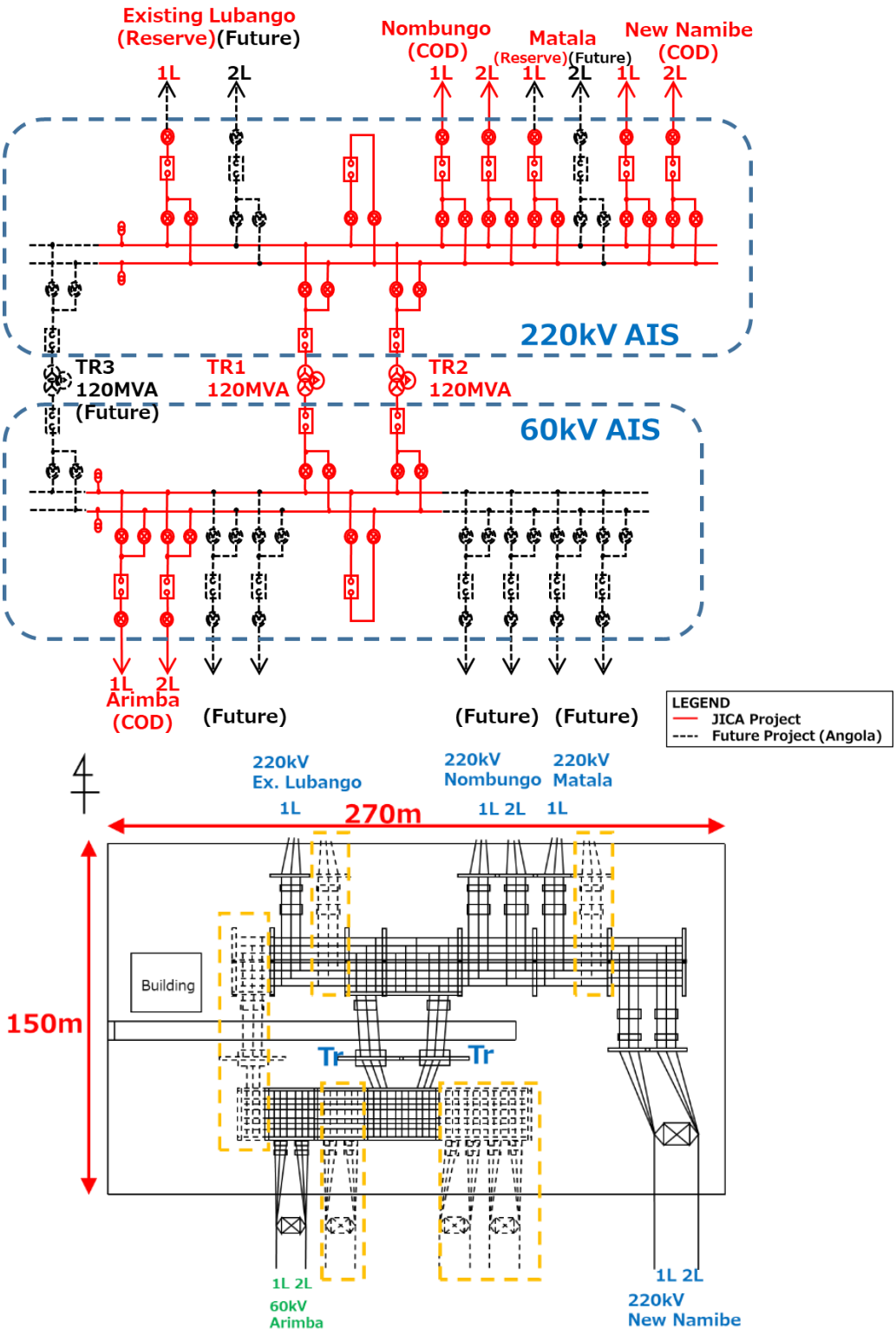


Figure 7.5-10 Single line diagram and outline layout of the 220/60 kV East Lubango SS

Source: JICA Survey Team

Table 7.5-9 220/60 kV East Lubango SS List of Main Equipment

No.	Name of equipment	Technical specification	Unit	Qty.
1	**Transformer**			
1-1	Main Transformer TR1, TR2	220/60/15 kV, 120 MVA	unit	2
1-2	Auxiliary Transformer #1, #2	15/0.4kV, 400 kVA	unit	2
2	**220 kV switchgear (AIS)**			
2-1	220 kV Transformer feeder #1, #2	3150A, 50 kA	feeder	2
2-2	220 kV TL feeder (Nombungo 1L, 2L)	3150A, 50 kA	feeder	2
2-3	220 kV TL feeder (Namibe 1L, 2L)	3150A, 50 kA	feeder	2
2-4	220 kV TL feeder (Existing Lubango 1L)	3150A, 50 kA	feeder	1
2-5	220 kV TL feeder (Matala 1L)	3150A, 50 kA	feeder	1
2-6	220 kV Bus coupler	3150A, 50 kA	feeder	1
3	**60 kV switchgear (AIS)**			
3-1	60 kV Transformer feeder #1, #2	2500A, 31.5 kA	feeder	2
3-2	60 kV DL feeder (Arimba 1L, 2L)	2500A, 31.5 kA	feeder	2
3-3	60 kV Bus coupler	2500A, 31.5 kA	feeder	1
4	**Control panels, protective relays, etc.**			
4-1	Control Panel (220 kV)		Panel	9
4-2	Control Panel (60 kV)		Panel	5
4-3	Protection Relay (220/60 kV Transformer)		Panel	2
4-4	Protection Relay (220 kV TL)		Panel	6
4-5	Protection Relay (220 kV Bus Protection)		Panel	1
4-6	Protection Relay (60 kV DL)		Panel	2
4-7	Protection Relay (60 kV Bus Protection)		Panel	1
4-8	SAS		set	1
4-9	SCADA system		set	1
4-10	RTU (for communication connection)		set	1
4-11	Optic fiber communication system		set	1
4-12	DC Charger, battery		set	1
4-13	LV AC Distribution system		set	1
4-14	Firefighting Equipment		set	1

Source: JICA Survey Team

Table 7.5-10 220/60 kV East Lubango SS Construction Classification

No.	Line name	Equipment Installation (GIS etc.)	Conductor Connection (TL/DL etc.)	Demarcation point
1	**220 kV TL**			
1-1	Nonbungo 1L, 2L	JICA Project	JICA Project	-
1-2	New Namibe 1L, 2L	JICA Project	JICA Project	-
1-3	Existing Lubango 1L(Reserve)	JICA Project	RNT	Conductor at Gantry / AIS
1-4	Existing Lubango 2L(Future)	RNT	RNT	-
1-5	Matala 1L(Reserve)	JICA Project	RNT	Conductor at Gantry / AIS
1-6	Matala 2L(Future)	RNT	RNT	-
2	**60 kV DL**			
2-1	Arimba 1L, 2L	JICA Project	JICA Project	-
2-2	(Future) 6 lines	RNT	ENDE	-
3	**220/60 kV Transformer**			
3-1	Transformer TR1, TR2	JICA Project	JICA Project	-
3-2	Transformer TR3 (Future)	RNT	RNT	-

Source: JICA Survey Team

(3) 60/15 kV Arimba SS

The single line diagram diagram and draft layout diagram for the 60/15 kV Arimba substation is shown below, which consists of 8 x 60 kV feeders (3 distribution lines, 2 transformers, and 3 future lines), 2 x 60/15 kV transformers, and 16 x 15 kV cubicle lines (10 distribution lines, 2 bus sections, and 2 transformers).

A 60 kV AIS and a 15 kV cubicle shall be adopted; single busbar system shall be applied for both.

The 60 kV feeder will be a two-circuit pull in of the transmission line for distribution between the 220/60 kV East Lubango SS and the 60/15 kV Arimba SS, which will be newly constructed under the project, also include one underground transmission line for the Arimba 2 PS interconnection and two feeders for the primary transformer. In addition, one 60 kV spare line will be installed for future connection of the Existing Lubango substation 1L (scheduled for 2030). In addition, space will be reserved for two future distribution lines (Existing Lubango 2L, line name to be determined).

The 60/15 kV transformers are two units with a capacity of 50 MVA, and 10 x 15 kV distribution lines are the main load, so the capacity per 15 kV distribution line is about 10 MVA (with the current of 385A).

The 15 kV feeder shall consist of 10 distribution lines (split into 4 and 6 lines per bank, taking into account the direction of distribution line installation, including those for future use), 2 feeders for secondary transformers, 2 feeders for auxiliary transformers, and 2 feeders for bus section.

In consultation with ENDE, the 15 kV cubicles will be divided into two groups and the design will be considered to transmit 15 kV distribution lines to the west and east based on future plans for 15 kV distribution lines, and a design will be prepared to locate them within the site area of the candidate site secured by ENDE.

The existing Arimba 1 PS is in operation, and a single 15 kV distribution line from the existing Arimba 1 PS to the Existing Lubango substation is already connected to the grid as a power supplying line, supplying electricity to the center of Lubango.

The connection of three 60 kV DL for future use (1L at the Existing Lubango substation and two (2) lines to be determined (Future)) and the connection of all 15 kV distribution lines will be connected by ENDE after the substation is completed.

For the construction of the 60/15 kV Arimba SS, the scope of the project will be the red line on the SLD below or the black line on the plan view. The scope of construction will also include the pulling work from the 60 kV DL.

The Arimba 2 PS under construction is planned to be connected to the 150/60 kV existing Lubango substation at 60 kV.

At the start of operation of the 60 kV Arimba substation, a 60 kV underground line will be connected from the 60/15 kV Arimba SS main line to the new Arimba 2 PS, and a first 60 kV DL from Arimba 2 PS to the 150/60 kV Existing Lubango SS. In 2030, a second 60 kV power line from the 60/15 kV Arimba SS to 150/60 kV Existing Lubango SS will be connected to the grid. In addition, in order to ensure a higher level of reliability in the event of future increases in demand, a second 60 kV DL to the 150/60 kV Existing Lubango SS is being prepared for a second 60 kV line.

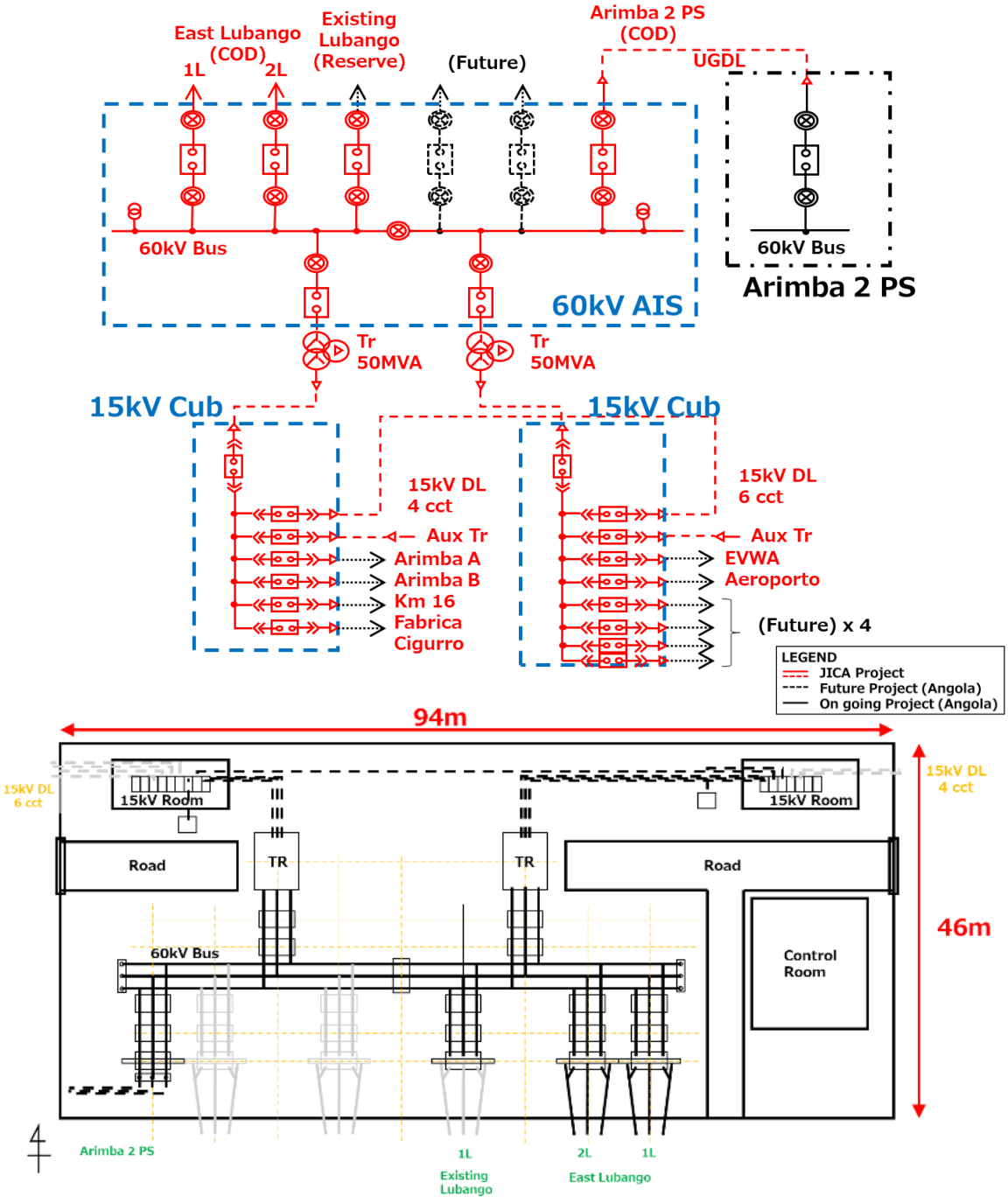


Figure 7.5-11 Single line diagram and outline layout of the 60/15 kV Arimba SS

Source: JICA Survey Team

Table 7.5-11 List of main equipment of Arimba substation

No.	Name of equipment	Technical specification	Unit	Qty.
1	**Transformer**			
1-1	Main Transformer Tr1, Tr2	60/15 kV, 50 MVA	unit	2
1-2	Auxiliary Transformer #1, #2	15/0.4kV, 250 kVA	unit	2
2	**60 kV switchgear (AIS)**			
2-1	60 kV Transformer feeder #1, #2	2500A, 31.5 kA	feeder	2
2-2	60 kV DL feeder (East Lubango 1L, 2L)	2500A, 31.5 kA	feeder	2
2-3	60 kV DL feeder (Existing Lubango 1L)	2500A, 31.5 kA	feeder	1
2-4	60 kV UGDL feeder (Arimba 2 PS)	2500A, 31.5 kA	feeder	
3	**15 kV Switchgear (cubicle)**			
3-1	15 kV Transformer feeder #1, #2	2500A, 25 kA	Panel	2
3-2	15 kV DL feeder	2500A, 25 kA	Panel	10
3-3	15 kV Auxiliary feeder		Panel	2
3-4	15 kV Bus Divider	2500A, 25 kA	Panel	2
3-5	15 kV Bus PT		Panel	2
4	**Control panels, protective relays, etc.**			
4-1	Control Panel (60 kV)		Panel	6
4-3	Protection Relay (60/15 kV Transformer)		Panel	2
4-4	Protection Relay (60 kV DL)		Panel	4
4-5	Protection Relay (60 kV Bus Protection)		Panel	1
4-6	SAS		set	1
4-7	SCADA system		set	1
4-8	RTU (for communication connection)		set	1
4-9	Optic fiber communication system		set	1
4-10	DC Charger, battery		set	1
4-11	LV AC Distribution system		set	1
4-12	Firefighting Equipment		set	1

(15 kV control and protection will be installed in cubicles)
Source: JICA Survey Team

Table 7.5-12 60/15 kV Arimba SS Construction Classification

No.	Line name	Equipment Installation (GIS etc.)	Conductor Connection (TL/DL etc.)	Demarcation point
1	**60 kV DL**			
1-1	East Lubango 1L, 2L	JICA Project	JICA Project	—
1-2	Existing Lubango 1L (Reserve)	JICA Project	ENDE	Conductor at Gantry / AIS
1-3	(Future) 2 lines	RNT	RNT	—
2	**60 kV Generation line**			
2-1	Arimba 2 PS (with underground cables)	JICA Project	JICA Project	Cable Head at Arimba2
3	**60/15 kV Transformer**			
3-1	Transformer Tr1, Tr2	JICA Project	JICA Project	—
4	**15 kV DL**			
4-1	15 kV DL	JICA Project	ENDE	Cable Head / 15 kV Cub

Source: JICA Survey Team

Table 7.5-13 Arimba 2 PS Construction Classification

No.	Line name	Equipment Installation (GIS etc.)	Conductor Connection (TL/DL etc.)	Demarcation point
1	**60 kV Generation line**			
1-1	Arimba 2 PS	PRODEL	JICA Project	Cable Head at Arimba 2

Source: JICA Survey Team

7.5.10. Designed for the Future

For the Namibe substation, the building design of the indoor substation shall allow for the addition of three 220 kV TL (including two lines for the Tobwa and one line for the transformer), one 220/60 kV transformer, and two 60 kV DL (including one line for the transformer) for future use equipment. This means that space for a new third 120 MVA indoor transformer and future line space for the primary and secondary transformer lines for new 220 kV GIS and 60 kV GIS should also be considered from the initial building design.

For the 220/60 kV East Lubango SS, RNT plans to add one new 120 MVA transformer and 220 kV and 60 kV DL when demand increases in the future. Therefore, in consideration of RNT's requirements, an outdoor substation design will be prepared that will provide space for the addition of one transformer, a 220 kV transformer primary line, and a 60 kV transformer secondary line (not including switchgear, steel structure, and bus bar), and bus bar space for the addition of two 220 kV TL and six 60 kV DL (not including switchgear and steel structure). Prepare an outdoor substation design that will provide space for two additional 220 kV TL and six additional 60 kV DL.

For the 60/15 kV Arimba SS, space is reserved on the limited site area for two 60 kV DL for future use, and 16 lines (including 10 distribution lines) will be installed as 15 kV cubicles from the beginning, with the expectation of connecting spare lines to the 15 kV distribution cubicles in the event of future demand increases.

7.6. Operation and Maintenance Plan

There is room for the transfer of Japanese experience and technology in the operation and maintenance of Angola's transmission and transformation facilities. Along with the construction work,

it is also necessary to transfer maintenance management technology such as patrols of transmission and substation equipment and equipment inspection.

For the transmission line facilities, though it is necessary to survey the current conditions of the facilities, there is stll room to improve maintenance and management system so that some corrosion on tower structures and bird nests left on upper parts of towers inNamibe area (near the coast) . According to the information from RNT, there are also concerns about corrosions of the insulators and insides of the line conductors.

For substation facilities, the equipment should be periodically patrolled to grasp the condition of the facilities based on the five senses and measurement data. Equipment diagnosis and condition monitoring maintenance for aged equipment are effective. For example, as a transformer diagnosis, the soundness and abnormal level of a transformer can be confirmed by analyzing the gas in the insulating oil. Appropriate maintenance and inspections should be performed according to the abnormality level based on the amount of gas generated. For GIS diagnosis, SF6 gas analyzer, gas detector, etc. can be used to check the gas condition.

If the values of the gas pressure system are regularly recorded during patrols and a downward trend in gas pressure is observed compared to the results of past patrols (previous and previous values), it is necessary to identify the location of the gas leak using a gas detector and repair the leaking area. Since a direct application of a gas detector cannot identify the leakage point if the gas leakage is slight, the leakage point can be identified by covering the tank (GIS flange, etc.) with a plastic bag and allowing it to accumulate for a certain period of time before measuring the presence of gas leakage with a gas detector. For partial discharge inside the GIS tank, corona and ultrasonic measurements from outside the tank are effective. In addition, an infrared thermography camera can be used to identify areas of abnormal overheating of equipment.

This section describes the differences in maintenance items such as patrols and inspections between indoor and outdoor substations. Patrols check the number of times the equipment operates, various gauges, and the presence or absence of oil and gas leaks. Inspections include cleaning of insulators, greasing of operating mechanisms, and measurement of characteristics by turning on and opening equipment.

When inspecting outdoor substations, if there are exposed charging sections around outdoor equipment, it is necessary to stop work on adjacent equipment, but basically, there are no building restrictions and a large work space can be secured. During patrols and inspections, be aware of weather conditions such as rain and wind. Work using heavy equipment such as cranes and ladders can be affected by the wind, so work may be halted in the event of strong winds. Ladders must be securely fastened at both ends with string or other means. In addition, when opening the doors of switchboards, the work is affected by rain and wind, so it is necessary to install work sheets above and around the panel to prevent water and sand from getting into the panel. Basically, terminal blocks are cured with vinyl tape and plastic terminal covers are installed, but in case of bad weather, it is necessary to consider postponing inspections.

In the case of indoor substations, there is no need to worry about weather conditions, but because work is performed in a limited space inside the building, work efficiency is reduced and inspections can take longer.

During and after abnormal weather conditions (storms, heavy rain, floods, etc.), extra patrols will be conducted to focus on identifying any abnormalities in the facilities.

When an abnormality occurs with equipment in use in Angola, an abnormality diagnostic method needs to be established to detect and respond to the abnormality as soon as possible. For example, RNT's maintenance base in Huila is located in Lubango and covers a wide area as far as the city of Moçâmedes, so it needs to be addressed as soon as possible, considering the long travel time.

7.7. Construction and Procurement Planning

7.7.1. Transmission Construction and Procurement Planning

(1) Construction Policy

At the start of the project, there will be a lot of discussions among the implementing agency (RNT), the consultants, and the contractors, and explanations to relevant agencies and obtaining permits and approvals will also be necessary, so activities will mainly take place in Luanda City. At the start of

construction, it would be optimal to establish a base in Lubango City, where the RNT office is located. However, it will be difficult to manage the entire 196 km of transmission line only in Lubango, and it will be necessary to establish a new materials yard, office, etc. on the Namibe side as the construction progresses. In particular, since the length of this project is approximately 196 km, the selection of an office and material storage area will be the first issue to be addressed. The Namibe Port is expected to be the main port for importing materials and equipment, and the importance of operations on the Namibe side will gradually increase in order to smoothly import and transport a large amount of materials and equipment to the site.

To ensure the success of the project, sufficient manpower and materials will be committed, and with safety first, high quality shall be maintained, and the construction shall be executed certainly within the contract period. For the success of the project, the executing agency, the consultants, and the contractors make sure that each party will certainly execute each of the responsibility described in Clause 7.7.3 Division of Responsibility.

(2) Procurement Policy

Construction materials can be procured locally, but all manufactured products must be imported. Since means of transportation is limited and will take a long time, it is important to plan for manufacturing and transportation well in advance so as not to affect the construction process.

Concrete mixing on site is abailable, but in order to ensure a certain level of the quality, it is preferable to transport the concrete from the ready-mixed concrete plant to the site by use of a ready-mixed concrete truck and place it to foundations. When large quantities of concrete are to be required, a ready-mixed concrete plant may be installed at the material yard, which is directly managed by the contractor is often adopted.

Existing transmission lines seem to use imported products from various countries, but because of competitive bidding, looks like some low-priced products of inferior quality tend to be used. In order to maintain the required quality, it would be effective to add the conditions to the tender specifications at the time of the bidding to exclude low-quality products.

Materials that need to be imported are shown in Table 7.7-1 and construction materials that can be procured in Angola are shown in Table 7.7-2.

The latest materials, equipment, and construction unit prices were reflected, taking into account the Corona outbreak after 2020, the situation in Ukraine, and other factors.

Table 7.7-1 Import Materials

Material Name	approximate quantity
220 kV TL Nombungo to Namibe	
Dteel tower structures	495 towers
LL-ACSR Conductor (2 conductors)	2,470 km
OPGW	206 km
Ground wire	211 km
Insulators and hardware	3,759 sets
Fittings for ground wire and OPGW	1 lot
Spacers and other line accessories	1 lot
60 kV DL East Lubango to Arimba	
Dteel tower structures	36 towers
AAAC Conductor (2 conductors)	132 km
OPGW	11 km
Insulators and hardware	300 sets
Fittings for ground wire and OPGW	1 lot
Spacers and other line accessories	1 lot

Table 7.7-2 Locally Procured Materials

Cement
Reinforcing steel bars
Aggregate for concrete (gravel)

(3) Construction Method

(a) Access road

The site works will be commenced after confirming the safety of the working site by checking the line route on the map, planning the access to the working site, and investigating buried hazardous materials, but site activities such as vehcle traffic, material transportation, site works, etc. shall be strictly confined where the safety have been confirmed.

In case there is an existing road running parallel to the site, access roads should be constructed from the existing road to the tower locations at 2~4 km intervals after carefully investigating the surrounding conditions such as the site topography, villages near by, etc. and other should be, with the right of way under the transmission line between each tower to be used as the access road. In case the transmission line is far from the existing road, only the right of way under the transmission line will be used as the access road.

The access road should be 10 to 20 m wide to allow large vehicles to pass each other with sufficient space, and the working area of the steel towers should be secured to allow for tower assembly. In addition, it is necessary to secure a sufficient area at both ends of each line stringing section for setting stringing tools & equipment, materials such as conductor, ground wire, line accessories, etc., and to confirm the safety of such a site.

Clearly delineate areas where safety has been confirmed, such as access roads and work sites, with wooden fences, etc., and prevent entry into areas where safety has not been confirmed. It is important to carefully conduct a preliminary survey to select the most appropriate route before planning the construction work, including the access road.

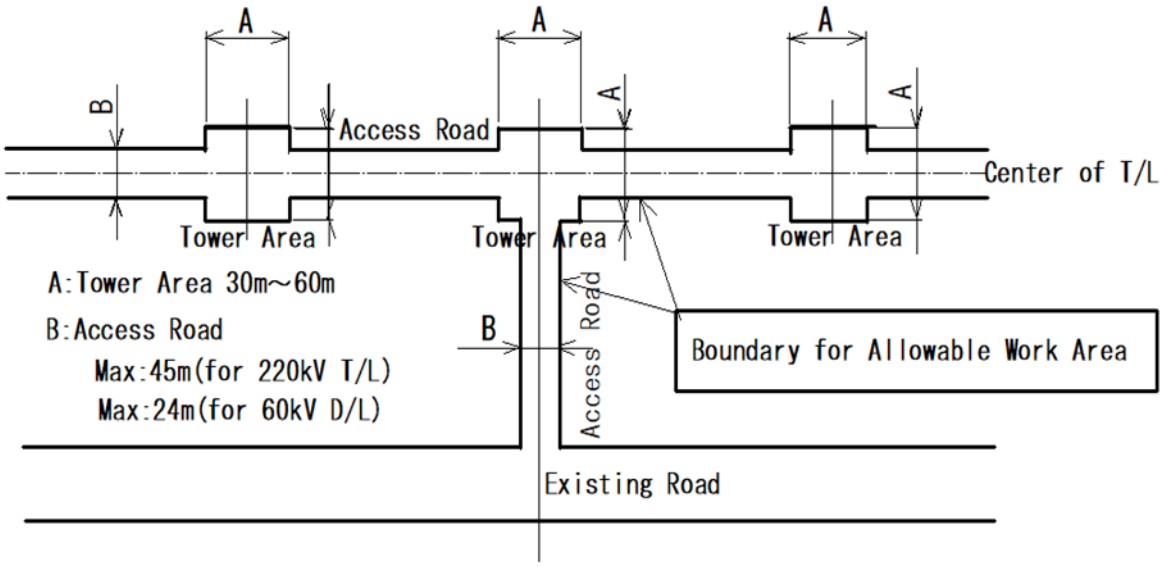


Figure 7.7-1 Access plan diagram

Source: JICA Survey Team

(b) Foundation type

Based on the results of the geological survey, it is assumed that silt and sandy soil will be distributed throughout the transmission line route, and inverted T-shape foundations, which are common use for transmission lines, will be mainly adopted. In stable ground with sufficiently compacted soil, the use of auger foundations is also recommended to shorten the construction period. In the Burco area, where sandstone and mudstone are exposed, anchor foundations will be effective. Pile foundations may be required in some soft ground with a high water level. Typical shapes of each foundation are shown below.

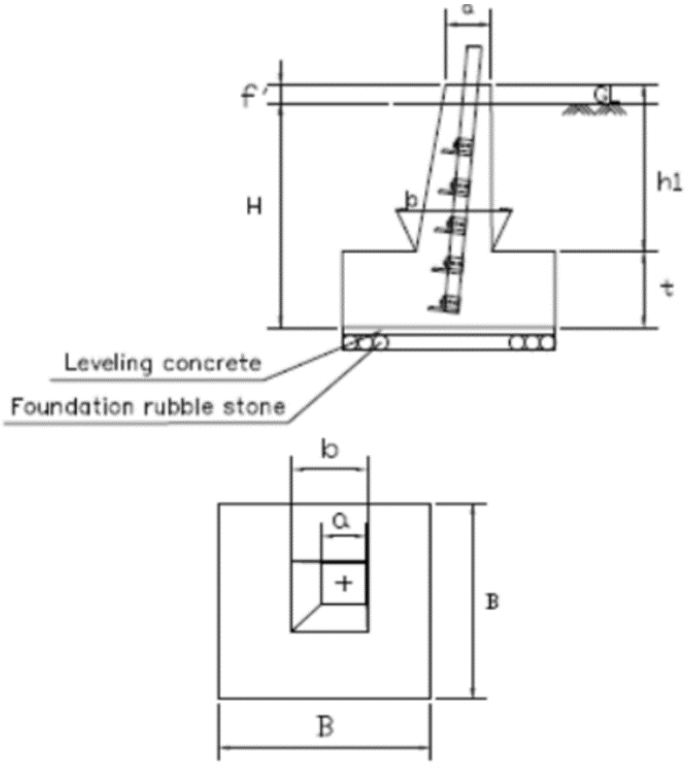


Figure 7.7-2 Inverted T-shaped foundation

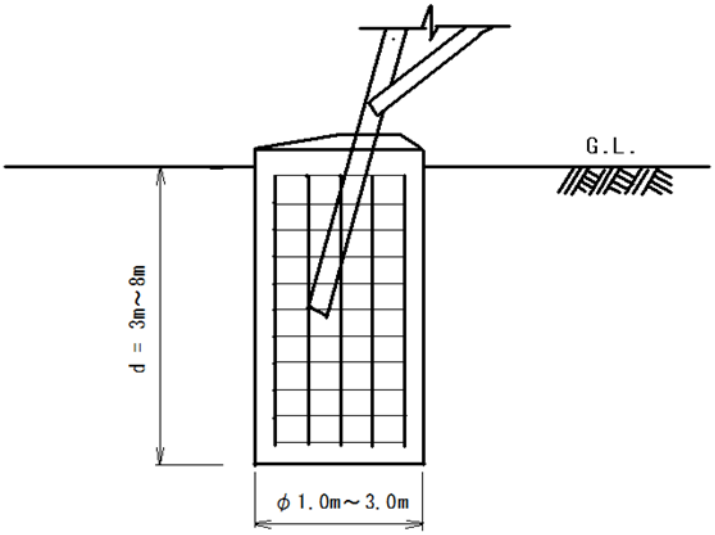


Figure 7.7-3 Auger foundation

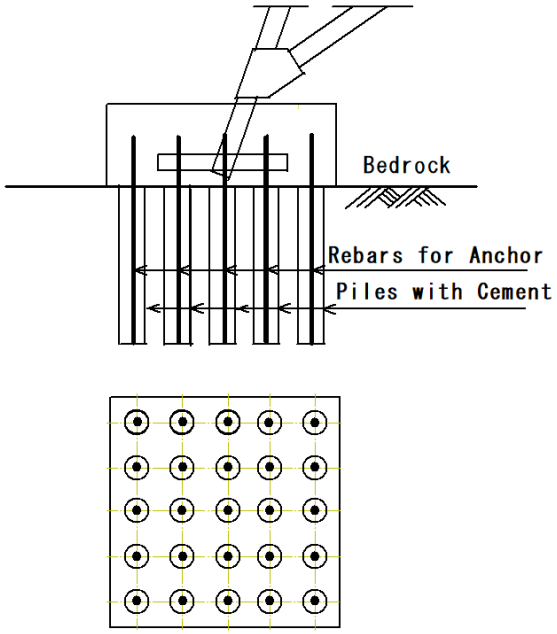


Figure 7.7-4 Anchor foundation

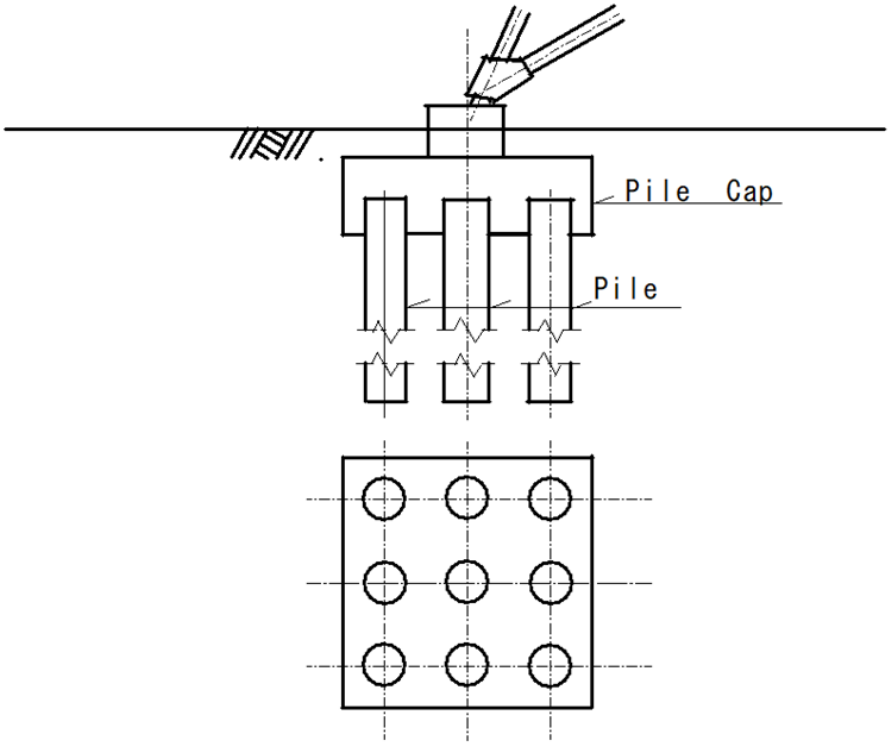


Figure 7.7-5 Pile foundation

Source: JICA Survey Team

(c) Construction work

Since field work such as geological surveys start from the section where the transmission line route has partially been determined based on the site survey results and the site area acquisition, it is expected that the construction work will not be limited to a certain area but will be spread widely along the transmission line route. During the peak season, foundation work, tower assembly, and stringing work progress simultaneously over a wide area, so it is important to prepare the work statements, plan & progress charts, etc., so that daily construction management may be carried out .

As a result of the prior field survey, although only visual confirmation from the ground surface was made, scattered areas of exposed bedrock were observed throughout the entire line section, and it was observed that the ground is relatively stable. Geological surveys were conducted at 13 locations,

including substations, and the results showed that the geology of the transmission line route is sandy soil with silt, with many granitic particles in the Lubango area, and exposed sandstone and mudstone in the Bruco area. Also, a large amount of gravel containing fragments of limestone was detected at the top of the canyon near the Namibe substation, near the coast and rivers. Soft ground that would require piles to be driven into the ground was not identified during this survey, but since a water level of 6 m was also detected in the riverbed of the canyon, additional ground investigation should be conducted to confirm water level fluctuations in the future, if necessary.

In the Bruco area, where the terrain is bare bedrock, special foundations, such as the foundation with holes drilled into the bedrock to anchor, should be considered. The overall geological variation will be carefully assessed and reflected in the design and construction methods.

According to the local construction company, the steel tower is assembled using only a crane truck, but in locations where it is difficult to bring in a crane truck, such as steep cliffs, the use of special tools such as a gin pole (a simple rod-shaped crane used for steel tower assembly) must be required.

The stringing work is expected to progress smoothly because many sections are flat and have long straight lines. However, there are some sections where are significant elevation differences, so it is important to study the stringing method carefully to ensure that tensile forces that will not exceed the allowable capacity of the stringing tools & equipment and to carry out the work safely.

In some areas, such as cliff areas, it is difficult to bring materials and equipment directly to the site by trailer, so it is necessary to consider transportation methods such as cableways (ropeways), crawler carrier or helicopters.

(d) Local contractor

The following 11 local contractors for works of transmission lines and substations are registered with RNT as of 2020. (Table 7.7-3)

We visited three of the local contractors (CME, TELECRINF, and ELECNOR) and research local contracting styles, construction methods, construction scale, construction personnel, and their owned tools & equipment. We confirmed that all the contractors had the necessary basic tools & equipment for stringing work and were capable of carrying out the entire project, from the foundation work to tower assembly and stringing work. The contract procedure was similar to that of a normal international bidding process, as it generally includes both materials and construction work. Bidding was generally competitive among local contractors, but there seemed to be no restrictions on bids from overseas contractors.

However, this project is large in scale and needs to be completed in a short period of time, requiring the use of a large number of tools & equipment and skillful personnel, and therefore the contractor's management, technical, and construction capabilities must be examined in detail at the time of bidding for a selection of a capable contractor.

Table 7.7-3 Local Contractor List

No	Company
1	E.I.P
3	CMEC
4	CME
5	PAOMATAPALO
6	PROEF
7	TELECTRINF
8	POWERGOL
9	AEE POWER
10	ELECNOR
11	OSSI-YETO

Source: RNT

CME Information

This company has experience in power supply works in Angola and Portugal, including transmission lines and substations.

The company has its own stringing tools & equipment, and their organization is able to respond immediately to construction work for transmission lines and substations.

Established: 1983 (founded in Portugal)
Sales: 109 mil. Euros (CME Group) 2018
Employees: 900 (CME Group) 2018
Experience: Table 7.7-4

Table 7.7-4 CME performance table (including transmission lines and substations)

- Rehabilitation and expansion of the public lighting system in Luanda's highest density area.
- Kunge hydroelectric rehabilitation, construction of the 30 kV line and the CAMACUPA MV-LV and IP networks.
- Remodelling work on the MV and LV electricity distribution network, with the installation of sectioning and transformation stations in the city of Luanda.
- Remodelling work on the MV and LV electricity distribution network, with the installation of sectioning and transformation stations in the city of Luanda.
- Electrical installations adaptation for the implementation of polling stations, inherent to the election process of September 5th 2008.
- LV and MV underground network repairs in the city of Luanda.
- Infrastructure construction contract for the 1st stage of the Kora Housing project (15ha) - Kuito.
- Optical Fiber Maintenance Contract - LADSOY.
- Expansion and Modernisation of 220/60/15 kV Cazenga Substation.
- Rehabilitation of MV and LV distribution networks in the City of Luena.
- Infrastructure construction contract for the 2nd stage of the Kora Housing project, Stage A+B-Kuito.
- Thermal production capacity increase in Luanda.
- Sumbe 60/16kV Substation
- 60 kV DL between Sumbe and Alto Chingo
- Electricity network for Benguela and Lobito (30 and 60 kV substations and lines)

Source: CME

ELECNOR Information

This company has experience in power supply works including transmission lines and substations in Angola, including design work and geological surveys. In addition to 220 kV TL and substations, the company has experience in transporting transformers and other heavy equipment, as well as mine and UXO search and clearance, although the actual work seems to have been outsourced to other companies.

The company has its own stringing tools & equipment, and their organization is able to respond immediately to construction work for transmission lines and substations.

Table 7.7-5 and Table 7.7-6 show the ELECNOR' s personnel transition and performance of ELECNOR respectively.

Table 7.7-5 ELECNOR Personnel Transition

Year	Number of Employees	Angolan (person)	Non-Angolans	Percentage of Angolans
2016	1,274	1,009	265	79%
2017	1,224	1,003	221	82%
2018	753	645	108	86%
2019	736	628	108	85%
2020	1,008	885	123	88%
Total	4,995	4,170	825	83%

Source: ELECNOR

The number of employees varies depending on the status of project orders.

Table 7.7-6 ELECNOR Experiences Table

Starting Year	Ending Year	Contract Identification	Role of Bidder
12/2008	12/2010	Contract name: 345 kV Coqueiros Transmission System - 500/230kV New Substation - 45km of 230kV Transmission Line and 19km of 500kV Transmission Lines Name of Employer: Coqueiros Transmissora de Energia S.A.	Contractor
01/2009	12/2010	Contract name: Contract for the construction of the Lucala-Pambos de Sonhe- Uige 220 kV TL and associated substations - 60/15/220 kV New Substation: - 84 km of 60 kV Transmission Lines & 37 km of 30 kV Transmission Lines Name of Employer: GAMEK (Gabinete de aproveitamento do Medio Kwanza)	Contractor
04/2009	11/2010	Contract name: 500 kV BTE Transmission System - 230/138 kV. Substations - 500 km of 230 kV. Transmission Lines 38.1 km of 138 kV Transmission Line Name of Employer: BRILHANTE TRANSMISSORA DE ENERGÍA, S.A.	Contractor
06/2009	11/2012	Contract name: Jardín Bco 1.(SF6) 230/115 kV. EPC, Turn Key Project. 4 AT - 1F - 75 MVA , 230/115 kV, 0/6 A Name of Employer: CFE - COMISIÓN FEDERAL DE ELECTRICIDAD.	Contractor
01/2010	05/2012	Contract name: Works related to electrical distribution and transport lines network Construction work and maintenance of the distribution network Name of Employer: Iberdrola Distribución, S.A. Address: C/ Gardoqui, 8. 48008 Bilbao.	Contractor
11/2011	05/2014	Contract name: Contract No. P11.0.006.1 Design, Supply, Construction and Commissioning with Quality Assurance Line Power supply to the 110 kV Transmission Line. 110 kV transmission line ,40 km Name of Employer: Anglo American Norte S.A.	Contractor
2012	2012	Contract name: Installation and commissioning of a 220/60/15 kV 120 MVA Power Transformer SE of Camama Name of Employer: Empresa Nacional de Electricidade (ENE)	Contractor
2010	2012	Contract name: ASTE 1B Thermoelectric Solar Plant 49,9 MW Name of Employer: ARIES SOLAR TERMOELÉCTRICA, S.L.	Contractor
2010	2012	Contract name: ASTE1-A Thermoelectric Solar Plant 49,9 MW Name of Employer: ARIES SOLAR TERMOELÉCTRICA, S.L.	Contractor
2010	2012	Contract name: Civil Construction and Supply of Equipment for Repair of the GOVE Dam and Construction al the Hydroelectric Plant and its Substation - Electrical generating facility (Francis 3x20 MW) - 11/220 kV Substation Name of Employer: GABHIC. Bureau d'administration du 8assin hydrographique du fleuve Cunene	Contractor
2009	2012	Contract name: 220 kV Fungurume-Kasumbalesa Transmission Line - 220 kV Transmission Lines,280km - Name of Employer: Société Nationale d'Électricité (SNEL)	Contractor
2009	2013	Contract name: Rehabilitation of Cambambe Hydroelectric Power Station Rehabilitation of Hydroelectric Power Station Name of Employer: ENE - Empresa Nacional de Electricidade	Contractor

2010	2013	Contract name: ASTELXOL-2 Thermoelectric Solar Plant 49,9 MW B Name of Employer: DIOXIPE SOLAR, S.L.	Contractor
2012	2013	Contract name: Cacuaco - Boavista Transmission System 220 kV 220 kV and 60 kV gas-insulated substation, extension to the Cacuaco Substation 220 kV TL spanning 21 km. Name of Employer: Empresa Nacional de Electricidade (ENE)	Contractor
12/2008	12/2010	Contract name: 345 kV Coqueiros Transmission System - 500/230kV New Substation - 45km of 230kV Transmission Line and 19km of 500kV Transmission Lines Name of Employer: Coqueiros Transmissora de Energia S.A.	Contractor
01/2009	12/2010	Contract name: Contract for the construction of the Lucala-Pambos de Sonhe- Uige 220 kV TL and associated substations - 60/15/220 kV New Substation: - 84 km of 60 kV Transmission Lines & 37 km of 30 kV Transmission Lines Name of Employer: GAMEK (Gabinete de aproveitamento do Medio Kwanza)	Contractor

Source: ELECNOR

TELECRINF Information

This company has experience in power supply works including transmission lines and substations in Angola and abroad and also able to carry out design work.

The workforce is basically employed domestically in Angola, but specialists may be invited from Portugal for special work.

In addition to construction work on 220 kV TL and substations, this company has experience in transporting heavy equipment such as transformers and stringing tools & equipment.

The company has its own stringing tools & equipment, and their organization is able to respond immediately to construction work for transmission lines and substations.

7.7.2. Substation Construction and Procurement Planning

(1) Equipment Procurement and Construction Policy

It is the policy of this project to procure substation equipment through international competitive bidding and not to limit the suppliers, but to adopt Japanese technology for equipment that requires high reliability and for which the application of Japanese technology is deemed appropriate.

The policy is to procure general-purpose equipment and materials for which cost reductions can be achieved with overseas products through international competitive bidding. However, the selection will be based on careful consideration of product quality control, manufacturing capacity, past performance, existence of complaints, and the financial status of the successful bidder and its subcontractors.

As a result of the interviews with RNT, several companies are active as construction contractors involved in transmission and substation facilities in Angola, and three of them, CME, TELECTRINF, and ELECNOR, were interviewed. They often enter projects as subcontractors and have experience in construction related to both transmission and substation facilities. For more information, see above 7.7.1(d) for more information.

As a result of interviews with contractors introduced by RNT regarding the status of procurement of substation equipment, the current situation in Angola is that materials and equipment related to substation equipment such as transformers and circuit breakers are imported from overseas (South Africa, Europe, China, etc.), while cement and other materials required for concrete production (rebar and aggregate are unknown) can be procured locally. For the actual labor work, which requires a high level of technical skills, the company secures workers mainly from Portugal and other European countries (or Angolans who have trained in Portugal and other European countries).

(2) Construction Method

(a) 220/60 kV New Namibe SS

The transportation road to the substation must be constructed to coincide with the new substation, and must be straight from the existing unpaved/desert road. The access road (to be maintained by the contractor) must be able to withstand the weight and size of the 220 kV equipment (transformers, GIS components, etc.) and the passage of delivery vehicles. Examples of specific measures to be taken by the contractor include the following

- Steel plate laying (existing unpaved, desert roads, curves, slopes)
- Temporary removal and restoration of obstacles
- Traffic control during transportation, placement of traffic guides

After construction of the substation, a paved road is desirable as the access road to the substation for patrolling, maintenance and management, as it needs to withstand frequent vehicle use and loads. However, based on the results of the field survey, it was determined that the existing unpaved road is functionally adequate due to its relatively hard ground surface and that full asphalting of the substation access road is not necessary, and asphalt roads will only be constructed to one steep uphill section that will act as a barrier to the transport of equipment such as transformers.

If there is backfill works, soil compaction and strain measurement tests should be performed after each layer is compacted, and settlement should be confirmed by a loaded plate test on the last layer.

The desert areas of the Namibe region are expected to have high soil resistivity (especially during the dry season). Since average values are used during calculation and design stages, the grounding resistance may not be satisfied even after the grounding work is completed. In that case, additional grounding work would be required.

Furthermore, when the GIS tank is opened for assembly works on site, such as cable connection, a clean room must be temporarily set up to provide a clean environment for the work. Coordination with construction, inspection, patrol, and traffic in other areas of the site and work space needs to be considered.

Figure 7.7-6 Situation near the proposed Namibe substation construction site

Source: JICA Survey Team's third survey photo

In order to monitor and control the substation equipment (all 220 kV and 60 kV switchgear, etc.) at the 220/60 kV New Namibe SS at Luanda Central Dispatch Center, the protection and control system to be installed at the 220/60 kV New Namibe SS will be connected to the existing monitoring and control system at Luanda Central Feed-in Command Station. In addition, the 220 kV Lubango to Namibe transmission line protection system at the 220/60 kV New Namibe SS should be coordinated within the JICA scope to integrate the transmission line protection system with the 220/60 kV East Lubango SS.

(b) 220/60 kV East Lubango SS and 60/15 kV Arimba SS

The access road to the substation must be straight from the existing unpaved road to the new substation. The road must be deisgned and construct by the contractor to be able to with stand and provide enough clearance for the heavy 220 kV equipment (transformers, etc.) transportation.

After the construction of the substations, access road for 60/15 kV Arimba SS can be as is, due to the available of paved road straight to the site. As for 220/60 kV East Lubango SS, asphalt road is considered for the unpaved and rough portion from the main road.

The results of geological surveys at two locations in the Lubango area will determine the foundation types for buildings and heavy equipment.

The proposed site for the 220/60 kV East Lubango SS has a slightly sloping slope in a southerly direction, and we anticipate additional costs to flatten it during civil engineering construction.

When excavating, backfilling should be considered at the same time and the minimum impact on the topography and environment should be considered. The location for dumping the excavated soil should be clarified in consultation with Lubango environmental agencies.

If there is backfill, soil compaction and strain measurement tests should be performed after each layer is compacted, and settlement should be confirmed by a loaded plate test on the last layer.

The proposed site for the 60/15 kV Arimba SS is not problematic because the flattening work has already been completed.

Soil resistance may be high depending on the results of the geological survey. Since average values are used during calculation and design, the grounding resistance may not be satisfied even after the grounding work is completed. In such cases, additional grounding work is required.

Figure 7.7-7 Situation near the proposed construction site of the 220/60 kV East Lubango SS

Source: JICA Survey Team's third survey photo

Figure 7.7-8 North (left) and south (right) of the proposed 60/15 kV Arimba SS

Source: JICA Survey Team's third survey photo

In order to monitor and control the substation equipment (all 220 kV and 60 kV switchgear, etc.) at the East Lubango and Arimba substations at the Luanda Central Dsipatch Center, the protection and control system to be installed at the 220/60 kV East Lubango and 60/15 kV Arimba substations will be connected to the existing monitoring and control system at the Central Dispatch Center. In addition, the 220 kV TL protection system at the 220/60 kV East Lubango SS will be coordinated with AfDB's 400/220/60 kV Nombungo SS to be the same manufacturer (model and specifications) for both ends. In addition, the 60 kV DL protection system for the new 60/15 kV Arimba SS should be coordinated with the 220/60 kV, East Lubango SS in the JICA scope.

The protection equipment for the 220 kV Nombungo - East Lubango line is being discussed with RNT on the assumption that the Nombungo end will be purchased and maintained in the project formation of the AfDB project. The scope of the JICA project only connects the transmission line to the AfDB project's 400/220/60 kV Nombungo SS, and all protection relay and switchgear equipment in that substation is outside the scope of this scope.

The latest schedule for the 400/220/60 kV Nombungo SS and associated transmission line for the AfDB project, as confirmed with RNT, is tentative, but construction is expected to begin in late 2022, with operation scheduled to begin in 2024.

(c) Civil engineering and building construction

In addition to the points noted above, the following civil and building-related work is anticipated for each substation.

- Vegetation clearing, leveling, grading, and compaction of substation grounds
- Excavation and backfilling
- Gravel paving on site
- Installation of new protective fencing
- Internal roads
- Outdoor steel structure foundations for 220 kV and 60 kV switchgear
- Equipment frame and support materials
- Foundations for equipment
- Main transformer oil pit
- Drainage pit and routing
- Cable pit construction
- Control building (including operation control room, 15 kV switchboard room, office, workroom, battery room, warehouse, hot water supply room, restrooms, etc.)
- Guard house for security guards adjacent to the main gate
- Control building air conditioning equipment (air conditioning, ventilation equipment, etc.)
- Lighting and power equipment in control building (distribution boards, outlets, etc.)
- Water supply system related (wells, water storage facilities, sewage and septic tank facilities, etc.)
- Building fire extinguishing systems (fire extinguishing systems, smoke and ventilation systems, etc.)

(3) Construction plan

In the Namibe region, inland transportation during the rainy season is often difficult, and civil engineering and foundation work may not be feasible. Therefore, in the Namibe region, the construction schedule should be set to avoid on-site construction and transportation of materials and equipment during the rainy season as much as possible. The transportation schedule for the entire year should include both dry and rainy seasons, with priority given to the transportation of large equipment such as transformers during the dry season. In the unlikely event of transport during the rainy season, it will be necessary to reinforce the transport routes (laying steel plates).

The Lubango area is also a highland area, and the construction schedule should be set to avoid on-site construction and transportation of materials and equipment during the rainy season so as to avoid flash floods and landslides. In addition, for work to be performed on the proposed 220/60 kV East Lubango SS site, where vegetation is present, attention should be paid to the risk of fire during the dry season.

(4) Procurement Materials

The materials required are listed below Table 7.7-7 and Table 7.7-8 below.

The latest materials, equipment, and construction unit prices were reflected, taking into account the Corona outbreak after 2020, the situation in Ukraine, and other factors.

Table 7.7-7 Equipment related to substations

Material Name		220/60 kV New Namibe SS	220/60 kV East Lubango SS	60/15 kV Arimba SS
220 kV equipment	Transformer	2 units	2 units	-
	ShR	1 unit	-	-
	GIS	8 bays	-	-
	CB	-	9 sets	-
	DS	-	24 sets	-
	CT	-	9 sets	-
	PT.	-	8 sets	-
	L.A.	-	8 sets	-
60 kV equipment	Transformer	-	-	2 units
	GIS	9 bays	-	-
	CB	-	5 sets	6 sets
	DS	-	12 sets	11 sets
	CT	-	5 sets	6 sets
	PT.	-	4 sets	6 sets
	L.A.	-	4 sets	6 sets
15 kV equipment	Aux. TR	2 units	2 units	2 units
	Cubicle	4 panels	4 panels	18 panels
Control protection equipment	Control panel	17 panels	14 panels	6 panels
	Protection Relay panel	15 panels	12 panels	7 panels
	Transmission equipment	1 lot	1 lot	1 lot
	Monitoring equipment	1 lot	1 lot	1 lot
	Lighting equipment	1 lot	1 lot	1 lot
Other facilities	Battery bank	1 lot	1 lot	1 lot
	Battery charger	2 panels	2 panels	2 panels
	Distribution board	4 panels	4 panels	2 panels
	Emergency generation	1 lot	1 lot	1 lot
	Water supply	1 lot	1 lot	1 lot
	Fire extinguishing	1 lot	1 lot	1 lot
	Forced ventilation and filter	1 lot	-	-
	In-house crane	1 lot	-	-

("Set" is equivalent to 3-phase)
(Main and backup protection relays on the same panel)
(not including spare parts)
Source: JICA Survey Team

Table 7.7-8 Components and materials related to substations

Material Name		220/60 kV New Namibe SS	220/60 kV East Lubango SS	60/15 kV Arimba SS
220 kV component	Steel structure (bank equivalent)	-	9 sets	-
	Busbar steel structure	-	2 sets	
	Feeder steel structure	4 sets	-	-
	Insulators and mounting hardware	10 sets	70 sets	-
	Overhead wires	200m	3,400m	-
	Power cable	550m	-	-
	Cable head	4 sets	-	-
60 kV component	Steel structure (bank equivalent)	-	5 sets	8 sets
	Busbar steel structure	-	2 sets	1 set
	Feeder steel structure	6 set	-	-
	Insulators and mounting hardware	10 sets	40 sets	10 sets
	Overhead wires	250m	1,000m	550m
	Power cable	650m	-	1,400m
	Cable head	6 sets	-	1 set
15 kV component	Power cable	750m	1,100m	850m
	Cable head	2 sets	2 sets	2 sets
Other component	Communication and control cables	1 lot	1 lot	1 lot
	Grounding and lightning resistant materials	1 lot	1 lot	1 lot
Civil works and building	Cement	1 lot	1 lot	1 lot
	Rebar	1 lot	1 lot	1 lot
	Concrete aggregate	1 lot	1 lot	1 lot

("Set" is 3-phase equivalent)
("Lot" is the applicable quantity)
(not including spare parts)
Source: JICA Survey Team

In addition, if the 220/60kV New Namibe SS is an indoor type, the following additional components will be required: fans for forced ventilation, filters for ventilation, overhead cranes, moving walls, etc. (The quantity depends on the size of the building and the number the main equipment)

Materials for civil engineering and building can be procured locally, but all manufactured products are imported.

Concrete may be mixed on site, but in order to ensure a certain level of quality, it is preferable to transport the concrete from the ready-mixed concrete plant to the site in a trucks and pour directly. When large quantities of concrete are to be placed, ready-mixed concrete production equipment is installed at the material yard and the contractor directly operates the plant is recommended.

It appears that products from various countries are being used for existing transmission lines, but because of competitive bidding, there is a tendency to use low-priced products of inferior quality. In order to maintain quality, it is necessary to set conditions in the technical specifications at the time of bidding that exclude low-quality products.

(5) Procurement Method

Namibe Port is recommended as the port to be used for procurement of materials and equipment for this project.

As a result of interviews with the Namibe port management agency, the following items were confirmed.

(a) Imported goods cannot be unloaded (crane not in operation)
Suppliers are encouraged to transport by ship with crane to implement unloading at the port.
Recommend Incoterm of CIF/CIP/DPU (formerly DAT), under which the supplier is responsible for unloading at the port.

(b) The port is experienced in handling heavy items (e.g. transformer tank, etc.).
(Unloading from vessels and then loading onto transport vehicles)

(c) Customs clearance usually takes two to three days.


Figure 7.7-9 Situation at Namibe Port

Source: JICA Survey Team's second survey photos

The procurement of materials and equipment to the Lubango region is also carried out by customs clearance from Namibe Port, loaded onto a railway at Namibe Port and transported to Lubango. The advantage of rail transport is that it can move at a constant speed, which limits the maximum acceleration (3G) and reduces transport problems compared to vehicle transport, making transport safer. In addition, when national roads are used, the transport route needs to be reinforced, whereas this is not necessary in the case of railways. On the other hand, RNT has experience in transporting transformers to the existing 150/60 kV Lubango SS, and has confirmed with RNT that it is possible to apply the system to 220/60 kV transformers.

Furthermore, an unloading point in Lubango was identified, which has experience in transporting heavy granite. It was confirmed by RNT that the unloading point is suitable for heavy loads and can therefore be used for transformer tanks. Although the existing crane is capable of handling the size of the large equipment (transformer tank), the detailed specifications of the existing crane, including its lifting capacity, will need to be reconfirmed at the next design stage, and the unloading method will also need to be considered.


Figure 7.7-10 Situation of unloading points in the city of Lubango

Source: JICA Survey Team's third survey photo

The following diagram illustrates possible inland transportation route options in the Namibe region.

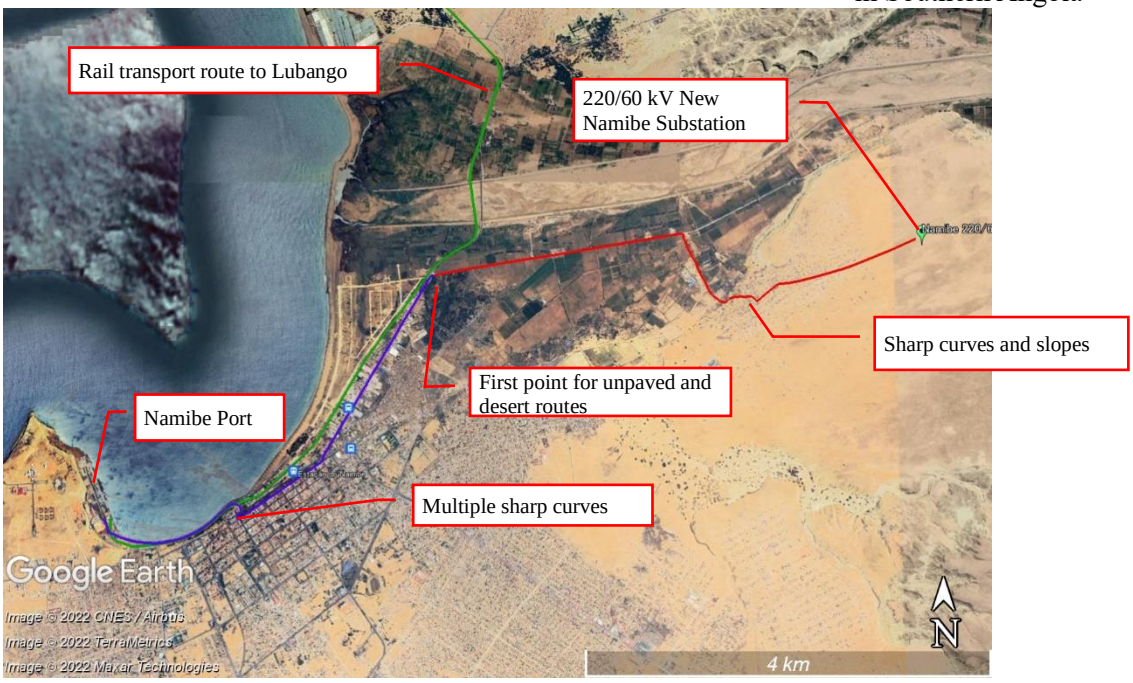


Figure 7.7-11 Namibe Projected Inland Transportation Routes

Source: Compiled by JICA Survey Team from Google Earth

The following diagram shows possible inland transportation route options in the Lubango region.

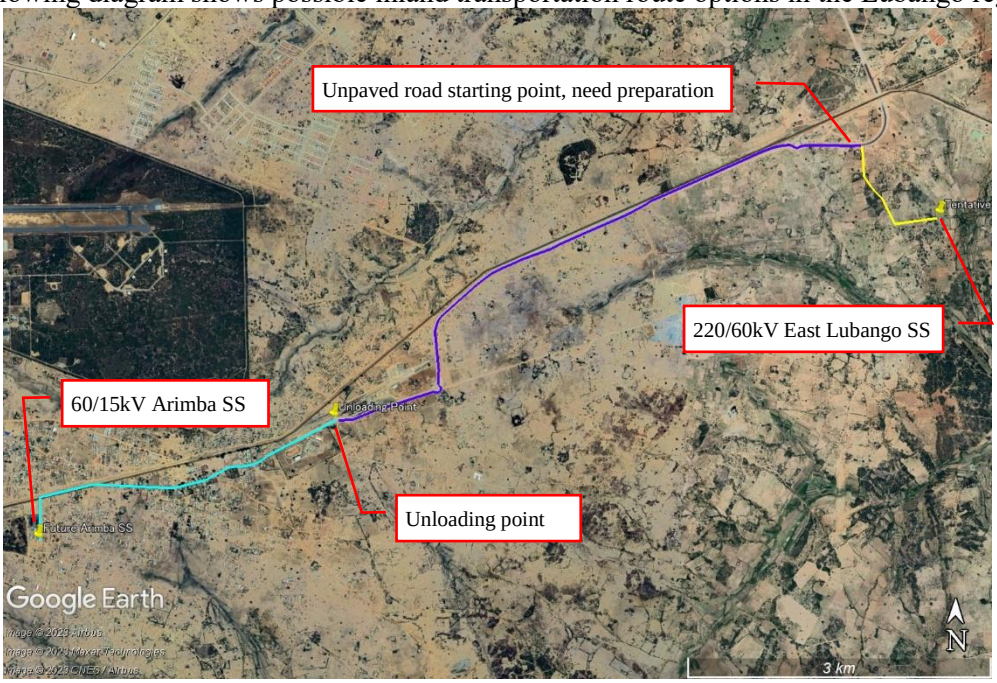


Figure 7.7-12 Lubango Projected Inland Transportation Routes

Source: Compiled by JICA Survey Team from Google Earth

As for the inland transportation of heavy items (transformers, etc.), it is expected to be possible by extending the axle length of module trailers to distribute the load in areas where there are weight restrictions. The road route to the new 60/15 kV Arimba SS is in good condition and requires little repair.

However, the following should be noted for the transportation route to each substation

(a) Road pavement condition

Each of the above routes does not pass through bridges, and for the Moçâmedes and Lubango urban areas, the roads are paved and were found to be wide enough for the passage of trailers. Therefore, it was determined that the routes could be used as transportation routes.

Outside of the urban area, it was confirmed that the road width is sufficient for trailer. However, since the road is in the desert (Namibe area) and unpaved, it is necessary to pay attention to shocks to transformers and other substation equipment during transportation. Therefore, transporters should

investigate the transportation route in advance, check and consider weight restrictions, road dimensions, transportation period (time), and impact on the transported items, as well as take measures such as installing and managing acceleration sensors (reusable for marine transportation).

(b) Access road at new substation

Currently, the road near the projected 220/60 kV New Namibe SS is an unpaved and desert road, plus there are many private houses along the road. Therefore, it is necessary to organize and repair the access road, take into account the transportation time, and cooperate with related agencies (transportation authorities, city hall, etc.).

Figure 7.7-13 Condition of unpaved (left) and desert (right) roads in Namibe

Source: JICA Survey Team's third survey photo

The road near the projected location of the 220/60 kV East Lubango SS is also an unpaved road. Therefore, an access road will need to be prepared.

Figure 7.7-14 Paved (left) and unpaved (right) roads in need of repair in Lubango

Source: JICA Survey Team's third survey photo

The road near the expected location of the 60/15 kV Arimba SS is a paved road, but there are many houses along the road. During transportation, caution will be required.

(c) Cautionary points on the road

It is anticipated that road reinforcement (e.g., laying steel plates) may be required in advance at sharp curves and gradients in the Namibe region. Therefore, transport route surveys and road reinforcement work will be the responsibility of the transporter.


Figure 7.7-15 Sharp curves in the urban area of Mocamedes


Figure 7.7-16 Slope (left) and sharp curves (right) outside the urban area of Mocamedes

Source: Photographs of the second and third rounds of the JICA survey Team

(d) Height Limitations

Investigation of the transportation route to the 220/60 kV New Namibe SS confirmed that multiple distribution lines cross the expected transportation route. Since sufficient distance cannot be secured for transformers transportation, it is necessary to discuss and coordinate measures such as temporary power outages and temporary relocation of distribution lines that will be obstructed with the relevant agencies (transportation, ENDE, etc.) in advance.

Figure 7.7-17 Condition of Road Crossing Distribution Lines to 220/60kV Namibe SS

Source: JICA Survey Team's third survey photo

In addition, the transport route to the 220/60 kV East Lubango SS would cross under the existing 150 kV transmission line. In order to ensure sufficient safety distance, it is necessary to transport under power outages. An efficient transportation plan is required to reduce the number of power outages as much as possible, for example, by bringing in the transformers in time for the power outage for the pulling work of the existing 150 kV transmission line into the 220/60 kV East Lubango SS.

Figure 7.7-18 Status of transmission line height restrictions to the 220/60 kV East Lubango SS
Source: JICA Survey Team's third survey photo

(e) Other

Road use permits must be obtained from the Namibe Transportation Authority or City Hall.

Three Angolan domestic suppliers (ECM, TELECTRINF, and ELECNOR) confirmed that they have experience in inland transportation (including heavy loads).

7.7.3. Division of Responsibility

Since the transmission and substation facilities of the project will be important facilities for the economic development of the Namibe region, support from RNT and related agencies (e.g., MINEA) will be required. The main work assignments of the Angolan implementing agency (RNT) and the contractor are expected to be as follows

The Angolan Implementing Agency (RNT) will be responsible for the following tasks (summary):

(a) Establishment of the organization corresponding to the implementation of this project
(b) Coordination and finalization of opinions with ministries, agencies, and local organizations involved in the project
(c) Acquisition of land and negotiation of compensation necessary to implement the construction of the 220 kV TL and the East Lubango/Namibe substation
(d) Obtained site access permits for 220 kV TL and East Lubango/Namibe substation
(e) Obtaining environmental permits for project implementation
(f) Selection of consultants and cooperation and support to consultants necessary for project implementation
(g) Contractor selection and contracting, application for Board of Audit procedures
(h) Close coordination with funding agencies for bidding, contracting, procurement, project progress, etc.
(i) Assistance with customs clearance procedures related to the import of materials and equipment
(j) Issuance of payment certificates to consultants and contractors
(k) Responding to contractor requests for contracts
(l) Handling of complaints from residents and others about the construction of the 220 kV TL and the East Lubango/Namibe substation
(m) Completion inspection and trial testing of the 220 kV TL and the East Lubango/Namibe substation
(n) Proper operation and maintenance of the 220 kV TL and the East Lubango/Namibe substation after completion of the facilities
(o) Secure budget and personnel to carry out the work

The Distribution company ENDE will be responsible for the following tasks (summary)

(a) Acquisition of land and compensation negotiations necessary to implement the construction of the 60 kV DL and the 60/15 kV Arimba SS
(b) Obtained site entry permits for 60 kV DL and 60/15 kV Arimba SS
(c) Handling complaints from residents and others about the construction of the 60 kV DL

and the 60/15 kV Arimba SS

(d) Completion inspection and trial testing of 60 kV DL and Arimba SS
(e) Proper operation and maintenance of 60 kV DL and 60/15 kV Arimba SS equipment after completion

The Contractor will be responsible for the following tasks (summary)

(a) Obtaining, applying for, and registering the necessary permits and licenses for project implementation
(b) Conduct surveying and geological investigations and prepare and submit survey drawings and geological survey data
(c) Detailed design and approval of manufactured products, foundations, buildings, etc.
(d) Procurement, manufacturing, inspection and testing of manufactured products
(e) Importing and transporting materials and equipment to the site
(f) Civil foundation work, construction, tower assembly, overhead wire work, and equipment installation for all materials and equipment
(g) Conduct completion tests and prepare completion documents
(h) Technology transfer to the Angolan side during a series of construction works and field trials

8. Mine and UXO Countermeasures in the Project

8.1. Survey Summary

8.1.1. Background and Objectives of the Survey

In Angola, in addition to landmines buried during the civil war, many unexploded ordnance (UXO) remain. Although exploration and demining of these ordnance is underway with the support of several donors, the danger of landmines and UXO is still remained. Although the rate of mine contamination in the project area is considered low, and the master plan on which the project is based states that there are no major safety issues, neither mine surveys nor searches for unexploded ordnancehave been conducted in the project area itself.

A major prerequisite for the development of this project and the field and geological surveys that preceded it was the confirmation of safety through the exploration and removal of mines and unexploded ordnance in the target area. Because of this background, the following surveys were conducted to ensure the safety of the main construction work.

8.1.2. Survey Content and Information Gathering Methods

(1) Survey Details

(a) Grasp contamination by mines and unexploded ordnance in the project area

(b) Clarification of issues by understanding similar cases in Angola (search of mines and UXOs and demining for implementation of specific infrastructure projects)

1. Clarification of all relevant mine action agencies (chain of command, division of duties, relationship between governmental and non-governmental organizations (NGOs, etc.), etc.) *We will also check whether the relevant organizations are in conflict with the so-called "Principle of Avoidance of Military Use" (the principle of avoiding use for military purposes or in furtherance of international conflicts) of the "Outline of Development Cooperation".
2. System of each operator (organization to search for and remove mines and UXOs)
3. Planning and development process for mine and UXO exploration and demining programs
4. Process for securing funds (budget) for activities to search for and remove mines and unexploded ordnance
5. Safety assurance after exploration and removal of mines and unexploded ordnance (certification process)
6. Confirmation of the results of exploration and removal of mines and unexploded ordnance for the implementation of transmission line and substation construction projects among various infrastructure projects.
7. Whether or not it is possible to trace the Japanese side's investment of equipment, budget, etc. (whether it is possible to confirm whether or not the equipment is used for purposes other than the intended purpose)

(c) Gather information on safety standards and responses to similar cases by other donors, etc.

(2) Information Gathering Methods

In this round of research, relevant information was collected and organized based on publicly available information from relevant organizations (Angolan government, international NGOs, etc.) and the results of interviews with relevant organizations. However, as a result of this survey, some information did not exist due to the fact that the relevant organizations had not conducted surveys or refused to provide such information at the decision of the relevant organizations even if it existed. In addition, some of the information that was available lacked objectivity and reliability.

It should be noted that while this report was prepared with as much objectivity as possible, it was prepared under these constraints.

8.2. Landmine and Unexploded Ordnance in Angola

8.2.1. Landmine and UXO Contamination

As indicated below, the Angolan government and NGOs are conducting a survey on the landmine and UXO contamination situation in Angola, but no survey on the landmine contamination situation has been conducted so far, covering all of the proposed project site. During this survey, maps of the route of the transmission line in the proposed project area were presented to the relevant agencies (CED, INAD, and ANAM) to confirm the availability of maps and other data showing the status of mine and UXO contamination in the proposed project area. However, since the Angolan government does not conduct mine countermeasures activities in the proposed project site, none of the agencies possess such data. On the other hand, the above-mentioned organizations pointed out that the possibility of ERW (Explosive Remnants of War) as well as mines and unexploded ordnance cannot be ruled out, and that there are records of mines and bombs being used to obstruct the transportation of military equipment and supplies along the transportation route from the port to the inland areas.

(1) Landmine contamination survey conducted by the Angolan government.

The Angolan government conducted the Landmine Impact Survey (LIS) from 2004 to 2007 to comprehend the status of landmine contamination throughout the country. LIS which was the first investigation across Angola was carried out by international and local NGOs and the National Demining Institute (Instituto Nacional de Desminagem (INAD) [11]under the supervision of Nacional Intersectorial de Desminagem e Assistência Humanitária (CNIDAH)[12]. The LIS is a survey to identify mine-contaminated areas based on interviews with communities, village chiefs, medical personnel, police, and the national army.

Approximately 10 years after the implementation of the LIS, a Non-Technical Survey (NTS) based on interviews with communities, national armed forces, and others was conducted throughout the country to confirm a more accurate landmine contamination status. The NTS in Wira and Namibe Provinces, the target areas of this project, were conducted by Halo Trust, an international NGO, and were completed in June 2015 in Wira and April 2016 in Namibe Province.

Note that these are all surveys of landmine contamination, and no survey specific to the contamination of unexploded ordnance was conducted.

(2) Feasibility that mines and unexploded ordnance have been searched for and removed in prior cases of power transmission line improvement projects.

The status of implementation of search and removal of mines and unexploded ordnance in other power line maintenance projects is as follows.

Northern transmission line: The Angolan government has implemented the project for the entire project site (60m wide).

Central transmission line: implementation and understanding under the responsibility of the Angolan government (Embassy of the People's Republic of China)

Southern transmission line: deemed unnecessary due to proximity to residential areas (AfDB)

Southern and Namibia transmission line project: inquiries to the AfDB Angola office were not answered.

In conducting exploration and demining activities in these areas, it has already been determined that the urban areas and residential areas are safe for local residents to live in.

(3) Mine and UXO contamination maps and other data

(a) LIS and NTS results

Based on the results of the LIS and NTS surveys with the status of Landmine and UXO contamination situation, tendency of landmine contamination status throughout Angola and in the provinces of Wira and Namibeis showed in Table 8.2-1.

[11] CNIDAH. 2012. "Angola: Ottawa convention article 5 extension request".

[12] CNIDAH was reorganized into ANAM (Angolan National Agency for Mine Action: Agência Nacional de Acção Contra Minas (National Agency of Mine Action)) in November 2020, in accordance with Presidential Decree No. 172/21 (July 2020). The new organization was renamed ANAM (National Agency of Mine Action) in November 2020.

Table 8.2-1 Landmine contamination situation throughout Angola and in Wira and Namibe provinces

	2007				December 2019			
	SHA	CHA	Contaminated area (km^2)	Contaminated area/ Total area %.	SHA	CHA	Contaminated area (km^2)	Contaminated area/ Total area %.
the whole nation (land, country)	3,321	-	1,025.37	0.082	94	1,075	90.42	0.007
Willa	108	-	53.66	0.068	0	36	3.33	0.004
Namibe	11	-	3.32	0.006	1	2	0.15	0.0003

Note: SHA: Suspected Hazardous Area, CHA: Confirmed Hazardous Area
Total area: nationwide 1,247,000 km^2 ,Wira 79,023 km^2 , Namibe 57,091 km^2

Source: Based on CNIDAH 2012 "Angola: Ottawa convention article 5 extension request" and data obtained from CNIDAH.

As shows, as of December 2019, there were 0 Suspected Hazardous Areas (SHA) in Willa Province and 1 in Namibe Province, which was a significant decrease from the 2007 LIS. In terms of Confirmed Hazardous Areas (CHA), which were not identified in the 2007 LIS, as of December 2019, there were 36 in Willa and 2 in Namibe.

In addition, a map of mine contamination throughout Angola based on the results of the LIS and NTS surveys is showed in Figure 8.2-1. Red circles on the map indicate mine-contaminated areas, green circles indicate areas where demining activities have already been completed, and yellow circles indicate areas where demining activities are underway. The project area covers the western part of Wira and the central part of Namibe Province (the area circled by the black line; transmission line route is indicated by the orange line), indicating the presence of several mine-contaminated areas and proximity to some post-de-mining sites.

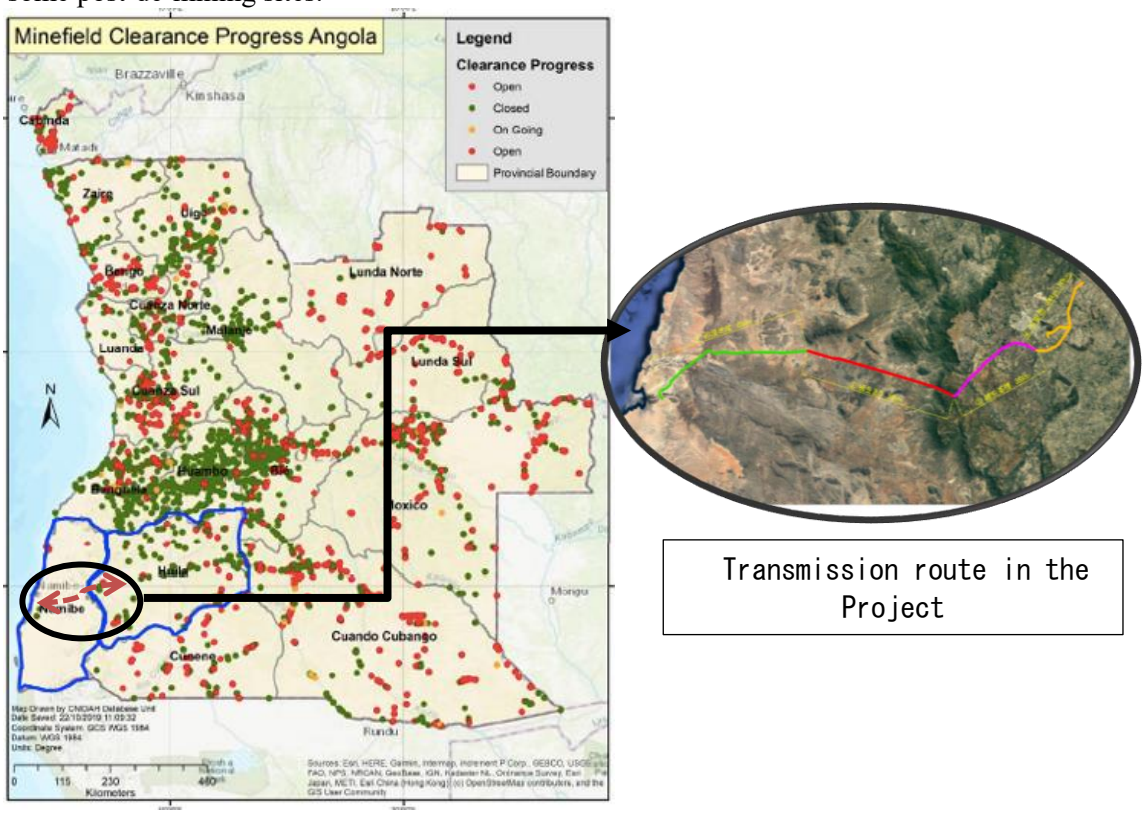


Figure 8.2-1 Map of mine contamination in Angola (as of November 2019)

Source: additions to CNIDAH 2019 "Article 5 implementation Work Plan (2020-2025) November 2019"

(b) Types of mines, unexploded ordnance, etc.

Human Rights Watch, a U.S. NGO, reports that at least 37 different types of landmines have been buried in Angola. On the other hand, James Madison University ORDATA reports that 95 different

types of mines were buried as Table 8.2-2 shows. The INAD is of the opinion that this is in line with the actual situation.

Table 8.2-2 Types of mines and unexploded ordnance

No	Name	Made in	Quantity
1	M14/M14E1	USA	28g
2	M16	USA	585g
3	M16A2	USA	601g
4	M18A1	USA	680g
5	Valmora69	Italy	596g
6	VS APFM 1	Italy	500g
7	VS･Mk2	Italy	15g
8	VS･50	Italy	N.A
9	No5 Mk1	UK	191.36g
10	MARK 2	UK	453.6g
11	No.4	Israel	N.A
12	APM･1	Austria	360g
13	APM･2	Austria	1,300g
14	PN･1	Cuba	N.A
15	FFV013	Sweden	Unknown
16	PRAC12	Sweden	Unknown
17	MON 100	Soviet Union	1,790g
18	MON 200	Soviet Union	1,200g
19	MON 50	Soviet Union	1,000g
20	OZM･160	Soviet Union	4,800g
21	OZM･3	Soviet Union	75g
22	OZM･4	Soviet Union	170g
23	OZM･72	Soviet Union	N.A
24	PMD･6	Soviet Union	200g
25	PMD･7	Soviet Union	800g
26	PMN	Soviet Union	234g
27	PMN･2	Soviet Union	108g
28	POMZ･2	Soviet Union	75g
29	POMZ･2M	Soviet Union	75g
30	PS･1/PS･1A	Spain	450g
31	PP･MI･D	Czechoslovakia	226.8g
32	PP･mi･Sk	Czechoslovakia	75g
33	PP･mi･Sr	Czechoslovakia	311.85g
34	Type 66	China	708g
35	Type 69	China	104.9g
36	Type 72 A/B/C	China	51g
37	APP M･57	Korea	N.A
38	DM28/DM31	German	510g
39	PPM･2	German	111g
40	Gyata･64	Hungary	200g
41	MI AP DV M･59	France	70g
42	NOMZ･2B	Vietnam	Unknown
43	PRB･M35	Belguim	99.23g
44	PRB･M409	Belguim	80g
45	PSM･1	Bulgaria	1,590g
46	M/966･BT2	Portugal	N.A
47	Mk･1	South Africa	380g
48	Mini･MS 803	South Africa	460g
49	Mini Claymore	South Africa	9,000g
50	R1M1	South Africa	680g
51	R2M1	South Africa	900g
52	R2M2	South Africa	56g
53	Shrapnel Rimi	South Africa	N.A
54	Shrapnel No.2 Rk1	South Africa	N.A
55	PMA･1/PMA･1A/VPMA･1	Yugoslavia	200g
56	PMA･2/VPMA･2	Yugoslavia	96g
57	PROM･1/VPROM･1	Yugoslavia	439g
58	MAI･GR1	Rumania	40g
59	MAI･75	Rumania	120g

No	Name	Made in	Quantity
1	WPM	Angola	N.A
2	M15	USA	10,000g
3	M19	USA	9,500g
4	M7A2	USA	1,600g
5	MAT･76	Rumania	9,350g
6	EP Mk 2	UK	Unknown
7	EP Mk 5 HC	UK	2,040g
8	Mk 7	UK	8,890g
9	TMP･44	UK	N.A
10	M/71	Egypt	6,250g
11	AT･8	Cuba	N.A
12	C･3･A	Spain	5,000g
13	C･3･B	Spain	4,650g
14	SPM	Soviet Union	950g
15	TM･46	Soviet Union	6,000g
16	TMN･46	Soviet Union	6,000g
17	TM･57	Soviet Union	7,000g
18	TM･62M	Soviet Union	7,000g
19	TM･62P2	Soviet Union	Unknown
20	TMD･B/TMD･44	Soviet Union	6,900g
21	TMK･2	Soviet Union	1,000g
22	PT･Mi･Ba･Ⅱ	Czechoslovakia	6,400g
23	PT･Mi･Ba･Ⅲ	Czechoslovakia	7,260g
24	PT･Mi･D	Czechoslovakia	6,200g
25	T･72	Czechoslovakia	N.A
26	DM･11	German	28.35g
27	TMA･2	Yugoslavia	N.A
28	TMA･3/VTMA･3	Yugoslavia	6,500g
29	TMA･4	Yugoslavia	5,760g
30	TMA･5/TMA･5A/VTMA･5	Yugoslavia	5,500g
31	Type 72 made of plas	China	5,400g
32	No8	South Africa	7,000g
33	PT･Mi･K	South Africa	N.A
34	FBM	South Africa	N.A
35	Mina UNITA	South Africa	N.A
36	UKA･63	Hungary	Unknown

Source: James Madison University ORDATA

(c) Landmine Casualties

The number of landmine casualties by the state as published by CNIDAH in 2017 is written in in Table 8.2-3.

Although the area covered by the project (Wira and Namibe provinces) does not have a large landmine-contaminated area compared to other provinces, the number of deaths among the casualties is more than 15% of the total number of deaths in the Angolan nation.

Table 8.2-3 Mine Casualties by State, 2012-2016

State	Death	Injured
Bengo	3	0
Benguela	14	16
Bié	22	16
Cabinda	18	20
Cuando Cubango	3	5
Cuanza Norte	4	3
Cuanza Sul	3	1
Cunene	8	23
Huambo	9	13
Huila	22	11
Luanda	3	3
Lunda Norte	0	1
Lunda Sul	3	0
Malanje	13	15
Moxico	22	66
Namibe	2	2
Uíge	2	1
Zaire	3	2
Total	154	198

Source: cnidah2017 "angola´s second article 5 extension request to the otawa mine ban treaty 2018 - 2025"

8.2.2. Measures to Combat Landmines and unexploded Ordnance in Angola

Angola signed the Anti-Personnel Mine Ban Treaty (commonly known as the Ottawa Treaty) in 1997 and ratified it in 2002 when the civil war ended. In accordance with Article 5 of the Convention, "Destruction of Anti-Personnel Mines in Mine-Laid Areas," the goal was to destroy anti-personnel landmines by December 31, 2013.[13] However, the goal was not met, and in 2012, an application was filed to extend the deadline for the clause, which was approved by the Conference of the Parties until January 1, 2018. After that, the country still failed to destroy all mines within the timeframe, and in 2017, it again applied for an extension, which was approved by the Conference of the Parties to be extended until December 31, 2025.[14] The Angolan government attributed these extensions to a lack of funding and operator capacity and resources. [15]

With the extension of the deadline for the implementation of Article 5 of the Ottawa Treaty, CNIDAH, the coordinating body for mine countermeasure activities in Angola, in 2017, submitted a request for an extension of its activity plan for the period 2018 - 2025 in "Angola´s second article 5 extension request to the Ottawa mine ban treaty 2018 - 2025".

In 2019, the government developed the National Mine Action Strategy 2020-2025, a five-year strategy for landmine action from 2020 to 2025, which includes land liberation, residual contaminated

[13] It stipulates, among other things, a commitment to dispose of or ensure the disposal of such materials within 10 years at the latest after the ratification of the Convention.
https://www.apminebanconvention.org/fileadmin/APMBC/clearing-mined-areas/art5_extensions/countries/16MSP_Angola_Request_for_Extension_Submitted_11_May.pdf
https://treaties.un.org/doc/Treaties/1997/09/19970918%2007-53%20AM/Ch_XXVI_05p.pdf
[14] https://www.apminebanconvention.org/states-parties-to-the-convention/angola/
[15] CNIDAH 2017 "Angola´s second article 5 extension request to the Ottawa mine ban treaty 2018 - 2025"

area management, mine avoidance education, victim support and advocacy, and communication and coordination.

In addition, a work plan on demining, Article 5 Implementation Work Plan (2020-2025) November 2019, was developed to support the Strategy. The work plan allocates activities in each state torelevant agencies.

Below are the main contents described in the activity and work plan up to 2025.

(1) Remove all anti-personnel mines by 2025

All anti-personnel mines known to remain in Angola will be removed by 2025. The work plan also includes a provincial demining plan for the period 2020-2025, with the Wira province planning to clear 3.33 km^2 of mine contaminated area by 0.55 km^2 each year. Eventually,, all mines are to be cleared by 2025. In Namibe Province, 0.15 km^2 of all mine contaminated area was planned to be cleared by 2020, but due to the slowdown in mine action activities as a result of the Corona pandemic, demining in Namibe Province was not completed by the end of 2020 .[16]

(2) Collection and disposal of unexploded ordnance

Official and humanitarian demining operators collect and dispose of remaining unexploded ordnance to prevent accidents caused by unexploded ordnance and to ensure the safety of the population.

The number of UXOs remaining is unknown because no NTS or other surveys focusing solely on UXOs have been conducted. The actual situation of UXO exploration and demining activities is the collection and disposal of unexploded ordnance found during mine exploration and clearance activities.

(3) Improve quality control of mine and UXO exploration and clearance activities

Improvement of the quality of mine and UXO exploration and demining activities through training and other means, and management of mine contamination status and demining data are described.

(4) required budget

The budget for clearing landmines buried throughout Angola is estimated to be about US$286 million within the period from 2020 to 2025, but only US$66 million has been committed at this time.

(5) Develop a comprehensive National Mine Action Standard (NMAS)

The National Mine Action Standard (NMAS), which defines mine countermeasure activities in Angola, was developed in 2001 in line with the International Mine Action Standards (IMAS)[17]. On the other hand, in order to create synergy with mine countermeasure activities, a more comprehensive NMAS is required, and the NMAS will be developed by the end of 2020 with the support of NPA (Norwegian People's Aid) and GICHD (Geneva International Centre for Humanitarian Demining).[18]. CNIDAH is also strengthening its capacity on information management, quality control, and post-delivery land records with the support of the UK Department for International Development (DFID).

(6) Organizational strengthening

The Angolan government is strengthening its structure by reorganizing CNIDAH, which was established in 2001 by presidential decree as a coordinating committee for mine countermeasure activities, into the Angolan National Agency for Mine Action (Agência Nacional de Acção Contra Minas (National Agency of Mine Action): ANAM) in November 2020.

Although the organization has been upgraded from a committee to an agency, the basic functions remain unchanged.

8.3. Government Agencies of Angola related to Mine and UXO Countermeasures

8.3.1. Major Government Agencies and Their Roles

Government Agencies of Angola related to mine and UXO countermeasures involved in this project are described in Chaper 2. The details of INAD, which will play a major role as operator, and other relevant government agencies are described below.

(1) Institute Nacional de Deminagem (INAD)

(a) General process of demining activities by INAD

[16] According to the Mine Action Review 2021 report.
[17] Interview from CNIDAH (March 10, 2022). The survey team visually examined only the cover page, as it is not publicly available.
[18] Hearing from ANAM (March 10, 2022). The survey team visually reviewed the draft version (February 19, 2020).

The general process for demining activities by INAD at infrastructure sites, etc.[19] is as follows

1. Survey
2. Cutting and root removal by machine if the site can be entered by machines.
3. Deployment of mine detection teams or mine detection dogs
4. Clearing of landmines and other objects, if found.
5. Crushing of mines, etc.[20]

Table 8.3-1 shows the tools used in each work process, and these tools are combined and placed in the right places for efficient demining activities.

Table 8.3-1 Tools, etc. used by INAD for each work process of demining activities

Work process	Tools used
Survey	Maps, communication equipment, regulatory lines, telescopes, rangefinders, GPS, etc.
Cutting open and removing roots	Mine clearing machines, brush cutters, scales, sickles, etc.
Detection	Mine detectors, high depth mine detectors, bomb locators, attachments, mine detection dogs, etc.
Manual removal	Plotter machine, shovels, etc.
Mechanical removal	Mine clearance equipment, transport equipment (transport of equipment, fuel, etc.)
Checking (e.g. result of calculation)	Mine detector
Crushing	Exploders, detonation cables, loudspeakers, etc.

Source: Prepared by JICA Survey Team based on materials obtained from INAD

(b) Repair shop (established with Huambo Provincial Office)

The repair shop and other facilities are located on the premises of the INAD Huambo Provincial Office. The shop was completed in 2014 and has 7 bays[21] (including 2 service pits[22]). It is equipped with a 10-ton overhead crane (lifting capacity) and all the necessary equipment for a repair shop, including lathes, milling machines, and washing machines for maintenance and management tools. In addition, manuals are also well organized. On the other hand, it does not have tools and equipment for large-scale repair work such as overhauls. In addition, the welding workshop is a temporary house, which poses a health and safety problem compared to the repair shop facilities, and there are concerns about ventilation of welding exhaust and electric shock due to ventilation of welding exhaust and rainwater inflow.

(c) Training Facilities

Two training buildings are located on the same site, and public operators are required to attend training in machine operation, repair, detection techniques, and first aid at these facilities.

The company also has accommodations, so it is possible to accept trainees from overseas, but the language used will be Portuguese.

(d) Status of Owned Equipment

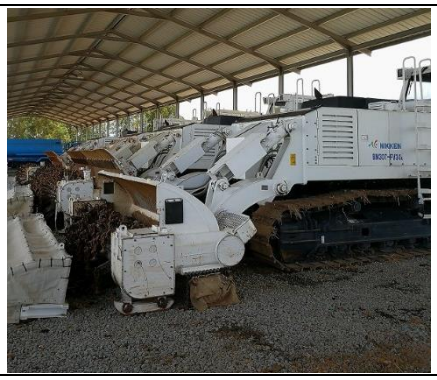
INAD's list of owned equipment is attached as "Attachment 8-2: List of Equipment". We confirmed at the site[23] the Japanese-made demining machines (32 Nikken-made[24] , of which 24 were push-type machines and 8 were swing-type machines), of which 10 were parked at the shop. 5 of the 10 were in a state of minor maintenance, such as oil changes, while the remaining 5 were awaiting procurement

[19] If unexploded ordnance or ERW is found during demining activities, it will be removed.
[20] Crushing may be done at the location where it was found or may be carried out by moving to a location where processing is possible, depending on the situation.
[21] Location of repair work, etc.
[22] Repair work area with work pits
[23] Time of the survey team's field survey (December 9th, 2019)
[24] Of the 32 units, 30 were purchased by INAD in 2007, 2009, and 2013, and the remaining 2 were provided by counterpart funds from the Japanese government (interview at INAD: November 29th, 2019).

of hydraulic parts. In addition, push-type flail hammers (hammers attached to the ends of chains) require constant welding repairs due to wear. INAD requested the replacement of the flail hammer attachment with a tiller (jaw) attachment.

These 10 units are scheduled to be put into operation at their dispatch sites in Angola once the repair work is completed.

Swing type



Push type

Tiller type

Flail hammer type

Figure 8.3-1 Demining machine and attachments

In this project, swing-type equipment is recommended because it is easy to adapt to the working environment of the target site (land undulations, vegetation, etc.) and rotary cutters will be used for clearing and demining. The results of checking the status of existing equipment are shown in Table 8.3-2.

Table 8.3-2 Status of Existing Swing Type Machine

No.	Procurement year	Location	Hour meter 2019.12	Hour meter 2022.6	Condition	Cause of Problem
1	2007	Huambo	3,589	3,596	×	Hydraulic failure, arm malfunction
2	2007	Huambo	3,075	3,075	×	Hydraulic failure, engine malfunction, arm malfunction
3	2013	Luanda Headquarters	1,853	1,890	○	Replacement required due to age-related deterioration making it difficult to see the window.
4	2013	Near Luanda	519	636	○	Replacement required due to age-related deterioration making it difficult to see the window.
5	2013	Cuanza Sul	457	1,119	○	Replacement required due to age-related deterioration making it difficult to see the window.
6	2013	Cunene	647	1,130	○	Replacement required due to age-related deterioration making it difficult to see the window.
7	2013	Moxico	107	418	○	Replacement required due to age-related deterioration making it difficult to see the window.
8	2013	Cuando Cubango	213	723	○	Replacement required due to age-related deterioration making it difficult to see the window.

Note: All swing models are Hitachi Type-V33

Source: Prepared by JICA Survey Team based on current survey and interviews.

As shown in the table above, 2 of the existing machines procured in 2007 are out of service due to malfunctions in major parts of the equipment (hydraulic failure, arm malfunction, etc.), but 6 of the machines procured in 2013 are deployed and in operation in various locations. Whenever the

equipment is operated, the engine, oil, fan belt, hydraulic system, and attachments are inspected at each startup, and the safety of windows and doors is checked to ensure that the equipment is in operational condition.

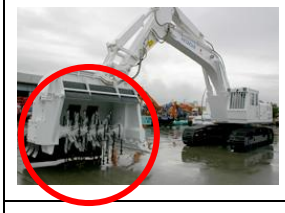
Regarding the operating hours of each piece of equipment, a comparison between the December 2019 field survey and the June 2022 field survey shows no significant increase in the number of operating hours despite the passage of approximately two and a half years. Furthermore, although 8 years have passed since the introduction of these equipments, the number of operating hours is still low compared to the standard operating hours value (660 hours/year) according to the Japan Construction Machinery Construction Association.

In addition to the above situation, it is unlikely that the number of operating hours will increase significantly in the future based on past performance, and there are no large-scale utilization plans for a sudden increase in operating hours prior to the start of this project, so rapid aging and deterioration of the equipment itself is not expected.

(e) Attachment Status

The results of the status check of exsisting attachments are shown in Table 8.3-3.

Table 8.3-3 Status of attachments (swing-type equipment)

Attachment	Present number	Operable Number	Number under repair	Inoperable Number	Remarks
Rotary cutter with grapple 	8 units	3 units (Luanda, Moxico, Cuanza Sul)	3 units (Luanda2, Huambo1), Parts (hydraulic cylinders, bearings) not expected to be procured (not locally available)	2 units (Hydraulic system failure)	Used more frequently than flail hammers, so failure frequency is also higher
Flail hammer 	8 units	6 units	-	2 units (Hydraulic system failure)	
Bucket 	8 units	7 units	-	1 unit (Hydraulic system failure)	

Source: Prepared by JICA Survey Team based on current situation survey and interviews.

There are two types of attachments used in this project: rotary cutters and grapples. As shown in the table above, only 3 of the existing rotary cutters with grapples are currently available for use, and there is no prospect for restoration of the 3 units that are currently under repair. On the other hand, 3 rotary

cutters are scheduled to be procured under the Economic and Social Development Plan (scheduled for delivery in June 2023), which will be deployed in all 6 operable swing-type units.

Attachments are attached to the main body of the equipment and are to be replaced as consumable parts depending on the frequency of use. Rotary cutters are used not only for mine clearance but also for root cutting, so they are used frequently and therefore break down more frequently. At present, only 3 units are available for use, and since these are used intensively, it is expected that breakdowns will further increase in the future.

Other attachments include a flail hammer, which removes mines by striking the ground surface with a hammer attached to a chain, and a bucket used for excavation, neither of which is expected to be used in the project.

(f) Spare parts and consumables

Most genuine spare parts are imported and cannot be procured locally. Similar substituted parts or made in-house parts are used. Welding and flailing operations are frequently performed due to the wear of flail hammers. In addition, procurement of spare parts, which are difficult to manufacture and process locally including hydraulic motors, hydraulic hoses, hydraulic pumps, and bulletproof glass, is difficult due to budgetary issues. The Economic and Social Development Program is planning to procure general consumables for 3 of the 6 existing swing-type equipment units that are currently operational, but it is necessary to procure similar consumables for the remaining 3 units as well.

(g) Maintenance budget

The maintenance budget for the last five years is shown in Table 8.3-4.

According to the standards of the Japan Construction Machinery Construction Association, maintenance costs were estimated for the number of equipment owned, and we found out that the allocated budget does not meet the required amount. As a matter of fact, the maintenance cost allocated to operation cost is also used to maintain the equipment.

According to interviews with INAD, both the initial budget and budget allocations have been increased since 2020, with particularly large increases in the January-March period of 2022. This is due to the fact that the Angolan government's budget tends to be affected by fluctuations in oil prices, and that the market price of parts and other items has been rising, but the Angolan government has no concrete plans to increase its maintenance budget in the future.

As equipment deteriorates over time, the time and costs spent on maintenance and management increase. It is imperative to take measures for equipment maintenance and management with a view to systematic budgeting by centrally managing data such as operating hours, formulating maintenance and management work plans, and developing equipment renewal plans based on service life and other factors.

Table 8.3-4 Maintenance budgets for the last five years

Year	Initial Budget (AOA)	Allocated Budget (AOA)	Allocated Budget (JPY)	Estimated annual maintenance cost of owned equipment (JPY)
2018	18.280.969,00	26.886.332,56	10,216,806	49,280,000
2019	61.240.925,00	29.333.127,89	8,213,276	49,280,000
2020	932.421.186,00	113.421.439,39	19,281,645	49,280,000
2021	928.760.551,00	101.229.581,84	17,209,029	49,280,000
2022 Jan-Mar	1.889.432.783,00	144.005.196,47	36,001,299	49,280,000

(Note 1) AOA to JPY conversion rates are approximate average rates for each year. 2018@0.38, 2019@0.28, 2020@0.17, 2021@0.17, 2022@0.25

(Note 2) Annual maintenance costs for owned equipment are calculated from the Japan Construction Machinery Association's Construction Machinery Loss Cost Table (1,760,000 yen/year per unit).

(Note 3) The number of owned equipment is the number of equipment currently available for operation (6 swing-type, 20 push-type, and 2 mine-wolf). Note that INAD considers inoperable equipment to be under repair and does not consider them out of service.

Source: Prepared by JICA Survey Team based on data obtained from INAD.

(h) Maintenance and Management Technology

The company has routine maintenance skills and inspects the engine, oil, fan belt, hydraulic system, attachment operation, etc. every time the equipment is started, and repairs as needed. On the other hand, the company does not have the technical capabilities to perform large-scale repairs and does not have the tools to use, so when overhauls or other repairs become necessary, the company have no choice but to place an order from the manufacturer. However, because of the high costs involved, special budgetary measures must be taken, but there is no prospect of securing a budget at this time.

In addition, INAD received maintenance technical training as part of its initial training when the equipment was introduced in 2014, but only a few operators and mechanics who attended that training are still with INAD. Furthermore, no training has been provided since that technical training, and the company recognizes the need for refresher training as well as training to acquire new skills and requests technical support.

(2) Presidential Guard (Casa de Segurança da Presidência da República : CSPR)

The CSPR is an agency designated by the government to conduct activities of specific importance, the details of which are undisclosed. In addition, CSPR's mine and UXO exploration and clearance activities are not disclosed in detail, although it is carried out at specific important sites designated by the government.

(3) Polícia de Guarda Fronteira de Angola (PGFA)

The PGFA is a border zone security force established in 1978 under the then Revolutionary Council. It also conducts mine and UXO exploration and clearance activities in border areas covering more than 5,000 km.

8.3.2. Mine Clearance System and Budget

Undislosed Information.

8.3.3. Assistance to Victims of Landmines and UXO

The Angolan government classifies cases in which workers are affected by mines or UXO during exploration and clearance operations as accidents (Accident), and cases in which civilians, for whatever reason, enter an area before the exploration and clearance are completed (Incidents). Although there are no international standards for compensation and support for victims of both incidents and accidents, the Angolan government has established the following assistance system.

It should be noted that according to the CED and INAD, accidents occurred shortly after the end of the civil war due to lack of operator skill, but operators under CED jurisdiction have not had any accidents in the past 10 years or so.

(1) Immediate assistance

The exploration and removal operators in the vicinity will perform the necessary actions according to the first aid procedures established by the Angolan government, after which the victims will be transferred to the military hospital for treatment. This also applies to incidents and accidents involving NGO groups.

(2) Subsequent assistance

In addition to compensation for medical treatment at the National Orthopedic Hospital, cost of occupational injuries covered by social insurance and the loan of prosthetic legs and arms, wheelchairs, crutches, walkers, etc. will be compensated. Operators are also compensated for their salary until they return to work. In addition, if an operator is unable to return to work, he/she will receive a disability pension in addition to the above compensation until retirement.

8.4. Process for Conducting Mine and UXO Exploration and Clearance

8.4.1. Process for Requesting, Conducting, and Safety Verification Surveys of Mines and UXO Search and Clearance

Basically, the request for the search and clearance of mines and UXOs prior to the implementation of government infrastructure projects is made to CND by the ministries/agencies that will be the main actors in the projects. In this project, MINEA/RNT will request CND to conduct mine and UXO exploration and clearance activities, and CND will conduct mine and UXO exploration and clearance activities in response to the request.

Figure 8.4-1 shows the process from the request for exploration and demining activities up to the issuance of a quality control certificate for the project.

After the request from MINEA/RNT, technical mine and UXO exploration and clearance activities are carried out, and after completion, a safety verification survey is conducted by the ANAM State Branch, after which the ANAM headquarters issues a quality control certificate (Certificado de Controlo de Qualidade) to the operator. According to ANAM, with the issuance of this certificate, the Angolan government officially guarantees the safety of the sites where mine and UXO exploration and clearance activities have been carried out. [25]

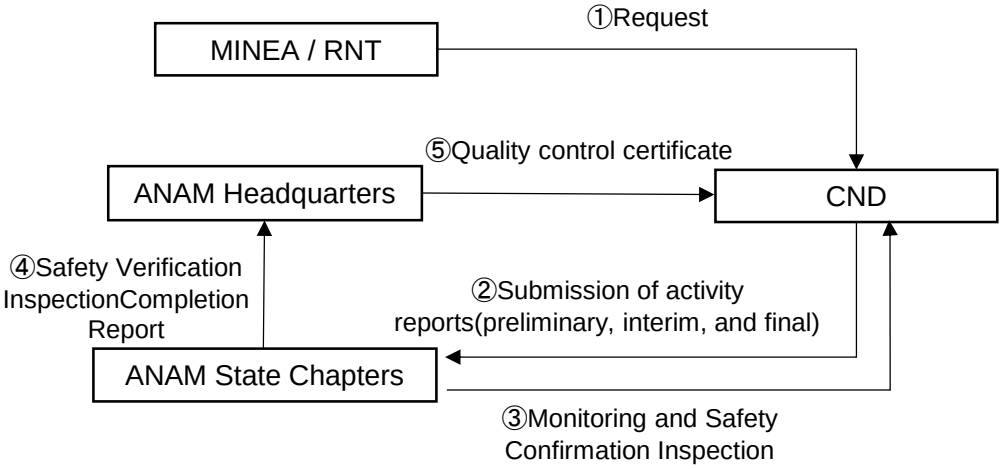


Figure 8.4-1 Process from the request for exploration and removal activities to the issuance of a quality control certificate for this project.

Source: Prepared by JICA Survey Team based on interviews, etc.

8.4.2. Process for Implementing Mine and UXO Exploration and Clearance from Technical Aspects

The National Standard for Demining Activities (NMS 2004-09-06), prepared by the ANAM, defines the process of demining activities in Angola as Figure 8.4-2. During the preparation phase of mine and UXO clearance, the contract between the operator and the client is supposed to clarify the requirements.

In the event that an accident such as a landmine or other accident occurs after a certificate of completion of demining activities has been issued, an investigation shall be conducted again.

[25] Responses to questionnaires collected from CNIDAH headquarters and interviews at CNIDAH Willa State Branch (December 5, 2019)

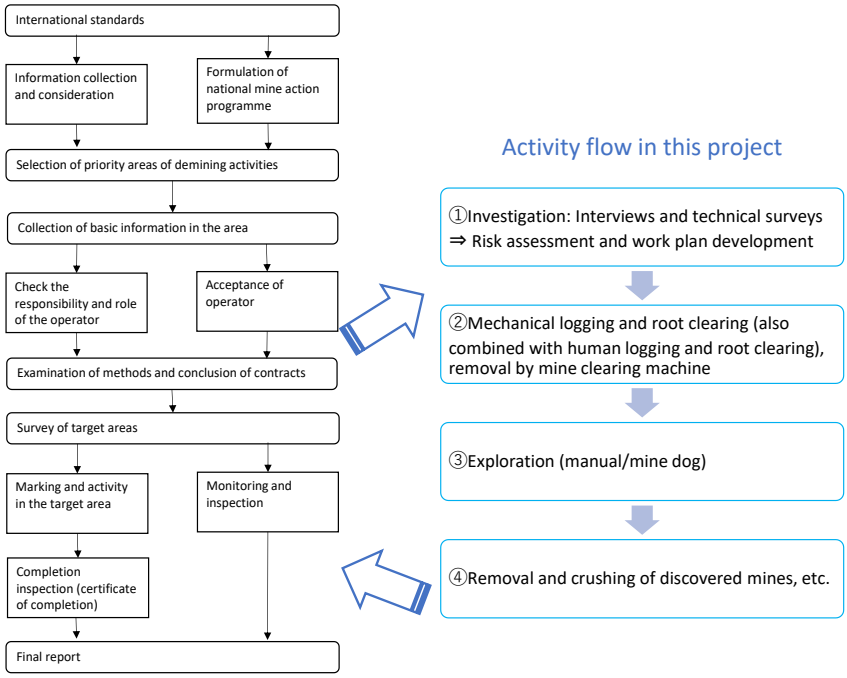


Figure 8.4-2 Process of demining activities

8.4.3. Status of Landmine and UXO Exploration and Clearance

In order to understand the implementation status of mine and UXO exploration and demining in Angola, we visited , a site about 120 km east of Luanda city (around Maria Telesa area), where INAD is conducting mine and UXO clearance activities (in this case, the pre-treatment process of mechanical demining and UXO clearance activities), and The interviews were conducted.[26]

(1) Site Overview

The site is based on a plan to install a power line network with a total length of 86 km, and demining activities are being carried out at the request of MINEA, the project owner of the plan.

The plan calls for the installation of new transmission lines in parallel with the existing transmission line network, and the mine and UXO clearance activity period is from early September 2019 to the end of December 2019.

(2) Status of Activities

The demining activities will begin with clearing and rooting by a swing-type demining machine, followed by the deployment of a manual mine detection team. A summary of the activities is as follows

1. The scope of the activity is 86 km x 60 m (width) along the transmission line and the depth of exploration is 30 cm[27] in accordance with NMAS, but the logging is being conducted over a width of 60 m to ensure a safe distance and access between the machines and workers.
2. INAD provides brief zones for access to the site in accordance with SOPs and maintains a safe distance from the machines.
3. The mechanical demining team consists of five members, who communicate with each other by a transceiver.
4. After completion of this activity, a report will be made to ANAM.

According to INAD, no mines or unexploded ordnance were found at the site.

8.4.4. Safety Certification Process after Mine and UXO Exploration and Clearance

(1) Safety certification process

The safety certification process is based on both internal inspections by demining activity operators and external inspections by ANAM. Operators publish a certificate of demining completion (as a QA letter) after the completion, and ANAM issues a quality control certificate after conducting a post-completion inspection.

[26] December 13, 2019 Implementation

[27] According to INAD, if there is a special specification from the requester regarding the scope and depth of exploration and removal, it will be performed accordingly, but at this site, both the scope and depth were uniform.

There are no established international standards for these certifications. It is the government agency that issues the certification, and if an accident should occur, the relief of the victims will be resolved in accordance with the domestic laws of the country concerned.

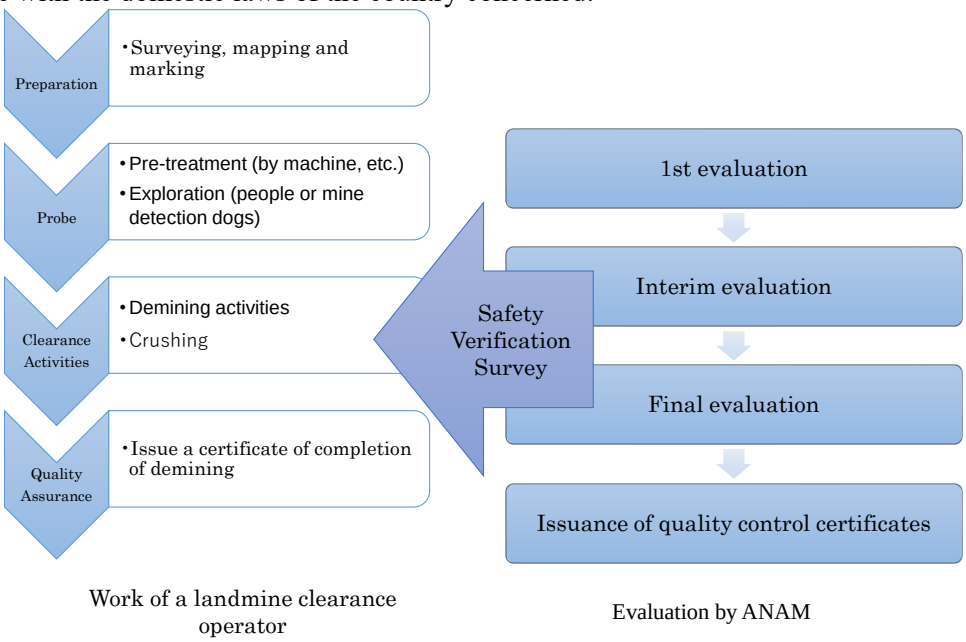


Figure 8.4-3 Safety Verification Process

(2) Points to keep in mind when signing the contract

It is important that the government of Angola bears responsibility for the victims of mines and unexploded ordnance in the project site and ancillary sites. It is important that the parties to the contract agree on safety guarantees at the time of the contract between the requesting party and the operator.

8.5. Basic Information on Institutions other than the Angolan Government that carry out Exploration and Clearance of Mines and unexploded Ordnance

8.5.1. Halo Trust

Halo Trust is a British international NGO that conducts landmine clearance in Angola and other parts of the world. In Angola, Halo Trust started its activities as an international NGO in 1994 to carry out demining activities. An overview is as follows.

(1) Description

Halo Trust has a proven track record of implementing activities with support from various donors including the Embassy of Japan, DFID, EU, and USAID. Currently, the headquarters is located in Huambo, in the central part of the country, with bases in the central and southeastern parts of the country, where demining and exploration activities are conducted. As of February 2020, Halo Trust has a total of 450 staff (about 300 field workers including operators and 150 non-field workers), 29 Demining Teams (Demining Teams) and 3 Explosive Ordnance Disposal (EOD) Teams. The budget is Table 8.5-1.

Table 8.5-1 Halo Trust Budget Trends (2012-2020)

Year	Budget (Millions of U.S. dollars)
2012-2013	Approx. 7.2
2013-2014	Approx. 6.2
2014-2015	Approx. 5.1
2015-2016	Approx. 4.6
2016-2017	Approx. 3.5
2017-2018	Approx. 4.6
2018-2019	Approx. 6.3
2019-2020	Approx. 5.4

Source: Prepared by JICA Survey Team based on interviews with Halo Trust

(2) Target Areas (States) and Activities

As of February 2020, the company has bases in Lobito (Benguela Province), Kuito (Bie Province), and Menongue-Cuito Cuanavale (Cuando Cubango Province). Activities are also carried out in the province of Cuanza Sul Province, but not based there. Starting in 2020, a contract will be made with the Angolan government to increase its staff to conduct mine and UXO exploration and demining activities around natural parks in the southeastern province of Cuando Cubango. The project is to conduct exploration and clearance around the national park in order to promote tourism development in the region as the Angolan government. [28]

(3) Results of Demining Activities in the Project Area

Halo Trust conducted NTS in June 2015 in Wira and April 2016 in Namibe, the target area of the project, but not in the vicinity of the proposed project site, as the area has very few residents.[29]

8.5.2. MAG (Mine Advisory Group)

MAG is a British international NGO that has been active in Angola since 1994. An overview is given below.

(1) Description

MAG registered as an NGO in Angola in 1994that implements long-term development projects, and began demining activities in 1995. The largest donor to MAG's operations is the British government, with additional support from the Japanese and U.S. governments for projects such as demining activities. As of February 2020, MAG has a staff of 160, but plans to increase this number by about 30 as it expands its operations. The budget size for the past five years is approximately US$3.5 million/year.

(2) Target Areas (States) and Activities

MAG is in charge of the northeastern provinces of Lunda Norte, Lunda Sur, and Mósico, which were assigned according to the Mine Action Work Plan developed by ANAM in coordination with relevant agencies. It also focuses on mine avoidance education.

(3) Views on Demining Activities in the Project Area

Regarding the mine exploration and demining activities in this project, we recognize that surveys are essential even if the traces of mines and UXOs are determined to be minimal, and if the activities are to be implemented, they need to be monitored from a professional perspective, including the quality aspects of the same activities.

8.5.3. NPA (Norwegian People's Aid)

NPA is a Norwegian international NGO that has been active in Angola since 1989. An overview is as follows:[30].

(1) Description

In 1989, NPA registered as an NGO in Angola implementing long-term development projects, and began demining activities in 1995. The largest donor to NPA is the Norwegian government, with additional support for demining activities and capacity-building projects from the Japanese and British governments. As of February 2020, there are 47 staff members (including 2 international staff) and the budget size for the past 5 years is about 1.5 million USD/year.

(2) Target Areas (States) and Activities

NPA's main demining areas are in Bengo, Kwanza Norte, and Zaire provinces, mainly in the northern part of the country as allocated by the Mine Action Work Plan. In addition, ANAM is implementing a DFID-funded capacity building project, as part of which, NPA is sending capacity building advisors to ANAM. The capacity building project is the Angolan government's focus for the formulation of NMAS based on IMAS, monitoring, quality control, data collection and management.

(3) Views on Demining Activities in the Project Area

Mine exploration and demining activities for national projects such as this project are under the jurisdiction of the CED, so one of the four agencies under the jurisdiction of the CED will be in charge of these activities. If the applicant requests that demining and clearance activities be conducted under

[28] Hearing from Halo Trust (December 13, 2019 and February 16, 2020)
[29] CNIDAH Namibe Provincial Branch (December 9, 2019) and hearing from Halo Trust (December 13, 2019).
[30] Hearing from NPA (December 4, 2019 and February 17, 2020)

specifications different from those for humanitarian demining, for example to a depth of several meters, the details of the activity method, certificate (which may be different from the normal ANAM certificate because it is different from NMAS), etc., should be discussed with the ANGOLA government agencies.

In addition, if mine exploration and clearance activities are to be conducted under the special specifications mentioned above, the quality aspects of the same activities need to be monitored from a professional perspective.

In general, a depth of 30 cm is sufficient in terms of mine clearance, but there are cases where large unexploded bombs dropped by air strikes remain in deeper areas. NPA believes that even areas declared mine-free in Angola cannot be guaranteed to be 100% free of mines and unexploded ordnance.

8.5.4. Local NGO (APOCOMINAS)

As noted above, donor support for mine countermeausure has been declining, and the only local NGO substantially active is APACOMINAS.[31] APACOMINAS was established for demining and exploration in 2004, after the civil war. An overview is as follows

(1) Description

Founded in 2004, the NGO has a track record of conducting landmine and UXO identification, survey and demining activities, and mine avoidance education throughout Angola. In the past, the organization had been active with support from the EU and the Japanese Embassy's grassroots grants, but now donor funding has ceased, forcing the closure of the Luanda office in September 2019. The number of staff rose to about 250 at its peak, but now stands at 49.

(2) Track Record

From 2004 to 2019, APACOMINAS has cleared approximately 6.3 ㎢ of mines and unexploded ordnance, removing 1,611 anti-personnel mines, 53 anti-tank mines, and 11,954 unexploded ordnance. The Japanese Embassy's Grassroots Grant Program conducted demining and mine avoidance education in Quanza Sur Province.

(3) Results of Demining Activities in the Project Area

In 2019, in the village of Caraculo, Namibe Province, APACOMINAS carried out the search and clearance of mines and unexploded ordnance in the target village for a project to install solar panels.

8.5.5. Private-Sector Business

From 2012 to 2016, 25 private companies were reported to have conducted mine exploration and demining activities[32] , but in 2019, CNIDAH (at the time) certified 12 companies. Since the drop in oil prices and due to the decrease in national infrastructure development projects, the number of work requests to private companies has decreased and many companies are likely to withdraw from the project. Although private companies are considered to be more expensive but work faster than government and NGO operators[33] , it has been noted that some companies conduct improper exploration and demining activities[34] . In 2019, Halo Trust re-explored and demined in the areas where private companies had conducted exploration and removal to ensure safety.

8.5.6. NGO Operator Structure, Budget, etc.

Undislosed Information.

[31] Hearing from APACOMINAS (December 3, 2019)
[32] CNIDAH (2017). "Angola´s second article 5 extension request to the Ottawa mine ban treaty 2018 - 2025 Angola".
[33] Hearing at CNIDAH Willa State Branch (December 5, 2019)
[34] Hearing from Halo Trust (December 13, 2019)

8.6. Mine and UXO Search and Clearance Measures in the Advanced Case of Transmission Line Improvement Project

The main transmission line projects and plans that precede the Southern Transmission System Enhancement Project are as follows

1. Northern Power Line Improvement Project (Lauca-Bita (Kilamba)): Implemented by a Brazilian company.
2. Central Power Line Improvement Project (Lauca-Huambo): Financed by the Export-Import Bank of China and implemented by a Chinese company.
3. Southern Transmission Line Improvement Project (Huambo-Lubango): implemented by AfDB.
4. Southern Namibia - Namibia Intercountry International Transmission Line Development Plan Study: under consideration by AfDB.

For each of the precedents, the following interviews were conducted with the Brazilian Embassy in Angola, the Chinese Embassy in Angola, the AfDB Angola Office, and the Gabinete de Abinete de Kwanza (Central Kwanza River Utilization Agency), an agency under MINEA, regarding the measures taken to search for and remove mines and UXO in the project implementation or planning stages. The results of the interviews with the Embassy of Brazil in Angola, the Embassy of China in Angola, the AfDB Angola office, the Gabinete de Abinete do Médio Kwanza (GAMEK), a subordinate agency of MINEA, and others are as follows

8.6.1. Northern Power Line Improvement Project

(1) Outlook of Embassy of Brazil in Angola

The Lauca-Bita transmission line improvement project was not an economic cooperation by the Brazilian government, but an investment project by a private company that received credit from the Brazilian government. Therefore, the Brazilian government (Brazilian Embassy) did not request or consult with Angolan government officials regarding mine exploration and clearance.

The Brazilian government provided technical assistance to the FAA in the field of demining. The cooperation consisted of training on demining techniques and the use of search and removal equipment. Through the training, the FAA's demining capability was evaluated to have reached a sufficient level, and the technical cooperation has been completed.

(2) Outlook of GAMEK

Prior to the implementation of the Lauca-Bita transmission line project, GAMEK requested CED to search for and remove mines, and the FAA carried out the work. GAMEK recognizes that FAA military personnel who buried mines during the civil war have the best knowledge of information pertaining to remaining mines and unexploded ordnance, and are highly skilled at removing them. The FAA's exploration and demining period was six months for the 300-kilometer section of land to be cleared, and construction work was started sequentially from the point where the exploration and demining was completed and the certification was granted. Of the necessary expenses, the procurement of exploration and demining equipment, spare parts, and fuel were provided in-kind by the project implementer (GAMEK), while other costs (personnel expenses for FAA operators and procurement of equipment) were spent by the Angolan government (Ministry of National Defense). The exploration and removal work could be outsourced by GAMEK to a private company, but this would be more expensive than a public operator.

8.6.2. Central Japan Power Transmission Line Improvement Project

The following is the outlook of the Chinese Embassy in Angola.

The power transmission project between Lauca and HHuambo was implemented as an investment project by a private Chinese company. For all infrastructure projects involving China, including this power transmission project, it is the responsibility of the Angolan government to search for and clear mines and unexploded ordnance prior to project implementation in accordance with IMAS, and the Chinese government trusts and respects the results of these searches. It is the responsibility of the Angolan government to ensure the safety of the project area, which will be discussed during the negotiation of the project contract between the Chinese government and the Angolan government, and

the Chinese Embassy will not request the Angolan government to conduct another survey of mines and UXOs before the project is implemented.

China has implemented many infrastructure projects, not limited to power transmission projects, and there have been no accidents caused by landmines or unexploded ordnance in the implementation of its projects so far. The Chinese Embassy believes that it is necessary to recognize that landmines and unexploded ordnance from World War II can still be found in Asian countries and European regions, and that the effects of the war still exist decades after the civil war, not only in Angola.

8.6.3. Southern Power Line Improvement Project

The outlooks of the AfDB Angola office are presented below.

The AfDB conducted a feasibility study (F/S) of the HHuambo - Lubango transmission line project and found that the project area has a proven performance of safe livelihoods, with residents already settled in the area and many of them engaged in economic activities such as agricultural production. The AfDB decided that there was no need to re-examine the landmines due to the following reasons.

1. Having a track record of implementing resettlement from the proposed steel tower site
2. Working with local government and local communities to obtain reliable information on remaining mines
3. Referring to an advice from the Halo Trust, an international NGO.

8.6.4. Project Plan for the Construction of an International Power Transmission Line between Southern Namibia and Namibia

The outlooks of the AfDB Angola office are presented below.

AfDB is envisioning an international power transmission project (400 KVA) to Lubango and the neighboring country of Namibia, and is in the process of selecting a consultant for a FS starting in April 2021. The safety confirmation of mines and UXOs will be discussed in future missions, including the results of the FS.

8.7. Study on Mine and UXO Countermeasures in the Proposed Project Site Results

Based on the above survey results, the results of the study on mine and UXO countermeasures in the proposed project area are as follows. It is assumed that the exploration and clearance activities for mines and UXOs will be conducted in accordance with IMAS and NMAS, this chapter presents points that require special attention.

8.7.1. Necessity of Exploration and Removal of Mines and unexploded Ordnance at the Project Site

As a result of discussions with relevant agencies and information gathering, the status of landmine and UXO burial in the proposed project area cannot be confirmed. Therefore, phased exploration and demining activities covering the entire project area are necessary to ensure the safety of the proposed project area. The main reasons are listed below.

- Till date, no landmine contamination survey covering all of the proposed project site has been conducted.
- The Angolan government has not conducted any mine action activities in the proposed project area.
- The possibility of ERW (Explosive remnants of war), not limited to mines and unexploded ordnance, cannot be ruled out.
- There are records of mines and bombs being used to obstruct the transport of military supplies and equipment on the transportation routes from the ports to the interior.

The project area is located in the Willa and Namibe provinces, and Halo Trust, an international NGO, is implementing the NTS in both provinces.According to the map of mine contamination in Figure 8.2-1, it is difficult to say that the contamination is higher than in other provinces. On the other hand, since the NTS is an interview survey, it is limited to areas around urban areas and residential areas, and

is not conducted around power line routes far from residential areas, and the status of mine contamination is not known.

Maps of the transmission line route were presented to the relevant agencies (CED, INAD, and ANAM) to confirm the availability of maps and other data showing the contamination status of mines and UXO in the proposed project site. However, none of the agencies possessed such data, as the Angolan government does not conduct mine action activities in the proposed project site.

Several Angolan government agencies (ANAM, CED, INAD, etc.) pointed out that the possibility of ERW (Explosive Remnants of War) as well as mines and unexploded ordnance cannot be excluded at the proposed project site, and that there are records of mines and bombs being used on the transportation routes from the port to inland to obstruct transportation of military equipment and supplies and materials.

In addition, international NGOs such as MAG and NPA, which are engaged in demining activities in Angola, have expressed the view that mine and UXO surveys are necessary after identifying project sites and ancillary sites.

On the other hand, it is necessary to conduct landmine and UXO exploration and demining activities based on the fact that in prior cases, in urban areas and residential areas, it has already been determined that the area is safe for local residents to live.

8.7.2. Methods for conducting the exploration and removal of mines and unexploded ordnance required for the project site

The proposed project site is as follows (refer to "Attachment 8-3: Map of Proposed Project Site) are as follows.

- Extension of transmission line route: approx. 196 km x 45 m
- Extension of distribution line route: approx. 10 km x 24 m
- Site for steel tower construction: 45m x 45m x approx. 500 locations
- Substation sites: 270m x 150m, 120m x 90m, 100m x 50m
- Incidental sites such as loading corridors, material storage areas, etc.: 6m x 100m x approx. 500 locations

The following work will be carried out in phases to confirm the safety of the project implementation, assuming that the activities will be carried out for approximately 11 months in all areas that fall under the proposed project site.

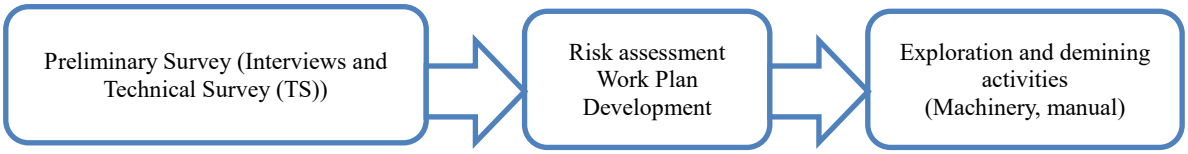


Figure 8.7-1 Work Procedure

(1) Vegetation, etc. on the proposed project site

The total length of the proposed project site, approximately 206 km of transmission and distribution line routes, is divided into zones based on the natural environment.Figure 8.7-2 shows the classification of the project site according to the natural environment. In demining activities, natural conditions are an important factor in carrying out activities, and the organization of mine exploration and clearance activity teams, exploration methods, and deployment of equipment will be considered in light of these factors.

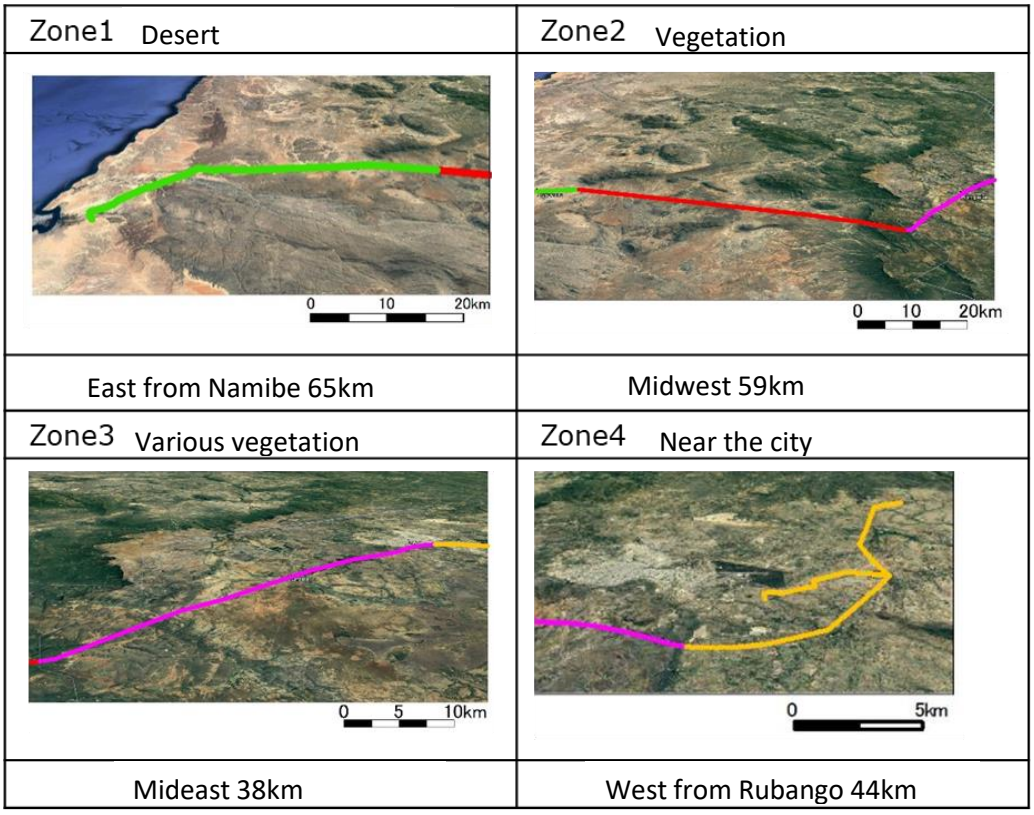


Figure 8.7-2 Vegetation in each zone

(2) preliminary investigation

The purpose of the pre-survey is to contribute to the understanding of the situation, risk assessment and specific work planning for the exploration and demining activities. The followings are excerpts of the contents of the pre-survey as described in Angola's Angola's Standard Operation Procedure (SOP).

- ✓ Prior to conducting demining activities, survey the relevant area, conduct a risk assessment, and prepare a work plan
- ✓ Composition of removal team (number of people assigned, etc.)
- ✓ Types and methods of reporting
- ✓ Confirmation of the work environment, including securing the area where equipment is used, securing aisles, and ensuring the safety of removal workers

The TS conducted at this stage is a simple survey of about 10 cm of the surface layer using a detector, etc., focusing on areas where it is difficult to conduct an interview.

(3) risk assessment

In accordance with the SOP, the following risk assessment will be conducted based on the information collected in the above preliminary surveys (interviews and TS). Note that Field Risk Assessment (July 2013) is recommended in IMAS before exploration.

- Information based on actual local experience and information
- Report on general ERW removal activities based on field experience
- Methods and quantification of risks to avoid explosions and damage from landmines due to vegetation and geology at demining activity sites

Table 8.7-1 Environmental Risks

Risk (surveyed object: explosives) value (WC)	Environment surrounding the site	The way of checking	Risk-adjusted value (additive value)
+2	Crag	Detecting, marking, and visual search only are dangerous	+1
+3	Soft soil	Drying and detection by detector	0
+2	There is vegetation	Vegetation removal and detection	0
+1	Sloping land	Slip and exploration is done from the top of the slope down.	0
+1	Vegetation thrives	Vegetation removal by machine	0
+1	There is barbed wire.	Mechanical removal	0

Source: JICA Survey Team

(4) Work Plan Development

The search and clearance of mines and UXOs in the proposed project area will be carried out in accordance with the implementation process of the Angolan government. At this point, the following points should be kept in mind when developing a mine and UXO exploration and clearance work plan.

1. Since a wide variety of mines and unexploded ordnance may remain, it is necessary to develop an exploration and removal plan that takes this into account.
2. Within the Namibe Province, deserts are widespread, but there is vegetation in the Willa Province. There are also mountains, hills, and other slopes. In consideration of such terrain and vegetation, as well as from the perspective of ensuring the safety of mine and UXO exploration and clearance activities, the use of demining equipment, especially in locations where it is used, should be avoided in steep terrain.
3. For mine and UXO exploration along the power line installation route, the width and depth shall be 45 m and 30 cm, respectively, in accordance with the ROW. However, at the location of the tower installation, the depth shall be 10 m, and a work plan shall be developed to ensure a work space that takes into account heavy vehicle traffic and other factors.
4. The scope of daily activities of residents in and around urban areas and residential areas has already been confirmed to be safe for local residents to live in, so the scope of demining activities should be narrowed down or simple exploration and removal should be conducted, except in cases where special exploration such as high depth exploration at the location of steel towers is required.

(5) Methods of conducting landmine and UXO exploration and clearance activities

The scope of demining activities in the project is shown in Table 8.7-2. Although there is no Angolan standard for the width of exploration of transmission line routes and distribution line routes, the basic rule is to explore the realm of the ROW. However, there was one case where the exploration was done at a width of 60 m to allow for a margin. In this project, 45 m of ROW for the transmission line route and 24 m of ROW for the distribution line route will be explored, and the depth will be 30 cm according to NMAS[35] . When the location of the steel tower is determined, if there are areas outside the explored area, additional exploration will be conducted to ensure that there are no unexplored areas. In addition, a depth of 10 m should be used at the location of the steel tower in consideration of the geological survey and foundation work. Furthermore, the scope should also include ancillary sites that allow for heavy vehicle traffic and work space for materials and equipment storage to ensure the safety of the construction work.

Likewise, this activity will be carried out in accordance with Angola's SOPs. The specific implementation method (for an image of the demining operation, please refer to "Attachment 8-4. Images of Mine Clearance Work").

[35] Since mines are designed to explode upon contact or weight, etc., they will not function if buried too deep, so NMAS has set a search depth of 30 cm.

Table 8.7-2 Scope of Mine and UXO Search and Clearance Activities

Subject (of taxation, etc.)	Range (extension x width x depth x number of locations)
Extension of transmission line routes	Approx. 196 km x 45 m x 30 cm
Extension of distribution line routes	Approx. 10 km x 24 m x 30 cm
Site for steel tower construction	45m x 45m x 30cm x approx. 500 locations
Steel towers' leg positions	4 legs x 10m x approx. 500 locations
Substation sites (3 in total)	270 m x 150 m x 30 cm, 120 m x 90 m x 30 cm, and 100m x 50m x 30cm
Ancillary sites such as loading aisles, material storage areas, etc.	100m x 6m x 30cm x approx. 500 locations

Source: JICA Survey Team

(a) Activities by Zone

Demining activities are tailored to the vegetation and other conditions of the target area showed in Table 8.7-3 (refer to Figure 8.7-2 for color-coded zones).

Table 8.7-3 Activities by Zone

Zone1 Green (desert with few bushes)	Zone2 Red (has plants)	Zone3 Purple (various kinds of plants)	Zone4 Orange (suberb area)
65km	59km	38km	34km＋10km
Interview 			
Technical Survey（Surface Exploration with Manual） 			
Mechanical Removal 	Mechanical removal/deforestation/rooting 		
Manual exploration and removal  			

(Note 1) In Zone 1 to Zone 3, manual work shall be used on slopes and other terrain unsuitable for the use of equipment.
(Note 2) Zone 4 is an urban area and cliff section, and only manual work is required.

Source: JICA Survey Team

(b) Exploration Depth

The exploration depths for each survey phase, taken from INAD's SOPs, are shown inTable 8.7-4. According to INAD, the sensitivity of the bomb locator can be adjusted to allow exploration of about 10 m underground. Since borehole investigations and foundation work will be conducted in the area where the towers are to be installed, the location of the four legs of each tower shall be at a depth of 10 m.

Note that INAD believed, based on previous experience, unexploded ordnance could not penetrate the ground and reach a depth of more than 10 meters.[36]

Figure 8.7-3 Bomb Locator

Table 8.7-4 Exploration Depth, etc.

	Probe width	Exploration Lane Length	Exploration Depth	Remarks
TS.	50cm	10m～	10cm	Different types of probes are used depending on the soil type.
Manual exploration	50cm	10m～	30cm	
High Depth Exploration	25m to 50m	25m to 50m	3 to 5m Using a medium depth probe	The maximum depth that can be explored by the bomb locator is 10 meters below the surface.

Source: Prepared by JICA Survey Team based on interviews with INAD

(c) Mines and unexploded ordnance to be removed

As noted in 8.2.1 (3) (b) above, there are 95 types of landmines buried in Angola. In addition, there is a possibility that not only mines and unexploded ordnance but also abandoned ERW may remain in the project area, so it is necessary to keep in mind that all of these should be targeted and made safe.

Some ERW contain metal parts (e.g., shell casings and mortars) and some do not (e.g., PE34 and TNT explosives), and some ERW can be effectively detected by magnetic survey activities using metal detectors, while others cannot be detected using metal detectors. Exploration and removal activities require sufficient experience, knowledge, and equipment.

(d) Phased exploration and demining activities considering the overall process

[36] The CED and INAD have indicated that they would like to promptly obtain information on the location of 500 possible steel tower boring sites.

The exploration and removal activities for mines and UXO involved in this project should be carried out in phases in accordance with the overall process of determining the transmission, distribution line routes, the location of the towers, etc. The construction process and the flow of exploration and removal activities are shown in Figure 8.7-4.

The first phase of the survey will be to explore and remove mines and unexploded ordnance at a depth of 30 cm across the entire line after the planned route of the transmission and distribution lines and the substation locations have been determined.

The second survey will be conducted once the location of the tower and ancillary sites have been determined based on the contractor's survey results. The ancillary and adjustment sites[37] will be explored and removed to a depth of 30 cm. Additionally, the geological survey site[38] will be explored at a depth of 10 m.[39]

After the final determination of the tower location, etc., a 10m high depth survey will be conducted at the location of the tower legs as the third stage of the survey.

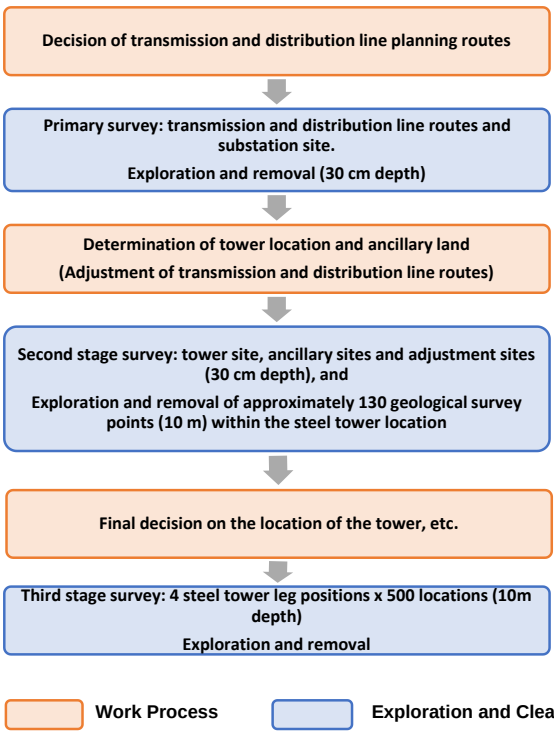


Figure 8.7-4 Construction process and flow of exploration and removal activities

(e) Process and necessary equipment for the search and removal of mines and unexploded ordnance involved in this project

The demining equipment to be used for the exploration and demining involved in this project shall be a versatile swing type that can cope with the slope and unevenness of the land and is suitable for clearing and rooting work. The construction period and necessary equipments required for the exploration and clearance of mines and UXOs in this project, calculated based on the work capacity of the demining machine (by demining machine and clearing and rooting work)[40] and high-depth exploration work capacity relative to the overall workload, are as follows.

1. Primary Research

Table 8.7-5 shows that the number of demining machines required is 5 and the time required is 7 months.

Table 8.7-5 Number of demining machines required for the first survey and the time required

								Mechanical Removal					Mechanical Removal/ Deforestation				
Location	Characteristic	km	m	m2	m	m3	%	m3/hr	hr/month	month/un	Unit	Month	m2/hr	hr/month	month/un	Unit	Month
Zone 1	desert, bushes	65	45	2,925,000	0.3	877,500	100%	600	175	8.3571	1.1939	7					
Zone 2	plants	59	45	2,655,000			100%						1200	175	12.643	1.8061	7
Zone 3	various plants	38	45	1,710,000			100%						1000	175	9.7714	1.3959	7
Zone 4	surberb area	44	45	1,980,000	0.3	594,000	0%										
Substation		0.27	150	40,500	0.3	12,150	100%	600	175	0.1157	0.0165	7					
Substation		0.12	90	10,800	0.3	3,240	100%	600	175	0.0309	0.0044	7					
Substation		0.1	50	5,000	0.3	1,500	100%	600	175	0.0143	0.002	7					
										total	1.2169	7			total	3.202	7
															Total	4.4189	

[37] Areas that were outside the scope of the primary survey due to contractor survey results.

[38] Approximately 130 of the steel tower locations will be selected.

[39] Work will be performed manually using a high depth probe, bomb locator (capable of surveying 10m depth below the surface), etc.

[40] The work capacity/hour was set with reference to cases in Cambodia and other countries, taking into account that it may decrease depending on site conditions (e.g., land slope, vegetation conditions, etc.). In addition, assuming full operation, 7 hours/day x 25 days = 175 hours/month.

2. Secondary research

Table 8.7-6 shows that the number of demining machines required is two and the period is one month.

Besides, the high-depth exploration of 130 geological survey points will take two teams 0.65 months, but the second survey will be completed in one month because it will be conducted in parallel with the demining machine work.

Calculation of time required for high-depth exploration

4 locations/day x 25 days/month x 2 teams = 200 locations/month

130 locations / 200 locations = 0.65 months

Table 8.7-6 Number of demining machines required for the second survey and time required

										Mechanical Removal					Mechanical Removal/ Deforestation				
Location	Characteristic	Extension	Tower	Width	Extension	Area	Depth	Excavation	Survey	m3/hr	hr/month	month/un	Unit	Month	m2/hr	hr/month	month/un	Unit	Month
Workplace		km	number	m	m	m2	m	m3	%										
Zone 1	desert, bushes	65	165	6	100	99,000	0.3	29,700	100%	600	175	0.2829	0.2829	1					
Zone 2	plants	59	151	6	100	90,600	0.3	27,180	100%						1200	175	0.4314	0.4314	1
Zone 3	various plants	38	97	6	100	58,200	0.3	17,460	100%						1000	175	0.3326	0.3326	1
Zone 4	surberb area	34	87	6	100	52,200	0.3	15,660	10%	Manual									
	(Distribution	10	—	6	100	600	0.3	180	10%	600	175	0.0002	0.0002	1					
	計	206	500																
Tower (addition)			Tower	Width	Extension	Area	Depth	Excavation	Survey										
			number	m	m	m2	m	m3	%										
Zone 1	desert, bushes		165	45	45	2,025	0.3	608	10%	600	175	0.0006	0.0006	1					
Zone 2	plants		151	45	45	2,025	0.3	608	10%						1000	175	0.0012	0.0012	1
Zone 3	various plants		97	45	45	2,025	0.3	608	10%						1000	175	0.0012	0.0012	1
Zone 4	surberb area		87	45	45	2,025	0.3	608	10%	Manual									
												total	0.2836	1				total	0.7663	1
																		Total		1.0499

3. Tertiary Research

One team will conduct high depth surveys of 500 tower locations. A period will be three months equivalent to a total of two teams working, one of which accomplishes four locations per day including movement from one site to the other.

Calculation of time required for high-depth exploration

4 locations/day x 25 days/month x 2 teams = 200 locations/month

500 locations / 200 locations = 2.5 months

As mentioned above, the search and clearance activities for mines and UXOs will proceed in line with the progress of the power works, and the total time required is 11 months.

For required demining equipment, as mentioned in 8.3.1 (1) (d) above, six of INAD's existing swing-type equipment are in operational condition and can be utilized in this project. However, as described in 8.3.1 (1) (e), the rotary cutter (with grapple), which is the attachment used in this project, is used frequently and is expected to have more malfunction in the future. Therefore, three sets of rotary cutters, which are subject to significant breakdowns and wear and tear, will be procured for this project to ensure that the mine and UXO exploration and clearance activities of this project can be carried out without any problems. Moreover, mobile repair vehicles and trailers for transporting demining equipment are required.

Furthermore, as for spare parts and consumables, since similar products are substituted for the locally available genuine parts, and since the Economic and Social Development Plan plans to procure 3 units of swing-type equipment for the 6 existing swing-type equipment that can be operated, this project will procure batteries (which are used for Stand By machines) and oil, etc in addition to similar consumables for the remaining 3 units. The Economic and Social Development Plan calls for the procurement of cockpit windows (bulletproof glass) for four units, but the remaining two units that are still operational are becoming difficult for operators to see outward due to age-related deterioration, so two units will be procured under this project to ensure work safety.

Then, equipment (detectors, GPS, radios, etc.), high depth mine detectors, and bomb locators will be required to accommodate the number of people to be removed, and will be procured in the quantities needed for the work.

Since all procured equipment is for INAD, a civilian agency, and will not be used by the FAA, it does not violate the "Principle of Avoidance of Military Use" stipulated in the Outline of Development Cooperation.

(f) Formation of teams for exploration and removal activities

The CED has been considering the formation of a mine and UXO exploration and clearance activity teams for this project which are four manual teams (INAD: 2 teams, FAA: 2 teams) and four mechanical teams (INAD: 2 mechanical removal teams, INAD: 2 bush removal teams) as shown in Table 8.7-7. The team composition will be finalized by contract with the project sponsor, together with a work plan reflecting the results of the preliminary survey and other information.

Table 8.7-7 Organization of exploration and removal teams

(Data) Item		Subject (of taxation, etc.)	Remarks
INAD	Manual team x 2	Zone 1, Zone 4	Total number of workers: 90
	Equipment removal team x 2	Zone1, Zone2	Total number of workers: 24
	Shrub removal team x 2	Zone2, Zone3	Total number of workers: 24
FAA	Manual team x 2	Zone2, Zone3	Total number of workers: 90

Source: JICA Survey Team, based on interviews, etc.

The number of people in each team will vary depending on each operator. For example, the basic composition of the manual team will be 18 peoplepeople/team for INAD and 69 peoplepeople/team for FAA. In the mine and UXO exploration and clearance activities of this project, CED expects INAD and FAA to collaborate with each other, as the work will be carried out by machines and manuals within a limited period of time. Considering the wide range of manual work involved, a manual team of 69 peoplepeople/team is being considered.

Of the 69 personnel that make up the manual team, 45 are mine exploration and clearance workers, while the other 24 are a leader, deputy leader, medical officer, mine and UXO clearance worker (EOD), mechanic, internal quality control worker (QA), cook, and driver.

8.7.3. Operators of Mine and UXO Exploration and Clearance

About details on the activities and equipment owned by each of the potential operators in the project, please refer to "Attachment 8-1. Operator Comparison Chart" and "Attachment 8-2: List of Equipment".

(1) Operator Selection

As described in Section 8.4.2 above, the selection of operators is carried out by the CED, which manages the overall planning of mine and UXO exploration and clearance activities for the four official operators, INAD, FAA, CSPR, and PGFA. In addition, the CED selects and determines the most appropriate operator to conduct the mine and UXO exploration and clearance activities for each national project, taking into consideration factors such as operational status and structure (including the existence of local branches).

The CED shall conduct mine and UXO exploration and clearance activities under the project in a limited period of time, using both mechanical and manual means, and therefore, as described in Section 8.7.2 (5) (f) above, INAD and the FAA are expected to collaborate on the project.

(2) Operator's ability to implement

According to chapter8.3.1(1) , "Attachment 8-1. Operator Comparison Chart" and "Attachment 8-2: List of Equipment", INAD has the capabilities, systems, and experience necessary for the exploration and removal of mines and UXOs involved in this project.

The FAA has been conducting mine and UXO exploration and clearance activities in national projects such as this project under the coordination of the CED, and since the FAA conducts controlled activities under the military chain of command in a limited area of activity in the project area, the FAA is able to conduct mine clearance operations quickly. GAMEK, which was the project entity for the northern transmission line improvement project, evaluated the FAA as having a good understanding of information on remaining mines and unexploded ordnance, and as possessing advanced clearance technology. In addition, the Brazilian government has provided technical assistance to the FAA in demining (training in demining techniques and methods of using search and removal equipment), and has completed this technical assistance based on its assessment that the FAA's demining capability has reached a satisfactory level. Based on these backgrounds, it can be evaluated that the FAA has the

necessary capacity, structure, and track record for mine and UXO exploration and clearance activities related to this project.

(3) Operational cost

The operational costs of mine and UXO exploration and clearance activities conducted by government projects are set at a unit cost per m2.

Note that all public operator removal crews are government employees, and operational costs do not include personnel costs.

Table 8.7-8 shows the status of INAD's recent operational cost estimates and actual budgeted costs for infrastructure projects.

Table 8.7-8 Initial estimates and actual budgeted costs of mine action activities for INAD's recent infrastructure projects

Project	State	Implementation period	m2	unit price（m2) (KWZ)	Initial estimate (KWZ)	Actually budget amount(KWZ)	Ratio
Transmission line project (75km)	Huambo	2021/2/23～ 2021/3/26	4,500,000	46.00	207,000,000	95,000,000	45.9%
Water network project (42km)	Cuanza Norte	2020/11/5～ 2021/4/12	2,520,000	50.67	127,688,400	57,870,047	45.3%
Hydropower site	Lunda Norte	2021/2/18～ 2022/1/11	5,570,000	43.68	243,297,600	194,950,000	80.1%
Bukura district	Bengo	2021/11/16～ 2022/1/10	216,800	100.11	21,703,848	12,887,676	59.4%
Solar power generation project	Moxico	2022/4/27～ ongoing	312,027	94.22	29,399,184	28,394,460	96.6%
Fertilizer factory construction	Zaire	2022/4/2～ ongoing	1,522,853	53.00	80,711,209	82,177,716	101.8%
New airport construction	Zaire	2022/4/4～ ongoing	98,395,600	13.35	1,313,581,260	125,138,748	9.5%
						Average	62.7%

Source: JICA Survey Team

As shown in the table above, there is a difference between the initial estimate and the actual budgeted amount depending on the project. This is because INAD prepares work plans and operational cost estimates based on the project owner's initial request (in most cases, a wide range of mine and UXO exploration and clearance activities are desired), but in many cases, the project owner faces a budget limitation, so the scope of exploration and demining activities is diminished so that the total cost is lowered. During this process of narrowing down the scope of exploration/demining activities, the project owner and INAD agree on it by using the results of Non-Technical Surveys (NTS), etc. to identify areas where activities are unnecessary, or to reduce the area of exploration/removal. Therefore, although the actual budgeted amount is often reduced compared to the original estimate, the agreed-upon exploration and demining activities are completed.

Since it is essential that the search and removal of mines and unexploded ordnance be carried out smoothly and reliably within the construction period to the extent necessary to ensure the safety of the entire project site, operational costs shall be included in the project cost.

(4) Maintenance and Management System

INAD has a dedicated repair shop in the province of Huambo, and the said repair work is equipped with a set of equipment and tools for maintenance and management. And, a control ledger for the equipment exists, and the technical capacity to perform routine and regular maintenance is ensured. Based on these circumstances, the period of demining activities in this project is approximately 11 months, and the maintenance and management system for the equipment during this period is considered to be satisfactory.

However, when the equipment was installed and maintenance technical guidance was provided as part of the initial instruction,no training has been provided since 2014 and new training is needed to acquire new skills. Also, there is a lack of understanding of the importance of scheduled inspections.

(5) Maintenance Budget

In the current severe financial situation, the maintenance budget is not sufficient, and although various efforts are being made to maintain and manage equipment, it is not possible to create a budget plan that predicts the future, making it even more difficult to secure a budget. If it becomes possible to properly understand and manage the condition of equipment and its renewal period, it will be feasuble to formulate a budget plan for maintenance and management after equipment procurement, and based on this plan, budget allocation can be equalized and budget measures, including multi-year budgets, can be considered. In the future, it will also be possible to request cooperation from donors.

8.7.4. Monitoring and Certification Bodies

ANAM will be responsible for quality control and quality assurance of mine exploration and clearance activities, safety verification inspection and issuance of quality control certificates after completion of the activities. ANAM will deploy a monitoring team (3-member team) to respond when exploration and removal activities are conducted by operators. ANAM will also conduct monitoring and quality control activities for the mine exploration and removal activities involved in this project and issue a quality control certificate.

Forbye, CED is required to pay 10% of the operational costs of mine and UXO exploration and clearance activities to ANAM as expenses for monitoring and quality control and issuance of quality control certificates. The quality control certificate is a guarantee of the safety of the project site, and it is essential that monitoring and quality control by ANAM be carried out smoothly and reliably; therefore, this cost shall also be included in the project cost.

8.7.5. Proposal for Technical Assistance

We propose two technical assistances for mine countermeasure activities in this project to improve the maintenance and management system so as to secure a planned budget, and improve maintenance and management skills.

(1) Maintenance of Maintenance Records

<Current Status>

Management information, such as daily operation and maintenance records, is not consolidated and analyzed in a timely manner, making it impossible to develop equipment maintenance schedules and budget plans.

<Technical Assistance Details>

Operation and maintenance records for equipment deployed at each location are consolidated in the equipment management department, and the equipment management department analyzes these records to reflect them in equipment utilization plans, create maintenance schedules, and formulate budget plans for future needs, thereby improving equipment operation and maintenance management efficiency.

<Expected effects>

By accumulating and analyzing the operation and maintenance records of the equipment, it is possible to estimate whether the personnel allocation is appropriate, whether the cost of fuel is reasonable based on the area of exploration and removal activities, whether the maintenance period of the removal equipment based on work hours is appropriate, when spare parts need to be procured, and whether the equipment allocation and utilization plan is appropriate. On top of that, it will be possible to identify future maintenance and management costs, skills, etc., which will help prevent wasteful ordering of spare parts and encourage systematic budgeting.

(2) Improvement of Equipment Maintenance and Management Skills

<Current Status>

INAD has not provided maintenance technical training by outside experts since receiving maintenance technical instruction as part of the initial instruction when the equipment was installed in 2014. Moreover, only a few operators and mechanics who attended the technical instruction in 2014 belong to INAD today. As a result, the technicians responsible for maintenance and management are working without understanding the contents of the repair manual, and the lack of maintenance and management skills and knowledge of the technicians is an issue.

<Technical Assistance Details>

We will improve maintenance and management skills, including basic knowledge of equipment, characteristics, and failure detection, by preparing manuals and providing maintenance and management guidance to technicians. Specifically, training will be provided on the structure of equipment and how to respond to malfunctions, and a rebuild system will be established. In particular, for equipment maintenance and management, the program will provide basic training in hydraulics, structure, maintenance, and electronic control systems, using actual equipment, and establish a system that enables periodic ToT (training by trainers) at the local level.

<Expected effects>

It will improve the skills of the technicians and lead to equipment life extension measures. More, the establishment of the ToT will establish a sustainable technician training system.

(3) Evaluation Indicators

The evaluation indicators of this technical support are as follows.

- Input: 1.5MM of experts in maintenance record keeping, equipment placement, utilization planning, and building technical guidance and training systems.
- Quantitative evaluation index
  The management information related to maintenance and management will be better prepared than before the technical assistance, which will help shorten the procurement period for spare parts and other items.
  Maintenance and management skills of more than 10 operators and mechanics will be improved.
- Qualitative Evaluation Indicators
  Information for equipment deployment and utilization planning and personnel allocation planning will be organized and used for planned maintenance and management budget measures.
  Smooth maintenance and management of equipment; establishment of a sustainable technician training system through the ToT.

(4) Technical Assistance Process

The process chart for technical assistance in (1) and (2) above is shown in Table 8.7-9.

Table 8.7-9 Technical Assistance Process Chart

Item \ Month	1	2	3	4	5
1. Arrenging maintenance and management records					
Listing operation and maintenance record sheets					
Preparation of record-keeping					
Construction of a system to consolidate record sheets					
Analysis of maintenance records					
Spare parts management guidance					
Reflecting maintenance and management plans and budget plans in the development and utilization plan					
2. Improvement of equipment maintenance and management skills					
Maintenance of manuals for demining equipment					
Maintenance and management skills instruction for demining equipment					
Establishment of technician training system					

The start of this technical assistance is expected to correspond to the demining activities in the project, and to include on-the-job training in recording and accumulating the day-to-day operations of the same activities.

8.8. Implementation Issues

8.8.1. CND

(1) Operational Costs and Maintenance Budgets

Operational costs for mine and UXO exploration and clearance activities are paid to CND by the project owner or the local government through a necessary budget allowance. A certain percentage of these operational costs include maintenance and management costs, but CND receives budget allocations from the government for major maintenance and equipment upgrades. The detail of these budget allocations is not known because they are all undisclosed.

However, the Angolan government's finances are facing a serious budget shortfall, resulting in a reduction in the scale of activities due to insufficient operational costs and inability to procure necessary spare parts due to a lack of maintenance budget. Although the budget has recently shown an upward tendency due to the increase in oil prices and the appreciation of the exchange rate which are the main source of gocernment funding, we will keep a close eye on future trends and continue to request the Ministry of Finance, MINDENVP, CND, and other Angolan government agencies to keep the operation cost and maintenance budget, which is the biggest challenge in terms of operation and maintenance.

(2) Equipment Update

As mentioned earlier, most of the equipment in the company's fleet has only a small number of operating hours, but it has exceeded its useful life and will need to be replaced sooner or later. However, due to budget shortfalls, the company is forced to continue using aging equipment with low working capacity. As aging equipment malfunctions more frequently, more money, time, and labor are spent on

repairs, and as the number of inoperable pieces of equipment increases, the number of pieces of equipment necessary for activities will fall short. In order to achieve the government's goal of complete elimination of landmines, it is necessary to conduct safe and efficient mine and UXO exploration and clearance activities, and it is therefore extremely important to encourage the systematic renewal of equipment and the securing of budgets in the future.

8.8.2. ANAM

ANAM is not yet equipped with the necessary equipment and materials for monitoring and quality control, and is looking forward to support from Japan. Considering the importance of safety assurance and quality control, it is necessary to provide equipment and materials and technical support to conduct appropriate activities. However, although ANAM has been reorganized (upgraded) into an agency, its actual organizational structure remains unchanged and weak. Even if ANAM were to develop equipment and materials as part of this project, it would be difficult to consider it as a target for support because it does not have an equipment maintenance and management system in place. However, in order for ANAM to maintain its independence in conducting monitoring and quality control activities, it would be desirable for the Angolan side to secure a budget for the introduction of equipment and materials necessary for the activities.

Currently, ANAM conducts its monitoring and quality control activities using the equipment and other materials used by the operators and issues quality control certificates, and the same will apply to this project

9. Environmental and Social Considerations

The project falls in or near sensitive areas (nationally designated protected areas) listed in the JICA Guidelines for Environmental and Social Considerations (issued in April 2010), and is therefore classified as A in the Environmental Category.

9.1. Overview of Project Components with Environmental and Social Impacts

9.1.1. Project Components and Locations

The project consists of the following four components covering approximately 200 km in the southern part of Angola, between Lubango City of Huíla Province and Moçâmedes City (formerly Namibe City) of Namibe Province, as shown in Figure 9.1-1.

- Installation of 220 kV TL(approx. 196km between 400/220/60 kV Nombungo SS and 220/60 kV New Namibe SS)
- Installation of 60 kV DL (between 220/60 kV East Lubango SS and 60/15 kV Arimba SS)
- Construction of three substations (220/60 kV New Namibe SS, 220/60 kV East Lubango SS, and 60/15 kV Arimba SS)
- Demining work prior to the construction work of the above-mentioned project components

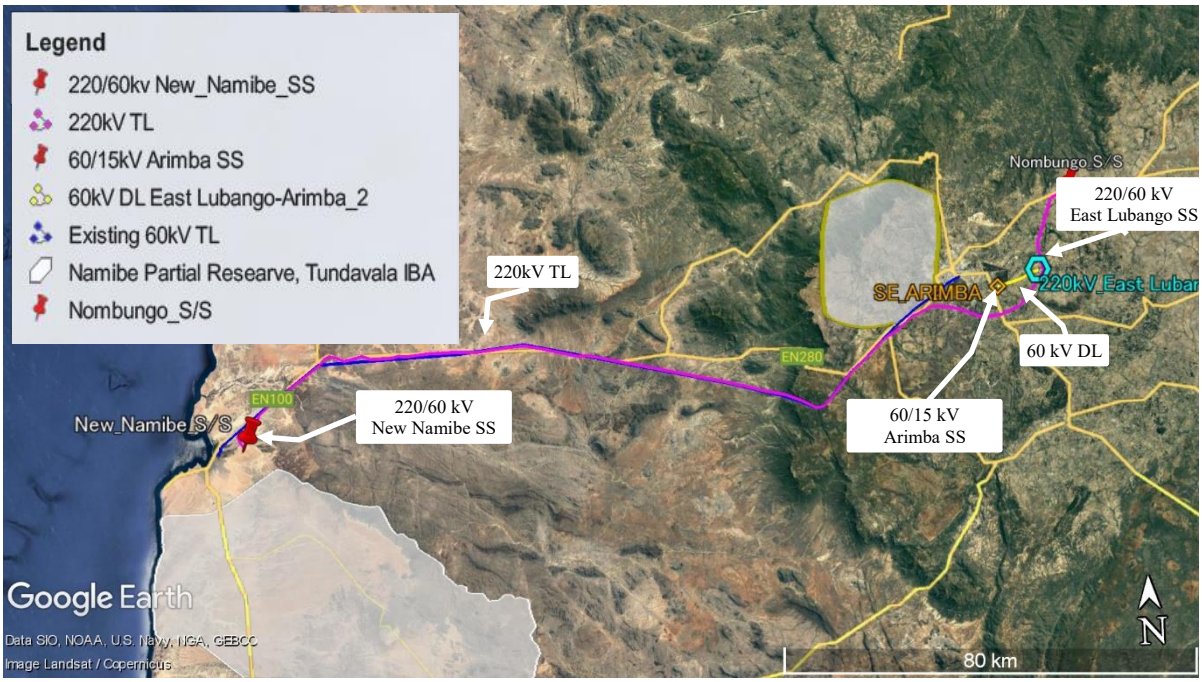


Figure 9.1-1 Project Area

Source: JICA Survey Team

9.1.2. Overview of Project Components

The construction of the 220 kV TL and the two 220/60 kV substations in East Lubango and Namibe will be conducted by Rede Nacional de Transporte de Electricidade (RNT), while the construction of the 60/15 kV Arimba SS and the 60 kV DL between the 60/15 kV Arimba SS and the 220/60 kV East Lubango SS will be of Empresa Nacional de Distribuição de Electricidade (ENDE). The 400/220/60 kV substation and 400 kV transmission planned in Nombungo is an AfDB-supported RNT project.[41]

Outlines of the project components managed by RNT and ENDE aregiven below.

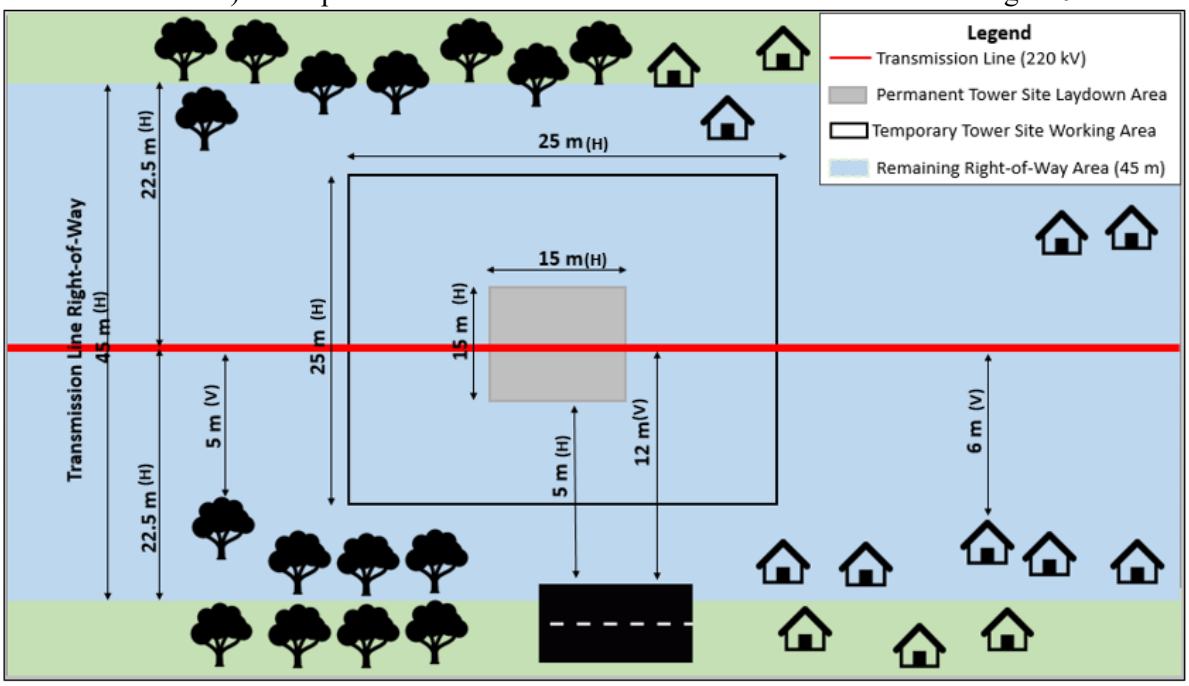
[41] The AfDB-funded Project is not an "inseparable part" of the project, since the AfDB-supported project can be implemented regardless of this project, although this project will not be able to connect to the national grid and supply power from the north-central region to Namibe if the 400 kV TL to be developed under the AfDB support project is not extended from the national grid to Lubango.

(1) RNT components

- **Construction of a new 220 kV TL (approximately 196 km between 400/220/60 kV Nombungo SS and 220/60 kV New Namibe SS, double circuits)**

Starting 400/220/60 kV Nombungo SS, the line will be extended along the southern part of Lubango City where the 220/60 kV East Lubango SS is to be constructed to avoid the populated area of central Lubango City and Tundavala Important Bird and Biodiversity Area (IBA). It will go along the 60 kV existing DL to avoid those areas between the cultivated area of Humpata Municipality of Huíla Province and the scenic area of Mt. Leba, through steep cliffs and valleys in Bibala Municipality of Namibe Province, to reach the National Road No. 280 east of Caraculo. Then it will keep going along the National Road No. 280 to minimize the negative impacts caused by construction work and maintenance activities, and to minimize excavation, compaction, and erosion of the topsoil of the semi-arid step zones and desert zones, and finally to be connected to the 220/60 kV New Namibe SS constructed in the outskirts of Moçâmedes City.

The total length is approximately 196 km, with a standard transmission tower spacing of 400 m and the number of planned tower is 495. A schematic diagram of the ROW (45 m-wide with 22.5 m on each side of the line) and separation distances from trees and structures is shown in Figure 9.1-2.



Note: Subscripts (H) and (V) indicate horizontal distance (H) and actual vertical separation distance (V), respectively.

Figure 9.1-2 Schematic diagram of ROW widths and separation distances from trees and structures for 220 kV TL

Source: JICA Survey Team

- **Construction of two new substations (220/60 kV East Lubango SS and 220/60 kV New Namibe SS)**

The 220/60 kV East Lubango SS is located in bush, approximately 13 km south of the 400/220/60 kV Nombungo SS, avoiding the urban area of Lubango City, with a pre-condition to locate at the intersection of the project's 220 kV TL and the 150 kV existing transmission line (the existing Lubango: between Ferrovia SS and Matala). The planned site area is 40,500 m2 (270 m east-west and 150 m north-south).

The site for the 220/60 kV New Namibe SS was selected in the flat desert about 7 km northeast of the center of Moçâmedes City, avoiding the vicinity of the nationally designated Namibe Partial Reserve and the restricted airspace of the Namibe Airport. The proposed site area is 11,700 m^2 or 14,300 m^2, 130 m from east to west and 90 m (outdoors) to 110 m (indoors) from north to south.

(2) ENDE components

- **60 kV New distribution line (approx. 10km between 220/60 kV East Lubango SS and 60/15 kV Arimba SS, double circuits)**

A magnified view of the 60 kV DL route for ENDE is shown in Figure 9.1-3. The route starts from the 220/60 kV East Lubango SS, avoiding houses and cultivated land as much as possible, going along

the existing road, railway, and 150 kV existing transmission line, to reach the ENDE-owned site that borders the south side of the existing Arimba 2 PS that is about 9 km west of the substation. The total length of the route is approximately 10 km, with a standard transmission tower spacing of 300 m and the planned tower number counts 36. A schematic diagram of the ROW width of the 60 kV DL (24 m, 12 m per side) and the separation distances from trees and structures is shown in Figure 9.1-4.

Figure 9.1-3 60 kV Distribution Line Route for ENDE

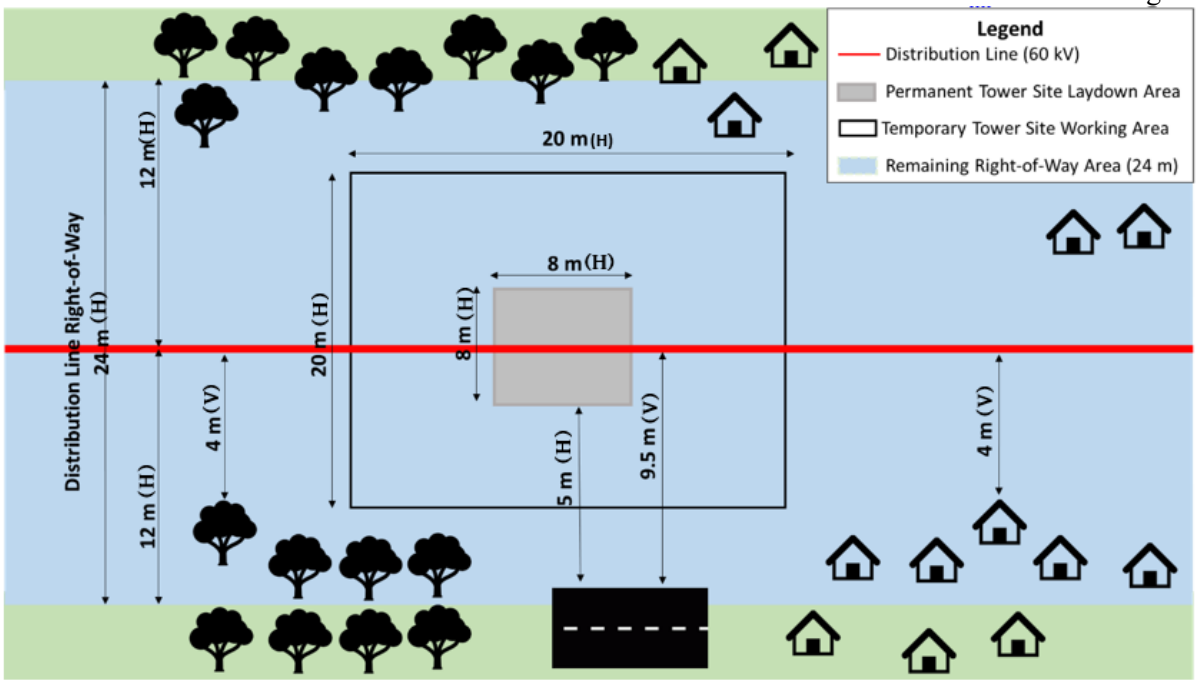
Source: JICA Survey Team

- **Construction of new 60 kV underground distribution line (approx. 500m between Arimba 2 PS and 60/15 kV Arimba SS)**

To connect the Arimba2 PS to the 60/15 kV Arimba SS, a 60 kV level cable line (one circuit) will be accommodated in a concrete trough and buried in the public road adjacent to the west side.

- **Construction of a new 60/15 kV Arimba SS**

To be constructed on ENDE land, that is 46 m east-west and 94 m north-south, bordering the existing Arimba PS.



Note: Subscripts (H) and (V) indicate horizontal distance (H) and actual vertical separation distance (V), respectively.

Figure 9.1-4 Schematic diagram of ROW widths and separation distances from trees and structures for 60 kV DL

Source: JICA Survey Team

9.2. Basic Information of Environmental and Social Conditions

9.2.1. Natural Environment

(1) Climate and Weather

The climate of the Huíla and Namibe provinces, where the project area is located, is characterized by the topography and geography of both provinces in southwestern Angola.

Huíla occupies the southern tip of the African highlands, which are more than 1,800 m above sea level, and is located more than 120 km inland east of the eastern Atlantic coast, where Namibe Province is located. The climate is warm and is classified as a temperate summer rainy climate (CWb) by the Köppen climate classification.

Namibe Province slopes gently from about 500 m above sea level (Bibala Municipality) down the steep cliffs from the African Highlands where Huíla Province is located to the eastern Atlantic coast. The climate is classified as subtropical arid (BWh) or subtropical steppe (BSh).

Table 9.2-1 shows the average monthly temperature and monthly precipitation for the Huíla and Namibe provinces.

In Huíla average temperatures are lowest in June and July, with no precipitation for the three months of June-August and less than 10 mm of precipitation in May and September, which corresponds to the dry season (winter). The highest average temperature is in October, with precipitation exceeding 50 mm from October to April and 100 mm from November to March, peaking in March, with annual precipitation of 827 mm.

In Namibe, the lowest average temperature is in July, with no precipitation for the three months from June to August, and less than 10 mm of precipitation in May and September, which corresponds to the dry season (winter) as in Huíla Province. Average temperatures are relatively high from December to April, and precipitation exceeds 10 mm from October to April, peaking in March at 73 mm, for an annual precipitation of 309 mm.

Comparing Huíla and Namibe, the maximum temperature tends to be higher in Huíla and the minimum temperature tends to be lower in Huíla in both months, showing the difference between Huíla in the highlands and Namibe in the coastal areas. Huíla is affected by the hot and rainy northern Angola and the central plateau with low temperatures during the dry season, and by the rainfall brought by the moist air from the Atlantic Ocean, while Namibe is characterized by a semi-arid region near the northern edge of the Namib Desert with low precipitation.

In Lubango, precipitation increases significantly during the rainy season compared to the dry season, while in Moçâmedes, precipitation is low in both the dry and rainy seasons. Annual precipitation ranges from 800 to 850 mm in Lubango and 50 to 100 mm in Namibe.[42]

In Lubango, the rainy season is cloudy and dreary every day, and the dry season is mostly sunny or clear. The climate is warm all year round, with annual temperatures ranging from 8°C to 31°C, rarely falling below 6°C or above 33°C.

Summers in Moçâmedes generally tend to be short, stiflingly hot, and overcast, while winters are short and pleasant, with almost cloudless days. The climate is mild all year round, with annual temperatures often ranging between 17°C (63°F) and 31°C (81°F).

Table 9.2-1 Average monthly temperature and monthly precipitation in Huíla and Namibe provinces (1991-2020)

item	unit	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.r	Dec.
Huíla													
Maximum temperature	℃	27.1	26.5	26.7	27.0	26.4	24.5	24.8	27.0	29.4	29.4	28.3	27.3
Average temperature	℃	21.3	21.0	21.2	20.8	18.9	16.5	16.5	18.8	21.5	22.3	21.8	21.4
Minimum temperature	℃	15.5	15.5	15.7	14.6	11.5	8.6	8.3	10.6	13.7	15.2	15.3	15.6
Pecipitation	mm	135	144	167	74	5	0	0	0	6	54	104	138
Namibe													
Maximum temperature	℃	25.6	26.2	26.5	26.3	24.6	22.4	21.0	22.0	23.4	24.7	25.3	25.3
Average temperature	℃	21.3	21.9	22.3	21.7	19.2	17.1	16.2	17.3	18.8	20.0	20.8	21.0
Minimum temperature	℃	17.1	17.7	18.1	17.1	13.8	11.9	11.4	12.6	14.2	15.4	16.2	16.7
Precipitation	mm	49	55	73	33	2	0	0	0	1	19	36	41

Source: World Bank: https://climateknowledgeportal.worldbank.org/country/angola/climate-data-historical (accessed March 23, 2022).

Annual mean temperature distribution map (Figure 9.2-1) shows that the regions of Lubango and Humpata in southwestern Angola are plateaus with elevations exceeding 1,800 m and have the lowest mean temperatures. This difference in temperature indicates the presence of steep cliffs and a gradient in temperature distribution up to the coastal Moçâmedes (John and Stephanie Mendelsohn, 2018).

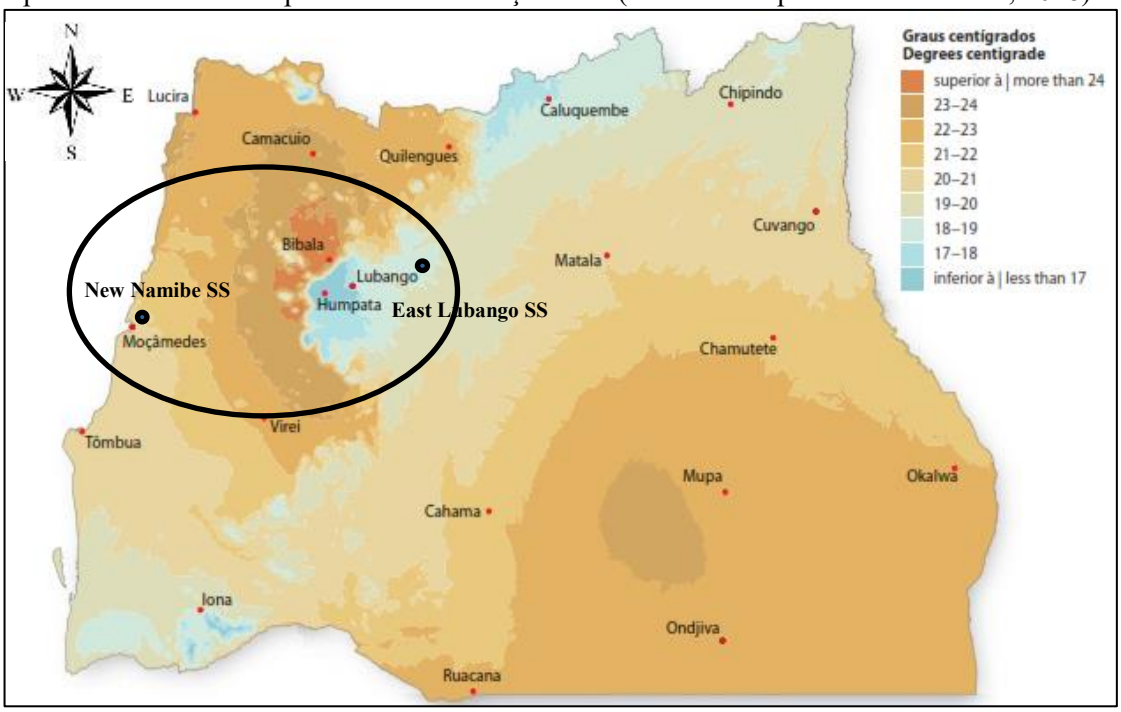


Figure 9.2-1 Average temperatures in southwestern Angola (highlighting Huíla and Namibe provinces)

Source: John & Stephanie Mendelsohn (2018)

[42] Source John & Stephie Mendelsohn, South West Angola. Port, Arte e Cinencia, 2018

There are no actual wind measurements in the vicinity of the project area, and according to a model analysis based on statistics from January 1960 to December 2016 by a private company[43] , in Lubango, the wind is calm throughout the year, with average wind speeds of 7.4 miles per hour (about 3.3 m/s) with a statistical tendency to be stronger mainly during the dry season (July), and in Namibe Namibe tends to be slightly stronger during the rainy season (October to February), with an average wind speed of 7.6 miles per hour (about 3.4 m/s). Westerly winds tend to prevail in Lubango from November to February, while easterly winds prevail from April to August. In Namibe, westerly winds tend to prevail throughout the year, followed by southerly winds, with westerly winds becoming slightly weaker from May to August.

(2) Geological features

The project area extends from the Humpata Plateau to the Namib Desert, which geologically contains older rocks from the Proterozoic to younger sediments of the Neogene and Quaternary periods. The project area is mainly composed of Proterozoic rocks (Figure 9.2-2) and are represented by the Southwest Angola Metamorphic Body, the Mottled Rock-Gabbro-Norite Charnockitic Complex, and remetamorphosed basement (mainly Eburnean). Proterozoic outcrops are apparently interrupted by granitic intrusive rocks that occurred late in the orogenic movement, mainly during the Eburnean (Pereira *et al.*, 2003).

Proterozoic outcrops are found mainly in the project area. Proterozoic outcrops are also common in the project area, mainly in certain areas of the Huíla and Namibe provinces.

The Lower Eocene (Proterozoic-Paleoproterozoic) rocks that outcrop only in the lower southwestern part of the project area are gneiss (biotite-hornblende, biotite-high quality, pomegranite-siltstone with cyanite and graphite), hornblende, biotite-schist and hornblende, reptite, and quartzite. The Upper Proterozoic (Mesoproterozoic to Neoproterozoic), which comprises the majority of the outcrops in the project area, is characterized by diorite gneiss, plagioclase gneiss, diorite schist with garnet and cyanite, sometimes carbonaceous, epidotite, metaschist, calcite and marble, and siltstone. Mesoproterozoic to Neoproterozoic igneous and ultrametamorphic rocks have also been identified, mainly in the northeastern part of the project area, and are represented by biogranite, granodiorite, and diorite. Nevertheless, small outcrops are also identified in the center and southwest of the project area, intruding the aforementioned metasedimentary sequence.

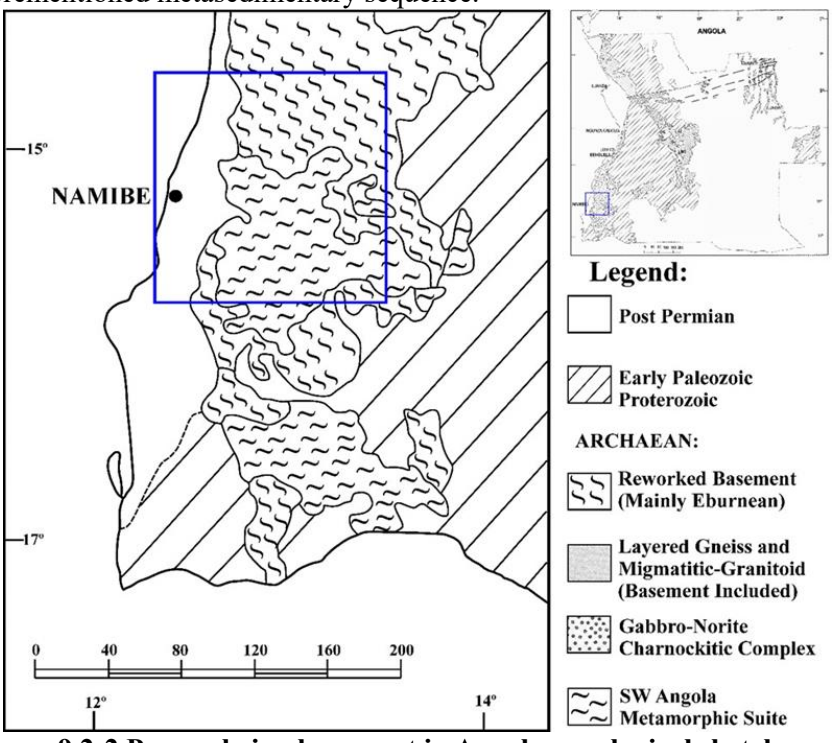


Figure 9.2-2 Precambrian basement in Angola - geological sketch map

Source: Pereira *et al.* 2003.

[43] Statistical model wind forecast results: weatherspark.com (accessed February 2021)

Proterozoic outcrops have also been identified in the project area. Paleoproterozoic (Lower Proterozoic) sedimentary rocks, represented by the Oendolongo Group unit, outcrop only to a small extent north of the project area and are characterized mainly by sedimentary rocks such as conglomerate, quartzite, sandstone, siltstone, microschist, and itabirite. Paleoproterozoic igneous and ultrametamorphic rocks occur in the northern part of the project area, mainly dolerite and kibara granite (mottled biotite granite and leucocratic granite) intrusive bodies. Acidic, neutral, basic, and ultrabasic dikes of Paleoproterozoic age have also been detected in the northern and northeastern parts of the project area.

The Mesozoic to early Neoproterozoic metasedimentary rocks are represented by units of the Chela Group, characterized by the Humpata Formation (quartzite, conglomerate, sandstone, siltstone, mudstone, and volcaniclastic material) and the Leyba Formation (dolomitic limestone with stromatolites, sandy limestone, and chert). These formations are found primarily on the Humpata Plateau (northeast of the project area). Neoproterozoic igneous and ultrametamorphic rocks characterized primarily by dolerite and mottled rock have also been identified in the southern part of the Humpata area.

Younger outcrops of Mesozoic to Cenozoic (Cretaceous to Quaternary) age are common along the Namibe Coast, part of the Namibe Sedimentary Basin. The Lower Cretaceous (Aptian) is represented by marls, limestones, sandstones, and gypsum, with outcrops in the northern part of the Namibe Basin (northwest of the project area). The Upper Cretaceous to Upper Cretaceous (Cenomanian, Turonian) is characterized by lithic and semi-lithic limestone, marl, sandstone, and conglomerate, and these outcrops are found in the central as well as the northwestern portion of the project area.

The Late Upper Cretaceous (Maastrichtian) also outcrops in the northwestern and central part of the project area and is composed of igneous and ultrametamorphic rocks, characterized by basalt, dolerite, espilite, trachyldesite-basalt, rhytite, trachyldesite, tephrite, granite -characterized by porphyre and rhyolite. Paleozoic (Paleocene to Eocene) rocks are sedimentary rocks composed of limestone and marl, which outcrop in the west-central part of the project area.

The youngest undifferentiated Quaternary deposits, characterized by weathered sands and sands and alluvial-alluvial clays, are found in the southwestern and Humpata areas of the project area, respectively.

In general, the relationship between the physical and biological components of ecosystems and habitats is complex. It is also clear that this complex relationship is closely related to the geological background of a particular area, as it influences soil formation and topography. These soils are inherently fertile, but tend to be poorly drained. The sedimentary rocks in the project area are found mainly in the coastal area (Namibe Basin) and in the Humpata area.

Compared to sedimentary rocks, igneous rocks have distinct chemical and physical characteristics, primarily low calcium mineral content, which is thought to have a significant impact on vegetation communities in general. This type of rock has a specific mineralogical composition and, consequently, a specific chemistry, which has a specific influence on the development of plant communities. The influence of igneous host rocks on plant growth is more pronounced when the rocks are mafic or ultramafic with high magnesium and iron contents. In the project area, the igneous mafic and ultramafic rocks are mainly located in the center of the project area.

(3) Geomorphology and undulations

The project area, from the Humpata Plateau (Huíla Region) in the east to the Namibe Desert (Namibe Region) in the west, presents a highly irregular landscape in terms of distribution, shape, and representativeness, consisting mainly of two major topographic units: marginal mountain ranges and steep slopes. The escarpment is also known as the transition zone between the coastal plain and the inland plateau (Figure 9.2-3).

In the project area, the Marginal Range Topographic Unit, which comprises the northern half of the plateau from the Humpata Plateau to the Chela Mountains, is represented by very sharp undulations at an elevation of 2300 m, with a steep drop toward the west to an elevation of 1000 m. The Steep Cliffs Terrain Unit, which extends parallel to the Atlantic Ocean, is a broad flat area that occupies most of the study area and descends gradually to the west with elevations varying from 600 m to 300 m.

The geomorphic unit of the cliff zone from the Chela Mountains down to the Atlantic Ocean is represented by a series of plateaus of various levels on a steep horizon with impressive traces of spires, shafts, and sometimes bare rock. Granite formations are exposed on this flat terrain, the so-called Island Hills or "inselbergs" (residual hills), which have a spectacular aspect with elevations similar to those

identified on the Humpata plateau. The ancient plateau, a tectonically uplifted flat terrain found only in the municipalities of Lubango and Chibia (Chibia), and the coastal zone found near the town of Moçâmedes, are the only two areas of the plateau that have been identified.

The Humpata Plateau is a marginal mountain terrain unit (Figure 9.2-3), a structural undulation that exhibits the highest level of flatness in southwestern Angola and constitutes a major component of the geology of the southern sector of the Congo Craton, which has been stable since Proterozoic times (Duarte *et al.*, 2014).

The Humpata Plateau is typically characterized by two subunit surfaces, Humpata (about 2,000 m elevation) and Bimbe (about 2,300 m elevation). The surfaces of these two subunits are relatively wide and steeply stepped, allowing them to be separated from the lower plateau surface, also called the main plateau of the Humpata surface. In addition, the small surface of the Bimbe subunit has an uneven surface of about 100 to 300 m, which leads to the development of a series of steep slopes and flattening, allowing the formation of mountain structures and giving rise to the regional name "Serra da Chela" (Chela Mountains) (Joaquim, 2015).

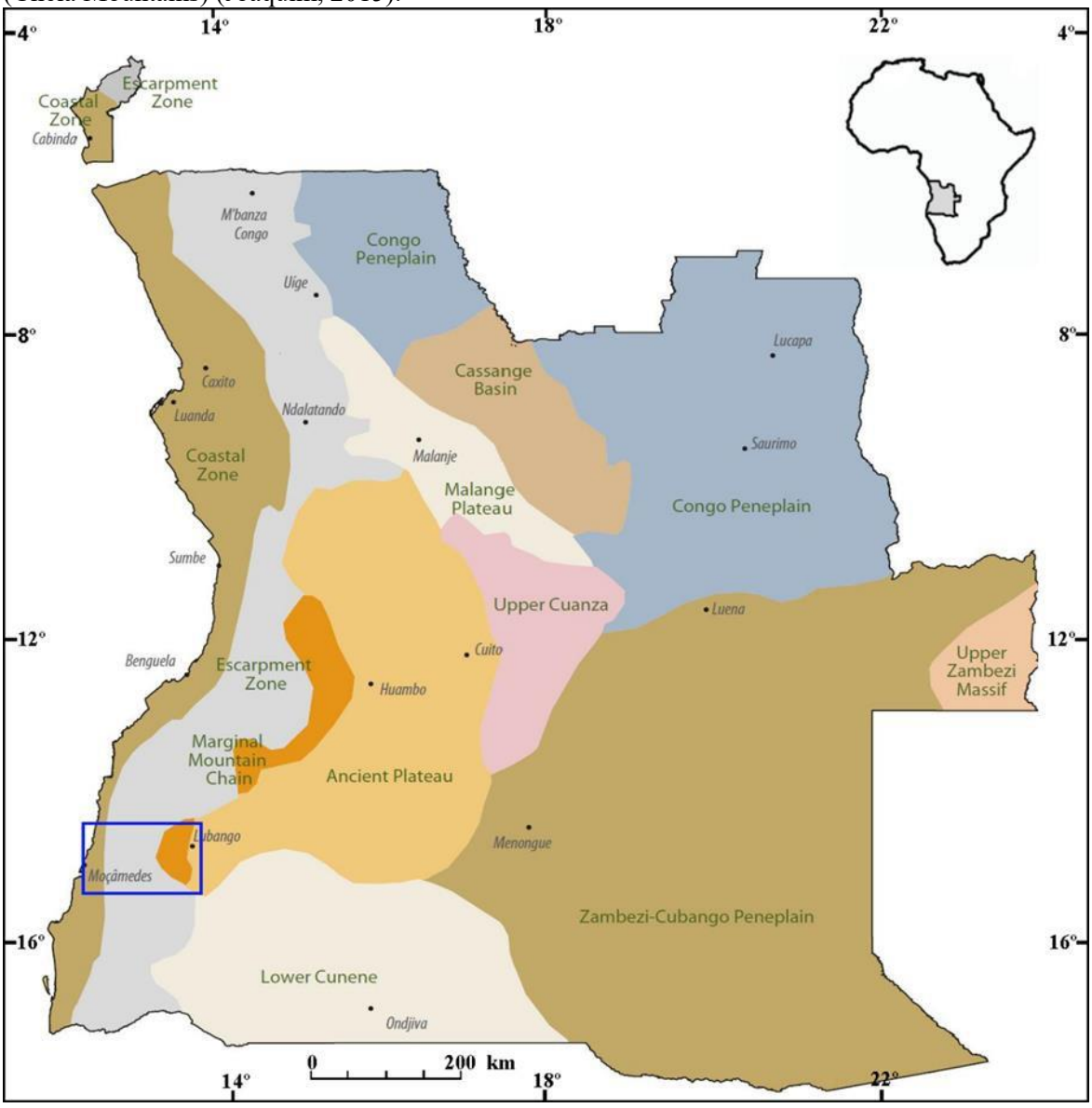


Figure 9.2-3 Major geomorphic units in Angola

Note: Blue rectangles indicate the approximate extent of the project area.
Source: Huntley *et al.* 2019

The project area from Mt. Leba Moçâmedes is located in the Escarpment Topographic Unit, a vast plain formed by the coalescence of irregular steep slopes 300 to 600 m above sea level, and as mentioned above, residual hills of various sizes are a typical feature of the Namibe Province. These residual hills were formed as a result of the coalescence of steep slopes. That is, differential erosion of

sedimentary units of volcaniclastic, metamorphic, and carbonate rocks unconformably placed on sialobasal granites of pre-Ebernian origin (Pereira *et al.*, 2003), which are mainly found in the north-central part of the project area.

Major isolated remnant hills such as Serra de Gandarengos, Serra da Chonga, and Serra da Lua reach elevations of 1,575 m, 1,413 m, and 1,067 m, respectively. On the other hand, the coastal part of Namibe is located in the Coastal Zone geomorphic unit, which is less than 100 m above sea level and belongs to a lithostratigraphic unit with low resistance, mainly from the Mesozoic to Cenozoic eras.

(4) Soil

According to the FAO-UNESCO soil classification system, the project area is characterized mainly by leptosols and calcisols, followed by cambisols and finally ferrasols.

Leptosols in the project area are found mainly in Namibe Province and the northern part of the Humpata Plateau, and the bedrock is characterized by hard rocks such as Proterozoic and Eocene gneisses and granites. Historically, the soils are shallow and young, characterized by many coarse fragments, which have low water holding capacity and are closely related to the parent materials (igneous and metamorphic rocks) in the area. Found in lowlands in dry climates, such as is typical of the Namibe Province, but also forming in sub-humid climatic uplands or accidental terrain where soil formation is delayed by low temperatures or erosion, such as north of the Humpata Plateau, calcisols are soils with significant accumulation of secondary calcium carbonate and are found in areas with distinct dry seasons or in common on calcareous parent materials in dry areas where carbonate-rich groundwater comes close to the surface. In the project area, they are found only along the Namibe coast, where the lithologic background is characterized by carbonate rocks.

Cambisol is considered to be in the early stages of soil formation due to the presence of significant amounts of weathered minerals and the lack of evidence of advanced soil formation such as terrestrial forests, organic matter, and aluminum and iron compounds. However, moderately developed soils are present in all environments, from sea level to upland, under all types of vegetation. In the project area, they were found on the border between the Huíla and Namibe provinces and in flat areas at the foot of the Humpata Plateau, where many waterways exist.

Feral soles are highly weathered soils with very low cation exchange capacities and very few easily weathered minerals. These soils comprise the red soils and loess typical of humid tropical climates, where high temperatures and humidity promote weathering of rocks and rapid decomposition of soil organic matter.

The soil cover classification of the project area is herbaceous shrub savanna in the Angola highlands where Lubango is located, and the old escarpment on the western side of the Angola highlands is bordered by forest. From the escarpment to the Atlantic Ocean, savanna forest extends to the midpoint of the escarpment, followed by herbaceous shrub savanna and herbaceous savanna/steppe to the west of the escarpment.

In humid climates, such as the Humpata Plateau, where soil temperatures are high and permeability is high, primary minerals that are easily weathered will eventually dissolve and be removed from the soil. In addition, less soluble compounds such as iron and aluminum oxides and hydroxides and coarse quartz grains remain in the soil mass. Feral soles are chemically poor soils, usually characterized by a relative accumulation of stable primary and secondary minerals, which become clayey due to weathering and strong water retention at the permanent wetting point, but the presence of microaggregates reduces the soil's water storage capacity.

(5) Hydrology

Angola is one of the richest African countries in terms of hydrology. The project area included in Figure 9.2-4. The Giraúl River, which flows mainly from east to west through the Namibe Province and empties into the Atlantic Ocean, and the Bero River, which roughly parallels it to the south, and the Caculovar River, which flows southward from above the Angolan highlands to join the Cunene River, the Tchangalala River, and the Caculovar, Tchangalala The Cunene River flows westward across the border with Namibia and empties into the Atlantic Ocean. The rivers in these basins are dry for most of the year, with the exception of the Cunene River.

The Giraul River originates in the Bibala area in the northeastern part of Namibe Province, near the border of Huíla Province, and flows to the town of Moçâmedes. The watershed belongs to the Steep Cliff Landform Unit, which changes abruptly from 2200 m to 950 m in just 5 km as the upper reaches become the Leyba Mountains. It then flows at a very gentle slope with an average gradient of 0.45% for more than 100 km (Teixeira Pinto *et al* ., 2019), and the bedrock of the main part of this basin is

composed of a variety of Eocene and Proterozoic rocks (mainly gneiss and granite). Nevertheless, the bedrock along the coast is characterized by Mesozoic and Cenozoic rocks (mainly limestones and mudstones) and Quaternary sediments. This results in high erosive flows during the rainy season, influenced by the precipitation of the Angolan highlands. Subsequently, precipitation decreases and large amounts of sediments are deposited on the flat riverbed.

The Belo River originates in the southwestern part of the Hula Province and empties into the Atlantic Ocean at the city of Moçâmedes. It belongs to the Steep Cliff Landform Unit, which is restricted in an east-west direction by the Marginal Range Geomorphology Unit, and like the Gilaúl River, it has an elevation difference of about 1000 m from the upper part of the Belo River (about 2094 m) (DNA, 2005). Average annual precipitation is lower (54 mm) than that of the Gilaúl River.

The main rivers that are expected to intersect the transmission line route in the proposed project area are shown in Figure 9.2-5 and Figure 9.2-6.

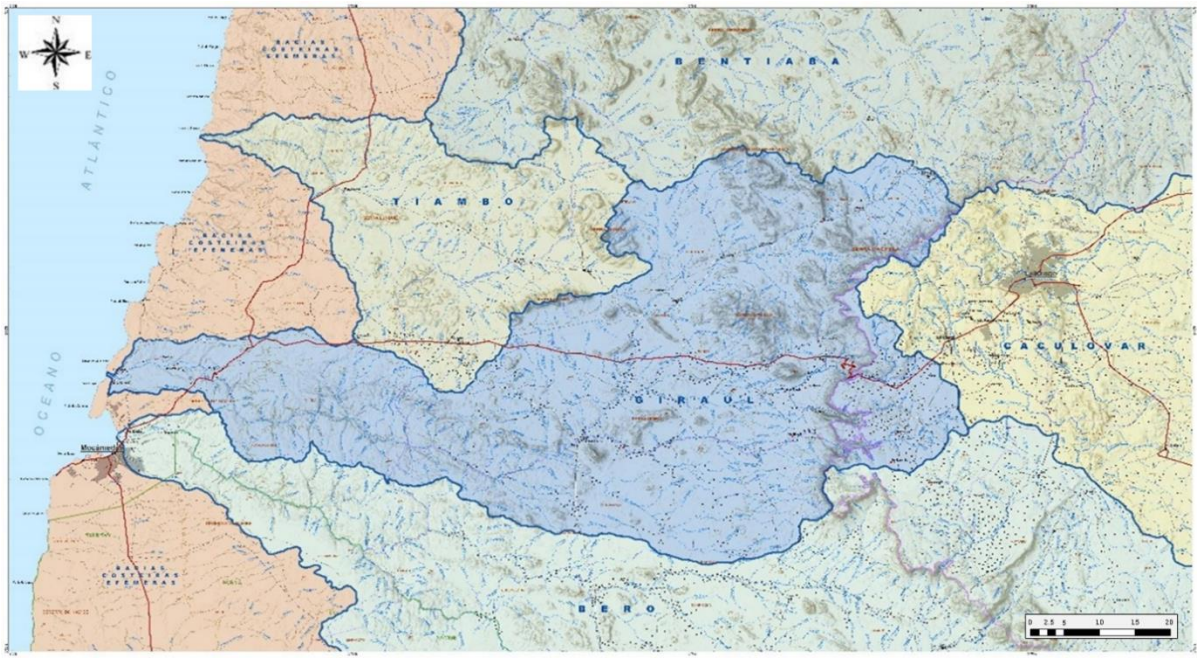


Figure 9.2-4 Watershed map of the project area

Source: JICA Survey Team

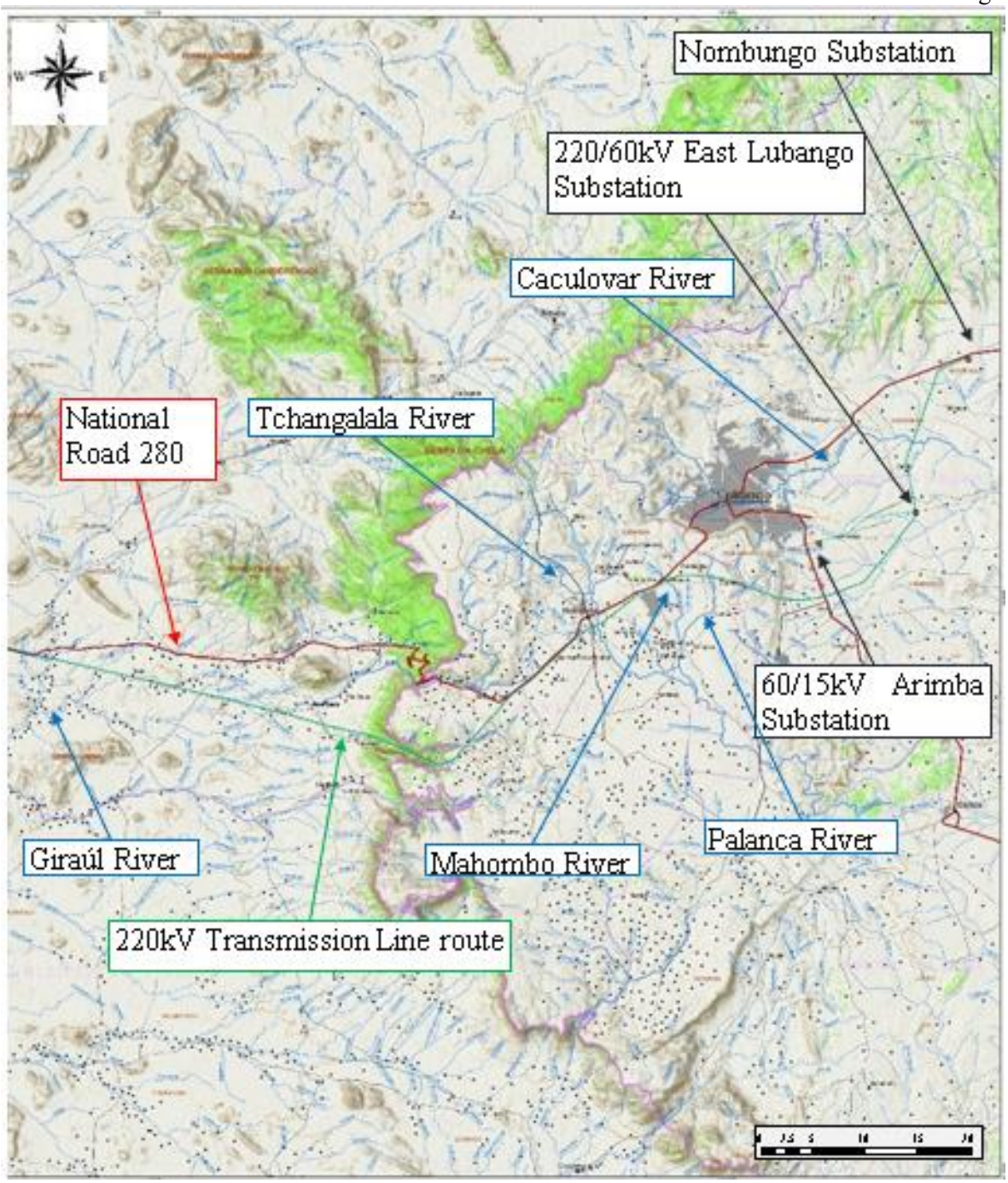


Figure 9.2-5 Major rivers intersecting the transmission line route in the project area (around Lubango)

Source: JICA Survey Team

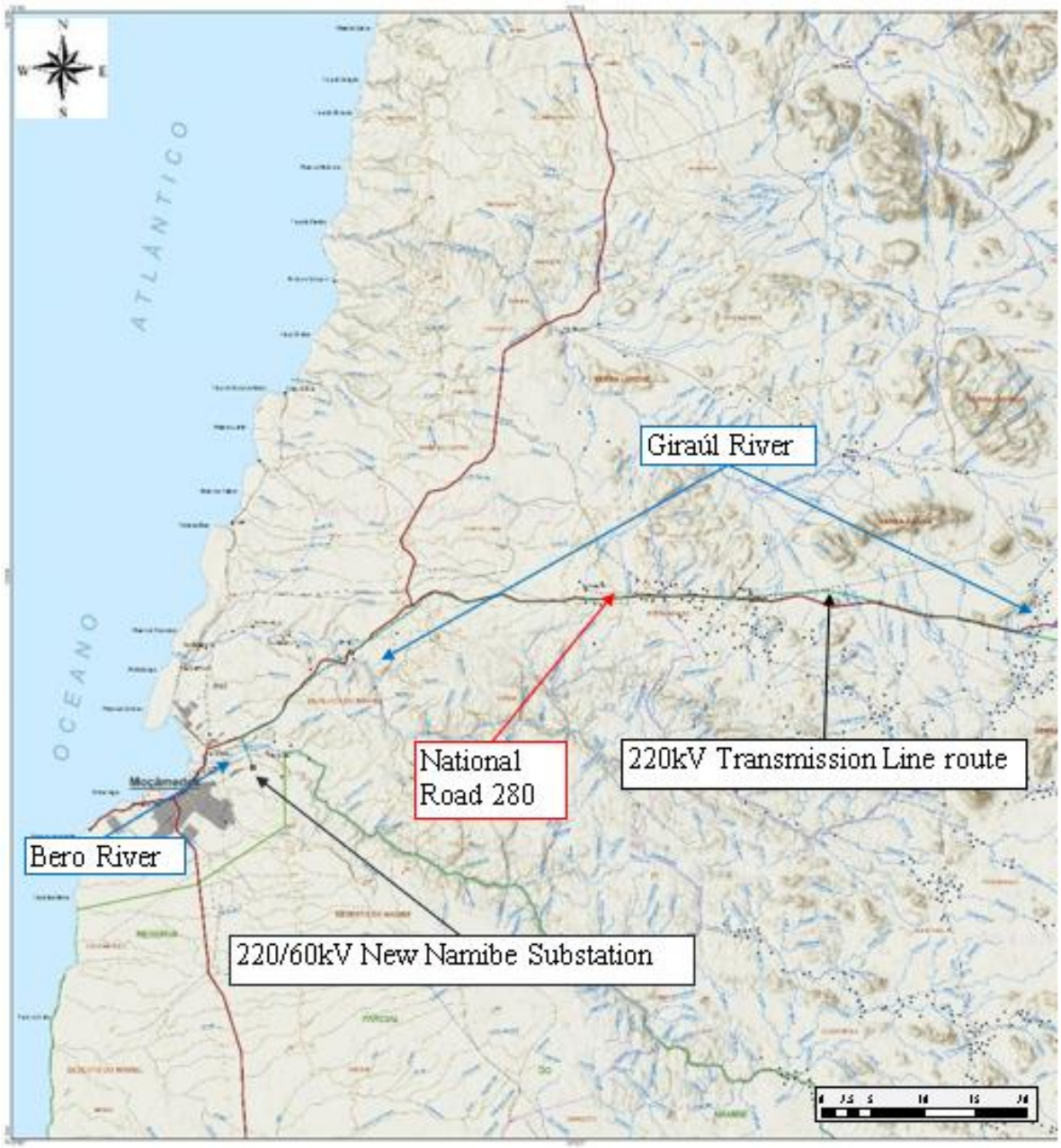


Figure 9.2-6 Major rivers that intersect the transmission line route in the proposed project area (around Moçâmedes)

Source: JICA Survey Team

(6) Protected area

(a) National parks and nature reserves

National parks and nature reserves designated by Angolan law are Figure 9.2-7. It shows the 14 areas designated by Angolan law. These 11 areas were established before 1980, before the civil war, and were devastated by the civil war and no bioinventory survey was conducted. After the end of the civil war, three national parks were designated in 2011 with the cooperation of international organizations and others and the government's efforts to achieve the Aichi Targets, increasing the area of protected areas to 12.58% of the national land area, up from 6.5% before that.

In Namibe Province, the western part of the project area, the Namibe Partial Reserve is located approximately 10 km south of the proposed site of the 220/60 kV New Namibe SS, and Iona National Park is located to the south of the Namibe Subprotected Area. In the eastern region of Huíla Province, Bicuar National Park is located more than 100 km east of the proposed project area.

The Namibe Partial Reserve is a buffer area of the Iona National Park, but the Angolan Ministry of Environment ("MINAMB") has a policy that "no substation or power line construction is allowed in the area, no matter how buffer zone or partial protected area it is", so the proposed site for the 220/60 kV New Namibe SS was selected in the desert 10 km north of the partial protected area boundary. The

proposed site for the 220/60 kV New Namibe SS was selected in the desert 10 km north of the boundary of the partial reserve.

Further south, Iona National Park in Namibe Province, designated in December 1957 to protect desert species, such as oryx, mountain zebra, and impala, is now considered the most important protected area in Angola for its diversity and richness of reptiles.

Bicuar National Park was designated in December 1964 to protect elephants, plain zebra, giant serval antelopes, and other animals.

One of the areas that MINAMB is considering for future inclusion in its network of conservation areas is the area around the Tundavala Gorge, near the border between the Huíla and Namibe provinces. The area around Tundavala is known to be important from geological, biological, and cultural aspects, and was proposed as a nature reserve by Huntley & Matos (1994) and mentioned in the Angola National Biodiversity Strategy and Action Plan (NBSAP, 2020) as a protected area to be gazetted in the future.

(b) Ramsar Convention registered wetlands

Angola has ratified the Ramsar Convention, but currently has no registered wetlands.

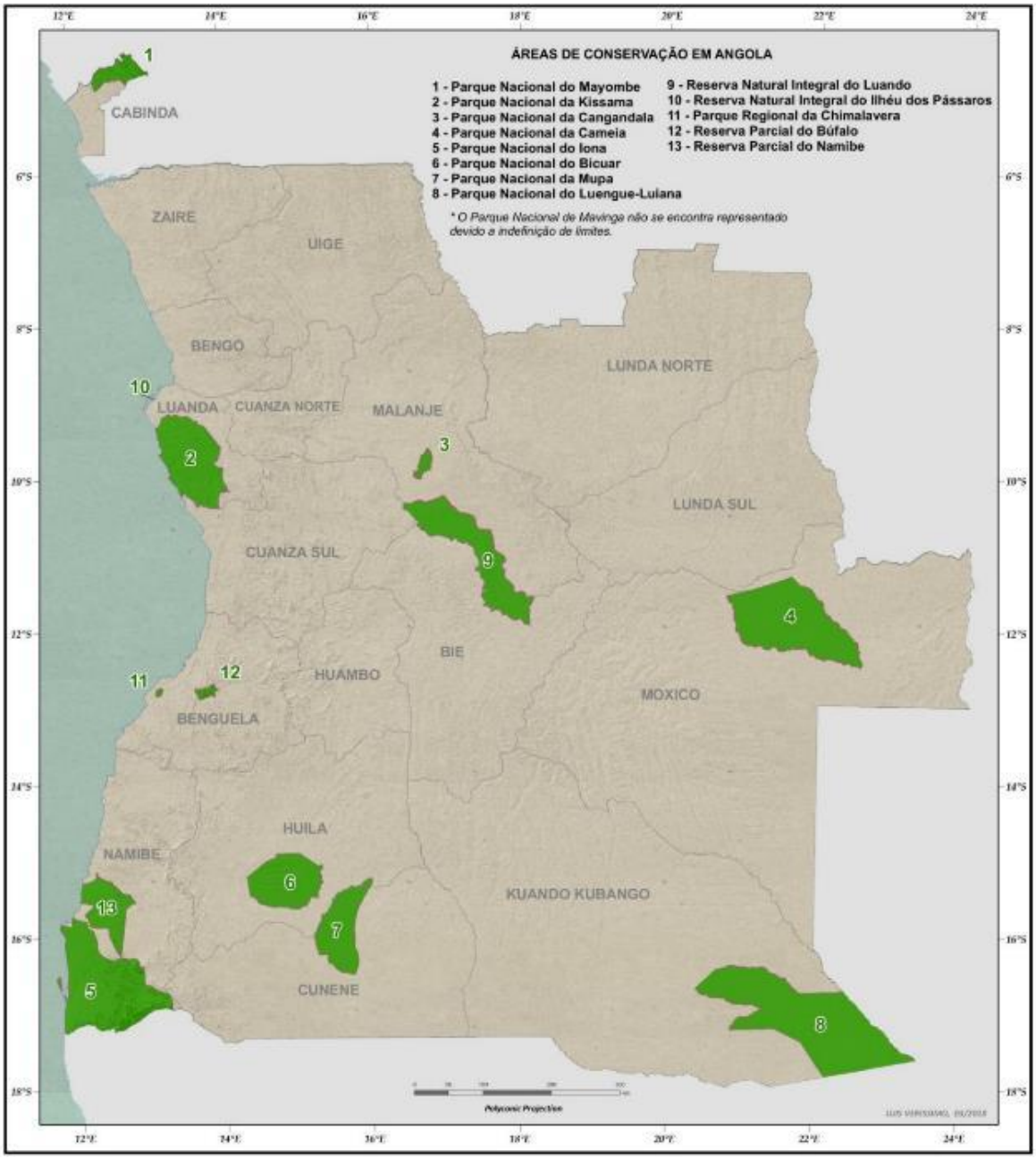


Figure 9.2-7 National parks and protected areas in Angola

Note: Mavinga National Park (Kuando Kubango Province) is not shown because its boundaries have not been determined.
Source: JICA Survey Team

(7) Ecosystem

(a) Important Bird and Biodiversity Areas (IBA)/Key Biodiversity Areas (KBA)

Among the 23 IBAin Angola recognized by BirdLife International as important habitats for birds, two national parks already mentioned in the Huíla and Namibe provinces (Bicuar National Park: IBA AO001) The trigger species for the IBA designation criteria are the following: (1) the species of the Tundavala area (AO0023), which is close to the project area, and (2) the species of the Iona National Park (IBA AO012), which was recognized in 2001. The 16 species listed in Table 9.2-2 (all of which are of least concern (LC)) are mostly A2 (regionally restricted species) or A3 (biome: species restricted to a biome system). Note that the trigger species for A1 such as Angola Cave-chat (*Xenocopsychus ansorgei)* and Cinderella Waxbill (*Estrilda thomensis*) were listed as NT, near threathened, but according to the current BirdLife International database, due to their wide range and large population size, they have been revised to LC.

Table 9.2-2 List of trigger species for IBA (AO0023) in the Tundavala area (certified in 2001)

No.	(biological) species (English name, scientific name, Japanese name, in that order)	IUCN Category*1	seasonality	Year of evaluation	habitat estimation	IBA Standards Trigger species*2
1	Red-backed Mouse bird *Colius castanotus*	LC	residentresident	1998	present	A3
2	Western Green Tinkerbird *Pogoniulus coryphaea*	LC	resident	1998	present	A3
3	Red-capped Crombec *Sylvietta ruficapilla*	LC	resident	1998	present	A3
4	Miombo Wren-warbler *Calamonastes undosus*	LC	resident	1998	present	A3
5	Benguela Long-tailed Starling *Lamprotornis benguelensis*	LC	resident	1998	present	A3
6	Kurrichane Thrush *Turdus libonyana*	LC	resident	1998	present	A3
7	Angola Slaty-flycatcher *Melaenornis brunneus*	LC	resident	1998	present	A2, A3
8	Angola Cave-chat *Xenocopsychus ansorgei*	LC	resident	1998	present	A1, A2, A3
9	Miombo Rock-thrush *Monticola angolensis*	LC	resident	1998	present	A3
10	Bronze Sunbird *Nectarinia kilimensis*	LC	resident	1998	present	A3
11	White-breasted Sunbird *Cinnyris talatala*	LC	resident	1998	present	A3
12	Western Miombo Sunbird *Cinnyris gertrudis*	LC	resident	1998	present	A3
13	Chestnut-backed Sparrow-weaver *Plocepasser rufoscapulatus*	LC	resident	1998	present	A3
14	Cinderella Waxbill *Estrilda thomensis*	LC	resident	1998	present	A1, A2
15	Angola Waxbill *Coccopygia bocagei*	LC	resident	1998	present	A3
16	Fülleborn's Longclaw *Macronyx fuelleborni*	LC	resident	1998	present	A3

Notes: *1. IUCN Category: LC (Least Concern)

*2. IBA reference trigger species definition;

A1. Globally Endangered: Locations where a number of globally endangered species are known to occur or are thought to occur regularly.

A2. Habitat-limited species: Sites where significant populations of at least two range-limited species are known or thought to occur.

A3. biologically restricted species: where it is known or thought to hold important components of a group of species whose distribution is mostly or completely restricted to a single biome.

A4. population-forming species: where 1% or more of the world population of one or more species is known or thought to congregate on a regular basis.

Source: Prepared by JICA Survey Team based on BirdLife International website (http://datazone.birdlife.org/site/factsheet/tundavala-iba-angola)

The Tundavala area was also recognized as a Key Biodiversity Areas (KBA) by the IUCN in 2001, and the criteria for KBA designation is B2 (species whose habitat is mostly restricted to the area). Figure 9.2-8 and Figure 9.2-9 show the protected areas and important bird habitats in the project area.

On the southeast side of the IBA in the Tundavala area, near the urban area of Humpata, National Road 280 and the 60 kV existing DL are within the IBA boundary. The transmission line route of this project is planned to pass outside the IBA, however, there is a section of approximately 10 km that is close to the IBA boundary, and approximately 2 km of this section is within 100 m of the IBA boundary, where is the most developed area in Humpata Municipality, cultivated land, factories, and settlements, on the other hand, the most natural area is on the Tundavala Gap side. A discussion of whether or not this area qualifies as an important natural habitat is discribed in the other section.

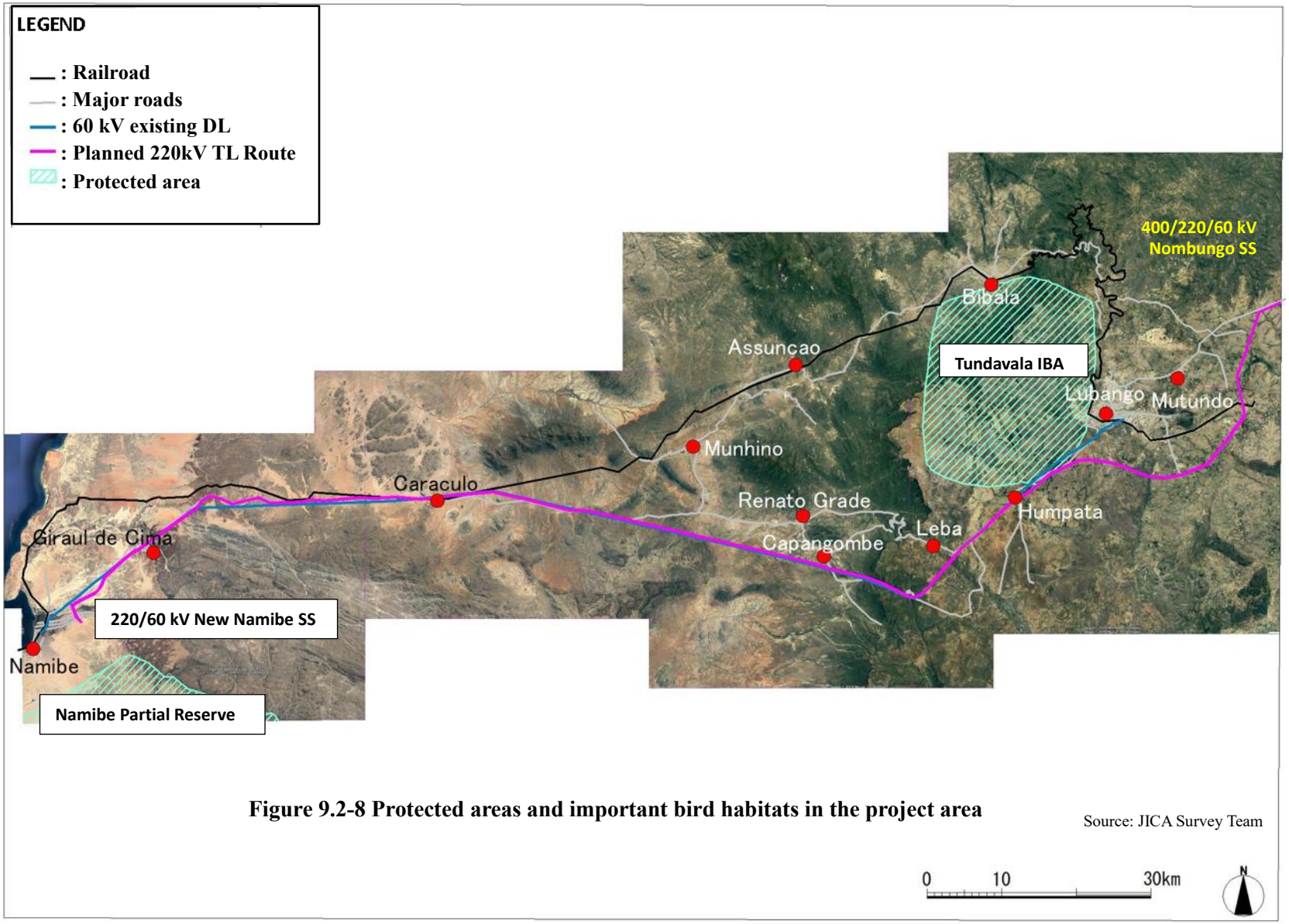


Figure 9.2-8 Protected areas and important bird habitats in the project area

Source: JICA Survey Team

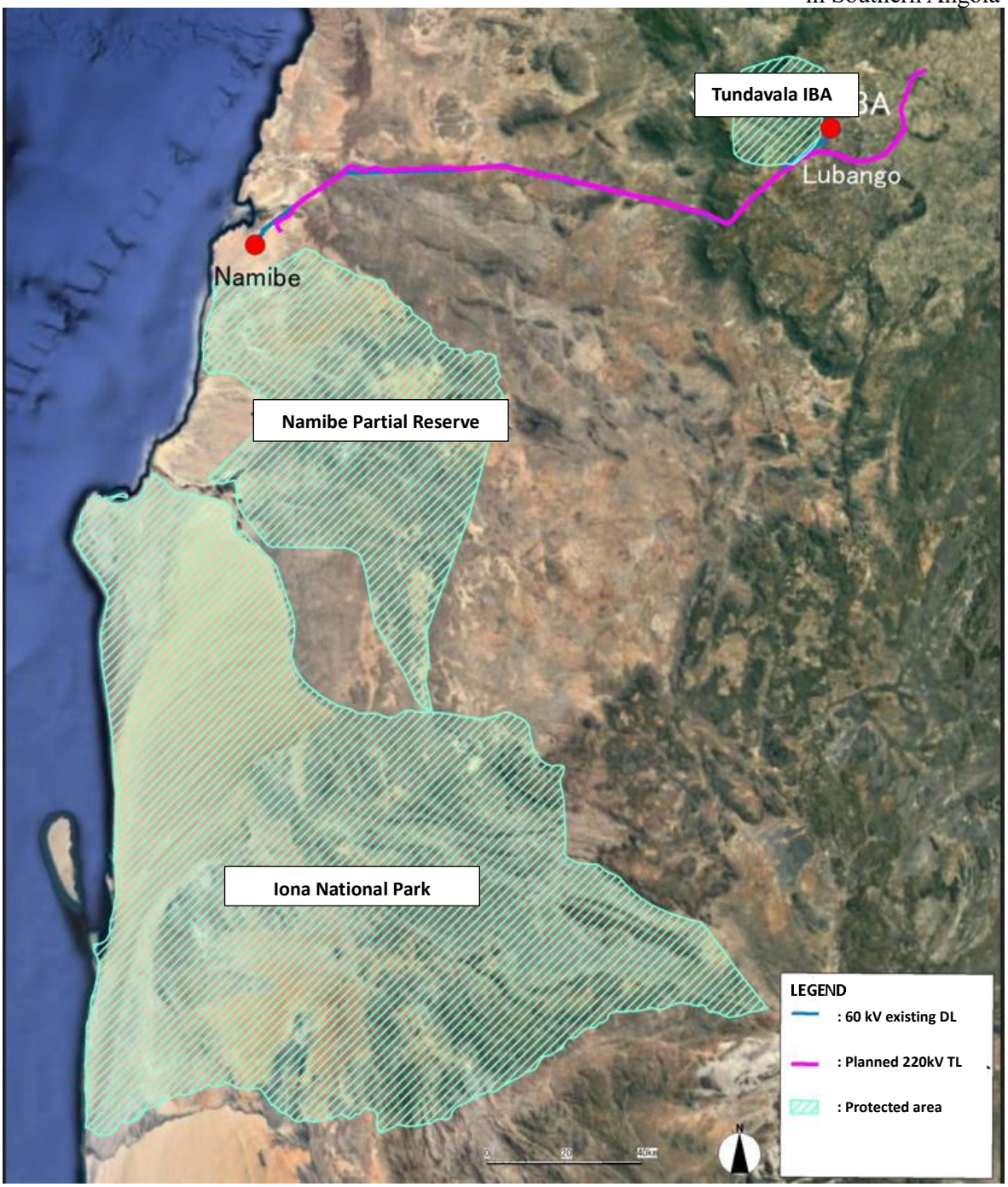


Figure 9.2-9 Protected areas and important important bird habitats in the project area

Source: JICA Survey Team

(b) Ecoregions (biogeographic regions)

Ecoregions are defined in different ways for different purposes, but for this project, based on the referenced literature, ecoregions are defined as "geographic divisions that take into account factors such as species, habitat, topography, and climate," which is similar to WWF's definition for conservation assessment purposes. Figure 9.2-10 shows the classification of Angola's ecoregions. Between and around Lubango and Moçâmedes, the Angola Miombo Forest Area (No. 49), Angola Mopane Forest (No. 55), Angola Cliff Savanna and Forest (No. 81), Angola Mountain Forest-Steppe Mosaic (No. 82), Kaokoveld Desert (No. 106) The project area is divided into six areas, including the Namibian Steppe Forest (No.109) and the Kaokoveld Desert (No.106), and these areas tend to be distributed in a north-south direction. Therefore, the project area crosses these ecoregions in an east-west direction.

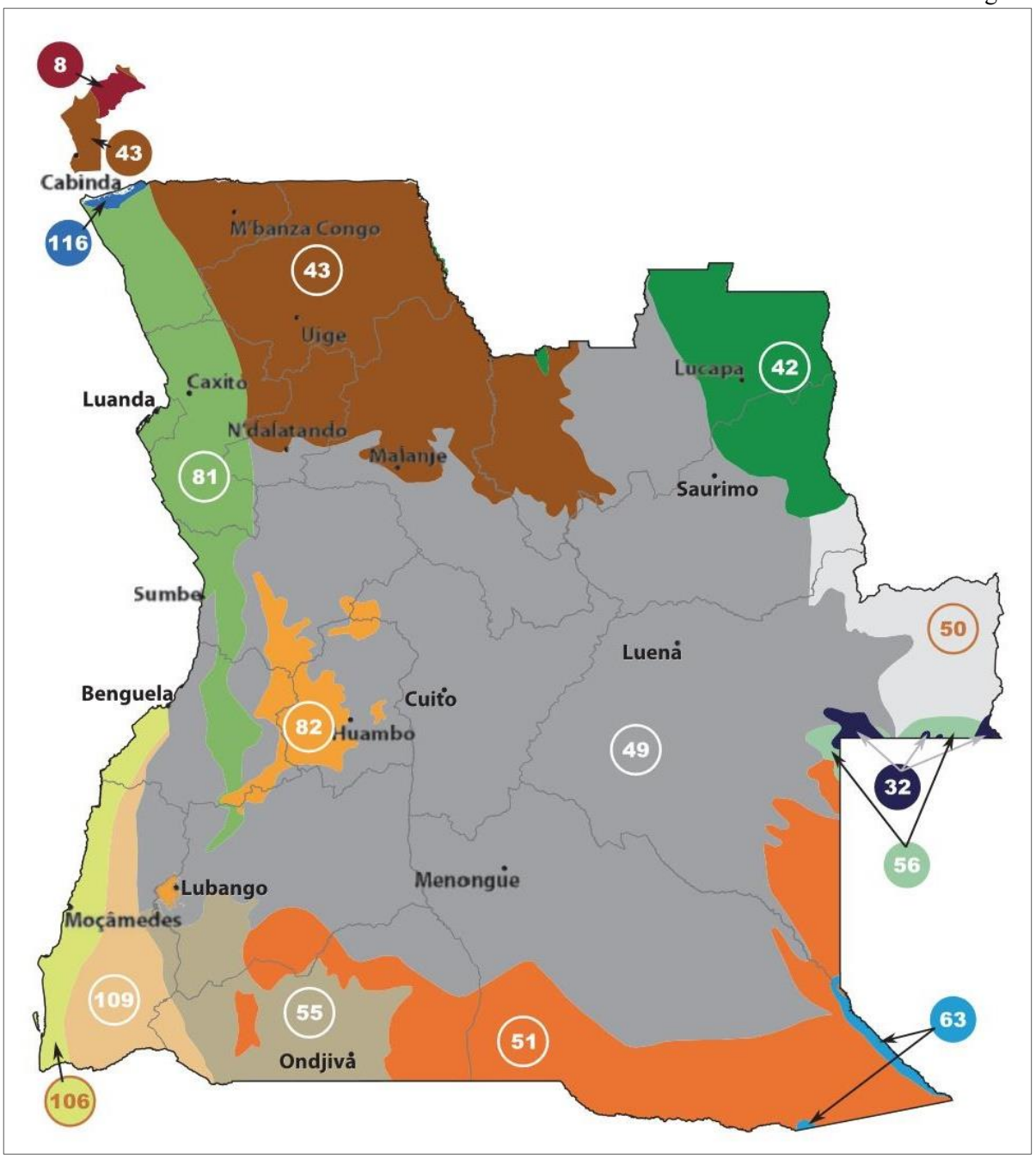


Figure 9.2-10 Angola's ecoregions

Source: Burgess *et al*.[44]

A summary of the ecoregions in the vicinity of the project area is shown in the Table 9.2-3.

[44] BURGESS, N., Hales, J. A., Underwood, E., Dinerstein, E., Olson, D., Itoua, I., & Newman, K. 2004. Terrestrial ecoregions of Africa and Madagascar: a Island Press.

Table 9.2-3 Ecoregion Classification for Angola with Focus on Huíla and Namibe Provinces

Ecoregion classification by Burgess *et al*, (2004)	Ecoregion classifications and designations with a focus on the Huíla and Namibe project areas
49 - Angola miombo forest area	1 - Angolan Highlands (no species characteristic of miombo forests are recognized in the Lubango municipality area)
82 - Angola Highlands-Montane Forest-Steppe Mosaic	
81 - Savannah and forest of Angola cliffs	2 – Angolan Escarpment
55 - Angola Mopane Woodland	3 - Mopane Woodlands
109 - Namib Steep Slope Forest Area	4 - Semi-Arid Spiny Savanna
106 - Kaokoveld Desert	5 - Namib Desert

Source: JICA Survey Team

- **Angolan Highlands**

The project area is located within the Huíla Province and includes the Nombungo Substation to Lubango City area and the Humpata Plateau. Overall, the area has been heavily affected by human intervention and the local landscape has lost its natural characteristics, but there is a small mosaic of natural grasslands, rock outcrops, farmlands, sparse reed beds, plantations, and poor-growing miombo forests. In particular, many of the miombo forests, a typical leguminous tree species in the region, have been artificially degraded due to urbanization. The area from the western part of Lubango City to Humpata is adjacent to the Tundavala area, but along National Road 280, the area has been developed into residential areas, factories, and cultivated land, and there is little natural continuity with the Tundavala area.

The main plant species include tree species such as *Podocarpus milanjianus*, *Pittosporum viridiflorum* (cheesewood), Coca genus (*Erythroxylum dekindtii*), *Ficus* sp., and wild holly, Ilex genus (*Ilex mitis*), as well as several species of Protea genus. In addition, the area is home to isolated and small stands of stunted species such as zebrawood (*Brachystegia spiciformis*) and one of the species forming miombo (*Julbernardia paniculata*), as well as Proteaceae family (*Faurea saligna, F. rochetiana*, etc.) and Phragmitaceae family (*F. rochetiana*), Myrtaceae family (*Syzygium guineense*), *Cussonia angolensis*, and Ochnaceae family (*Ochna pulcra*).

- **Angolan Escarpment (Steep cliffs on the western edge of the Angolan Highlands)**

The power line route runs through a gorge on the back side of the ridge south of Mt. Leba and National Highway 280. The village of Tchvinguilo in southern Humpata Municipality, Huíla Province is located above the gorge, and the village of Bruco in Bibala Municipality, Namibe Province is at the foot of the gorge. In the vicinity of both villages, there are many cultivated fields along the existing 60 kV power lines, and in recent years, deforestation is said to be progressing due to the cutting of trees for charcoal production. On the other hand, the 6-km-long canyon section is highly natural.

Plants include Fabaceae family (*Humulária welwitschii)*, Asteraceae family (*Vernonia exsertiflora, Geigeria acicularis, Vernonia poskeana*), Aspleniaceae family (*Asplenium aethiopicum*), Combretaceae family (*Combretum platypetalum*), Lauraceae family (*Cassia* sp.), and other species are abundant at cliff edges and crevices, as are evergreen shrubs of Apocynaceae family (*Carissa edulis*), succulents of Euphorbiaceae family (*Euphorbia dekindt*), Combretaceae family (*Pteleopsis anisoptera),* and Buxaceae family (*Buxus benguelensis*) are found somewhat farther from the valley line. A shrubby species of the Commiphoraceae family (*Commiphora angolensis*), , Euphorbiaceae family (*Spirostachys africana*, *Pycnocoma dentata, Croton mubango, Euphorbia gracilicaulis*), Bignoniaceae family (*Rhigozum brevispinosum*), Tiliaceae family (*Grewia mossamedensis*), Pteridaceae family (*Actiniopteris radiata)*, and African Baobab (*Adansonia digitata*) grow abundantly on rock outcrops near the bluff. They grow abundantly on rock outcrops near the cliffs.

- **Mopane Woodlands**

The power line route corresponds to the section of the route from Bruco area to Caraculo area, where it joins National Road 280 midway through the route, which is hilly savanna and forest area. The area has been affected by anthropogenic influences, mainly deforestation caused by cattle grazing and wood and charcoal production. It is characterized by a diversity of features: a transition zone between wet forests at the foot of steep cliffs and the semi-arid Namib Desert.

The main dominant plant species are mopane of Fabaceae family(*Colophospermum mopane*) and other leguminous trees of Fabaceae family (*Acacia kirkii*, *A. nilotica, A. hebeclada, Dichrostachys cinerea, Indigofera schimperi*), Araceae family (*A. erubescens*), Zygophyllaceae family (*Balanites*

angolensis), Combretaceae family (*Combretum apiculatum, Rhigoz prunoides Terminalia prunoides, T. sericea*), Burseraceae family*Commiphora* sp., Poaceae family (*Dichanthium papillosum*), shrub of Malvaceae (*Grewia villosa*), Euphorbiaceae family (*Jatropha campestris*), Asteraceae family (*Melanthera marlothiana)*, Fabaceae family (*Peltophorum africanum)*, Olacaceae family (*Ximenia americana, X. caffra*). Passifloraceae family (*A. kirkii*) is abundant in alluvial soils and forms compact communities.

- **Semi-Arid Spiny Savanna**

The transmission line route roughly follows National Road 280 and the 60 kV existing DL, which corresponds to the section leading to Caraculo.

The region is relatively large, corresponding to roughly the central part of the coastal plain, where acacia forests are distributed over rocky, arid savannas. The region is arid and relatively sparsely populated due to the lack of water resources, so it is an area not much affected by human activities, except for mining and ranching around Caraculo.

The main plant species in the region are woody species such as *Acacia kirki*, *A. nilotica*, and *A. hebeclada*, *Dichrostachys cinerea*, Araceae family (*A. erubescens*), Zygophyllaceae family (*Balanites angolensis*), shrub of Burseraceae family (*Commiphora angolensis*), and Bignoniaceae family (*Rhigozum brevispinosum*). Herbaceous species are sparse, but the main species are Poaceae family (*Schmidtia kalahariensis*, *S. pappaphoroides*, *Melinis repens*, *Dactyloctenium aegyptium*, *Urocloa oligotricha*).

- **Namib Desert**

It corresponds to the section from Caraculo to the 220/60 kV New Namibe SS to be built near the city of Moçâmedes.

The area is located on the northern edge of the Namib Desert, often considered the oldest desert in the world, and is the driest and has the lowest annual rainfall in the project area. The desert area has a small population and is relatively unaffected by human activity. Although the overall terrain is desert, there are many granite outcrops and the terrain is relatively flat.

The vegetation is sparse and typical of desert environments, dominated by grass species of Poaceae (*Stipagrostis. prodigiosa*, *S. hirtigluma*, *S. uniplumis*), as well as wild crowberry (*Danthoniopsis mossamedensis*) and other Poaceae family (*Aristida ordeacea*, *Melinis repens*) are also found Euphorbiaceae family (*Euphorbia virosa*, *Euphorbia tirucalli*), the evergreen shrub Salvadora family (*Salvadora persica*), Apocynaceae family (*Hoodia currori*), Zingiberaceae family (*H. parviflora, H. mossamedensis*), and Zygophyllaceae family (*Tribulus zeiheri*) are found. *Cyphostemma uter*, which has a stem (tuberous root) shaped like a leather bag for holding wine, and *Welwitschia mirabilis,* which is said to have a life span of over 1000 years, are desert plants characteristic of this region. (Not identified within the project area.)

(c) Plant communities in the project area

Surveys of plant communities were conducted during the rainy (April 2021) and dry (June 2021) seasons, respectively.

- **400/220/60 kV Nombungo SS planned area (TL 0 km: 14°47'16.73 "S13°42'15.94" E)**

Dense stands of shrub species represented by *Acacia ataxacantha* were found around the proposed 400/220/60 kV Nombungo SS site. In the human-influenced areas, zebrawood (*Brachystegia spiciformis*) and Combretaceae family (*Combretum collinum*, *Pteleopsis anisoptera*) were the main medium-sized shrubs, while shrubs such as Celastraceae family (*Gymnosporia sengalensis, Elachyptera parvifolia*), *Brachystegia lingifolia* (Fabaceae family), *Bridelia angolensis* (Euphorbiaceae family), and the succulent of Xanthorrhoeaceae family (*Aloe littoralis*), Rubiaceae family (*Gardenia* ssp.), Ebenaceae family (*Euclea divinorumEuclea natalensis*), and Polygalaceae family (*Securidaca longepedunculata*) (see Figure 9.2-11). Herbaceous species were dominated by Asteraceae family (*Helichrysum kraussi*) and (*Solanum incanum*).

Figure 9.2-11 Overview of vegetation around 400/220/60 kV Nombungo SS
Source: JICA Survey Team

- **Vegetation community between the 400/220/60 kV Nombungo SS site and the 220/60 kV East Lubango SS site (TL 0-17 km)**

In this section, the impact of agriculture and grazing has resulted in a fragmented regional landscape of grasslands and bare land, especially in the vicinity of Mateata village. (See Figure 9.2-12). Around Ivantala swamp, cultivated lands are widespread, with a variety of species such as Chrysobalanaceae fmily(*Parinari curatellifolia*), evergreen of Dipterocarpaceae family (*Syzygium guineense* ssp. *Detarium macrocarpum*), Cicadaceae family (*Terminalia sericea*), Fabaceae family(*Peltophorum africanum, Burkea africana*), Cycadaceae family (*Pteleopsis Anisoptera*), Dipterocarpaceae family (*Monotes* sp.), shrubs are Anacardiaceae family (*Rhus quartiniana*), and succulent plants of Anacardiaceae family (*Aloe littoralis and Faurea* sp.).

In the shrub layer, some of the species that grow into tall trees under normal conditions were found, such as Myrtaceae family (*S. guineense*) (Water Berry), Combretaceae family (*T. sericea*, *Pseudolachnostylis maprouneifolia, Combretum platypetalum, Terminalia brachystemm*), Proteaceae family (*Protea* sp.), and Ebenaceae family (*Euclea crispa*), all of which grow to be tall trees under normal conditions. Among herbaceous plants, *H. kraussi* (Asteraceae), Annonaceae family (*Annona stenophyla, Lannea edulis*), Celastraceae family (*Gymnosporia senegalensis*), *Parinari capense* (Chrysobalanaceae family), *Cassia singuei* (Fabaceae family), Rubiaceae family (*Gardenia volkensii)*, Asparagaceae family (*Asparagus* sp), etc., and as exotic species, *Psidium guajava* (Myrtaceae family) and a kind of cactus, *Opuntia ficus-indica* were found.

Figure 9.2-12 Vegetation around the village of Matera
Source: JICA Survey Team

- **Vegetation community around Ivantala Swamp** (TL 10km: 14°51'34.75 "S 13°40'13.67 "E)

Most of the native species in the region are shrubs, including members of the Fabaceae family (*Pericopsis angolensis*, *Brachystegia longifolia, Julbernardia paniculata*, *Acacia* sp.), Verbenaceae

family (*Lantana angolensis*), *Rhus quartiniana* (Anacardiacea family), *Faurea* sp. (Proteaceae family), *Combretum collinum* (Combretaceae family used for gum production), *Dombeya rotundifolia* (Malvaceae family), etc. In herbaceous plants, there are *Clematis villosa* (Ranunculaceae family), *Gymnosporia senegalensis* (Ranunculaceae), *Aloe littoralis* (Anacardiaceaefamily), and Asparagaceae family (*Asparagus africanus*), and Asteraceae family (*Bidens pilosa)* were found.

The area surrounding the swamp was heavily farmed, with many vegetables, and *Agave sisalana* (Asparagaceae family), were used as fences in the area, bananas (*Musa* sp.) and lemons (*Citrus limon)* were found in the area.

At the water's edge, reeds (*Phragmites mauritianu)*, Polygonaceae family (*Persicaria limbata, Polygonum decipiens*), as well as small shrubs of Ebenaceae family (*Diospyros lycioides, Euclea divinorum*), Rhamnaceae family (*Ziziphus abyssinica)*, Fabaceae family (*Acacia kirkii)*, and Apocynaceae r family (*Carissa spinarum*) were seen.

Also the miombo forest formulation large woody plants such as Fabaceae family (*Brachystegia* sp), Cicadaceae family (*Pteleopsis anisoptera*), Fabaceae family (*Peltophorum africanum*), Moraceae family (*Ficus sur*), and Ebenaceae family (*Diospyros kirkii*) were scattered.

Figure 9.2-13 Riparian vegetation in Ivantala Swamp

Source: JICA Survey Team

- **Near the planned site of 220/60 kV East Lubango SS** (at 17 km TL)

Pteleopsis anisoptera - Diospyros lycioides (Ebenaceae) Community

The area around Poiares Muhaha settlement, the proposed site of the 220/60 kV East Lubango SS, was dominated by shrubs and dotted with tall trees such as the Indian rubber tree (*Ficus elastica*). Shrub species included Combretaceae family (*Pteleopsis anisoptera, T. sericea*), Ebenaceae family (*Disopyros lycioides, Euclea natalensis*), Anacardiaceae family (*Aloe littorali*), Loganiaceae family (*Strychnos cocculoides, S. spinosa)*, Ochnaceae family (*Ochna pulchra)*, Fabaceae family (*Cassia singueana, Dichrostachys cinerea, Peltophorum africanum, Pericopis angolensis*), Ranunculaceae family (*Gymnosporia senegalensis, Elachyptera parvifolia*), Verbenaceae family (*Lantana cama*), evergreens of Sapotaceae family (*Englerophytum megalismontanum*) were also seen (See also Figure 9.2-14).

Herbaceous species found included Annonaceae family (*Annona senegalensis*), a kind of campanulids (*Emilia coccinea)*, and Ebenaceae family (*Euclea crispa)* and Melinis genus of Poaceae family. The appearance of Melinis genus is known to be an indicator of degraded land.

Figure 9.2-14 Vegetation at the proposed 220/60 kV East Lubango SS site (Poiares Muhaha settlement)

Source: JICA Survey Team

・ **South side of the planned 220/60 kV East Lubango SS** (around TL 20km)

Pteleopsis anisoptera - Acacia ataxacatha community

In this area, a number of woody species grew, including Fabaceae family (*Acacia ataxacatha, Piliostigma thonningii*), Myrtaceae family (*E. parvifolia, P. africanum*), and Indian rubber tree (*Ficus elastica*), and exotic species such as *Eucalyptus* sp. was also observed.

The regional landscape around this area is mainly cultivated with vegetables, but woody species such as native Malvaceae family (*Dombeya rotundifolia)*, poison ivy, Anacardiaceae family (*Rhus quartiniana),* and Apocynaceae family (*Carissa spinarum*), and herbaceous species such as Asteraceae family (*Vernonia* sp., *Vernonia gerberiformis* ssp. *Macrocyanus*), Fabaceae family (*Eriosema* sp.), and other herbaceous species.

Figure 9.2-15 Indian rubber tree (Ficus elastica) and the Acacia shrub community in the background

Source: JICA Survey Team

・ **South of Arimba** (around 30 km from TL)

Uapaca kirkiana - Brachystegia longifolia community

Miombo forests are found in the foothills south of the 220/60 kV East Lubango SS (Figure 9.2-16), dominated by Caesalpiniaceae family (*Brachystegia longifolia*) and Pyllanthaceae family (*Uapaca kirkiana*), with Chrysobalanaceae (*Parinari curatelifolia)*, Dipterocarpaceae family (*Monotes* sp.), Ochraceae (*Ochna pulchra*), and Sapindaceae family (*Dodonaea viscosa*) were found together. Vegetation in this area is generally shrubby due to shallow soils and massive rock outcrops.

The main herbaceous species found in this area are Asteraceae family (*Helychrysum kraussi, Pleiotaxis rugosa)*, Fabaceae family (*Eriosema* sp., *Crotalaria* sp.), Primulaceae family (*Myrsine africana)*, the succulent of Aloeaceae genus Anacardiaceae of Anacardiaceae family (*Aloe littoralis*), Asparagaceae family (*Asparagus africanus*), Anacardiaceae family (*Rhus natalensis*), and Acanthaceae family (*Justicia* sp.).

Miombo forest at the foot of the mountains near TL30km

Sugar plum *(Uapaca kirkiana)*

Figure 9.2-16 Vegetation conditions in south of Arimba

Source: JICA Survey Team

Brachystegia spiciformis - Parinari curatellifolia Community

In addition to the species that occur and form communities on shallow stony soils in the Mumue neighborhood (between 30 and 35 km of the TL route), other species of the shrub layer were conspicuous, especially members of the Dipterocarpaceae (*Monotes* sp., *P. Anisoptera)*, Proteaceae family (*Protea* sp.), Loganiaceae(*Strychnos spinosa*), and Pyllanthaceae family (*Bridelia tenuifolia*). Among herbaceous plants, steraceae family (*H. kraussi, Stoebe plumosa*, *Geigeria acicularis, Dicoma elegans*), Acanthaceae family (*Justicia* sp.), Anacardiaceae family (*Aloe littoralis*), and Malvaceae family (*Whalteria indica*) were found. In addition, Fabaceae family tree (*Julbernardia paniculata*, *B. madagascariensis*), *Eucalyptus parvifolia*, Ochnaceae family (*Ochna pulchra*), and Anacardiaceae (*Rhus kirkii*) were also seen.

This area is experiencing environmental degradation due to the extraction of soil, sand, and gravel.

Figure 9.2-17 Zebrawood (Brachystegia spiciformis) - Parinari curatellifolia

Source: JICA Survey Team

Helychrysum kraussi - Stoebe plumosa communities (around Heva de Cima settlement: 35-40 km TL)

There were few trees and shrubs in the area, with only a few herbaceous species such as Asteraceae (*Eupatorium africanum, Helychrysum aureum, Stoebe plumosa*), Solanaceae family (*Solanum incanum*, *Solanum* sp.), and woody species such as Sapindaceae family (*Dodonaea viscosa*:'hopbush') and a few others (Figure 9.2-18). The soils in this area are highly acidified, and species characteristic of nutrient-poor and acidified soils, such as the non-native species of Dennstaedtiaceae family (*Pteridium aquillinum* ssp.), Rutaceae family, (*Calodendrum capense*) were found.

Figure 9.2-18 Overview of vegetation near the Heva de Cima area
Source: JICA Survey Team

- **South side of Christ's Hill**

Parinari curatellifolia- Julbernardia paniculata community (TL 45-60 km)

It consists of a shrubby Chrysobalanaceae family (*Parinari curatellifolia*) and a legume tree of Fabaceae family (*Julbernardia curatellifolia*), and were found on rocky outcrops with shallow soil. Herbaceous species such as Combretaceae family (*Terminalia sericea)*, Ochnaceae family (*Ochna pulchra*), and Loganiaceae family (*Strychnos* sp.), and an exotic species of Dennstaedtiaceae family (*Pteridium aquillinum* subsp. centrali-africanum) were abundant (See Figure 9.2-19).

Figure 9.2-19 Vegetation in the south of Christ's Hill
Source: JICA Survey Team

- **Tchivinguilo area** (TL 70 km)

Pteleopsis anisoptera - Carissa spinarum community

In the Tchvinguilo area, the landscape was characterized by dense bushes so dense that the ground cannot be seen are found, and include shrubs of Ranunculaceae family (*Elachyptera parvifolia*), Fabaceae family (*Acacia ataxacatha, Cassia singueana, Dichrostachys cinerea*), succulent Anacardiaceae family (*Aloe littorallis),* Anacardiaceae family (*Rhus natalensis)*, and Rubiaceae family (*Canthium lactescens, Vangueria infausta* subsp. *infausta),* and others. Although shrubs dominated the area, herbaceous species such as Asteraceae (*H. kraussi, Kleinia fulgens),* Anacardiaceae family (*Rhus quartiniana*), and Combretaceae family (*Combretum collinum)* used for gum production were also found in the area.

Figure 9.2-20 Overview of vegetation in Tchvinguilo area (Aloe littoralis)
Source: JICA Survey Team

Colophospermum mopane - Sclerocarya birrea community

In the Tchvinguilo area, there were tall stands of mopane members of the Fabaceae family (*Colophospermum mopane),* a legume, and other trees such as Anacardiaceae family (*S. birrea),*

Euphorbiaceae (*Spirostachys africana)*, Burseraceae family (*Commiphora mollis*), Combretaceae family (*Combretum collinum, Terminalia prunioides*), Zygophyllaceae family (*Balanites welwitschia*), and African baobab (*Adansonia digitata*). In the shrub layer, Euphorbiaceae family (*Croton gratissimus*), Malvaceae (*Grewia* sp), Rhamnaceae family (*Ziziphus abyssinica*), Ebenaceae family (*Euclea divinorum*), and Olacaceae family (*Ximenia caffra*) were seen. In the herbaceous species, Poaceae family (*Eragrostis superba, Aristida stipitata, Eragrostiis rigidior*), *Bidens pilosa*, Acanthaceae family (*Barleria* sp.) and others were found.

Figure 9.2-21 Tall tree layer in Tchvinguilo area
Source: JICA Survey Team

- **Bruco-Caraculo** (TL 85km-140km)

Colophospermum mopane - *Commiphora multijuga* community

Mopane (*Colophospermum mopane*), a leguminous tree, is dominant in this area, and the shrub layer is dominated by Burseraceae family (*Commiphora multijuga*), Combretaceae family (*Terminalia sericea, T. prunioides*), Anacardiaceae family (*S. birrea*), Burseraceae family (*Commiphora mollis*), Bignoniaceae family (*Catophrates alexandrii*), Malvaceae family (*Hibiscus elliottiae*) were seen.

Figure 9.2-22 Predominantly *Commiphora multijuga* and *Colophospermum mopane*
Source: JICA Survey Team

- **Caraculo area**

Terminalia sericea - Colophospermum mopane community (near 100 km TL)

The shrubby community is slightly different from the aforementioned section and is dominated by Bignoniaceae family (*Catophrates alexandrii*), Zygophyllaceae family (*Balanites welwitschia*: Angolan green-thorn) and Capparaceae family (*Boscia* sp.). Other dominant species were Burseraceae family (*Commiphora africana*) and Fabaceae family (*Acacia karoo*). Grasses such as Poaceae family (*Aristida* sp. and *Eragrostis* sp.) were also found. Other species included Burseraceae family (*Commiphora mollis, C. multijuga*) and Salvadaceae family (*Salvadora persica).*

Salvadora persica - Terminalia prunioides Community (TL 100-160 km)

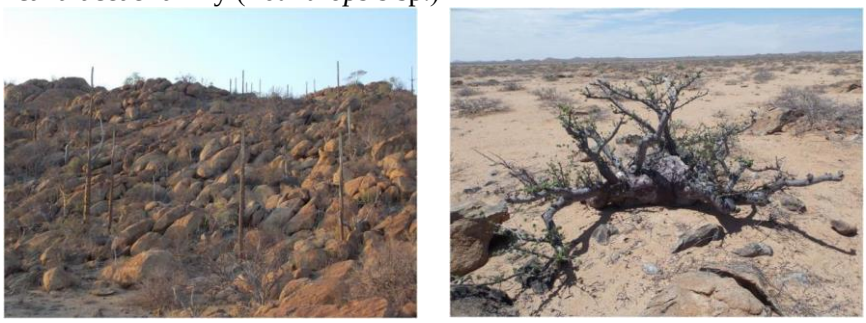
The evergreen Salvadaceae family (*Salvadora persica*) was dominant, while Combretaceae family (*Terminalia sericea)* and Fabaceae family (Acacia *cf. welwitschii, Acacia* sp.) were also found. In this section, the community of mopane of Fabaceae family (*Colophospermum mopane*), another leguminous tree, was less abundant, and grass species such as Poaceae family (*Aristida* sp., *Stipagrostis*

sp.) were conspicuous. In the lower part of the shrub layer, t Acanthaceae faamily (*Blepharis furcata)*, succulent Asparagaceae family (*Sanseviara pearsonii)*, Nyctaginaceae family (*Phaeoptilum spinosu)*, Apocynaceae family (*Hoodia currori)*, Vitaceae family (*Cyphostemma uter*), Euphorbiaceae family (*Euphorbia saxicola*), Burseraceae family (*Commiphora capensis*) and Zygophyllaceae family (*Zygophylum cordifolim*) were found.

Figure 9.2-23 Overview of Salvadora persica vegetation in the Caraculo area
Source: JICA Survey Team

Euphorbia eduardoi - Sterculia africanaCommunity

Between Caraculo and the Giraulu River (140-180 km TL), there are fewer tall trees, and trees adapted to the dry environment such as *Euphorbia eduardoi* (Euphorbiaceae family), *Sterculia africana* (Malvaceae family), and *Moringa ovalifolia* (Moringaceae family). The dominant herbaceous species were Acanthaceae family (*Acanthopsis* sp.).



Euphorbia eduardoi *Sterculia africana*

Figure 9.2-24 Euphorbia eduardoi - Sterculia africana community
Source: JICA Survey Team

- **Around the planned site of the 220/60 kV New Namibe SS** (Aída area)

Euphorbia virosa var. arenicola - Hydnora africana

In the vicinity of the proposed 220/60 kV New Namibe SS (Aída area), herbaceous communities adapted to the generally dry environment were distributed, including Euphorbiaceae family, such as *Euphorbia virosa ssp, Euphorbia arenaceous, Euphorbia lignosa, and Euphorbia lignosa.* Insectivorous of Aristolochiaceae family (*Hydnora africana*) and Rutaceae family (*H. Abyssinica*) were identified.

Figure 9.2-25 Euphorbia virosa var. arenicola near the 220/60 kV New Namibe SS
Source: JICA Survey Team

The overview of the 220 kV TL route is shown in Figure 9.2-26, Figure 9.2-27, and Figure 9.2-28.

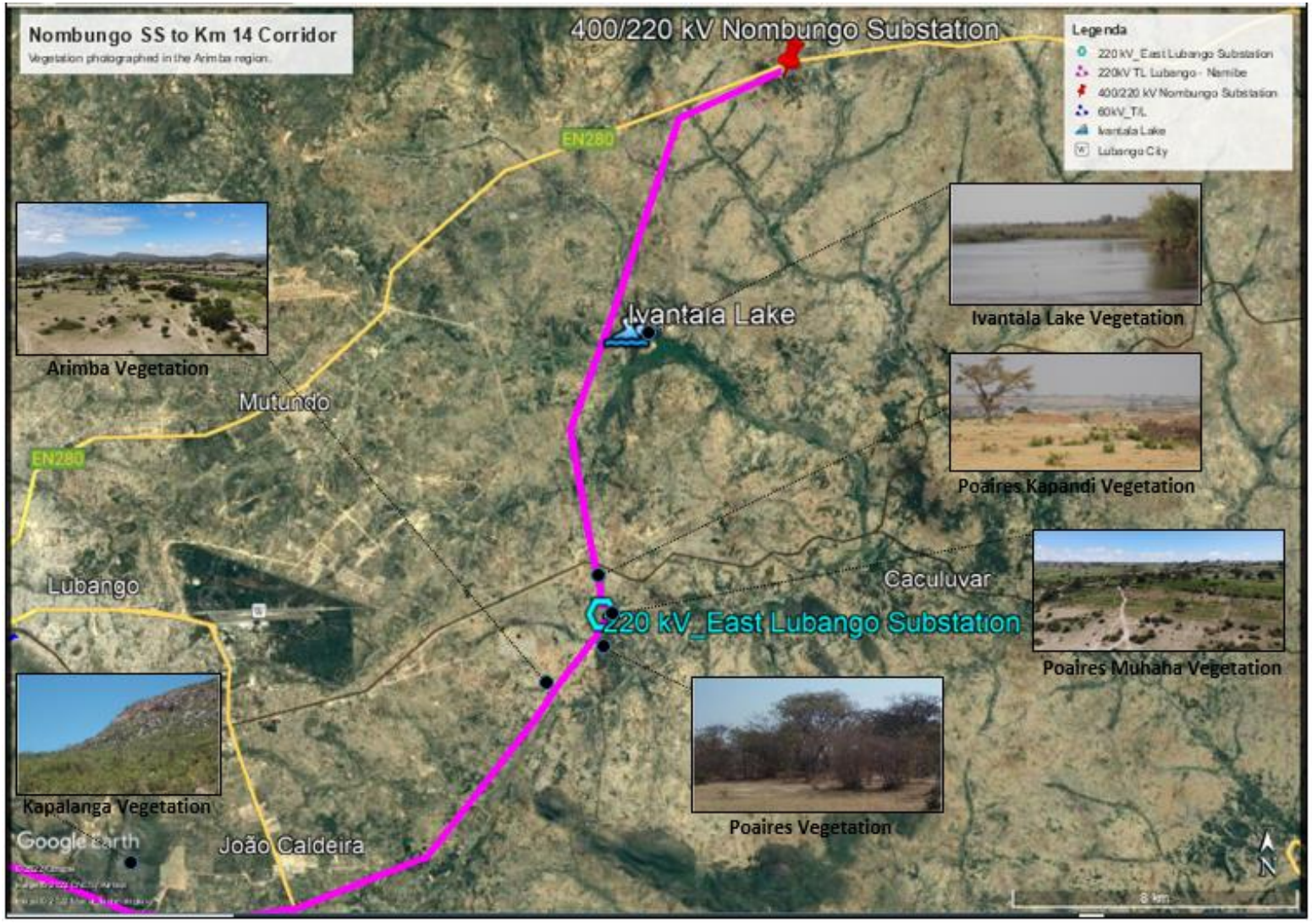


Figure 9.2-26 Overview of transmission line routes in the Lubango region (TL 0 km to 36 km)

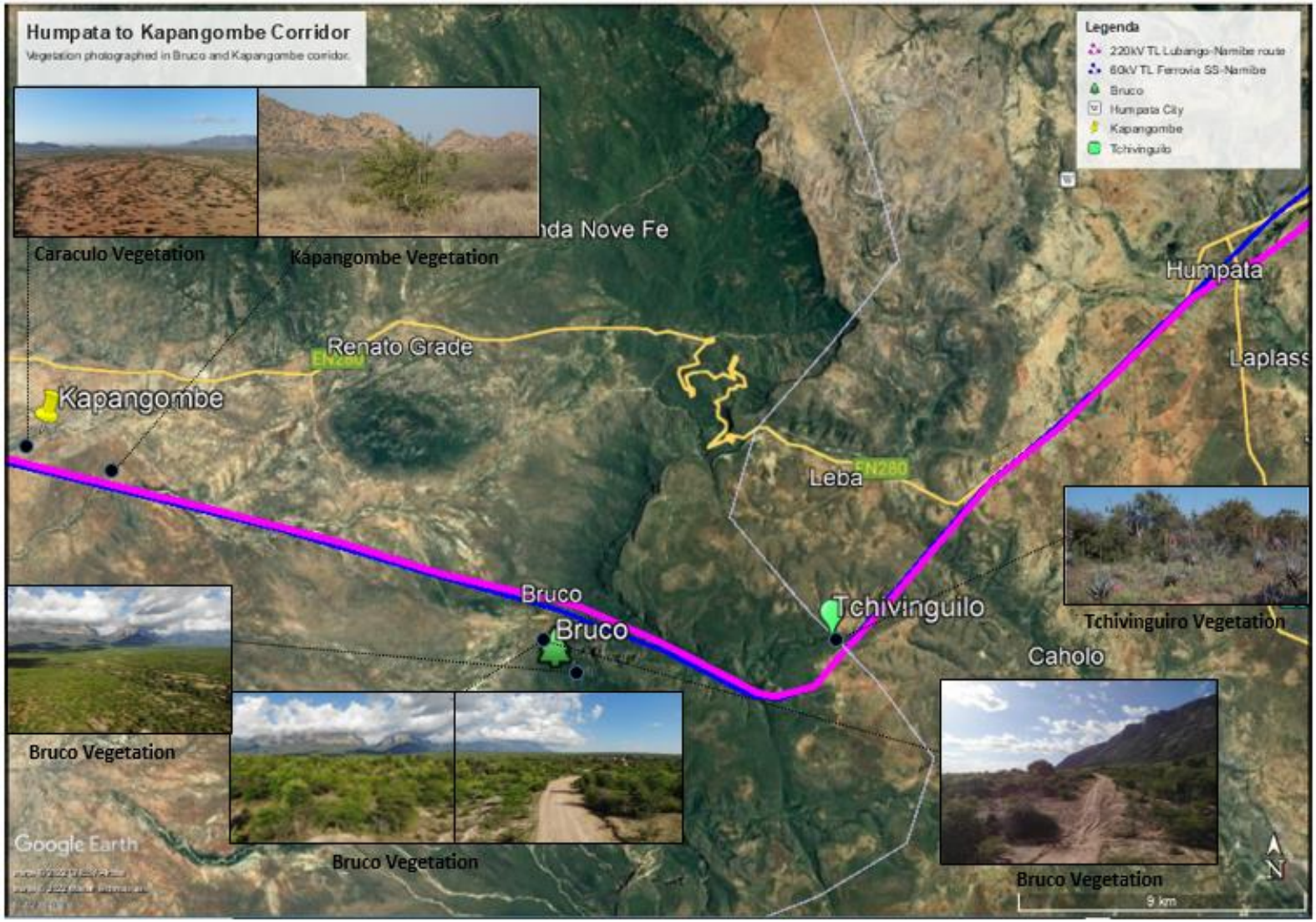


Figure 9.2-27 Overview of the Humpata-Tchivinguilo-Bruco-Capangombe transmission line route (TL 70km-130km)

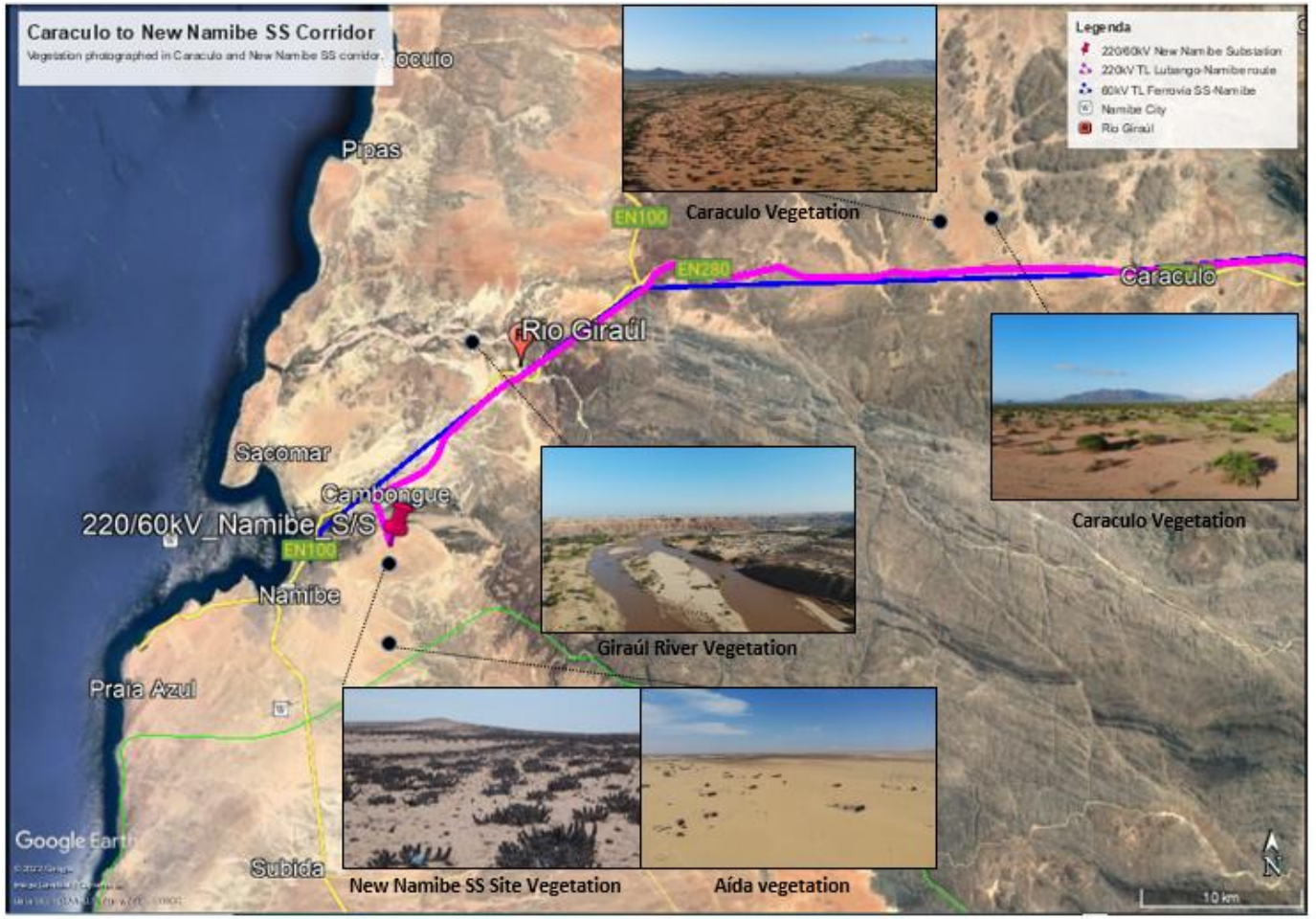


Figure 9.2-28 Overview of the transmission line route between Caraculo and the 220/60 kV New Namibe SS (TL 140 km to 196 km)

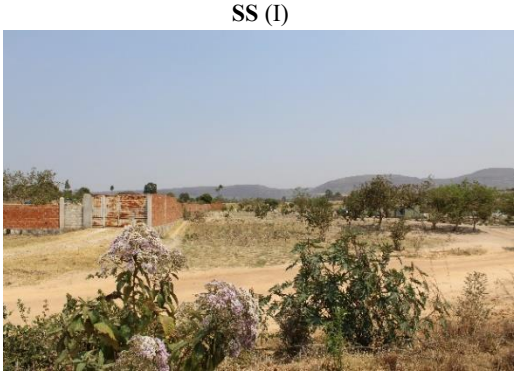
- **Vegetation in the area of the proposed 60 kV DL project** (between 220/150 kV East Lubango SS and 60/15 kV Arimba SS)

The general situation along the distribution line between the 60/15 kV Arimba SS and the 220/60 kV East Lubango SS is shown in Figure 9.2-29 (Photos 1-16). No vegetation was observed in and around the proposed site of the 60/15 kV Arimba SS (Photos 1-4). Photos 5 and 6 show vegetation near the distribution line route, but outside of the ROW, consisting of sparse shrubs and isolated trees. Photo 7 shows the condition of the road that is to be used as the route of the distribution line. Photos 11 through 14 show the 150 kV existing TL and sparse vegetation. Photos 15 and 16 are closer to the 220/60 kV East Lubango SS, where vegetation was sparse. Human activities have had a significant impact on this section, and vegetation is found only around the 220/60 kV East Lubango SS and to the west of it. The main plant species found within the project impact area are similar to those near the 220/60 kV East Lubango SS. No significant and relevant vegetation patches were identified in the distribution line corridor. There were scattered shrubs and isolated trees, which could easily be avoided during installation of the towers. Twenty-two plant species were identified during this period, 21 LC and one DD in the IUCN Red List categories.

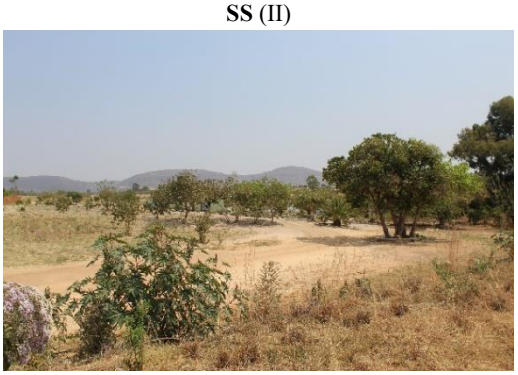
(Photos 1 and 2) Proposed site of the 60/15 kV Arimba SS

(Photo 3) View of the other side of the 60/15 kV Arimba SS (I)

(Photo 4) View of the other side of the 60/15 kV Arimba SS (II)



(Photo 5) View of DL route (I)



(Photo 6) View of DL route (II)

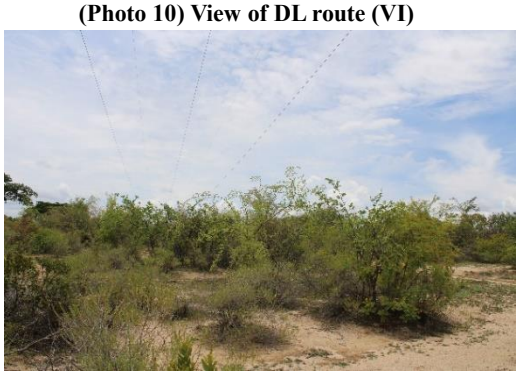
(Photo 7) View of DL route (III)

(Photo 8) View of DL route (IV)

(Photo 9) View of DL route (V)

(Photo 10) View of DL route (VI)

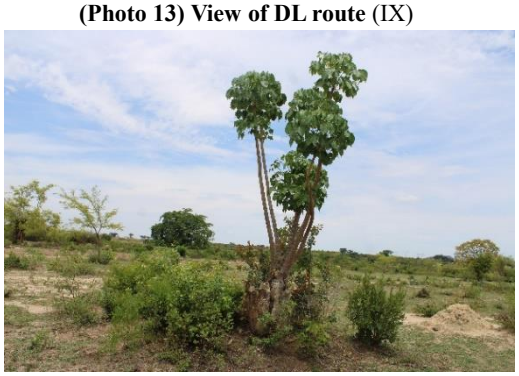
(Photo 11) View of DL route (VII)



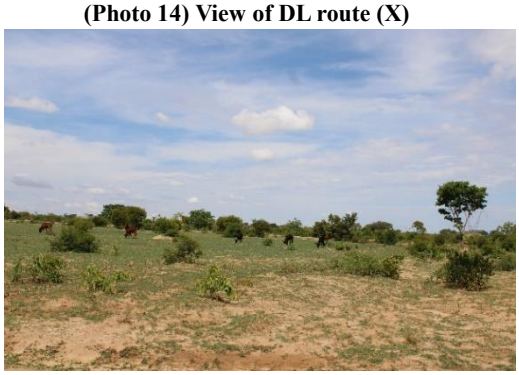
(Photo 12) View of DL route (VIII)

(Photo 13) View of DL route (IX)

(Photo 14) View of DL route (X)



(Photo 15) View of DL route (XI)



(Photo 16) View of DL route (XII)

Figure 9.2-29 Overview of 60 kV DL route between 60/15 kV Arimba SS and 220/60 kV East Lubango SS

(d) Birds in the project area

Bird surveys were conducted during the wet season (March-April 2021) and the dry season (August 2021). Due to considerations as a safety measure for landmines, observations were basically made in all project areas by random census using binoculars and telescopes from existing roads.

A total of 163 species were identified in the wet and dry seasons, and by ecoregion: 72 in the Angolan highlands, 58 in the escarpment, 58 in the Mopane Woodlands, 35 in the semi-arid savanna, and 25 in the Namib Desert. Of these, the species that are assumed to be potentially affected by the transmission line project were selected, and the IUCN categories, endemism, seasonality (resident/migratory), type (habitat characteristics), and Table 9.2-4 shows the list of species identified.

・ **IUCN Endangered Category**

Ludwig's bustards (*Neotis ludwigii)*, classified as Endangered (EN) by the IUCN, was identified near Caraculo in Ecoregion 5 (Namib Desert) during a preliminary expedition (November 2020). According to the Illustrated Guide to the Birds of Angola (Dean, 2000)[45] , "Its habitat status is not well known, and it may roam in certain areas, possibly as a resident bird, not uncommonly in the flat, open bushland southwest of the Namibe, and possibly further north in Benguela. (Pinto, 1983). In addition, an illustrated book for southern Africa, mainly South Africa (Sinclair *et al.*, 2014)[46] shows a distribution range in South Africa and western Namibia (Namib Desert). It is believed to be a resident bird, but given that it was not confirmed during subsequent wet and dry season surveys, the area around Caraculo is not considered to be its primary habitat. However, it should be noted that it is 80-100 cm in length, weighs 2.2-6 kg, and is reportedly vulnerable to collisions with power lines.

・ **Endemic species**

Two endemic species were identified: the red backed mousebird (*Colius castanotus)*, the trigger species for the Tundavala IBA, and Ludwig's double-collared sunbird (*Cinnyris ludovicensis),* while two semi-endemic species were identified: the Benguela long-billed lark (*Certhilauda benguelensis*) and the trigger species of the Tundavala IBA, the Angola Cave-chat (*Xenocopsychus ansorgei)*, were identified as semi-indigenous species.

The red backed mousebird is widely distributed in Angola and is said to be resilient to loss of vegetation, fragmentation and loss of animal habitats, and habitat degradation due to human activities and urbanization, and was found in Ecoregions 1, 2, and 3. According to the illustrated book of endemic species of Angola (Pinto and Fernandes, 2020)[47], the distribution range is centered in central Angola, near the border between the Huíla and Namibe provinces. The Ludwig's double-collared sunbird is widely distributed in the mountains of central Angola, with a banded distribution near the border between the Huíla and Namibe provinces, according to the above-mentioned illustrated book.

Benguela long-billed lar has a distribution range in the coastal deserts of Namibe and Benguela Provinces, and was found in Ecoregions 4 and 5 in this study. The Sekirei's Thrush was found in Ecoregions 1 and 2, and according to the above-mentioned illustrations, its main distribution area appears to be near the border between Huíla and Namibe Provinces.

All four of the above endemic and semi-endemic species are commonly found and are IUCN category LC (Low Concern).

・ **Birds of Prey**

Twelve raptor species were identified.

Western osprey (*Pandion haliaetus)* were found in a desert area along the coast (Ecoregion 5). Since it was on the inland side, it might be resting.

Black-winged Kite (*Elanus caeruleus)* is widespread as an insectivore and was found on the Humpata Plateau in Ecoregion 1and Tchivinguilo in Ecoregion 2.

Yellow-billed Kite (*Milvus aegyptius) is* found on the eastern side of the Lubango and is a common and widespread migrant species.

Black-chested Snake Eagle (*Circaetus pectoralis)* was found in the savanna area (ecoregions 3 and 4).

African Marsh Harrier (*Circus ranivorus)* was observed hunting above the Ivantala Swamp. This is a relatively rare species and is thought to be sensitive to pollution and habitat change.

Gymnogene (*Polyboroides typus) was found in* the Mopane Forest area of Ecoregions 2 and 3.

Pale Chanting Goshawk (*Melierax canorus) was found in* dry savanna.

Little Sparrowhawk (*Accipiter minullus) were* found on the steep slopes west of Tchvinguilo (Ecoregion 2).

Augur Buzzard (*Buteo auguralis) was found on* steep cliffs, but is also a common species on the coastal plain.

Lanner Falcon (*Falco biarmicus) were* also found in ecoregions 2, 4, and 5 and are considered a common species.

Peregrine Falcon (*Falco peregrinus)* was observed in the Mopane Forest area near Capangombein Ecoregion 3. This species, which is widespread but somewhat rare and generally rarely observed

[45] W.R.J. Dean(2000): The Birds of ANGOLA - An annotated checklist. British Ornithologits' Union, 433pp.
[46] Ian Sinclair, Phil Hockey, Warwick Tarboton, aand Peter Ryan (2014): The Larger Illustrated Guide to the BIRDS of Southern Africa. 464pp.
[47] Pedro Vaz Pinto and Fernando Hugo Fernandes (2020): 50 Aves de Angola - Raridade e Endemismo. 117pp.

outside of known breeding areas, is a highly specialized top predator that preys primarily on birds in flight and is considered an excellent environmental indicator because it is highly vulnerable to pollution and trophic pyramid collapse.

- **Waterfowl**

Sixteen species of waterfowl were identified: six species of ducks, five species of herons, two species of cormorants, and one each of Little Grebe, African Jacana, and Hamerkop, all found in the Ivantala Swamp.

Spur-winged Goose (*Plectropterus gambianus) is* a large waterfowl that is known to be frequently involved in collisions with power lines in southern Africa, and five other duck species, White-faced Whistling Duck (*Dendrocygna viduata)*, Fulvous Whistling Duck (*Dendrocygna bicolor*), Cape Teal (*Anas capensis)*, Yellow-billed duck (*Anas undulata*), and Red-billed teal (*Anas erythrorhyncha)* may also commonly aggregate.

- **Migratory birds**

Since information residents in Angola is scarce and their routes are difficult to identify, 16 migratory species were identified based on the results of voluntary surveys in the entire proposed project area and by matching them with a checklist of Angolan bird species (Dean, 2000).

Ospreys and falcons as raptors may be affected due to their large range and relatively large size. Most other species are small.

The most common routes for wide-area crossings are in Figure 9.2-30 shows a north-south route between Africa and Eurasia, and Angola is located near the southern end of this major route. It is said that migratory birds tend to follow geographical boundaries and discontinuities in their migration routes, and in the vicinity of the project area, the steep cliffs of Ecoregion 2 may be a migratory route due to the continuity of the terrain from the north. Another possible route is the coastline, but in this study, only two species, osprey and Olive bee-eater, were found in Ecoregion 5 near the coast, and all other species were found in Ecoregions 1 or 2, with the exception of Spotted Flycatche, of which five species were also found in Ecoregion 3. Five of the species were also found in Ecoregion 3.

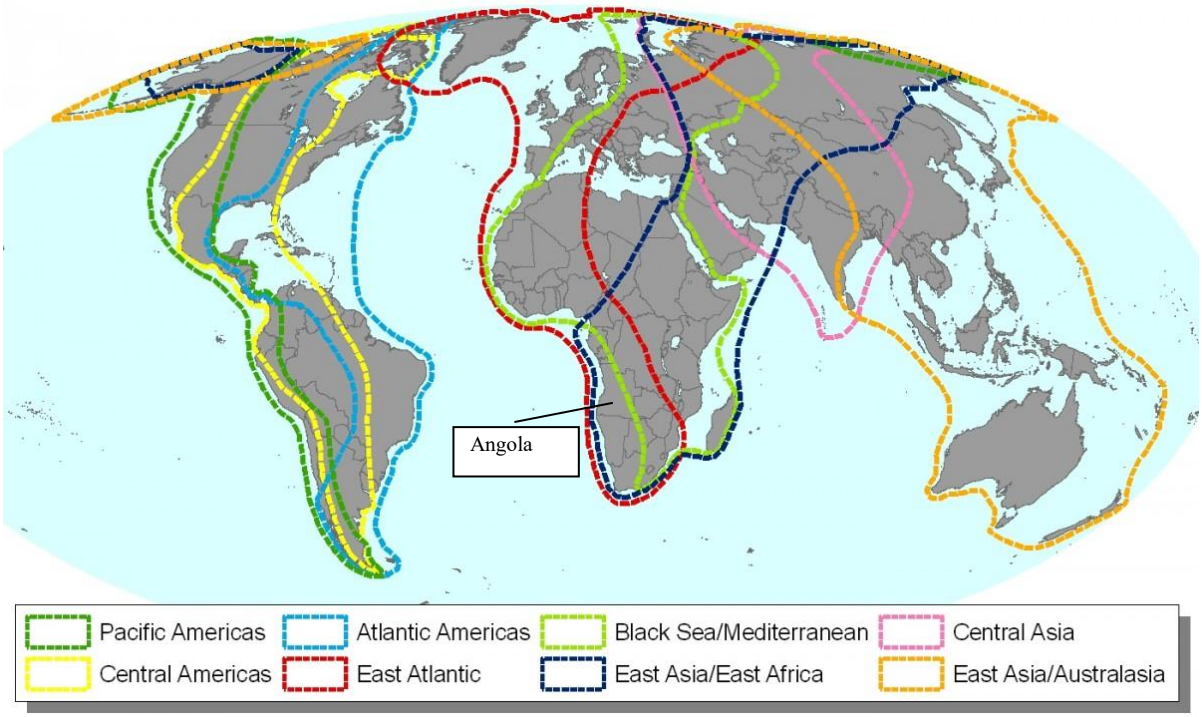


Figure 9.2-30 Major Migratory Bird Routes in the World

Source: UNEP (https://www.unep-aewa.org/node/2) African-Eurasian Migratory Waterbirds (AEWA)[48] website (accessed February 2022)

Since it was difficult to determine what behavior the birds' flight was based on at the time of observation and to determine the migratory route from the direction of flight, we decided to use the method of determining the "migratory route" based on the ecological characteristics of the birds and their relationship to their breeding or wintering grounds. The results of the observations showed that

[48] AEWA: AEWA is an intergovernmental treaty developed under the framework of the Convention on Migratory Species (CMS) and administered by the United Nations Environment Programme (UNEP), of which Angola is not a member.

all but one of the 16 species characterized as migratory birds had South Africa as their breeding or wintering grounds, and their migration route was estimated to be in a north-south direction between Angola and South Africa. The remaining species wintered near the coast and bred in woodlands, suggesting an east-west direction, and no species was observed that might take a migratory route between northern Africa and Eurasia (Table 9.2-4 and Table 9.2-5).

Table 9.2-4 Species and characteristics of birds identified in the project area of the 220 kV TL that require consideration regarding the impact of the project

No	Scientific Name	Common Name (English)	IUCN[1]	Endemism	Seasonality[2]	Type[3]	Observed Ecoregion[4]	1. Angolan Highlands	2. Angolan escarpment	3. Mopane woodlands	4. Semi-arid spiny savannas	5. Namib Desert	Rainy/Dry (Both)
1	*Numida meleagris*	Helmeted Guineafowl	LC	WS	R	NS	1,2,3	Obs.	Obs.	Obs.	x	x	
2	*Scleroptila gutturalis*	Orange River Francolin	LC	WS	R	NS	4	x	x	x	Obs.	x	
3	*Pternistis afer*	Red-necked Spurfowl	LC	WS	R	NS	1,2,3	Obs.	Obs.	Obs.	x	x	
4	*Dendrocygna viduata*	White-faced Whistling Duck	LC	WS	R	AQ	1	Obs.	x	x	x	x	
5	*Dendrocygna bicolor*	Fulvous Whistling Duck	LC	WS	R	AQ	1	Obs.	x	x	x	x	
6	*Plectropterus gambensis*	Spur-winged Goose	LC	WS	R	AQ	1	Obs.	x	x	x	x	
7	*Anas capensis*	Cape Teal	LC	WS	R	AQ	1	Obs.	x	x	x	x	
8	*Anas undulata*	Yellow-billed Duck	LC	WS	R	AQ	1	Obs.	x	x	x	x	
9	*Anas erythrorhyncha*	Red-billed Teal	LC	WS	R	AQ	1	Obs.	x	x	x	x	
10	*Tachymarptis melba*	Alpine Swift	LC	WS	M	NS	1,2	Obs.	Obs.	x	x	x	Both
11	*Neotis ludwigii*	Ludwig's Bustard	EN	WS	R	NS	5	x	x	x	x	Obs.	
12	*Chrysococcyx caprius*	Diederick Cuckoo	LC	WS	M	NS	2	x	Obs.	x	x	x	rainy
13	*Pterocles Namaqua*	Namaqua Sandgrouse	LC	WS	R	NS	5	x	x	x	x	Obs.	
14	*Pterocles bicinctus*	Double-banded Sandgrouse	LC	WS	R	NS	4	x	x	x	Obs.	x	
15	*Columba livia*	Rock Dove	LC	WS	R	NS	1,2	Obs.	Obs.	x	x	x	
16	*Streptopelia semitorquata*	Red-eyed Dove	LC	WS	R	NS	1,2	Obs.	Obs.	x	x	x	
17	*Gallinula chloropus*	Common Moorhen	LC	WS	R	AQ	1	Obs.	x	x	x	x	
18	*Fulica cristata*	Red-knobbed Coot	LC	WS	R	AQ	1	Obs.	x	x	x	x	
19	*Tachybaptus ruficollis*	Little Grebe	LC	WS	R	AQ	1	Obs.	x	x	x	x	
20	*Actophilornis africanus*	African Jacana	LC	WS	R	AQ	1	Obs.	x	x	x	x	
21	*Microcarbo africanus*	Reed Cormorant	LC	WS	R	AQ	1	Obs.	x	x	x	x	
22	*Bubulcus ibis*	Western Cattle Egret	LC	WS	R	AQ	1,2,3	Obs.	Obs.	Obs.	x	x	
23	*Ardea cinerea*	Grey Heron	LC	WS	R	AQ	1	Obs.	x	x	x	x	
24	*Ardea melanocephala*	Black-headed Heron	LC	WS	R	AQ	1,2,5	Obs.	Obs.	x	x	Obs.	
25	*Egretta garzetta*	Little Egret	LC	WS	R	AQ	1	Obs.	x	x	x	x	
26	*Scopus umbretta*	Hamerkop	LC	WS	R	AQ	1,2	Obs.	Obs.	x	x	x	
27	*Pandion haliaetus*	Western Osprey	LC	WS	R	BP	5	x	x	x	x	Obs.	rainy
28	*Elanus caeruleus*	Black-winged Kite	LC	WS	R	BP	1,2	Obs.	Obs.	x	x	x	
29	*Milvus aegyptius*	Yellow-billed Kite	LC	WS	R	BP	1	Obs.	x	x	x	x	
30	*Circaetus pectoralis*	Black-chested Snake Eagle	LC	WS	R	BP	3,4	x	x	Obs.	Obs.	x	
31	*Circus ranivorus*	African Marsh Harrier	LC	WS	R	BP	1	Obs.	x	x	x	x	
32	*Polyboroides typus*	Gymnogene	LC	WS	R	BP	2,3	x	Obs.	Obs.	x	x	
33	*Melierax canorus*	Pale Chanting Goshawk	LC	WS	R	BP	4	x	x	x	Obs.	x	
34	*Accipiter minullus*	Little Sparrowhawk	LC	WS	R	BP	2	x	Obs.	x	x	x	

No	Scientific Name	Common Name (English)	IUCN[1]	Endemism	Seasonality[2]	Type[3]	Observed Ecoregion[4]	1. Angolan Highlands	2. Angolan escarpment	3. Mopane woodlands	4. Semi-arid spiny savannas	5. Namib Desert	Rainy/Dry (Both)
35	*Buteo augur*	Augur Buzzard	LC	WS	R	BP	2,3	x	Obs.	Obs.	x	x	
36	*Colius castanotus*	Red-backed Mousebird	LC	ES	R	NS	1,2,3	Obs.	Obs.	Obs.	x	x	
37	*Merops pusillus*	Little Bee-eater	LC	WS	M	NS	1	Obs.	x	x	x	x	Both
38	*Merops superciliosus*	Olive Bee-eater	LC	WS	M	NS	5	x	x	x	x	Obs.	rainy
39	*Merops apiaster*	European Bee-eater	LC	WS	M	NS	2,3	x	Obs.	Obs.	x	x	rainy
40	*Falco rupicolus*	Rock Kestrel	LC	WS	R	BP	2,4,5	x	Obs.	x	Obs.	Obs.	
41	*Falco biarmicus*	Lanner Falcon	LC	WS	R	BP	2,4,5	x	Obs.	x	Obs.	Obs.	
42	*Falco peregrinus*	Peregrine Falcon	LC	WS	M	BP	3	x	x	Obs.	x	x	Dry
43	*Terpsiphone viridis*	African Paradise Flycatcher	LC	WS	M	NS	1,2,3	Obs.	Obs.	Obs.	x	x	Both
44	*Certhilauda benguelensis*	Benguela Long-billed Lark	LC	NE	R	NS	4,5	x	x	x	Obs.	Obs.	
45	*Psalidoprocne pristoptera*	Black Saw-wing	LC	WS	M	NS	1,2	Obs.	Obs.	x	x	x	Both
46	*Pseudhirundo griseopyga*	Grey-rumped Swallow	LC	WS	M	NS	1	Obs.	x	x	x	x	Dry
47	*Hirundo dimidiata*	Pearl-breasted Swallow	LC	WS	M	NS	2	x	Obs.	x	x	x	rainy
48	*Cecropis cucullata*	Greater Striped Swallow	LC	WS	M	NS	2	x	Obs.	x	x	x	Dry
49	*Cecropis abyssinica*	Lesser Striped Swallow	LC	WS	M	NS	1,2,3,4	Obs.	Obs.	Obs.	Obs.	x	Both
50	*Hippolais icterina*	Icterine Warbler	LC	WS	M	NS	2	x	Obs.	x	x	x	rainy
51	*Cinnyricinclus leucogaster*	Violet-backed Starling	LC	WS	M	NS	1,2,3	Obs.	Obs.	Obs.	x	x	Both
52	*Cossypha ansorgei*	Angola Cave Chat	LC	NE	R	NS	1,2	Obs.	Obs.	x	x	x	
53	*Muscicapa striata*	Spotted Flycatcher	LC	WS	M	NS	3	x	x	Obs.	x	x	rainy
54	*Cinnyris ludovicensis*	Ludwig's Double-collared Sunbird	LC	ES	R	NS	1	Obs.	x	x	x	x	

1. IUCN: LC - Least Concern; DD - Data Defficient; NT - Near Threatened; VU - Vulnerable; EN - Endangered; CR - Critically Endangered
2. Endemism: WS-Wide spread species, ES - Endemic Species; NE - Near Endemic Species; ER – Endemic Subspecies.
3. Seasonal: R resident, M migratory/migratory
4. Type: NS No classification, AQ Waterfowl, BP - Birds of Prey (Raptor)

Ecoregions: 1. Angolan highlands, 2. Angolan escarpment, 3. Mopane woodlands, 4. Semi-arid spiny savannas, 5. Namib Desert.

Source: JICA Survey Team

Table 9.2-5 Breeding and wintering grounds of migratory birds identified in the project area of the 220 kV TL

No	Scientific Name	Common Name (English)	Type[1]	Observed Ecoregion[2]	1. Angolan plateau	2. Angolan Escarpment	3. Mopane woodlands	4. Semi-arid spiny savanna	5. namib sand	Breeding and wintering area[3]	Migrating Direction	Rainy/Dry (Both)
10	*Tachymarptis melba*	Alpine Swift	NS	1,2	Obs.	Obs.	x	x	x	Breeding in South Africa.	Spring: to the south Autumn: to the north	Both
12	*Chrysococcyx caprius*	Diederick Cuckoo	NS	2	x	Obs.	x	x	x	Wintering in South Africa.	Spring: to the north Autumn: to the south	rainy
27	*Pandion haliaetus*	Western Osprey	BP	5	x	x	x	x	Obs.	Wintering in South Africa.	Spring: to the north Autumn: to the south	rainy
37	*Merops pusillus*	Little Bee-eater	NS	1	Obs.	x	Obs.	x	x	Breeding in South Africa.	Spring: to the south Autumn: to the north	Both
38	*Merops superciliosus*	Olive Bee-eater	NS	5	x	x	x	x	Obs.	Breeding in South Africa.	Spring: to the south Autumn: to the north	rainy
39	*Merops apiaster*	European Bee-eater	NS	2,3	x	Obs.	Obs.	x	x	Wintering in South Africa.	Spring: to the north Autumn: to the south	rainy
42	*Falco peregrinus*	Peregrine Falcon	BP	3	x	x	Obs.	x	x	Breeding in South Africa.	Spring: to the south Autumn: to the north	Dry
43	*Terpsiphone viridis*	African Paradise Flycatcher	NS	1,2,3	Obs.	Obs.	Obs.	x	x	Breeding in South Africa.	Spring: to the south Autumn: to the north	Both
45	*Psalidoprocne pristoptera*	Black Saw-wing	NS	1,2	Obs.	Obs.	x	x	x	Wintering in South Africa.	Spring: to the north Autumn: to the south	Both
46	*Pseudhirundo griseopyga*	Grey-rumped Swallow	NS	1	Obs.	x	x	x	x	Wintering in coastal areas	East or West?	Dry
47	*Hirundo dimidiata*	Pearl-breasted Swallow	NS	2	x	Obs.	x	x	x	Breeding in South Africa.	Spring: to the south Autumn: to the north	rainy
48	*Cecropis cucullata*	Greater Striped Swallow	NS	2	x	Obs.	x	x	x	Breeding in South Africa.	Spring: to the south Autumn: to the north	Dry
49	*Cecropis abyssinica*	Lesser Striped Swallow	NS	1,2,3,4	Obs.	Obs.	Obs.	Obs.	x	Breeding in South Africa.	Spring: to the south Autumn: to the north	Both
50	*Hippolais icterina*	Icterine Warbler	NS	2	x	Obs.	x	x	x	Wintering in South Africa.	Spring: to the north Autumn: to the south	rainy
51	*Cinnyricinclus leucogaster*	Violet-backed Starling	NS	1,2,3	Obs.	Obs.	Obs.	x	x	Wintering in South Africa.	Spring: to the north Autumn: to the south	Both
53	*Muscicapa striata*	Spotted Flycatcher	NS	3	x	x	Obs.	x	x	Wintering in South Africa.	Spring: to the north Autumn: to the south	rainy

1. Type: NS No classification, BP - Birds of Prey
2. Observed Ecoregions: 1. Angolan Highlands, 2. Angolan Escarpment, 3. Mopane Woodlands, 4. Semi-arid Spiny Savanna, 5. Namib Desert
3. Symbol in each ecoregion: “Obs.”-Observed, x-not observed

* Migratory birds in the table are categorized as LC (Low Concern) by the IUCN, and endemism is only for species that are widespread.

Source: JICA Survey Team

(e) Mammals in the project area

Mammals were also surveyed during the rainy season (March-April 2021) and dry season (August 2021)., The list of species that could potentially occur in the Huíla and Namibe Provinces amounted to 147 species, and these included the IUCN's high threatened category of large mammals such as the lycaon (EN), large cat family's such as cheetah, lion and leopard (VU), impala (VU), giraffe (VU), hippopotamus (VU), mountain zebra (VU), black rhinoceros (CR), and other large mammals. While the presence of these species cannot be completely ruled out, they have already been developed, and without records of sightings or encounters, the likelihood of their occurrence can be considered low. In light of this Table 9.2-6 lists the 12 species that were identified in the field, narrowing the list from 147 species to 47 species that are likely to occur.

Five carnivore species were identified, and one roadkill of Side-striped Jackal (*Canis adustus) was* found on a road near the 400/220/60 kV Nombungo SS (0 km TL route). This species is relatively rare but widespread and considered highly adaptable. Cape Fox (*Vulpes chama)* was seen at night near the valley of Giraul River (180 km of the TL route). Egyptian Mongoose (*Herpestes ichneumon) was* seen crossing the road east of Caraculo (140 km of the TL route), and this mongoose is considered a very common animal with high adaptive capacity. Aardwolfs (*Proteles cristata) were also observed* west of Caraculo (140 km of the TL route), and sightings are quite common in southwestern Angola. In addition, Common Genet (*Genetta genetta)* was confirmed west of Caraculo. A small carnivore, the genet is widespread, common, and considered highly adaptable.

Blue Duiker (*Philatomba monticola) is the* only confirmed even-toed ungulates. This species is believed to be widespread in central and northern Angola and was previously known to be associated with steep-sided thickets and remnant forest stands along the cliffs bordering the Humpata Plateau. The study area between Tchvinguilo and Bruco (Km 70 to 85 of the TL route) may be the southern limit of the distribution of this species in West Africa.

Hyrax, Kaokoveld Rock Dassie (*Procavia capensis),* has been sighted in the coastal desert and may also be found in inland areas where acacia and mopane grow. Also, Bush Hyrax (*Heterohyrax brucei) is* common in the highlands, but may also be found on steep slopes and coastal plains. African Savanna Hare (*Lepus victiriae)* was spotted near Ivantala swamp, a species that is widespread in the Angolan highlands.

Two primate species were identified, and Chacma Baboon (*Papio ursinus)* was found in four of the five ecoregions. This species is fairly common locally, with a continuous distribution from the desert coast to the mountains, often said to forage in large groups. A herd of over 50 individuals was once observed 20 km east of Moçâmedes. The other species is the endemic Pluto Monkey (*Cercopithecus mitis mitis), a* species adapted to deciduous forests and found mainly in the Angolan Escarpment. It is very common in western Angola, but could be an indicator species for biodiversity, similar to Blue Duiker, since its southernmost distribution area in the world is thought to be on the Angolan Escarpment north of Bruco.

Congo Rope Squirre (*Funisciurus congicus) was* observed once in Ecoregion 3, but may be common and widespread throughout the region. Damara Ground Squirrel (Xerus princeps), recorded in the coastal desert and Semi-arid spiny savannas, appears to be common in these two ecoregions.

Table 9.2-6 List of mammals that may occur in Huíla and Namibe Provinces and their confirmation during field surveys

No.	Scientific Name	Common Name English)	IUCN[1]	Endemism-	Check Location[2]
1	*Canis adustus*	Side-striped Jackal	LC	WSWS	1(TL0km)
2	*Canis mesomelas*	Black-backed Jackal	LC	WS	
3	*Vulpes chama*	Cape Fox	LC	WS	5(TL180km)
4	*Felis silvestris*	wild cat (feline, Felis tigrina)	LC	WS	
5	*Leptailurus serval*	Serval	LC	WS	
6	*Atilax paludinosus*	Marsh Mongoose	LC	WS	
7	*Herpestes ichneumon*	Egyptian Mongoose	LC	WS	4(TL140km)
8	*Herpestes sanguineus*	Common Slender Mongoose	LC	WS	4
9	*Ichneumia albicauda*	White-tailed Mongoose	LC	WS	
10	*Proteles cristata*	Aardwolf	LC	WS	4(TL140km)
11	*Ictonyx striatus*	Striped Polecat	LC	WS	
12	*Civettictis civetta*	African Civet	LC	WS	
13	*Genetta angolensis*	Miombo Genet	LC	WS	
14	*Genetta genetta*	Common Genet	LC	WS	4
15	*Genetta maculata*	Large-spotted Genet	LC	WS	
16	*Oreotragus oreotragus*	Klipspringer	LC	WS	
17	*Philantomba monticola*	Blue Duiker	LC	WS	2 (TLKm 70-85)
18	*Raphicerus* campestris	Steenbok	LC	WS	
19	*Sylvicapra grimmia*	Common Duiker	LC	WS	
20	*Eidolon helvum*	Straw-colored Fruit Bat	LC	WS	
21	*Epomophorus angolensis*	Angolan Epauletted Fruit Bat	NT	NE	
22	*Epomophorus wahlbergi*	Wahlberg's Epauletted Fruit Bat	LC	WS	
23	*Heterohyrax brucei bocagei*	Bush Hyrax	LC	ES	1
24	*Procavia capensis*	Kaokoveld Rock Dassie	LC	WS	5 (Coastal)
25	*Lepus victoriae*	African Savanna Hare	LC	WS	1（TLKm15)
26	*Lepus capensis*	Cape Hare	LC	WS	
27	*Pronolagus randensis*	Jameson's Red Rock Hare	LC	WS	

No.	Scientific Name	Common Name English)	IUCN[1]	Endemism-	Check Location[2]
28	*Cercopithecus mitis mitis*	Pluto Monkey	DD	ER	2
29	*Chlorocebus cynosuros*	Malbrouck Monkey	LC	WS	
30	*Papio ursinus*	Chacma Baboon	LC	WS	3
31	*Fukomys bocagei*	Bocage's Mole Rat	LC	NE	
32	*Fukomys mechowi*	Mechow's Mole Rat	LC	WS	
33	*Graphiurus rupicola*	Stone Dormouse	LC	WS	
34	*Hystrix africaeaustralis*	Cape Porcupine	LC	WS	
35	*Aethomys chrysophilus*	Red Rock Rat	LC	WS	
36	*Desmodillus auricularis*	Cape Short-eared Gerbil	LC	WS	
37	*Gerbilliscus setzeri*	Setzer's Hairy-footed Gerbil	LC	WS	
38	*Gerbilliscus paeba*	Hairy-footed Gerbil	LC	WS	
39	*Mastomys natalensis*	Natal Multimammate Mouse	LC	WS	
40	*Micaelamys namaquensis*	Namaqua Rock Rat	LC	WS	
41	*Cricetomys ansorgei*	Southern Giant Pouched Rat	LC	WS	
42	*Dendromus* melanotis	Gray African Climbing Mouse	LC	WS	
43	*Petromyscus collinus*	Pygmy Rock Mouse	LC	WS	
44	*Steatomys krebsii*	Kreb's Fat Mouse	LC	WS	
45	*Steatomys pratensis*	Fat Mouse	LC	WS	
46	*Funisciurus congicus*	Congo Rope Squirrel	LC	WS	3
47	*Xerus princeps*	Damara Ground Squirrel	LC	NE	4, 5

1. IUCN: LC - Least Concern; DD - Data Deficient; NT - Near Threatened; VU - Vulnerable; EN - Endangered; CR - Critically Endangered (species in shaded cells indicate species identified during field surveys) (Species in shaded cells indicate species identified during field surveys.)
2. Endemism: WS-Wide spread, ES-Endemic species, NE-Near Endemic species, ER-Endmic sub-species
3. Ecoregions: 1. Angola highlands, 2. steep cliffs, 3. mopane woodlands, 4. dry savanna, 5. Namib Desert.

Source: JICA Survey Team

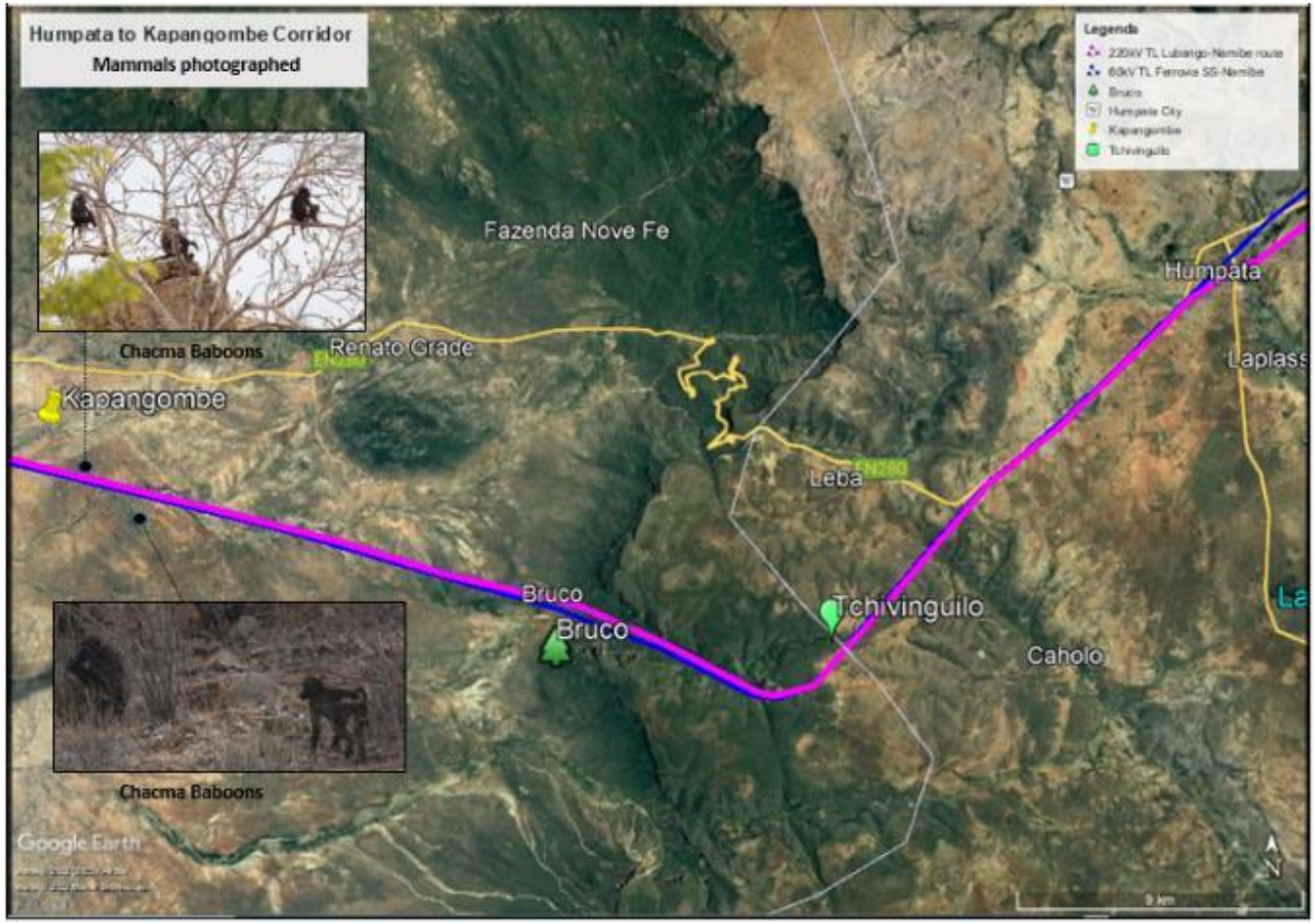


Figure 9.2-31 Chacma baboons identified in the Capangombe area (between TL Km100 and Km130)

Source: JICA Survey Team

(f) Reptiles in the project area

Reptiles were also surveyed during the rainy (March-April 2021) and dry (August 2021) seasons, a total of 152 species were listed for possible occurrence in the Huíla and Namibe provinces, and 32 species were identified. (See also Table 9.2-7).

Most reptile species in Angola have not been assessed by the IUCN and are therefore not listed as endangered and are listed as Not Evaluated (NE). Only three confirmed species have been assessed and are classified as Least Concern (LC). The exceptions are one vulnerable (VU) and four data deficient (DD) species, even among all species included in the Huíla and Namibe lists.

In terms of endemism and rarity, seven species of reptile endemic to Angola were identified. Coastal Flat Gecko (*Afroedura vazpintorum)*, lizard of Geckoidae is only recently described (Branch *et al.*, 2021) and has not yet been evaluated from a conservation perspective, but this species is fairly common and tolerant, adapted to shelter in rocky environments in tight spaces between rocks It is strongly associated with and is thought to be distributed from the desert coast to the highlands of the Humpata Plateau. It was found in Anglan Escarpment area near Tchvinguilo (TL route 70 km). Benguela Tropical Gecko (*Hemidactylus* cf. *benguellensis) is a* very recently taxonomically revised species (Lobón-Rovira *et al.*, 2021), a common gecko, diverse in morphology, with a wide variety of habitats in southern Angola (including sites strongly affected by human activities It is highly adapted to the diverse habitats of southern Angola (including areas strongly affected by human activities). It has been recorded in the past from the desert coast to the highlands.

Feather-Tailed Gecko (*Kolekanos plumicaudus)* of Geckidae is the only representative of a monotypic genus. Until recently, it was known to be found only in Iona National Park, but this study has revised its distribution and extended it to the vicinity of the Giraul River, 180 km of the TL route (Vaz Pinto *et al.*, 2021). Angolan Thick-Toed Gecko (*Pachydactylus angolensis)* of Geckoidae is an endemic and poorly known species, but is relatively common in sandy areas of the dry coastal plain. Namib Day Gecko (*Rhoptropus* sp.) was recorded in Angolan Escarpment. This endemic species appears to be widespread in the steep cliffs and Mopane-Acacia woodlands, and was found in the upper Bruco during this survey. Serodio's Sand Lizard (*Pedioplanis serodioi)* of Canadidae are found below the steep slopes of the Mopane ewoodlandsand are thought to prefer sandy valleys in the general, rocky and forested landscape. Schack's Rock Agama (*Agama schacki)* was also a fairly common diurnal lizard species and are thought to be widespread in the Angolan highlands and rocky areas of Angolan Escarpment.Gaboon Viper (*Bitis gabonica)*, a venomous snake of the family Cuscariidae, is a species that inhabits the moist forests of Central Africa, but is also known to occur along the cliffs of Angola. Although this species was not identified, eyewitness accounts indicate that it inhabits the steep cliffs between Tchvinguilo and Bruco, which may thus correspond to the southwestern limit of its global distribution.

Table 9.2-7 List of reptiles potentially occurring in Huíla and Namibe Provinces and confirmed during field surveys

No.	Scientific Name	Common Name(English)	IUCN[1]	Endemism-	Observed Ecoregion[2]
1	*Pelomedusa subrufa*	Helmeted Terrapin	NE	WS	
2	*Pelusios nanus*	African Dwarf Mud Turtle	NE	WS	
3	*Pelusios rhodesianus*	Variable Mud Turtle	LC	WS	
4	*Kinixys belliana*	Bell's Hinge-Back Tortoise	NE	WS	
5	*Stigmochelys pardalys*	Leopard Tortoise	LC	WS	
6	*Afroedura vazpintorum*	Coastal Flat Gecko	NE	ES	1
7	*Condrodactylus fitzsimonsi*	Button-Scaled Thick-Toed Gecko	NE	WS	
8	*Condrodactylus pulitzerae*	Pulirtzer's Thick-Toed Gecko	NE	WS	
9	*Hemidactylus mabouia*	Tropical House Gecko	NE	WS	
10	*Hemidactylus cf. benguellensis*	Benguela Tropical Gecko	NE	ES	2
11	*Kolekanos plunicaudus*	Feather-Tailed Gecko	NE	ES	
12	*Lygodactylus nyanyeka*	Nyaneka Dwarf Gecko	NE	WS	
13	*Pachydactylus angolensis*	Angolan Thick-Toed Gecko	NE	ES	5
14	*Pachydactylus caraculicus*	Angolan Banded Thick-Toed Gecko	NE	WS	
15	*Pachydactylus oreophilus*	Kaokoland Rock Gecko	NE	WS	
16	*Pachydactylus punctatus*	Speckled Thick-Toed Gecko	NE	WS	
17	*Rhoptropus afer*	Namib Day Gecko	NE	WS	
18	*Rhoptropus barnardi*	Barnard's Namib Day Gecko	NE	WS	
19	*Rhoptropus biporosus*	FitzSimons' Namib Day Gecko	NE	WS	
20	*Rhoptropus boultoni*	Boulton's Namib Day Gecko	NE	WS	
21	*Rhoptropus montanus*	Mountain Namib Day Gecko	NE	WS	
22	*Rhoptropus sp.*	Namib Day Gecko	NE	ES	2
23	*Rhoptropus taeniosticus*	Angolan Namib Day Gecko	NE	ES	
24	*Heliobolus lugubris*	Bushveld Lizard	NE	WS	
25	*Pedioplanis benguelensis*	Bocage's Sand Lizard	NE	WS	
26	*Pedioplanis haackei*	Haacke's Sand Lizard	NE	ES	
27	*Pedioplanis serodioi*	Serodio's Sand Lizard	NE	ES	3
28	*Cordylus machadoi*	Machado's Girdled Lizard	NE	NE	
29	*Cordylus namakuyus*	Kaokoveld Girdled Lizard	NE	ES	
30	*Cordylosaurus subtessellatus*	Dwarf Plated Lizard	LC	WS	
31	*Gerrhosaurus nigrolineatus*	Black-Lined Plated Lizard	NE	WS	
32	*Matobosaurus maltzahni*	Western Giant Plated Lizard	NE	WS	
33	*Panaspis cabindae*	Cabinda Snake-Eyed Skink	DD	WS	
34	*Trachylepis acutilabris*	Wedge-Snouted Skink	NE	WS	

No.	Scientific Name	Common Name(English)	IUCN[1]	Endemism-	Observed Ecoregion[2]
35	*Trachylepis albopunctata*	Angolan Variable Skink	NE	WS	
36	*Trachylepis hoeschi*	Hoesch's Skink	NE	WS	
37	*Trachylepis sulcata*	Western rock Skink	NE	WS	
38	*Varanus niloticus*	Nile Monitor	LC	WS	
39	*Chamaeleo anchietae*	Anchieta´s Chameleon	LC	WS	
40	*Chamaeleo dilepis quilensis*	Quilo Flap-Neck Chameleon	LC	WS	
41	*Agama aculeata*	Western Ground Agama	LC	WS	
42	*Agama anchietae*	Anchieta's Agama	NE	WS	
43	*Agama planiceps*	Namib Rock Agama	NE	WS	
44	*Agama schacki*	Schack's Rock Agama	NE	ES	1.2
45	*Afrotyphlops schlegeii*	Schlegel's Giant Blind Snake	NE	WS	
46	*Bitis arietans*	Puff Adder	NE	WS	
47	*Boaedon angolensis*	Angolan House Snake	NE	ES	
48	*Boaedon mentalis*	Southern Brown House Snake	NE	WS	
49	*Boaedon variegatum*	Variegated House Snake	NE	ES	
50	*Hemirhagerrhis viperina*	Western Bark Snake	NE	WS	
51	*Lycophidion multimaculatum*	Spotted Wolf Snake	NE	WS	
52	*Psammophis leopardinus*	Leopard Sand Snake	NE	WS	
53	*Psammophis mossambicus*	Olive Whip Snake	NE	WS	
54	*Psammophis namibiensis*	Namib Sand Snake	NE	WS	
55	*Psammophis trigrammus*	Western Sand Snake	NE	WS	
56	*Psammophylax tritaeniatus*	Striped Skaapsteker Snake	LC	WS	
57	*Pythonodipsas carinata*	Western Keeled Snake	NE	WS	
58	*Naja anchietae*	Anchieta's Cobra	NE	WS	
59	*Naja nigricincta*	Western Barred Spitting Cobra	NE	WS	
60	*Crotaphopeltis hotamboeia*	Red-Lipped Snake	NE	WS	
61	*Dasypeltis palmarum*	Palm Egg Eater	NE	WS	
62	*Dasypeltis scabra*	Common Egg Eater	LC	WS	
63	*Dispholidus typus punctatus*	Spotted Boomslang	NE	WS	
64	*Philothamnus angolensis*	Angolan Green Snake	NE	WS	

1. (IUCN): LC - Least Concern; DD - Data Defficient; NT - Near Threatened; VU - Vulnerable; EN - Endangered; CR - Critically Endangered
2. Endemism: WS-Wide spread, ES-Endemic species, NE-Near Endemic species, ER-Endemic sub-species
3. Ecoregions: 1. Angola Highlands, 2. Steep Cliffs, 3. Mopane Forest, 4. Arid Savanna, 5. Namib Desert

Source: JICA Survey Team

Figure 9.2-32 Occurrence of reptiles in the Semi-arid Spiny Savannas and Namib Desert ecoregion

Source: JICA Survey Team

(g) Amphibians in the project area

Amphibians were also surveyed during the rainy season (March-April 2021) and the dry season (August 2021) Overall, seven amphibian species were identified, with three species in the Angolan Highlands, two in the Angolan Escarpment, and one in the Mopane Woodlans, by ecoregion. Table 9.2-8 lists the species that may occur in the Huíla and Namibe provinces and those identified in this study.

Regarding endemism and rarity, two frogs, *A*shy Reed Frog (*Hyperolius cinereus*) of Hyperolidae and Anchieta's Tree Frog (*Leptopelis anchietae*) of Snappingidae were identified, as well as a widely distributed species of endemic frog, the Snappingidae frog (*Hyperolius angolensis angolensis*), a widely distributed species, was also identified. All of these species are common and are not considered to be of conservation concern.

No species listed as the threatened species by IUCN are present on the lists compiled for the Huíla and Namibe provinces. All 20 amphibian species confirmed or expected to occur are listed as Least Concern (LC), with only the endemic Grandison's toad (*Poyntonophrynus grandisoni)* listed as Data Deficient (DD) by IUCN.

Table 9.2-8 List of amphibian species identified in Huíla and Namibe provinces

No.	Scientific Name	Generic name (Japanese name)	IUCN[1]	Endemism-[2]	Observed Ecoregion[3]
1	*Xenopus petersii*	Peters Pratanna.	LC	WS	
2	*Mertensophryne mocquardi*	Bufonidae	LC	WS	
3	*Poyntonophrynus dombensis*	Bufonidae	LC	WS	
4	*Poyntonophrynus grandisonae*	Bufonidae	DD	ES	
5	*Poytonophrynus pachnodes*	pygmy toad (Trichopsis pumila)	NE	ES	
6	*Sclerophys funerea*	Bufonidae	LC	WS	
7	*Sclerophys garmani*	Bufonidae	LC	WS	
8	*Sclerophrys gutturalis*	Guttural toad (Bufo gargarizans)	LC	WS	1
9	*Sclerophrys pusilla*	Bufonidae	LC	WS	
10	*Sclerophrys regularis*	Bufonidae	LC	WS	
11	*Phrynomantis bisfasciatus*	Rhinophrynidae	LC	WS	
12	*Phrynomantis annectens*	Rhinophrynidae	LC	WS	4
13	*Breciceps adspersus*	American football frog (Rana americana)	NE	WS	3
14	*Hemisus marmoratus*	shovelnose frog (Rana rugosa)	LC	WS	
15	*Hemisus guineensis*	shovelnose frog (Rana rugosa)	LC	WS	
16	*Hyperolius angolensis angolensis*	Hyperoliidae	LC	ES	1
17	*Hyperolius angolensis insignis*	Hyperoliidae	LC	ES	
18	*Hyperolius benguellensis*	Hyperoliidae	LC	WS	
19	*Hyperolius bocagei*	Hyperoliidae	LC	WS	
20	*Hyperolius chelaensis*	Hyperoliidae	DD	endemic species	
21	*Hyperolius cinereus*	Hyperoliidae	LC	endemic species	1
22	*Hyperolius concolor*	Hyperoliidae	LC	WS	
23	*Hyperolius nasutus*	Hyperoliidae	LC	WS	
24	*Kasina kuvangensis*	Hyperoliidae	LC	WS	
25	*Kasina senegalensis*	Hyperoliidae	LC	WS	
26	*Leptopelis anchietae*	Arthroleptidae	LC	ES	2
27	*Leptopelis bocagii*	Arthroleptidae	LC	WS	
28	*Leptopelis cynnamoneus*	Arthroleptidae	LC	WS	
29	*Hildebrandtia ornata*	Ranidae	LC	WS	
30	*Hildebrandtia ornatissina*	Ranidae	DD	ES	

No.	Scientific Name	Generic name (Japanese name)	IUCN[1]	Endemism-[2]	Observed Ecoregion[3]
31	*Ptychadena anchietae*	family of frogs	LC	WS	
32	*Ptychadena ansorgii*	family of frogs	LC	WS	
33	*Ptychadena bunoderma*	family of frogs	LC	WS	
34	*Ptychadena grandisonae*	family of frogs	LC	WS	
35	*Ptychadena mascareniensis*	family of frogs	LC	WS	
36	*Ptychadena oxyrhynchus*	family of frogs	LC	WS	
37	*Ptychadena porosissima*	family of frogs	LC	WS	
38	*Phrynobatrachus cryptotis*	family of frogs	DD	WS	
39	*Phrynobatrachus mababiensis*	family of frogs	DD	WS	
40	*Phrynobatrachus natalensis*	family of frogs	LC	WS	
41	*Amietia angolensis*	family of frogs	LC	WS	2
42	*Pyxicephalus adspersus*	African bullfrog	LC	WS	
43	*Tomopterna cryptotis*	family of frogs	LC	WS	
44	*Tomopterna damarensis*	family of frogs	DD	WS	
45	*Tomopterna tandyi*	family of frogs	LC	WS	
46	*Tomoptera tuberculosa*	family of frogs	LC	WS	
47	*Amnirana darlingi*	Ranidae	LC	WS	

1. (IUCN): LC - Least Concern; DD - Data Defficient; NT - Near Threatened; VU - Vulnerable; EN - Endangered; CR - Critically Endangered
2. Endemism: WS-Wide spread, ES-Endemic species
3. Ecoregions: 1. Angolan Highlands, 2. Angolan Escarpmet, 3. Mopane woodlands, 4. Semi-arid Spiny Savanna, 5. Namib Desert

Source: JICA Survey Team

(h) Confirmation of the applicability of important natural habitats

In "Annex 1: Environmental and Social Considerations Required for Target Projects" of "JICA Guidelines" (April 2010), regarding ecosystems and biota, "Projects shall not involve significant conversion or significant degradation of critical natural habitats or critical forests. With reference to the World Bank Safeguard Policy and other definitions, "natural habitats" are considered to be (1) terrestrial and (including marine) water areas where natural ecosystems are formed mainly by native plants and animals, and (2) terrestrial and (including marine) water areas that are essentially undisturbed by human intervention. Among these "natural habitats," "critical natural habitats" are those areas that are extremely important for the conservation of biodiversity and/or the maintenance of the main functions of ecosystems, such as: (i) areas listed as "Threatened Species" on the Red List of the International Union for Conservation of Nature (IUCN)as "Critically Endangered CR)", "Endangered: EN", "Vulnerable: VU", and "Near Threatened: NT", (ii) important habitats for endemic species and/or species with limited distribution areas, (iii) important habitats for migratory species, (iv) areas with highly critical and/or unique ecosystems; and (v) areas associated with important evolutionary processes.

The proposed route of the 220 kV TL will pass near the Tundavala IBA/KBA boundary, about 15 km northwest of the Lubango urban area, and therefore, we have confirmed whether or not important natural habitats in the project area are included in the project area (Table 9.2-9**)**.

In Angola, the IBA/KBA in the Tundavala area is not a national park or protected area, and no legal designation or regulations have been established. Although the Tundavala area is considered to be a potential habitat for IUCN endangered species, no other sightings of the species were confirmed, although there were records of sightings in 1973 and 1980 in the area around the project area. No endangered species were identified during this survey in the project area. As for endemic species, two trigger species for IBA status were confirmed in this survey (both are LC: Least Concern in the IUCN category), but they are known to be distributed over a wide area, including the project area. No instances of occurrence of migratory and aggregating species were identified, and no documented or studied cases of association of critical or unique ecological areas with important evolutionary processes were identified.

Based on the above, it is assumed that the project area does not qualify as a critical natural habitat.

Table 9.2-9 Results of checking the applicability of important natural habitats in the project area

Item	Confirmation Result
(i) Listed as "Critically Endangered" on the Red List of the International Union for Conservation of Nature (IUCN) Threatened IA (CR) Threatened IB (EN). Threatened II (VU). Habitats important for species that are classified as "Semi-Threatened (NT)"	According to the literature (Dean, 2000)[49] , the EN-listed Swiestra's Francolin (*Pternistis swierstrai*) of Phasianidae is considered a possible inhabitant of the Tundavala area, and sightings have been reported on the northern slopes of the Tundavala area in Humbia, (Pinto, 1973) and Mt. Leba (Pinto, 1980) (from Dean, 2000), but no subsequent reports were confirmed. It was not confirmed in this survey in the project area. Since the habitat of this species is highland rocky areas, near mountain tops, grasslands, and woodlands, it is considered unlikely to occur in and around the project area. Based on the above, it is assumed that the project site is not an important habitat for the species under these conditions.
(ii) Habitats important for endemic species and/or species with a limited distribution area.	Of the 16 trigger species (all of Least Concern (LC)) in the IBA certification criteria for the Tundavala area, in the project area, the endemic Red-backed Mousebird (*Colius castanotus*) was confirmed by this survey from the Angolan Highlands to the Mopane Woddlands below the Angolan Escarpment, and the semi-endemic Angola Cave Chat (*Xenocopsychus ansorgei*) was confirmed wide range from the Angolan highlands to the escarpment. According to the IUCN Red List and literature, Red-backed Mousebird is distributed from the coastal area on

[49] W. R. J. Dean (2000): The Birds of Angola. 433pp. British Ornithologists' Union, 2000

Item	Confirmation Result
	the Congo border to the Angolan escarpment, western Angolan highlands, and southern part of the project area. Both species are known to be widespread in Angola. Although some endemic species have been confirmed in the project area, these species are not considered to be important habitats for these species because their distribution areas are not limited.
(iii) Habitats that support globally significant assemblages of migratory and/or gregarious species.	No records of migratory organisms / or herd species observed in groups in and around the project area were identified.
(iv) Areas where extremely critical and/or unique ecosystems are recognized.	No records were identified that the project area and its surroundings were found to be extremely critical and/or unique ecosystems.
(v) Areas associated with important evolutionary processes	No historical records or surveys were identified that indicate that the project area and its surroundings are an area associated with significant evolutionary processes.

Source: JICA Survey Team

9.2.2. Social Environment

Since the ceasefire agreement in April 2002 to the present, the demographic data of the whole country have not been accurately collected. Although the national population census was conducted in 2014, there were no reliable socioeconomic sample surveys conducted before or after the census in the areas covered by this study. In the absence of proper registration of residents, population inflows and outflows have not been accurately recorded at the local government level.

In light of this situation, this survey provided a bird's-eye view of the demographics of the project area based mainly on the results of the population census, while directly interviewing information on the local population to the extent that it was available at the local government level, and collecting and analyzing information during the field reconnaissance survey for the formulation of an abbreviated resettlement action plan. Although it was difficult to collect quantitative data on the general population, industry, livelihood, and education of the area by gender and age, the population changes, attributes, and circumstances of the project area at the village level were collected directly from local traditional leaders, known as Sobas.

(1) Population

The population of the area covered by the project is as follows.

- Target Provinces

The project is located in Huíla Province and Namibe Province, which according to the 2014 population census has a relatively low urban population (817,000: 32.7%) and the literacy rate (15 years and older) remains 50.9%. The Portuguese language population is the largest (54% of the total), followed by a relatively large non-Portuguese language population, i.e., Umbundu (32%), Nyaneka-Humbi (24%), and Muhumbi (11%). Regarding religion, Catholics account for more than 1.5 million people, or 60.6% of the total, while Protestants number 630,000 (25%).

In Namibe Province, the urban population is 316,000, or approximately 64% of the total population, and the literacy rate for those aged 15 and older is approximately 64%. The Portuguese language population accounts for 68% of the province's population, followed by Umbundu (20%), Nyaneka-Humbi (12%), and Muhumbi (11%). The Catholic population is 201,000 (about 41%) and the Protestant population is 141,000 (25%).

Table 9.2-10 Population Overview of Huíla and Namibe Provinces (2014)

Item	huíla province	Namibe province
Provincial capital	Lubango	Moçâmedes
Area	79,022 km2	57,091 km2
Population	2,497,422 (1,186,589 males and 1,310,833 females)	495,326 (240,144 males and 255,182 females)
Population under 15 years old	1,242,459 (49.7%)	238,763 (48.2%)
Urban population	817,039 (32.7%)	315,656 (63.7%)
Literacy rate	50.9% (% of population aged 15 and over)	64.3% (% of population aged 15 and over)
Main languages (% of province population)	Portuguese (54%), Umbundu (32%), Nyaneka-Humbi (24%), Muhumbi (11%), etc.	Portuguese (68%), Umbundu (20%), Nyaneka-Humbi (12%), Muhumbi (11%), etc.
Major religions	Catholic (60.6%), Protestant (25.2%), Indigenous religion (0.1%), Muslim (0.1%), Jew (0.2%), etc.	Catholic (40.6%), Protestant (28.5%), Indigenous religion (0.1%), Muslim (0.1%), Jew (0.2%), etc.

Note: The total language population is greater than 100% because of the presence of a population that speaks more than one language.

Source: Instituto Nacional de Estatística, 2014

- Municipalities covered by the project

The project facilities (transmission and distribution lines and substations) are located in Lubango and Humpata Municipalities in the Province of Huíla, Bibala Municipality and Moçâmedes Municipality) in Namibe Province. The population profile of each municipality is shown in the table below, and the project facilities are shown on a map reflecting the administrative divisions of these municipalities (Table 9.2-11).

Table 9.2-11 Population Overview of Project Municipalities in Huíla and Namibe Provinces (2014)

Province	Huíla		Namibe	
Municipality	Lubango	Humpata	Bibala	Moçâmedes
Area	3,147km2	1,244km2	7,700m2	8,930km2
Population	894,564 (437,859 males and 456,705 females)	103,759 (49,829 males and 53,930 females)	76,612 (36,146 males and 40,466 females)	347,502 (170,634 males and 176,868 females)
Population under 15 years old	400,442 (44.8%)	42,988 (41.4%)	33,083 (43.2%)	136,046 (39.1%)
Urban population	600,751 (77%)	4,810 (5%)	10,791 (16.7%)	256,790 (87.8%)
Literacy rate	71.2% (% of population aged 15 and over)	38.1% (% of population aged 15 and over)	34.2% (% of population aged 15 and over)	79.4% (% of population aged 15 and over)
Main languages (% of province population)	Portugal (60.6%), Umbundu (18.4%), Nyaneka (16.9%), etc.	Portugal (37.2%), Nyaneka (55.0%), etc.	Portugal (29.1%), Nyaneka (27.4%), Muhumbi (19.6%), etc.	Portugal (66.8%), Umbundu (20.6%), Nyaneka (4.9%), etc.
Major religions	Catholic (46.0%), Protestant (27.9%), Indigenous religion (0.1%), Muslim (0.2%), Jew (0.3%), etc.	Catholic (49.9%), Protestant (12.4%), Jew (0.2%), etc.	Catholic (21.2%), Protestant (9.7%), Jew (0.1%), etc.	Catholic (40.5%), Protestant (30.9%), Indigenous religion (0.1%), Muslim (0.1%), Jew (0.2%), etc.

Note: The total language population is greater than 100% because of the presence of a population that speaks more than one language.

Source: Instituto Nacional de Estatística, 2014

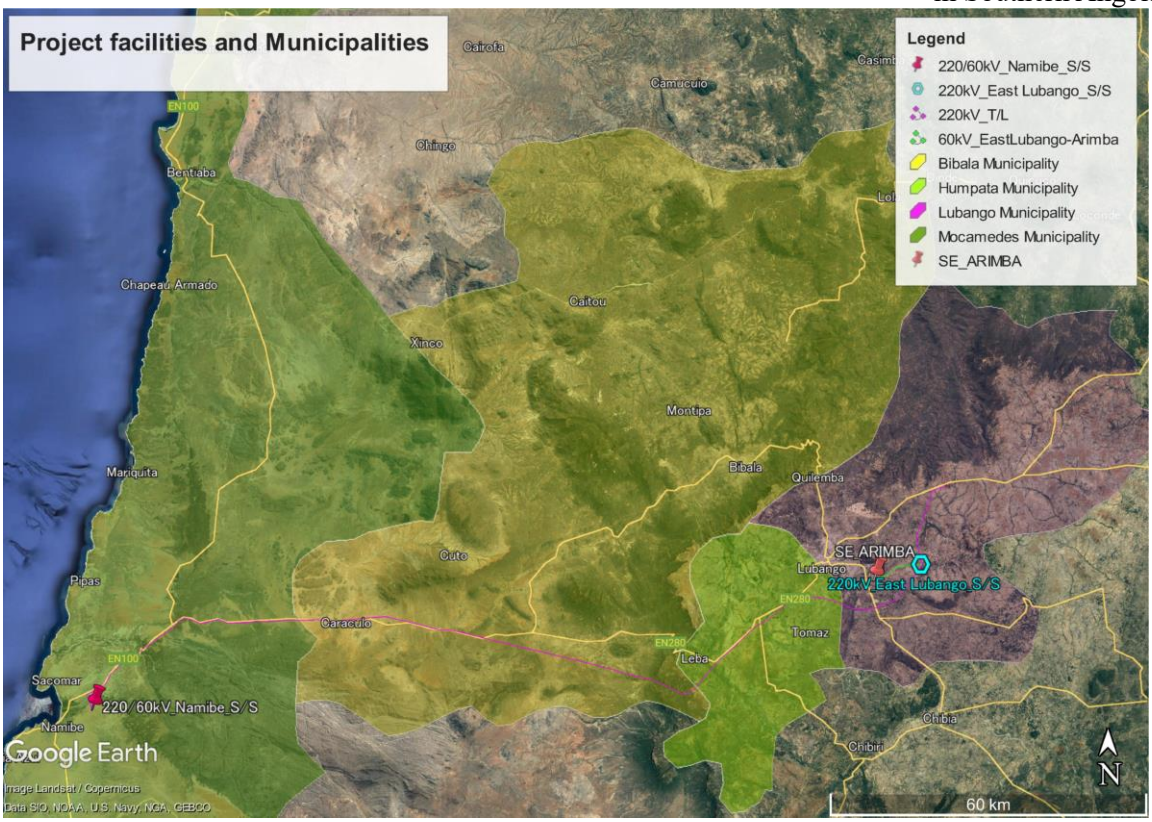


Figure 9.2-33 Overview of Project Facilities and Project Area (Municipality Level)

Note: Displayed information collected on https://data.humdata.org/dataset/angola-administrative-levels-0-3 on Google Earth (accessed January 2022). The project components on the map were created by the JICA Survey Team.

Source: JICA Survey Team

- Project area

The project will be implemented in eight communes (Hoque, Arimba, Lubango, Palanca, Humpata, Kapangombe, Bibala and Moçâmedes) in each municipality. According to the 2014 census, the population of these eight communes is 1,060,169 (509,802 males and 550,367 females). communes had a population of 1,060,169 (509,802 males and 550,367 females).

Table 9.2-12 Population by Gender in Project Communes (2014)

No.	Commune	Municipality	Male	Female	Total
1	Hoque	Lubango	30,837	33,638	64,475
2	Arimba		22,206	23,878	46,084
3	Lubango		278,659	302,521	581,180
4	Palanca	Humpata	9812	10,601	20,413
5	Humpata		17,091	18,596	35,687
6	Kapangombe	Bibala	6827	7489	14,316
7	Bibala		11,974	13,442	25,416
8	Moçâmedes	Moçâmedes	132,396	140,202	272,598
Total			509,802	550,367	1,060,169

Source: Instituto Nacional de Estatística, 2014

According to the data directly collected during the social survey (wet and dry seasons) conducted in the Preparatory Survey, there are 15 settlements (settlements/neighborhoods) where the project components are located (or pass through) under these communes for which information on population could be collected. The estimated population of the 15 settlements is 53,340, 25,429 males and 27,911 females. The population of each settlement based on field survey results is shown in the table below. According to the information provided by Soba and others in each village, the average age of the population is roughly around 20 years old, with a median age of 15 years. The age structure of the population in the project area is very young, with the 0-14 year old population accounting for more than 50% of the total population, and the 15-24 year old population together accounting for 70% of the total population. On the other hand, the population over 65 years old accounts for 3% of the total population.

Table 9.2-13 Project area (settlement level) (2021)

Settlements/neighborhoods	Municipality	Male	Female	Total
Nombungo	Lubango	843	908	1,751
Mateta		1,070	1,246	2,316
Mavanda		1,138	1,178	2,316
Poiares Muhaha		2,389	2,741	5,130
Poiares Kapandi				
Tchiwaya		4,557	4,975	9,532
Kapalanga		476	558	1,034
Calumue	Humpata	113	118	231
Heva de Cima		2,702	2,930	5,632
Kamba				
Palanca		4,800	5,200	10,000
Jamba I		871	940	1,811
Camponês		4,800	5,280	10,080
Onculuvala		470	517	987
Aída	Mocamedes	1,200	1,320	2,520
Total		25,429	27,911	53,340

Note: Since the 2014 Census results are only available up to commune level, this study collected demographic statistics at the settlement level, which is subordinate to commune. However, the collection status varied from one another, with a total of 15 settlements for which information could be collected.

Source JICA Survey Team

(2) Ethnicity, language and religion

1) Angola Outlook

Angola is home to a diverse ethnic population, with Bantu ethnic groups such as the Ovimbundu, Kimbundu, and Congolese (Bakongo or Kongo) comprising the majority of the population (37%, 25%, and 13% respectively[50]). There is a close connection between ethnicity and language, with the Ovimbundu, Kimbundu, and Congolese speaking predominantly Umbundu, Kimbundu, and Kikongo (Kikongo or Kongo), respectively, in addition to the official language, Portuguese. These languages are national languages as defined by the Department of National Language Education, Ministry of Education. Angolans people are classified in the census according to which language they speak, not their ethnicities.

2) Target Provinces

The various ethnic groups in Huíla and Namibe are divided into four major ethnolinguistic communities: the Nyanyeka-Humbi, Nganguela, Herero, and Mbundu. See ESIA 5.3.1.16 Ethnolinguistic Groups in Huíla and Namibe for details on each community. Population and gender data for each of these ethnolinguistic communities could not be identified.

3) Project area (village level)

The language spoken on a daily basis in the local area reflects the attributes of the local population. In the project area, the majority of settlements in Lubango and Humpata municipalities are inhabited by Nyaneka-Humbi people, with a small number of Ovimbundo people due to their cultural similarity. Due to the climatic conditions of the project area, which are suitable for agriculture and pastoralism, Muílas, Mucubal, Gangela, Cuanyama, Tchokwé, and Bakongo were also identified in the settlements and neighboring areas, but they have adapted to the culture and lifestyle of the Nyaneka-Humbi as they have settled down in search of a better life. The irmain language is Nyaneka-Humbi.

On the other hand, in the Aída settlement in Moçâmedes Municipality, the Ovimbundo are predominant, with mixed populations of Nyaneka-Humbi, Mucubal, Ambundu, Gangela, Fyote, Tchokwé, and Cuanyama. With the exception of the Mucubal, these peoples follow similar customs, emphasizing basically subsistence domestic agriculture, raising livestock (cattle, pigs, goats, chickens, etc.), forest products (firewood), alcoholic beverage production, fishing and informal trade. The Mucubal people are engaged in livestock (cattle rearing) and related activities (such as sour milk production).

There are several Christian denominations in and around the project area[51], and in addition to proselytizing to the local population, they also play a role in controlling youth insecurity, donating clothing and various food items including necessities, and raising awareness among the population

[50] See CIA World Factbook (https://www.cia.gov/library/publications/the-world-factbook/geos/ao.html, accessed January 2022). Gender data could not be verified.

[51] Catholic Church, Bon Deus Church, Seventh Day Adventist Church, Pentecostal Church, Evangelical Congregational Church in Angola (IECA), etc.

through education and social mobilization. They also set up literacy centers for adults, offer marriage counseling, and provide space for primary classes.

Population and gender data for each of these ethnolinguistic communities could not be ascertained.

(3) House type, tenure, and land use

The table below shows the housing condition and occupation type identified in the villages in the project area. The "permanent residence" was constructed of permanent materials such as cement blocks, bricks, and tiles, and painted. In villages located in rapidly urbanizing areas (Palanca, Calumue, etc.), two-story dwellings were also observed. The "temporary residence" is of simple construction, with tin sheets used to shield them from wind and rain, and natural materials used to fill in the gaps, with a separate toilet.

Table 9.2-14 House materials and living style (2021)

House type and living style	Lubango Municipality						Humpata Municipality						M M
	Nombungo	Mateta.	Mavanda.	Poiares Muhaha & Kapandi	Tchiwaya	Kapalanga	Calumue	Heva and Kamba	Palanca	Jamba I	Camponês	Onculuvala	Aída.
Permanent residence					■		■	■	■		■		■
Temporary building	■	■	■	■	■	■						■	
Collective housing (without notification)	■	■	■	■	■	■						■	
With notification							■		■		■		

Note: Yellow highlights indicate those identified during fieldwork and interviews. M.M." stands for Moçâmedes Municipality.
Source: JICA Survey Team

In the settlements where "collective housing" was observed, a “quimbo” or “ombala” living arrangement is used. The structure at the center is occupied by the family head (often the settlement head), and his wives, children, and relatives live in the buildings surrounding the head’s house.

Note that these housing complexes have not been officially notified, and no land ownership or construction permits have been obtained. Therefore, no property or inhabitant taxes are paid. Most of the inhabitants of the settlements in which collective housing is found (Nombungo, Mateta, Mavanda, Poiares, Tchiwaya, Kapalanga, and Onculuvala) have inherited their land from generation to generation according to customary law. When new land is acquired, the land is requested and transferred to Soba. However, this is not a formal grant of ownership by law, which requires a separate application at the town hall, and most locals do not follow this practice.

On the other hand, in settlements near urban areas, officially notified land and buildings were also identified and construction permits were obtained ("notified"). When acquiring land under national law, it is only necessary to submit an application to the municipality/commune office, but it is customary to obtain the consent of Sobas in order to reach a consensus in local community.

(4) Livelihood

In each settlement in the project area, products are sold at markets (such as the Mutondo and Mangueiras markets in northern Lubango) in addition to individual traders along National Road No. 280. Local livelihoods depend on agricultural income and sales in urban areas, but household income is unstable because residents themselves have low purchasing power and because everyone produces the same products. In addition, they are faced with a shortage of food supplies, as prices have risen markedly in urban markets.

1) Agricultural products

Basically, self-help farming is practiced. Cultivated land is located adjacent to dwellings, and their areas vary from small to large. Agriculture is mainly rain-fed during rainy season, and during dry season, vegetable gardens called "naca" are created on the riverbanks.

Major agricultural products include corn, cassava, sweet potatoes, reindeer potatoes, millet, sorghum, cabbage, lettuce, pumpkin, peas, carrots, onions, sugar cane, eggplant, garlic, spinach, peppers, and various beans. Along with these crops, fruits (oranges, lemons, mandarins, guavas, melons, strawberries, bananas, pears, mangoes, etc.) are also produced. In "naca," production is possible throughout a year and income is secured. Of these, corn, cassava, and beans are the staple foods of the population.

2) Livestock products

In the villages surveyed, some households were able to raise cattle, goats, pigs, sheep, and chickens. Beef is one of the staple foods of local people. Pastoralism is one of the main traditions of local people, and animals symbolize their wealth and social status. Cattle, in particular, is considered valuable property by the Nyaneka-Humbi and Mucubal people.

The transmission route of the project has the potential to cross grazing lands between Kapangombe and Caraculo in Namibe Province. Grazing in this area is dependent on the availability and quality of pasture and the availability of water sources. Even in dry season, movement to other grazing areas may be short time and short distance, depending on the availability of water and pasture. However, in very dry years, they will continue to move in search of pasture and water.

3) Forest Products

Mushrooms, wild fruits, charcoal, and wood are seen being collected and sold along the roadside.

4) Hunting

Poaching of African foot vole, monkey, gorungo (imbabara), paca, and porcupine have been confirmed in more than half of the 15 settlements[52]. However, activity is limited to dry season (June-September), when agricultural production is greatly reduced due to very few hunters. Game meat is sold on the main roads in the region.

5) Fishing industry

Some inhabitants of several settlements (Mavanda, Aída) fish in the Gulf of Moçâmedes. The main species of fish caught in the area are tilapia, horse mackerel, cape mackerel, grouper, sardine, shrimp, squid, and catfish. Fish are sold on the main roads in the region.

6) Other

Sales transactions of aggregates (e.g., stones, rocks, and sand for construction), cosmetic oils, food products, and alcoholic and non-alcoholic beverages are also seen.

(5) Health and medical care

1) Health and medical facilities

The table below shows health and medical facilities in each settlement. Almost all surveyed settlements in Humpata and Moçâmedes municipalities are located in semi-urban areas, and both health centers and health posts are well maintained. On the other hand, the settlements in Lubango Municipality are located in rural areas and have only one health post, and some of them do not have any health care facilities.

Table 9.2-15 Health Care Facilities (2021)

Type of medical facility	Lubango Municipality						Humpata Municipality						M M
	Nombungo	Mateta.	Mavanda.	Poiares Muhaha & Kapandi	Tchiwaya	Kapalanga	Calumue	Heva and Kamba	Palanca	Jamba I	Camponês	Onculuvala	Aída.
Hospital													
Health center													
Health post													

Note 1: Yellow highlights indicate those identified during fieldwork and interviews. M.M." stands for Moçâmedes Municipality.

Note 2: Health centers provide pediatric, general outpatient, laboratory, and obstetric care, as well as immunizations and medicines. Health posts provide only first aid.

Source: JICA Survey Team

However, health centers and health posts lack adequate medical facilities and equipment, both doctors and paramedical staff are often absent, and the quality of medical services is not high. In case of serious illness, patients are transported to hospitals in Lubango. However, in most cases, local people are unable to pay for transportation, and often take local traditional treatments and herbs because medicines are costly.

2) Disease

The main diseases found in the project area include malaria, acute diarrheal diseases, respiratory diseases, skin infections, measles, typhoid fever, malnutrition, and rheumatic diseases. Of these,

[52] Nombungo, Mateta, Mavanda, Poiares Muhaha, Poaires Kapandi, Tchiwaya, Kapalanga, and Onculuvala.

malaria is the most commonly identified. On the other hand, HIV/AIDS is not listed. Quantitative data such as gender morbidity could not be identified.

(6) Education

1) Educational Facilities

Angola has 12 years of compulsory education[53]. Of the 15 communities surveyed, 5 have all primary education (grades 1-6) and the first cycle (grades 7-9) and second cycle (10-12 years) of secondary education. While other communities have only primary school or no facilities, and they receive education in neighboring communities or attend church classes.

Table 9.2-16 Educational Facilities (2021)

Type of educational facility	Lubango Municipality						Humpata Municipality						M M
	Nombungo	Mateta.	Mavanda.	Poiares Muhaha & Kapandi	Tchiwaya	Kapalanga	Calumue	Heva and Kamba	Palanca	Jamba I	Camponês	Onculuvala	Aida.
Primary education facilities	■			■		■	■	■	■		■	■	■
First secondary education facilities	■						■		■		■		■
Secondary education facilities	■						■		■		■		■

Note 1: Yellow highlights indicate those identified during fieldwork and interviews. M.M." stands for Moçâmedes Municipality.

Note 2: In some areas, there are also integrated educational facilities that combine the first cycle of primary and secondary education. The second cycle of secondary education includes schools that integrate specialized technical education and schools for training teachers and nursing technicians.

Source: JICA Survey Team

2) School attendance

In settlements where educational facilities are not available locally, it is observed that some children do not go on to higher education after completing primary education and are unable to read and write satisfactorily, while others take the time to go on to further education in distant areas or move to semi-urban areas.

Girls have lower opportunities to attend school than boys as a result of the priority given to their traditional roles in the family and local community (domestic labor and farm work). In addition, family poverty, parental relocation, physically limited number of school facilities, absence of teachers, school facilities with poor sanitation, and lack of water and water supply facilities in schools are other reasons why girls' education has not improved.[54]

On the other hand, education providers are also faced with issues such as few training opportunities for teachers, lack of housing facilities for teachers, and delays in the payment of teachers' salaries and other bonuses.

(7) Water use

Three of the 15 settlements (Palanca, Campones, and Jamba I) have access to spring water and public water distribution for drinking, but the others, especially the six settlements located in rural areas, depend heavily on river water for domestic use and rainwater for agriculture, and they have no access to water at all during dry season (June to August). In these settlements, disinfection by boiling is not routinely practiced, and purification systems are not widely available.

(8) Electricity

Three settlements (Calumue, Palanca, and Camponês) are supplied with electricity through the distribution lines extended. However, consumers have complained about the unfair and irregular supply. In the rest of the settlements, there is no electricity supply and there are currently no plans to electrify them, so small number of residents use private generators, while majority of them use diesel lamps, battery lanterns, candles, and burning wood for nighttime lighting.

[53] The education basic law was established in 2016, making it compulsory from elementary through high school.

[54] According to the United Nations Population Fund (UNFPA), the country's enrollment rates for primary education (2010-2020), first round of secondary education (2010-2019), and second round of secondary education (2009-2019) are 82%, 76%, and 18%, respectively, while those of girls remained 78%, 76%, and 71% of those of boys. https://www.unfpa.org/data/world-population/AO (accessed January 2022). Quantitative data on gender at the project site level could not be identified.

(9) Sanitation

The 15 settlements lack basic sanitation infrastructure such as sewage and waste disposal facilities. Most of the waste is organic, but a small amount of other wastes such as cans, oil bottles, plastics, and packaging materials are also generated. Household waste is buried and sometimes incinerated, resulting soil and air polluted. In rural areas, most houses do not have toilet facilities, and people use open space, burying their wastes or leaving them there. A few houses have toilet facilities (e.g., septic tanks or wells with water for cleaning), but they do not clean or clear excreta, and when the tanks becomes full, they close them and build new ones. No data on gender usage could be verified.

(10) Cultural assets

1) Target Provinces

According to data obtained from the Instituto Nacional do Património Cultural (INPC), there are 183 designated cultural properties in Huíla and 75 in Namibe, but the records for each are outdated and are currently being updated. These designated cultural properties are not located in or near the project area.

Table 9.2-17 National Designated Cultural Properties in Huíla and Namibe Provinces

Unit: Number

Types of Cultural Properties		Huíla Province	Namibe Province
Structure	Civil engineering structure	59	37
	Religious building	17	2
	Military construct	21	4
	Funeral buildings	11	6
Monument	Prehistoric site	28	9
	Proto-historic site	6	4
	Historic site	11	6
	Historic district	8	unknown
	Landscape or nature reserve	22	7
Total		183	75

Note: Cultural property types are based on INPC data. Registered cultural and natural resources in Huíla and Namibe Provinces are as of 2012 and 1994, respectively.

Source: JICA Survey Team

2) Areas covered by the project

No historical or cultural heritage sites recognized by the Angolan Ministry of Environment (MINAMB) or UNESCO have been identified. During the site reconnaissance survey (wet and dry seasons), the presence of an early Boer cemetery was confirmed in the Jamba farm in Humpata Municipality. In the study of Angolan colonial history, the Boers are considered to be of high historical and cultural value because of their significant influence on the development of agriculture in the Huíla Province.

(11) Others (UNESCO World Cultural Heritage)

There is one cultural heritage site registered with UNESCO in the city of Mbanza-Congo, Zaire Province in northwest Angola, which is about 1,000 km away from the project area. There are no UNESCO World Cultural Heritage sites in the project area.

Table 9.2-18 UNESCO World Heritage Site in Angola

No.	Property Name	Year of inscription	Inscription type	Summary
1	Mbanza Kongo, Vestiges of the Capital of the former Kingdom of Kongo	2017	cultural heritage	The town of Mbanza Kongo was the political and spiritual capital of the Kingdom of Kongo, one of the largest constituted states in Southern Africa from the 14th to the 19th centuries. It illustrates the profound changes caused by the introduction of Christianity and the arrival of the Portuguese into Central Africa in the 15th century. (Selection criteria: (iii) (iv))

Source: https://whc.unesco.org/en/list/1511/ (accessed March 2020)

9.3. Environmental and Social Considerations Legal System in Angola

9.3.1. Related Organizations

Indicates the implementing and cooperating agencies and competent authorities for the project and the roles of the authorities and state governments involved in the licensing and approval process.

(1) Ministry of Energy and Water (MINEA)

MINEA was reorganized by Decree No. 223/20 (August 28, 2020). It is the administrative department responsible for formulating, implementing, executing, and administering administrative policies in the areas of energy and water. These tasks are carried out by central executive bodies such as the State Directorate General of Electric Energy, the Directorate General of Rural and Rural Electrification, and the Directorate General of Renewable Energy and Water. The State Directorate General of Electric Energy is the direct executive agency of MINEA, and its purpose is to accompany the planning, research, conception, and implementation of policies related to the production, transportation, distribution, and use of electric energy. The state enterprises responsible for the electric power sector are as follows The Transmission and Transformation Corporation (RNT) and the Electricity Distribution Corporation (ENDE) will be the operators of the project, and under the Environmental Impact Assessment (EIA) system under Angolan national law, the EIA procedure will be carried out for each of them.

Public Electricity Production Company (PRODEL)
National Electricity Transportation Company (RNT)
National Electricity Distribution Company (ENDE)

(2) Ministry of Environment (MINAMB)

The Ministry of Environment (MINAMB) was formed in 2020 by the merger of the Ministry of Culture, Tourism and Environment into the Ministry of Culture, Tourism and Environment (MCTA) under Presidential Decree No. 162/20 (June 8, 2020), and in December 2022, by Presidential Decree No. 278/22 (December 7, 2022), it became the Ministry of Environment again The MINAMB's mission is to formulate, implement, and manage administrative policies related to the environment, climate change, and sustainable development, and is responsible for the promotion, conservation, and pollution control of environmental quality, the preservation and valorization of natural heritage, and the conservation and rational use of natural resources.

The Presidential Decree also reorganized the Executive Branch, abolishing the Department of Environment and Climate Change (DNAAC) and the Department of Prevention and Environmental Impact Assessment (DNPAIA), which was in charge of the EIA process, and creating the Department of Environment, Department of Environmental Education, Department of Climate Action and Sustainable Development, and Department of Environmental Technology. temporarily handled by the Environmental Technology Bureau, and the online system (SIA) for the EIA process and consultant registration continues to be used.

There has been no reorganization of the external institutions supervised by MINAMB, and the National Institute for Biodiversity Conservation (INBC: renamed from INBAC by Presidential Decree No. 96/21 April 21, 2021) is responsible for ensuring the preparation and implementation of policies on the sustainable management of biodiversity and the national environmental conservation system, and It will be responsible for reviewing and providing guidance from the perspective of the protected area in the EIA procedures of the project, both in the submissions from the operators and in the review process by MINAMB.

The National Institute for Environmental Management (INGA), the agency responsible for environmental management and monitoring, has also not been reorganized.

(3) Ministry of Transportation (MINTRANS)

The Ministry of Transportation (MINTRANS) was reorganized by Presidential Decree No. 233/20 (September 14, 2020) MINTRANS has the mission to propose the formulation, implementation, execution and management of government policies in the transportation sector.

These missions are carried out by supervisory bodies with their own structures, such as the Civil Aviation Institute (INAVIC), the Angolan Maritime and Port Institute, the National Road Transport Institute, the Angolan Railway Institute, the National Shippers' Council, and the Hydrographic and Maritime Signals Institute. Of these, INAVIC is a public institution with administrative, financial and property rights, with juridical personality and management rights, in accordance with Presidential

Decree No. 2/15 (January 2, 2015) INAVIC coordinates, guides, controls, inspects, permits all activities related to the civil aviation sector deployed within Angola or in the airspace under its jurisdiction INAVIC is an agency to assist the aviation authorities in the coordination, guidance, management, inspection, licensing, and regulation of all activities related to the civil aviation sector deployed in the airspace within Angola or under its jurisdiction, and the project may consult on the restricted areas of Lubango and Namibe airports and the coordination of power lines.

(4) Huíla and Namibe Provincial Government

Huíla and Namibe provinces are responsible for promoting the direction of socioeconomic development in accordance with the principles and strategic options established by the central government, and for ensuring that public services are provided in their respective regions. In the environmental area, in accordance with the Law on the Organization and Functions of State Administrative Agencies, the State is empowered to promote measures aimed at the defense and conservation of the environment, promote and encourage local business development initiatives, promote sanitation and the environment, rural and urban capital construction, and promote environmental education campaigns. In Huíla and Namibe provinces, activities related to environmental issues fall under the jurisdiction of the Department of Environment, Waste Management and Community Services.

9.3.2. Relevant Laws and Regulations

(1) Relevant domestic laws and regulations

The need to protect the environment and the requirements to achieve sustainable development are set forth in Article 39 of the Constitution of the Republic of Angola (enacted in 1992 and amended in 2010), which states that "People have the right to live in an unpolluted and healthy environment and the obligation to defend and preserve it, and the State, within the framework of sustainable development, must take the necessary measures to protect the rights of future generations and The State shall take the necessary measures to protect the environment and the species of flora and fauna throughout the land, maintaining ecological balance, ensuring the correct location of economic activities and the rational use and utilization of all natural resources, while respecting the preservation of different species." and was the basis for the passage of the Environmental Framework Law (Law No. 5/98 of June 19th).

Furthermore, Article 90 (e) of the Constitution provides that "the State shall promote social development by ensuring that all citizens enjoy the benefits arising from the collective endeavor of development, especially for the quantitative and qualitative improvement of living standards. Article 15 of the Constitution also allows communities to use and access land without prejudice to the possibility of acquiring land for public use on the basis of fair compensation as provided by law.

The Environmental Framework Law was enacted in light of the need to prevent and mitigate the potential adverse social and environmental impacts of projects involving the construction of infrastructure, the development of natural resources, and the associated discharge of wastewater.

In cases where there is no national law on a particular aspect or where the national law is incomplete, especially in the area of technical specifications, the project proponent must implement international instruments containing good practices in the relevant field or appropriate standards in force in other countries.

Table 9.3-1 shows a summary of Angolan environmental and social legislation.

Table 9.3-1 Summary of Environmental and Social Laws and Regulations in Angola

No	Title of Laws and Regulations	law number	Purpose, etc.
Environmental			
1	Environmental Framework Law	Law No. 5/98 of June 19th	It establishes general obligations regarding the protection of the environment and the sustainable use of natural resources, as well as their contribution to the quality of life.
2	Environmental Licensing Rates	Executive Decree No. 96/09 of October 6th	It stipulates the cost of environmental assessment fees, including issuance and renewal of facility establishment and operation permits, consultant registration fees, and stakeholder consultation meetings.
3	National Policy on Forests, Wild Fauna and Conservation Areas	Resolution No. 01/10 of 14th January	Promote the contribution of each business sector to the sustainable development of the country through the conservation, protection, development and wise use of forests, wildlife and conservation areas for the benefit of present and future generations.
4	Regulation on Responsibility for Environmental Damage	Presidential Decree No. 194/11 of July 7th	Based on the principle of "polluter pays," it defines responsibilities regarding environmental risks and degradation in order to prevent and remedy environmental damage.
5	Regulation on Public Consultation	Executive Decree No. 87/12 of February 24th	Public consultation is positioned as a procedure within the framework of public participation to collect opinions and suggestions from stakeholders in the environmental impact assessment of the project.
6	Term of Reference for the Elaboration of Environmental Impact Studies	Executive Decree No. 92/12 of March 1st	Guidelines for the preparation of studies subject to environmental impact assessment, including the layout of the minimum content to be included in the environmental and social impact assessment report
7	Regulation of Waste Management	Presidential Decree No. 190/12 of August 24th	All public and private entities that generate waste or engage in activities related to waste management must prepare a Waste Management Plan (WMP) before commencing their activities.
8	Executive Decree Regarding Construction and Demolition Waste Management	Executive Decree No. 17/13 of January 22nd	Establish legal regulations related to the prevention, reuse, collection, transportation, storage, sorting, treatment, recovery, and management of disposal of waste resulting from the construction or demolition of buildings.
9	Forest and Wildlife Law	Law No. 6/17 of January 24th	Indicates norms aimed at guaranteeing the conservation and sustainable use of the country's forests and fauna.
10	Forest Regulation	Presidential Decree No. 171/18 of July 23rd	It establishes regulations for the sustainable use of forestry resources and their ecosystems, and establishes norms and procedures for their conservation and sustainable use.
11	National Biodiversity Strategy and Action Plan	Presidential Decree No. 26/20 of February 6th	It aims to ensure the conservation and sustainable use of the components of biodiversity in Angola, taking into account the fair and equitable distribution of the benefits derived from the use of the resources of conservation, preservation, protection and restoration.
12	Environmental Impact Assessment Regulation and Environmental Licensing Procedure	Presidential Decree No. 117/20 of April 22nd	Approval of the General Regulations on Environmental Impact Assessment and Environmental Permitting Procedures. Establishes rules and procedures regulating impact assessment, environmental permitting, and inspection, applicable to all public or private activities that, because of their nature, location, or scale, have the potential to cause significant environmental and social impacts and directly or indirectly affect environmental factors. With its passage, Decree No. 51/04 of July 23rd and Decree No. 59/07 of July 13th were repealed.
Sanitation and Safety			
13	General Regulation of Occupational Health and Safety Services	Executive Decree No. 6/96 of February 2nd	It establishes principles aimed at promoting workplace safety, health and hygiene in businesses, commercial and industrial establishments and cooperatives.
14	General Regulation of Safety and Health at Work Signalling	Executive Decree No. 128/04 of November 23rd	It establishes minimum requirements for the installation and use of occupational health and safety signs in the workplace and applies to public enterprises, joint ventures, cooperatives, and private enterprises.

No	Title of Laws and Regulations	law number	Purpose, etc.
15	Legal System for Work-Related Accidents and Occupational Diseases	Decree No. 53/05 of August 15th	Provides a legal regime for occupational injuries and occupational illnesses, taking into account events that occur in the course of employment in enterprises and government agencies and that cause injury or physical harm to employees, resulting in partial or total, temporary or permanent inability to work or death.
16	General Labour Law	Law No. 7/15 of June 15th	It stipulates that employers are responsible for ensuring the quality of the work environment, including the adoption of appropriate measures for safety and health at the workplace.
Energy Field			
17	Regulation on Substation Safety	Decree No. 42895, dated March 31st of 1960	For the protection of personnel and common interests in substations and transformer stations, it prescribes the technical conditions that must be met during the operation and work of the substation.
18	Regulation of the Protection of High Voltage Transmission	Decree No. 46.847 dated 1966	The following restrictions are specified for the safety of high-voltage transmission lines: i) Houses and structures are allowed as long as the distance from the transmission line axis to the top of the structure is at least 4-5 meters ii) Crops and trees are allowed as long as the distance to the transmission line axis is at least 4 meters iii) A 50 m wide protective corridor is established.
19	General Electricity Law	Law No. 14-A/96 of May 31st	It establishes the general principles of the legal regime for the activities of production, transmission, distribution and use of electrical energy.
20	Regulation of Electric Power Production	Decree No. 47/01 of July 20th	It regulates the legal measures for the production of electrical energy within the scope of the Public Electrical System (Public Electrical System: PES), while private power generation and supply outside the scope of the PES may only be developed in accordance with the rules set forth in the Regulations on the Authorization and Safety of Electrical Installations.
21	Regulation of Licensing of Installations of Production, Transport and Distribution of Energy	Decree No. 41/04 of July 2nd	The principles and rules that must be observed when authorizing the design, construction and operation of facilities for the generation, transmission and distribution of electricity for public consumption, as well as the legal and administrative provisions governing the installation and operation of the facilities.
Water sector			
22	The Water Law	Law No. 6/02 of June 21st	It establishes the general principles of the legal system for the use of water resources.
23	Regulation of Water Quality	Presidential Decree No. 261/11, of October 6th	It establishes water quality standards and criteria aimed at protecting the aquatic environment and improving the quality of water for its primary uses. It applies to inland water, including surface water and groundwater, and to water for aquaculture, livestock, agricultural irrigation, and seaside resorts.
24	Regulations on the General Use of Water Resources	Presidential Decree No. 82/14 of April 21st	establishes a regime for the planning, management and general use of water resources, including mechanisms for economic and financial sanctions It establishes rates, tariffs, methods of payment and collection thereof, and a regime of occupation, expropriation, and easements, as well as a system of inspection and sanctions applicable to surface water and groundwater (rivers, waterways, etc.).
25	Regulation of Public Water Supply and Sanitation of Wastewater	Presidential Decree No. 83/14 of April 22nd	It establishes rules governing activities related to public water supply and wastewater sanitation.
Social			
26	Spatial Planning and Urbanism Law	Law No. 3/04 of June 25th	As biophysical spaces, for all urban and rural soils and subsoils, continental shelves, and inland water bodies, the objective is to ensure actions leading to the occupation and use of these spaces through the implementation of spatial and urban planning measures.
27	The Land Law	Law No. 9/04 of November 9th	Establish a foundation for a general legal system for land that includes the assets originally held by the state, the rights

No	Title of Laws and Regulations	law number	Purpose, etc.
			imposed on land, and a general scheme for transfer, construction, exercise, and abolition.
28	Cultural Heritage Law	Law No. 14/05 of October 7th	It defines cultural heritage as all tangible and intangible property that, by virtue of its perceived value, should be subject to the authority and protection of the law, and indicates a series of acts that may be considered an infringement on cultural heritage.
29	General Regulation for Land Concession	Decree No. 58/07 of July 13th	It establishes the legal framework for the right to use available land within Angola, does not apply to private land, and indicates the obligation to always provide fair and adequate compensation to the owner and other affected right holders in the event of expropriation of land for public or temporary use.
30	Regulation on Resettlement	Presidential Decree No. 117/16 of May 30th	It establishes a system of resettlement and physical relocation in specific situations such as natural disasters, reconstruction, urban redevelopment, public works projects, and fires, with the aim of improving social conditions for the people.
31	Public Expropriation Law	Law No. 1/21 of January 7th	It establishes the principles and rules to be followed by competent bodies of government agencies when they carry out expropriations for public projects. Within the scope of the expropriation process, several general principles must be monitored, including legality, reasonableness, proportionality, equity, public interest, fair and prompt compensation, respect for private property, and the right of the community to have and oppose land rights. It is important to note that, in addition to the national government, local governments may be allowed to expropriate, and expropriations for public and private legal entities of this nature may also be allowed, provided that the reasons for public interest are adequately explained.

Source: JICA Survey Team

(2) International environmental treaties ratified by Angola

The main international conventions related to the environment that Angola has ratified or concluded are found in Table 9.3-2.

Table 9.3-2 Major international environmental treaties ratified by Angola

No	name	Year of ratification	Purpose, etc.
1	United Nations Framework Convention on Climate Change (UNFCCC)	August 1998	The purpose of the UNFCCC is to stabilize the concentration of greenhouse gases in the atmosphere. The commitments and obligations of all countries (Parties to the Convention) were defined. Projects implemented in Angolan territory must comply with Angolan legislation (Resolution no. 13/98 of 28th August) aimed at minimizing greenhouse gas emissions.
2	United Nations Convention on Biological Diversity (UNCBD)	July 1997	The purpose of the UNCBD is the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising from the use of genetic resources.
3	Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) (CMS)	April 2003	The CMS provides a global platform for the conservation and sustainable use of migratory animals and their habitats. It also brings together the countries through which migratory animals pass, i.e., range countries, and creates a legal foundation for internationally coordinated conservation measures throughout their migratory range.
4	Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal	February 2017	It is intended to reduce the transfer of hazardous waste between countries, especially from developed countries to less developed countries (LDCs). However, it does not cover the transfer of radioactive waste. It also supports the environmentally sensitive management of hazardous and other wastes generated by LDCs by minimizing the amount and toxicity of the wastes and managing them as close as possible to their sources.
6	Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	February 2017	CITES is an international agreement between governments. Its purpose is to ensure that international trade in specimens of wild animals and plants does not threaten the survival of species.
7	Convention on Wetlands (Ramsar Convention). Angola is the newest signatory to the Convention on Wetlands of International Importance	October 2021	The Ramsar Convention promotes an integrated approach to managing wetland systems, ensuring that human use of wetlands occurs in a manner that preserves their natural "capital" for future generations. It provides a list of wetlands of international importance.
8	Convention Concerning the Protection of the World Cultural and Natural Heritage	November 1991	To encourage the identification, protection and conservation of cultural and natural heritage throughout the world considered to be of outstanding value to humanity. The Convention defines the types of natural or cultural heritage that may be considered for inscription on the World Heritage List.

Source: JICA Survey Team

9.3.3. Legal System for Environmental Impact Assessment Procedures

(1) Overview of Environmental Impact Assessment System

The Environmental Framework Law (Law No. 5/98 (June 19, 1998)) states that an Environmental Impact Assessment (EIA) is mandatory when it "interferes with the balance and harmony between society and the environment" and defines the scope of projects subject to an EIA. of April 2020 Presidential Decree No. 117/20 (April 22, 2020) the previous laws and regulations related to EIA procedures were consolidated and a systematic system was established. This clearly indicated that EIAs would be mandatory for all public or private projects listed in the Annex to the Presidential Decree, except for projects that the government considers essential for national defense or national security.

(2) EIA Procedural Flow

The procedural flow of the EIA in accordance with Presidential Decree No. 117/20 is shown in Figure 9.3-1. Screening and scoping report review is conducted as Phase 1, Phase 2 is the preparation of the environmental impact statement, and Phase 3 is the submission and approval of the EIA report.

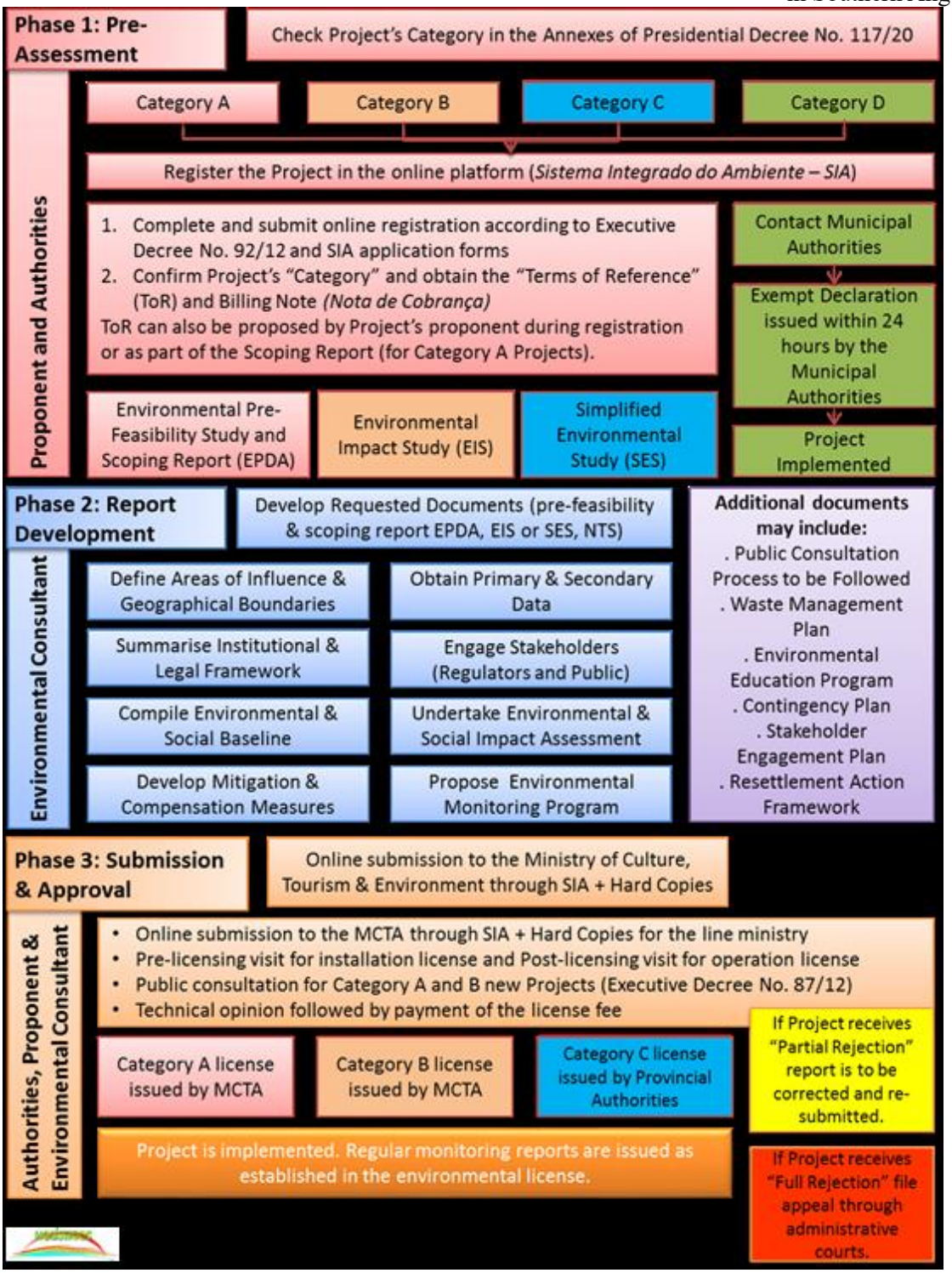


Figure 9.3-1 EIA Procedural Flow in Angola

Source: JICA Survey Team

(3) Key issues of the Pre-evaluation Phase (Phase 1)

(a) Project registration and project categolization in the online platform system

Starting in 2019, for the implementation of the EIA, the project will be registered in the MINAMB's platform, the System for Environmental Integration (SIA), and all instructions, etc. from MINAMB and submission of documents, etc. from the project will be done on SIA. In this project, environmental approvals need to be obtained by each project operator, so the project component of RNT and the project component of ENDE were applied for by RNT and ENDE, respectively.

- RNT's business: registration received January 19, 2021; certified as Category A on January 22, 2021

- ENDE's business: registration received January 20, 2022; certified as Category C on January 26, 2022

(b) Category classification

The categorization of projects is described in the Annex to Presidential Decree No. 117/20, which lists the individual project by sector. The categorization is as follows

- Category A: Projects listed in Annex I that require a preliminary survey and scoping report (EPDA) and supervision by an independent professional auditor with a proven track record.
- Category B: Projects listed in Annex II and subject to an Environmental Impact Study (EIS)
- Category C: Projects listed in Annex III and subject to a simplified environmental impact study (SES)
- Category D: Projects listed in Annex IV and not subject to the EIA process and environmental approvals
- Category E: Projects listed in Annex V and deemed to have "fatal flaws".

(4) Key issues for the Environmental Impact Study Phase (Phase 2)

The structure of the report to be prepared by the project proponent during the environmental impact study phase and submitted to MINAMB is as follows

(a) Structure of the Ex-ante Evaluation and Scoping Report (EPDA) (Presidential Decree No. 117/20, Article 12)

- Summary for the public, including key issues addressed, conclusions and recommendations
- ID and address of the business as well as the interdisciplinary team in charge of preparing the EIA
- Limitations of areas of indirect impact of activities and land use patterns in areas of direct and indirect impact
- A description of the activity and the various actions provided within it, as well as the respective options for planning, construction, exploration, and if it is a temporary activity, its deactivation phase
- Biophysical and socioeconomic description of the site
- Identification and assessment of critical activity problems
- Indication of potential environmental impacts of activities
- Identification and description of aspects to be studied in detail during the EIA

(b) Composition of the Environmental Impact Study Report (Presidential Decree No. 117/20, Article 14)

- Project Description
- Environmental Impact Study Report
- All technical and localization alternatives of the project, including the hypothesis of non-execution of the project
- Non-technical summary including key issues addressed, conclusions and recommendations
- Legal framework for the activity and incorporation into existing territorial plans for the area of direct impact of the activity
- Actions that differ from the description of activities provided in the plan, constitution, exploitation phase, and temporary deactivation, if applicable
- delimitation and geographic representation, as well as environmental context of reference to the sphere of influence of the activity
- Detailed description and comparison of the various alternatives and projected future environmental impacts. Issues related to the availability of mitigation measures.
- Identification and evaluation of impacts and identification of mitigation measures
- Environmental management plans for activities, including impact monitoring, environmental education programs, and accident response plans
- ID of the interdisciplinary team that prepared the EIA
- Report on Resident Information Sessions

(c) Composition of the Simplified Environmental Survey Report (SES) (Presidential Decree No. 117/20, Article 15)

- Business ID and address
- Location of the activity on an appropriately scaled tuna map showing the direct and indirect impact areas of the activity and current land use patterns
- Framework for activities in existing spatial planning
- A description of the activities during the planning, construction, and exploration phases and the various actions anticipated therein, and the respective alternatives, as well as the point of deactivation if the activity is temporary
- Explanation of the resident briefing process to be implemented
- Identification of environmental elements on which the study focuses
- Description of methodology for identifying, classifying, and evaluating potential environmental impacts of activities and alternatives
- ID of the team executing the SES

(5) Report Submission and Approval Phase (Phase 3)

(a) Report

Environmental Impact Assessment (EIA) and Simplified Environmental Study (SES) reports must be prepared in Portuguese and a summary version for the public (non-technical summary) must be prepared.

(b) Consultation

Category A and Category B projects are required to hold a public consultation meeting after the submission of the Environmental Impact Study Report. Comments here will be considered in the review process by MINAMB.

(c) Reviewing

MINAMB must forward the documents to the relevant competent ministries within 5 days of receiving the report from the operator. The relevant ministries must submit their opinions to the MINAMB within 5 days of receiving these documents. The review process is set to take no more than 30 days, but it is said that it usually takes two to three months.

(d) Appeal for rejection

If a project is rejected by MINAMB or receives a negative technical opinion from the competent ministry, it may appeal the decision. Appeals are filed through the Administrative Court.

(e) Publication of EIA Report

While the Environmental Assessment Report is a proprietary document of the operator and therefore is not open to inspection or copying, there is no impediment to publishing the Environmental Assessment Report based on the donor's guidelines.

(6) Environmental monitoring and audits (after project start-up)

According to Article 33 of Presidential Decree No. 117/20, the competent environmental authority is responsible for monitoring the implementation of the environmental monitoring and management plan in the implementation of specific projects. It is reported that the project may be carried out in collaboration with a research institute for technical aspects. The operator is required to submit an audit report to MINAMB to obtain or renew an environmental license (installed or in service).

9.3.4. Environmental Standards and Protected Area Designation, etc.

Undislosed Information.

9.3.5. Gap Analysis between Angolan Laws and JICA Guidelines

In implementing this project, the differences between the Angolan environmental laws and regulations and the JICA Guidelines for Environmental and Social Considerations (April 2010 version) are shown in Table 9.3-3.

Table 9.3-3 Gap Analysis between Angolan Environmental Laws and JICA Guidelines

No	subject matter	JICA Guidelines for Environmental and Social Considerations	Angolan domestic law	Existence or non-existence of gaps and policy for addressing them
1.	Underlying principles	In implementing a project, the environmental and social impacts of the project should be studied and examined as early as possible in the planning stage, and alternatives and mitigation measures to avoid or minimize such impacts should be considered, and the results should be reflected in the project plan. (JICA Guidelines, Appendix 1)	All public and private projects are required to conduct environmental assessment studies, evaluate impacts, and develop environmental management and monitoring plans.	There is no difference.
2.	information disclosure	-The Environmental Assessment Report must be written in the official or widely used language of the country where the project is to be implemented. It must be written in a language and style that can be understood by local people. -The Environmental Assessment Report must be publicly available in the country where the project is implemented, including to local residents and other stakeholders, and must be accessible to local residents and other stakeholders at any time, and copies must be available for acquisition. (JICA Guidelines, Appendix 2)	The environmental assessment report must be prepared in Portuguese, the official language, and a summary version for the public (non-technical summary) must be prepared. However, since the Environmental Assessment Report is a proprietary document of the operator, inspection and acquisition of copies are not permitted.	While there are no differences in the use of official languages and the preparation of summary fields for the public, there are limitations on the full publication of the report, and the summary version for the public and the report for JICA will be utilized. Note that the official government language is Portuguese, and since non-Portuguese is almost never used as a written language, the information is published in Portuguese.
3.	public consultation	-In particular, for projects that are considered to have a significant impact on the environment, it is necessary that information is disclosed to the public and that the results are reflected in the project content after sufficient consultation with local residents and other stakeholders from an early stage, such as when alternatives to the project plan are being considered. (JICA Guidelines, Appendix 1, Social Acceptability) -In preparing the environmental assessment report, sufficient information must be disclosed in advance, consultations must be held with local residents and other stakeholders, and records of the consultations, etc. must be prepared. -Consultations with local residents and other stakeholders should be conducted as necessary throughout the project preparation and implementation period, but especially during the selection of environmental impact assessment items and drafting. (JICA Guidelines, Appendix 2. EIA Reports for Category A Projects)	For Category A and Category B projects, public consultation takes place only once after the environmental assessment report is submitted to the Ministry of the Environment, but explanations are provided to the relevant authorities at the planning stage.	While there are differences, they do not preclude the implementation of two stakeholder consultations in accordance with JICA guidelines.
4.	Impact Assessment Items	The scope of impacts to be studied and considered with respect to environmental and social considerations includes human health and safety and the natural environment (including transboundary or global	As indicated in the previous section (3), the sub-items to be evaluated for impacts are defined, and the Ministry of	There is no difference.

No	subject matter	JICA Guidelines for Environmental and Social Considerations	Angolan domestic law	Existence or non-existence of gaps and policy for addressing them
		environmental impacts) through air, water, soil, waste, accidents, water use, climate change, ecosystems and biota, as well as social considerations for matters such as the following Population displacement, including involuntary resettlement; local economies, including employment and livelihoods; land use and local resource use; social organizations, including social capital and local decision-making bodies; existing social infrastructure and social services; socially vulnerable groups such as the poor and indigenous peoples; equity in damage and benefit sharing and in the development process; gender rights of children, cultural heritage, local conflicts of interest, HIV/AIDS and other infectious diseases, and the working environment (including occupational safety)." (JICA Guidelines, Appendix 1. Scope of Impacts to be Assessed)	Environment will present the implementation items (TOR) after the EIA project is registered.	
5	Monitoring/Mitigation Measures	1) During the project implementation period, the existence of situations that were difficult to predict, the implementation status and effectiveness of pre-planned mitigation measures, etc. must be ascertained, and appropriate measures must be taken based on the results of these assessments. 2) If adequate monitoring is considered essential for proper environmental and social considerations, such as for projects where mitigation measures should be implemented while monitoring their effectiveness, the project plan must include a monitoring plan and ensure the feasibility of that plan. 3) Efforts should be made to disclose monitoring results to local stakeholders involved in the project. 4) In the event that a third party or other party makes a specific suggestion that environmental and social considerations are insufficient, etc., a forum must be established with sufficient information disclosure for stakeholders involved in the project to discuss and consider countermeasures, and efforts must be made to agree on procedures to resolve the problem.	In the environmental assessment report: mitigation measures and: monitoring content and implementation system, and reporting methods should be described. There is no provision for publication of monitoring results.	Since there is no provision for publicizing the results of the monitoring, the project will hold periodic community consultations as part of the monitoring study, explain the summary of the results to residents, provide opportunities to hear their opinions, and ensure a grievance redress mechanism.
6	Ecosystems and Biota	Projects shall not involve significant conversion or significant degradation of critical natural habitats or critical forests.	There is a strong need to conserve ecosystems and biota and to preserve protected areas, etc.	There is no difference.
7	Indigenous peoples	Every effort must be made to avoid impacts of the project on indigenous peoples by considering all possible means. If avoidance is not possible after such consideration, effective	N/A	If indigenous peoples are identified among the affected population, an "Indigenous Peoples Plan" shall be developed

No	subject matter	JICA Guidelines for Environmental and Social Considerations	Angolan domestic law	Existence or non-existence of gaps and policy for addressing them
		measures for indigenous peoples must be taken to minimize impacts and compensate for losses.		in accordance with JICA guidelines to avoid, reduce, and compensate for the impact.

Source: JICA Survey Team

9.4. Examination of Alternatives

9.4.1. Selection Process for Project Target Areas

Angola's long-term development policy in the electricity sector calls for increasing the installed capacity from 2,120 MW to 8,742 MW and the electrification rate from 30% to 60% by 2025, but these goals have not been achieved. The power transmission line from Lubango to Namibe is only connected by the existing 60 kV DL, and there are no plans to build a new transmission line, making it impossible to meet future demand. In addition, Namibe Port, the main port in southern Angola, is positioned as the starting point for distribution from southern Angola to northern Namibia, and economic development, including the Proejct for Improvement of Namibe Port and port development in the region by Japanese private companies, is underway. The need for a stable power supply to the region is expected to increase.

Therefore, this project was selected with the highest priority for the construction of new transmission line and substations in southern Angola. This project will increase the transmission capacity and stabilize the electricity supply to the region, and is positioned as a high priority project essential for the economic growth of the metropolitan area in the National Electricity Master Plan until 2040, which was developed by JICA's technical cooperation project for power development master plan" (2017 - 2018).

9.4.2. Environmental and Social Impact without Project

A comparison of the impact of not implementing the project is shown in the table below. If the project is not implemented, there will be no negative impacts during construction period because the construction itself will not occur. On the other hand, there is concern that the amount and capacity of electricity supply will remain at the current level or decline over the long term, which could result not only in a decline in the quality of social infrastructure and social services and negative impacts on business and household economy and livelihood activities, but also in a medium- to long-term increase in the amount borne by consumers.

Table 9.4-1 Anticipated Environmental and Social Impacts without Project Implementation

Main impact items	Positive Impact	negative influence
Electricity demand, stable supply of electricity	None.	The gap between electricity supply and demand in southern Angola is large. If the project is not implemented, it will be even more difficult to meet the increasing electricity demand. In addition, there is concern that the duration and frequency of power outages will increase. Even if this project is not implemented, other projects should be considered and implemented as soon as possible.
environmental pollution	No environmental pollution will occur during construction.	The existing 60 kV transmission facilities were built in the 1950s and are deteriorated. There are concerns about increased maintenance work, frequent replacement of transmission equipment, and increased waste generation.
natural environment	By not implementing the project, there will be no need to construct access roads to the transmission line ROW, which in turn will eliminate the need to cut down trees and clear the land. Therefore, there will be no impact on the natural environment.	None.
Socio-economic environment	Access restrictions, traffic blockades, and worker camps caused by the laying of power lines and the construction of substation facilities will be eliminated.	If the project is not implemented, employment opportunities and other contributions to local employment will not be obtained. If only the existing 60 kV transmission facilities continue to be used, there will be no improvement in electricity supply and capacity, and there will be long-term negative impacts on social infrastructure, quality of social services, and business and household economy and livelihood activities. On the other hand, it could lead to an increase in the price of electricity sold and a corresponding increase in the power purchase cost. The increased cost could be borne by higher government subsidies or reflected in the amount borne by consumers.
Others	None.	There are long-term concerns about the adverse effects of continued use of existing facilities. Specifically, increased environmental impact due to aging, increased risk of industrial accidents, fire and electrical accidents, etc., and increased maintenance costs.

Source: JICA Survey Team

The above results show the superiority of the project implementation in terms of environmental and socioeconomic aspects.

9.4.3. Comparison of Design Alternatives in this Study

(1) 220 kV TL

The transmission line planned for the optimal proposal for the project is the route between the 400/220/60 kV Nombungo SS (northeast of Lubango) and the 220/60 kV New Namibe SS (northeast of Moçâmedes).

Lubango is the second largest city in Angola, located at the southwestern edge of the Angolan highlands at an altitude of around 1,700 m. The Tundavala area, about 15 km west of Lubango, is recognized as one of the IBAs (Important Bird and Biodiversity Area), internationally recognized as an important habitat for bird species. The steep cliffs of approximately 1,000 m on the western edge of the plateau and Mt. Leba are important scenic spots for the region. In addition, there is the Namibe Partial Researve located in the south of Moçâmedes City.

In light of the above, special consideration should be given to areas important for the habitat of these organisms, scenic spots important to the area, and nationally designated protected areas when selecting routes. As a result, four routes were examined as shown in Figure 9.4-1.

The site reconnaissance survey revealed that sharing the ROW of the railway was not possible with Plan A. In the preliminary consultations conducted in February 2020 (See 9.11.1), participants raised

their opinions that Plan A is relatively gentle in terms of elevations, can avoid resettlement, and is optimal in terms of safety against mines and UXOs.

Plan B is the shortest route through the vicinity of the 150/60 kV Existing Lubango SS, and was considered technically superior for the extension of new 220 kV TL. However, the plan collected negative opinions from the government officials of Huíla Province and RNT staff, as it would pass the most populated area of Lubango City. In addition to this, the plan crosses the front of Mt. Leba and passes through the west side of the hill where the Christ the King Statue is located, just south of the 150/60 kV Existing Lubango SS, and a dense residential area in downtown Lubango, which could affect the view of the Christ Statue from the front (north) side of the city center. For this reason, the plan was discussed for rejection.

In place of Plan B, Plan C was added as a route that bypasses the south side of the National Route No. 280 and the east side of the city center along the railway. This plan basically follows the road and the existing 60 kV DL south and east in its entirety, and was thought to reduce the impact on the landscape since it passes by the Christ Statue with few residences. However, the plan could result in the displacement of 200 informal residents.[55]

To resolve these issues, Plan D was separately studied. Plan D is a route that follows the national highway or the 60 kV existing DL for about 80 km west of the project area near Namibe, with river crossings upstream of the 60 kV existing DL to avoid urban areas and shorten the installation distance.

[55] According to Lubango Municipality officials, the majority of the informal residents were middle- and low-income families who had been internally displaced during the civil war.

Figure 9.4-1 Project Area and Alternative Transmission Line Routes

Source: JICA Survey Team

The detailed technical study is presented in Chapter 5 as shown in Table 5.2-1. The following table shows its results as well as the detailed environmental and social comparisons.

Table 9.4-2 Items considered in route selection and comparison results

	Plan A		Plan B		Plan C		**Plan D**	
Natural environment	×		×		○		◎	
Important Bird Habitat Tundavala IBA	Although avoided, there is a high degree of natural degree continuity to the north, and there is concern about the impact.	×	It can be avoided, but it passes closer than Plans C and D.	△	Impact avoidable.	○	Most avoidable as it is the farthest.	◎
Sanctuary Namibe Partial Reserve	Impacts to the Namibe Partial Reserve will be avoided or minimized.	○	ditto	○	ditto	○	ditto	○
Landscape of tourist attractions, etc. Lubango City	No impact is anticipated.	◎	There is concern about the impact on the cultural landscape (Christ the King Statue seen from the Lubango City).	×	Impact avoidable.	○	Impact avoidable.	○
Mt. Leba	No impact is assumed.	◎	The impact is expected to be significant.	×	Impact avoidable.	○	ditto	○
Flora and fauna	The route is more natural than the southern route, and the construction is expected to have a greater impact on the area, as well as on birds flying along the cliff line around the Tundavala area.	△	The impact on trees in the shrub savanna section from the base of Mt. Leba to Caraculo is expected to be small, and the impact on flora and fauna is expected to be small, but the impact on trees on the slopes of Mt. Leba is expected to be large.	×	Although construction impacts in the shrub savanna section from the base of Mt. Leba to Caraculo are expected to be greater than in Plan B, recovery is expected in the steep cliff area, and direct and indirect impacts from the access road during operation period can be minimized by the provision of the access road for the existing 60 kV DL.	○	ditto	○
Impact on forests	The impact of logging on highly natural and secondary forests is anticipated as significant, and there is concern that human impacts will increase deforestation because they will increase the number of new access roads into the forest.	×	Although the area logged is small, it is expected to take time to recover as the logging will be on steep slopes.	△	The impact of new logging and the inducement of illegal logging and increased degradation can be minimized because the access road can be shared with the existing 60 kV DL access road.	○	ditto	○
Precious species	Consideration should be given to the conservation of an endangered (EN) bird species that occurs near Caraculo (Ludwig's bustard (*Neotis ludwigii*)).	△	ditto	△	ditto	△	ditto	△

	Plan A		Plan B		Plan C		**Plan D**	
Social environment	◎		×		△		◎	
Land acquisition and resettlement	Temporary land use restrictions during construction and permanent (small-scale) acquisition of the tower base are anticipated. Since the proposed route mainly passes through agricultural lands and not through dense residential areas such as urban centers, it is expected that less than 200 people in total will be permanently resettled and that the number of people who will need to be temporarily relocated during the construction period will also be small.	○	Temporary land use restrictions during construction and permanent (small-scale) acquisition of the base of the tower are anticipated. Since the proposed route will pass through dense residential areas in downtown Lubango in addition to agricultural lands, the impact on land use and local life, especially in Lubango City, will be significant, and the combined impact of permanent relocation and temporary displacement could be on the order of 5,000 people.	×	Temporary land use restrictions during construction and permanent (small-scale) acquisition of the base of the tower are also anticipated. Although the proposed route mainly passes through agricultural lands and avoids dense residential areas in the Lubango urban area, it is foreseeable that the informal population living near the railway tracks will be affected, and permanent displacement of up to 200 people is likely.	△	Temporary land use restrictions during construction and permanent (small-scale) acquisition of the base of the tower are anticipated. Since the proposed route mainly passes through agricultural lands and not through dense residential areas such as urban centers, it is expected that less than 200 people in total will be permanently resettled and that the number of people who will need to be temporarily relocated during the construction period will also be small.	○
Cultural property	Almost no impact	◎	Although there is no impact on the Christ the King Statue itself, which is an important cultural property, the cultural landscape formed by the Sstatue will be damaged. In addition, it is possible to maintain a certain distance from cultural properties located along the National No. Route 280 and near the route from Caraculo to Humpata.	△	A certain distance from cultural assets located near the route from Caraculo to Humpata can be addressed.	○	ditto	○
Impact on Indigenous Peoples	The construction of overhead power lines and there will be no land division. Construction will be phased in various locations, thus avoiding impacts to grazing routes.	○	ditto	○	ditto	○	ditto	○
Schools, religious facilities, local community facilities	Impact is avoidable	◎	ditto	◎	ditto	◎	ditto	◎
Landmine	Not yet explored and cannot be determined. Safety	-	ditto	-	ditto	-	ditto	-

	Plan A		Plan B		Plan C		**Plan D**	
	should be confirmed based on a detailed location study of the route and towers.							
Technical and economic considerations (as listed in Table 5.2-1)								
Line length	194km	○	185 km	◎	197km	△	196 km	○
Passing point	National road: 2 Railway: 3 Large rivers: 2 Existing transmission line: 1	△	National road: 1 Railway: 1 Large rivers: 2 Existing transmission line: 1	○	National road: 1 Railway: 1 Large rivers: 2 Existing transmission line: 1	○	National Road: 7 Railway: 3 Large rivers: 2 Existing transmission line: 4	△
Facility formation	The route from Nombungo to Namibe, which passes through the western mountains, does not directly contribute to the enhancement and stabilization of power supply in the urban area of Lubango and surrounding areas.	×	This plan will directly contribute to the supply of electricity to the Lubango area by drawing on the 150/60kV Existing Lubango SS. However, there are issues of uncertainty, such as site expansion of the 150/60kV Existing Lubango SS where there is not enough land available and securing transmission line routes in the surrounding overcrowded urban area, which may limit the stable supply of electricity in the Lubango area where demand is expected to increase.	△	(same as on the left)	△	The construction of the East Lubango Substation under the project will contribute to the stability of electricity supply to the Lubango region.	◎
Construction costs	The cost is higher than Plan D because it passes through mountainous areas and steep slopes in the north, and because of the construction cost of the main body and the development of the access road.	○	Although the track length is the shortest, it passes through a dense residential area, is expected to be difficult to construct in the steep terrain of Mt. Leba, and is more expensive than Plans A and C.	×	Access road for the existing 60 kV DL can be utilized, but is more expensive than Plan D because the line is the longest and passes through densely populated residential areas.	△	Lowest cost due to the low maintenance of access roads, as access roads can be utilized for existing 60 kV DL and are often along major roads without passing through densely populated residential areas	◎
Construction work	In the northern mountainous areas, there are no access roads from the existing roads, so the construction will be all new, and the process is expected to be longer than in Plan D.	○	The construction is more difficult than Plan C, considering the passage through the dense residential area in the city of Lubango and the difficulty of construction in the steep terrain of Mt. Leba.	×	Construction is more difficult than Plans A and D because the project passes through a dense residential area in the city of Lubango.	△	The proximity and parallel location to the existing 60 kV DL and the existing road makes it the easiest to construct compared to other plans.	◎

	Plan A		Plan B		Plan C		**Plan D**	
Maintenability	Maintenance is inferior to Plan D because of the long distance between mountainous areas in the north and the maintenance of access roads.	○	The area near Mt. Leba is steep, and its maintainability is inferior to that of other plans. In addition, there are concerns about public disasters due to the passage of urban areas, and preventive measures against such disasters will increase.	×	There are concerns about public disasters caused by passing through urban areas, and measures to prevent such disasters will increase.	△	Many sections are in close proximity to or parallel to existing 60 kV DL and existing roads, so access roads can be shared and maintenance is easy.	◎
Maintenance costs	Maintenance costs are relatively high due to the need for new patrol routes	△	Maintenance costs are quite high due to the need for new patrol routes on the steep slopes of the cliffs.	×	Highly economical because the same patrol route can be used as for existing distribution line	○	Some portions are along existing 60 kV DL, while others are new routes.	◎
Comprehensive evaluation	Although the impact on the natural environment associated with construction and service is expected to be relatively large, the social impacts, such as resettlement, are expected to be relatively small. The project is expected to have a long extension through the mountainous terrain, and as it is a new construction, the construction cost is expected to rise, the maintenance and management effort and cost are expected to be high, and the benefits and ripple effects to the local community are expected to be small.	△	The project is expected to have a significant impact on the natural environment in the forested area and on the natural environment and natural and cultural landscape around Mt. Leba, with strong local opposition. In addition, large-scale land use changes and impacts on local society are anticipated.	×	Although the impact on the natural environment is expected to be relatively small and the spillover effects relatively large, it is assumed that the relocation of informal residents will occur and that coordination with the authorities for the highly restricted area at Lubango Airport will be necessary.	△	In terms of the natural environment, although it is important to take measures to preserve the swamps and canyons that are unique at the regional level, the project is expected to minimize and reduce impacts during construction and during service, and the project is expected to have a significant impact on the residents who use the route, as little impact is expected on them.	◎

Note: Landscape is one of the social environment items, but it is tentatively listed under the natural environment item because careful consideration must be given to its impact on the natural landscape in addition to the cultural landscape.

Source: JICA Survey Team

An overview of each plan's route is shown from Figure 9.4-2 to Figure 9.4-5. Figure 9.4-6 shows comparison of distances by each route's vegetation category.

Near Namibe

Near Namibe

Near Giraul de Cima

West of Giraul de Cima

Figure 9.4-2 Overview of the area around the 220 kV TL route (Namibe~Giraul de Cima)

Source: JICA Survey Team

Between Giraul de Cima and Caraculo

Between Giraul de Cima and Caraculo

Between Giraul de Cima and Caraculo

Between Giraul de Cima and Caraculo

Figure 9.4-3 Overview of the area around the 220 kV TL route (Giraul de Cima to Caraculo)

Source: JICA Survey Team

Between Caraculo and Renato Grade

Between Caraculo and Renato Grade

Between Caraculo and Renato Grade

Between Caraculo and Renato Grade

Figure 9.4-4 Overview of the area around the 220 kV TL route (Caraculo to Renato Grade)

Source: JICA Survey Team

Near west of Renato Grade

Near west of Renato Grade

Near Assunção

Near West Bibala

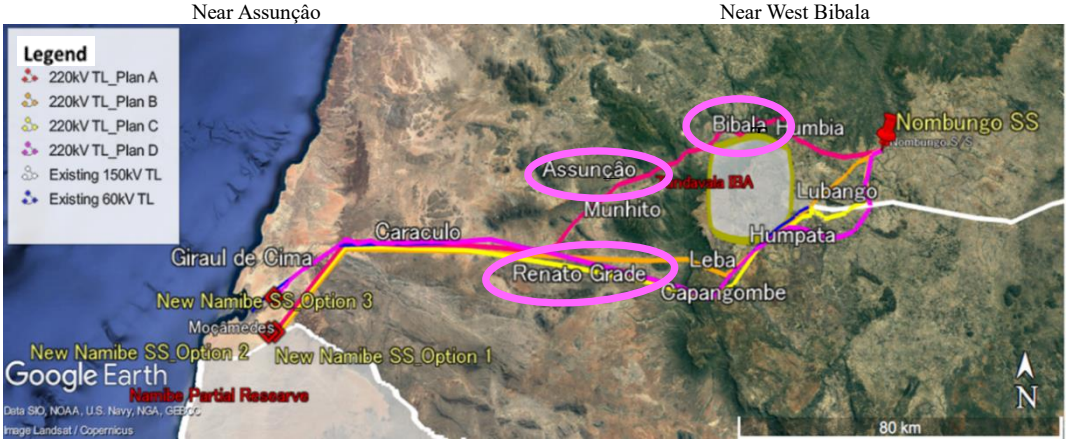


Figure 9.4-5 Overview of the area around the 220 kV TL route (Renato Grade/ Assunção to Bibala)

Source: JICA Survey Team

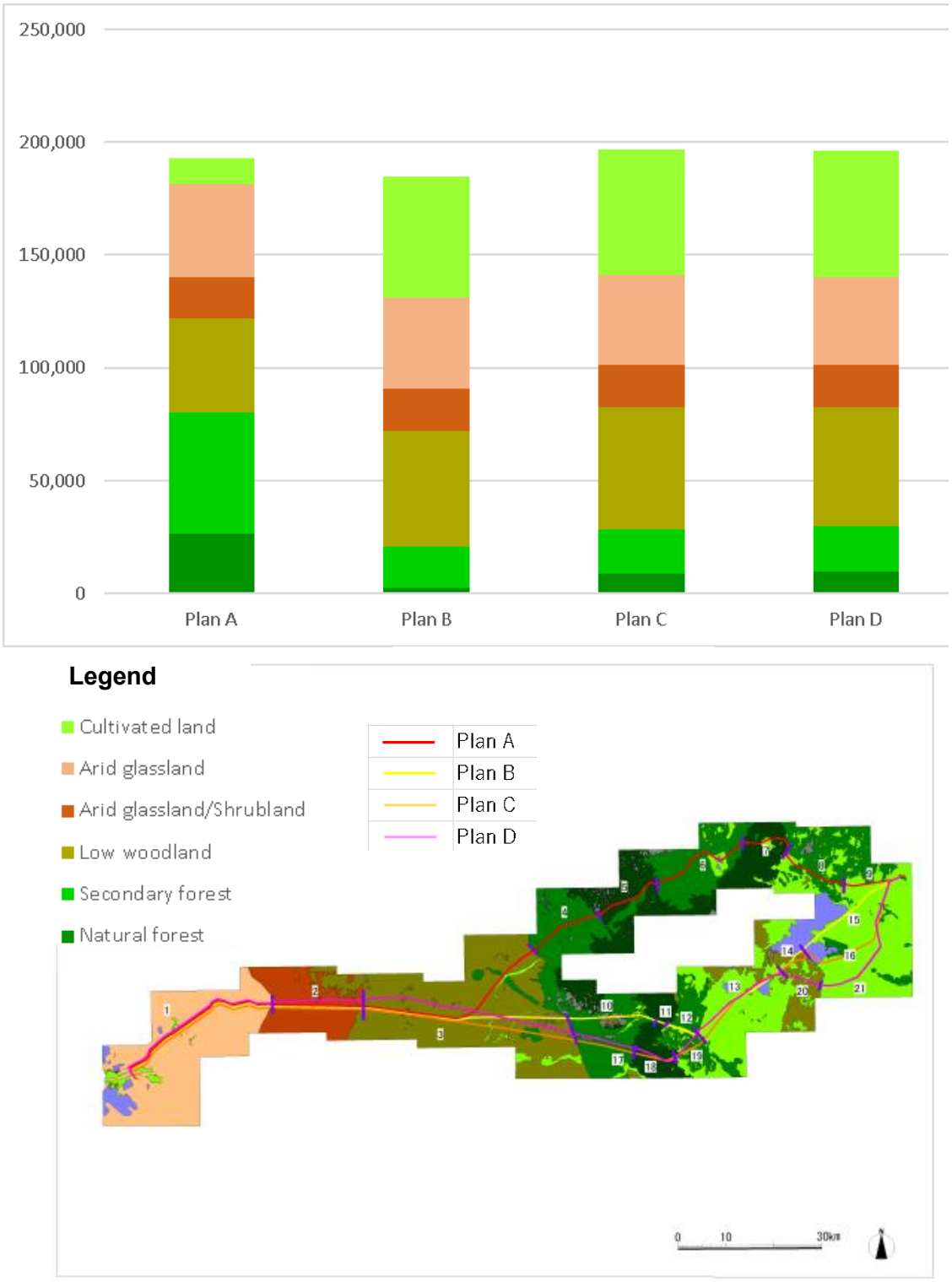


Figure 9.4-6 Comparison of distances by each route's vegetation category

Source: JICA Survey Team

In the process of plan selection, Plan B, which received an "X (negative)" in the study shown in Table 9.4-2, was rejected, and the remaining three plans were analyzed more quantitatively by allocating weights based on the magnitude of impact and the environmental and social impact items specifically mentioned in the JICA Environmental Guidelines, and by assigning points based on scores, etc. to refine the comparison.

As a result, Plan D collected the highest evaluation score in terms of natural environmental, social, technical, and economic aspects, and based on discussions with the executing agencies and

the results of the site reconnaissance survey, it was agreed to select this plan. The details of the quantitative comparative study are described in Chapter 1.

(2) 60 kV DL

As shown in the figure, two routes, the yellow line (Plan A) and the green line (Plan B), were proposed by the JICA survey team, and field checks were conducted jointly with RNT/ENDE.

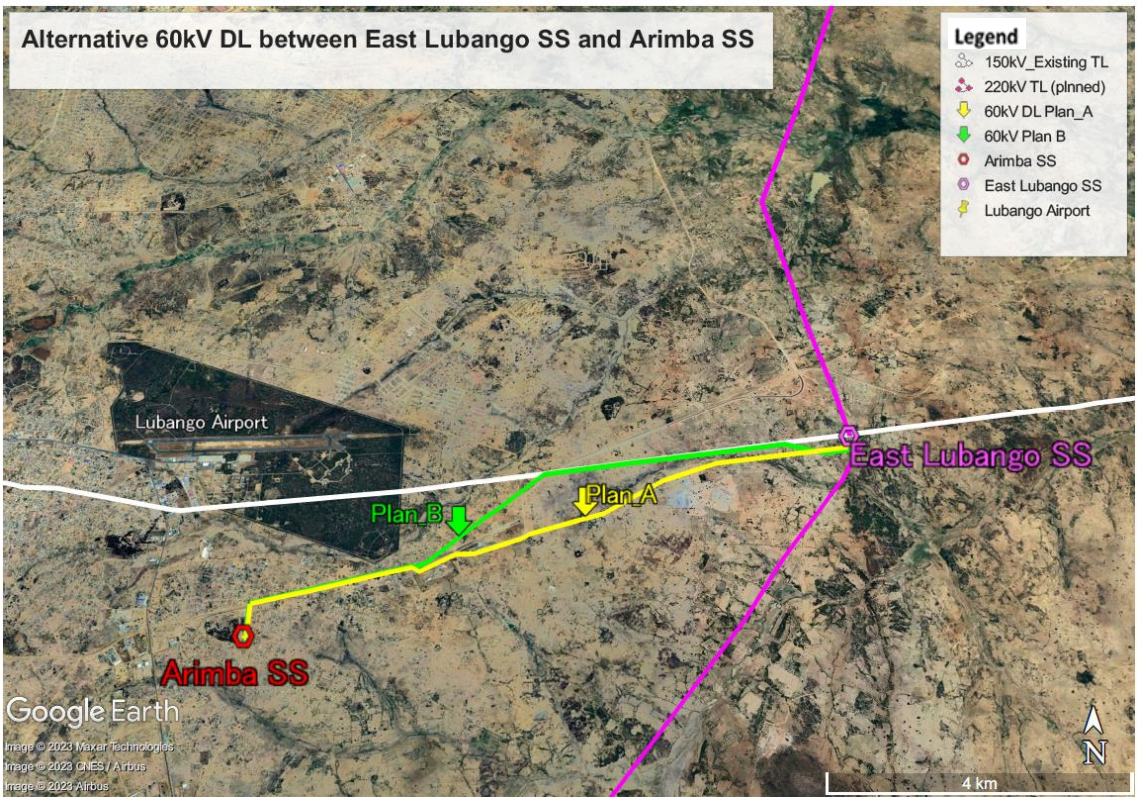


Figure 9.4-7 Alternative routes of 60 kV DL between 220/60 kV East Lubango SS and 60/15 kV Arimba SS

Source: JICA Survey Team

Based on discussions with the executing agency and the results of the site inspection, Plan B was selected because of its superiority from an economic standpoint in addition to environmental and social aspects. The table below shows a comparison of alternatives for the 60 kV DL.

Table 9.4-3 Items considered in selecting the 60 kV route and comparison results

Item	Subjects to be taken into account	Plan A (yellow)	**Plan B (Green)**	remarks
Natural environment	Sanctuary	N/A	N/A	-
	Rivers	There is a river nearby (disappears during dry season), but no crossing is required.	N/A	-
	Trees and shrubs	Due to the high development and low natural level of the area, tree cutting is expected to be limited to the vicinity of the 220/60 kV East Lubango SS.	Because the area is highly developed and of low naturalness, tree removal would be limited to the vicinity of the 220/60 kV East Lubango SS. The loss of vegetation and fragmentation and loss of animal habitat due to the installation of access roads and material storage areas along the 150 kV existing TL would be reduced.	Plan B has an advantage.
	Plant	No rare species, typical communities, etc. are identified.	ditto	There is no difference in superiority.
	Animal	Birds and reptiles were the only	ditto	There is no difference in

Item	Subjects to be taken into account	Plan A (yellow)	**Plan B (Green)**	remarks
		species widely found.		superiority.
Community	Land acquisition and resettlement	Resettlement is not foreseen to occur because the project does not pass through a dense residential area. Even if it were to occur, the scale and impact would be small because the area is not densely populated.	ditto	There is no difference in superiority.
	Impact on Indigenous Peoples	Neither settlement nor seasonal migration has been confirmed.	ditto	There is no difference in superiority.
	Schools, religious facilities, local community facilities	It is in close proximity to a settlement in the vicinity of the 220/60 kV East Lubango SS. On the other hand, it is located at a sufficient distance from the elementary school.	It avoids a settlement and an elementary school in the vicinity of the 220/60 kV East Lubango SS.	Plan B has an advantage.
	Structure	There is a quarry nearby.	It is along an existing road, and no large structures such as factories are identified.	Plan B has an advantage.
	Cultural property	none in particular	none in particular	There is no difference in superiority.
Properties requiring consideration	Lubango Airport	The route extends in the south direction of the airport and no impacts are anticipated.	No impacts are anticipated on the section of the route that extends south of the airport. On the other hand, after taking the route along the existing road, there is a section that runs parallel to the 150 kV existing TL approximately 2.4 km east of the airport.	Verbal confirmation was obtained from the executing agency that there were no problems with both routes.
	Existing 150 kV transmission line	None in particular.	The line runs parallel to the south side of the 150 kV existing TL (less than 4 km). Consideration will be given to the location so that both sides will not be affected in the event of a tower collapse. The section running parallel to the transmission line will facilitate inspection.	Plan B has an advantage.
	Railway	Part of the route parallels the northern side of the railway.	ditto	Discussions regarding separation distances, etc., including whether ROW sharing is possible.
	Land mine	Unexplored yet and cannot be determined.	ditto	Safety should be confirmed based on a detailed location study of the route and towers.
Design	Extension distance (km)	10 km	10.3 km	No difference in superiority. There is no difference in the number of towers as there is almost no difference in the distribution line extension.
	Construction costs	Construction costs are somewhat high because the route bends at approximately 10 points.	Although the route turns at approximately four to five points, it is a straight route with few angle points, thus reducing construction costs.	Plan B has an advantage.
	Design for areas with large elevation differences	There is almost no difference in elevation between the sections along the road/railway and the sections not along the road.	Easiest to design as it follows the road/railway. Almost no difference in elevation.	There is no difference in superiority.
	Geotechnical design	In addition to the section along the existing transmission line and railway, the ground is assumed to be relatively stable in the section close to the road and railway.	Assumed to be relatively stable as it is along existing power lines and railways	There is no difference in superiority.
Early	Shortening of	Shortening of construction	Along existing power lines and	Plan B has an advantage.

Item	Subjects to be taken into account	Plan A (yellow)	**Plan B (Green)**	remarks
realization	construction period	period is possible for sections along existing power lines and railways. In sections that pass through areas in the middle of residential development, a certain amount of time is required to coordinate with local residents.	railways, shortening the construction period is possible.	
Economic viability	Maintenance costs	Although the economical efficiency is relatively high, dust from the quarry plant has severely contaminated the insulators of the 150 kV existing TL, and the insulators have been replaced, which may have an impact on the 60 kV route design.	Highly economical, as maintenance and management can be carried out efficiently because the same patrol route can be used as for the existing transmission line.	Plan B has an advantage.
	Ripple effect	220/60 kV East Lubango SS and 60/15 kV Arimba SS are expected to have benefits and spillover effects, such as compensating for the vulnerability of the RNT's supply system plan from the Nombungo and Matala substations to future increased demand in the Lubango area and ensuring the future reliability of the 60 kV distribution system in the Lubango area.	(same as on the left)	There is no difference in superiority.
Comprehensive evaluation		It is assumed that there will be virtually no impact on the natural environment. Some social impacts are expected due to the proximity to the local community, especially during the construction period, and the presence of a quarry plant nearby. On the other hand, benefits and ripple effects on the local community are assumed.	It is assumed that there will be virtually no impact on the natural environment. Due to the long section along the existing road and railway, the impact of air pollution, noise and vibration on residential space due to construction is expected to be relatively small. Almost no temporary impact on local residents, especially during the construction period. Highly superior and economical in terms of design. Benefits and spillover effects to the region are envisioned.	-
Selection Results		Rejected	Adopted	-

Note: Since there was almost no difference in total length between the plans, it was difficult to make a quantitative evaluation of construction and maintenance costs.

Source: JICA Survey Team

(3) Substation

(a) 220/60 kV New Namibe SS

RNT initially considered two candidate sites for the 220/60 kV New Namibe SS around the Namibe Partial Reserve, but the first field survey revealed that one of them falls within the Namibe Airport's height restriction zone and the other within the Namibe Partial Researve. Based on participants' opinions at the preliminary discussions and discussions with the former Department of Environmental Impact Prevention and Assessment of Ministry of Environment, RNT decided not to target both sites and requested that RNT consider other candidates.

A second field survey was conducted outside the Namibe Partial Reserve boundary and at a potential site located approximately 10 km north-northwest of the same site, together with government officials of Namibe Province. The officials from the Department of Environment confirmed that both sites are environmentally sound, although surface runoff and sediment erosion countermeasures are required during rainfall events. Regarding the restricted area of the airport, the officials explained that the proposed site near the boundary of the Namibe Partial

Reserve would require a decision based on an inspection of the current conditions by the authorities.

Figure 9.4-8 shows the proposed location of the 220/60 kV New Namibe SS.

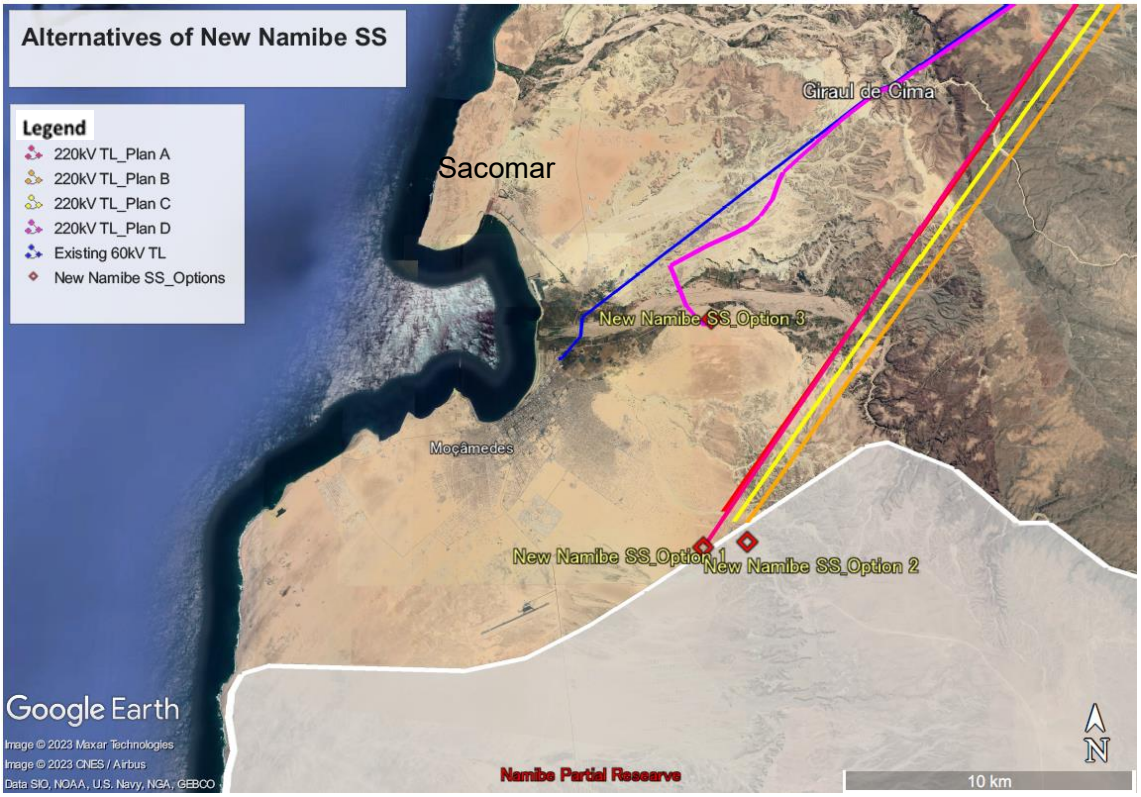


Figure 9.4-8 Alternative locations for 220/60 kV New Namibe SS

Source: JICA Survey Team (on Google Earth)

Table 9.4-4 shows a comparison of the candidate sites for 220/60 kV New Namibe SS. Option 3 is the best from an environmental standpoint and is advantageous due to the shorter distance of the main transmission line. From a social standpoint, there was concern about the possibility that temporary relocation of residents would be required for the heavy material delivery route, but Option 3 was selected because it avoids dense residential areas by using existing public roads, and it also has advantages for the construction of new distribution line to the Sacomar Port and other ENDE consumers. At the time of the preliminary discussions (February 2020), there was a concept for the development of a Namibe Special Economic Zone in the northern suburbs of Moçâmedes, but as of August 2022, no concrete plan had been formulated. There are no port developments other than Sacomar in the development plan for Namibe Province, nor are there any development projects that would lead to electricity demand.

Table 9.4-4 Comparison of calternative sites for 220/60 kV New Namibe SS

item	Option 1	Option 2	**Option 3**
Facility area*1	(Same as option 3)	(Same as option 3)	Approx. 1.43 ha
Sanctuary	Located within the Namibe Partial Reserve.	Located near the boundary of the Namibe Partial Reserve.	It is about 8 km from the Namibe partial reserve.
Ecosystem	The Namibe Partial Reserve has been established as a buffer area for Iona National Park in the south, and its ecological impact is potentially the greatest of the three sites.	It is considered equivalent to Option 1.	Since it is located across the urban area from the Namibe Reserve, the impact on terrestrial animals is expected to be minimal. Although several towers will be constructed, they are located more than 10 km from the coast and are expected to have little impact on waterfowl. Although the site is located at the western edge of the desert area, it is close to the urban area of Moçâmedes, so it is expected to be least affected by the loss of vegetation and fragmentation and loss of animal habitats due to construction work and substation service.
Indigenous peoples	Neither settlement nor seasonal migration has been confirmed.	ditto	ditto
Resettlement	None.	None.	None. (Although there was concern about temporary relocation to secure a route for heavy cargo delivery, relocation could be avoided by using the public road for delivery.)
Landscape	Impact on the natural landscape due to the facilities, including the towers leading to the substation, is anticipated.	ditto	The impact on the natural landscape due to the facilities, including the towers leading to the substation, is expected to be relatively small.
Construction cost*2	Middle	Middle	Low (due to shorter transmission line distance)
Electricity supply to consumers	Need to coordinate with ENDE regarding power supply to consumers	ditto	It is ideal because of its advantage in the construction of new distribution line to customers associated with the development of Sacomar Port and other ENDE consumers such as Namibe Port (it is the furthest from the Namibe Partial Reserve, which is advantageous from the perspective of preserving the desert ecosystem and is expected to have a ripple effect on the local economy).
Comprehensive evaluation and selection results	Not adopted because construction in protected areas is not permitted.	Outside of protected area, but not adopted due to proximity	adopted (The farthest from the Namibe Partial Reserve is advantageous in terms of preserving the desert ecosystem, and it is also expected to have a ripple effect on the local economy.)

Note: *1. The area for facilities was determined by schematic design after the target site was determined, and there is no difference by option.
*2. It was difficult to make a quantitative evaluation of construction costs, etc.

Source: JICA Survey Team

(b) 220/60 kV East Lubango SS

Option 1 (red on the west side) was selected as the candidate site subject to technical examination, but since a settlement was identified nearby, Option 2 (pink on the east side), which avoids it, was selected based on discussions with the executing agency and the results of the site inspection. The table below shows a comparison of the candidate sites for 220/60 kV East Lubango SS.

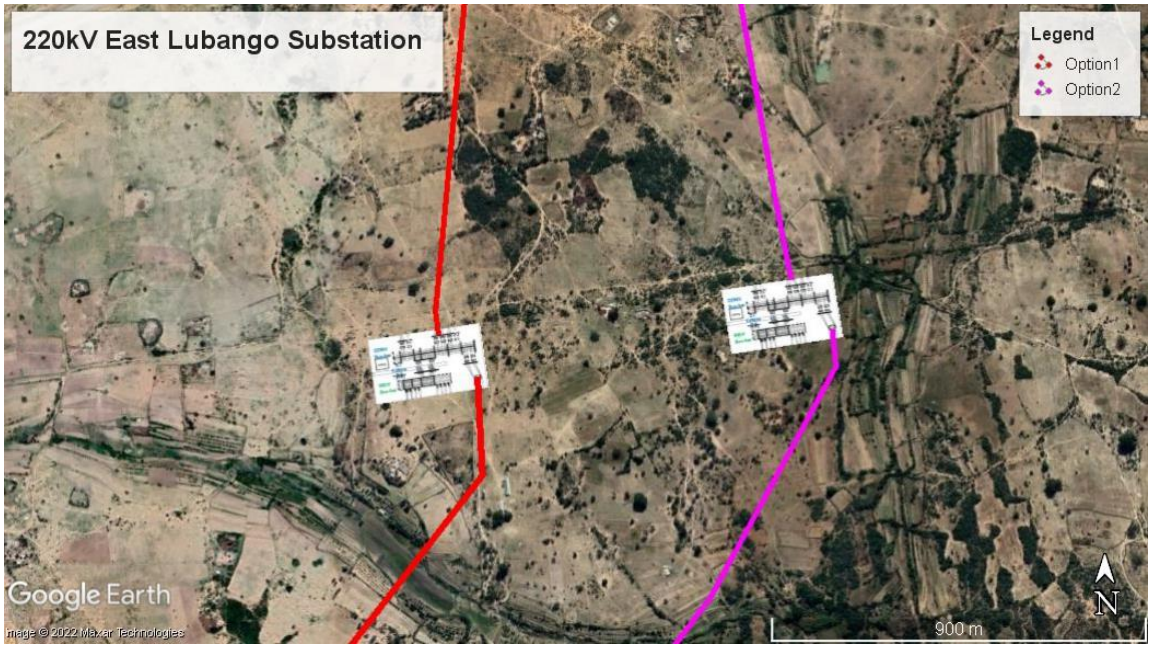


Figure 9.4-9 Alternative sites for 220/60 kV East Lubango SS

Source: JICA Survey Team

Table 9.4-5 Comparison of 220 kV/60 kV East Lubango SS Candidate Sites

item	Option 1 (red)	**Option 2 (peach color)**
Facility Area	Approx. 4.05 ha	ditto
Impact on the natural environment	The vegetation is a shrub savanna characteristic of the Angolan plateau, but the sparse presence of medium and low shrubs suggests a strong influence of human activities, and little impact on specific plant and animal species or ecosystems is assumed.	ditto
Indigenous peoples	N/A	N/A
Resettlement	A settlement was identified in the vicinity and there was a possibility of relocation.	None
Landscape	none in particular	ditto
Construction costs	Flat ground and low civil engineering and development costs.	The slope is slight, so additional costs to flatten it during civil engineering construction should be considered.
Electricity supply to consumers	It is necessary to consider the route and amount of power supply to each consumer based on ENDE's 60 kV DL plan.	ditto
Comprehensive evaluation and selection results	rejected	adopted

Note: It was difficult to conduct a quantitative evaluation of construction costs and other factors.

Source: JICA Survey Team

(c) 60 kV/15 kV Arimba SS

60/15 kV Arimba SS is planned to be connected to 220/60 kV East Lubango SS with 60 kV new DL, as well as the Arimba2 PS (under planning). The site is adjacent to the south side of the power station, with forest land to the west. Since the surrounding area has already been developed with residential land, there are no suitable candidate sites for alternative sites, and for this reason, no comparison of alternatives has been conducted.

60/15 kV Arimba SS and the diesel-powered Arimba2 PS are connected with a 60 kV UGDL. This 60 kV new UGDL will strengthen the distribution system between 220/60 kV East Lubango SS, 60/15 kV Arimba SS, and the 150/60 kV existing Lubango SS. The distribution line routes for 60/15 kV Arimba SS and nearby areas are shown in the figure below. The route from 220/60 kV East Lubango SS (yellow-green) passes through the east side of the planned substation and is connected from the south. The orange route will be connected to the Arimba2 PS by an underground line (approx. 480 m).

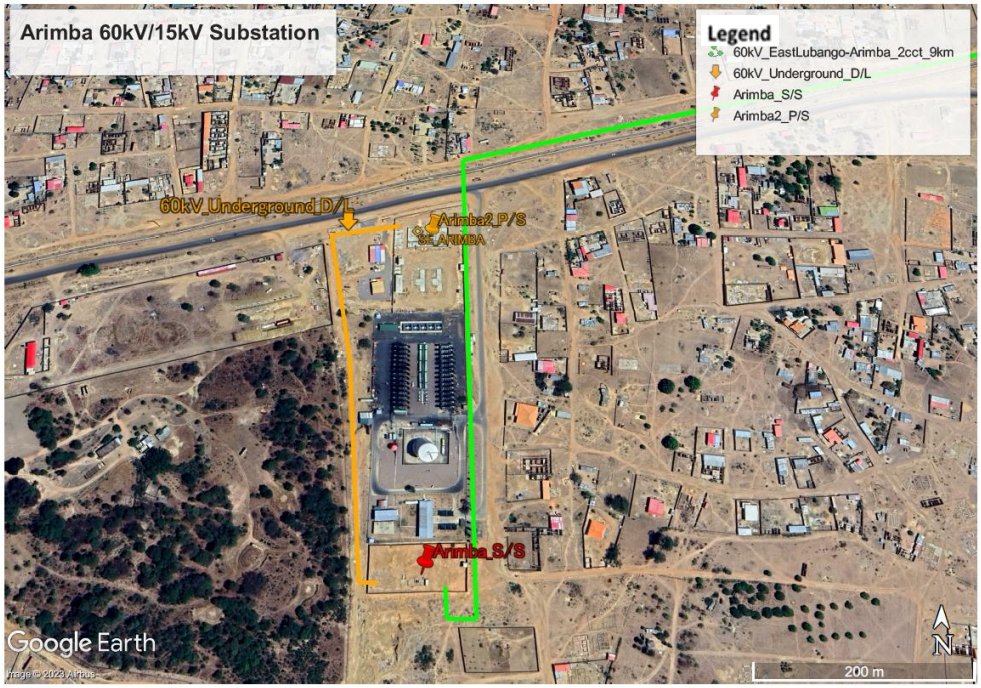


Figure 9.4-10 60/15 kV Arimba SS and its surroundings

Source: JICA Survey Team

9.5. Scoping Draft and Study TOR

9.5.1. Scoping Draft

(1) 220 kV TL

The 220 kV TL, which was agreed upon with RNT after examining alternatives, was characterized based on existing data and site inspections. The anticipated impacts were determined in accordance with the JICA Guidelines for Environmental and Social Considerations (April 2010), and summarized in

Table 9.5-1.

The degree of environmental impact assessed in the scoping was done assuming that no avoidance or mitigation measures were taken, and does not assume the implementation of avoidance or mitigation measures for the impact. Since it is assumed that the project implementation will cause impacts or it cannot be judged whether impacts will occur, the items subject to environmental and social assessments are marked with " ✓ " separately for pre-construction/construction and operation phases.

In order to ensure safety in the implementation of the project, the project is planned to conduct demining work under the Angolan government system based on a request from the competent authority of the project (MINEA) to the Angolan government, which was considered as an influencing factor in the scoping.

Table 9.5-1 220 kV TL Scoping Results

Classification.	Impact item		Evaluation: pre- & Construction	Evaluation: operation	Reasons for evaluation
Pollution	1	Air pollution	✓		**Pre-construction**: Emission of air pollutants (SOx, NOx, etc.) and generation of dust are expected due to the operation of heavy equipment for clearing and rooting for demining work, and for deep excavation at the location of the tower. **During construction**: Emission of air pollutants (SOx, NOx, etc.) and dust generation are expected due to the maintenance of the transmission line ROW, the construction road, and the operation of heavy equipment in the construction of the tower, and the traffic of construction vehicles. **Operation**: No air pollution impact is expected.
	2	Water pollution	✓	✓	**Pre-construction:** In areas where surface water exists, soil runoff during rainfall is expected to cause water pollution of rivers due to clearing and root removal during demining work. In addition, wastewater generated from workers' camp is expected to have an impact. **During construction:** In areas where surface water is present, there is the potential for turbidity of river water due to runoff of sediment particles from exposed areas of fill and cut soil during rainfall, and water pollution due to runoff when ground improvement chemicals are used at the tower construction site. In addition, the impact of wastewater discharged from the workers' camp is anticipated. **Operation**: Where surface water is present, removal of vegetation under the line and along the administrative roadway is expected to cause turbidity due to sediment runoff from exposed areas.
	3	Soil pollution	✓		**Pre- and during construction:** Possible soil contamination due to leakage of lubricating oil and fuel oil from construction vehicles and construction equipment, etc., and soil contamination due to spillage when ground improvement chemicals are used at the tower construction site. **Operation**: No potential for soil contamination by the transmission facility is anticipated.
	4	Sediment	✓		**During construction**: If the use of ground improvement chemicals is required, the impact of chemical runoff during rainfall is expected. **Operation**: No impact on bottom sediments is expected from the transmission facility.
	5	Noise and Vibration	✓	✓	**Pre-construction**: Noise and vibration are expected to be generated due to the operation of heavy equipment for clearing and rooting in the sdeminingwork as well as heavy equipment for deep excavation at the location of the steel tower. **During construction:** Noise and vibration are expected to be generated by the operation of heavy machinery and the passage of construction vehicles. **Operation:** Impact of wind noise generation from the transmission line is expected during high winds.
	6	Offensive odors	✓		**Pre-construction:** Waste, domestic wastewater, etc. will be disposed of at the workers' camp, and the impact of odors is anticipated. **During construction:** Waste, domestic wastewater, etc. will be generated at the workers' camp, and the impact of odors is anticipated. **Operation:** No odor is expected to be generated.
	7	Waste	✓		**Pre-construction:** Plants generated by demining work will be waste. In addition, waste and domestic wastewater will be generated at the workers' camp. **During construction:** Waste and sewage are generated at construction sites and workers' camp. **Operation:** No general or hazardous waste is expected to be generated.
	8	Land subsidence	✓	✓	**During construction:** Land subsidence due to vehicular traffic on the access road is expected. **Operation:** Ground subsidence is expected near the towers.

Classification.	Impact item		Evaluation: pre- & Construction	Evaluation: operation	Reasons for evaluation
Natural environment	9	Protected area	✓	✓	**Pre- and during construction:** Depending on the location of the substation, the Namibe Partial Reserve may be affected. **Operation:** Depending on the location of the substation, the Namibe Partial Reserve may be affected.
	10	Ecosystem	✓	✓	**Pre-construction**: demining work will involve clearing and rooting, resulting in loss of vegetation and fragmentation and loss of animal habitat on a certain scale, as well as air pollution and noise and vibration due to the operation of heavy machinery and deep excavation at the location of the steel tower, which is expected to have an impact on animals. **During construction:** After the demining work, air pollution, noise and vibration generated by the operation of heavy equipment and construction vehicles for the construction access road, ROW maintenance, and tower construction are expected to affect animals. **Operation: The** possibility of bird strike is assumed for the entire line, and in wooded areas, the impact of tree cutting to ensure clearance under the line at regular intervals and the fragmentation and loss of animal habitat is assumed.
	11	Hydrology	✓	✓	**Pre-construction**: demining work will involve clearing and root removal, which is expected to have an impact on water quality due to changes in water retention capacity and evaporation rate. **During construction:** Since there will be little new vegetation removal for the construction of the towers, it is assumed that there will be no impact on hydrology **Operation:** Changes in rainfall runoff are expected due to topographical changes caused by the development of the tower site and tree cutting to secure clearance under the line in the forested area.
	12	Topography and Geology	✓	✓	**Pre-construction**: Logging and root clearing for demining work will be conducted, and the potential for topographic change due to erosion is anticipated. **During construction:** construction access road and ROW and topographic impacts due to tower construction are expected. **Operation:** Possible topographic change due to soil runoff is assumed.
Social environment	13	Land acquisition and resettlement	✓		**Pre- and during construction:** The transmission line route between Namibe and Humpata municipalities is planned mostly along the existing 60 kV DL, avoiding residential areas and houses based on secondary information. In addition, the route in Lubango Municipality (Lubango City to 400/220/60 kV Nombungo SS) is largely rerouted to the south, avoiding the central part of Lubango City. However, temporary or permanent relocation may occur if land acquisition for agricultural land or housing occurs, which should be confirmed in the environmental assessment study and resettlement study. **Operation:** No specific impact is expected.
	14	The poor	✓	✓	**During construction:** The presence or absence of poor people among the affected population and the degree of their impact is unknown at this stage and needs to be confirmed through the environmental assessment survey and resettlement survey. **Operation:** If compensation and support measures during the transition period are not adequately provided, it is expected that the level of impoverishment will increase.
	15	Ethnic Minorities and Indigenous Peoples	✓	✓	**During construction:** People who move seasonally in a north-south direction between Bibala Municipality, Namibe Province and Humpata Municipality, Huíla Province will be confirmed. In addition, since there are various ethnic groups and languages among the permanent residents, the social survey in the environmental assessment study will be conducted to understand the details of the residence and activity areas of each ethnic group to confirm whether and to what extent the project will have an

Classification.	Impact item		Evaluation: pre- & Construction	Evaluation: operation	Reasons for evaluation
					impact on them. If indigenous peoples are identified and included in the affected population, an indigenous peoples plan will be developed. **Operation:** Unknown at this stage and will be confirmed by future surveys.
	16	Local economy, including employment and means of livelihood	✓		**During construction:** Local employment opportunities as construction workers and local commerce may be promoted. On the other hand, access to the area around the towers and the approach road will need to be restricted, which may affect farming and grazing activities if farmland or other land is included on the ROW. **Operation:** No specific impact is expected.
	17	Land use and utilization of local resource	✓		**During construction:** The transmission line route between Namibe and Lubango City is planned along the existing 60 kV DL, and although the route avoids residential areas and houses based on secondary information, the land at the base of the tower, although small in scale, will be unavailable, and therefore, the presence and use of agricultural land and private land and houses should be confirmed through field surveys. In addition, access to the area around the tower and the approach road will be restricted during the construction period, which may have a certain degree of impact on activities such as farming and grazing. **Operation:** Not foreseen in particular.
	18	Water use	✓		**During construction:** In areas with low precipitation, construction workers' drinking water and water for construction may deprive local residents of water for domestic and agricultural use (especially during dry season) when they secure water at the construction site. **Operation:** Not foreseen in particular.
	19	Existing social infrastructures and social services	✓		**Pre- and during construction:** When demining work is conducted, there may be an impact on the lives of nearby residents. In addition, an increase in traffic is anticipated. Religious facilities and other facilities used by local residents on a daily basis (educational, medical, community facilities, etc.) need to be considered during the construction period if they are located in or near the project area. **Operation:** No negative impacts on existing social infrastructure are foreseen.
	20	Social institutions such as social infrastructure and local decision-making institutions	✓	✓	**During construction:** The existence and extent of the impact of the project on the local residents and community is unknown at this stage. The existence and extent of the impact of the project on the local residents and community will be confirmed in the social environment survey in the environmental assessment study. **Operation:** Unknown at this stage and will be confirmed by future surveys.
	21	Misdistribution of benefits and losses	✓	✓	**During construction:** There will be potential damage to residents and landowners in and around the Namibe-Lubango transmission line ROW, including land acquisition for towers and access restrictions that will affect agricultural activities. On the other hand, some residents may benefit through employment and commercial opportunities. **Operation:** Unknown at this stage and will be confirmed by future surveys.
	22	Local conflicts of interest	✓		**During construction:** If there are residents who will be affected, such as residents and landowners in and around the ROW, there may be a conflict of interest with residents who will benefit through employment and commercial opportunities. **Operation:** No specific impacts are foreseen.
	23	Cultural heritage	✓	✓	**Pre- and during construction:** There are no cultural or complex heritage sites registered on UNESCO's World Heritage List in and around the project area, including the transmission line construction site. On the other hand, it is necessary to confirm if there are any historical, cultural or archaeological properties or cultural assets designated or recognized in Angola. **Operation:** The degree of impact is unknown at this stage.

Classification.		Impact item	Evaluation: pre- & Construction	Evaluation: operation	Reasons for evaluation
	24	Landscape	✓	✓	**During construction:** Although the project will pass along the east side of Mt. Leba along the existing 60 kV DL, it is anticipated that there will be impacts on the natural landscape due to tree cutting in the ROW, construction of access roads, and entry of heavy equipment. In addition, although the impact on the view of the Christ the King Statue from the city of Lubango will be avoided, it is necessary to confirm whether there will be any impact on this and other cultural landscapes. **Operation:** Permanent impact on the landscape due to overhead power lines and towers is expected.
	25	Gender	✓	✓	**During construction and operation:** The degree of impact is unknown at this stage.
	26	Children's rights	✓	✓	**During construction and operation:** The degree of impact is unknown at this stage.
	27	Infectious diseases such as HIV/AIDS	✓		**During construction:** Influx of construction workers may spread infectious diseases. **Operation:** No negative impacts are foreseen.
	28	Working environment (including occupational safety)	✓	✓	**Pre- and during construction:** the occupational safety impact of conducting demining work should be identified. In general, construction work involves a high risk of accidents. **Operation:** During maintenance, there is a possibility of accidents such as electric shock and falling.
Others	29	Accidents	✓	✓	**Pre- and during construction:** The possibility of accidents during the implementation of demining work is assumed. In addition, accidents may occur due to construction activities and traffic accidents may occur due to increased traffic. **Operation:** If appropriate measures are not taken, such as restricting entry, unforeseen accidents may occur.
	30	Cross-boundary impact and climate change			**During construction:** construction activities will generate CO_2, but are not expected to affect climate change. **Operation:** Transmission lines do not cross the border. Also, no CO_2 is generated.

Source: JICA Survey Team

(2) 60 kV DL

The following table shows the estimated impacts of the 60 kV DL, based on the JICA Guidelines for Environmental and Social Considerations (April 2010), after confirming the characteristics of the line through on-site inspections, existing data and discussions with relevant parties. The results are summarized as shown in Table 9.5-2.

The degree of environmental impact assessed in the scoping was done assuming that no avoidance or mitigation measures were taken, and does not assume the implementation of any avoidance or mitigation measures for the impact. Verbal confirmation was given that the project will not enter the altitude restricted zone at Lubango Airport.

Table 9.5-2 60 kV DL scoping results

Classification.	Impact item		Evaluation: Pre-construction & construction	Evaluation: Operation	Reasons for evaluation
Pollution	1	Air pollution	✓		**Pre-construction:** Since the area is already developed and heavily trafficked by residents and vehicles, the need for mine exploration is assumed to be low. However, air pollutant (SOx, NOx, etc.) emissions and dust generation are expected due to the operation of heavy machinery for deep excavation at the location of the tower. **During construction**: Emission of air pollutants (SOx, NOx, etc.) and dust generation are expected due to the maintenance of the transmission line ROW, the construction road, and the operation of heavy equipment in the construction of the tower, and the traffic of construction vehicles. **Operation:** No air pollution impact is expected.
	2	Water pollution	✓		**Pre-construction:** There are no rivers in the vicinity, and water pollution from demining work is not expected, but wastewater from workers' camp is expected to have an impact. **During construction:** Groundwater pollution is expected due to the use of ground improvement agents at the tower construction site and the effects of sewage runoff from the workers' camp. **Operation:** No water pollution impact is expected.
	3	Soil pollution	✓		**Pre- and during construction:** Possible soil contamination due to leakage of lubricating oil and fuel oil from construction vehicles and construction equipment, etc., and soil contamination due to spillage when ground improvement chemicals are used at the tower construction site. **Operation**: No potential for soil contamination by power distribution facilities is anticipated.
	4	Sediment			**During construction:** There are no rivers in the vicinity and no impact is anticipated. **Operation: There are** no rivers in the vicinity, so no impact is anticipated.
	5	Noise and Vibration	✓	✓	**Pre-construction**: Since the area is already developed and heavily trafficked by residents and vehicles, it is assumed that the need for a mine survey is low. However, noise and vibration are expected to be generated by the operation of heavy machinery for deep excavation at the location of the tower. **During construction:** Noise and vibration are expected to be generated by the operation of heavy machinery and the passage of construction vehicles. **Operation:** Impact of wind noise generation from the transmission line is expected during high winds.
	6	Offensive odors	✓		**Pre-construction:** Waste, domestic wastewater, etc. will be disposed of at the workers' camp, which is expected to have an impact on odors. **During construction:** Waste, domestic wastewater, etc. will be generated at the workers' camp, and the impact of odors is anticipated. **Operation:** No odor is expected to be generated.
	7	Waste	✓		**Pre-construction:** Plants generated by demining work will be waste. In addition, waste and domestic wastewater will be generated at the workers' camp. **During construction:** Waste and sewage are generated at construction sites and workers' camp. **Operation:** No general or hazardous waste is expected to be generated.
	8	Land subsidence	✓	✓	**During construction:** Land subsidence due to vehicular traffic on the access road is expected. **Operation:** Ground subsidence is expected near the towers.

Natural environment	9	Protected area			**During construction:** There are no protected areas in the vicinity and no impact is anticipated. **Operation:** There are no protected areas in the vicinity and no impact is anticipated.
	10	Ecosystem	✓	✓	**Pre-construction**: Since the area is already developed and heavily trafficked by residents and vehicles, the need for landmine exploration is assumed to be low. However, if clearing and rooting for demining work are conducted, removal of vegetation and fragmentation or loss of animal habitats will occur on a certain scale, and air pollution and noise and vibration from heavy equipment operation will affect animals. Air pollution and noise/vibration caused by the operation of heavy machinery are expected to affect animals. **During construction:** After the demining work, air pollution, noise and vibration generated by the operation of heavy equipment and construction vehicles for the construction access road, ROW maintenance, and tower construction are expected to affect animals. **Operation:** potential for bird strike on all lines is anticipated.
	11	Hydrology			**Pre-construction**: The terrain is flat and there are few wooded areas, so the impact of demining work on hydrology is not expected. **During construction:** Since there will be little new vegetation removal for the construction of the towers, it is assumed that there will be no impact on hydrology. **Operation:** No impact on hydrology is expected.
	12	Topography and Geology			**Pre- and during construction:** No impact is expected due to the flat topography and little topographic alteration. **Operation:** No topographic impacts are anticipated.
Social environment	13	Land acquisition and resettlement	✓		**Pre- and during construction:** The section of the distribution line route planned along the existing road avoids the residential development area, and no private land acquisition or involuntary resettlement is anticipated. On the other hand, final confirmation, avoidance, and mitigation measures for economic activities and illegal settlements in the section planned along the railway need to be taken at the detailed design stage. **Operation:** Not anticipated.
	14	The poor	✓	✓	**During construction:** Regarding the socioeconomic situation and living environment of the residents of the area, the presence or absence of poor people among the affected residents and the degree of their impact are unknown at this stage. **Operation:** Unknown at this stage.
	15	Ethnic Minorities and Indigenous Peoples			**During construction and operation:** no indigenous presence has been identified, both in terms of settlement and seasonal migration. Therefore, no specific impacts are anticipated.
	16	Local economy, including employment and means of livelihood	✓		**During construction:** Local employment opportunities as construction workers and local commerce may be promoted and stimulated. On the other hand, since the area around the tower and the approach road will be off-limits, some restrictions may be imposed on economic activities, etc. **Operation:** Not expected.
	17	Land use and utilization of local resource	✓		**During construction: the** distribution line route is planned along the existing road and existing railway, and during the site inspection in September 2021, it was confirmed that residential areas and houses have been avoided. However, the land at the base of the towers, although small in scale, will not be available, and final confirmation, avoidance, and impact mitigation measures will be necessary during the construction phase. In addition, since the area around the tower and the approach road will be off-limits during the construction period, some restrictions may be imposed on economic activities, etc., if they are taking place. **Operation:** Not foreseen in particular.
	18	Water use	✓		**During construction:** When securing drinking water for construction workers and construction water at the construction site (especially during the dry season), it is necessary to coordinate with the local residents' domestic water supply. **Operation:** Not foreseen in particular.
	19	Existing social infrastructures and social services	✓		**Pre- and during construction:** The area is already developed and heavily trafficked by residents and vehicles, and demining work may impact the lives of nearby residents. Increased traffic is anticipated. If facilities that local residents use on a daily basis (railway stations, educational, medical,

					and community facilities, etc.) are located in the vicinity, consideration must be given during the construction period. **Operation:** Not foreseen in particular.
	20	Social institutions such as social infrastructure and local decision-making institutions	✓	✓	**During construction:** The existence and extent of the impact of the project on the local residents and community is unknown at this stage. The existence and extent of the impact of the project on the local residents and community will be confirmed by the social and environmental survey. **Operation:** Unknown at this stage and will be confirmed by future surveys.
	21	Misdistribution of benefits and losses	✓	✓	**During construction:** The existence and extent of the impact of the project on the local residents and community is unknown at this stage. The existence and extent of the impact of the project on the local residents and community will be confirmed by a social and environmental survey. **Operation:** Unknown at this stage and will be confirmed by future surveys.
	22	Local conflicts of interest	✓	✓	**During construction:** The existence and extent of the impact of the project on the local residents and community is unknown at this stage. The existence and extent of the impact of the project on the local residents and community will be confirmed by a social and environmental survey. **Operation:** Unknown at this stage and will be confirmed by future surveys.
	23	Cultural heritage			**Pre-, during and operation:** There are no cultural or complex heritage sites registered as World Heritage Sites by UNESCO, or historical, cultural or archaeological assets or cultural properties designated or recognized in Angola in the vicinity of the distribution line construction site and its surroundings.
	24	Landscape	✓	✓	**During construction**: impacts to the natural landscape are expected to occur due to ROW clearance, access road construction, heavy equipment, etc. Impacts to cultural landscapes are not anticipated. Note that since the distribution line route is located in a residential development area and railways and 150 kV transmission line are already in place, impacts on the urban landscape are expected to be limited. **Operation:** Permanent impact on the landscape due to overhead power lines and towers is expected.
	25	Gender	✓	✓	**During construction and operation:** The degree of impact is unknown at this stage.
	26	Children's rights	✓	✓	**During construction and operation:** The degree of impact is unknown at this stage.
	27	Infectious diseases such as HIV/AIDS	✓		**During construction**: Influx of construction workers may spread infectious diseases. **Operation:** No negative impacts are foreseen.
	28	Working environment (including occupational safety)	✓	✓	**Pre- and during construction**: Since the area is already developed and heavily trafficked by residents and vehicles, the possibility of accidents due to mines is assumed to be low; however, the impact on occupational safety due to the implementation of mine search and removal operations should be confirmed. In general, the risk of accidents is high in construction work. **Operation:** During maintenance, there is a possibility of accidents such as electric shock and falling.
Others	29	Accidents	✓	✓	**Pre-construction:** The area is already developed and heavily trafficked by residents and vehicles, and the possibility of accidents due to mines and UXOs is assumed to be low; however, there is a possibility of accidents when excavation is conducted for exploration at the location of the steel tower. **During construction:** accidents may occur due to construction activities and traffic accidents may occur due to a significant increase in traffic. **Operation:** If appropriate measures are not taken, such as restricting entry, unforeseen accidents may occur.
	30	Cross-boundary impact and climate change			**During construction:** construction activities will generate CO_2, but are not expected to affect climate change. **Operation:** Distribution lines do not cross the border. No CO_2 is generated.

Source: JICA Survey Team

(3) Substations

(a) 220/60 kV New Namibe SS point

The candidate sites selected through the comparative study of alternatives were characterized by site inspections and existing data, and the results were used to develop a list of alternatives. The scoping of the sites is shown in Table 9.5-3.

Table 9.5-3 220/60 kV New Namibe SS Scoping Results

Classification.	Impact item		Evaluation		Reasons for evaluation
			Pre-construction & construction	Operation	
Pollution	1	Air pollution	✓		**Pre-construction**: Emission of air pollutants (SOx, NOx, etc.) and generation of dust are expected due to the operation of heavy equipment in the demining work. **During construction**: Emissions of air pollutants (SOx, NOx, etc.) and dust emissions are expected due to the construction of access roads, operation of heavy equipment for substation construction, and traffic of construction vehicles. **Operation:** No air pollution impact is expected.
	2	Water pollution	✓	✓	**Pre-construction:** Due to excavation from demining work, soil runoff is expected to be affected during rainfall, and drainage from workers' camp is expected to be affected. **During construction:** The construction of the substation site is expected to be affected by the muddying of the river due to soil runoff during rainfall and sewage runoff from the construction site and workers' camp. **Operation:** When staff are stationed in the facility, domestic wastewater is generated.
	3	Soil pollution	✓		**Pre- and during construction:** Since the proposed construction site is a desert and there are no sources of contamination in the surrounding area, soil contamination is not expected at the current location; however, it is assumed that there is a possibility of soil contamination due to leakage of lubricating oil and fuel oil from construction vehicles and construction machinery. **Operation:** No soil contamination is anticipated at the substation site or in the surrounding area.
	4	Sediment	✓		**During construction:** If the use of ground improvement chemicals is required, the impact of chemical runoff during rainfall is expected. **Operation:** No impact from the substation is expected.
	5	Noise and Vibration	✓	✓	**Pre-construction**: Noise and vibration are expected to be generated by the operation of heavy equipment during the sdemining work. **During construction:** Noise and vibration are expected to be generated by the construction of the access road, operation of heavy equipment for the substation construction, and construction vehicle traffic. **Operation:** Noise and vibration are expected to be generated by the traffic of related vehicles, and background noise is expected to increase at the sound receiving point due to the noise generation of transformers from the substation.
	6	Offensive odors	✓	✓	**Pre-construction:** Waste and domestic wastewater are generated in the workers' camp, and the possibility of foul odors is assumed. **During construction:** If waste, domestic wastewater, etc. are not properly treated at the workers' camp, odors are expected to be generated. **Operation:** When staff are stationed in the facility, waste, domestic wastewater, etc. will be generated, and the potential for odor generation is anticipated.
	7	Waste	✓	✓	**Pre-construction:** Plant materials are generated as waste in the sdemining work. Waste and domestic wastewater will be generated at the workers' camp. **During construction:** waste and sewage are generated at the construction site and workers' camp **Operation:** When staff are stationed in the facility, waste, domestic wastewater, etc. are expected to be generated.

Classification.	Impact item		Evaluation: Pre-construction & construction	Evaluation: Operation	Reasons for evaluation
	8	Land subsidence	✓	✓	**During construction:** Land subsidence due to vehicular traffic on the access road is expected. **Operation:** Ground subsidence at the substation is expected.
Natural environment	9	Protected area			**Pre- and during construction:** no impact on the Namibe Partial Reserve is anticipated. **Operation:** no impact on Namibe Partial Reserve is expected.
	10	Ecosystem	✓	✓	**Pre-construction**: Excavation will be conducted for demining work, resulting in removal of vegetation, fragmentation and loss of animal habitats on a certain scale, and air pollution and noise and vibration caused by the operation of heavy machinery are expected to affect animals. **During construction:** After demining work, air pollution and noise/vibration impacts due to construction access roads, substation site preparation, and construction vehicle traffic and heavy equipment operation during substation construction are anticipated. **Operation:** A portion of the desert is permanently altered by the construction of a substation.
	11	Hydrology			**Pre- and during construction:** No impact on water quality is anticipated due to the relatively flat topography and lack of major topographic modification. **Operation:** No impact is expected due to the relatively flat topography and lack of major topographic changes.
	12	Topography and Geology	✓	✓	**Pre- and during construction**: The terrain is relatively flat and topographical changes are expected to be minor. **Operation**: Although the terrain is relatively flat and there will be no major topographic alteration, erosion is expected in the long term if proper drainage measures are not taken.
Social environment	13	Land acquisition and resettlement			**Pre- and during construction:** the proposed substation site is located on uninhabited desert land, and the need to widen the access road is not anticipated. **Operation:** Not expected.
	14	The poor			**Pre- and during construction:** The proposed substation site is located on uninhabited desert land and is not expected to affect the poor. **Operation:** Not expected.
	15	Ethnic Minorities and Indigenous Peoples			**During construction:** The proposed substation site is located on uninhabited desert land, and the need to widen the access road is not anticipated, nor is the impact on minorities and indigenous peoples. **Operation:** Not expected.
	16	Local economy, including employment and means of livelihood	✓		**During construction:** local employment opportunities as construction workers and local commerce may be promoted and stimulated. **Operation:** unskilled employment in substation maintenance may occur.
	17	Land use and utilization of local resource			**During construction:** The proposed substation site is located on uninhabited desert land and no land use for agriculture or grazing has been identified. **Operation:** Not foreseen in particular.
	18	Water use			**During construction:** The proposed substation site is located on uninhabited desert land and will require access to necessary construction water from the City of Moçâmedes, but no land use for agriculture or grazing has been identified and therefore no impact on water use is anticipated. **Operation:** Not foreseen in particular.
	19	Existing social infrastructures and social services	✓		**Pre- and during construction:** Since the site is located in the desert, no impact on the lives of nearby residents is anticipated even if mines or UXOs are disposed of as a result of demining work. On the other hand, consideration must be given during the construction period due to the expected increase in traffic.

Classification.	Impact item		Evaluation: Pre-construction & construction	Evaluation: Operation	Reasons for evaluation
					Operation: No negative impacts on existing social infrastructure are foreseen.
	20	Social institutions such as social infrastructure and local decision-making institutions			**During construction:** no specific negative impacts on social and relational capital or local decision-making institutions are foreseen. **Operation:** Not expected.
	21	Misdistribution of benefits and losses			**During construction and operation:** No negative impacts are foreseen.
	22	Local conflicts of interest			**During construction and operation:** No negative impacts are foreseen.
	23	Cultural heritage			**Before, during and operation:** there are no cultural or complex heritage sites listed on the UNESCO World Heritage List or historical, cultural or archaeological properties or cultural assets designated or recognized in Angola in the vicinity of the proposed substation site and its surroundings.
	24	Landscape	✓	✓	**During construction:** Since the proposed substation site is located in a desert and there are no inhabitants in the vicinity, no impact on the cultural landscape is anticipated, but construction work and intrusion of heavy machinery are expected to affect the natural landscape. **Operation:** permanent impact on the landscape by the substation is expected.
	25	Gender	✓	✓	**During construction and operation:** The degree of impact is unknown at this stage.
	26	Children's rights	✓	✓	**During construction and operation:** The degree of impact is unknown at this stage.
	27	Infectious diseases such as HIV/AIDS	✓		**During construction:** Possible outbreak and spread of infectious diseases due to influx of construction workers. **Operation:** No negative impacts are foreseen.
	28	Working environment (including occupational safety)	✓	✓	**Pre- and during construction:** the occupational safety impact of conducting demining work should be identified. In general, construction work involves a high risk of accidents. **Operation:** During maintenance, there is a possibility of accidents such as electric shock and falling.
Others	29	Accidents	✓	✓	**Pre-construction:** Since demining work will be carried out, the possibility of accidents during exploration and removal activities is assumed. **During construction:** accidents may occur due to construction activities and traffic accidents may occur due to increased traffic. **Operation:** If appropriate measures are not taken, such as restricting entry, unforeseen accidents may occur.
	30	Cross-boundary impact and climate change			**During construction:** construction activities will generate CO_2, but are not expected to affect climate change. **Operation:** The substation does not cross the border. Also, no CO_2 is generated.

Source: JICA Survey Team

(b) 220/60 kV East Lubango SS

The characteristics of the 220/60 kV East Lubango SS site were determined from the site visit and existing documents and data, and the facts were confirmed through discussions with the parties concerned. The scoping was conducted as shown in Table 9.5-4.

Table 9.5-4 220/60 kV East Lubango SS Scoping Results

Classification.	Impact item		Evaluation: Pre- construction & construction	Evaluation: Operation	Reasons for evaluation
Pollution	1	Air pollution	✓		**Pre-construction**: Emission of air pollutants (SOx, NOx, etc.) and generation of dust are expected due to the operation of heavy equipment in the demining work. **During construction**: Emissions of air pollutants (SOx, NOx, etc.) and dust emissions are expected due to the construction of access roads, operation of heavy equipment for substation construction, and traffic of construction vehicles. **Operation:** No air pollution impact is expected.
	2	Water pollution	✓	✓	**Pre-construction:** There are no rivers in the vicinity, and water pollution from demining work is not expected, but wastewater from workers' camp is expected to have an impact. **During construction:** There are no rivers in the vicinity, so the construction is not expected to have any impact, but domestic wastewater from the workers' camp is expected to have an impact. **Operation:** When staff is located in the facility, the impact of domestic wastewater is expected.
	3	Soil pollution	✓		**Pre- and during construction:** Possible leakage of lubricating oil and fuel oil from construction vehicles, construction equipment, etc. **Operation:** No soil contamination is anticipated at the substation site or in the surrounding area.
	4	Sediment			**During construction:** There are no rivers in the vicinity, and no impact on bottom sediment is anticipated. **Operation:** There are no rivers in the vicinity, and no impact on bottom sediment is anticipated.
	5	Noise and Vibration	✓	✓	**Pre-construction**: Noise and vibration are expected to be generated by the operation of heavy equipment during the sdemining work **During construction:** Noise and vibration are expected to be generated by the construction of the access road, operation of heavy equipment for the substation construction, and construction vehicle traffic. **Operation:** Noise and vibration are expected to be generated by the traffic of related vehicles, and background noise is expected to be generated from the substation.
	6	Offensive odors	✓	✓	**Pre-construction:** Waste and domestic wastewater are generated in the workers' camp, and the possibility of odors is assumed. **During construction:** If waste, domestic wastewater, etc. are not properly treated at the workers' camp, odors are expected to be generated. **Operation:** When staff are stationed in the facility, waste, domestic wastewater, etc. will be generated, and the potential for odor generation is anticipated.
	7	Waste	✓	✓	**Pre-construction:** Plant materials are generated as waste in the demining work. Waste and domestic wastewater will be generated at the workers' camp. **During construction:** Waste and sewage are generated at the construction site and workers' camp. **Operation:** When staff are stationed in the facility, waste, domestic wastewater, etc. are expected to be generated.
	8	Land subsidence	✓	✓	**During construction:** Land subsidence due to vehicular traffic on the access road is expected. **Operation:** Ground subsidence at the substation is expected.

Natural environment	9	Protected area			**Pre- and during construction:** There are no protected areas in the vicinity and no impact is anticipated. **Operation: There are** no protected areas in the vicinity and no impact is anticipated.
	10	Ecosystem	✓	✓	**Pre-construction**: Excavation will be conducted for demining work, resulting in removal of vegetation, fragmentation and loss of animal habitats on a certain scale, and air pollution and noise and vibration caused by the operation of heavy machinery are expected to affect animals. **During construction:** After demining work, air pollution and noise/vibration impacts due to construction access roads, substation site preparation, and construction vehicle traffic and heavy equipment operation during substation construction are anticipated. **Operation:** A portion of the desert is permanently altered by the construction of the substation.
	11	Hydrology			**Pre- and during construction:** No impact on water quality is anticipated due to the relatively flat topography and lack of major topographic modification. **Operation:** No impact is expected due to the relatively flat topography and lack of major topographic changes.
	12	Topography and Geology	✓	✓	**Pre- and during construction**: The terrain is relatively flat and topographical changes are expected to be minor. **Operation**: Although the terrain is relatively flat and there will be no major topographic alteration, erosion is expected in the long term if proper drainage measures are not taken.
Social environment	13	Land acquisition and resettlement			**Pre- and during construction:** The proposed substation site is located on public land with savannas, and there are no settlements or agricultural lands in the vicinity, so land acquisition and resettlement are not expected. **Operation:** Not expected.
	14	The poor			**During construction:** The proposed substation site is located in a savanna area and there are no villages or agricultural lands in the vicinity, so no impact on the poor is anticipated. **Operation:** Not expected.
	15	Ethnic Minorities and Indigenous Peoples			**During construction:** No impact is anticipated as there are no indigenous people in or around the substation. **Operation:** Not expected.
	16	Local economy, including employment and means of livelihood	✓		**During construction: L**ocal employment opportunities as construction workers and local commerce may be promoted and stimulated. **Operation:** Employment in substation maintenance is expected to occur.
	17	Land use and utilization of local resource			**During construction:** The proposed substation site is located on public lands with savannas, and there are no villages or agricultural lands in the vicinity, so no impacts on land use or local resources are anticipated. **Operation:** Not expected.
	18	Water use	✓		**During construction:** The proposed substation site is located on public lands with savannas, and it is necessary to secure the necessary water for construction. Coordination with domestic water needs of local residents (especially during the dry season) may be required. **Operation:** Not foreseen in particular.
	19	Existing social infrastructures and social services	✓		**Pre- and during construction:** Since the proposed substation site is located on public land where savanna spreads and there are no villages or agricultural lands in the vicinity, even if mines or UXOs are found, the impact on residents and social services due to the demining work is expected to be small. On the other hand, the section from the nearest existing paved road to the planned construction site is unpaved, so it is necessary to prepare a delivery route. In order to ensure separation from the existing 150 kV transmission line, it will be necessary to take measures such as shutting down the transmission line during transport. An increase in traffic is anticipated. Although no facilities used by local residents on a daily basis are identified in the project area or vicinity, consideration should be given to the use of existing roads during the construction period. **Operation:** No negative impacts on existing social infrastructure are foreseen.

	20	Social institutions such as social infrastructure and local decision-making institutions			**During construction and operation:** no negative impacts on social capital or local decision-making bodies are foreseen.
	21	Misdistribution of benefits and losses			**During construction and operation:** No negative impacts are foreseen.
	22	Local conflicts of interest			**During construction and operation:** No negative impacts are foreseen.
	23	Cultural heritage			**Pre-, during and operation:** There are no cultural or complex heritage sites registered on the World Heritage List of UNESCO, or historical, cultural or archaeological properties or cultural assets designated or recognized in Angola in the area of the substation construction site and its surroundings.
	24	Landscape	✓	✓	**During construction:** The proposed substation site is located on public land with savannas, and there are no villages or farmlands in the vicinity. Therefore, no impact on cultural landscape is anticipated, but construction work and intrusion of heavy machinery are expected to affect the natural landscape. **Operation:** permanent impact on the landscape by the substation is expected.
	25	Gender	✓	✓	**During construction and operation:** The degree of impact is unknown at this stage.
	26	Children's rights	✓	✓	**During construction and operation:** The degree of impact is unknown at this stage.
	27	Infectious diseases such as HIV/AIDS	✓		**During construction:** Influx of construction workers may spread infectious diseases. **Operation:** No negative impacts are foreseen.
	28	Working environment (including occupational safety)	✓	✓	**Pre- and during construction:** the occupational safety impact of conducting demining work should be identified. In general, construction work involves a high risk of accidents. **Operation:** Possible accidents during maintenance.
Others	29	Accidents	✓	✓	**Pre- and during construction:** The proposed substation site is located on public lands where savannas spread, and the likelihood of finding mines and unexploded ordnance is considered low; however, if found, demining work will be conducted, and the possibility of accidents is assumed. In addition, the possibility of accidents during construction is assumed. **During construction:** accidents may occur due to construction activities and traffic accidents may occur due to increased traffic. **Operation:** If appropriate measures are not taken, such as restricting entry, unforeseen accidents may occur.
	30	Cross-boundary impact and climate change			**During construction:** construction activities will generate CO_2, but are not expected to affect climate change. **Operation:** The substation does not cross the border. Also, no CO_2 is generated.

Source: JICA Survey Team

(c) 60/15 kV Arimba SS

The characteristics of the 60/15 kV Arimba SS site were determined from the site visit and existing data and documents, and the facts were confirmed through discussions with the relevant parties. The scoping was conducted as shown in Table 9.5-5.

Table 9.5-5 60/15 kV Arimba SS Scoping Results

Classification.	Impact item		Evaluation: Pre- & construction	Evaluation: Operation	Reasons for evaluation
Pollution	1	Air pollution	✓		**Pre-construction**: The land has already been developed and secured by the operator, and the possibility of accidents due todemining work is assumed to be low, but the operation of heavy machinery and other equipment is expected to have an impact when safety checks are conducted on unexploded ordnance at deep depths. **During construction**: Emissions of air pollutants (SOx, NOx, etc.) and dust emissions are expected due to the construction of access roads, operation of heavy equipment for substation construction, and traffic of construction vehicles. **Operation:** No air pollution impact is expected.
	2	Water pollution	✓	✓	**Pre-construction:** There are no rivers in the vicinity, and water pollution from demining work is not expected, but wastewater from workers' camp is expected to have an impact. **During construction:** There are no rivers in the vicinity, so the construction is not expected to have any impact, but domestic wastewater from workers' camp is expected to have an impact. **Operation:** When staff is located in the facility, the impact of domestic wastewater is expected.
	3	Soil pollution	✓		**Pre- and during construction:** Possible leakage of lubricating oil and fuel oil from construction vehicles, construction equipment, etc. **Operation:** No soil contamination is expected.
	4	Sediment			**During construction:** There are no rivers in the vicinity, and no bottom sediment impacts are anticipated. **Operation:** There are no rivers in the vicinity, and no impact on bottom sediment is anticipated.
	5	Noise and Vibration	✓	✓	**Pre-construction**: The land has already been developed and secured by the operator, and the possibility of accidents due to demining work is assumed to be low, but the operation of heavy machinery and other equipment is expected to have an impact when safety checks are conducted on unexploded ordnance at deep depths. **During construction**: Noise and vibration are expected to be generated by the construction of the access road, operation of heavy equipment for the substation construction, and construction vehicle traffic. **Operation:** Noise and vibration are expected to be generated by the traffic of related vehicles, and background noise is expected to be generated from the substation.
	6	Offensive odors	✓	✓	**Pre-construction:** Waste and domestic wastewater are generated in the workers' camp, and the possibility of foul odors is assumed. **During construction:** If waste, domestic wastewater, etc. are not properly treated at the workers' camp, odors are expected to be generated. **Operation:** When staff are stationed in the facility, waste, domestic wastewater, etc. will be generated, and the potential for odor generation is anticipated.
	7	Waste	✓	✓	**Pre-construction:** Plant materials are generated as waste in the sdemining work. Waste and domestic wastewater will be generated at the workers' camp. **During construction**: Waste and sewage will be generated at the construction site and workers' camp. **Operation:** When staff are stationed in the facility, waste and domestic wastewater are expected to be generated.
	8	Land subsidence	✓	✓	**During construction:** Land subsidence due to vehicular traffic on the access road is expected. **Operation:** Ground subsidence at the substation is expected.

Natural environment	9	Protected area			**Pre- and during construction:** There are no protected areas in the vicinity and no impact is anticipated. **Operation:** There are no protected areas in the vicinity and no impact is anticipated.
	10	Ecosystem	✓		**Pre-construction:** The land has already been developed and secured by the operator, and the possibility of accidents due to mines and unexploded ordnance is assumed to be low, but the operation of heavy machinery and other equipment is expected to have an impact when safety checks are conducted on unexploded ordnance at deep depths. **During construction:** Air pollution and noise/vibration impact on animals due to construction access road, substation site development, and construction vehicle traffic and heavy equipment operation during substation construction is anticipated. **Operation:** No ecological impact is expected.
	11	Hydrology			**Pre- and during construction:** No impact is expected due to the absence of rivers in the vicinity. **Operation:** No impact is expected due to the absence of rivers in the vicinity.
	12	Topography and Geology	✓	✓	**Pre- and during construction:** The site has already been cleared and fenced, and the impact is expected to be minimal. **Operation**: Although the land has already been cleared and is not expected to undergo major topographical changes, erosion is expected in the long term if proper drainage measures are not taken.
Social environment	13	Land acquisition and resettlement			**Pre- and during construction:** The proposed substation site has already been acquired and is separated from the outside by a fence. There is no land acquisition or relocation of residents. **Operation:** Not expected.
	14	The poor			**During construction:** the proposed substation site has already been acquired and is separated from the outside by a fence. No impact on the poor is expected. **Operation:** Not expected.
	15	Ethnic Minorities and Indigenous Peoples			**During construction:** The proposed substation site has already been acquired and is separated from the outside by a fence. No impact on indigenous people is anticipated. **Operation:** Not expected.
	16	Local economy, including employment and means of livelihood	✓		**During construction:** local employment opportunities as construction workers and local commerce may be promoted and stimulated. **Operation:** employment in substation maintenance is expected to occur.
	17	Land use and utilization of local resource			**During construction:** the proposed substation site has already been acquired and is separated from the outside by a fence. Impacts to land use and local resources are therefore not anticipated. **Operation:** Not expected.
	18	Water use	✓		**During construction:** Water for construction work needed for the substation construction needs must be secured, which may require coordination (especially during the dry season) with the domestic water needs of the local population in the surrounding area. **Operation:** Not foreseen in particular.
	19	Existing social infrastructures and social services	✓		**Pre- and during construction:** Since the proposed substation site is located in an enclosed area that has already been developed and cleared, even if mines or unexploded ordnance are discovered, the impact of the disposal work on residents and social services is expected to be small. On the other hand, an increase in traffic is anticipated. Although no facilities used by local residents on a daily basis are identified in or around the project area, consideration should be given to the use of existing roads and the installation of underground lines during the construction period. **Operation:** No negative impacts on existing social infrastructure are foreseen.
	20	Social institutions such as social infrastructure and local decision-making institutions			**During construction and operation:** no negative impacts on social capital or local decision-making bodies are foreseen.

	21	Misdistribution of benefits and losses			**During construction and operation:** No negative impacts are foreseen.
	22	Local conflicts of interest			**During construction and operation:** No negative impacts are foreseen.
	23	Cultural heritage			**During construction and operation:** There are no cultural or complex heritage sites registered on the UNESCO World Heritage List, or historical, cultural or archaeological properties or cultural assets designated or recognized in Angola in the area of the substation construction site and its surroundings.
	24	Landscape	✓	✓	**During construction:** Although the proposed substation site is located in an enclosed area that has already been developed and cleared, and therefore is not expected to impact the cultural landscape, the construction of underground power lines around the substation and the intrusion of heavy machinery and other equipment into the substation site are expected to impact the landscape. **Operation:** permanent impact on the landscape by the substation is expected.
	25	Gender	✓	✓	**During construction and operation:** The degree of impact is unknown at this stage.
	26	Children's rights	✓	✓	**During construction and operation:** The degree of impact is unknown at this stage.
	27	Infectious diseases such as HIV/AIDS	✓		**During construction:** Influx of construction workers may spread infectious diseases. **Operation:** No negative impacts are foreseen.
	28	Working environment (including occupational safety)	✓	✓	**Pre- and during construction:** the occupational safety impact of conducting demining work should be identified. In general, construction work involves a high risk of accidents. **Operation:** Possible accidents during maintenance.
Others	29	Accidents	✓	✓	**Pre-construction:** The site has already been developed and secured by the operator, and the possibility of accidents due to mines and unexploded ordnance is assumed to be low; however, if discovered, accidents may occur during disposal operations. **During construction:** accidents may occur due to construction activities and traffic accidents may occur due to increased traffic. **Operation:** If appropriate measures are not taken, such as restricting entry, unforeseen accidents may occur.
	30	Cross-boundary impact and climate change			**During construction:** construction activities will generate CO_2, but are not expected to affect climate change. **Operation:** The substation does not cross the border. Also, no CO_2 is generated.

Source: JICA Survey Team

9.5.2. TOR of the Environmental and Social Survey

In this study, an environmental assessment study based on the JICA Guidelines (April 2010) and the World Bank OP4.01 were conducted and to be approved by the Angolan government side. On the other hand, the potential for resettlement or loss of livelihoods, although not on a large scale, and the impact on indigenous peoples will be confirmed in this study, and a draft abbreviated resettlement plan (ARAP) / indigenous peoples plan (IPP) will be prepared as necessary. Since the study on environmental and social considerations will examine multiple proposals for both the transmission line route and the substation locations, it is necessary to proceed reasonably and without omission in consultation with the relevant agencies and local communities.

(1) Survey Items, Methods, Predictions, and Proposed Countermeasures

Based on the information (existence or non-existence of studies, results of studies, and environmental forecasts) that have been identified through the EIA conducted in accordance with the Angolan Environmental Protection Law, the items, methods, and draft measures for the studies to be conducted in this study are shown in the table below. The selection of survey items was based on the opinions of the participants in the preliminary discussions held in February 2020, including the governments of Huíla and Namibe provinces and project stakeholders in Luanda (for details, see 9.11.1 for details).

Table 9.5-6 Study Items, Methods, Predictions and Draft Measures (220 kV TL & Associated Facilities)

Environmental Items	Survey item	Study method	Anticipated measures
Air pollution	- Related Environmental Standards - Weather (meteorology) information - Current air quality (PM2.5 and PM10) around the subject area	- Obtaining Air Quality Standards - Obtain weather data (temperature, humidity, etc.) from nearby weather stations - Atmospheric Measurement ✧ Once during the dry season ✧ 1 East Lubango SS, 1 Namibe substation, 2 total	- Take measures to prevent air pollution during construction.
Water pollution	- Related Environmental Standards - Nearby river conditions (flow rate, turbidity) - Wastewater treatment method - Whether or not ground improvement agents are used	- Obtain water quality and effluent standards - Check river conditions - Obtain wastewater treatment plans from workers' camp - Confirmation of whether or not ground improvement agents are used	- Take measures to prevent water pollution during construction. - Domestic wastewater and other wastewater shall meet the respective effluent standards by having wastewater treatment facilities installed. - Take post-completion rainfall-runoff measures as necessary.
Soil pollution	- Related Environmental Standards	- Obtain relevant standards and existing materials	- Take measures to prevent oil contamination during construction.
Sediment	- Rivers - Spillage of pollutants	- Obtain topographic maps and river location maps - Confirmation of use of ground improvement materials, etc.	- Take measures to prevent spillage during construction.
Noise and Vibration	- Related Environmental Standards - Noise and vibration in the vicinity of the protected area and along the expected route	- Obtain noise standards - Noise and vibration measurements ✧ Two rainy seasons and two dry seasons ✧ 2 locations north and south of the IBA in Lubango and 1 location in Lubango city, for a total of 3 locations.	- Take measures against noise and vibration during construction.
Offensive odors	- Related Environmental Standards	- Obtain environmental standards for odor sources	- During construction, measures will be taken to handle domestic wastes.
Waste	- Related laws and regulations - Current Status of Waste Disposal	- Interviews with relevant organizations, local governments, etc. - Confirmation of disposal methods for waste, PCBs, and sulfur hexafluoride	- Develop a plan for handling industrial and domestic wastes during construction.
Land subsidence	- Geological features - Terrain - Transportation route of heavyweight material	- Obtain geologic and topographic maps - Obtain borehole survey results	- Selection of tower location and construction method with consideration for the ground
Protected area	- Information on protected	- Confirmation of	- If the power line route

Environmental Items	Survey item	Study method	Anticipated measures
	areas, etc. - Related laws and regulations	protected areas, etc. designated by the government - Obtaining information on rare species	passes close to protected areas, etc., consider changing the route, etc. - Select appropriate construction time and methods based on the behavior of valuable species.
Ecosystem	- Current status of ecologically important sites (breeding and foraging areas) - Flora and fauna (mammals, birds (resident and migratory), reptiles, amphibians, insects, plants)	- Confirmation of distribution of flora and fauna - Existing material research, interviews - Confirmation of species by voluntary trampling - Collecting information on plant and animal sightings and past survey results - Confirmation of bird ecology ✧ Migratory season (wintering season: March to early May, breeding season: September to October, two times in total) ✧ In the five representative ecoregion categories, the observation is basically based on voluntary observation while taking into consideration the safety of mines. - Interviews with research institutes, universities, schools and NGOs ✧ Collect information on the species and location and timing of sightings.	- Estimate the extent of impact on ecologically important sites (breeding and foraging areas), and develop countermeasures if it is foreseen to be significant. - If a valuable species is present along the transmission line route, estimate the extent of the impact and, if severe, develop countermeasures. - If the distribution of large birds is near the transmission line route, measures should be developed.
Hydrology	- Satellite image - Field reconnaissance	- Satellite imagery of topography - Assumption of topography and stream flow based on site visit	- Assuming rainwater runoff during rainfall, the impact on soil erosion and other factors will be studied and reflected in the design of soil erosion countermeasures.
Topography and Geology	- Geological Status	- Obtaining geological information	- A geological survey will be conducted during detailed design to determine the location of the tower.
Land acquisition and resettlement	- Check easement (ROW) status of power lines - Confirmation of the existence of private land in the land subject to land acquisition - Confirmation of the use of the land in question	- Site visit, collection of existing data - Interviews with local authorities - Interviews with local residents - Obtain relevant legal systems and relevant case studies	- If land acquisition and resettlement are unavoidable, the size of the site should be confirmed and a proposed RAP or ARAP should be developed.
The poor			

Environmental Items	Survey item	Study method	Anticipated measures
	- Identification of poor residents among the affected population	- Site visits, collection of existing data, interviews, etc.	- If included in the affected population, prepare a compensation and livelihood restoration plan.
Ethnic Minorities and Indigenous Peoples	- Identification of indigenous peoples among the affected population	- Site visits, collection of existing data, interviews, etc.	- If included in the affected population, a draft Indigenous Peoples Plan shall be prepared.
Local economy, including employment and means of livelihood	- Gathering and analyzing information on population size, composition, and distribution, as well as local economic and industrial conditions	- Interviews with local authorities - Gathering data related to local employment situation and income	- Reflecting Residents' Considerations in Environmental Management Plans
Land use and utilization of local resource	- Current status of land use	- Collection of related materials - socio-economic survey	- Consider measures to be taken if the tower construction affects activities such as grazing and agriculture.
Water use	- Confirmation of the availability of water for domestic and agricultural use	- socio-economic survey - Interviews with local residents	- Take measures to prevent water pollution during construction. - During construction, priority will be given to securing water for domestic and agricultural use for residents. - Have wastewater treatment facilities installed for domestic and other wastewater discharged by construction workers to meet effluent standards.
Existing social infrastructures and social services	- Current Traffic Volume - Current status of surrounding residential conditions, social infrastructure and services	- Traffic volume statistical data collection - Collection of related materials - Interviews with local authorities	- Develop a schedule for vehicle operations during construction. - Identify the impact of demining work.
Social institutions such as social infrastructure and local decision-making institutions	- Identification of regional networks and social structures	- Interviews with local authorities - Interviews with local residents	- Explanation of the project plan to residents during the period of this cooperative preparatory study - Explanation to residents during the project implementation period
Misdistribution of benefits and losses	- Confirmation of occupation and livelihood of local residents who may be affected by the project	- Gathering data on local employment conditions and income - Interviews with local residents	- Reflecting Residents' Considerations in Environmental Management Plans
Local conflicts of interest	- Confirmation of occupation and livelihood of local residents who may be affected by the project	- Gathering data on local employment conditions and income - Interviews with local residents	- Reflecting Residents' Considerations in Environmental Management Plans
Cultural heritage	- Confirmation of the existence of designated and recognized cultural assets in Angola	- document collection	- If cultural heritage sites are present, the siting plan should avoid such sites.

Environmental Items	Survey item	Study method	Anticipated measures
Landscape	- Identification of scenic, natural and cultural landscapes along the route	- document collection - On-site inspection and visual confirmation - Interviews with relevant government agencies - Local interviews	- In selecting the route, the layout plan should avoid areas that need to be considered for landscaping. - Reflect considerations in the environmental management plan, if necessary.
Gender	- Gender identification among the affected population - literacy rate - Access to medical facilities - immunization rate - Living Environment and Socioeconomic Conditions - Identification of the need for gender considerations and mainstreaming needs	- Obtain relevant legislation and existing materials - (national) census - Interviews with local residents	- Reflect considerations in the environmental management plan, if necessary.
Children's rights	- Number of children among the affected population - percentage of school attendance - Access to medical facilities - immunization rate	- Obtain relevant legislation and existing materials - (national) census - Interviews with local residents	- Reflect considerations in the environmental management plan, if necessary.
Infectious diseases such as HIV/AIDS	- related laws and regulations - health care index	- Obtain relevant legislation and existing materials	- Develop an occupational health and safety plan during construction.
Working environment (including occupational safety)	- related laws and regulations	- Obtain relevant legal systems and relevant case studies	- An occupational health and safety plan shall be developed during construction and during service, respectively.
Accidents	- related laws and regulations	- Obtain relevant legal systems and relevant case studies	- During construction and operation, accident prevention and response measures shall be developed, respectively.

Source: JICA Survey Team

Table 9.5-7 Survey Items, Methods, Predictions and Draft Measures (60 kV DL & Associated Facilities)

Environmental Items	Survey item	Study method	Anticipated measures
Air pollution	- Related Environmental Standards - Weather (meteorology) information - Air quality (PM2.5, PM10) around the target area	- Obtaining Air Quality Standards - Obtain weather data (temperature, humidity, etc.) from nearby weather stations - Atmospheric Measurement ✧ Once during the dry season ✧ 1 location at Arimba substation	- Take measures to prevent air pollution during construction.
Water pollution	- Related Environmental Standards - Wastewater treatment method - Whether or not ground improvement agents are used	- Obtain relevant environmental standards - Obtain wastewater treatment plans from workers' camp - Confirmation of whether or not ground improvement agents are used	- Proper wastewater treatment - Measures to prevent ground improvement agent runoff
Soil pollution	- Related Environmental Standards	- Obtain relevant standards and existing materials	- Take measures to prevent oil contamination during construction.
Noise and Vibration	- Related Environmental Standards - Noise and vibration in the vicinity of the protected area and along the expected route	- Obtain noise standards - Noise measurements ✧ 1 dry season ✧ 1 location at Arimba substation	- Take measures to prevent noise during construction.
Offensive odors	- Related Environmental Standards	- Obtain environmental standards for odor sources	- During construction, measures for handling domestic wastes and take measures.
Waste	- Related laws and regulations - Current Status of Waste Disposal	- Interviews with relevant organizations, local governments, etc. - Confirmation of disposal methods for waste, PCBs, and sulfur hexafluoride	- Develop a plan for handling industrial and domestic waste during construction.
Land subsidence	- Geological features - Terrain - Transportation route of heavyweight material	- Obtain geologic and topographic maps - Obtain borehole survey results	- Selection of tower location and construction method with consideration for the ground -
Ecosystem	- Current status of ecologically important sites (breeding and foraging areas) - Flora and fauna (mammals, birds (resident and migratory), reptiles, amphibians, insects, fish, plants)	- Confirmation of distribution of flora and fauna - Existing material research, interviews - Confirmation of species by voluntary trampling - Collecting information on plant and animal sightings and past survey results - Confirmation of bird ecology - Once during the dry season - on-the-spot investigation	- Estimate the extent of impact on ecologically important sites (breeding and foraging areas) and develop countermeasures if it is foreseen to be significant. - If a valuable species is present on the distribution line route, estimate the extent of the impact and, if severe, develop countermeasures. - If the distribution of large birds is near distribution line routes, measures should be developed.

Environmental Items	Survey item	Study method	Anticipated measures
Land acquisition and resettlement	- Check easement (ROW) status of distribution line - Confirmation of the existence of private land in the land subject to land acquisition - Confirmation of the use of the land in question	- Site visit, collection of existing data - Interviews with local authorities - Interviews with local residents - Obtain relevant legal systems and relevant case studies	- If land acquisition and resettlement are unavoidable, the size of the site should be confirmed and a proposed RAP or ARAP should be developed.
The poor	- Identification of poor residents among the affected population	- Site visits, collection of existing data, interviews, etc.	- If included in the affected population, prepare a compensation and livelihood restoration plan.
Local economy, including employment and means of livelihood	- Gathering and analyzing information on population size, composition, and distribution, as well as local economic and industrial conditions	- Interviews with local authorities - Gathering data related to local employment situation and income	- Reflecting Residents' Considerations in Environmental Management Plans
Land use and utilization of local resource	- Current status of land use	- Collection of related materials - socio-economic survey	- Consider measures to be taken if the construction of the towers affects activities such as grazing and agriculture.
Water use	- Confirmation of the availability of water for domestic and agricultural use	- socio-economic survey - Interviews with local residents	- Take measures to prevent water pollution during construction. - During construction, priority will be given to securing water for domestic and agricultural use for residents. - Have wastewater treatment facilities installed for domestic and other wastewater discharged by construction workers to meet effluent standards.
Existing social infrastructures and social services	- Current Traffic Volume - Current status of surrounding residential conditions, social infrastructure and services	- Traffic volume statistical data collection - Collection of related materials - Interviews with local authorities	- Develop a schedule for vehicle operations during construction. - Identify the impact of demining work.
Social institutions such as social infrastructure and local decision-making institutions	- Identification of regional networks and social structures	- Interviews with local authorities - Interviews with local residents	- Explanation of the project plan to residents during the period of this cooperative preparatory study - Explanation to residents during the project implementation period
Misdistribution of benefits and losses	- Confirmation of occupation and livelihood of local residents who may be affected by the project	- Gathering data on local employment conditions and income - Interviews with local residents	- Reflecting Residents' Considerations in Environmental Management Plans
Local conflicts of	- Confirmation of	- Gathering data on local	- Reflecting Residents'

Environmental Items	Survey item	Study method	Anticipated measures
interest	occupation and livelihood of local residents who may be affected by the project	employment conditions and income - Interviews with local residents	Considerations in Environmental Management Plans
Landscape	- Identification of natural and cultural landscapes along the route	- document collection - On-site inspection and visual confirmation - Interviews with relevant government agencies - Local interviews	- In selecting the route, the layout plan should avoid areas that need to be considered for landscaping. - Reflect considerations in the environmental management plan, if necessary.
Gender	- Gender identification among the affected population - literacy rate - Access to medical facilities - immunization rate - Living Environment and Socioeconomic Conditions - Identification of gender-sensitive needs and mainstreaming needs	- Obtain relevant legislation and existing materials - (national) census - Interviews with local residents	- Reflect considerations in the environmental management plan, if necessary.
Children's rights	- Number of children among the affected population - percentage of school attendance - Access to medical facilities - immunization rate	- Obtain relevant legislation and existing materials - (national) census - Interviews with local residents	- Reflect considerations in the environmental management plan, if necessary.
Infectious diseases such as HIV/AIDS	- related laws and regulations - health care index	- Obtain relevant legislation and existing materials	- Develop an occupational health and safety plan during construction.
Working environment (including occupational safety)	- related laws and regulations	- Obtain relevant legal systems and relevant case studies	- An occupational health and safety plan shall be developed during construction and during service, respectively.
Accidents	- related laws and regulations	- Obtain relevant legal systems and relevant case studies	- During construction and operation, accident prevention and response measures shall be prepared, respectively.

Source: JICA Survey Team

Table 9.5-8 Survey Items, Methods, Predictions and Draft Measures (Substations)

Environmental Items	Survey item	Study method	Anticipated Measures
Air pollution	- Related Environmental Standards - Weather (meteorology) information - Current air quality (PM2.5 and PM10) around the subject area	- Obtaining Air Quality Standards - Obtain weather data (temperature, humidity, etc.) from nearby weather stations - Atmospheric Measurement ✧ Once during the dry season ✧ One East Lubango SS, one Namibe substation, and three Arimba substations in total	- Take measures to prevent air pollution during construction.
Water pollution	- Related Environmental Standards	- Obtain water quality and effluent standards ✧	- Measures to prevent soil runoff and treatment of domestic wastewater during construction.
Soil pollution	- Related Environmental Standards	- Obtain relevant standards and existing materials	- Take measures to prevent oil contamination during construction.
Sediment	- Rivers - Spillage of pollutants - (220/60 kV New Namibe SS only)	- Obtain topographic maps and river location maps - Confirmation of use of ground improvement materials, etc.	- Take measures to prevent spillage during construction.
Noise and Vibration	- Related Environmental Standards - Noise and vibration at the proposed substation site and nearby residential areas	- Obtain noise standards - Noise and vibration measurements ✧ Once during the dry season ✧ Around the planned substation site (around the planned site)	- Take measures against noise and vibration during construction. - Predict the noise level during operation and take countermeasures as necessary.
Offensive odors	- Related Environmental Standards	- Obtain environmental standards for odor sources	- Take measures and take steps to handle domestic wastes during construction.
Waste	- Related laws and regulations - Current Status of Waste Disposal	- Interviews with relevant organizations, local governments, etc. - Confirmation of disposal methods for waste, PCBs, and sulfur hexafluoride	- Develop a plan for handling industrial and domestic waste during construction. - Ensure compliance with laws and regulations regarding the disposal of depreciated equipment during operation.
Land subsidence	- Geological features - Terrain - Transportation route of heavyweight material	- Obtain geologic and topographic maps - Obtain borehole survey results	- Selection and design of construction methods that take into account the ground
Ecosystem	- Biota - Threatened species - habitat	- Collection of information on biota - Obtaining information on rare species - on-the-spot investigation	- Habitat Conservation, and - Minimizing Impact
Topography and Geology	- Geological status	- Obtaining geological information	- The geology will be investigated during detailed design and reflected in the design.
Local economy, including employment and means of livelihood	- Gathering and analyzing information on population size, composition, and distribution, as well as local economic and industrial conditions	- Interviews with local authorities - Gathering data related to local employment situation and income	- Reflecting Residents' Considerations in Environmental Management Plans

Environmental Items	Survey item	Study method	Anticipated Measures
Water use	- Confirmation of the availability of water for domestic and agricultural use	- socio-economic survey - Interviews with local residents	- Take measures to prevent water pollution during construction. - During construction, priority will be given to securing water for domestic and agricultural use for residents. - Have wastewater treatment facilities installed for domestic and other wastewater discharged by construction workers to meet effluent standards.
Existing social infrastructures and social services	- Current Traffic Volume - Current status of surrounding residential conditions and social infrastructure and services	- Traffic volume statistical data collection - Collection of related materials - Interviews with local authorities	- Develop a schedule for vehicle operations during construction. - Identify the impact of demining work.
Landscape	- Confirmation of natural and cultural landscapes around candidate sites	- document collection - On-site inspection and visual confirmation - Interviews with relevant government agencies - Local interviews	- Reflect considerations in the environmental management plan, if necessary.
Gender	- Gender identification among the affected population - literacy rate - Access to medical facilities - immunization rate - Living Environment and Socioeconomic Conditions - Identification of gender-sensitive needs and mainstreaming needs	- Obtain relevant legislation and existing materials - (national) census - Interviews with local residents	- Reflect considerations in the environmental management plan, if necessary.
Children's rights	- Number of children among the affected population - percentage of school attendance - Access to medical facilities - immunization rate	- Obtain relevant legislation and existing materials - (national) census - Interviews with local residents	- Reflect considerations in the environmental management plan, if necessary.
Infectious diseases such as HIV/AIDS	- related laws and regulations - health care index	- Obtain relevant legislation and existing materials	- Develop an occupational health and safety plan during construction.
Working environment (including occupational safety)	- related laws and regulations	- Obtain relevant legal systems and relevant case studies	- An occupational health and safety plan shall be developed during construction and during service, respectively.
Accidents	- related laws and regulations	- Obtain relevant legal systems and relevant case studies	- During construction and operation, accident prevention and response measures shall be developed, respectively.

Source: JICA Survey Team

(2) Collection of baseline information

In order to predict and minimize environmental impacts, it is necessary to collect and organize further baseline information in this study in addition to the information collected in the existing environmental assessment. In the natural environment, data on meteorology, air quality, water quality, and organisms will be collected through up-to-date documents and surveys. For the ecosystem survey, since the transmission line route covers a long distance, the environment on the route will be organized together with the results of the existing material survey based on the results of the field inspection.

- Understanding Seasonal Change

Because the habitat and growth conditions of plants and animals are subject to seasonal changes, field surveys were conducted twice a year, during the rainy season (November to March) and the dry season (June to September).

- Understanding the ecology and migratory characteristics of birds

Birds were surveyed twice, once during the wintering season (March to early May) and once during the breeding season (September to October). Since it was difficult to distinguish migratory characteristics and identify routes, efforts were made to identify species and analyzed based on ecological characteristics.

In the social environment, data on the living conditions of residents and the social environment (land use, transportation, sanitation, demographics, education, social infrastructure, occupation, income, etc.) related to land acquisition and resettlement will be collected through documents and surveys.

(3) Prediction and evaluation of environmental impact

The information collected for the items identified in the scoping will be reviewed to predict and evaluate the negative impacts on the natural and social environment at the time of design, during construction, and when the project is in operation.

(4) Environmental management and monitoring plans

An environmental management plan and monitoring plan will be prepared for items for which negative environmental impacts are assumed in the above environmental forecasting and assessment.

(5) Conduct on-site reconnaissance survey

This study identified local consulting firm to conduct a supplemental on-site survey. The survey items and survey methodology for the supplemental field survey envisioned are as in Table 9.5-9. The details of implementation was finalized based on the final scoping plan and instructions from the MINAMB, and after consultation with RNT/ENDE and others.

Table 9.5-9 Major Supplemental Survey Items and Methods

No.	Survey item		Method of investigation
A. Natural Environment			
1	Water quality Disposition (in airs) to be magnanimous	(1) Water quality	Collection of existing data, analysis by electrode and instrumental analysis methods as needed
		(2) Air quality	Collection of existing data
		(3) Soil	Confirmation and collection of existing data, measurement of grain size, three-phase distribution, permeability, etc.
2	Flora and fauna	(1) Vegetation	Collection of existing data, satellite image analysis, and, if necessary, a survey using the coded method
		(2) Animals	Collection of existing data and field surveys. Transect method surveys (for mammals, birds, reptiles, amphibians, and insects) as needed.
		(3) Freshwater fishes	Collection of existing data, surveys using fishing net capture methods if necessary
		(4) Migratory birds	Collection of existing data, visual observation, root census method, fixed-point census method
B. Social Environment			
1	Land use status, local population		Update by collecting existing data and statistical materials, interviews with relevant departments and offices at the prefectural, municipality, and village levels, and site visits
2	Understanding of socioeconomic conditions and daily traffic lines in the project area		Field visits, household interviews, resident group interviews, etc.
3	Socio-economic survey for the preparation of a draft abbreviated resettlement plan		Conduct socioeconomic surveys (population census, asset inventory survey, and household survey) targeting land users, those with means of livelihood, etc.
4	Socio-economic survey for the preparation of the draft Indigenous Peoples Plan (only if necessary)		Conduct a social assessment targeting indigenous peoples in the EIA.

Source: JICA Survey Team

9.6. Results of Environmental and Social Considerations Survey

The results of the survey are presented below. The majority of the baseline information collected was combined with existing information that had been collected prior to the survey, as described above. The baseline information is presented separately for the natural environment and the social environment in Section 9.2.

9.6.1. Pollution

(1) Air pollution

The most abundant polluting gases in the project area are carbon dioxide (CO_2) and methane (CH_4). The gases with the greatest impact on human health are nitrogen oxides (NOx), carbon monoxide (CO), sulfur dioxide (SO_2), and fine suspended particles (PM10). As is the case in developing countries that have begun to industrialize, the urban areas of Lubango and Moçâmedes have seen a large influx of population, in this case due to wartime conditions. Unplanned urban growth and the uncontrolled development of various industrial sectors have contributed to increasing air pollution levels (MINUA, 2006).

There are no actual data on air quality in Angola because the country has no specific air quality legislation or monitoring network. However, based on information from the specialized literature on air pollution and knowledge of the Angolan reality, it is estimated that the main emissions to the Angolan air are due to the combustion of fossil fuels. The following sources of emissions are mentioned.

- Vehicle to be driven.
- Generators used to supply energy.
- Torch to produce and burn oil

Road traffic is the source of most emissions of CO (carbon monoxide), COVNM (non-methane volatile organic compounds), and lead; CH_4 (methane) emissions are mostly from the final deposition of municipal solid waste; and water treatment facilities are considered important sources of NH3 (ammonia) and N_2O (nitrous oxide). Large tracts of land, existing water bodies, and meteorological factors also influence air quality in Angola.

There is no specific monitoring of air quality in Huíla and Namibe provinces, but they are generally considered good quality areas due to the low presence of industry and slash-and-burn farming. In addition, there is only small-scale agricultural activity in both provinces, and there is still no significant road transportation network in the urban design of the cities of Lubango and Moçâmedes (the capital), as well as in other areas.

Angola has no air quality legislation. Therefore, International Finance Corporation (IFC) guidelines and best practices applicable to the project were used. For ambient air quality standards, the International Finance Corporation's General Environmental, Health, and Safety Guidelines (IFC, 2007)[56] requires the following, and the standards are set forth as shown in Table 9.6-1.

"Emissions of solid particles from dust shall not exceed established limits and relevant environmental quality standards in matters of environmental quality by applying legal standards, or in the absence of such standards, the current World Health Organization (WHO)[57] air quality guidelines, or other internationally recognized sources of information, to The concentration of pollutants will not meet or exceed them."

Table 9.6-1 IFC Air Quality Guidelines

Pollutant	Average Period	Air Quality Standards (mg/m^3)
$PM_{2.5}$ PM_{10}	Annual average	35
	24 hours	75

Source: IFC, 2007.

[56] International Finance Corporation (April 30, 2007) Environmental, Health and Safety Guidelines.EHS Guidelines (General). Environmental Air Emissions and Ambient Air Quality.
[57] WHO. Air Quality Guidelines (2021) PM 24-hour values are in the 99th percentile

In this study, since there are currently no major emission sources of SO_2 and NO_2 in the project area, it was determined that it would be difficult to ensure the safety of surveyors and prevent theft and vandalism of survey equipment for continuous observation by installing measurement devices. Only PM2.5 and PM10 were measured at the planned 200/60 kV East Lubango SS, planned 60/15 kV Arimba SS, Arimba Municipality, and planned 200/60 kV New Namibe SS during the daytime.

The maximum PM2.5 value of 0.18 mg/m3 and the maximum PM10 value of .0.35 mg/m3 were both recorded during the dry season at the proposed 200/60 kV New Namibe substation, and although much lower than the IFC standard, the seasonal and regional differences were evident.

At the start of construction, in conjunction with the safety confirmation of mines and determination of the location of the tower, pre-construction data (baseline values) for dust (PM10 and PM2.5) monitoring during tower construction work should be obtained, and at each substation, at a stage when safe observations can be made before the start of demining work. SO_2 , NO_2、 O^3 pre-monitoring construction data (baseline values) should be obtained.

(2) Water pollution

All rivers in the project area are seasonal rivers, with no water flow in the dry season and sometimes no water flow even in the rainy season. There is no existing data on water quality measurement and monitoring by the governments of Huíla and Namibe, and no water quality survey has been conducted for any project in the past. There have been cases[58] where water quality surveys have not been conducted for transmission line projects in other regions.

Basically, there will be no impact from the construction work because the transmission line towers will not be built near the riverbank, riverbed, or river channel. The company also plans to consign disposal of wastewater containing oil and other hazardous substances to a specialized contractor. In addition, the possibility of water pollution due to runoff from the use of chemical substances such as ground improvement materials was assumed, but there are no plans to use ground improvement materials, and no impact of surface water pollution is assumed.

The project planned to conduct a water quality survey when possible, but decided against it because the location of the steel tower could not be determined, it was difficult to ensure mine safety, and it was deemed difficult to collect safe and representative water quality samples. It would be desirable to determine water quality monitoring sites when surface water is available for use in villages, etc., and obtain baseline values as pre-monitoring construction data in conjunction with the confirmation of mine safety and determination of tower locations prior to the start of construction work.

(3) Soil pollution

Sedimentary rocks in the project area are found mainly in the coastal areas of Namibe Province and in the Humpata Municipality. Compared to sedimentary rocks, igneous rocks have distinct chemical and physical characteristics, mainly low calcium mineral content, and are distributed in the central part of the project area.

The three substation sites have no sources of emissions that could cause soil contamination, and based on the site location and historical satellite photos, there were no sources of contamination. Therefore, soil analysis was not conducted, and efforts were concentrated on baseline mapping, etc. After determining the location of the steel tower and the workers' camp, material storage area, etc., it is desirable to confirm the situation prior to the search and removal activities for mines and UXOs.

Since there are various pollution factors such as fuel and lubricant leaks and untreated wastewater spills in project implementation, careful consideration must be given to the management of hazardous materials, fuels, and lubricants.

In principle, waste generated from the implementation of the project, including liquid waste, should be entrusted to an approved contractor for treatment and disposal.

[58] Two examples of transmission line projects where water quality surveys have not been conducted are the 400 kV Huambo - Lubango transmission line project supported by the African Development Bank and the Lauca - Bita transmission line project in northern Angola.

In the development of the site, all overburden from civil engineering work is planned to be disposed of on site. In the event that soil contamination occurs due to unforeseen circumstances, it is to be treated and disposed of as waste by a specialized contractor.

(4) Sediment

No ground improvement agents are used in the construction of the transmission line, and domestic wastewater from the workers' camp is collected and treated by a specialized company, so there will be no impact on the bottom sediment.

(5) Noise and Vibration

Given its proximity to National Highway (EN) 280 and the high anthropogenic impact in the area, the site is a potential noise source that could interfere with the sound conditions in the area. On the other hand, the presence of vehicular traffic and residential areas along EN 280 is also a noise source that should be considered.

Sound is a normal and desirable part of human life, but when noise is heard when it is not wanted, it can have adverse effects such as interference and annoyance. Noise is measured and quantified in decibels (dB).

Table 9.6-2 Noise sources, noise levels, and corresponding permissible values

Cause	Noise level, dB (A)	intolerance
Sound of a moon rocket launch at an altitude of 100 m Gunner's position during bombardment	140	intolerable (Pain in ear)
Ship's engine room; In front of speakers at a rock concert	120	
Textile mills; Press room with presses in operation; Position of the operator of the punch press and sawing machine	100	Very noisy
Side of busy highway, shouting	80	noisy
Department stores, restaurants, speeches	60	
Quiet residential environment level	40	quiet
Recording Studio Environmental Levels	20	Very quiet
Limit perceived by a young person with healthy ears (reference sound pressure of 20 μPascal)	0*	Very quiet

Note: *0 dB (decibel): means equal to the reference sound pressure (20 μPascal) (logarithm of 1 → 0).

Source: Bies *et al*, 2017.[59]

The term "sound level" is usually used to describe two different sound characteristics: power and sound pressure. Every sound source has a sound power level (SPL). The sound power level is the sound energy emitted from a sound source and is an absolute value that is not affected by the surrounding environment. The sound energy generated is propagated by means of pressure fluctuations and other factors. This pressure fluctuation, also called sound pressure level (SPL), is what the human ear hears and what a microphone can measure. Note that sound is physically qualified by amplitude and frequency.

The amplitude of sound is measured in decibels (dB) as the log ratio of sound pressure to a reference sound pressure (20 micro Pascal). The reference sound pressure corresponds to the typical limits of human hearing. For the average listener, a 3 dB change in a broadband sound is considered "barely noticeable," a 5 dB change is "clearly noticeable," and a 10 dB change doubles the apparent loudness (if the sound is reduced). Sound waves have several different wavelengths, which are called frequencies. Frequency is expressed in units of Hertz (Hz), which is the number of cycles of a wave in one second.

The typical human ear can hear frequencies between 20 and 20,000 Hz. Typically, the human ear is sensitive to mid-frequency (1,000-8,000 Hz) sounds and not to low or high frequency sounds. Therefore, aural correction (A-correction) was developed to simulate the frequency response of the human ear similar to typical sounds at ambient levels. the A-correction emphasizes mid-range sounds and removes high and low frequencies. the A-correction value is expressed in

[59] David A. Bies, Colin H. Hansen, Carl Q. Howard (2017): Engineering Noise Control 5th edition. CRC Press

weighted decibels (dBA) for any given noise level. A correction value is the amount of sound that is eliminated from the sound level.

In Angola, there are no guidelines or laws regarding noise levels during the exploration and operational preparation phase. However, IFC's Environmental, Health, and Safety (EHS) Guidelines contain adopted standards and guidelines, which are discussed below IFC's EHS Guidelines provide criteria for noise levels adopted for this project. The criteria are described as follows.

"Sound impacts shall not exceed the levels indicated in the guidelines and shall not result in a maximum increase in background levels of 3 dB at the nearest off-site sound receiving point." IFC's EHS guideline thresholds are shown in Table 9.6-3.

Table 9.6-3 Noise levels based on IFC guidelines for EHS

Place of reception	Established noise level - 1 hour LAeq, dB(A)	
	Daytime (07:00 - 22:00)	Night (22:00 - 07:00)
Residential, industrial, and Education District school zone	55	45
Industrial and commercial	70	70

Source: IFC, 2007.

The field survey of noise levels was also conducted for the same reason as the air quality survey, and was preliminary and conducted at three proposed substation sites and at the roadside and in the village around Arimba and Humpata, and only measured for 15 minutes. Therefore, it is necessary to take into consideration the monitoring during construction, the construction time period, and the speed of construction vehicles.

It has been observed and confirmed in experimental buildings that the effect of noise generation from wind shear on power lines during strong winds is proportional to wind speed when strong winds blow at right angles to the power lines, such as at river crossings, and that the perpendicular direction of the wind blowing direction becomes stronger while the distance attenuates (Kubokawa et al., 2004).[60] There are no residences in the vicinity of the river crossings that fall under this condition, which will be the large diameter section in this project, and no impact is anticipated.

At the start of construction, it is desirable to obtain pre-construction data (baseline values) for noise level monitoring during tower construction in conjunction with mine safety confirmation and determination of the location on the tower.

(6) Offensive odors

All general waste from worker dormitories, etc., should be disposed of by a specialized contractor, and storage should be limited to a short period of time in sealable containers to prevent the generation of foul odors.

(7) Waste

In Angola, the rapid increase in the amount of waste generated as a result of urbanization has created an urgent need for the construction of final disposal sites. This has also led to the problem of waste being scattered in temporary storage areas in the open fields around settlements. There are still no final disposal sites in Huíla and Namibe provinces, while one has already been constructed in neighboring Huambo province.

In accordance with the national "Waste Management Regulations", a "Waste Management Plan" is to be developed for this project and submitted to MINAMB together with the EIA report.

The waste generated by the project will mainly consist of domestic waste from the workers' camp and various wastes generated during construction work, both of which will be separated and collected under the responsibility of the operator, and properly collected and disposed of under a contract with a licensed specialist. In this case, it is assumed that waste generated in the Huíla and Namibe provinces will need to be transported to the Huambo province for disposal, which will require coordination and consultation between the operator and each province. It is also important to provide thorough guidance and management to waste disposal companies so that they can

[60] Kubokawa H, Imoto S, Ohgi I, Kitajima T, Tanabe K (2004): Wind noise control of overhead power lines. Journal of the Japan Society of Wind Engineering No.98, p.29-36

properly dispose of waste on their own responsibility. On the other hand, from the viewpoint of soil conservation and vegetation preservation, the excavated soil will be backfilled according to a stratigraphic sequence so that seeds and roots can be regenerated, and no overburden will be disposed of.

Workers' camp, to be selected by the operator and contractor, are expected to be built on the outskirts of Lubango and Moçâmedes, in line with the transmission line construction zone, and for the substations, near the respective proposed construction sites.

(8) Land subsidence

Although the ground in the project area is relatively stable, the possibility of ground subsidence due to project implementation cannot be ruled out due to the construction location of the steel tower, substation, and heavy material delivery route. The results of the borings conducted in this study indicate that the ground is generally stable, and the possibility of ground subsidence is considered low.

9.6.2. Natural Environment

(1) Protected area

Bicuar National Park is located in Huíla Province, and Iona National Park and its buffer zone, Namibe Partial Reserve, are designated in Namibe Province. Bicuar National Park is located approximately 70 km east of the project area, and Iona National Park is 70 km south of the project area. Both of these national parks aim to protect terrestrial animals and will not be affected by the project. In addition, the Namibe Partial Reserve is located approximately 7 km from the 220/60 kV New Namibe SS, and urban areas are spread out between the two areas, so the project is expected to have little impact on the Namibe Partial Reserve. On the other hand, there are records of large mammals such as cheetahs and buffaloes in Namibe Province in the past, and in recent years, Namibe Province and research institutions have been conducting surveys using sensor cameras and other equipment, but to date there have been no confirmed cases.

A new environmental conservation area is being considered for designation in the vicinity of the proposed project area, and although the scope and boundaries of one of the candidate areas, the "Chela Mountains," have not yet been determined, the possibility of overlap with the proposed project area cannot be denied. In addition, there is a candidate area for the Namibe Bird Sanctuary in the vicinity of the Tundavala area to the north of the proposed "Chela Mountains" area.

Therefore, given the potential impact of this project on the proposed environmental conservation area, it is important to implement adaptive mitigation measures and monitoring that take advantage of the healing power of nature.

(2) Ecosystem

1) Ecoregion

The project area is characterized by changes in elevation and topography, as well as climate and vegetation, which have led to the differentiation of ecoregions in an almost east-west direction, resulting in the characteristics and diversity of the flora and fauna, but with a marked boundary with the impact of the development of human activities.

In the Tundavala area, designated as IBA/KBA, grazing and cultivation coexist with flora and bird diversity, while the Ivantala swamp, surrounded by cultivated land to the east of the city of Lubango, forms a habitat for waterfowl. In the eastern part of the city of Lubango, there is an Ibantara swamp surrounded by cultivated land that forms a habitat for waterfowl, and in the vicinity of the proposed Nombungo substation, roadkill of a side-striped jackal was seen.

In the Angolan escarpment from Humpata to Bruco, the route of the existing 60 kV DL is being cultivated, including the canyon area, but the project area is a highly natural area with dense vegetation and tall trees, including the cliff landscape, and therefore mammals are naturally seen. The reptiles and amphibians are also relatively common here. Therefore, it is necessary to search for and remove mines and unexploded ordnance manually as much as possible, minimize clearing and root removal, and pay attention to measures to prevent soil erosion and restore vegetation. In addition, it is important to prevent the construction and maintenance of roads, which will place an additional burden on flora and fauna.

In the steep cliffs from Umpata to Burco, the route of the existing 60 kV distribution line is

being cultivated, including the canyon area, but the project area is a highly natural area with dense vegetation and tall trees, including the cliff landscape, and therefore mammals are naturally seen. The reptiles and amphibians are also relatively common here. Therefore, it is necessary to search for and remove mines and unexploded ordnance manually as much as possible, minimize clearing and root removal, and pay attention to measures to prevent soil runoff and restore vegetation. In addition, it is important to prevent the construction and maintenance of roads from placing a new human burden on flora and fauna.

The area from Bruco to Capangombe is secondary forest-like and has been disturbed by humans, but the vegetation is dense and there are many tall trees, and mammals and raptors can be seen here as well. Therefore, as in the section up to Bruco, attention must be paid to preventing soil runoff, restoring vegetation, and preventing secondary impacts from logging. As one approaches Caraculo from Capangombe, the area becomes shrubland and semi-arid spiny savanna.

The area from Caraculo to Moçâmedes is a semi-arid spiny savanna and desert, but mammals are found near the coast, reptiles are relatively common, and desert-specific plant species can be seen. Although the impact of the search and removal of mines and UXOs is expected to be less than in forested areas, it is necessary to minimize the impact of construction activities because the desert ecosystem is a harsh environment and excavation, compaction, and erosion of the surface soil due to construction may have a significant impact on it. For this reason, the transmission line route is to follow the existing road as much as possible to minimize the impact of the construction as well as the impact during service. This is also expected to be effective in reducing the impact on the endangered (EN) Ludwig's Bustard (*Neotis ludwigii)*, which has been sighted near Caraculo.

In order to conserve this diversity as much as possible, it is considered important to avoid expanding the boundary between nature and human activities as much as possible, and to plan construction and environmental management so as not to cause degradation of vegetation and forests. In addition, from the main purpose of the Bonn Convention, it is desirable to avoid obstacles to wildlife migration by installing fences, etc. According to the "Angola's Sixth National Report on Biodiversity and Achievement of Aichi Targets 2011-2020" (2019), the main measures for wildlife conservation are monitoring, patrols, education and awareness raising, and and other soft measures. On the other hand, the "Forest and Wildlife Law" (Law No. 6/27) establishes the right to use as well as conservation of forests and wildlife, and does not prevent the installation of fences and structures. In addition, the "Forestry Regulation" (Presidential Decree No. 171/18) specifically stipulates the sustainable management and use of forest resources and their ecosystems.

2) Birds

As a rare species, Ludwig's Bustard (*Neotis ludwigii)*, categorized as Endangered (EN) on the IUCN Red List of Threatened Species, was found near Caraculo in Ecoregion 5 (Namib Desert). This species is large, measuring 80-100 cm in length and 2.2-6 kg in weight, and is considered vulnerable to collisions with power lines. Its distribution is mainly in South Africa and the western part of Namibia, but sightings have also been recorded in the project area, suggesting that special consideration should be given to this species.

Ivantala swamp, located south of Nombungo, provides habitat for waterfowl, which can be impacted for species with collective behavior.

Although the transmission line route is closer in the Tundavala area, Angolan Highlands (Humpata Plateau) and Angolan Escarpment, the impact on the crossing route is expected to be small since the route passes through the Bruco Gorge and is the furthest route from Tundavala on the southern slope in the Humpata Plateau.

3) Mammals

Mammal habitat is considered to be in the wooded area, including Angolan Escarpment from Humpata to just before Caraculo, but the impact of the construction is expected to be temporary for many species, given their relatively high migratory capacity.

However, for species that use woodlands as habitat, such as bats, the sudden loss or fragmentation of habitat due to construction could be very damaging.

4) Reptiles

Overall, there are no reptile species that can be considered high risk in terms of being directly affected by the project. The only factor of relevance for reptiles is the potential for local habitat degradation. In the project area, species that inhabit forested areas in steep cliffs are likely to be impacted.

In this regard, the Gabon adder (*Bitis gabonica), a* venomous snake of the family Cnidaria, is a species that inhabits the moist forests of Central Africa, but is also known to occur along the cliffs of Angola. Although this species was not identified, eyewitness accounts indicate that it inhabits the steep cliffs between Tchivinguilo and Bruco, which may thus correspond to the southwestern limit of its global distribution.

In addition, reptiles are considered to be the top priority of the ecosystem in the Namib Desert, and excavation, compaction, and erosion of surface soil in the desert may have an impact on reptiles.

5) Amphibian

There is little likelihood in terms of direct impacts by the transmission line. The only factor relevant to amphibians is the potential for localized habitat degradation, which is likely to be impacted in steep cliff areas and in Bruco Canyon.

6) Loss of biomass

The area of vegetation removal Pre- and during construction and the area to be occupied after the operation. Table 9.6-4 shows the area of vegetation to be removed Pre- and during construction and the area to be occupied after operation. This area of vegetation will be lost and biomass offsets will be considered. Although the demining work prior to construction will result in the need to remove approximately 920 ha of vegetation, it will be possible to implement measures to prevent topsoil erosion thereafter, and by aiming for early regeneration through transplantation of herbaceous species and tree planting, the area in service will be approximately 134 ha, which is more than 10 percent of the initial vegetation loss area This will facilitate offsetting the loss of biomass. In Angola, when tree cutting occurs, the offset plan is determined in consultation with MINAMB. Basically, the offset will be in terms of area, and it is customary to transplant seeds grown in the nursery if necessary, but in some cases, transplanting events will be part of the plan.

Table 9.6-4 Area of vegetation removal Pre- and during construction and area occupied after service

classification	Pre- and during construction	at the time of publication
Temporary disappearance along ROW (ROW 45m wide)	882.00 ha	-
Permanent occupancy along ROW	-	117.60 ha
Temporary steel tower construction space (25 m x 25 m)	30.94 ha	-
Permanent steel tower foundation (15 m x 15 m)	-	11.14 ha
220/60 kV East Lubango SS	4.05 ha	4.05 ha
220/60 kV New Namibe SS	1.43 ha	1.43 ha
plan	**918.42 ha**	**133.96 ha**

Source: JICA Survey Team

(3) Hydrology

(a) Surface water (depth: 0-200 meters)

Angola is the source of several major river basins, including the Kwanza, Cunene, Kuberai, Kubango/Okavango, and Zambia rivers. It is also located downstream of the Congo River, a major river in the western region that originates in the highlands of the East African Rift Valley and is fed by major tributaries such as the Chambesi, Uele, and Ubangi Rivers (Masse & Laurent, 2015).

(b) Underground water

According to a March 2005 report5 by the National Water Resources Authority (DNA for its Portuguese acronym), most of the large alluvial plains in the western part of the country extend along the lower part of river courses within 100 km of the coastline. The largest aquifers in this category are located in Huíla, Benguela, Quanzasul, Bengo, and Zaire provinces. Some groundwaters in the alluvial plains are reported to have high iron and sulfate contents. High mineral content in groundwater is common in areas of low precipitation and high potential

evapotranspiration. Elevated iron concentrations may also be due to lack of circulation in deep groundwater basins. In parts of the delta and in the lower part of the alluvial plain, groundwater quality is affected by saline water.

According to a DNA report (DNA, 2005), groundwater use for irrigation is important in coastal and southwestern provinces, especially in the Dande, Bengo, Quansa, Longa, Cuebu, Cunene, and Kubango basins. [61]

Rainfall is not sufficient for crops, and when rivers dry up, groundwater from the alluvial plain is used. A significant portion of the river water may be used for irrigation, and water withdrawn from the alluvial plain after the river has dried up must be replenished with river water at the beginning of the next rainfall season. In some watersheds, agriculture will use all available groundwater.

According to hydrogeologic map data, groundwater potential is sufficient to supply most villages in rural areas of Angola. At the time of the study (2005), water demand in rural areas was estimated to be less than about 30 liters per capita per day.

More recent studies indicate that low (0.1 - 0.5 l/s) to moderate (1 - 5 l/s) productivity aquifers exist on the Angolan plateau, including the province of Uwambo (MacDonald *et al.*, 2012). [62]

The project is not expected to directly withdraw surface water or groundwater, so there will be no impact on surface water or groundwater.

(4) Topography and Geology

Among topography and geology, consideration of soil erosion is considered particularly important, regardless of the size of the project.

When vegetation is removed by demining work, soil runoff caused by rainfall will have a significant impact on the topography, delaying vegetation recovery and affecting the entire ecosystem, creating a negative chain of events. Soil erosion prevention measures are especially important when working on steep slopes along power line routes. In particular, topsoil erosion prevention measures are extremely important from the perspective of vegetation recovery, with the idea that early recovery of vegetation is the key to early and effective topsoil runoff prevention measures. Basically, the following methods are used: (1) backfilling of topsoil that has been stripped away, (2) construction of earth retaining structures along contour lines using logged trees, (3) transplanting grasses, and (4) chipping or spreading branches and leaves from logged trees.

In addition, although the substation is located on a relatively flat site, the topography may change over time due to erosion, so stormwater drainage measures should be considered.

9.6.3. Social Environment

(1) Land acquisition and resettlement

The three substations of the project (5.65 ha in total) are owned by the public and ENDE, and no private land will be acquired. No illegal occupation or economic activities have been identified, and therefore no resettlement or economic losses are anticipated.

In the Angolan national law (Land Law), we could not identify any provisions that make compensation for the creation of easements obligatory, but the obligation to compensate is provided for ownership, customary rights, superficies, and land occupation rights. The customary measures in Angola confirmed in this study that when transmission line poles or towers and their foundations are constructed on privately owned land, no land rights are acquired, while many landowners do not receive compensation for the creation of easements, and compensation for actual damage caused by the installation of semi-permanent towers (or long-term leases) is received in some cases, but this is rare. Cases were also rare. Compensation for the creation of easements under overhead transmission line ROW is also not provided by international organizations and other support programs[63]. Since no cases that should be comprehensively

[61] DNA (National Water Directorate of the Ministry of Energy and Water of the Republic of Angola). 2005.Final report: assessment of rapid water resources and water use in Angola. SwecoGrøner.
Retrieved February 14, 2020, from http: //bibliotecaterra.angonet.org/sites/default/files/00-_final_report_-_full.pdf.

[62] MacDonald A. M., Bonsor H. C., Dochartaigh B. E., and Taylor R. G. 2012. Quantitative map of groundwater resources in Africa. Environmental Research Letter (7), 7 pp.

[63] 400 kV TL project between Huambo and Lubango (supported by the African Development Bank), and the Lauca-

followed as good practice could be identified, this project will provide compensation payments based on the JICA Environmental Guidelines for actual damages and impediments to the land use of the affected residents of the tower and ROW. In addition, since it is anticipated that land use restrictions will be imposed during the construction period, such as access roads, material storage areas, and restricted access to the transmission and distribution line ROW due to safety considerations, compensation for the temporary acquisition of private land and land for use included in these areas is anticipated. Permanent acquisition will be made for the steel tower portion and maintenance land (See 10.4 for specific measures for compensation and support).

In the process of technical studies, alternative plans (transmission and distribution routes and substation construction sites) were considered, and project plans were developed based on these plans. As a result, social impacts were minimized, and thus land use impacts and resettlement along the transmission routes in Moçâmedes and Bibala municipalities are not anticipated, but land use impacts and associated livelihood impacts in the more populous Lubango and Humpata Municipalities, land use impacts and associated livelihood impacts are expected to occur.

(2) The Poor

In the process of the field reconnaissance study conducted for this brief, the negative impacts were minimized through careful investigation of local conditions and living standards in the project-affected areas, discussions with RNT and local government officials, and consideration of alternative plans to minimize the negative impacts on local residents. It was also confirmed that there were no affected residents under the poverty line at the time of conducting this feasibility study.

In addition, since residents along the 220 kV transmission route have relatively low incomes and dependence on farmland as a source of livelihood and income is more prevalent in rural communities where agriculture and livestock are the main livelihood activities, if alternative farmland and crop compensation are not provided appropriately, their living standards may deteriorate further from those before project implementation. In addition to the creation of employment opportunities and local business opportunities during the construction period, it is desirable to have a plan that is conducive to local residents, such as the development of maintenance roads for use in local daily life.

(3) Ethnic minorities and indigenous peoples

Although the Angolan government endorses the "United Nations Declaration on the Rights of Indigenous Peoples"[64], indigenous peoples' rights are not stipulated in the Constitution, nor has a protective law on their rights and livelihoods. According to the Ministry of Social Action, Family and Women's Promotion (MASFAMU)[65], in Angola, certain ethnic groups in addition to women, children, the poor, and the disabled are targeted for various types of assistance as "socially vulnerable groups," and in the project area, technical training is provided to Khoisan people in Huíla province to help them establish agricultural technology In the target areas, the project aims to provide technical training to Khoisan people in Huíla Province to help them establish their agricultural skills and promote their settlement through agricultural activities.

In discussions with local government officials and local residents[66] and interviews, Mumuila and Mucubal people were mentioned as distinctive ethnic groups. In addition, at a briefing and exchange of opinions on the development of a abbreviated resettlement plan[67], local officials requested that consideration be given to the Mumuila and Mucubal people, who are seasonal migrants.

These ethnic groups are not mentioned in the report of the International Work Group for Indigenous Affairs (IWGIA), and are not considered to be well understood internationally.[68] In

Bita transmission line project (supported by the U.K.), etc.

[64] 2007.

[65] The survey team interviewed MASFAMU on February 19, 2022.

[66] February 2020 (see 9.11.1(2)).

[67] September 2021 (see 10.10.2(3)).

[68] https://iwgia.org/images/yearbook/2020/IWGIA_The_Indigenous_World_2020.pdf (accessed January 2022). The report states that "indigenous peoples called Ovatjimba and Ovatue people hunt, gather, and raise livestock along the border with neighboring Namibia, where many indigenous peoples have been identified (most of the approximately 26,000 population lives on the Namibian side)." However, there is no specific mention of these ethnic groups by

light of this situation, the social environment survey in the environmental assessment study was conducted to determine the extent of residence and activities of each ethnic group, and the indigenousness of the people living in the project area was determined in light of the four requirements of OP 4.10 (Indigenous Peoples) of the World Bank Safeguard Policies. However, no residents who should be considered "indigenous" under JICA guidelines were identified in the project area. Specifically, they are as follows.

1) Residents

While there are various ethnic groups and languages in the project area, the existence of Mumuila (Nyaneka-Humbi people) and Mucubal (Herero people), who are believed to be grazers, was confirmed in the settlements of Poiares Muhaha, Tchiwaya, Kapalanga, and Onculuvala located around the project area in Humpata Municipality. The Mumuila (Nyaneka-Humbi) and Mucubal (Herero) people were confirmed to be grazers.

In general, the Mucubal people maintain a nomadic lifestyle based on customs and traditions inherited from their ancestors and continued from generation to generation, and they visit markets to use water during the dry season, search for pasture and grazing land, secure food, make and sell alcohol, and purchase necessities such as cloth. The Mumuila are also found in large numbers on the Chera Plateau, particularly in Lubango and Humpata municipalities, where they are said to live collectively, maintain ethnic customs, practices, traditions, and ways of life, and subsist on traditional agriculture and cattle raising. Both of these ethnic groups are characterized by the ornaments and hair ornaments they wear and have their own unique festival customs and dances, which are often visited by foreign tourists and other commercial interests.

However, it is clear that the Mumuila and Mucubal people who are established in each of the project settlements are distinct from the above-mentioned commercial groups and, despite the distinctive nature of their clothing, do not maintain different and distinct characteristics and identity as a unique and indigenous cultural group compared to other residents. The results of the study revealed that the clustered housing is a form of family residence that is also found among other residents, and no differences in lifestyle were observed. In addition, social surveys and stakeholder consultations confirmed that there was no actual collective attachment to a particular land or territory, no customary and unique cultural, economic, social, or political institutions or social systems that separated them from the surrounding population, but rather, they maintained contact and interaction with the residents and Sobas, and did not have a unique cultural identity. It was also clear that, with the exception of the illiterate, the Mumuila and the Mucubal people routinely use a typical local language such as Nyaneka-Humbi, and communicate with other ethnic groups. The Mumuila and Mucubal people are considered economically poor and socially vulnerable in Angolan society, which is composed of many ethnic groups. Those who have settled in the project site are individual migrants who came in search of better living conditions and were already integrated and assimilated into the local living environment.

2) Nomadic and pastoralists

Although information was available on the seasonal migration of the Mucubal people in search of water and food, grazing is not a way of life found only among the Mucubal and Mumuila people; it is also practiced by the Nyaneka-Humbi, Herero, Umbundu, and Khoisan people. For this reason, field surveys were conducted (twice in total, during the rainy and dry seasons) with the assumption that the project may encounter or intersect with groups grazing along the project's transmission line route. However, during the survey period, all grazing group settlements and the presence of grazing groups were not identified along the project route. It was also difficult to identify the migration routes because they varied from year to year depending on the availability of pasture and water.

ARAP will be updated when tower locations and power line routes are finalized based on the topographic survey and detail design. The impacts which have not been identified during this Preparatory Survey and their extent, etc. will be examined and confirmed then. RNT will conduct local consultation meetings throughout the porject implementation (both pre-construction and construction periods). Unlike railway or road, overhead transmission lines do not divide areas, and tower construction and transmission line installation will be done in phases, so that the degree

MASFAMU, and no local government officials or buckwheat were identified in the project area.

of impact on grazing will be likely mitigated. However, in order to avoid impacts, the construction plan should be designed not to disturb seasonal migration periods, and this can be thoroughly implemented during construction by reviewing the plan as needed according to the site conditions.

Note that the ROW and construction access road will be maintained on the premise of mine clearance, which will indirectly support safe movement during the grazing process.

(4) Local economy, including employment and means of livelihood

1) Transmission line

The results of a social survey revealed that unemployment among local youth is a serious problem. In Humpata Municipality, the municipality market is open, but while the market attracts a large volume of food and processed goods, street sales along Route 280 are not doing well. Taxis and motorcycles are used for shopping at the municipality market and in urban areas such as Lubango City, but when there is a lack of transportation, people also travel on foot.

During the period of tower construction and transmission line installation, access to the transmission line route ROW and surrounding agricultural land will be restricted, resulting in loss of income from farming. These impacts will be felt most severely by affected residents in Humpata Municipality, where agriculture and livestock rearing constitute the majority of livelihoods. The ROW of the 220 kV TL and 60 kV DL of the project is 45 m and 24 m, respectively, and approximately 300 ha of the transmission line ROW and 13 ha of the distribution line ROW will be temporarily restricted in land use during the construction period, requiring the cutting of trees under the ROW, which may have an impact on the income from non-timber forest products in areas with rich vegetation. This may have an impact on the income derived from the extraction of non-timber forest products in areas with rich vegetation. However, the impact would be small due to the proximity of alternative forest lands. In addition, impacts on grazing will be avoided, and this can be thoroughly addressed during construction by reviewing the situation on site as needed. No negative impacts on employment or livelihoods are anticipated for the permanent residents of Moçâmedes and Bibala Municipalities. Local employment opportunities as construction workers are anticipated, and local commerce could be promoted and stimulated.

Since no land rights will be acquired, the ROW will be available for use when the project is in operation, but height restrictions will be imposed because it will be necessary to maintain 8 m and 3 m distance between vertical power lines and buildings/trees, respectively. Although there is a possibility of local employment for labor work such as pruning to avoid tree contact during operation, it will be extensive, but only a small number at each location.

2) Distribution lines

It is a semi-urban area near the city of Lubango, less dependent on agriculture than the settlements along the 220 kV TL route, and with easier access to markets.

As with the transmission line route above, access to the distribution line route ROW and surrounding area will be restricted during the period of tower construction and distribution line installation work, but there will be no agricultural land and limited impact on means of livelihood. On the other hand, local employment opportunities as construction workers are anticipated, and local commerce may be promoted and stimulated.

Although there is a possibility that local employment for labor work such as pruning to avoid tree contact may occur during operation, it is negligible due to the short total length of the project.

3) Proposed substation construction site

Three sites are located in urban or semi-urban areas, on publicly owned or ENDE-owned land, with no resident inhabitants.

No negative impacts are anticipated, as no production activities would take place. Local employment opportunities as construction workers are anticipated, which may promote and stimulate local commerce.

(5) Land use and utilization of local resource

Temporary land use restrictions are expected during the construction period due to construction of substation facilities and equipment, laying of tower bases, construction of access roads, material storage areas, and restricted access to the transmission and distribution line ROW (total length of 205 km over the entire length) due to safety considerations.

Of these, three substations are on public land or land owned by RNT/ENDE and are not expected to affect land use. On the other hand, the construction of the towers and laying of transmission and distribution lines is expected to have an impact on land use and livelihoods, especially in Lubango and Humpata municipalities. However, since the tower construction and transmission line installation will be carried out in sections, it is expected that the impact will be mitigated by avoiding the farming season as much as possible.

Although tree clearing under the ROW will be required, no significant impact on non-timber forest product extraction is anticipated due to the proximity of alternative forest lands. However, since the transmission line will not disrupt the travel routes, and since the construction of the tower and installation of the transmission line will be done in sections, it is unlikely that the construction plan will interfere with grazing activities by avoiding the seasonal migration period. Therefore, it is considered unlikely that the construction plan will interfere with grazing activities by avoiding the seasonal migration period.

No land use impacts are generally expected during operation.

(6) Water use

As mentioned above, many of the villages in the project area use river water and wells for domestic use. Although agriculture is dependent on rainwater, access to water becomes extremely difficult during the dry season (June to August). In particular, according to the household and livelihood survey conducted along the 220 kV TL route, approximately 60% of the surveyed households had access to drinking water within a 30-minute distance (including tap water use), while 30% of the households had to spend 30 minutes to 1 hour to obtain water, and less than 10% spent 1 to 2 hours. On the other hand, since the 60 kV DL route is close to urban areas and planned urban areas have been developed, more than 70% of the surveyed households were able to obtain drinking water within 30 minutes (including tap water use), and 20% of the households spent "30 minutes to 1 hour", which was better than those along the 220 kV TL (See 10.3.3 for details) The number of households that had access to drinking water was about 20%.

The water supply vehicles will be supplied by the municipal water systems of Moçâmedes and Lubango, where the construction office is located. Therefore, the use of river water, well water, and rainwater that local residents normally use is not originally anticipated, and there is no possibility that they will be deprived of their scarce water.

(7) Existing social infrastructures and services

Demining work on the route may involve restricting access to the area for a certain period of time, which may have an impact on existing social services.

In view of the scale of the explosion of the anti-personnel mines that are the main target of disposal, the possibility of impact on social infrastructures is considered to be extremely low.

Increased traffic in the project area could lead to an increase in traffic accidents. On the other hand, positive impacts, such as infrastructure development during the construction period, are foreseen. The local economy is expected to be strengthened by better access to social services and local markets throughout the year, as the access road development will indirectly help ensure safe travel routes.

(8) Social institutions, such as social capital and decision-making institutions

In rural areas of Angola, "Soba," a local traditional leader, enjoys a great deal of trust among the local people, even more so than local government officials. In this Preparatory Survey, the importance of the position of Soba has been confirmed by the local government in the project area, as they advised "Soba as an intermediary and witness the seizure of the Soba.[69] The study was conducted with the cooperation of Soba in holding stakeholder consultations, and through the same process, it was confirmed that Soba is a bridge between the local government and the local residents, as well as a coordinator of opinions. In the villages in the project area, it is customary to obtain the authority and endorsement of the Soba to resolve various local issues, such as mediation on land use, grant of customary rights and inheritance, and mediation of disputes among residents. No people were identified.

[69] See Table 10.10-4.

No particular positive or negative impact on local decision-making is expected from the implementation of the project. In implementing the project, it is envisioned that these existing mechanisms will be utilized to provide screening support, complaint handling, and monitoring in a manner that ensures fairness and transparency, such as by having Soba intervene to confirm the existence of land rights and occupancy status when acquiring land and providing compensation (See 10.5.1 and 10.9.1).

(9) Misdistribution of benefits and losses

While farmland and houses under the transmission and distribution line ROW will be compensated, there is a risk that people in the surrounding areas will develop a sense of unfairness; RNT / loan consultant and contractor will work to resolve such unfairness through careful and continuous explanations in the local community. RNT should also ensure access by local people by assigning a grievance officer at the local office or project office.

(10) Local conflicts of interest

RNT, the loan consultant, and the contractor will make careful and continuous efforts to explain the project in the local community to eliminate misunderstandings and inequities. RNT will ensure access by local residents by assigning a grievance officer at the local office or project office.

The implementation of the project will also result in an influx of outsiders, such as engineers employed by the contractor, and the development of work camps. The contractor will provide guidance to these outsiders and instruct them on local adaptation.

(11) Cultural Heritage

There are no cultural heritage sites in the project area according to national law. However, there is a Boer cemetery located 230 m from the transmission route (Jamba farm, Humpata Municipality). Since the Boers have had a significant impact on the development of agriculture in the Huíla Province and are considered to have high historical and cultural value, the impact on this cemetery will be avoided by not constructing a steel tower in the vicinity. No other heritage sites were identified as having historical or cultural value.

(12) Landscape

However, an alternative route was considered to avoid damage to the landscape, and since the proposed route is approximately 5 km away from the city of Lubango and follows the ROW of the existing 60 kV DL to the east of Mount Leba, no negative impacts to the scenic area are anticipated. not foreseen. In addition, the transmission route from Humpata Municipality to Moçâmedes Municipality is generally along National Road No. 280 and passes through desert areas along the way, which will mitigate impacts by eliminating the need to clear trees in the ROW.

On the other hand, landscape changes will occur due to ROW tree cutting during construction on other transmission line routes, as well as impacts on the landscape due to worker camp construction, construction work, and heavy equipment entering the area. The distribution line will pass through the urban area of Arimba commune, which will mitigate the impacts to some extent, but the impacts during construction will remain as well. Three substations are located within the desert, savanna, and acquired parcels, but will similarly be impacted during construction.

(13) Gender

In stakeholder consultations in the project areas, women's participation was encouraged through village heads, and consultations were held at times that facilitated women's participation to the greatest extent possible, but the ratio of male to female participation was generally higher (See 9.11.2). Even when they did participate, women were not often seen actively coming forward to express their opinions, and when asked individually after the consultations, many said that their spouses were representing their opinions.

Apart from formal group discussions, individual interviews were conducted with women in the local community, which revealed cases of harassment on local peopole by incoming external personnel and workers in past infrastructure projects in the area. This project requires thorough implementation of measures to prevent such harassment (e.g., providing guidance to outside personnel and workers, enforcing a code of conduct, etc.), as well as respecting the position of

local women and incorporating their opinions while actively listening to them. In addition, moves to provide employment opportunities for women and to support local commerce are also expected.

(14) Children's Rights

According to the new labor law (New General Labour Law No. 7/15 of 15 June 2015), children under 14 years of age are prohibited from working in the Angolan country, while those between 14 and 16 years of age require parental consent. In addition, workers under 18 years of age will be subject to restrictions on the hours and duration of work per day and per week, and employers will also be required to provide care and support for school-aged children. RNT/ENDE will comply with the law and will not allow children under the age of 14 to work.

(15) Infectious diseases such as HIV/AIDS

According to field surveys, malaria, diarrhea, and other diseases have been identified in many local communities. If preventive measures are not taken, infectious diseases may spread due to the influx of construction workers and other factors.

(16) Working environment (including occupational safety)

In this project, demining work will be conducted by the Angolan government prior to the start of construction. Since the project targets explosives and involves danger, the impact on workers in the event of an accident is significant. In accordance with IMAS and NNAS, safety measures will be taken to ensure the safety of operator workers engaged in demining work prior to construction. SOPs stipulate the wearing of protective clothing and other safety measures for operators. The SOPs and other regulations specify safety measures and work procedures in detail, and training is conducted.

Prior entry by construction workers will be prohibited until the exploration and removal work defined by the Angolan government is completed and safety is confirmed. During the construction period, in anticipation of the possibility of finding mines or unexploded ordnance, safety measures will be thoroughly enforced by educating workers, informing them of what to do if found and how to contact us, and posting notices at all times. In the event of discovery, construction work will be suspended immediately and will not be resumed until the safety of the workers is confirmed. The suspension period is not included in the contracted construction period.

Dust, noise, and vibration are foreseen to be generated during site preparation and construction work, but their impact will be limited. Since the construction period is short (approximately 3 years), deterioration of facilities at the workers' camp is not foreseen. National laws provide regulations on occupational health and safety, and preventive measures are required to be taken. During the period of service, no particular problems are expected to occur as long as RNT/ENDE takes appropriate occupational safety and health measures in accordance with national laws and internal regulations.

9.6.4. Others

(1) Accidents

The project is premised on the completion of demining work conducted by the Angolan government prior to the start of construction.[70] Since the project targets explosives and involves risks, the search and removal of mines and UXOs will be conducted under strict safety control to enhance safety, and the SOP stipulates the wearing of protective clothing as a safety measure for the operators engaged in the activities.[71] In addition, equipment such as mine detectors to be used for this activity will be procured by the project. Measures will also be taken to prevent accidents from occurring, such as prohibiting entry to the area and posting notices.

During construction, assuming the possibility that mines and unexploded ordnance may be discovered, educate construction workers, inform them of what to do if mines or unexploded ordnance are discovered, and provide contact information, which should be posted near the

[70] The proposed project site is not a front line in the civil war, and it is unlikely that anti-tank mines are buried there. There is also no record of large-scale air strikes, so the possibility of large unexploded ordnance is also considered low.

[71] According to the CED and INAD, no accidents have been identified under operators under CED jurisdiction for about the past 10 years, and the probability of accidents occurring is low (see 8.3.3.). Quality control and quality assurance of mine detection and clearance activities, including safety verification inspections of personnel engaged in demining work, will be carried out by ANAM (See 8.4, 8.7, 8.8).

construction site at all times. If mines or unexploded ordnance are found, construction work will be suspended immediately to prevent accidents from occurring during disposal activities, and entry to the area and traffic will be prohibited until disposal is completed. This suspension period is not included in the contracted construction period.

During the construction period, traffic accidents may increase due to the increased traffic volume, and especially traffic in the urban area must be supervised during school and commuting hours. Fires may occur due to workers' mishandling of cigarettes, etc. Therefore, fire prevention measures must be taken through appropriate management.

9.7. Impact Assessment

Based on the results of the above environmental and social impact study, the impact assessment by the project and the reasons for it are presented separately for transmission line, distribution line, and substations. The results of the impact assessment during scoping are also included.

Table 9.7-1 220 kV TL Impact Assessment

Classification.	Impact item		Impact assessment during scoping		Impact assessment based on survey results		Reasons for Evaluation
			Pre- construction & construction	operation	Pre- construction & construction	operation	
Pollution	1	Air pollution	✓		B-	N/A	**Pre-construction:** Emissions of air pollutants (SOx, NOx, etc.) and dust emissions are expected due to the operation of heavy equipment for clearing and rooting for demining work and for deep excavation at the location of the tower, but the impact will be temporary and limited in scope. **During construction:** Heavy equipment will be in operation for the construction of the transmission line ROW, construction roads, and towers, and air pollutant (SOx, NOx, etc.) emissions and dust will be generated by construction vehicle traffic, but the impact is expected to be temporary and limited in scope, and the amount of work will be greatly reduced by mine/UXO exploration and clearance activities. The amount of construction work is expected to be significantly reduced by demining work. **Operation:** No air pollution impact is expected.
	2	Water pollution	✓	✓	B-	B-	**Pre-construction: In** areas where surface water is present, impacts are expected if soil runoff occurs during rainfall due to clearing and rooting as part of demining work. Impacts are expected if wastewater generated at the workers' camp is not properly treated. **During construction:** The construction of the transmission line ROW and construction road will be carried out in coordination withdemining work, which will significantly reduce the impact, and since there are no plans to construct steel towers in the river channel, the impact is expected to be minor. In addition, there are no plans to use ground improvement chemicals in the construction of the towers, and water pollution from chemicals is not expected. However, wastewater will be generated at the workers' camp, and if it is not properly treated, it is expected to have an impact. **Operation:** Where surface water is present, removal of vegetation under the line and along the administrative roadway is expected to cause turbidity due to sediment runoff from exposed areas.
	3	Soil pollution	✓		B-	N/A	**Pre- and during construction:** Possible soil contamination due to leakage of lubricating oil and fuel oil from construction

Classification.	Impact item		Impact assessment during scoping		Impact assessment based on survey results		Reasons for Evaluation
			Pre- construction & construction	operation	Pre- construction & construction	operation	
							vehicles, construction machinery, etc. is assumed. On the other hand, there is no plan to use ground improvement agents in the construction of the steel tower. **Operation**: No potential for soil contamination by the transmission facility is anticipated.
	4	Sediment	✓		D	N/A	**During construction**: There are no plans to use ground improvement chemicals and no impact on bottom sediment is anticipated. **Operation**: No impact on bottom sediments is expected from the transmission facilities.
	5	Noise and Vibration	✓	✓	B-	B-	**Pre-construction**: Noise and vibration are expected to be generated by the operation of heavy machinery for clearing and rooting during the demining work, and by the operation of heavy machinery for deep excavation at the location of the steel tower, but the extent of the noise and vibration will be limited and temporary. On the other hand, vehicles used to transport team members are expected to cause noise and vibration along the roadside. **During construction:** Noise and vibration due to the operation of heavy equipment and the passage of construction vehicles is expected, but the extent of noise and vibration will be limited and temporary. **Operation:** It is assumed that there is a possibility of noise generation from wind noise of the transmission line during high winds and noise generation from corona discharge.
	6	Offensive odors	✓		B-	N/A	**Pre-construction:** If waste, domestic wastewater, etc. are generated at the workers' camp and not properly managed and treated, odors are expected to be generated. **During construction:** If waste, domestic wastewater, etc. are not properly treated at the workers' camp, odors are expected to be generated. **Operation:** No odor is expected to be generated.
	7	Waste	✓		B-	N/A	**Pre-construction**: If waste materials are not properly disposed of at the workers' camp, odors are expected to be generated. Plant materials generated by demining work will be waste, which will be impacted if not properly disposed of. **During construction:** Impacts are expected if waste and wastewater generated at construction sites are not properly managed and discharged. In addition, waste and domestic wastewater will be generated at the workers' camp, which may be affected if they are not properly disposed of. **Operation:** No waste is expected to be generated.
	8	Land subsidence	✓	✓	D	D	**During construction:** Geological survey confirms that the ground is stable, and no subsidence is anticipated. **Operation:** Geological survey confirms that the ground is stable, and no subsidence is anticipated.
Natural environment	9	Protected area	✓	✓	D	D	**Pre- and during construction:** The proposed site of the 220/60 kV New Namibe SS was determined to be 15 km north of the boundary of the Namibe Partial Reserve, and no impact on the protected area is anticipated. **Operation:** The proposed site of the 220/60 kV New Namibe SS has been determined to be 15 km north of the boundary of the Namibe Partial Reserve, and no impact on the protected area is anticipated.

Classification.	Impact item		Impact assessment during scoping		Impact assessment based on survey results		Reasons for Evaluation
			Pre- construction & construction	operation	Pre- construction & construction	operation	
	10	Ecosystem	✓	✓	A-	A-	**Pre-construction**: Demining work will involve clearing and rooting, resulting in loss of vegetation and fragmentation and loss of animal habitat on a certain scale, as well as air pollution and noise and vibration due to the operation of heavy machinery and deep excavation at the location of the steel tower, which is expected to have an impact on animals. **During construction:** After the demining work, air pollution, noise and vibration generated by the operation of heavy equipment and construction vehicles for the construction access road, ROW maintenance, and tower construction are expected to affect animals. **Operation: The** possibility of bird strike is anticipated along the entire line, especially in the vicinity of Caraculo in the desert area, as Ludwig's Bustard (*Neotis ludwigii)*, which is classified as Endangered (EN) by the IUCN, has been confirmed near Caraculo in Ecoregion 5 (Namib Desert). It has been confirmed near Caraculo in Ecoregion 5 (Namib Desert) and is expected to be impacted. In forested areas, the impact is expected to be the felling of trees to maintain separation distances under the line at regular intervals and the fragmentation and loss of animal habitats.
	11	Hydrology	✓	✓	B-	B-	**Pre-construction**: Logging and root clearing fordemining work will take place, and the impact on hydrology is expected to be limited in scope. **During construction:** Little new vegetation will be removed for the construction of the towers, so it is assumed that there will be little impact on hydrology. **Operation:** Flood control measures are necessary due to the expected changes in rainfall runoff caused by topographical changes due to the construction of the tower site and the cutting of trees to maintain the separation distance under the line in the forested area.
	12	Topography and Geology	✓	✓	B-	B-	**Pre-construction**: Logging and root clearing fordemining work will be conducted, and the potential for topographic change due to erosion is anticipated. **During construction:** Construction access road and ROW and topographic impacts due to tower construction are expected. **Operation:** Erosion impacts are expected due to removal of vegetation from the access road and under the line.
Social environment	13	Land acquisition and resettlement	✓		B-	N/A	**Pre and during construction:** In the construction of the transmission and distribution lines, ROW clearance, tower maintenance, access roads and material storage areas, and land use restrictions in restricted access areas due to safety considerations are anticipated, so temporary acquisition of private land and land used in these areas is expected (permanent acquisition is expected for the tower portion and maintenance land). (Permanent acquisition will be made for the) **Operation:** No permanent resettlement will occur and no specific impacts are expected.
	14	The poor	✓	✓	B-	D	**During construction:** Negative impacts were minimized through discussions with the implementing agency and local government officials to ensure that negative impacts on local

Classification.	Impact item		Impact assessment during scoping		Impact assessment based on survey results		Reasons for Evaluation
			Pre- construction & construction	operation	Pre- construction & construction	operation	
							residents were minimized and alternative options were considered, and it was confirmed that there were no affected residents under the poverty line at the time of conducting this feasibility study. It should be noted that since the residents of the 220 kV transmission route have relatively low incomes and dependence on agricultural land as a source of livelihood and income is more prevalent in rural communities where agriculture and livestock are the main livelihood activities, if alternative agricultural land and crop compensation are not properly provided, their living standards may deteriorate further from those before the project implementation. In addition to creating job opportunities and local business opportunities during the construction period, support that contributes to local residents, such as maintenance roads for use in local livelihoods, is desirable. **Operation:** No specific impact is expected.
	15	Ethnic Minorities and Indigenous Peoples	✓	✓	D	D	**During construction:** While there are various ethnic groups and languages in the project area, the Mumuila (Nyaneka-Humbi) and Mucubal (Herero), who are believed to be grazers, were identified in a settlement located near the project area in Humpata Municipality. However, they did not maintain different and distinctive characteristics as a unique and indigenous cultural group compared to other inhabitants, and their way of life as a congregation did not differ from that of other ethnic groups. There was no actual collective attachment to the locality or region, no customary cultural, economic, social, or political institutions that separated them from the surrounding population, and they were already integrated and assimilated into the local living environment. In addition, communication was conducted in typical languages spoken locally, such as Nyaneka-Humbi, with the exception of illiterate people. On the other hand, the overhead power line does not divide the area, and the construction of the tower and the laying of the power line will be done in phases, so the project's impact on grazing can be avoided regardless of ethnic groups (the existence of grazing communities and grazing groups along the project's power line route was not confirmed during the social survey period). **Operation:** no negative impacts are anticipated; the ROW and construction access road will be maintained on the premise of mine clearance, which will indirectly support safe travel during the grazing season.
	16	Local economy, including employment and means of livelihood	✓		B-/B+	N/A	**During construction:** Access to the transmission line ROW and surrounding land will be restricted, which may result in a partial loss of income for residents whose livelihoods depend on agriculture. These impacts will be greater for affected residents in Humpata Municipality, where agriculture and livestock raising are the majority of livelihoods. In addition, tree felling under the ROW will be required, which may have an impact on income from non-timber forest product extraction in areas with rich vegetation, but the impact will be small due to the proximity of alternative forest lands. Although there will be no acquisition of land rights by the project, it will be necessary to maintain vertical distances of

Classification.	Impact item		Impact assessment during scoping		Impact assessment based on survey results		Reasons for Evaluation
			Pre- construction & construction	operation	Pre- construction & construction	operation	
							8 m and 3 m between the power lines and buildings/trees, respectively, and compensation will be provided if it is assumed that conventional crops cannot be grown due to height restrictions. Since the overhead transmission line will not divide the area and the construction of the tower and the laying of the transmission line will be done in phases, any impact of the project on grazing can be avoided, and this will be ensured by reviewing the situation on site as needed during the construction. On the other hand, it is expected that local employment opportunities as construction workers and local business will be promoted. **Operation:** No negative impacts are anticipated. Local employment in labor tasks (e.g., pruning to avoid tree contact) may occur, but only a small number.
	17	Land use and utilization of local resource	✓		B-	N/A	**During construction:** Temporary land use restrictions are expected during the construction period, including construction of substation facilities, laying of tower base, construction of access roads, storage of materials, and restriction of access to the transmission and distribution line ROW due to safety concerns. During the construction of the tower and installation of transmission and distribution lines, changes in local land use are expected, especially in Lubango and Humpata municipalities. However, since the tower construction and transmission line installation will be carried out in sections, it is expected that the process will avoid the farming season as much as possible, thereby reducing the impact. In addition, although tree felling under the ROW will be required, no significant impact on the collection of non-timber forest products is anticipated due to the proximity of alternative forest areas. By avoiding the seasonal migration period, the construction plan is unlikely to interfere with grazing activities. No problems are anticipated for the distribution line route and the proposed substation construction site. **Operation:** Not foreseen in particular.
	18	Water use	✓		D	N/A	**During construction: Since it is** necessary to secure a large amount of water for the construction work, a construction water truck is planned to be introduced, and no negative impact on local residents is expected. **Operation:** No specific water use is required for maintenance and other operations of the project facilities, and therefore no negative impacts are foreseen.
	19	Existing social infrastructures and social services	✓		B-	N/A	**Preconstruction:** Mine exploration and clearance work on the route may involve restricting access to the area for a certain period of time, which may have an impact on existing social services. The possibility of impact on social infrastructures is extremely low, considering the scale of the explosion of the anti-personnel mines that are the main target of the mine clearance. **During construction:** Increased traffic in the project area may result in increased traffic accidents, etc. However, the facilities that local residents use on a daily basis are not located near the transmission line ROW, so the impact will be minimized.

Classification.	Impact item		Impact assessment during scoping		Impact assessment based on survey results		Reasons for Evaluation
			Pre- construction & construction	operation	Pre- construction & construction	operation	
							Operation: No negative impacts are foreseen. On the other hand, the local economy is expected to be strengthened through better access to social services and local markets throughout the year, as the access road improvements will indirectly help ensure safe travel routes.
	20	Social institutions such as social infrastructure and local decision-making institutions	✓	✓	D	D	**During construction:** No project impacts are anticipated. The stakeholder consultations for this study were conducted with the cooperation of Soba, which bridges the gap between the local government and local residents and coordinates their opinions. **Operation:** No negative impacts are foreseen.
	21	Misdistribution of benefits and losses	✓	✓	B-	D	**During construction:** damage to residents and landowners in and around the transmission line ROW between Namibe and Lubango City, such as land acquisition for steel towers and access restrictions, which may affect agricultural activities. While farmland and homes under the transmission and distribution line ROW will be compensated, people in the surrounding areas may suffer from a growing sense of injustice. In addition, some residents may benefit through employment and commercial opportunities. **Operation:** No negative impacts are foreseen.
	22	Local conflicts of interest	✓		B-	N/A	**During construction:** If there are residents who will be affected, such as residents and landowners in and around the ROW, there may be a conflict of interest with residents who will benefit through employment and commercial opportunities. There is a possibility that disputes may arise between residents depending on whether they receive compensation or not. In addition, the implementation of the project may cause conflicts with local residents due to the influx of outsiders such as engineers hired by the contractor and the development of labor camps. **Operation:** No specific impacts are foreseen.
	23	Cultural heritage	✓	✓	B-	D	**Pre and during construction:** Although there are no cultural or complex heritage sites to be inscribed on the UNESCO World Heritage List and no historical, cultural, or archaeological properties or cultural assets designated or recognized in Angola, a Boer cemetery was identified about 230 m from the transmission route (Jamba Farm, Humpata Municipality). Since the Boers have had a significant impact on the development of agriculture in the Huíla Province and are considered to have high historical and cultural value, it is hoped that the impact on the cemetery will be avoided by not constructing a steel tower in the vicinity. **Operation:** No specific impacts are foreseen.
	24	Landscape	✓	✓	B-	D	**During construction:** The selected route will follow the existing 60 kV DL and pass along the east side of Mt. Leyba, avoiding impacts on the view of the Christ the King Statue from Lubango City and other impacts on the cultural landscape are not anticipated. In addition, the transmission

Classification.	Impact item		Impact assessment during scoping		Impact assessment based on survey results		Reasons for Evaluation
			Pre- construction & construction	operation	Pre- construction & construction	operation	
							line route from Humpata Municipality to Moçâmedes Municipality is generally along Route 280 and passes through desert areas along the way, which will mitigate impacts by eliminating the need to cut down trees in the ROW. On the other hand, other transmission line routes will be affected by landscape changes due to ROW tree cutting during construction, construction of labor camps, construction work, and heavy equipment. **Operation:** No specific impacts are foreseen.
	25	Gender	✓	✓	B-	D	**During construction:** While it is difficult to obtain voluntary and active participation, expression of opinions and activities by women in the local communities in the area, it is necessary to consider gender mainstreaming measures such as providing work opportunities for women and moves to support local commerce. On the other hand, past infrastructure projects have experienced harassment on local people by incoming human resources and workers from outside, and such cases may occur in this project as well. **Operation:** No specific impacts are foreseen.
	26	Children's rights	✓	✓	B-	D	**During construction:** Children under 14 years of age are prohibited from working in the country of Angola, while those between 14 and 16 years of age require parental consent. In addition, restrictions are imposed on the hours and duration of work per day and per week for workers under 18 years of age, and employers are required to provide consideration and support for school-aged children. In this project, thorough compliance with these laws and regulations is required. **Operation:** No specific impacts are foreseen.
	27	Infectious diseases such as HIV/AIDS	✓		B-	N/A	**During construction:** According to field surveys, malaria, diarrhea, and other diseases are frequently observed in the local community. If preventive measures are not taken, infectious diseases may spread due to the influx of construction workers, etc. Worker education and proper management of sanitary conditions are required. **Operation:** No negative impacts are foreseen.
	28	Working environment (including occupational safety)	✓	✓	A-	D	**Pre-construction:** Mine exploration and clearance activities must be conducted and completed by the Angolan government prior to the start of construction. However, because these activities involve explosives and are dangerous, the impact on workers in the event of an accident is significant. In conducting this activity, safety measures will be taken for the operator workers, including the wearing of protective clothing in accordance with the SOP. **During construction:** Assuming that mines and unexploded ordnance may be found during construction, construction workers will be educated and made aware of how to deal with them and who to contact. If found, construction work will be suspended immediately and will not resume until the safety of the construction workers is confirmed (the said suspension period will not be included in the contractual construction period). It is foreseen that dust, noise and vibration will be generated during site preparation and construction work, but the impact will be limited. National legislation establishes

Classification.	Impact item		Impact assessment during scoping		Impact assessment based on survey results		Reasons for Evaluation
			Pre- construction & construction	operation	Pre- construction & construction	operation	
							regulations regarding occupational health and safety, and preventive measures are required to be taken. **Operation:** No specific impacts are foreseen.
Others	29	Accidents	✓	✓	A-	D	**Pre-construction:** Mine exploration and clearance activities are subject to implementation and completion by the Angolan government side prior to the start of construction, but they are hazardous because of the explosive materials involved. Therefore, their implementation will be carried out in accordance with safety measures and work procedures based on SOPs, and the equipment to be used will be newly procured by the project. In addition, measures will be taken to prevent the occurrence of accidents, such as prohibiting entry to the surrounding area and posting signs to raise awareness and publicize the project. **During construction:** If mines or unexploded ordnance are found during construction, construction work will be suspended immediately to avoid the risk of accidents, and measures will be taken to prevent accidents, such as prohibiting access to the area and traffic until the disposal is completed (the said suspension period is not included in the construction period under the contract). In addition, traffic accidents may increase due to increased traffic during the construction period. In particular, when implementing construction in areas close to urban areas or areas with a certain amount of traffic, supervision during school and commuting hours is required. In addition, fire prevention measures are required through proper management, such as workers' cleaning up of cigarettes. **Operation:** No specific impacts are foreseen.
	30	Cross-boundary impact and climate change			N/A	N/A	**During construction:** construction activities will generate CO_2, but are not expected to affect climate change. **Operation:** Transmission lines do not cross the border. Also, no CO_2 is generated.

Note: A+/-: Significant positive/negative impacts are expected.
B+/-: some positive/negative impact expected.
C+/-: The extent of the positive/negative impact is unknown (further investigation is needed, and in the process the impact can be clarified).
D: No impact is anticipated.
N/A: Impact assessment was not performed due to a D in the scoping phase.

Source: JICA Survey Team

Table 9.7-2 60 kV DL Impact Assessment

Classification.	Impact item		Impact assessment during scoping		Impact assessment based on survey results		Reasons for Evaluation
			Pre- construction & construction	operation	Pre- construction & construction	operation	
Pollution	1	Air pollution	✓		B-	N/A	**Pre-construction:** Heavy equipment operation for deep excavation at the location of the tower is expected to emit air pollutants (SOx, NOx, etc.) and generate dust, but the impact will be temporary and limited in scope. **During construction:** Heavy equipment will be in operation for the construction of the transmission line ROW, construction roads, and towers, and air pollutant (SOx, NOx, etc.) emissions and dust will be generated by construction vehicle traffic, but the impact is expected to be temporary and limited in scope, and the amount of work will be greatly reduced by demining work. The amount of construction work is expected to be significantly reduced by demining work. **Operation:** No air pollution impact is expected.
	2	Water pollution	✓		B-	**N/A**	**Pre-construction:** Wastewater is generated at the workers' camp and is expected to be impacted if not properly treated. **During construction:** Wastewater will be generated from workers' camp and is expected to be impacted if not properly treated. **Operation**: No wastewater is generated and no impact is expected.
	3	Soil pollution	✓		B-	N/A	**Pre- and during construction:** While the possibility of soil contamination due to leakage of lubricating oil and fuel oil from construction vehicles and construction machinery is assumed, the use of ground improvement agents in the construction of the steel tower is not planned. **Operation**: No potential for soil contamination by power distribution facilities is anticipated.
	4	Sediment			N/A	N/A	**During construction**: There are no plans to use board improvers, and no impact on bottom sediment is anticipated. **Operation**: No impact on bottom sediment by power distribution facilities is expected.
	5	Noise and Vibration	✓	✓	B-	B-	**Pre-construction**: Noise and vibration are expected to occur due to the operation of heavy machinery for deep excavation at the location where the tower will be installed. **During construction:** Noise and vibration are expected to be generated by the operation of heavy machinery and the passage of construction vehicles. **Operation:** Wind noise from power lines is expected to occur during high winds. Also, there is a possibility of corona discharge noise during rainfall.
	6	Offensive odors	✓		B-	N/A	**Pre-construction:** Waste, wastewater, etc. will be generated at the workers' camp, and if the waste is not properly managed, odors are expected to be generated. **During construction:** If waste, wastewater, etc. are not properly disposed of at the workers' camp, odors are expected to be generated. **Operation:** No odor is expected to be generated.
	7	Waste	✓		B-	N/A	**Pre-construction**: The plants generated by demining work will become waste, which is expected to cause impacts if not properly disposed. **During construction:** Impacts are expected if waste and sewage generated at construction sites are not properly

Classification.	Impact item		Impact assessment during scoping		Impact assessment based on survey results		Reasons for Evaluation
			Pre- construction & construction	operation	Pre- construction & construction	operation	
							managed. In addition, waste and domestic wastewater will be generated at the workers' camp, and the impact is expected if they are not properly treated. **Operation:** No waste is expected to be generated.
	8	Land subsidence	✓	✓	D	D	**During construction:** Geological survey confirms that the ground is stable, and no subsidence is anticipated. **Operation:** Geological survey confirms that the ground is stable, and no subsidence is anticipated.
Natural environment	9	Protected area			N/A	N/A	**Pre- and during construction:** There are no protected areas in the vicinity and no impact is anticipated. **Operation:** There are no protected areas in the vicinity and no impact is anticipated.
	10	Ecosystem	✓	✓	B-	B-	**Pre-construction**: Since the area is already developed and heavily trafficked by residents and vehicles, the areas requiring clearing and rooting for demining work are assumed to be limited, and the impact on animals due to air pollution and noise and vibration generated by the operation of heavy equipment is also expected to be limited. **During construction:** After the demining work, the construction access road, ROW, and the operation of heavy equipment and construction vehicles for tower construction are expected to cause air pollution, noise, and vibration, which may impact animals, but the type and distribution of fauna is expected to be limited and the impact is expected to be minor. **Operation:** Bird strike is expected to be possible along the entire route, but the species present are limited and the impact is expected to be minor. There will be little need for logging to maintain separation distances.
	11	Hydrology			N/A	N/A	**Pre-construction**: The terrain is flat and there are few wooded areas, so the impact of demining work on hydrology is not expected. **During construction:** little new vegetation will be removed for the construction of the towers, so it is assumed that there will be little impact on hydrology. **Operation:** Little to no impact on hydrology is expected.
	12	Topography and Geology			N/A	N/A	**Pre- and during construction:** No impact is expected due to the flat topography and stable geology. **Operation:** No impact is expected due to the flat topography and stable geology.
Social environment	13	Land acquisition and resettlement	✓		B-	N/A	**Pre and during construction:** Temporary relocation and access restrictions are foreseen under the ROW and at and around the tower construction site, and compensation is expected for the temporary acquisition of private and use lands included in these areas. Permanent acquisition will be made for the tower portion and maintenance land, but the impact will be limited. **Operation:** Not expected.
	14	The poor	✓	✓	D	D	**During construction:** The distribution line route was in a semi-urban area, with well-developed residential areas and no poor people were identified. **Operation:** Not expected.
	15	Ethnic Minorities and			N/A	N/A	**During construction:** Although the presence of a variety of ethnic groups and languages was observed in the local settlement, there were no differences in lifestyles among the

Classification.	Impact item		Impact assessment during scoping		Impact assessment based on survey results		Reasons for Evaluation
			Pre- construction & construction	operation	Pre- construction & construction	operation	
		Indigenous Peoples					ethnic groups, as they did not maintain different and distinctive characteristics as a unique and distinct cultural group compared to other inhabitants. There was also no actual collective attachment to the locality or region, nor any customary cultural, economic, social, or political institutions that separated them from the surrounding population. Communication among the local population, with the exception of the illiterate, took place in the typical languages spoken locally, such as Nyaneka-Umbi. **Operation:** No specific impacts are anticipated.
	16	Local economy, including employment and means of livelihood	✓		B+	N/A	**During construction:** The area around the towers and the approach road will be off-limits, but there will be no agricultural land and limited impact on means of livelihood. On the other hand, local employment opportunities as construction workers and local business may be promoted and stimulated. **Operation:** No negative impacts are anticipated. Local employment in labor tasks (e.g., pruning to avoid tree contact) may occur, but only a small number.
	17	Land use and utilization of local resource	✓		B-	N/A	**During construction:** Land use restrictions will occur under the ROW and at and around the tower construction site, but the impact will be limited. **Operation:** Not foreseen in particular.
	18	Water use	✓		D	N/A	**During construction:** A large amount of water for construction will be secured through the introduction of construction water trucks, so no impact on local residents' domestic water supply is anticipated. **Operation:** Not foreseen in particular.
	19	Existing social infrastructures and social services	✓		B-	N/A	**Pre-construction:** Although the likelihood of finding mines and unexploded ordnance is low due to the urbanization of the area, the implementation of mine exploration and clearance work may restrict access to the area, which may affect existing social services. **During construction:** traffic is expected to increase. **Operation:** Not foreseen in particular.
	20	Social institutions such as social infrastructure and local decision-making institutions	✓	✓	D	D	**During construction:** No project impacts are anticipated. The stakeholder consultations for this feasibility study are being conducted with the cooperation of Soba, which will serve as a bridge between the local government and residents and coordinate their opinions. **Operation:** No negative impacts are foreseen.
	21	Misdistribution of benefits and losses	✓	✓	B-	D	**During construction:** There is a potential impact on daily life of residents and landowners in and around the distribution line ROW due to acquisition of land for the tower and access restrictions. While the area under the distribution line ROW will be compensated, people in the surrounding areas may feel inequity. In addition, some residents may benefit through employment and commercial opportunities. **Operation:** No negative impacts are foreseen.

Classification.	Impact item		Impact assessment during scoping		Impact assessment based on survey results		Reasons for Evaluation
			Pre- construction & construction	operation	Pre- construction & construction	operation	
	22	Local conflicts of interest	✓	✓	B-	D	**During construction:** There may be conflicts of interest between residents who will be affected, such as residents and landowners in and around the ROW, and residents who will benefit through employment and commercial opportunities. In addition, disputes may arise among residents depending on whether or not they receive compensation. Furthermore, there is a possibility of conflict between contractor-side parties (engineers, workers, etc.) and local residents. **Operation:** No specific impacts are foreseen.
	23	Cultural heritage			N/A	N/A	**Before, during and operation:** There are no cultural or complex heritage sites registered as World Heritage Sites by UNESCO, or historical, cultural or archaeological assets or cultural properties designated or recognized in Angola in the vicinity of the distribution line construction site and its surroundings.
	24	Landscape	✓	✓	B-	D	**During construction:** The distribution line route is located in a residential development area, where railways and 150 kV transmission line are already in place, so the impact on the urban landscape will be limited, but there will be landscape changes due to ROW tree cutting during construction, and landscape impacts due to worker camp construction, construction work, and heavy equipment entering the area. **Operation:** No specific impacts are foreseen.
	25	Gender	✓	✓	B-	D	**During construction:** While it is difficult to obtain voluntary and active participation, expression of opinions and activities by women in the local communities in the area, it is necessary to consider gender mainstreaming measures such as providing work opportunities for women and moves to support local commerce. On the other hand, past infrastructure projects have experienced harassment on local people by incoming human resources and workers from outside, and such cases may occur in this project as well. **Operation:** No specific impacts are foreseen.
	26	Children's rights	✓	✓	B-	D	**During construction:** Children under 14 years of age are prohibited from working in the country of Angola, while those between 14 and 16 years of age require parental consent. In addition, restrictions are imposed on the hours and duration of work per day and per week for workers under 18 years of age, and employers are required to provide consideration and support for school-aged children. In this project, thorough compliance with these laws and regulations is required. **Operation:** No specific impacts are foreseen.
	27	Infectious diseases such as HIV/AIDS	✓		B-	N/A	**During construction:** According to field surveys, malaria, diarrhea, and other diseases are frequently observed in the local community. If preventive measures are not taken, infectious diseases may spread due to the influx of construction workers, etc. Worker education and proper management of sanitary conditions are required. **Operation:** No negative impacts are foreseen.
	28	Working environment (including occupatio	✓	✓	A-	D	**Pre-construction:** Mine exploration and clearance activities must be conducted and completed by the Angolan government prior to the start of construction. However, because these activities involve explosives and are dangerous, the impact on workers in the event of an accident is

Classification.	Impact item		Impact assessment during scoping		Impact assessment based on survey results		Reasons for Evaluation
			Pre- construction & construction	operation	Pre- construction & construction	operation	
		nal safety)					significant. In conducting this activity, safety measures will be taken for the operator workers, including the wearing of protective clothing in accordance with the SOP. **During construction:** Assuming that mines and unexploded ordnance may be found during construction, construction workers will be educated and made aware of how to deal with them and who to contact. If found, construction work will be suspended immediately and will not resume until the safety of the construction workers is confirmed (the said suspension period will not be included in the contractual construction period). It is foreseen that dust, noise and vibration will be generated during site preparation and construction work, but the impact will be limited. National legislation establishes regulations regarding occupational health and safety, and preventive measures are required to be taken. **Operation:** No specific impacts are foreseen.
Others	29	Accidents	✓	✓	A-	D	**Pre-construction:** Demining work is subject to implementation and completion by the Angolan government side prior to the start of construction, but they are hazardous because of the explosive materials involved. Therefore, their implementation will be carried out in accordance with safety measures and work procedures based on SOPs, and the equipment to be used will be newly procured by the project. In addition, measures will be taken to prevent the occurrence of accidents, such as prohibiting entry to the surrounding area and posting signs to raise awareness and publicize the project. **During construction:** If mines or unexploded ordnance are found during construction, construction work will be suspended immediately to avoid the risk of accidents, and measures will be taken to prevent accidents, such as prohibiting access to the area and traffic until the disposal is completed (the said suspension period is not included in the construction period under the contract). In addition, traffic accidents may increase due to increased traffic during the construction period. In particular, when implementing construction in areas close to urban areas or areas with a certain amount of traffic, supervision during school and commuting hours is required. In addition, fire prevention measures are required through proper management, such as workers' cleaning up of cigarettes. **Operation:** No specific impacts are foreseen.
	30	Cross-boundary impact and climate change			N/A	N/A	**During construction:** construction activities will generate CO_2, but are not expected to affect climate change. **Operation:** Distribution lines do not cross the border. No CO_2 is generated.

Note: A+/-: Significant positive/negative impacts are expected.
B+/-: some positive/negative impact expected.
C+/-: The extent of the positive/negative impact is unknown (further investigation is needed, and in the process the impact can be clarified).
D: No impact is anticipated.
N/A: Impact assessment was not performed due to a D in the scoping phase.

Source: JICA Survey Team

Table 9.7-3 220/60 kV New Namibe SS Impact Assessment

Classification.	Impact item		Impact assessment during scoping		Impact assessment based on survey results		Reasons for Evaluation
			Pre- construction & construction	operation	Pre- construction & construction	operation	
Pollution	1	Air pollution	✓		B-	N/A	**Pre-construction:** Emissions of air pollutants (SOx, NOx, etc.) and dust emissions are expected due to the operation of heavy equipment in the demining work but the impact will be temporary and limited in scope. **During construction:** Emissions of air pollutants (SOx, NOx, and others) and dust emissions are expected due to the operation of heavy equipment and the passage of construction vehicles during the construction of the access road and substation facilities, but the impact will be temporary and limited in scope. **Operation:** No air pollution impact is expected.
	2	Water pollution	✓	✓	B-	B-	**Pre-construction:** Although soil runoff is expected to occur during rainfall due to demining work, the proposed substation construction site is a flat desert terrain and is expected to be largely unaffected by soil runoff. **During construction:** Soil runoff is expected to occur during rainfall due to the construction of the substation site. Wastewater will be discharged at the workers' camp, etc., and if not properly treated, it is assumed that this will have an impact. **Operation**: Since staff will be located in the facility, wastewater is expected to be generated and impacted if not properly treated.
	3	Soil pollution	✓		B-	N/A	**Pre- and during construction:** Since the proposed construction site is a desert and there are no sources of contamination in the surrounding area, soil contamination is not expected at the current location; however, it is assumed that there is a possibility of soil contamination due to leakage of lubricating oil and fuel oil from construction vehicles and construction machinery. **Operation:** No soil contamination is anticipated at the substation site or in the surrounding area.
	4	Sediment	✓		D	N/A	**During construction**: The ground at the proposed substation construction site is stable and no ground improvement chemicals are planned to be used, so no impact on the bottom sediment is anticipated. **Operation**: No impact from the substation is expected.
	5	Noise and Vibration	✓	✓	B-	B-	**Pre-construction**: Noise and vibration are expected to occur due to the operation of heavy equipment during the search and removal of mines and unexploded ordnance, but the impact will be temporary and limited in scope. **During construction:** Noise and vibration are expected to be generated by the construction of the access road, operation of heavy equipment for substation construction, and traffic of construction vehicles. The substation site is located in a desert area, far from residential areas, but along the access road, it is expected to be susceptible to passing vehicles. **Operation:** Noise and vibration are expected to be generated by the traffic of related vehicles, and background noise is expected to be generated from the substation.
	6	Offensive odors	✓	✓	B-	B-	**Pre-construction:** If waste and wastewater are generated at the workers' camp and not properly treated, odors are expected to occur.

Classification.	Impact item		Impact assessment during scoping		Impact assessment based on survey results		Reasons for Evaluation
			Pre- construction & construction	operation	Pre- construction & construction	operation	
							During construction: If the waste and wastewater generated at the workers' camp is not treated in a regular manner, foul odors are expected to occur. **Operation:** Since personnel will be stationed in the facility, odors are expected to be generated if the waste, wastewater, etc. generated are not properly treated.
	7	Waste	✓	✓	B-	B-	**Pre-construction:** Waste and wastewater will be generated at the workers' camp, and if the waste is not properly disposed of, odors are expected to be generated. Plant materials generated by demining work will be waste, and if not properly disposed of, may have an impact. **During construction:** Potential impacts if waste and sewage generated at construction sites are not properly managed. **Operation:** Since staff will be located in the facility, waste and wastewater will be generated and the impact of not properly disposed of is anticipated.
	8	Land subsidence	✓	✓	D	D	**During construction:** Geological survey confirms that the ground is stable, and no subsidence is anticipated. **Operation:** Geological survey confirms that the ground is stable, and no subsidence is anticipated.
Natural environment	9	Protected area			N/A	N/A	**Pre- and during construction:** No impact on the Namibe Partial Reserve is anticipated. **Operation:** No impact on the Namibe Partial Reserve is anticipated.
	10	Ecosystem	✓	✓	B-	B-	**Pre-construction**: Although the removal of vegetation and fragmentation or loss of animal habitat due to demining work will occur on a certain scale, and air pollution and noise and vibration caused by the operation of heavy equipment are expected to impact animals, the impact is expected to be minor because the scope of the impact will be limited and temporary. **During construction:** After the demining work, it is anticipated that air pollution, noise, and vibrations resulting from the operation of heavy equipment and construction vehicles for the construction access road, substation site, and construction will have an impact on animals, but the impact is expected to be minor because the scope of the impact will be limited and temporary. **Operation:** Although a portion of the desert will be permanently altered by the substation construction, the impact is expected to be minor, as the loss of vegetation is minimal and the fauna is a species commonly found in the desert and the loss of habitat is minimal.
	11	Hydrology			N/A	N/A	**Pre- and during construction:** No impact on water quality is anticipated due to the relatively flat topography and lack of major topographic modification. **Operation:** No impact is expected due to the relatively flat topography and lack of major topographic changes.
	12	Topography and Geology	✓	✓	B-	B-	**Pre- and during construction**: The terrain is relatively flat and topographical changes are expected to be minor. **Operation**: Although the terrain is relatively flat and there will be no major topographical changes, erosion is expected in the long term if appropriate stormwater drainage measures are not taken.

Classification.	Impact item		Impact assessment during scoping		Impact assessment based on survey results		Reasons for Evaluation
			Pre- construction & construction	operation	Pre- construction & construction	operation	
Social environment	13	Land acquisition and resettlement			N/A	N/A	**Pre and during construction**: the proposed substation site is located on uninhabited desert land, and the need to widen the access road is not anticipated. **Operation:** Not expected.
	14	The poor			N/A	N/A	**During construction:** The proposed substation site is located on uninhabited desert land, the need to widen the access road is not anticipated, and the impact on the poor is not expected. **Operation:** Not expected.
	15	Ethnic Minorities and Indigenous Peoples			N/A	N/A	**During construction:** The proposed substation site is located on uninhabited desert land, and the need to widen the access road is not anticipated, nor is the impact on minorities and indigenous peoples. **Operation:** Not expected.
	16	Local economy, including employment and means of livelihood	✓		B+	N/A	**During construction:** local employment opportunities as construction workers and local commerce may be promoted and stimulated. **Operation:** unskilled employment in substation maintenance may occur, but only a small number.
	17	Land use and utilization of local resource			N/A	N/A	**During construction:** The proposed substation site is located on uninhabited desert land and no land use for agriculture or grazing has been identified. **Operation:** Not foreseen in particular.
	18	Water use			N/A	N/A	**During construction:** The proposed substation site is located on uninhabited desert land and will require access to necessary construction water from the City of Moçâmedes; however, no land use for agriculture or grazing was identified and therefore no impacts to these water uses are anticipated. **Operation:** Not foreseen in particular.
	19	Existing social infrastructures and social services	✓		B-	N/A	**Pre-construction:** Since the potential displacement site is located in an uninhabited desert area, there is no anticipated impact on social infrastructure and services due to mine exploration and disposal operations electricity. **During construction:** Consideration should be given during the construction period due to the anticipated increase in traffic. Facilities used by local residents on a daily basis (educational, medical, community facilities, etc.) are not in close proximity to the proposed substation site and the road used for access, and the impact on these facilities will be minimal. **Operation:** Not foreseen in particular.
	20	Social institutions such as social infrastructure and local decision-making institutions			N/A	N/A	**During construction:** No negative impacts on social capital or local decision-making bodies are foreseen. The stakeholder consultations for this study are being held with the cooperation of Soba, which bridges the gap between the local government and residents and coordinates their opinions. **Operation:** Not expected.
	21	Misdistrib			N/A	N/A	**During construction and service:** No land use change will

Classification.	Impact item		Impact assessment during scoping		Impact assessment based on survey results		Reasons for Evaluation
			Pre- construction & construction	operation	Pre- construction & construction	operation	
		ution of benefits and losses					occur and no local damage will be caused. No negative impacts are foreseen, as there are no residents who will benefit from the project.
	22	Local conflicts of interest			N/A	N/A	**During construction and service:** No land use change will occur and no local damage will be caused. No negative impacts are foreseen, as there are no residents who will benefit from the project.
	23	Cultural heritage			N/A	N/A	**Before, during and operation:** there are no cultural or complex heritage sites listed on UNESCO's World Heritage List or historical, cultural or archaeological assets or cultural properties designated or recognized in Angola in the vicinity of the proposed substation site or in the vicinity of the site.
	24	Landscape	✓	✓	B-	D	**During construction:** worker camp construction, construction work, heavy equipment entering the area, etc. will impact the landscape. **Operation:** No specific impacts are foreseen.
	25	Gender	✓	✓	B-	D	**During construction:** While it is difficult to obtain voluntary and active participation, expression of opinions and activities by women in the local communities in the area, it is necessary to consider gender mainstreaming measures such as providing work opportunities for women and moves to support local commerce. On the other hand, past infrastructure projects have experienced harassment on local people by incoming human resources and workers from outside, and such cases may occur in this project as well. **Operation:** No specific impacts are foreseen.
	26	Children's rights	✓	✓	B-	D	**During construction:** Children under 14 years of age are prohibited from working in the country of Angola, while those between 14 and 16 years of age require parental consent. In addition, restrictions are imposed on the hours and duration of work per day and per week for workers under 18 years of age, and employers are required to provide consideration and support for school-aged children. In this project, thorough compliance with these laws and regulations is required. **Operation:** No specific impacts are foreseen.
	27	Infectious diseases such as HIV/AIDS	✓		B-	N/A	**During construction:** According to field surveys, malaria, diarrhea, and other diseases are frequently observed in the local community. If preventive measures are not taken, infectious diseases may spread due to the influx of construction workers, etc. Worker education and proper management of sanitary conditions are required. **Operation:** No negative impacts are foreseen.
	28	Working environment (including occupational safety)	✓	✓	A-	D	**Pre-construction:** Mine exploration and clearance activities must be conducted and completed by the Angolan government prior to the start of construction. However, because these activities involve explosives and are dangerous, the impact on workers in the event of an accident is significant. In conducting this activity, safety measures will be taken for the operator workers, including the wearing of protective clothing in accordance with the SOP. **During construction:** Assuming that mines and unexploded ordnance may be found during construction, construction workers will be educated and made aware of how to deal with them and who to contact. If found, construction work will be suspended immediately and will not resume until the safety

Classification.	Impact item		Impact assessment during scoping		Impact assessment based on survey results		Reasons for Evaluation
			Pre- construction & construction	operation	Pre- construction & construction	operation	
							of the construction workers is confirmed (the said suspension period will not be included in the contractual construction period). It is foreseen that dust, noise and vibration will be generated during site preparation and construction work, but the impact will be limited. National legislation establishes regulations regarding occupational health and safety, and preventive measures are required to be taken. **Operation:** No specific impacts are foreseen.
Others	29	Accidents	✓	✓	A-	D	**Pre-construction:** Demining work is subject to implementation and completion by the Angolan government side prior to the start of construction, but they are hazardous because of the explosive materials involved. Therefore, their implementation will be carried out in accordance with safety measures and work procedures based on SOPs, and the equipment to be used will be newly procured by the project. In addition, measures will be taken to prevent the occurrence of accidents, such as prohibiting entry to the surrounding area and posting signs to raise awareness and publicize the project. **During construction:** If mines or unexploded ordnance are found during construction, construction work will be suspended immediately to avoid the risk of accidents, and measures will be taken to prevent accidents, such as prohibiting access to the area and traffic until the disposal is completed (the said suspension period is not included in the construction period under the contract). In addition, traffic accidents may increase due to increased traffic during the construction period. In particular, when implementing construction in areas close to urban areas or areas with a certain amount of traffic, supervision during school and commuting hours is required. In addition, fire prevention measures are required through proper management, such as workers' cleaning up of cigarettes. **Operation:** No specific impacts are foreseen.
	30	Cross-boundary impact and climate change			N/A	N/A	**During construction:** construction activities will generate CO_2, but are not expected to affect climate change. **Operation:** The substation does not cross the border. Also, no CO_2 is generated.

Note: A+/-: Significant positive/negative impacts are expected.
B+/-: some positive/negative impact expected.
C+/-: The extent of the positive/negative impact is unknown (further investigation is needed, and in the process the impact can be clarified).
D: No impact is anticipated.
N/A: Impact assessment was not performed due to a D in the scoping phase.

Source: JICA Survey Team

Table 9.7-4 200/60 kV East Lubango SS Impact Assessment

Classification.	Impact item		Impact assessment during scoping		Impact assessment based on survey results		Reasons for Evaluation
			Pre- construction & construction	operation	Pre- construction & construction	operation	
pollution	1	Air pollution	✓		B-	N/A	**Pre-construction:** Emissions of air pollutants (SOx, NOx, etc.) and dust emissions are expected due to the operation of heavy equipment during the demining work but the impact will be temporary and limited in scope. **During construction:** Emissions of air pollutants (SOx, NOx, and others) and dust emissions are expected due to the operation of heavy equipment and the passage of construction vehicles during the construction of the access road and substation facilities, but the impact will be temporary and limited in scope. **Operation:** No air pollution impact is expected.
	2	Water pollution	✓	✓	B-	B-	**Pre-construction:** If wastewater is generated at the workers' camp and not properly treated, impacts are expected. **During construction:** Wastewater will be generated at the workers' camp and if not properly disposed of, an impact is anticipated. There are no plans to use ground improvement chemicals. **Operation**: Potential impact if wastewater from facility personnel is generated and not properly treated.
	3	Soil pollution	✓		B-	N/A	**Pre- and during construction:** No soil contamination is assumed at the current location because the proposed construction site is located in the savanna and there are no sources of contamination in the surrounding area. There is a possibility of soil contamination due to leakage of lubricating oil and fuel oil from construction vehicles and construction equipment. **Operation:** No soil contamination is anticipated at the substation site or in the surrounding area.
	4	Sediment			N/A	N/A	**During construction**: There are no rivers in the vicinity and no impact is anticipated. **Operation:** There are no rivers in the vicinity, so no impact is anticipated.
	5	Noise and Vibration	✓	✓	B-	B-	**Pre-construction**: Noise and vibration are expected to occur due to the operation of heavy equipment during the demining work, but the impact will be temporary and limited in scope. **During construction:** Noise and vibration are expected to be generated by the construction of the access road, operation of heavy equipment for substation construction, and traffic of construction vehicles. The substation site is located in a desert area, far from residential areas, but along the access road, it is expected to be susceptible to passing vehicles. **Operation:** Noise and vibration are expected to be generated by related vehicle traffic, and background noise is expected to be generated from the substation.
	6	Offensive odors	✓	✓	B-	B-	**Pre-construction:** Waste and wastewater will be generated at the workers' camp, and if not properly treated, the impact is expected. **During construction:** waste and wastewater will be generated at the workers' camp, and if not properly disposed of, impacts are expected. **Operation:** Since staff will be stationed in the facility, odors are expected to be generated if the generated waste, domestic wastewater, etc. is not properly treated.
	7	Waste	✓	✓	B-	B-	**Pre-construction:** Waste will be generated at the workers' camp and impacts are anticipated if not properly disposed of. Plants generated by demining work will be waste, and if not properly disposed of, impacts are anticipated. **During construction:** Waste and domestic wastewater will be generated at the workers' camp, and the impact is expected if they

Classification.	Impact item		Impact assessment during scoping		Impact assessment based on survey results		Reasons for Evaluation
			Pre- construction & construction	operation	Pre- construction & construction	operation	
							are not properly disposed of. Potential impacts if waste and wastewater generated at construction sites are not properly managed and disposed of. **Operation:** Since staff will be located in the facility, waste, domestic wastewater, etc. will be generated and the impact of not properly disposed of is anticipated.
	8	Land subsidence	✓	✓	D	D	**During construction:** Geological survey confirms that the ground is stable, and no subsidence is anticipated. **Operation:** Geological survey confirms that the ground is stable, and no subsidence is anticipated.
natural environment	9	Protected area			N/A	N/A	**Pre- and during construction:** There are no protected areas in the vicinity and no impact is anticipated. **Operation:** There are no protected areas in the vicinity and no impact is anticipated.
	10	Ecosystem	✓	✓	B-	B-	**Pre-construction**: Although the removal of vegetation and fragmentation or loss of animal habitat due to demining work will occur on a certain scale, and air pollution and noise and vibration caused by the operation of heavy machinery are expected to impact animals, the impact is expected to be minor because the scope of the impact will be limited and temporary. **During construction:** After the demining work, it is anticipated that air pollution, noise, and vibrations resulting from the operation of heavy equipment and construction vehicles for the construction access road, substation site, and construction will have an impact on animals, but the impact is expected to be minor because the scope of the impact will be limited and temporary. **Operation:** Although a part of the desert will be permanently altered by the substation construction, the impact is expected to be minor because the area has been subject to loss of vegetation and fragmentation and loss of animal habitat due to human activities such as tree cutting, cultivation, and housing construction, and the flora and fauna are monotonous and the loss as habitat is slight.
	11	Hydrology			N/A	N/A	**Pre- and during construction:** No impact is expected from demining work and from the construction of the substation facilities. **Operation:** There are no rivers in the vicinity, so no impact is anticipated.
	12	Topography and Geology	✓	✓	B-	B-	**Pre- and during construction:** The terrain is relatively flat and topographical changes are expected to be minor. **Operation:** Although the terrain is relatively flat and there will be no major topographical changes, erosion is expected in the long term if appropriate stormwater drainage measures are not taken.
social environment	13	Land acquisition and resettlement			N/A	N/A	**Pre and during construction:** The proposed substation site is located on public land with savannas, and there are no villages or agricultural lands in the vicinity. Therefore, land acquisition and resettlement are not expected. **Operation:** Not expected.
	14	The poor			N/A	N/A	**During construction:** The proposed substation site is located on public land in a savanna expanse, with no villages or farmland in the vicinity. Therefore, no impact on the poor is anticipated. **Operation:** Not expected.
	15	Ethnic Minorities and Indigenous Peoples			N/A	N/A	**During construction:** No impact is anticipated as there are no indigenous people in or around the substation. **Operation:** Not expected.

Classification.	Impact item		Impact assessment during scoping		Impact assessment based on survey results		Reasons for Evaluation
			Pre- construction & construction	operation	Pre- construction & construction	operation	
	16	Local economy, including employment and means of livelihood	✓		B+	N/A	**During construction:** local employment opportunities as construction workers and local commerce may be promoted and stimulated. **Operation:** employment in substation maintenance is expected to occur.
	17	Land use and utilization of local resource			N/A	N/A	**Under construction:** The proposed substation site is located on public lands with savannas, and there are no villages or agricultural lands in the vicinity, so no impacts on land use or local resources are anticipated. **Operation:** Not expected.
	18	Water use	✓		D	N/A	**Under construction:** The proposed substation site is located on public land with an expanse of savannah. Since a construction water truck will be introduced by construction workers, there is no anticipated impact on the daily use of water by local residents in the surrounding area. **Operation:** Not foreseen in particular.
	19	Existing social infrastructures and social services	✓		B-	N/A	**Pre-construction:** The proposed substation site is located on public land with savannas, and there are no settlements or agricultural lands in the vicinity. Therefore, no impact on social infrastructures and services is expected due to the mine exploration and disposal work. **During construction:** Since the section from the nearest existing paved road to the proposed construction site is unpaved, it is necessary to prepare a haul road. In order to ensure separation from the existing 150 kV transmission line, measures such as stopping the transmission line during transport will be necessary. In addition, an increase in traffic is anticipated. Although there are no facilities in the project area or its vicinity that local residents use on a daily basis, consideration must be given to the use of the existing road during the construction period. **Operation:** No negative impacts on existing social infrastructures are foreseen. The loading ramp to be constructed will equally improve accessibility for the local population.
	20	Social institutions such as social infrastructure and local decision-making institutions			N/A	N/A	**Under construction:** No negative impacts on social capital or local decision-making bodies are foreseen. The stakeholder consultations for this study are being conducted with the cooperation of Soba, which will bridge the gap between the local government and residents and coordinate their opinions. **Operation:** Not expected.
	21	Misdistribution of benefits and losses			N/A	N/A	**During construction and operation:** no local damage will occur. No negative impacts are foreseen, especially since the loading road to be constructed will equally improve accessibility for local residents.
	22	Local conflicts of interest			N/A	N/A	**During construction and operation:** no local damage will occur. No negative impacts are foreseen, especially since the loading road to be constructed will equally improve accessibility for local residents.
	23	Cultural heritage			N/A	N/A	**During construction and operation:** there are no cultural or complex heritage sites listed on UNESCO's World Heritage List

Classification.	Impact item		Impact assessment during scoping		Impact assessment based on survey results		Reasons for Evaluation
			Pre- construction & construction	operation	Pre- construction & construction	operation	
							or historical, cultural or archaeological properties or cultural assets designated or recognized in Angola in the vicinity of the proposed substation site or in the vicinity of the site.
	24	Landscape	✓	✓	B-	D	**During construction:** worker camp construction, construction work, heavy equipment entering the area, etc. will impact the landscape. **Operation:** No specific impacts are foreseen.
	25	Gender	✓	✓	B-	D	**Under construction:** While it is difficult to obtain voluntary and active participation, expression of opinions and activities by women in the local communities in the area, it is necessary to consider gender mainstreaming measures such as providing work opportunities for women and moves to support local commerce. On the other hand, past infrastructure projects have experienced harassment on local people by incoming human resources and workers from outside, and such cases may occur in this project as well. **Operation:** No specific impacts are foreseen.
	26	Children's rights	✓	✓	B-	D	**Under Construction:** Children under 14 years of age are prohibited from working in the country of Angola, while those between 14 and 16 years of age require parental consent. In addition, restrictions are imposed on the hours and duration of work per day and per week for workers under 18 years of age, and employers are required to provide consideration and support for school-aged children. In this project, thorough compliance with these laws and regulations is required. **Operation:** No specific impacts are foreseen.
	27	Infectious diseases such as HIV/AIDS	✓		B-	N/A	**During construction:** According to field surveys, malaria, diarrhea, and other diseases are frequently observed in the local community. If preventive measures are not taken, infectious diseases may spread due to the influx of construction workers, etc. Worker education and proper management of sanitary conditions are required. **Operation:** No negative impacts are foreseen.
	28	Working environment (including occupational safety)	✓	✓	A-	D	**Pre-construction:** Mine exploration and clearance activities must be conducted and completed by the Angolan government prior to the start of construction. However, because these activities involve explosives and are dangerous, the impact on workers in the event of an accident is significant. In conducting this activity, safety measures will be taken for the operator workers, including the wearing of protective clothing in accordance with the SOP. **During construction:** Assuming that mines and unexploded ordnance may be found during construction, construction workers will be educated and made aware of how to deal with them and who to contact. If found, construction work will be suspended immediately and will not resume until the safety of the construction workers is confirmed (the said suspension period will not be included in the contractual construction period). It is foreseen that dust, noise and vibration will be generated during site preparation and construction work, but the impact will be limited. National legislation establishes regulations regarding occupational health and safety, and preventive measures are required to be taken. **Operation:** No specific impacts are foreseen.
Others	29	Accidents	✓	✓	A-	D	**Pre-construction:** Demining work is subject to implementation and completion by the Angolan government side prior to the start of construction, but they are hazardous because of the explosive materials involved. Therefore, their implementation will be

Classification.	Impact item		Impact assessment during scoping		Impact assessment based on survey results		Reasons for Evaluation
			Pre- & construction	operation	Pre- & construction	operation	
							carried out in accordance with safety measures and work procedures based on SOPs, and the equipment to be used will be newly procured by the project. In addition, measures will be taken to prevent the occurrence of accidents, such as prohibiting entry to the surrounding area and posting signs to raise awareness and publicize the project. **During construction:** If mines or unexploded ordnance are found during construction, construction work will be suspended immediately to avoid the risk of accidents, and measures will be taken to prevent accidents, such as prohibiting access to the area and traffic until the disposal is completed (the said suspension period is not included in the construction period under the contract). In addition, traffic accidents may increase due to increased traffic during the construction period. In particular, when implementing construction in areas close to urban areas or areas with a certain amount of traffic, supervision during school and commuting hours is required. In addition, fire prevention measures are required through appropriate management, such as workers' cleaning up of cigarettes. **Operation:** No specific impacts are foreseen.
	30	Cross-boundary impact and climate change			N/A	N/A	**During construction:** construction activities will generate CO_2, but are not expected to affect climate change. **Operation: The** substation does not cross the border. Also, no CO_2 is generated.

Note: A+/-: Significant positive/negative impacts are expected.
B+/-: some positive/negative impact expected.
C+/-: The extent of the positive/negative impact is unknown (further investigation is needed, and in the process the impact can be clarified).
D: No impact is anticipated.
N/A: Impact assessment was not performed due to a D in the scoping phase.

Source: JICA Survey Team

Table 9.7-5 60/15 kV Arimba SS Impact Assessment

Classification.	Impact item		Impact assessment during scoping		Impact assessment based on survey results		Reasons for Evaluation
			Pre- & construction	operation	Pre- & construction	operation	
Pollution	1	Air pollution	✓		B-	N/A	**Pre-construction:** Emissions of air pollutants (SOx, NOx, etc.) and dust emissions are expected due to the operation of heavy equipment in the demining work, but the impact will be temporary and limited in scope. **During construction:** Emissions of air pollutants (SOx, NOx, and others) and dust emissions are expected due to the operation of heavy equipment and the passage of construction vehicles during the construction of the access road and substation facilities, but the impact will be temporary and limited in scope. **Operation:** No air pollution impact is expected.

Classification.	Impact item		Impact assessment during scoping		Impact assessment based on survey results		Reasons for Evaluation
			Pre- construction & construction	operation	Pre- construction & construction	operation	
	2	Water pollution	✓	✓	B-	B-	**Pre-construction:** Potential impacts if wastewater generated at the workers' camp is not properly treated. **During construction:** No ground improvement chemicals will be used at the tower construction site. Wastewater will be generated from the workers' camp, which could have an impact if not properly treated. **Operation**: Wastewater from facility personnel will be generated, and impacts are anticipated if not properly treated.
	3	Soil pollution	✓		B-	N/A	**Pre- and during construction:** No soil contamination is expected at the current location because the proposed construction site is on a cleared site and there are no sources of contamination in the surrounding area. However, soil contamination due to leakage of lubricating oil and fuel oil from construction vehicles, construction machinery, etc. is assumed to be a possibility. **Operation:** No soil contamination is anticipated at the substation site or in the surrounding area.
	4	Sediment			N/A	N/A	**During construction**: There are no rivers in the vicinity and no impact is anticipated. **Operation**: There are no rivers in the vicinity, so no impact is anticipated.
	5	Noise and Vibration	✓	✓	B-	B-	**Pre-construction**: Noise and vibration are expected to occur due to the operation of heavy equipment during the sdemining work, but the impact will be temporary and limited in scope. **During construction:** Noise and vibration are expected to occur due to the construction of the access road, operation of heavy equipment for substation construction, and traffic of construction vehicles. The substation site is located in a desert area, far from residential areas, but along the access road, it is expected to be susceptible to passing vehicles. **Operation:** Noise and vibration are expected to be generated by related vehicle traffic, and background noise is expected to be generated from the substation.
	6	Offensive odors	✓	✓	B-	B-	**Pre-construction:** Waste and wastewater will be generated at the workers' camp, and if not properly disposed of, foul odors are expected to occur. **During construction:** Waste and wastewater will be generated at the workers' camp, and if not properly disposed of, odors are expected to occur. **Operation:** Since staff will be stationed in the facility, odors are expected to be generated if the generated waste, domestic wastewater, etc. is not properly treated.
	7	Waste	✓	✓	B-	B-	**Pre-construction:** Plant materials generated by demining work will be waste, and therefore, potential impacts if not properly disposed of. In addition, waste and domestic wastewater will be generated at the workers' camp, which will be affected if not properly disposed of. **During construction:** Impacts are expected if wastes and wastewater generated at construction sites are not properly managed or treated. In addition, waste and domestic wastewater will be generated at the workers' camp, which may be affected if they are not properly disposed of.

Classification.	Impact item		Impact assessment during scoping		Impact assessment based on survey results		Reasons for Evaluation
			Pre- construction & construction	operation	Pre- construction & construction	operation	
							Operation: Since staff will be located in the facility, waste, domestic wastewater, etc. will be generated and the impact of not properly disposed of is anticipated.
	8	Land subsidence	✓	✓	D	D	**During construction:** Geological survey confirms that the ground is stable, and no subsidence is anticipated. **Operation:** Geological survey confirms that the ground is stable, and no subsidence is expected.
Natural environment	9	Protected area			N/A	N/A	**Pre- and during construction:** There are no protected areas in the vicinity and no impact is anticipated. **Operation:** There are no protected areas in the vicinity and no impact is anticipated.
	10	Ecosystem	✓		B-	N/A	**Pre-construction**: The site has already been cleared and no loss of habitat for flora and fauna will occur due to the deminingwork. Although air pollution and noise/vibration generated by the operation of heavy equipment are expected to affect animals, the impact is expected to be minor because there is little flora and fauna in the area and the extent of the impact is limited and temporary. **During construction:** Although air pollution and noise/vibration from the operation of heavy equipment and construction vehicles for the development of access roads, substation site, and construction are expected to impact animals, the impact is expected to be minor because the scope of the impact is limited and temporary. **Operation:** Although the terrain is relatively flat and there are no major topographic changes, the land has already been cleared over the years, so there is no impact.
	11	Hydrology			N/A	N/A -	**Pre- and during construction:** No impact is expected from demining work and from the construction of the substation facilities. **Operation:** There are no rivers in the vicinity, so no impact is anticipated.
	12	Topography and Geology	✓	✓	B-	B-	**Pre- and during construction:** The land has already been cleared and topographical changes are expected to be minor. **Operation:** Although the terrain is relatively flat and there will be no major topographical changes, erosion is expected in the long term if appropriate stormwater drainage measures are not taken.
Social environment	13	Land acquisition and resettlement			N/A	N/A	**Pre and during construction:** The proposed substation site has already been acquired and is separated from the outside by a fence. There is no land acquisition or relocation of residents. **Operation:** Not expected.
	14	The poor			N/A	N/A	**Under construction:** the proposed substation site has already been acquired and is separated from the outside by a fence. No impact on the poor is expected. **Operation:** Not expected.
	15	Ethnic Minorities and Indigenous Peoples			N/A	N/A	**During construction:** The proposed substation site has already been acquired and is separated from the outside by a fence. No impact on indigenous people is anticipated. **Operation:** Not expected.
	16	Local economy, including	✓		B+	N/A	**During construction:** local employment opportunities as construction workers and local commerce may be promoted and stimulated.

Classification.	Impact item		Impact assessment during scoping		Impact assessment based on survey results		Reasons for Evaluation
			Pre- construction & construction	operation	Pre- construction & construction	operation	
		employment and means of livelihood					**Operation:** employment in substation maintenance is expected to occur.
	17	Land use and utilization of local resource			N/A	N/A	**During construction:** the proposed substation site has already been acquired and is separated from the outside by a fence. Impacts to land use and local resources are therefore not anticipated. **Operation:** Not expected.
	18	Water use	✓		D	N/A	**During construction:** The construction water required for the substation construction work will be supplied by a construction water truck, so no impact on the water supply for local residents is anticipated. **Operation:** Not foreseen in particular.
	19	Existing social infrastructures and social services	✓		B-	N/A	**Pre-construction:** The area has already been developed and cleared, and the possibility of finding mines or unexploded ordnance is low. However, if they are found, access to the area may be restricted for a certain period of time for removal work, which may affect social services in the surrounding area. **During construction:** Increased traffic is expected. Although no facilities used by local residents on a daily basis are identified in the project area or vicinity, consideration should be given during the construction period to the use of existing roads and the installation of underground lines. **Operation:** No negative impacts on existing social infrastructures are foreseen.
	20	Social institutions such as social infrastructure and local decision-making institutions			N/A	N/A	**During construction:** No negative impacts on social capital or local decision-making bodies are foreseen. The stakeholder consultations for this study are being conducted with the cooperation of Soba, which will bridge the gap between the local government and residents and coordinate their opinions. **Operation:** Not expected.
	21	Misdistribution of benefits and losses			N/A	N/A	**During construction and operation:** No negative impacts are foreseen, as this is a candidate substation site that has already been acquired.
	22	Local conflicts of interest			N/A	N/A	**During construction and operation:** No negative impacts are foreseen, as this is a candidate substation site that has already been acquired.
	23	Cultural heritage			N/A	N/A	**Before, during and operation:** There are no cultural or complex heritage sites registered on the World Heritage List of UNESCO, or historical, cultural or archaeological properties or cultural assets designated or recognized in Angola in the area of the substation construction site and its surroundings.
	24	Landscape	✓	✓	B-	D	**During construction:** worker camp construction, construction work, heavy equipment entering the area, etc. will impact the landscape. **Operation:** No specific impacts are foreseen.

Classification.	Impact item		Impact assessment during scoping		Impact assessment based on survey results		Reasons for Evaluation
			Pre- construction & construction	operation	Pre- construction & construction	operation	
	25	Gender	✓	✓	B-	D	**Under construction:** While it is difficult to obtain voluntary and active participation, expression of opinions and activities by women in the local communities in the area, it is necessary to consider gender mainstreaming measures such as providing work opportunities for women and moves to support local commerce. On the other hand, past infrastructure projects have experienced harassment on local people by incoming human resources and workers from outside, and such cases may occur in this project as well. **Operation:** No specific impacts are foreseen.
	26	Children's rights	✓	✓	B-	D	**Under Construction:** Children under 14 years of age are prohibited from working in the country of Angola, while those between 14 and 16 years of age require parental consent. In addition, restrictions are imposed on the hours and duration of work per day and per week for workers under 18 years of age, and employers are required to provide consideration and support for school-aged children. In this project, thorough compliance with these laws and regulations is required. **Operation:** No specific impacts are foreseen.
	27	Infectious diseases such as HIV/AIDS	✓		B-	N/A	**During construction:** According to field surveys, malaria, diarrhea, and other diseases are frequently observed in the local community. If preventive measures are not taken, infectious diseases may spread due to the influx of construction workers, etc. Worker education and proper sanitary conditions must be maintained. **Operation:** No negative impacts are foreseen.
	28	Working environment (including occupational safety)	✓	✓	A-	D	**Pre-construction:** Demining work is be conducted and completed by the Angolan government prior to the start of construction. However, because these activities involve explosives and are hazardous, the impact on workers in the event of an accident is significant. In conducting this activity, safety measures will be taken for the operator workers, including the wearing of protective clothing in accordance with the SOP. **During construction:** Assuming that mines and unexploded ordnance may be found during construction, construction workers will be educated and made aware of how to deal with them and who to contact. If found, construction work will be suspended immediately and will not resume until the safety of the construction workers is confirmed (the said suspension period will not be included in the contractual construction period). It is foreseen that dust, noise and vibration will be generated during site preparation and construction work, but the impact will be limited. National legislation establishes regulations regarding occupational health and safety, and preventive measures are required to be taken. **Operation:** No specific impacts are foreseen.
Others	29	Accidents	✓	✓	A-	D	**Pre-construction:** Demining work is subject to implementation and completion by the Angolan government side prior to the start of construction, but they are hazardous because of the explosive materials involved. Therefore, their implementation will be carried out in accordance with safety measures and work procedures based on SOPs, and the equipment to be used will be newly procured by the project.

Classification.	Impact item		Impact assessment during scoping		Impact assessment based on survey results		Reasons for Evaluation
			Pre- construction & construction	operation	Pre- construction & construction	operation	
							In addition, measures will be taken to prevent the occurrence of accidents, such as prohibiting entry to the surrounding area and posting signs to raise awareness and publicize the project. **During construction:** If mines or unexploded ordnance are found during construction, construction work will be suspended immediately to avoid the risk of accidents, and accident prevention measures will be taken, such as prohibiting entry to the area and traffic until the disposal is completed (the said suspension period is not included in the construction period under the contract). In addition, traffic accidents may increase due to increased traffic during the construction period. In particular, when implementing construction in areas close to urban areas or areas with a certain amount of traffic, supervision during school and commuting hours is required. In addition, fire prevention measures are required through appropriate management, such as workers' cleaning up of cigarettes. **Operation:** No specific impacts are foreseen.
	30	Cross-boundary impact and climate change			N/A	N/A	**During construction:** construction activities will generate CO_2, but are not expected to affect climate change. **Operation:** The substation does not cross the border. Also, no CO_2 is generated.

Note: A+/-: Significant positive/negative impacts are expected.
B+/-: some positive/negative impact expected.
C+/-: The extent of the positive/negative impact is unknown (further investigation is needed, and in the process the impact can be clarified).
D: No impact is anticipated.
N/A: Impact assessment was not performed due to a D in the scoping phase.

Source: JICA Survey Team

9.8. Mitigation Measures

For all items rated A- and B- in 9.7 above, sources of potential impact, mitigation measures, implementing organizations, responsible organizations, and costs are shown in Table 9.8-1 through Table 9.8-5 by project component, divided into pre-construction, during construction and operation periods.

Table 9.8-1 Environmental Management Plan (220 kV TL)

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
Pre-construction phase						
1	Air pollution	- Air pollutant emissions from the implementation of demining work	- Appropriately maintain the equipment and vehicles used and reduce the generation of air pollutants. - During demining work, water will be sprayed as necessary to prevent dust generation. - Reduce speed on unpaved access roads to prevent dust generation.	CND	Consultant / RNT/CND	Measures can be taken through standard, careful management and operation, and special cost is not required.
2	Water pollution	- Generation of wastewater in workers' camp, etc.	- All wastewater from workers' camp etc. is collected and treated from the site for proper disposal at an approved municipal facility. - Installation of watertight septic tanks (or equivalent) to collect wastewater from the site, including vehicle and machinery washing waste water. - When mobile chemical toilets are used, they should be installed and collected by an approved contractor and disposed of properly. - When discharging wastewater into the environment, Angolan legislation on wastewater standards (Annex VI of Presidential Decree No 261/11 of 6 October) shall be complied with.	CND	Consultant / RNT/CND	Measures can be taken through standard, careful management and operation, and special cost is not required.
		- Turbidity generation due to the implementation of demining work.	- In sections where clearing and rooting has been carried out due to demining work, ROWs, construction roads, material storage areas and post-service management roads should be promptly secured to prevent sediment run-off. - If the location of the steel tower and ROW are determined and there is concern about the impact on surface water, well water, spring water, etc., appropriate measures should be taken in consultation with users.	CND	Consultant / RNT/CND	Measures can be taken through standard, careful management and operation, and special cost is not required.
3	Soil pollution	- Spills of lubricating oil, fuel oil, etc. from heavy machinery.	- Ensure that lubricants and fuel oils are properly managed and that a receptacle is available in case of spillages when refilling.	CND	Consultant / RNT/CND	Measures can be taken through standard, careful management and operation, and special cost is not required.

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
4	Noise and vibration	- Noise and vibration caused by the implementation of demining work	- Appropriately maintain and manage the equipment and vehicles used to reduce noise and vibration.	CND	Consultant / RNT/CND	Measures can be taken through standard, careful management and operation, and special cost is not required.
5	Offensive odors	- Generation of odors due to improper waste management.	- Proper transport of waste and dumping of waste into designated disposal facilities by licensed contractors to avoid the accumulation of odour, pest control problems, general litter and other nuisance sources of waste on the site. - Provide training, education and signage to ensure compliance with waste management plans.	CND	Consultant / RNT/CND	Measures can be taken through standard, careful management and operation, and special cost is not required.
6	Waste	- Cutting and de-rooting result in plant bodies becoming waste. - Waste is generated in the workers' camp.	- Plants are not discarded, but used for soil retention and surface cover to prevent soil erosion and also encourage regeneration where possible. - Waste management plans prepared for power utilities are applied mutatis mutandis to properly dispose of waste generated at workers' camp.	CND	Consultant / RNT/CND	Measures can be taken through standard, careful management and operation, and special cost is not required.
7	Ecosystems	- Selection of transmission line ROW and tower construction sites	- As considerations for the ecosystem in the project area, (1) the route around the area where the endangered species (Ludwig's bustard (*Neotis ludwigii*)) was confirmed was taken as close to the road as possible, (2) if there are habitats for bats in the forest in Bruco Gorge, such habitats should be avoided and logging and root cutting should be done manually as much as possible, (3) in Ivantala swamp, a detour route to the west was already planned, and (4) as a topographical and landscape element, the impact on the residual hills should be avoided. Based on the detailed design and the results of the geomorphological survey carried out by the Contractor, habitats of high ecological (including local landscape) value (habitats of endangered species, forest and bat and other habitats in the Bruco, Ivantala Swamp, residual hills, etc.) will be avoided and no impact will be confirmed before the tower construction point and ROW are finalized. - Vegetation clearance should be as little as possible and limited to strictly necessary areas, mainly in the Humpata, Tchvinguilo and Bruco areas and near Ivantala Swamp.	Consultant	RNT	Included in the Consultancy Services

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
			- Wherever possible, create new or temporary accesses based on existing accesses (mainly in the Humpata, Tchvinguilo and Bruco areas, near Ivantala Swamp). - Minimise actions that have a negative impact on flora and vegetation, and the felling of trees, particularly baobabs, fruit trees, species of plants that are unique or desirable for protection in the ecoregion, regenerating miombo trees and species undergoing natural vegetation regeneration should be avoided as much as possible to determine the tower location. .			
		- Planning of demining work.	- Based on the finalised tower construction sites and ROW, determine the scope and methods of demining work, access roads, temporary storage of rooted vegetation where possible, etc., and study the layout of ROW, material storage areas, access roads and post-service management roads for transmission line construction, soil erosion prevention measures and vegetation restoration plans will be formulated.	CND	Consultant / RNT/CND	Proper planning and designing will be taken by consultants without special cost.
		- Clearing and de-rooting by carrying out demining work	- Areas targeted for deforestation or logging operations should be marked in advance with visible markers (e.g. coloured tape) so that intervention areas can be identified, facilitating the work of machine operators. These operations should be carried out carefully, taking into account the ecological or landscape benefits of vegetation formation. - Prompt transition to and coordination of transmission line construction works, based on soil erosion prevention measures and vegetation restoration plans, to prevent soil erosion and promote rapid vegetation recovery - Measures to prevent illegal tree felling and hunting, as it is easier to enter the forest through felling and root clearing.	CND	Consultant / RNT/CND	Proper planning and designing will be taken by consultants without special cost.
8	Hydrology	- Increased rainfall run-off associated with the implementation of demining work	- Plants are not discarded, but used for soil retention and surface cover to prevent soil erosion and also encourage regeneration where possible	CND	Consultant / RNT/CND	Proper planning and designing will be taken by consultants without special cost.
9	Topography and geology	- Surface soil erosion from the implementation of demining work.	- Plants are not discarded, but used for soil retention and surface cover to prevent soil erosion and also encourage regeneration where possible	CND	Consultant / RNT/CND	Proper planning and designing will be taken by consultants without special cost.

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
10	Land acquisition and resettlement	- Selection of transmission line ROW and tower construction sites	- Avoid private land and used land area as much as possible, based on the detailed design and the results of the geological and topographical survey carried out by the Contractor, the tower construction sites and ROW are finalised.	Consultant	RNT	Included in the Consultancy Services
			- Provide alternative agricultural land and houses of equal or greater value. - Pay compensation equivalent to the replacement value of standing crops and fruit and trees where agricultural land is affected. - Provide a preliminary explanation to the inhabitants of the area concerned.	RNT	RNT	RNT
11	Existing social infrastructures and services	Impact on social services of demining work.	- Enforce access restrictions, etc. around mine exploration and clearance operation sites. - Provide information on the scope of impact and publish the work schedule	CND	Consultant / RNT/CND	Included in the cost of demining work
12	Cultural heritage	Selection of transmission line ROW and tower construction sites	- Based on the detailed design and the results of the geological and topographical survey carried out by the Contractor, finalise ROW and the tower construction sites, avoid Boer cemeteries and other sites with cultural and historical values, and confirm that there will be no impact.	Consultant	RNT	Included in the Consultancy Services
13	Working environment (including occupational safety)	- Accidents and injuries to operators caused by explosions of mines and UXO	- Continue to educate operators and ensure that they know the procedures and who to contact to prevent accidents and injuries. Ensure that operators are given instructions on first aid as stipulated in the SOPs, in case of an accident. - Ensure safety measures for workers (e.g. wearing protective clothing and proper equipment maintenance).	CND	Consultant / RNT/CND	Included in the cost of demining work
14	Accidents	- Conduct demining work	- Carry out safety checks and take accident prevention measures such as prohibiting access to the area and traffic until the process is complete. - Provide safety measures for operator / workers engaged in demining work (e.g. wearing protective clothing and proper equipment maintenance).	CND	Consultant / RNT/CND	Included in the cost of demining work
Construction phase						
1	Air pollution	- Emissions of air pollutants (SOx, NOx and others) and dust	- Ensure proper maintenance of equipment and vehicles used and reduce emissions of air pollutants (SOx, NOx and others). - Construction vehicle traffic routes are supposed to bypass the	Contractor	Consultant / RNT	Measures can be taken through standard, careful

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
		emissions due to the operation of heavy machinery in the construction of transmission line ROW, construction roads and towers, and the passage of construction vehicles.	vicinity of residential areas hospitals, schools, etc., and where unavoidable, speed limits are limited to 30 km/hour or less. - On unpaved roads, water is sprayed by sprinkler trucks as necessary to reduce dust generation. - When transporting earth, sand, etc., do not fill the load fully, but cover it with plenty of room. - Effectively educate and train relevant personnel.			management and operation, and special cost is not required.
2	Water pollution	- Generation of wastewater in workers' camp, etc.	- All effluent from worker quarters etc. is collected and treated from the site for proper disposal at an approved municipal facility. - Installation of watertight septic tanks (or equivalent) to collect waste water from the site, including vehicle and machinery washing waste water. - When mobile chemical toilets are used, they should be installed and collected by an approved contractor and disposed of properly. - When discharging wastewater into the environment, Angolan legislation on wastewater standards (Annex VI of Presidential Decree No 261/11 of 6 October) shall be complied with.	Contractor	Consultant / RNT	Measures can be taken through standard, careful management and operation, and special cost is not required.
		- Turbidity run-off from power line ROW and construction road maintenance	- In sections where clearing and rooting has been carried out due to demining work, ROWs, construction roads, material storage areas and post-service management roads should be promptly secured to prevent sediment run-off. - If the location of the steel tower and ROW are determined and there is concern about the impact on surface water, well water, spring water, etc., appropriate measures should be taken in consultation with users.	Contractor	Consultant / RNT	Measures can be taken through standard, careful management and operation, and special cost is not required.
3	Soil pollution	- Lubricating oil and fuel oil leaks from construction vehicles, construction machinery, etc.	- Properly maintain vehicles and heavy equipment and, in particular, store and control lubricants and fuel oil, etc. at the workers' filling stations.	Contractor	Consultant / RNT	Measures can be taken through standard, careful management and operation, and special cost is not required.
4	Noise and vibration	- Noise and vibration caused by the operation of heavy machinery and the	- Avoid residential areas, schools, hospitals and other neighbourhoods when selecting worker accommodation.	Contractor	Consultant / RNT	Measures can be taken through standard, careful

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
		passage of construction vehicles.	- Construction activities, especially noisy ones, should be limited to daytime only and avoided at night and on weekends. - Construction vehicle traffic routes are supposed to bypass the vicinity of residential areas hospitals, schools, etc., and where unavoidable, speed limits are limited to 30 km/hour or less. - Contractors need to present preliminary information to local residents in the vicinity of the construction site on upcoming construction activities, including information on the commencement of planned activities, their nature and duration. This communication should also include information on the nature and objectives of the project. - Implement a grievance redress mechanism (GRM) to address complaints about noise and vibration impacts.			management and operation, and special cost is not required.
5	Offensive odors	- Generation of odours due to improper waste management.	- Proper transport of waste and dumping of waste into designated disposal facilities by licensed contractors to avoid the build-up of odour, pest control problems, general rubbish and other nuisance sources on the site. - Provide training, education and signage to ensure compliance with waste management plans.	Contractor	Consultant / RNT	Measures can be taken through standard, careful management and operation, and special cost is not required.
6	Waste	- Improper storage, handling and disposal of general and hazardous waste.	- Implement a Waste Management Plan (WMP) to establish waste management priorities and hierarchy. - WMPs also include the proper management, treatment and disposal of toilet and domestic wastewater. - Train employees on storage methods, waste handling, prevention of leakage/disposal and what to do in the event of a leakage, and provide them with the personal protective equipment necessary for handling hazardous waste. - Train employees to recycle and reuse waste materials such as glass, iron, steel, wood, cardboard paper and plastic as much as possible. - Develop spill response and emergency response plans that incorporate the potential for accidental release of hazardous waste.	Contractor	Consultant / RNT	Measures can be taken through standard, careful management and operation, and special cost is not required.
7	Ecosystems	- Post-vegetation clearing and rooting of vegetation	- Backfilling of surface soil. - Restrict the movement of machinery and vehicles into the	Contractor	Consultant / RNT	Proper planning and designing will be

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
			work zone. Mainly between Tchvinguilo and Bruco. - For the most affected areas (e.g. temporary access routes, construction sites, offices), develop and implement various short- to long-term vegetation restoration plans, including removal/relocation of protected species and afforestation/reforestation. - Strictly prohibit the collection of trees and hunting by workers.			taken by consultants without special cost.
		- Fragmentation and loss of bird habitat	- To preserve nesting sites, expert surveys are carried out prior to demining work. - Conservation of habitats of endangered species (optimal routes and monitoring) - Hunting in and around the project area is prohibited.	Contractor	Consultant / RNT	Proper planning and designing will be taken by consultants without special cost.
		- Fragmentation and loss of fauna habitats.	- Restrict the movement of machinery and vehicles to the work area. - Prevent unnecessary destruction of trees (e.g. dead trees and old specimens) as habitat for geckos, snakes, bats and genets. - Establish speed limits for vehicles to prevent roadkill. - Train workers not to interfere with animals unnecessarily.	Contractor	Consultant / RNT	Proper planning and designing will be taken by consultants without special cost.
8	Topography and geology	- Soil erosion due to vegetation removal.	- On sloping terrain, earth retaining works should be implemented.	Contractor	Consultant / RNT	Proper planning and designing will be taken by consultants without special cost.
9	Land acquisition and resettlement	- Temporary and permanent acquisition of private land and used land area - Restrictions on access to and land use of construction sites and their surroundings	- Provide assistance to the project affected persons in the transition period and implement livelihood restoration and improvement activities	RNT	RNT	RNT
			- Explain the progress to the residents of the area concerned with regard to the implementation of access restrictions around the construction site, and handle complaints as necessary.	Contractor	Consultant / RNT	Included in the Contractor's contract
10	The poor	- Temporary and permanent acquisition of private land and used land area	- Implement livelihood improvement activities as required.	RNT	RNT	RNT
			- Employ local and project affected persons in unskilled labour quotas.	Contractor	Consultant / RNT	Included in the Contractor's contract

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
11	Local economies, such as employment and livelihood, etc.	- Temporary and permanent acquisition of private land and used land area - Restrictions on access to and land use of construction sites and their surroundings - Loss of agriculture and other means of livelihood	- Provide assistance in the transition period and livelihood restoration / improvement activities to maintain the livelihood levels of project affected households.	RNT	RNT	RNT
			- Employ local and project affected persons in unskilled labour quotas.	Contractor	Consultant / RNT	Included in the Contractor's contract
12	Land use and utilization of local resource	- Restrictions on access to and land use of construction sites and their surroundings	- Explain the progress to the residents of the area concerned and handle complaints as required.	RNT	RNT	RNT
			- Enforce access restrictions around construction sites	Contractor	Consultant / RNT	Included in the Contractor's contract
13	Existing social infrastructures and services	- Increase in traffic accidents, etc.	- Provide education on compliance with traffic rules, traffic signage and safe driving - Provide training on safe vehicle operation	Contractor	Consultant / RNT	Included in the Contractor's contract
14	Misdistribution of benefits and damages	- Temporary and permanent acquisition of private land and used land area - Restrictions on access to and land use of construction sites and their surroundings	- Explain the progress to the residents of the area concerned and handle complaints as required.	RNT	RNT	RNT
			- Enforce access restrictions around construction sites	Contractor	Consultant / RNT	Included in the Contractor's contract
15	Local conflicts of interest	- Temporary and permanent acquisition of private land and used land area - Restrictions on access to and land use of construction sites and their surroundings. - Conflicts between migrant workers and local residents	- Explain the progress to the residents of the area concerned in line with the stakeholder engagement plan. - Establish a grievance mechanism to handle complaints as required.	RNT	RNT	RNT
			- Provide instructions to personnel and workers from outside and ensure that local communities are well taken care of.	Contractor	Consultant / RNT	Included in the Contractor's contract

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
16	Cultural heritage	- construction of a steel tower - Workers' camps and material storage areas established.	- Stop construction work immediately if any objects of cultural or historical value are found in and around the construction site during construction, document and share with the National Institute of Cultural Heritage (INPC).	Contractor	Consultant / RNT	Included in the Contractor's contract
17	Landscape	- Tree felling in the ROW - Establishment of workers' camps - Entry of heavy machinery, set up of material storage area	- Minimise the extent of logging where possible and plant trees after construction is completed. - In labour camps and material storage areas, use bare land wherever possible and keep sufficient distance from residential areas and public facilities (schools and hospitals). - Temporary structures should be removed and restored to their original state as soon as construction is completed.	Contractor	Consultant / RNT	Included in the Contractor's contract
18	Gender	- Harassment by personnel and workers from outside	- Explain the progress to the residents of the area concerned and handle complaints as required.	RNT	RNT	RNT
			- Provide instructions to personnel and workers from outside to ensure the code of conduct, including a ban on harassment of local people. - Respect local culture and take into account local women's views while actively listening to them. - Provide employment opportunities for women and support local trading activities.	Contractor	Consultant / RNT	Included in the Contractor's contract
19	Children's rights	- Possibility of child labour and inappropriate work by minors.	- Explain the progress to the residents of the area concerned and handle complaints as required.	RNT	RNT	RNT
			- Ensure employment compliant with the law and prohibition of minors' school attendance.	Contractor	Consultant / RNT	Included in the Contractor's contract
20	Infectious diseases such as HIV/AIDS	- Spread of infectious diseases due to influx of construction workers, etc.	- Provide instructions on health and hygiene to construction workers - Ensure that routine precautionary measures are taken, such as washing hands and gargling. - Regularly disinfect labour camps and construction site offices. - Encourage immunisations and keep medicines always available in labour camps and construction site offices	Contractor	Consultant / RNT	Included in the Contractor's contract
21	Working environment (including	- Accidents and injuries to workers caused by explosions of mine and	- Prohibit prior entry by construction workers to areas other than those where demining work is completed and safety is confirmed by the Government of Angola	Contractor	Consultant / RNT	Included in the Contractor's contract

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
	occupational safety)	UXO	- Educate workers and make sure they know the procedures and local contacts - If mines or UXO are found, suspend construction work and not resume until the safety of construction workers is confirmed.			
			- If mines or UXO are found, demining work is to be carried out. - Ensure instructions on first aid as stipulated in the SOPs in the event of an accident. - Ensure safety measures for workers (e.g. wearing protective clothing and proper equipment maintenance).	CND	Consultant / RNT/CND	Included in the cost of demining work
		- Accidents at construction sites. - hygiene problem	- Manuals on occupational accident prevention (including safety education and training) should be prepared and thoroughly implemented. - Provide safety equipment - Ensure that cranes and other lifting equipment use is below the expected weight. - Maintenance checks and proper checking of lifting equipment - Use of equipment and devices to prevent electrical shock. - Establish medical posts in labour camps and conduct regular health check-ups. - Fire precautions are taken and fire extinguishers etc. are deployed at the site office and labor camps. - Keep medical supplies and lifesaving equipment always available and installed in labour camps and construction site offices.	Contractor	Consultant / RNT	Included in the Contractor's contract
22	Accidents	- Accidents caused by explosions of mine and UXO	- Inform the public about the procedures of demining work when they are found, and contact details, and post them near the construction site at all times. - If mine or UXO are found, suspend construction work and not resume the construction work until the safety of construction workers and the surrounding population is confirmed.	Contractor	Consultant / RNT	Included in the Contractor's contract
			- If mine or UXO are found, carry out demining work. - Take measures such as traffic restrictions to ensure safety in	CND	Consultant / RNT/CND	Included in the cost of demining work

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
			the vicinity. - Take measures to prevent accidents, such as prohibiting entry and traffic in the vicinity until the demining work is completed.			
		- Traffic accidents due to increased traffic volume	- Provide education on compliance with traffic rules, traffic signage and safe driving. - Provide training on safe vehicle operation. - Carry out regular inspections and maintenance of equipment and instruments.	Contractor	Consultant / RNT	Included in the Contractor's contract
Operation phase						
1	Water pollution	- Removal of vegetation under railway lines and on administrative roads causes turbidity due to sediment run-off from exposed areas.	- Prevent exposure of the soil surface as much as possible by managing within the isolation distance standard below the line.	RNT	RNT	RNT Measures can be taken through standard, careful management and operation, and special cost is not required.
2	Noise and vibration	- Noise and vibration caused by the passage of related vehicles.	- Standardise speed limits and passing routes for the vehicles concerned.	RNT	RNT	RNT Measures can be taken through standard, careful management and operation, and special cost is not required.
3	Ecosystems	- Birds striking power lines.	- The route of the 220 kV TL was chosen to avoid the route where the tower protrudes over the ridge line, and in the vicinity of the Tundavala IBA, the route passes through the valley line on the back of Mt. Leba as in the steep cliff area in the Tundavala area, similar to the existing transmission line (60 kV), to reduce the risk of bird strikes. Therefore, it is considered necessary to accumulate information in order to decide on the application of further mitigation measures in the project area after carefully examining other good practices and studies on bird strike mitigation measures. In this regard, monitoring should be carried out around Ivantara Swamp, around Humpata, between Tchvinguilo and Bruco, and around Caraculo, where endangered species are thought to be present,	RNT	RNT	RNT Very careful monitoring prepared by RNT should be conducted, and proper measures should be considered based on accumulated information.

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
			and if birds are observed striking power lines, consider wearing markers to increase the visibility of power lines and ground lines.			
4	Hydrology	- Stormwater run-off from vegetation removal.	- Earth retaining works in sloping areas. Bare land cover.	RNT	RNT	RNT Measures can be taken through standard, careful management and operation, and special cost is not required.
5	Topography and geology	- Soil erosion due to vegetation removal.	- On sloping terrain, earth retaining works should be implemented.	RNT	RNT	RNT Measures can be taken through standard, careful management and operation, and special cost is not required.

Source: JICA Survey Team.

Table 9.8-2 Environmental Management Plan (60 kV DL)

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
Pre-construction phase						
1	Air pollution	- Air pollutant emissions from the implementation of demining work	- Appropriately maintain the equipment and vehicles used and reduce the generation of air pollutants. - During demining work, water will be sprayed as necessary to prevent dust generation. - Reduce speed on unpaved access roads to prevent dust generation.	CND	Consultant / ENDE/CND	Measures can be taken through standard, careful management and operation, and special cost is not required.
2	Water pollution	- Generation of wastewater in workers' camp, etc.	- All effluent from worker quarters etc. is collected and treated from the site for proper disposal at an approved municipal facility. - Installation of watertight septic tanks (or equivalent) to collect waste water from the site, including vehicle and machinery washing waste water. - When mobile chemical toilets are used, they should be installed and collected by an approved contractor and	CND	Consultant / ENDE/CND	Measures can be taken through standard, careful management and operation, and special cost is not required.

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
			disposed of properly. - When discharging wastewater into the environment, Angolan legislation on wastewater standards (Annex VI of Presidential Decree No 261/11 of 6 October) shall be complied with.			
		- Mine and UXO exploration and clearance operations, resulting in muddy run-off	- In sections where clearing and rooting has been carried out due to demining work, ROWs, construction roads, material storage areas and post-service management roads should be promptly secured to prevent sediment run-off. - If the location of the tower and ROW are determined and there is concern about the impact on surface water, well water, spring water, etc., appropriate measures should be taken in consultation with the users.	CND	Consultant / ENDE/CND	Proper planning and designing will be taken by consultants without special cost.
3	Soil pollution	- Spills of lubricating oil, fuel oil, etc. from heavy machinery.	- Ensure that lubricants and fuel oils are properly managed and have containers available to catch spills when refilling.	CND	Consultant / ENDE/CND	Proper planning and designing will be taken by consultants without special cost.
4	Noise and vibration	- Noise and vibration caused by the implementation of demining work	- Appropriately maintain and manage the equipment and vehicles used to reduce noise and vibration.	CND	Consultant / ENDE/CND	Proper planning and designing will be taken by consultants without special cost.
5	Offensive odors	- Generation of odours due to improper waste management.	- Proper transport of waste and dumping of waste into designated disposal facilities by licensed contractors to avoid the build-up of odour, pest control problems, general rubbish and other nuisance sources on the site. - Provide training, education and signage to ensure compliance with waste management plans.	CND	Consultant / ENDE/CND	Proper planning and designing will be taken by consultants without special cost.
6	Waste	- Cutting and de-rooting result in plant bodies becoming waste. - Waste is generated in the workers' camp.	- Plants are not discarded, but are used for soil retention and surface cover to prevent soil erosion and also encourage regeneration where possible. - Waste management plans prepared for power utilities are applied mutatis mutandis to properly dispose of waste generated at workers' camp.	CND	Consultant / ENDE/CND	Proper planning and designing will be taken by consultants without special cost.
7	Ecosystems	- Selection of distribution line ROW and tower construction sites	- Although the area is already well developed, the tower construction point and ROW will be finalised based on the detailed design and the results of the geological and topographical survey carried out by the Contractor,	Consultant	ENDE	Proper planning and designing will be taken by consultants without special cost.

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
			confirming the presence of valuable plants and communities such as miombo woodland.			
		- Clearing and rooting through the implementation of demining work	- Areas targeted for deforestation or logging operations should be marked in advance with visible markers (e.g. coloured tape) so that intervention areas can be identified, facilitating the work of machine operators. These operations should be carried out carefully, taking into account the ecological or landscape benefits of vegetation formation. - Prompt transition and linkage to transmission line construction works, based on soil erosion prevention measures and vegetation restoration plans, to prevent soil erosion and promote rapid vegetation recovery.	CND	Consultant / ENDE/CND	Proper planning and designing will be taken by consultants without special cost.
8	Land acquisition and resettlement	- Selection of distribution line ROW and tower construction sites	- Avoid private land and used land area as much as possible, based on the detailed design and the results of the geological and topographical survey carried out by the Contractor, the tower construction sites and ROW are finalised.	Consultant	ENDE	Included in the Consultancy Services
			- Provide alternative agricultural land and houses of equal or greater value. - Provide a preliminary explanation to the inhabitants of the area concerned.	ENDE	ENDE	ENDE
9	Existing social infrastructures and services	- Impact on social services of demining work	- Enforce access restrictions, etc. around mine exploration and clearance operation sites. - Provide information on the scope of impact and publish the work schedule	CND	Consultant / ENDE/CND	Included in the cost of demining work
10	Working environment (including occupational safety)	- Accidents and injuries to operators caused by explosions of mines and UXO	- Continue to educate operators and ensure that they know the procedures and who to contact to prevent accidents and injuries. Ensure that operators are given instructions on first aid as stipulated in the SOPs, in case of an accident. - Ensure safety measures for workers (e.g. wearing protective clothing and proper equipment maintenance).	CND	Consultant / ENDE/CND	Included in the cost of demining work
11	Accidents	- Conduct demining work	- Carry out safety checks and take accident prevention measures such as prohibiting access to the area and traffic until the process is complete. - Provide safety measures for operator / workers engaged in demining work (e.g. wearing protective clothing and proper	CND	Consultant / ENDE/CND	Included in the cost of demining work

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
			equipment maintenance).			
Construction phase						
1	Air pollution	- Emission of air pollutants (SOx, NOx and others) and generation of dust due to the operation of heavy machinery in the construction of transmission line ROW, construction roads and the construction of towers, and the passage of construction vehicles.	- Appropriately maintain and manage the equipment and vehicles used and reduce emissions of air pollutants (SOx, NOx and others). - Construction vehicle traffic routes are supposed to bypass the vicinity of residential areas hospitals, schools, etc., and where unavoidable, speed limits are limited to 30 km/hour or less. - On unpaved roads, water is sprayed by sprinkler trucks as necessary to reduce dust generation. - When transporting earth, sand, etc., do not fill the load fully, but cover it with plenty of room. - Effectively educate and train relevant personnel.	Contractor	Consultant / ENDE	Measures can be taken through standard, careful management and operation, and special cost is not required.
2	Water pollution	Generation of wastewater in workers' camp, etc.	- All effluent from worker quarters etc. is collected and treated from the site for proper disposal at an approved municipal facility. - Installation of watertight septic tanks (or equivalent) to collect wastewater from the site, including vehicle and machinery cleaning waste water. - When mobile chemical toilets are used, they should be installed and collected by an approved contractor and disposed of properly. - When discharging wastewater into the environment, Angolan legislation on wastewater standards (Annex VI of Presidential Decree No 261/11 of 6 October) shall be complied with.	Contractor	Consultant / ENDE	Measures can be taken through standard, careful management and operation, and special cost is not required.
		Muddy run-off due to maintenance of distribution line ROW and construction roads	- In sections where clearing and rooting has been carried out due to demining work, ROWs, construction roads, material storage areas and post-service management roads should be promptly secured to prevent sediment run-off. - If the location of the tower and ROW are determined and there is concern about the impact on surface water, well water, spring water, etc., appropriate measures should be	Contractor	Consultant / ENDE	Proper planning and designing will be taken by consultants without special cost.

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
			taken in consultation with the users.			
3	Soil pollution	Lubricating oil and fuel oil leaks from construction vehicles, construction machinery, etc.	Properly maintain vehicles and heavy equipment and, in particular, store and control lubricants and fuel oil, etc. at the workers' filling stations.	Contractor	Consultant / ENDE	Measures can be taken through standard, careful management and operation, and special cost is not required.
4	Noise and vibration	Noise and vibration caused by the operation of heavy machinery and the passage of construction vehicles.	- Avoid residential areas, schools, hospitals and other neighbourhoods when selecting worker accommodation. - Construction activities, especially noisy ones, should be limited to daytime only and avoided at night and on weekends. - Construction vehicle traffic routes are supposed to bypass the vicinity of residential areas hospitals, schools, etc., and where unavoidable, speed limits are limited to 30 km/hour or less. - Contractors need to present preliminary information to local residents in the vicinity of the construction site on upcoming construction activities, including information on the commencement of planned activities, their nature and duration. This communication should also include information on the nature and objectives of the project. - Implement a grievance redress mechanism (GRM) to address complaints about noise and vibration impacts.	Contractor	Consultant / ENDE	Measures can be taken through standard, careful management and operation, and special cost is not required.
5	Offensive odors	Generation of odours due to improper waste management.	- Proper transport of waste and dumping of waste into designated disposal facilities by licensed contractors to avoid the build-up of odour, pest control problems, general rubbish and other nuisance sources on the site. - Provide training, education and signage to ensure compliance with waste management plans.	Contractor	Consultant / ENDE	Measures can be taken through standard, careful management and operation, and special cost is not required.
6	Waste	Improper storage, handling and disposal of general and hazardous waste.	- Implement a Waste Management Plan (WMP) to establish waste management priorities and hierarchy. - WMPs also include the proper management, treatment and disposal of toilet and domestic wastewater. - Train employees on storage methods, waste handling, prevention of leakage/disposal and what to do in the event of a leakage, and provide them with the personal protective equipment necessary for handling hazardous waste.	Contractor	Consultant / ENDE	Measures can be taken through standard, careful management and operation, and special cost is not required.

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
			- Train employees to recycle and reuse waste materials such as glass, iron, steel, wood, cardboard paper and plastic as much as possible. - Develop spill response and emergency response plans that incorporate the potential for accidental release of hazardous waste.			
7	Ecosystems	Post-vegetation clearing and rooting of vegetation	- Backfilling of surface soil. - Strictly prohibit the collection of trees and hunting by workers.	Contractor	Consultant / ENDE	Measures can be taken through standard, careful management and operation, and special cost is not required.
8	Land acquisition and resettlement	- Temporary and permanent acquisition of private land and used land area - Restrictions on access to and land use of construction sites and their surroundings	- Provide assistance to the project affected persons in the transition period	ENDE	ENDE	ENDE
			- Explain the progress to the residents of the area concerned with regard to the implementation of access restrictions around the construction site, and handle complaints as necessary.	Contractor	Consultant / ENDE	Included in the Contractor's contract
9	Land use and utilization of local resource	- Restrictions on access to and land use of construction sites and their surroundings	- Explain the progress to the residents of the area concerned and handle complaints as required.	ENDE	ENDE	ENDE
			- Enforce access restrictions around construction sites	Contractor	Consultant / ENDE	Included in the Contractor's contract
10	Existing social infrastructures and services	- Increase in traffic accidents, etc.	- Provide education on compliance with traffic rules, traffic signage and safe driving - Provide training on safe vehicle operation	Contractor	Consultant / ENDE	Included in the Contractor's contract
11	Misdistribution of benefits and damages	- Temporary and permanent acquisition of private land and used land area - Restrictions on access to and land use of construction sites and their surroundings	- Explain the progress to the residents of the area concerned and handle complaints as required.	ENDE	ENDE	ENDE
			- Enforce access restrictions around construction sites	Contractor	Consultant / ENDE	Included in the Contractor's contract
12	Local conflicts of interest	- Temporary and permanent acquisition of private land and used land area - Restrictions on access to	- Explain the progress to the residents of the area concerned in line with the stakeholder engagement plan. - Establish a grievance mechanism to handle complaints as required.	ENDE	ENDE	ENDE

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
		and land use of construction sites and their surroundings. - Conflicts between migrant workers and local residents	- Provide instructions to personnel and workers from outside and ensure that local communities are well taken care of.	Contractor	Consultant / ENDE	Included in the Contractor's contract
13	landscape	- Tree felling in the ROW - Establishment of labour camps - Entry of heavy machinery, set up of material storage area	- Minimise the extent of logging where possible and plant trees after construction is completed. - In labour camps and material storage areas, use bare land wherever possible and keep sufficient distance from residential areas and public facilities (schools and hospitals). - Temporary structures should be removed and restored to their original state as soon as construction is completed.	Contractor	Consultant / ENDE	Included in the Contractor's contract
14	Gender	- Harassment by personnel and workers from outside	- Explain the progress to the residents of the area concerned and handle complaints as required.	ENDE	ENDE	ENDE
			- Provide instructions to personnel and workers from outside to ensure the code of conduct, including a ban on harassment of local people. - Respect local culture and take into account local women's views while actively listening to them. - Provide employment opportunities for women and support local trading activities.	Contractor	Consultant / ENDE	Included in the Contractor's contract
15	Children's rights	- Possibility of child labour and inappropriate work by minors.	- Explain the progress to the residents of the area concerned and handle complaints as required.	ENDE	ENDE	ENDE
			- Ensure employment compliant with the law and prohibition of minors' school attendance.	Contractor	Consultant / ENDE	Included in the Contractor's contract
16	Infectious diseases such as HIV/AIDS	- Spread of infectious diseases due to influx of construction workers, etc.	- Provide instructions on health and hygiene to construction workers - Ensure that routine precautionary measures are taken, such as washing hands and gargling. - Regularly disinfect labour camps and construction site offices. - Encourage immunisations and keep medicines always available in labour camps and construction site offices	Contractor	Consultant / ENDE	Included in the Contractor's contract
17	Working environment	- Accidents and injuries to workers caused by	- Prohibit prior entry by construction workers to areas other than those where demining work is completed and safety is	Contractor	Consultant / ENDE	Included in the Contractor's contract

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
	(including occupational safety)	explosions of mine and UXO	confirmed by the Government of Angola - Educate workers and make sure they know the procedures and local contacts - If mines or UXO are found, suspend construction work and not resume until the safety of construction workers is confirmed.			
			- If mines or UXO are found, demining work is to be carried out. - Ensure instructions on first aid as stipulated in the SOPs in the event of an accident. - Ensure safety measures for workers (e.g. wearing protective clothing and proper equipment maintenance).	CND	Consultant / ENDE/CND	Included in the cost of demining work
		- Accidents at construction sites. - hygiene problem	- Manuals on occupational accident prevention (including safety education and training) should be prepared and thoroughly implemented. - Provide safety equipment - Ensure that cranes and other lifting equipment use is below the expected weight. - Maintenance checks and proper checking of lifting equipment - Use of equipment and devices to prevent electrical shock. - Establish medical posts in labour camps and conduct regular health check-ups. - Fire precautions are taken and fire extinguishers etc. are deployed at the site office and labor camps. - Keep medical supplies and lifesaving equipment always available and installed in labour camps and construction site offices.	Contractor	Consultant / ENDE	Included in the Contractor's contract
18	Accidents	- Accidents caused by explosions of mine and UXO	- Inform the public about the procedures of demining work when they are found, and contact details, and post them near the construction site at all times. - If mine or UXO are found, suspend construction work and not resume the construction work until the safety of construction workers and the surrounding population is confirmed.	Contractor	Consultant / ENDE	Included in the Contractor's contract

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
			- If mine or UXO are found, carry out demining work. - Take measures such as traffic restrictions to ensure safety in the vicinity. - Take measures to prevent accidents, such as prohibiting entry and traffic in the vicinity until the demining work is completed.	CND	Consultant / ENDE/CND	Included in the cost of demining work
		- Traffic accidents due to increased traffic volume	- Provide education on compliance with traffic rules, traffic signage and safe driving. - Provide training on safe vehicle operation. - Carry out regular inspections and maintenance of equipment and instruments.	Contractor	Consultant / ENDE	Included in the Contractor's contract
Operation phase						
1	Noise and vibration	- Noise and vibration caused by the passage of related vehicles.	- Standardise speed limits and passing routes for the vehicles concerned.	ENDE	ENDE	ENDE
2	Ecosystems	- Birds striking power lines.	- Monitoring between East Lubango SS and Arimba substation, and if birds are observed striking transmission line, consider wearing markers to increase the visibility of transmission line and ground lines.	ENDE	ENDE	ENDE

Source: JICA Survey Team.

Table 9.8-3 Environmental Management Plan (220/60 kV New Namibe SS)

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
Pre-construction phase						
1	Air pollution	- Air pollutant emissions from the implementation of demining work	- Appropriately maintain the equipment and vehicles used and reduce the generation of air pollutants. - During demining work, water will be sprayed as necessary to prevent dust generation. - Reduce speed on unpaved access roads to prevent dust generation.	CND	Consultant / RNT/CND	Measures can be taken through standard, careful management and operation, and special cost is not required.
2	Water pollution	- Generation of wastewater in workers' camp, etc.	- All effluent from worker quarters etc. is collected and treated from the site for proper disposal at an approved municipal facility. - Installation of watertight septic tanks (or equivalent) to collect waste water from the site, including vehicle and machinery washing waste water. - When mobile chemical toilets are used, they should be installed and collected by an approved contractor and disposed of properly. - When discharging wastewater into the environment, Angolan legislation on wastewater standards (Annex VI of Presidential Decree No 261/11 of 6 October) shall be complied with.	CND	Consultant / RNT/CND	Measures can be taken through standard, careful management and operation, and special cost is not required.
3	Soil pollution	- Spills of lubricating oil, fuel oil, etc. from heavy machinery.	- Ensure that lubricants and fuel oils are properly managed and have containers available to catch spills when refilling.	CND	Consultant / RNT/CND	Measures can be taken through standard, careful management and operation, and special cost is not required.
4	Noise and vibration	- Noise and vibration caused by the implementation of demining work	- Appropriately maintain the equipment and vehicles used and reduce the occurrence of vibrations.	CND	Consultant / RNT/CND	Measures can be taken through standard, careful management and operation, and special cost is not required.

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
5	Offensive odors	- Generation of odours due to improper waste management.	- Proper transport of waste and dumping of waste into designated disposal facilities by licensed contractors to avoid the build-up of odour, pest control problems, general rubbish and other nuisance sources on the site. - Provide training, education and signage to ensure compliance with waste management plans.	CND	Consultant / RNT/CND	Measures can be taken through standard, careful management and operation, and special cost is not required.
6	Waste	- Waste is generated in the workers' camp.	- Waste management plans prepared for power utilities are applied mutatis mutandis to properly dispose of waste generated at workers' camp. - Provide training, education and signage to ensure compliance with waste management plans.	CND	Consultant / RNT/CND	Measures can be taken through standard, careful management and operation, and special cost is not required.
7	Ecosystems	- Fragmentation and loss of habitats for flora and fauna, especially reptiles, due to the implementation of demining work	- Installation of sandbags and sedimentation ponds to prevent sediment run-off, if necessary.	CND	Consultant / RNT/CND	Measures can be taken through standard, careful management and operation, and special cost is not required.
8	Topography and geology	- Surface soil erosion from the implementation of demining work	- Plants are not discarded, but used for soil retention and surface cover to prevent soil erosion and also encourage regeneration where possible	CND	Consultant / RNT/CND	Measures can be taken through standard, careful management and operation, and special cost is not required.
9	Working environment (including occupational safety)	- Accidents and injuries to operators caused by explosions of mines and UXO	- Continue to educate operators and ensure that they know the procedures and who to contact to prevent accidents and injuries. Ensure that operators are given instructions on first aid as stipulated in the SOPs, in case of an accident. - Ensure safety measures for workers (e.g. wearing protective clothing and proper equipment maintenance).	CND	Consultant / RNT/CND	Included in the cost of demining work
10	Accidents	- Conduct demining work	- Carry out safety checks and take accident prevention measures such as prohibiting access to the area and traffic until the process is complete. - Provide safety measures for operator / workers engaged in demining work (e.g. wearing protective clothing and proper equipment maintenance).	CND	Consultant / RNT/CND	Included in the cost of demining work

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
Construction phase						
1	Air pollution	- Emissions of air pollutants (SOx, NOx and others) and dust emissions due to the operation of heavy machinery and the passage of construction vehicles during the construction of access roads and substations	- Ensure proper maintenance of equipment and vehicles used and reduce emissions of air pollutants (SOx, NOx and others). - Construction vehicle traffic routes are supposed to bypass the vicinity of residential areas hospitals, schools, etc., and where unavoidable, speed limits are limited to 30 km/hour or less. - On unpaved roads, water is sprayed by sprinkler trucks as necessary to reduce dust generation. - When transporting earth, sand, etc., do not fill the load fully, but cover it with plenty of room. - Effectively educate and train relevant personnel.	Contractor	Consultant / RNT	Measures can be taken through standard, careful management and operation, and special cost is not required.
2	Water pollution	Generation of wastewater in workers' camp, etc.	- All effluent from worker quarters etc. is collected and treated from the site for proper disposal at an approved municipal facility. - Installation of watertight septic tanks (or equivalent) to collect wastewater from the site, including vehicle and machinery washing waste water. - When mobile chemical toilets are used, they should be installed and collected by an approved contractor and disposed of properly. - When discharging wastewater into the environment, Angolan legislation on wastewater standards (Annex VI of Presidential Decree No 261/11 of 6 October) shall be complied with.	Contractor	Consultant / RNT	Measures can be taken through standard, careful management and operation, and special cost is not required.
3	Soil pollution	Lubricating oil and fuel oil leaks from construction vehicles, construction machinery, etc.	Properly maintain vehicles and heavy equipment and, in particular, store and control lubricants and fuel oil, etc. at the workers' filling stations.	Contractor	Consultant / RNT	Measures can be taken through standard, careful management and operation, and special cost is not required.
4	Noise and vibration	Noise and vibration caused by the operation of heavy machinery and the passage of construction vehicles.	- Avoid residential areas, schools, hospitals and other neighbourhoods when selecting worker accommodation. - Construction activities, especially noisy ones, should be limited to daytime only and avoided at night and on weekends.	Contractor	Consultant / RNT	Measures can be taken through standard, careful management and operation, and

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
			- Construction vehicle traffic routes are supposed to bypass the vicinity of residential areas hospitals, schools, etc., and where unavoidable, speed limits are limited to 30 km/hour or less. - Contractors need to present preliminary information to local residents in the vicinity of the construction site on upcoming construction activities, including information on the commencement of planned activities, their nature and duration. This communication should also include information on the nature and objectives of the project. - Implement a grievance redress mechanism (GRM) to address complaints about noise and vibration impacts.			special cost is not required.
5	Offensive odors	Generation of odours due to improper waste management.	- Proper transport of waste and dumping of waste into designated disposal facilities by licensed contractors to avoid the build-up of odour, pest control problems, general rubbish and other nuisance sources on the site. - Provide training, education and signage to ensure compliance with waste management plans.	Contractor	Consultant / RNT	Measures can be taken through standard, careful management and operation, and special cost is not required.
6	Waste	Improper storage and handling of general and hazardous waste.	- Implement a Waste Management Plan (WMP) to establish waste management priorities and hierarchy. - WMPs also include the proper management, treatment and disposal of toilet and domestic wastewater. - Train employees on storage methods, waste handling, prevention of leakage/disposal and what to do in the event of a leak, and provide them with the personal protective equipment necessary for handling hazardous waste. - Train employees to recycle and reuse waste materials such as glass, iron, steel, wood, cardboard paper and plastic as much as possible. - Develop spill response and emergency response plans that incorporate the potential for accidental release of hazardous waste.	Contractor	Consultant / RNT	Measures can be taken through standard, careful management and operation, and special cost is not required.
7	Ecosystems	- Air pollution, noise and vibration caused by the operation and passage of construction vehicles	- (Same as air pollution, noise and vibration mitigation measures.)	Contractor	Consultant / RNT	Measures can be taken through standard, careful management and operation, and special cost is not required.

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
8	Topography and geology	- Soil erosion from land clearance, foundation works, etc.	- Installation of sandbags and sedimentation ponds to prevent sediment run-off, if necessary.	Contractor	Consultant / RNT	Measures can be taken through standard, careful management and operation, and special cost is not required.
9	Existing social infrastructures and services	- Increase in traffic accidents, etc.	- Provide education on compliance with traffic rules, traffic signage and safe driving - Provide training on safe vehicle operation	Contractor	Consultant / RNT	Measures can be taken through standard, careful management and operation, and special cost is not required.
10	Landscape	- Establishment of labour camps - Entry of heavy machinery, set up of material storage area	- In labour camps and material storage areas, use bare land wherever possible and keep sufficient distance from residential areas and public facilities (schools and hospitals). - Temporary structures should be removed and restored to their original state as soon as construction is completed.	Contractor	Consultant / RNT	Included in the Contractor's contract
11	Gender	- Harassment by personnel and workers from outside	- Explain the progress to the residents of the area concerned and handle complaints as required.	RNT	RNT	RNT
			- Provide instructions to personnel and workers from outside to ensure the code of conduct, including a ban on harassment of local people. - Respect local culture and take into account local women's views while actively listening to them. - Provide employment opportunities for women and support local trading activities.	Contractor	Consultant / RNT	Included in the Contractor's contract
12	Children's rights	- Possibility of child labour and inappropriate work by minors.	- Explain the progress to the residents of the area concerned and handle complaints as required.	RNT	RNT	RNT
			- Ensure employment compliant with the law and prohibition of minors' school attendance.	Contractor	Consultant / RNT	Included in the Contractor's contract
13	Infectious diseases such as HIV/AIDS	- Spread of infectious diseases due to influx of construction workers, etc.	- Provide instructions on health and hygiene to construction workers - Ensure that routine precautionary measures are taken, such as washing hands and gargling. - Regularly disinfect labour camps and construction site	Contractor	Consultant / RNT	Included in the Contractor's contract

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
			offices. - Encourage immunisations and keep medicines always available in labour camps and construction site offices			
14	Working environment (including occupational safety)	- Accidents and injuries to workers caused by explosions of mine and UXO	- Prohibit prior entry by construction workers to areas other than those where demining work is completed and safety is confirmed by the Government of Angola - Educate workers and make sure they know the procedures and local contacts - If mines or UXO are found, suspend construction work and not resume until the safety of construction workers is confirmed.	Contractor	Consultant / RNT	Included in the Contractor's contract
			- If mines or UXO are found, demining work is to be carried out. - Ensure instructions on first aid as stipulated in the SOPs in the event of an accident. - Ensure safety measures for workers (e.g. wearing protective clothing and proper equipment maintenance).	CND	Consultant / RNT/CND	Included in the cost of demining work
		- Accidents at construction sites. - hygiene problem	- Manuals on occupational accident prevention (including safety education and training) should be prepared and thoroughly implemented. - Provide safety equipment - Ensure that cranes and other lifting equipment use is below the expected weight. - Maintenance checks and proper checking of lifting equipment - Use of equipment and devices to prevent electrical shock. - Establish medical posts in labour camps and conduct regular health check-ups. - Fire precautions are taken and fire extinguishers etc. are deployed at the site office and labor camps. - Keep medical supplies and lifesaving equipment always available and installed in labour camps and construction site offices.	Contractor	Consultant / RNT	Included in the Contractor's contract
15	Accidents	- Accidents caused by explosions of mine and	- Inform the public about the procedures of demining work when they are found, and contact details, and post them near	Contractor	Consultant / RNT	Included in the Contractor's contract

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
		UXO	the construction site at all times. - If mine or UXO are found, suspend construction work and not resume the construction work until the safety of construction workers and the surrounding population is confirmed.			
			- If mine or UXO are found, carry out demining work. - Take measures such as traffic restrictions to ensure safety in the vicinity. - Take measures to prevent accidents, such as prohibiting entry and traffic in the vicinity until the demining work is completed.	CND	Consultant / RNT/CND	Included in the cost of demining work
		- Traffic accidents due to increased traffic volume	- Provide education on compliance with traffic rules, traffic signage and safe driving. - Provide training on safe vehicle operation. - Carry out regular inspections and maintenance of equipment and instruments.	Contractor	Consultant / RNT	Included in the Contractor's contract
Operation phase						
1	Water pollution	- Generation of domestic wastewater by facility personnel	- Proper disposes of wastewater, rubbish, fuel and oil etc.. - Provide training to operator of wastewater, rubbish, fuel and oil.	RNT	RNT	RNT Measures can be taken through standard, careful management and operation, and special cost is not required.
2	Noise and vibration	- Noise and vibration from related vehicle traffic is expected to be generated, and background noise from substations	- Standardise speed limits and traffic routes for the vehicles concerned, and take all possible measures to prevent noise from substation facilities, especially transformers.	RNT	RNT	RNT Measures can be taken through standard, careful management and operation, and special cost is not required.
3	Offensive odors	- Generation of odours due to improper waste management.	- Ensure proper disposal of waste generated by the activities of maintenance personnel as a manned facility.	RNT	RNT	RNT Measures can be taken through standard, careful management and operation, and

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
						special cost is not required.
4	Waste	- Impact of improper waste management.	- Ensure proper disposal of waste generated by the activities of maintenance personnel as a manned facility.	RNT	RNT	RNT Measures can be taken through standard, careful management and operation, and special cost is not required.
5	Ecosystems	- Permanent habitat loss due to substations.	- Drainage systems for rainfall from substations to prevent erosion caused by rainfall, wind, etc. to avoid erosion in the vicinity of substations.	RNT	RNT	RNT Measures can be taken through standard, careful management and operation, and special cost is not required.
6	Topography and geology	- Erosion due to long-term rainfall	- Improvement of stormwater drainage systems around substations.	RNT	RNT	RNT Measures can be taken through standard, careful management and operation, and special cost is not required.

Source: JICA Survey Team.

Table 9.8-4 Environmental Management Plan (220/60 kV East Lubango SS)

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
Pre-construction phase						
1	Air pollution	- Air pollutant emissions from the implementation of demining work	- Appropriately maintain the equipment and vehicles used and reduce the generation of air pollutants. - During demining work, water will be sprayed as necessary to prevent dust generation.	CND	Consultant / RNT/CND	Measures can be taken through standard, careful management and operation, and special cost is not required.
2	Water pollution	- Generation of wastewater in workers' camp, etc.	- All effluent from worker quarters etc. is collected and treated from the site for proper disposal at an approved municipal facility. - Installation of watertight septic tanks (or equivalent) to collect waste water from the site, including vehicle and machinery washing waste water. - When mobile chemical toilets are used, they should be installed and collected by an approved contractor and disposed of properly. - When discharging wastewater into the environment, Angolan legislation on wastewater standards (Annex VI of Presidential Decree No 261/11 of 6 October) shall be complied with.	CND	Consultant / RNT/CND	Measures can be taken through standard, careful management and operation, and special cost is not required.
3	Soil pollution	- Spills of lubricating oil, fuel oil, etc. from heavy machinery.	- Ensure that lubricants and fuel oils are properly managed and that a receptacle is available in case of spillages when refilling.	CND	Consultant / RNT/CND	Measures can be taken through standard, careful management and operation, and special cost is not required.
4	Noise and vibration	- Noise and vibration caused by the implementation of demining work	- Appropriately maintain and manage the equipment and vehicles used to reduce noise and vibration.	CND	Consultant / RNT/CND	Measures can be taken through standard, careful management and operation, and special cost is not required.
5	Offensive odors	- Generation of odours due to improper waste management.	- Proper transport of waste and dumping of waste into designated disposal facilities by licensed contractors to avoid the build-up of odour, pest control problems, general rubbish and other nuisance sources on the site.	CND	Consultant / RNT/CND	Measures can be taken through standard, careful management and operation, and

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
			- Provide training, education and signage to ensure compliance with waste management plans.			special cost is not required.
6	Waste	- Waste is generated in the workers' camp.	- Waste management plans prepared for power utilities are applied mutatis mutandis to properly dispose of waste generated at workers' camp.	CND	Consultant / RNT/CND	Measures can be taken through standard, careful management and operation, and special cost is not required.
7	Ecosystems	- Fragmentation and loss of habitats for flora and fauna, especially reptiles, due to the implementation of demining work	- After the completion of mine/UXO search and clearance activities, the topsoil is returned and the surface is flattened/smoothed to limit the effects of erosion during rainfall.	Consultant	RNT	Measures can be taken through standard, careful management and operation, and special cost is not required.
8	Topography and geology	- Surface soil erosion from the implementation of demining work.	- Installation of sandbags and sedimentation ponds to prevent sediment run-off, if necessary.	CND	Consultant / RNT/CND	Measures can be taken through standard, careful management and operation, and special cost is not required.
9	Working environment (including occupational safety)	- Accidents and injuries to operators caused by explosions of mines and UXO	- Continue to educate operators and ensure that they know the procedures and who to contact to prevent accidents and injuries. Ensure that operators are given instructions on first aid as stipulated in the SOPs, in case of an accident. - Ensure safety measures for workers (e.g. wearing protective clothing and proper equipment maintenance).	CND	Consultant / RNT/CND	Included in the cost of demining work
10	Accidents	- Conduct demining work	- Carry out safety checks and take accident prevention measures such as prohibiting access to the area and traffic until the process is complete. - Provide safety measures for operator / workers engaged in demining work (e.g. wearing protective clothing and proper equipment maintenance).	CND	Consultant / RNT/CND	Included in the cost of demining work
Construction phase						
1	Air pollution	- Emissions of air pollutants (SOx, NOx and others) and dust emissions due to the operation of heavy	- Ensure proper maintenance of equipment and vehicles used and reduce emissions of air pollutants (SOx, NOx and others). - Construction vehicle traffic routes are supposed to bypass	Contractor	Consultant / RNT	Measures can be taken through standard, careful management and operation, and

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
		machinery and the passage of construction vehicles during the construction of access roads and substations	the vicinity of residential areas hospitals, schools, etc., and where unavoidable, speed limits are limited to 30 km/hour or less. - On unpaved roads, water is sprayed by sprinkler trucks as necessary to reduce dust generation. - When transporting earth, sand, etc., do not fill the load fully, but cover it with plenty of room. - Effectively educate and train relevant personnel.			special cost is not required.
2	Water pollution	- Generation of wastewater in workers' camp, etc.	- All effluent from worker quarters etc. is collected and treated from the site for proper disposal at an approved municipal facility. - Installation of watertight septic tanks (or equivalent) to collect wastewater from the site, including vehicle and machinery washing wastewater. - When mobile chemical toilets are used, they should be installed and collected by an approved contractor and disposed of properly. - When discharging wastewater into the environment, Angolan legislation on wastewater standards (Annex VI of Presidential Decree No 261/11 of 6 October) shall be complied with.	Contractor	Consultant / RNT	Measures can be taken through standard, careful management and operation, and special cost is not required.
3	Soil pollution	- Lubricating oil and fuel oil leaks from construction vehicles, construction machinery, etc.	- Properly maintain vehicles and heavy equipment and, in particular, store and control lubricants and fuel oil, etc. at the workers' filling stations.	Contractor	Consultant / RNT	Measures can be taken through standard, careful management and operation, and special cost is not required.
4	Noise and vibration	- Noise and vibration caused by the operation of heavy machinery and the passage of construction vehicles.	- Avoid residential areas, schools, hospitals and other neighbourhoods when selecting worker accommodation. - Construction activities, especially noisy ones, should be limited to daytime only and avoided at night and on weekends. - Construction vehicle traffic routes are supposed to bypass the vicinity of residential areas hospitals, schools, etc., and where unavoidable, speed limits are limited to 30 km/hour or less. - Contractors need to present preliminary information to local	Contractor	Consultant / RNT	Measures can be taken through standard, careful management and operation, and special cost is not required.

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
			residents in the vicinity of the construction site on upcoming construction activities, including information on the commencement of planned activities, their nature and duration. This communication should also include information on the nature and objectives of the project. - Implement a grievance redress mechanism (GRM) to address complaints about noise and vibration impacts.			
5	Offensive odors	- Generation of odours due to improper waste management.	- Proper transport of waste and dumping of waste into designated disposal facilities by licensed contractors to avoid the build-up of odour, pest control problems, general rubbish and other nuisance sources on the site.	Contractor	Consultant / RNT	Measures can be taken through standard, careful management and operation, and special cost is not required.
6	Waste	- Improper storage, handling and disposal of general and hazardous waste.	- Implement a Waste Management Plan (WMP) to establish waste management priorities and hierarchy. - WMPs also include the proper management, treatment and disposal of toilet and domestic wastewater. - Train employees on storage methods, waste handling, prevention of leakage/disposal and what to do in the event of a leakage, and provide them with the personal protective equipment necessary for handling hazardous waste. - Train employees to recycle and reuse waste materials such as glass, iron, steel, wood, cardboard paper and plastic as much as possible. - Develop spill response and emergency response plans that incorporate the potential for accidental release of hazardous waste.	Contractor	Consultant / RNT	Measures can be taken through standard, careful management and operation, and special cost is not required.
7	Ecosystems	- Air pollution, noise and vibration caused by the operation and passage of construction vehicles	- (Same as air pollution, noise and vibration mitigation measures.)	Contractor	Consultant / RNT	Measures can be taken through standard, careful management and operation, and special cost is not required.
8	Topography and geology	- Soil erosion from land clearance, foundation works, etc.	- Installation of sandbags and sedimentation ponds to prevent sediment run-off, if necessary.	Contractor	Consultant / RNT	Measures can be taken through standard, careful management and operation, and

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
						special cost is not required.
9	Existing social infrastructures and services	- Increase in traffic accidents, etc.	- Provide education on compliance with traffic rules, traffic signage and safe driving. - Provide training on safe vehicle operation.	Contractor	Consultant / RNT	Included in the Contractor's contract
10	Landscape	- Establishment of labour camps - Entry of heavy machinery, set up of material storage area	- In labour camps and material storage areas, use bare land wherever possible and keep sufficient distance from residential areas and public facilities (schools and hospitals). - Temporary structures should be removed and restored to their original state as soon as construction is completed.	Contractor	Consultant / RNT	Included in the Contractor's contract
11	Gender	- Harassment by personnel and workers from outside	- Explain the progress to the residents of the area concerned and handle complaints as required.	RNT	RNT	RNT
			- Provide instructions to personnel and workers from outside to ensure the code of conduct, including a ban on harassment of local people. - Respect local culture and take into account local women's views while actively listening to them. - Provide employment opportunities for women and support local trading activities.	Contractor	Consultant / RNT	Included in the Contractor's contract
12	Children's rights	- Possibility of child labour and inappropriate work by minors.	- Explain the progress to the residents of the area concerned and handle complaints as required.	RNT	RNT	RNT
			- Ensure employment compliant with the law and prohibition of minors' school attendance.	Contractor	Consultant / RNT	Included in the Contractor's contract
13	Infectious diseases such as HIV/AIDS	- Spread of infectious diseases due to influx of construction workers, etc.	- Provide instructions on health and hygiene to construction workers - Ensure that routine precautionary measures are taken, such as washing hands and gargling. - Regularly disinfect labour camps and construction site offices. - Encourage immunisations and keep medicines always available in labour camps and construction site offices	Contractor	Consultant / RNT	Included in the Contractor's contract
14	Working environment (including	- Accidents and injuries to workers caused by explosions of mine and	- Prohibit prior entry by construction workers to areas other than those where demining work is completed and safety is confirmed by the Government of Angola	Contractor	Consultant / RNT	Included in the Contractor's contract

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
	occupational safety)	UXO	- Educate workers and make sure they know the procedures and local contacts - If mines or UXO are found, suspend construction work and not resume until the safety of construction workers is confirmed.			
			- If mines or UXO are found, demining work is to be carried out. - Ensure instructions on first aid as stipulated in the SOPs in the event of an accident. - Ensure safety measures for workers (e.g. wearing protective clothing and proper equipment maintenance).	CND	Consultant / RNT/CND	Included in the cost of demining work
		- Accidents at construction sites. - hygiene problem	- Manuals on occupational accident prevention (including safety education and training) should be prepared and thoroughly implemented. - Provide safety equipment - Ensure that cranes and other lifting equipment use is below the expected weight. - Maintenance checks and proper checking of lifting equipment - Use of equipment and devices to prevent electrical shock. - Establish medical posts in labour camps and conduct regular health check-ups. - Fire precautions are taken and fire extinguishers etc. are deployed at the site office and labor camps. - Keep medical supplies and lifesaving equipment always available and installed in labour camps and construction site offices.	Contractor	Consultant / RNT	Included in the Contractor's contract
15	Accidents	- Accidents caused by explosions of mine and UXO	- Inform the public about the procedures of demining work when they are found, and contact details, and post them near the construction site at all times. - If mine or UXO are found, suspend construction work and not resume the construction work until the safety of construction workers and the surrounding population is confirmed.	Contractor	Consultant / RNT	Included in the Contractor's contract

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
			- If mine or UXO are found, carry out demining work. - Take measures such as traffic restrictions to ensure safety in the vicinity. - Take measures to prevent accidents, such as prohibiting entry and traffic in the vicinity until the demining work is completed.	CND	Consultant / RNT/CND	Included in the cost of demining work
		- Traffic accidents due to increased traffic volume	- Provide education on compliance with traffic rules, traffic signage and safe driving. - Provide training on safe vehicle operation. - Carry out regular inspections and maintenance of equipment and instruments.	Contractor	Consultant / RNT	Included in the Contractor's contract
Operation phase						
1	Water pollution	- Generation of domestic wastewater by facility personnel	- Proper disposes of wastewater, rubbish, fuel and oil etc.. - Provide training to operator of wastewater, rubbish, fuel and oil.	RNT	RNT	RNT Measures can be taken through standard, careful management and operation, and special cost is not required.
2	Noise and vibration	- Noise and vibration from related vehicle traffic is expected to be generated, and background noise from substations	- Standardisation of speed limits and traffic routes for the vehicles concerned, and taking all possible measures to prevent noise from substation facilities, especially transformers.	RNT	RNT	RNT Measures can be taken through standard, careful management and operation, and special cost is not required.
3	Offensive odors	- Generation of odours due to improper waste management.	- Ensure proper disposal of waste generated by the activities of maintenance personnel as a manned facility.	RNT	RNT	RNT Measures can be taken through standard, careful management and operation, and special cost is not required.
4	Waste	- Impact of improper waste management.	- Ensure proper disposal of waste generated by the activities of maintenance personnel as a manned facility.	RNT	RNT	RNT Measures can be taken through standard, careful management

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
						and operation, and special cost is not required.
5	Ecosystems	- Permanent habitat loss due to substations.	- Drainage systems for rainfall from substations to prevent erosion caused by rainfall, wind, etc. to avoid erosion in the vicinity of substations.	RNT	RNT	RNT Proper planning and designing will b Measures can be taken through standard, careful management and operation, and special cost is not required.
6	Topography and geology	- Erosion due to long-term rainfall	- Improvement of stormwater drainage systems around substations.	RNT	RNT	RNT Measures can be taken through standard, careful management and operation, and special cost is not required.

Source: JICA Survey Team.

Table 9.8-5 Environmental Management Plan (60/15 kV Arimba SS)

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
Pre-construction phase						
1	Air pollution	- Air pollutant emissions from the implementation of demining work	- Appropriately maintain the equipment and vehicles used and reduce the generation of air pollutants. - During demining work, water will be sprayed as necessary to prevent dust generation.	CND	Consultant / ENDE/CND	Measures can be taken through standard, careful management and operation, and special cost is not required.
2	Water pollution	- Generation of wastewater in workers' camp, etc.	- All effluent from worker quarters etc. is collected and treated from the site for proper disposal at an approved municipal facility. - Installation of watertight septic tanks (or equivalent) to collect wastewater from the site, including vehicle and machinery washing waste water. - When mobile chemical toilets are used, they should be installed and collected by an approved contractor and disposed of properly. - When discharging wastewater into the environment, Angolan legislation on wastewater standards (Annex VI of Presidential Decree No 261/11 of 6 October) shall be complied with.	CND	Consultant / ENDE/CND	Measures can be taken through standard, careful management and operation, and special cost is not required.
3	Soil pollution	- Lubricating oil and fuel oil leaks from heavy machinery	- Properly store and manage lubricants and fuel oils, etc., and provide containers to catch spills when refilling.	CND	Consultant / ENDE/CND	Measures can be taken through standard, careful management and operation, and special cost is not required.
4	Noise and vibration	- Noise and vibration caused by the implementation of demining work	- Appropriately maintain and manage the equipment and vehicles used to reduce noise and vibration.	CND	Consultant / ENDE/CND	Measures can be taken through standard, careful management and operation, and special cost is not required.
5	Offensive odors	- Generation of odours due to improper waste management.	- Proper transport of waste and dumping of waste into designated disposal facilities by licensed contractors to avoid the build-up of odour, pest control problems, general rubbish and other nuisance sources on the site.	CND	Consultant / ENDE/CND	Measures can be taken through standard, careful management and operation, and

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
			- Provide training, education and signage to ensure compliance with waste management plans.			special cost is not required.
6	Waste	- Waste is generated in the workers' camp.	- Waste management plans prepared for power utilities are applied mutatis mutandis to properly dispose of waste generated at workers' camp.	CND	Consultant / ENDE/CND	Measures can be taken through standard, careful management and operation, and special cost is not required.
7	Ecosystems	- Fragmentation and loss of habitats for flora and fauna, especially reptiles, due to the implementation of demining work	- After the completion of mine/UXO search and clearance activities, the topsoil is returned and the surface is flattened/smoothed to limit the effects of erosion during rainfall.	Consultant	ENDE	Proper planning and designing will be taken by consultants without special cost
8	Topography and geology	- Surface soil erosion from the implementation of demining work	- Installation of sandbags and sedimentation ponds to prevent sediment run-off, if necessary.	CND	Consultant / ENDE/CND	Proper planning and designing will be taken by consultants without special cost
9	Existing social infrastructures and and services	- Impact on social services of demining work	- Enforce restrictions on entry and other measures in the vicinity of mine exploration and clearance operation sites. - Provide information on the scope of impact and publish a work schedule	CND	Consultant / ENDE/CND	Included in the cost of demining work
10	Working environment (including occupational safety)	- Accidents and injuries to operators caused by explosions of mines and UXO	- Continue to educate operators and ensure that they know the procedures and who to contact to prevent accidents and injuries. Ensure that operators are given instructions on first aid as stipulated in the SOPs, in case of an accident. - Ensure safety measures for workers (e.g. wearing protective clothing and proper equipment maintainance).	CND	Consultant / ENDE/CND	Included in the cost of demining work
11	Accidents	- Conduct demining work	- Carry out safety checks and take accident prevention measures such as prohibiting access to the area and traffic until the process is complete. - Provide safety measures for operator / workers engaged in demining work (e.g. wearing protective clothing and proper equipment maintainance).	CND	Consultant / ENDE/CND	Included in the cost of demining work
Construction phase						
1	Air pollution	- Emissions of air pollutants	- Ensure proper maintenance of equipment and vehicles	Contractor	Consultant / ENDE	Measures can be taken through standard,

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
		(SOx, NOx and others) and dust emissions due to the operation of heavy machinery and the passage of construction vehicles during the construction of access roads and substations	used and reduce emissions of air pollutants (SOx, NOx and others). - Construction vehicle traffic routes are supposed to bypass the vicinity of residential areas hospitals, schools, etc., and where unavoidable, speed limits are limited to 30 km/hour or less. - On unpaved roads, water is sprayed by sprinkler trucks as necessary to reduce dust generation. - When transporting earth, sand, etc., do not fill the load fully, but cover it with plenty of room. - Effectively educate and train relevant personnel.			careful management and operation, and special cost is not required.
2	Water pollution	- Generation of wastewater in workers' camp, etc.	- All effluent from worker quarters etc. is collected and treated from the site for proper disposal at an approved municipal facility. - Installation of watertight septic tanks (or equivalent) to collect wastewater from the site, including vehicle and machinery washing wastewater. - When mobile chemical toilets are used, they should be installed and collected by an approved contractor and disposed of properly. - When discharging wastewater into the environment, Angolan legislation on wastewater standards (Annex VI of Presidential Decree No 261/11 of 6 October) shall be complied with.	Contractor	Consultant / ENDE	Measures can be taken through standard, careful management and operation, and special cost is not required.
3	Soil pollution	- Lubricating oil and fuel oil leaks from construction vehicles, construction machinery, etc.	- Properly maintain vehicles and heavy equipment and, in particular, store and control lubricants and fuel oil, etc. at the workers' filling stations.	Contractor	Consultant / ENDE	Measures can be taken through standard, careful management and operation, and special cost is not required.
4	Noise and vibration	- Noise and vibration caused by the operation of heavy machinery and the passage of construction vehicles.	- Avoid residential areas, schools, hospitals and other neighbourhoods when selecting worker accommodation. - Construction activities, especially noisy ones, should be limited to daytime only and avoided at night and on weekends. - Construction vehicle traffic routes are supposed to bypass the vicinity of residential areas hospitals, schools, etc.,	Contractor	Consultant / ENDE	Measures can be taken through standard, careful management and operation, and special cost is not required.

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
			and where unavoidable, speed limits are limited to 30 km/hour or less. - Contractors need to present preliminary information to local residents in the vicinity of the construction site on upcoming construction activities, including information on the commencement of planned activities, their nature and duration. This communication should also include information on the nature and objectives of the project. - Implement a grievance redress mechanism (GRM) to address complaints about noise and vibration impacts.			
5	Offensive odors	- Generation of odours due to improper waste management.	- Proper transport of waste and dumping of waste into designated disposal facilities by licensed contractors to avoid the build-up of odour, pest control problems, general rubbish and other nuisance sources on the site.	Contractor	Consultant / ENDE	Measures can be taken through standard, careful management and operation, and special cost is not required.
6	Waste	- Improper storage, handling and disposal of general and hazardous waste.	- Implement a Waste Management Plan (WMP) to establish waste management priorities and hierarchy. - WMPs also include the proper management, treatment and disposal of toilet and domestic wastewater. - Train employees on storage methods, waste handling, prevention of leakage/disposal and what to do in the event of a leak, and provide them with the personal protective equipment necessary for handling hazardous waste. - Train employees to recycle and reuse waste materials such as glass, iron, steel, wood, cardboard paper and plastic as much as possible. - Develop spill response and emergency response plans that incorporate the potential for accidental release of hazardous waste.	Contractor	Consultant / ENDE	Measures can be taken through standard, careful management and operation, and special cost is not required.
7	Ecosystems	- Air pollution, noise and vibration caused by the operation and passage of construction vehicles	- (Same as air pollution, noise and vibration mitigation measures.)	Contractor	Consultant / ENDE	Measures can be taken through standard, careful management and operation, and special cost is not required.
8	Topography and geology	- Soil erosion from land clearance, foundation works,	- Installation of sandbags and sedimentation ponds to prevent sediment run-off, if necessary.	Contractor	Consultant / ENDE	Proper planning and designing will be taken

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
		etc.				by consultants without special cost
9	Existing social infrastructures and services	- Increase in traffic accidents, etc.	- Provide education on compliance with traffic rules, traffic signage and safe driving. - Provide training on safe vehicle operation.	Contractor	Consultant / ENDE	Included in the Contractor's contract
10	Landscape	- Establishment of labour camps - Entry of heavy machinery, set up of material storage area	- In labour camps and material storage areas, use bare land wherever possible and keep sufficient distance from residential areas and public facilities (schools and hospitals). - Temporary structures should be removed and restored to their original state as soon as construction is completed.	Contractor	Consultant / ENDE	Included in the Contractor's contract
11	Gender	- Harassment by personnel and workers from outside	- Explain the progress to the residents of the area concerned and handle complaints as required.	ENDE	ENDE	ENDE
			- Provide instructions to personnel and workers from outside to ensure the code of conduct, including a ban on harassment of local people. - Respect local culture and take into account local women's views while actively listening to them. - Provide employment opportunities for women and support local trading activities.	Contractor	Consultant / ENDE	Included in the Contractor's contract
12	Children's rights	- Possibility of child labour and inappropriate work by minors.	- Explain the progress to the residents of the area concerned and handle complaints as required.	ENDE	ENDE	ENDE
			- Ensure employment compliant with the law and prohibition of minors' school attendance.	Contractor	Consultant / ENDE	Included in the Contractor's contract
13	Infectious diseases such as HIV/AIDS	- Spread of infectious diseases due to influx of construction workers, etc.	- Provide instructions on health and hygiene to construction workers - Ensure that routine precautionary measures are taken, such as washing hands and gargling. - Regularly disinfect labour camps and construction site offices. - Encourage immunisations and keep medicines always available in labour camps and construction site offices	Contractor	Consultant / ENDE	Included in the Contractor's contract
14	Working environment (including	- Accidents and injuries to workers caused by explosions of mine and UXO	- Prohibit prior entry by construction workers to areas other than those where demining work is completed and safety is confirmed by the Government of Angola	Contractor	Consultant / ENDE	Included in the Contractor's contract

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
	occupational safety)		- Educate workers and make sure they know the procedures and local contacts - If mines or UXO are found, suspend construction work and not resume until the safety of construction workers is confirmed.			
			- If mines or UXO are found, demining work is to be carried out. - Ensure instructions on first aid as stipulated in the SOPs in the event of an accident. - Ensure safety measures for workers (e.g. wearing protective clothing and proper equipment maintenance).	CND	Consultant / ENDE/CND	Included in the cost of demining work
		- Accidents at construction sites. - hygiene problem	- Manuals on occupational accident prevention (including safety education and training) should be prepared and thoroughly implemented. - Provide safety equipment - Ensure that cranes and other lifting equipment use is below the expected weight. - Maintenance checks and proper checking of lifting equipment - Use of equipment and devices to prevent electrical shock. - Establish medical posts in labour camps and conduct regular health check-ups. - Fire precautions are taken and fire extinguishers etc. are deployed at the site office and labor camps. - Keep medical supplies and lifesaving equipment always available and installed in labour camps and construction site offices.	Contractor	Consultant / ENDE	Included in the Contractor's contract
15	Accidents	- Accidents caused by explosions of mine and UXO	- Inform the public about the procedures of demining work when they are found, and contact details, and post them near the construction site at all times. - If mine or UXO are found, suspend construction work and not resume the construction work until the safety of construction workers and the surrounding population is confirmed.	Contractor	Consultant / ENDE	Included in the Contractor's contract

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
			- If mine or UXO are found, carry out demining work. - Take measures such as traffic restrictions to ensure safety in the vicinity. - Take measures to prevent accidents, such as prohibiting entry and traffic in the vicinity until the demining work is completed.	CND	Consultant / ENDE/CND	Included in the cost of demining work
		- Traffic accidents due to increased traffic volume	- Provide education on compliance with traffic rules, traffic signage and safe driving. - Provide training on safe vehicle operation. - Carry out regular inspections and maintenance of equipment and instruments.	Contractor	Consultant / ENDE	Included in the Contractor's contract
Operation phase						
1	Water pollution	- Generation of domestic wastewater by facility personnel	- Proper disposes of wastewater, rubbish, fuel and oil etc - Provide training to operator of wastewater, rubbish, fuel and oil.	ENDE	ENDE	ENDE Measures can be taken through standard, careful management and operation, and special cost is not required.
2	Noise and vibration	- Noise and vibration from related vehicle traffic is expected to be generated, and background noise from substations	- Standardisation of speed limits and traffic routes for the vehicles concerned, and taking all possible measures to prevent noise from substation facilities, especially transformers.	ENDE	ENDE	ENDE Measures can be taken through standard, careful management and operation, and special cost is not required.
3	Offensive odors	- Generation of odours due to improper waste management.	- Ensure proper disposal of waste generated by the activities of maintenance personnel as a manned facility.	ENDE	ENDE	ENDE Measures can be taken through standard, careful management and operation, and special cost is not required.
4	Waste	- Impact of improper waste management.	- Ensure proper disposal of waste generated by the activities of maintenance personnel as a manned facility.	ENDE	ENDE	ENDE Measures can be taken through standard, careful management

No	Items (impacts)	Sources of Potential Impact	Proposed Mitigation Measures	Implementing Organization	Responsible Organization	Cost
						and operation, and special cost is not required.
5	Topography and geology	- Erosion due to long-term rainfall	- Improvement of stormwater drainage systems around substations.	ENDE	ENDE	ENDE Measures can be taken through standard, careful management and operation, and special cost is not required.

Source: JICA Survey Team

9.9. Monitoring Plan

For all items that were rated A- and B- for monitoring in the environmental management plan described in 9.8 above, the monitoring prameters, monitoring points, frequency, implementing organization, responsible organization, and costs are shown in Table 9.9-1 through Table 9.9-5 for each project component, divided into pre-construction and during construction and operation periods.

Table 9.9-1 Environmental Monitoring Plan (220 kV TL)

No	Items (impacts)	Monitoring Parameter	Monitoring Point	Frequency	Implementing Organization	Responsible Organization	Cost
Pre-construction phase							
1	Air pollution	PM10, PM2.5	10 tower locations and adjacent residential and other boundaries.	Once every 3 months before and after felling and de-rooting	Consultant	RNT	Included in the Consultancy Services
2	Water pollution	Wastewater treatment records	Workers' camp	Once a week	CND	Consultant / RNT/CND	Included in the cost of demining work
		Water quality items: pH, water temperature, conductivity, (transparency)	10 rivers and streams in the vicinity of the tower construction location	Once every 3 months before and after felling and de-rooting	Consultant	RNT	Included in the Consultancy Services
3	Soil pollution	Fuel, lubricant and other oil leakage records	Construction sites and workers' camp	Once a week	CND	Consultant / RNT/CND	Included in the cost of demining work
4	Noise and vibration	- Noise level - Complaint	- 10 tower locations and adjacent residential and other boundaries. - Municipalities, communes and settlements	- Once every 3 months before and after felling and de-rooting - At any time	Consultant	RNT	Included in the Consultancy Services
5	Offensive odors	- Sensory - Complaint	- Workers' camp - Municipalities, communes and settlements	- Once a week - At any time	CND	Consultant / RNT/CND	Included in the cost of demining work
6	Waste	Waste storage and transport	Construction sites and workers' camp	Once a week	CND	Consultant / RNT/CND	Included in the cost of demining work
7	Ecosystems	Flora and fauna	8 clear-cutting and rooting areas	Once every 6 months before and after felling and de-rooting	Consultant	RNT	Included in the Consultancy Services
		Birds	Ivantara swamp, Poires, Humpata, Tchivinguilo, Bruco, Capangombe, Caraculo, Moçâmedes	Once every 6 months before and after felling and de-rooting	Consultant	RNT	Included in the Consultancy Services
		Threatened species Ludwig's bustard (*Neotis ludwigii)*	20 km section near Caraculo	Once every 3 months before and after felling and de-rooting	Consultant	RNT	Included in the Consultancy Services
8	Hydrology	Presence or absence of erosion marks	10 points of towers within the clearing and rooting area on sloping terrain.	Once every three months	CND	Consultant / RNT/CND	Included in the Consultancy Services
9	Topography and geology	Status of vegetation	10 points of towers within the clearing and rooting	Once every 3 months before	Consultant	RNT	Included in the

No	Items (impacts)	Monitoring Parameter	Monitoring Point	Frequency	Implementing Organization	Responsible Organization	Cost
		recovery and soil erosion	area on sloping terrain.	and after felling and de-rooting			Consultancy Services
10	Land acquisition and resettlement	- Private land / used land area - Residential building - Place of work	Tower location, ROW	During geological investigation and detailed design	Consultant	RNT	Included in the Consultancy Services
		- Alternative land / buildings - Crop compensation - Compensation process (including local consultations)	Land acquisition points (construction sites, ROW, tower)	- When compensation is provided - Local consultation meeting	RNT	RNT	RNT
11	Existing social infrastructures and services	Impact on social services of demining work	- Tower location - ROW - Surrounding settlements and facilities	At any time	CND	Consultant / RNT/CND	Included in the cost of demining work
12	Cultural heritage	Objects with cultural and historical values	Tower location, ROW	During geological investigation and detailed design	Consultant	RNT	Included in the Consultancy Services
13	Working environment (including occupational safety)	Casualties among operators due to mine and UXO explosion	Tower location, ROW	At any time	CND	Consultant / RNT/CND	Included in the cost of demining work
14	Accidents	Accidents occurred due to mine and UXO explosion	Tower location, ROW and workshop	At any time	CND	Consultant / RNT/CND	Included in the cost of demining work
Construction phase							
1	Air pollution	PM10, PM2.5	10 tower locations and adjacent residential and other boundaries.	Once every three months before and after construction of a steel tower	Contractor	Consultant / RNT	Included in the Contractor's contract
2	Water pollution	Wastewater treatment records	Workers' camp	At any time	Contractor	Consultant / RNT	Included in the Contractor's contract
		Water quality items: pH, water temperature, conductivity, (transparency)	10 rivers/streams in the vicinity of the tower location	Once every three months before and after construction of a steel tower	Contractor	Consultant / RNT	Included in the Contractor's contract
3	Soil pollution	Fuel, lubricating oil and other leaks	Construction sites, workers' camp	At any time	Contractor	Consultant / RNT	Included in the Contractor's contract
4	Noise and vibration	- Noise level - Complaint	- 10 points of tower construction location and adjacent residential and other boundaries. - Municipalities, communes and settlements	- Once every three months before and after construction of a steel tower - At any time	Contractor	Consultant / RNT	Included in the Contractor's contract

No	Items (impacts)	Monitoring Parameter	Monitoring Point	Frequency	Implementing Organization	Responsible Organization	Cost
5	Offensive odors	- Sensory - Complaint	- Workers' camp - Municipalities, communes and settlements	- Once a week - At any time	Contractor	Consultant / RNT	Included in the Contractor's contract
6	Waste	Waste storage and transport	Workers' camp, construction sites	Once a week	Contractor	Consultant / RNT	Included in the Contractor's contract
7	Ecosystems	Flora and fauna	8 steel tower construction locations	Once every six months before and after construction of a steel tower	Contractor	Consultant / RNT	Included in the Contractor's contract
		Birds	Ivantara swamp, Poires, Humpata, Tchvinguilo, Bruco, Capangombe, Caraculo, Moçâmedes	Once every six months	Contractor	Consultant / RNT	Included in the Contractor's contract
		Threatened species Ludwig's bustard (*Neotis ludwigii)*	20 km section near Caraculo	Once every three months before and after construction of a steel tower	Contractor	Consultant / RNT	Included in the Contractor's contract
8	Topography and geology	Status of vegetation recovery and soil erosion	Same towers as before construction in the area of felling and rooting on sloping ground 10 points	Once every three months	Contractor	Consultant / RNT	Included in the Contractor's contract
9	Land acquisition and resettlement	- Livelihood level and means of the affected population - Resident relations (e.g. complaint handling)	Place of residence / place of livelihood of affected population	Once every three months (at any time for residents relations)	RNT	RNT	RNT
		Site management (e.g. access restrictions and boundary management)	- Tower location - ROW	Once every three months	Contractor	Consultant / RNT	Included in the Contractor's contract
10	The poor	Resident relations (e.g. complaint handling)	Place of residence and place of livelihood of local people	Once every three months (at any time for residents relations)	RNT	RNT	RNT
		Employment in construction work	Employment records (construction site offices)	Once every three months	Contractor	Consultant / RNT	Included in the Contractor's contract
11	Local economies, such as employment and livelihood, etc.	- Level and means of livelihood of affected population - Resident relations	Place of residence / place of livelihood of affected population	Once every three months (at any time for residents relations)	RNT	RNT	RNT
		Employment in construction	Employment records (construction site offices)	Once every three months	Contractor	Consultant / RNT	Included in the Contractor's contract
12		Resident relations (e.g.	Place of residence / place of livelihood of affected	At any time	RNT	RNT	RNT

No	Items (impacts)	Monitoring Parameter	Monitoring Point	Frequency	Implementing Organization	Responsible Organization	Cost
	Land use and utilization of local resource	complaint handling)	population				
		Site management (e.g. access restrictions and boundary management)	Tower location, ROW	Once every three months	Contractor	Consultant / RNT	Included in the Contractor's contract
13	Existing social infrastructures and services	- Construction plans (e.g. time, number and frequency of vehicle operations) - Vehicle operation record - Number of road accidents	- vehicle operation record - Accident records (construction site offices)	At any time	Contractor	Consultant / RNT	Included in the Contractor's contract
14	Misdistribution of benefits and damages	- Level and means of livelihood of affected population - Resident relations (e.g. complaint handling)	Concerned villages	Once every three months (at any time for residents relations)	RNT	RNT	RNT
15	Local conflicts of interest	- Livelihood level and means of the affected population - Resident relations (e.g. complaint handling)	Concerned villages	Once every three months (at any time for residents relations)	RNT	RNT	RNT
16	Cultural heritage	Objects with cultural and historical values	- Tower location - Construction work area	At any time	Contractor	Consultant / RNT	Included in the Contractor's contract
17	Landscape	- Trees and shrubs - Harmony between populated and natural landscapes	- ROW / tower location - Location of labor camps and material storage sites	Once every three months	Contractor	Consultant / RNT	Included in the Contractor's contract
18	Gender	Resident relations (e.g. complaint handling)	Concerned villages	At any time	RNT	RNT	RNT
		Number of times, content and number of participants in instruction to contractor and subcontractor employees	Guidance records (construction site offices)	Once every three months	Contractor	Consultant / RNT	Included in the Contractor's contract
19	Children's rights	Resident relations (e.g. complaint handling)	Concerned villages	At any time	RNT	RNT	RNT

No	Items (impacts)	Monitoring Parameter	Monitoring Point	Frequency	Implementing Organization	Responsible Organization	Cost
		Availability of employment in construction	Employment records (construction site offices)	Once every three months	Contractor	Consultant / RNT	Included in the Contractor's contract
20	Infectious diseases such as HIV/AIDS	- Number of diseases and infections - Having ready medical supplies - Number and type of vaccinations - Number of times, content and number of participants in instruction to contractor and subcontractor employees	- Sanitation records - Inventory ledger - Immunization records - Guidance records (construction site offices)	Once every three months	Contractor	Consultant / RNT	Included in the Contractor's contract
21	Working environment (including occupational safety)	Casualties among workers due to mine and UXO explosion	Construction site	At any time	Contractor	Consultant / RNT	Included in the Contractor's contract
		Demining work	Construction site	At any time	CND	Consultant / RNT/CND	Included in the cost of demining work
		- Number of times, content and number of participants in safety training for tractor and subcontractor employees - Standing availability of PPE - Work contents - Health status of workers - Number of accidents - Working hours	- Guidance records (construction site offices) - Inventory ledger - Operation record - Health record - Accident record - Working hours record	Once every three months	Contractor	Consultant / RNT	Included in the Contractor's contract
22	Accidents	Casualties among workers due to mine and UXO explosion	Construction site	At any time	Contractor	Consultant / RNT	Included in the Contractor's contract
		Demining work	Construction site	At any time	CND	Consultant / RNT/CND	Included in the cost of demining work
		- Work contents - Vehicle operation record - Number of accidents	- Vehicle operation record - Accident records (construction site offices)	At any time	Contractor	Consultant / RNT	Included in the Contractor's contract

No	Items (impacts)	Monitoring Parameter	Monitoring Point	Frequency	Implementing Organization	Responsible Organization	Cost
Operation phase							
1	Water pollution	Water quality items: pH, water temperature, conductivity, (transparency)	10 points for rivers/streams in the vicinity of the tower location and controlled road	Once every three months	RNT	RNT	RNT
2	Noise and vibration	- Noise level - Complaint	- Representative points under the transmission line and administrative roads, areas where wind noise is likely to occur and neighboring settlements. - Municipalities, communes and settlements	- Once every three months - At any time	RNT	RNT	RNT
3	Ecosystems	Flora and fauna	10 tower positions	Once every three months	RNT	RNT	RNT
		Birds	Ivantara swamp, Humpata, Tchvinguilo, Bruco	Once every three months	RNT	RNT	RNT
		Threatened species Ludwig's bustard (*Neotis ludwigii)*	- 20 km section near Caraculo				
4	Hydrology	Observation of erosion marks	10 points of towers within the clearing and rooting area on sloping terrain	Once every three months	RNT	RNT	RNT
5	Topography and geology	Status of vegetation recovery and soil erosion	10 points for towers within the felling and felling rooting area on sloping terrain	Once every three months	RNT	RNT	RNT

Source: JICA Survey Team

Table 9.9-2 Environmental Monitoring Plan (60 kV DL)

No	Items (impacts)	Monitoring Parameter	Monitoring Point	Frequency	Implementing Organization	Responsible Organization	Cost
Pre-construction phase							
1	Air pollution	PM10, PM2.5	Boundaries of dwellings and other structures in close proximity to the two tower locations	Once every 3 months before and after felling and de-rooting	Consultant	ENDE	Included in the Consultancy Services
2	Water pollution	Wastewater treatment records	Construction sites, workers' camp	Once a week	CND	Consultant / ENDE / CND	Included in the cost of demining work
		Water quality items: pH, water temperature, conductivity, (transparency)	If there is running water in the stream near the location of the tower	Once every 3 months before and after felling and de-rooting	Consultant	ENDE	Included in the Consultancy Services
3	Soil pollution	Fuel, lubricant and other oil leakage records	Construction sites, workers' camp	Once a week	CND	Consultant / ENDE / CND	Included in the cost of demining work
4	Noise and vibration	- Noise level - Complaint	- Boundaries of dwellings and other structures in close proximity to the two tower locations. - Municipalities, communes and settlements	- Once every 3 months before and after felling and de-rooting - At any time	Consultant	ENDE	Included in the Consultancy Services
5	Offensive odors	- Sensory - Complaint	- workers' camp - Municipalities, communes and settlements	- Once a week - At any time	CND	Consultant / ENDE / CND	Included in the cost of demining work
6	Waste	Waste storage and transport	Workers' camp, construction sites	Once a week	CND	Consultant / ENDE / CND	Included in the cost of demining work
7	Ecosystems	Flora and fauna	2 points of steel tower location within the clearing and rooting area	Once every 6 months before and after felling and de-rooting	Consultant	ENDE	Included in the Consultancy Services
		Birds	Observations are made at two tower positions within the clearing and rooting area	Once every 6 months before and after felling and de-rooting	Consultant	ENDE	Included in the Consultancy Services
8	Land acquisition and resettlement	- Private land / used land area - Residential building - Place of work	Tower location, ROW	During geological investigation and detailed design	Consultant	ENDE	Included in the Consultancy Services
		- Alternative land / buildings - Compensation process (including local consultations)	Land acquisition points (construction sites, ROW, tower)	- When compensation is provided - Local consultation meeting	ENDE	ENDE	ENDE
9	Existing social infrastructures and services	Impact on social services of demining work	- Tower location - ROW - Surrounding settlements and facilities	At any time	CND	Consultant / ENDE / CND	Included in the cost of demining work

No	Items (impacts)	Monitoring Parameter	Monitoring Point	Frequency	Implementing Organization	Responsible Organization	Cost
10	Working environment (including occupational safety)	Casualties among operators due to mine and UXO explosion	Tower location, ROW	At any time	CND	Consultant / ENDE / CND	Included in the cost of demining work
11	Accidents	Accidents occurred due to mine and UXO explosion	Tower location, ROW and workshop	At any time	CND	Consultant / ENDE / CND	Included in the cost of demining work
Construction phase							
1	Air pollution	PM10, PM2.5	Boundaries of dwellings and other structures in close proximity to the two tower locations	Once every three months before and after construction of a steel tower	Contractor	Consultant / ENDE	Included in the Contractor's contract
2	Water pollution	- Wastewater treatment records	- Substation construction site - workers' camp	At any time	Contractor	Consultant / ENDE	Included in the Contractor's contract
		Water quality items: pH, temperature, conductivity, (transparency)	If there is running water in the stream near the location of the tower	Once every three months before and after construction of a steel tower	Contractor	Consultant / ENDE	Included in the Contractor's contract
3	Soil pollution	Fuel, lubricant and other oil leakage records	Construction sites, workers' camp	At any time	Contractor	Consultant / ENDE	Included in the Contractor's contract
4	Noise and vibration	- Noise level - Complaint	- Boundaries of dwellings and other structures in close proximity to the two tower locations. - Municipalities, communes and settlements	- Once every three months before and after steel tower construction - At any time	Contractor	Consultant / ENDE	Included in the Contractor's contract
5	Offensive odors	- Sensory - Complaint	- Workers' camp - Municipalities, communes and settlements	- Once a week - At any time	Contractor	Consultant / ENDE	Included in the Contractor's contract
6	Waste	Waste storage and transport	Workers' camp, construction sites	Once a week	Contractor	Consultant / ENDE	Included in the Contractor's contract
7	Ecosystems	Flora and fauna	Two steel tower construction locations	Once every six months before and after construction of a steel tower	Contractor	Consultant / ENDE	Included in the Contractor's contract
		Birds	Two steel tower construction locations	Once every six months before and after construction of a steel tower	Contractor	Consultant / ENDE	Included in the Contractor's contract
8	Land acquisition and resettlement	- Livelihood level and means of the affected population - Resident relations (e.g. complaint handling)	Place of residence / place of livelihood of affected population	Once every three months (at any time for residents relations)	ENDE	ENDE	ENDE

No	Items (impacts)	Monitoring Parameter	Monitoring Point	Frequency	Implementing Organization	Responsible Organization	Cost
		Site management (e.g. access restrictions and boundary management)	- Tower location ROW	Once every three months	Contractor	Consultant / ENDE	Included in the Contractor's contract
9	Land use and utilization of local resource	Resident relations (e.g. complaint handling)	Place of residence/place of livelihood of affected population	At any time	ENDE	ENDE	ENDE
		Site management (e.g. access restrictions and boundary management)	Tower location, ROW	Once every three months	Contractor	Consultant / ENDE	Included in the Contractor's contract
10	Existing social infrastructures and services	- Construction plans (e.g. time, number and frequency of vehicle operations) - Vehicle operation record - Number of road accidents	- Vehicle operation record - Accident records (construction site offices)	At any time	Contractor	Consultant / ENDE	Included in the Contractor's contract
11	Misdistribution of benefits and damages	- Level and means of livelihood of affected population - Resident relations (e.g. complaint handling)	- Concerned villages	Once every three months (at any time for residents relations)	ENDE	ENDE	ENDE
12	Local conflicts of interest	- Livelihood level and means of the affected population - Resident relations (e.g. complaint handling)	- Concerned villages	Once every three months (at any time for residents relations)	ENDE	ENDE	ENDE
13	Landscape	- Trees and shrubs - Harmony between populated and natural landscapes	- ROW / tower location - Location of labor camps and material storage sites	Once every three months	Contractor	Consultant / ENDE	Included in the Contractor's contract
14	Gender	Resident relations (e.g. complaint handling)	Concerned villages	At any time	ENDE	ENDE	ENDE
		Number of times, content and number of participants in instruction to contractor and subcontractor	Guidance records (construction site offices)	Once every three months	Contractor	Consultant / ENDE	Included in the Contractor's contract

No	Items (impacts)	Monitoring Parameter	Monitoring Point	Frequency	Implementing Organization	Responsible Organization	Cost
		employees					
15	Children's rights	Resident relations (e.g. complaint handling)	Concerned villages	At any time	ENDE	ENDE	ENDE
		Availability of employment in construction	Employment records (construction site offices)	Once every three months	Contractor	Consultant / ENDE	Included in the Contractor's contract
16	Infectious diseases such as HIV/AIDS	- Number of diseases and infections - Having ready medical supplies - Number and type of vaccinations - Number of times, content and number of participants in instruction to contractor and subcontractor employees	- Sanitation records - Inventory ledger - Immunization records - Guidance records (construction site offices)	Once every three months	Contractor	Consultant / ENDE	Included in the Contractor's contract
17	Working environment (including occupational safety)	Casualties among workers due to mine and UXO explosion	Construction site	At any time	Contractor	Consultant / ENDE	Included in the Contractor's contract
		Demining work	Construction site	At any time	CND	Consultant / ENDE / CND	Included in the cost of demining work
		- Number of times, content and number of participants in safety training for tractor and subcontractor employees. - Standing availability of PPE - Work contents - Health status of workers. - Number of accidents - Working hours	- Guidance records (construction site offices). - Inventory ledger - Operation record - Health record - Accident record - Working hours record	Once every three months	Contractor	Consultant / ENDE	Included in the Contractor's contract
18	Accidents	Casualties among workers due to mine and UXO explosion	Construction site	At any time	Contractor	Consultant / ENDE	Included in the Contractor's contract
		Demining work	Construction site	At any time	CND	Consultant / ENDE / CND	Included in the cost of demining work
		- Work contents - Vehicle operation	- Vehicle operation record - Accident	At any time	Contractor	Consultant / ENDE	Included in the Contractor's contract

No	Items (impacts)	Monitoring Parameter	Monitoring Point	Frequency	Implementing Organization	Responsible Organization	Cost
		record - Number of accidents	records (construction site offices)				
Operation phase							
1	Noise and vibration	- Noise level - Complaint	- Two representative points under the railway line and on the administrative road, areas where wind noise is likely to occur and neighboring settlements - Municipalities, communes and settlements	- Once every three months - At any time	ENDE	ENDE	ENDE
2	Ecosystems	Flora and fauna	2 representative steel tower positions	Once every three months	ENDE	ENDE	ENDE
		Birds	2 representative steel tower positions	Once every three months	ENDE	ENDE	ENDE

Source: JICA Survey Team

Table 9.9-3 Environmental Monitoring Plan (220/60 kV New Namibe SS)

No	Items (impacts)	Monitoring Parameter	Monitoring Point	Frequency	Implementing Organization	Responsible Organization	Cost
Pre-construction phase							
1	Air pollution	- SO_2, NO_2, O_3 - PM10, PM2.5	- New Namibe substation - Boundaries of dwellings and other structures in close proximity to substations, access roads	- Once every 6 months before and after felling and de-rooting, for one week in a row - Once every 3 months before and after felling and de-rooting	Consultant	RNT	Included in the Consultancy Services
2	Water pollution	Wastewater treatment records	New Namibe substation, workers' camp	Once a week	CND	Consultant / RNT / CND	Included in the cost of demining work
3	Soil pollution	Fuel, lubricant and other oil leakage records	New Namibe substation, workers' camp	Once a week	CND	Consultant / RNT / CND	Included in the cost of demining work
4	Noise and vibration	- Noise level - Complaint	- New Namibe substation and adjacent residential and other boundaries, access roads - Municipalities, communes and settlements	- Once every 3 months before and after felling and de-rooting - At any time	Consultant	RNT	Included in the Consultancy Services
5	Offensive odors	- Sensory - Complaint	- New Namibe substation, workers' camp. - Municipalities, communes and settlements	- Once a week - At any time	CND	Consultant / RNT / CND	Included in the cost of demining work
6	Waste	Waste storage and transport	New Namibe substation, workers' camp	Once a week	CND	Consultant / RNT / CND	Included in the cost of demining work
7	Ecosystems	Flora and fauna	New Namibe substation	Once every 6 months before and after felling and de-rooting	Consultant	RNT	Included in the Consultancy Services
		Birds	New Namibe substation	Once every 6 months before and after felling and de-rooting	Consultant	RNT	Included in the Consultancy Services
8	Topography and geology	Topographic and vegetation changes and soil erosion	New Namibe substation	Once each before and after felling and de-rooting.	Consultant	RNT	Included in the Consultancy Services
9	Working environment (including occupational safety)	Casualties among operators due to mine and UXO explosion	New Namibe substation	At any time	CND	Consultant / RNT / CND	Included in the cost of demining work
10	Accidents	Accidents occurred due to mine and UXO explosion	New Namibe substation and workshop	At any time	CND	Consultant / RNT / CND	Included in the cost of demining work
Construction phase							

No	Items (impacts)	Monitoring Parameter	Monitoring Point	Frequency	Implementing Organization	Responsible Organization	Cost
1	Air pollution	- SO_2, NO_2, O_3 - PM10, PM2.5	- New Namibe substation - Boundaries of dwellings and other structures in close proximity to substations, access roads	- Once every six months for one week in a row - Once every three months	Contractor	Consultant / RNT	Included in the Contractor's contract
2	Water pollution	Wastewater treatment records	New Namibe substation, workers' camp	At any time	Contractor	Consultant / RNT	Included in the Contractor's contract
3	Soil pollution	Fuel, lubricant and other oil leakage records	New Namibe substation, workers' camp	At any time	Contractor	Consultant / RNT	Included in the Contractor's contract
4	Noise and vibration	- Noise level - Complaint	- New Namibe substation and adjacent residential and other boundaries, access roads - Municipalities, communes and settlements	- Once every three months - At any time	Contractor	Consultant / RNT	Included in the Contractor's contract
5	Offensive odors	- Sensory - Complaint	- New Namibe substation, workers' camp. - Municipalities, communes and settlements	- Once a week - At any time	Contractor	Consultant / RNT	Included in the Contractor's contract
6	Waste	Waste storage and transport	New Namibe substation, workers' camp	Once a week	Contractor	Consultant / RNT	Included in the Contractor's contract
7	Ecosystems	Flora and fauna	New Namibe substation	Once every three months	Contractor	Consultant / RNT	Included in the Contractor's contract
		Birds	New Namibe substation	Once every three months	Contractor	Consultant / RNT	Included in the Contractor's contract
8	Topography and geology	Topographic and vegetation changes and soil erosion	New Namibe substation	Once every six months	Contractor	Consultant / RNT	Included in the Contractor's contract
9	Existing social infrastructures and services	- Construction plans (e.g. time, number and frequency of vehicle operations) - Vehicle operation record - Number of road accidents	- Vehicle operation record - Accident records (construction site offices)	At any time	Contractor	Consultant / RNT	Included in the Contractor's contract
10	Landscape	- Trees and shrubs - Harmony between	- New Namibe substation - Location of labor camps and	Once every three months	Contractor	Consultant / RNT	Included in the Contractor's contract

No	Items (impacts)	Monitoring Parameter	Monitoring Point	Frequency	Implementing Organization	Responsible Organization	Cost
		populated and natural landscapes	material storage sites				
11	Gender	Resident relations (e.g. complaint handling)	Concerned villages	At any time	RNT	RNT	RNT
		Number of times, content and number of participants in instruction to contractor and subcontractor employees	Guidance records (construction site offices)	Once every three months	Contractor	Consultant / RNT	Included in the Contractor's contract
12	Children's rights	Resident relations (e.g. complaint handling)	Concerned villages	At any time	RNT	RNT	RNT
		Availability of employment in construction	Employment records (construction site offices)	Once every three months	Contractor	Consultant / RNT	Included in the Contractor's contract
13	Infectious diseases such as HIV/AIDS	- Number of diseases and infections - Having ready medical supplies - Number and type of vaccinations - Number of times, content and number of participants in instruction to contractor and subcontractor employees	- Sanitation records - Inventory ledger - Immunization records - Guidance records (construction site offices)	Once every three months	Contractor	Consultant / RNT	Included in the Contractor's contract
14	Working environment (including occupational safety)	Casualties among workers due to mine and UXO explosion	Construction site	At any time	Contractor	Consultant / RNT	Included in the Contractor's contract
		Demining work	Construction site	At any time	CND	Consultant / RNT / CND	Included in the cost of demining work
		- Number of times, content and number of participants in safety training for tractor and subcontractor employees - Standing availability of PPE - work contents - Health status of workers. - number of accidents - working hours	- Guidance records (construction site offices). - Inventory ledger - Operation record - Health record - Accident record - Working hours record	Once every three months	Contractor	Consultant / RNT	Included in the Contractor's contract

No	Items (impacts)	Monitoring Parameter	Monitoring Point	Frequency	Implementing Organization	Responsible Organization	Cost
15	Accidents	Casualties among workers due to mine and UXO explosion	Construction site	At any time	Contractor	Consultant / RNT	Included in the Contractor's contract
		Demining work	Construction site	At any time	CND	Consultant / RNT / CND	Included in the cost of demining work
		- Tasks - Vehicle operation record - Number of accidents	- Vehicle operation record - Accident records (construction site offices)	At any time	Contractor	Consultant / RNT	Included in the Contractor's contract
Operation phase							
1	Water pollution	Status of disposal of wastewater, garbage, fuel, oil, etc. and education implementation	New Namibe substation	Once every three months	RNT	RNT	RNT
2	Noise and vibration	- Noise level - Complaint	- New Namibe substation and adjacent residential and other boundaries, access roads - Municipalities, communes and settlements	- Once every three months - At any time	RNT	RNT	RNT
3	Offensive odors	- Sensory - Complaint	New Namibe substation	At any time	RNT	RNT	RNT
4	Waste	Waste storage and transport	New Namibe substation	At any time	RNT	RNT	RNT
5	Ecosystems	Flora and fauna	New Namibe substation	Once every three months	RNT	RNT	RNT
		Birds	New Namibe substation	Once every three months	RNT	RNT	RNT
6	Topography and geology	Topographic and vegetation changes and soil erosion	New Namibe substation	Once every six months	RNT	RNT	RNT

Source: JICA Survey Team

Table 9.9-4 Environmental Monitoring Plan (220/60 kV East Lubango SS)

No	Items (impacts)	Monitoring Parameter	Monitoring Point	Frequency	Implementing Organization	Responsible Organization	Cost
Pre-construction ('before' and 'during' covering mine and UXO search and clearance activities before and during implementation).							
1	Air pollution	- SO_2, NO_2, O_3 - PM10, PM2.5	- East Lubango SS - Boundaries of dwellings and other structures in close proximity to substations, access roads	- Once every 6 months before and after felling and de-rooting, for one week in a row - Once every 3 months before and after felling and de-rooting	Consultant	RNT	Included in the cost of Consultancy Services
2	Water pollution	Wastewater treatment records	East Lubango SS, workers' camp	Once a week	CND	Consultant / RNT / CND	Included in the cost of demining work
3	Soil pollution	Fuel, lubricant and other oil leakage records	East Lubango SS, workers' camp	Once a week	CND	Consultant / RNT / CND	Included in the cost of demining work
4	Noise and vibration	- -Noise level - Complaint	- East Lubango SS and adjacent residential and other boundaries, access roads - Municipalities, communes and settlements	- Once every 3 months before and after felling and de-rooting - At any time	Consultant	RNT	Included in the Consultancy Services
5	Offensive odors	- Sensory - Complaint	- East Lubango SS, workers' camp. - Municipalities, communes and settlements	- Once a week - At any time	CND	Consultant / RNT / CND	Included in the cost of demining work
6	Waste	Waste storage and transport	East Lubango SS, workers' camp	Once a week	CND	RNT	Included in the cost of demining work
7	Ecosystems	Flora and fauna	East Lubango SS	Once every 6 months before and after felling and de-rooting	Consultant	RNT	Included in the Consultancy Services
		Birds	East Lubango SS	Once every 6 months before and after felling and de-rooting	Consultant	RNT	Included in the Consultancy Services
8	Topography and geology	Topographic and vegetation changes and soil erosion	East Lubango SS	Once each before and after felling and de-rooting.	Consultant	RNT	Included in the Consultancy Services
9	Working environment (including occupational safety)	Casualties among operators due to mine and UXO explosion	East Lubango SS	At any time	CND	Consultant / RNT / CND	Included in the cost of demining work
10	Accidents	Accidents occurred due to mine and UXO explosion	East Lubango SS and workshop	At any time	CND	Consultant / RNT / CND	Included in the cost of demining work
Construction phase							
1	Air pollution	- SO_2, NO_2, O_3 - PM10, PM2.5	- East Lubango SS - Boundaries of dwellings and	- Once every six months for one week in a row	Contractor	Consultant / RNT	Included in the Contractor's contract

No	Items (impacts)	Monitoring Parameter	Monitoring Point	Frequency	Implementing Organization	Responsible Organization	Cost
			other structures in close proximity to substations, access roads	- Once every three months			
2	Water pollution	Wastewater treatment records	East Lubango SS, workers' camp	At any time	Contractor	Consultant / RNT	Included in the Contractor's contract
3	Soil pollution	Fuel, lubricant and other oil leakage records	East Lubango SS, workers' camp	At any time	Contractor	Consultant / RNT	Included in the Contractor's contract
4	Noise and vibration	- Noise level - Complaint	- East Lubango SS, and adjacent residential and other boundaries, access roads - Municipalities, communes and settlements	- Once every three months - -At any time	Contractor	Consultant / RNT	Included in the Contractor's contract
5	Offensive odors	- Sensory - Complaint	- East Lubango SS, workers' camp. - Municipalities, communes and settlements	- Once a week - At any time	Contractor	Consultant / RNT	Included in the Contractor's contract
6	Waste	Waste storage and transport	East Lubango SS, workers' camp	Once a week	Contractor	Consultant / RNT	Included in the Contractor's contract
7	Ecosystems	Flora and fauna	East Lubango SS	Once every three months	Contractor	Consultant / RNT	Included in the Contractor's contract
		Birds	East Lubango SS	Once every three months	Contractor	Consultant / RNT	Included in the Contractor's contract
8	Topography and geology	- Topographic and vegetation changes and soil erosion	- East Lubango SS	Once every six months	Contractor	Consultant / RNT	Included in the Contractor's contract
9	Existing social infrastructures and services	- Construction plans (e.g. time, number and frequency of vehicle operations) - Vehicle operation record - Number of road accidents	- vehicle operation record - Accident records (construction site offices)	At any time	Contractor	Consultant / RNT	Included in the Contractor's contract
10	Landscape	- Trees and shrubs - Harmony between populated and natural landscapes	- East Lubango SS - Location of labor camps and material storage sites	Once every three months	Contractor	Consultant / RNT	Included in the Contractor's contract
11	Gender	Resident relations (e.g. complaint	concerned villages	At any time	RNT	RNT	RNT

No	Items (impacts)	Monitoring Parameter	Monitoring Point	Frequency	Implementing Organization	Responsible Organization	Cost
		handling)					
		Number of times, content and number of participants in instruction to contractor and subcontractor employees	Guidance records (construction site offices)	Once every three months	Contractor	Consultant / RNT	Included in the Contractor's contract
12	Children's rights	Resident relations (e.g. complaint handling)	Concerned villages	At any time	RNT	RNT	RNT
		Availability of employment in construction	Employment records (construction site offices)	Once every three months	Contractor	Consultant / RNT	Included in the Contractor's contract
13	Infectious diseases such as HIV/AIDS	- Number of diseases and infections - Having ready medical supplies - Number and type of vaccinations - Number of times, content and number of participants in instruction to contractor and subcontractor employees	- Sanitation records - Inventory ledger - Immunization records - Guidance records (construction site offices)	Once every three months	Contractor	Consultant / RNT	Included in the Contractor's contract
14	Working environment (including occupational safety)	Casualties among workers due to mine and UXO explosion	Construction site	At any time	Contractor	Consultant / RNT	Included in the Contractor's contract
		Demining work	Construction site	At any time	CND	Consultant / RNT / CND	Included in the cost of demining work
		- Number of times, content and number of participants in safety training for tractor and subcontractor employees. - Standing availability of PPE - Tasks - Health status of workers. - Number of accidents - Working hours	- Guidance records (construction site offices). - Inventory ledger - Operation record - Health record - Accident record - Working hours record	Once every three months	Contractor	Consultant / RNT	Included in the Contractor's contract
15	Accidents	Casualties among workers due to mine and	Construction site	At any time	Contractor	Consultant / RNT	Included in the

No	Items (impacts)	Monitoring Parameter	Monitoring Point	Frequency	Implementing Organization	Responsible Organization	Cost
		UXO explosion					Contractor's contract
		Demining work	Construction site	At any time	CND	Consultant / RNT / CND	Included in the cost of demining work
		- work contents - Vehicle operation record - Number of accidents	- Vehicle operation record - Accident records (construction site offices)	At any time	Contractor	Consultant / RNT	Included in the Contractor's contract
Operation phase							
1	Water pollution	Status of disposal of wastewater, garbage, fuel, oil, etc. and education implementation	East Lubango SS	Once every three months	RNT	RNT	RNT
2	Noise and vibration	- Noise level - Complaint	- East Lubango SS and adjacent residential and other boundaries, access roads - Municipalities, communes and settlements	- Once every three months - At any time	RNT	RNT	RNT
3	Offensive odors	- Sensory - Complaint	- East Lubango SS	At any time	RNT	RNT	RNT
4	Waste	Waste storage and transport	East Lubango SS	At any time	RNT	RNT	RNT
5	Ecosystems	Flora and fauna	East Lubango SS	Once every three months	RNT	RNT	RNT
		Birds	East Lubango SS	Once every three months	RNT	RNT	RNT
6	Topography and geology	Topographic and vegetation changes and soil erosion	East Lubango SS	Once every six months	RNT	RNT	RNT

Source: JICA Survey Team

Table 9.9-5 Environmental Monitoring Plan (60/15 kV Arimba SS)

No	Items (impacts)	Monitoring Parameter	Monitoring Point	Frequency	Implementing Organization	Responsible Organization	Cost
Pre-construction ('before' and 'during' covering mine and UXO search and clearance activities before and during implementation).							
1	Air pollution	- SO_2, NO_2, O_3 - PM10, PM2.5	- Arimba substation - Substation and adjacent residential and other boundaries, access roads	- Once every 6 months before and after felling and de-rooting, for one week in a row - Once every 3 months before and after felling and de-rooting	Consultant	ENDE	Included in the Consultancy Services
2	Water pollution	Wastewater treatment records	Arimba substation, workers' camp	Once a week	CND	Consultant / ENDE / CND	Included in the cost of demining work
3	Soil pollution	Fuel, lubricant and other oil leakage records	Arimba substation, workers' camp	Once a week	CND	Consultant / ENDE / CND	Included in the cost of demining work
4	Noise and vibration	- Noise level - Nomplaint	- Residential and other boundaries in close proximity to Arimba substation, access roads - Municipalities, communes and settlements	- -Once every 3 months before and after opening and de-rooting - At any time	Consultant	ENDE	Included in the Consultancy Services
5	Offensive odors	- Sensory - Complaint	- Arimba substation, workers' camp. - Municipalities, communes and settlements	- Once a week - At any time	CND	Consultant / ENDE / CND	Included in the cost of demining work
6	Waste	Waste storage and transport	Arimba substation, workers' camp.	Once a week	CND	Consultant / ENDE / CND	Included in the cost of demining work
7	Ecosystems	Flora and fauna	Arimba substation	Once every 6 months before and after felling and de-rooting	Consultant	ENDE	Included in the Consultancy Services
		Birds	Arimba substation	Once every 6 months before and after felling and de-rooting	Consultant	ENDE	Included in the Consultancy Services
8	Topography and geology	Topographic and vegetation changes and soil erosion	Arimba substation	Once each before and after felling and de-rooting.	Consultant	ENDE	Included in the Consultancy Services
9	Existing social infrastructures and services	Impact on social services of demining work	Arimba substation Surrounding settlements and facilities	At any time	CND	Consultant / ENDE / CND	Included in the cost of demining work
10	Working environment (including occupational safety)	Casualties among operators due to mine and UXO explosion	Arimba substation	At any time	CND	Consultant / ENDE / CND	Included in the cost of demining work
11	Accidents	Accidents occurred due to mine and UXO explosion	Arimba substation and workshop	At any time	CND	Consultant / ENDE / CND	Included in the cost of demining work
Construction phase							

No	Items (impacts)	Monitoring Parameter	Monitoring Point	Frequency	Implementing Organization	Responsible Organization	Cost
1	Air pollution	- SO_2, NO_2, O_3 - PM2.5, PM10	- Arimba substation - Boundaries of dwellings and other structures in close proximity to substations, access roads	- Once every six months for one week in a row - Once every three months	Contractor	Consultant / ENDE	Included in the Contractor's contract
2	Water pollution	Wastewater treatment records	Arimba substation, Workers' camp	At any time	Contractor	Consultant / ENDE	Included in the Contractor's contract
3	Soil pollution	Fuel, lubricant and other oil leakage records	Arimba substation, Workers' camp	At any time	Contractor	Consultant / ENDE	Included in the Contractor's contract
4	Noise and vibration	- Noise level - Complaint	- Residential and other boundaries in close proximity to the 60/15 kV Arimba SS, access roads, and - Municipalities, communes and settlements	- Once every three months - At any time	Contractor	Consultant / ENDE	Included in the Contractor's contract
5	Offensive odors	- Sensory - Complaint	- Arimba substation, workers' camp - Municipalities, communes and settlements	- Once a week - At any time	Contractor	Consultant / ENDE	Included in the Contractor's contract
6	Waste	Waste storage and transport	Arimba substation, workers' camp	Once a week	Contractor	Consultant / ENDE	Included in the Contractor's contract
7	Ecosystems	Flora and fauna	Arimba substation	Once every three months	Contractor	Consultant / ENDE	Included in the Contractor's contract
		Birds	Arimba substation	Once every three months	Contractor	Consultant / ENDE	Included in the Contractor's contract
8	Topography and geology	- Topographic and vegetation changes and soil erosion	- Arimba substation	Once every six months after the start of construction.	Contractor	Consultant / ENDE	Included in the Contractor's contract
9	Existing social infrastructures and services	- Construction plans (e.g. time, number and frequency of vehicle operations) - Vehicle operation record - Number of road accidents	- vehicle operation record - Accident records (construction site offices)	At any time	Contractor	Consultant / ENDE	Included in the Contractor's contract
10	Landscape	- Trees and shrubs - Harmony between populated and	- Arimba substation - Location of workers' camp and material storage areas	Once every three months	Contractor	Consultant / ENDE	Included in the Contractor's contract

No	Items (impacts)	Monitoring Parameter	Monitoring Point	Frequency	Implementing Organization	Responsible Organization	Cost
		natural landscapes					
11	Gender	Resident relations (e.g. complaint handling)	Concerned villages	At any time	ENDE	ENDE	ENDE
		Number of times, content and number of participants in instruction to contractor and subcontractor employees	Guidance records (construction site offices)	Once every three months	Contractor	Consultant / ENDE	Included in the Contractor's contract
12	Children's rights	Resident relations (e.g. complaint handling)	Concerned villages	At any time	ENDE	ENDE	ENDE
		Availability of employment in construction	Employment records (construction site offices)	Once every three months	Contractor	Consultant / ENDE	Included in the Contractor's contract
13	Infectious diseases such as HIV/AIDS	- Number of diseases and infections - Having ready medical supplies - Number and type of vaccinations - Number of times, content and number of participants in instruction to contractor and subcontractor employees	- Sanitation records - Inventory ledger - Immunization records - Guidance records (construction site offices)	Once every three months	Contractor	Consultant / ENDE	Included in the Contractor's contract
14	Working environment (including occupational safety)	Casualties among workers due to mine and UXO explosion	Construction site	At any time	Contractor	Consultant / ENDE	Included in the Contractor's contract
		Demining work	Construction site	At any time	CND	Consultant / ENDE / CND	Included in the cost of demining work
		- Number of times, content and number of participants in safety training for tractor and subcontractor employees. - Standing availability of PPE - Work contents - Health status of workers. - Number of accidents	- Guidance records (construction site offices). - Inventory ledger - Operation record - Health record - Accident record - Working hours record	Once every three months	Contractor	Consultant / ENDE	Included in the Contractor's contract

No	Items (impacts)	Monitoring Parameter	Monitoring Point	Frequency	Implementing Organization	Responsible Organization	Cost
		- Working hours					
15	Accidents	Casualties among workers due to mine and UXO explosion	Construction site	At any time	Contractor	Consultant / ENDE	Included in the Contractor's contract
		Demining work	Construction site	At any time	CND	Consultant / ENDE / CND	Included in the cost of demining work
		- Work contents - Vehicle operation record - Number of accidents	- Vehicle operation record - Accident records (construction site offices)	At any time	Contractor	Consultant / ENDE	Included in the Contractor's contract
Operation phase							
1	Water pollution	Status of disposal of wastewater, garbage, fuel, oil, etc. and education implementation	Arimba substation	Once every three months	ENDE	ENDE	ENDE
2	Noise and vibration	- Noise level - Complaint	- Residential and other boundaries in close proximity to Arimba substation, access roads - Municipalities, communes and settlements	- Once every three months - At any time	ENDE	ENDE	ENDE
3	Offensive odors	- Sensory - Complaint	Arimba substation	At any time	ENDE	ENDE	ENDE
4	Waste	Waste storage and transport	Arimba substation	At any time	ENDE	ENDE	ENDE
5	Topography and geology	Topographic and vegetation changes and soil erosion	Arimba substation	Once every six months	ENDE	ENDE	ENDE

Source: JICA Survey Team

9.10. Implementation System

The implementation system of the environmental management plan and environmental monitoring plan for the project is shown below, divided into pre-construction, construction, and operation phases.

(1) Pre- and during construction phases

A Steering Committee consisting of MINEA, RNT, ENDE, and CND will be formed to ensure that the construction of the power facilities and demining work in the target area are carried out efficiently and in an integrated manner. Components will be implemented. Since the government agencies CND will conduct demining work prior to construction, collaboration with these agencies will be particularly important in terms of environmental and social considerations.

Therefore, RNT will take the lead in the environmental management structure and will be responsible for environmental management related to demining work, but will not be involved in the planning, quality control, and execution of demining work themselves, so the environmental management objectives and responses will be fully shared and implemented. The objectives and responses of environmental management are to be fully shared and implemented.

RNT, on behalf of the Steering Committee, will award a consultant contract for the basic design phase (ES1), where the consultant will update the environmental management plan and environmental monitoring plan for the entire project, and conduct mitigation measures and environmental monitoring studies during the pre-construction phase of demining work.

RNT and ENDE will then each enter into an EPC contract with contractor, and mitigation measures and environmental monitoring during construction will be performed by the EPC contractor, with RNT and ENDE responsible for the environmental management of their respective projects in coordination.

In the project area, RNT's office in Lubango has jurisdiction over Huíla and Namibe provinces, and ENDE's Lubango office has jurisdiction over Huíla province, and these offices will work together to implement mitigation measures and environmental monitoring, as well as serve as a point of communication with local stakeholders.

It is firmly recognized that the provision of explanatory opportunities from the project implementing side is extremely important in communicating with local stakeholders, consultation meetings with residents will be scheduled to be held on a regular basis to share construction schedules, progress, and environmental management requests/complaints. In addition, since there are circumstances where questions, opinions, requests, and complaints from the residents' side are more difficult to reach the project implementing side due to transportation, communication means, language barriers, etc., rather than being sent directly to the local office, work office, and workers' camp, etc., it is considered important to assume that the traditional leader of community, Soba is the meditor, along with the smallest administrative unit, commune, and its administrator, Municipality and state.

Although a monitoring system and grievance mechanism related to resettlement will be established separately (see 10.5), it is common for local stakeholders to receive requests and complaints without any distinction between the two processes, so it is necessary to clearly indicate the sorting and communication channels for complaints, etc., as well as to inform the project stakeholders, including contractors and workers.

The actual system for environmental management and monitoring pre- and during construction (including complaint handling and reporting system to JICA) is shown in Figure 9.10-1.

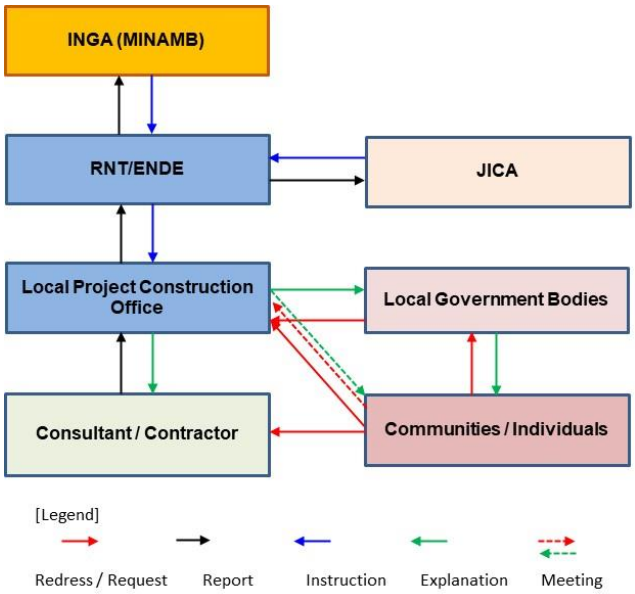


Figure 9.10-1 Implementing structure of the environmental management and monitoring (Pre- and during construction phases)

Source: JICA Survey Team

(2) Operation phase

In the operating phase, the respective environmental departments of RNT and ENDE will be responsible for implementation of environmental management and environmental monitoring. Responsible person will be appointed at the head office in Luanda and at the office in Lubango, respectively.

At the same time, educate staff on the contents of the environmental management plan prior to the start of operation, and periodically re-educate them after the facility is put into operation.

The office in Lubango will receive all requests and complaints from residents and will be responsible for sorting and communicating them to the relevant departments and, as the case may be, to the relevant agencies, until feedback is given to the stakeholders. In case of important matters, the necessary action will be taken at the Luanda head office, and the final report will be made to JICA.

Implementing structure of the environmental management and environmental monitoring in operation phase is shown in Figure 9.10-2.

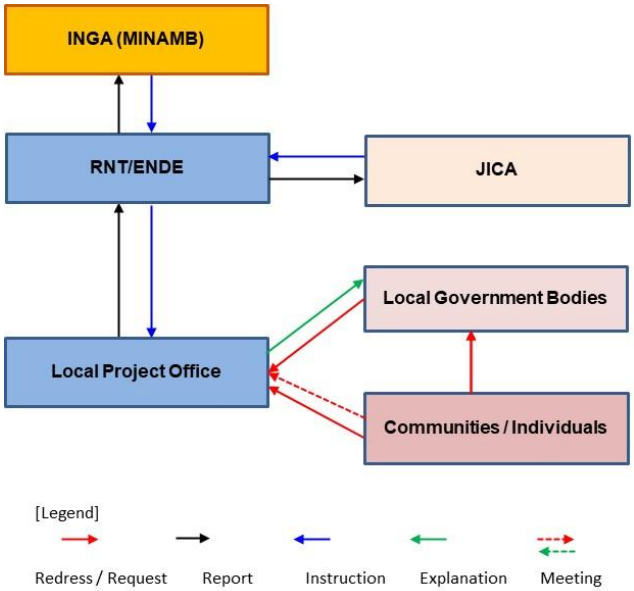


Figure 9.10-2 Implementing structure of the environmental management and environmental monitoring (Operation phase)

Source: JICA Survey Team

9.11. Stakeholder Consultation

9.11.1. Preliminary Discussion

(1) Consultation with government agencies

Preliminary discussions with relevant agencies were held in February 2020. A summary is provided below.

1) Purpose

- Explain the outline of the project and gather opinions and advice on the preparation and implementation of the project.
- Share anticipated impacts (draft scoping) and obtain input and advice.
- Share plans for conducting future surveys and their contents.

2) Agenda

- Explanation of project overview (RNT and JICA survey team)
- Explanation of scoping draft (JICA survey team)

3) Participants and venues

- Stakeholders in Huíla province, at the meeting room of Provincial Office
- Stakeholders in Namibe Province, at the conference hall of Provincial Office
- Stakeholders in Luanda, at the meeting room of MINEA

4) Summary of the meeting

The summary of each meeting is provided below.

Table 9.11-1 Summary of the meeting with relevant agencies in Huíla

Date and Time	February 13, 2020 10:00am-12:00pm
Vennue	Huíla Provincial Government Building, Lubango
Participants	26 people, including officials from the Huíla Provincial Government (Vice Governor, Department of Environment, Department of Economic Development, Department of Roads, etc.), administrators from Lubango and Humpata Municipalities, Railway Authority, INAD, 1 MINEA, 2 RNT, 2 ENDE, 6 JICA survey team members, and 3 interpreters.
Participant's Statement	・ Tundavala is also a tourist attraction, and we would like to see it addressed in the direction of conservation. Also, if vegetation clearing is necessary, please be careful about soil erosion.. ・ We would like a detailed environmental survey to be conducted on each route, including areas where biodiversity and migratory bird movements are recognized. The Huila Provincial Government wil prepare to accompany the environmental survey (Department of Environment). ・ Plan B should be rejected because it passes through an area of Lubango with a high concentration of housing (Lubango Municipality Administrator) ・ It is preferable to choose a route that is technically sound with respect to mine safety (INAD) ・ High-voltage transmission lines must be 50 m away from the railroad tracks and must be considered in the project plan (Railway Authority) ・ In the event of crop impacts and resettlement, it is difficult for the local government to bear the cost of compensation. In addition, the project is expected to make a contribution to the local community (Lubango and Humpata Municipalities).
Organizer's response	＜RNT＞ ・ Plan A was planned in parallel with the rail track, since the safety of the track from Lubango to Moçâmedes has been confirmed. Further detailed investigation will be conducted in the future. ・ The project will ensure benefits to all residents through the distribution of electricity by ENDE. ・ We would like you to provide us with relevant data. ＜JICA survey team ・ The survey TOR will be revised in the future in accordance with Angolan regulations. ・ In the Japanese Governmental Yen Loan Cooperation Project all compensation costs are to be borne by the partner country.

Source: JICA Survey Team

Table 9.11-2 Summary of the meeting with relevant agencies in Namibe Province

Date and Time	February 14, 2020 9:30am - 12:00pm
Venue	Namibe Provincial Government Building, Moçâmedes
Participaants	Namibe government officials (Governor, Vice Governor, Department of Environment, Department of Integration, Department of Economic Development, etc.), Namibe Port, Namibe Airport, CNIDAH, INAD, 1 MINEA, 2 RNT, 3 JICA Survey Team members, 2 interpreters, etc. 20 persons (Note: Governor and Vice Governor leave the meeting after opening)
Participant's Statement	・ The proposed substation construction site should consider aircraft takeoff/landing and angles. All data will be provided (Namibe Airport). ・ The same route as the existing 60 kV line should be used effectively. Information updating would be necessary, but would reduce costs (Integration Department). ・ We would like to see a substation installed near the Special Economic Zone in Namibe Province. In addition to the Namibe port itself, it will facilitate the feeding of electricity to factories in the SEZ. ・ An environmental assessment is needed. It is necessary to determine if transplantation or relocation of plant and animal species will be necessary. We also wish to see a study of soil erosion impact (Environmental Department).
Organizer's response	＜RNT＞ ・ We view Plan C as the best solution because it allows us to take advantage of existing transmission line routes. Substation location should be selected so that distribution of power by ENDE is facilitated. ＜JICA survey team ・ We share the importance of environmental conservation. We will revise the survey TOR in accordance with Angolan laws and regulations in the future.

(Note) Since officials from Moçâmedes and Bibalaa Municipalities were not able to attend the meeting, we visited them in the afternoon of the same day and separately later to gather their opinions. From Moçâmedes Municipality, JICA survey team heard the opinion that they would like to install a substation near the SEZ. Bibala Municipality expressed that although the project would not directly benefit Bibala Municipality, they welcomed the project because it would contribute to the stable supply of electricity. The Namibe SEZ that was mentioned at the time of these preliminary discussions was a development concept in the northern suburbs of Moçâmedes, but as of August 2022, no concrete plan has been formulated.

Source: JICA Survey Team

Table 9.11-3 Summary of Consultations with Relevant Agencies in Luanda

Date and Time	February 17, 2020 9:30am - 12:00pm
Venue	MINEA Conference Room, Luanda
Participants	MINAMB, MINCULT, INAD, Development Workshop (NGO), MINAGRIF, CED, 5 MINEA, 3 ENDE, 1 JICA office, 4 JICA survey team members, 2 interpreters (total 22 people)
Participant's Statement	・ We would like you to consider biodiversity conservation measures in Huíla and Namibe provinces. We would also like the project to be registered with the Ministry of Environment so that we can follow up on it (Ministry of Environment). ・ The project plan should be considered from both cultural and natural aspects. Between the two provinces, especially between Caraculo (a town on National Road 280) and Capamgombe (Currently Munhino, one of communes in Bibala Municipality), there are sites of cave paintings and murals between the two provinces. In addition, Mucubal travels between the two provinces (INPC). ・ Plan A is the best solution. Railroad and fiber optic lines are already in place and soil conditions are favorable. There are many cultural properties in the vicinity of Plan C. We faced difficulties in clearing mines in the existing 60 kV ROW. Also, soil conditions are not favorable (INAD). ・ Please keep in mind the considerations for life as it operates in the existing community (DW).
Organizer's response	<MINEA> ・ A joint site visit by all parties is desirable[72] . We would also like all parties to have a strong commitment to make the project better (Undersecretary in charge of electric power). <JICA survey team> ・ The protection of cultural assets and nature is also a part of the JICA Guidelines. The Angolan side is responsible for compensation costs and rresettlement procedures in case of displacement of residents and impact on their livelihoods.

Source: JICA Survey Team

(2) Local stakeholder and resident consultation

Separate interviews were conducted with local officials and local residents living near the transmission line route who had planned to participate in discussions with the abovementioned agencies but were unable to do so (February 2020).

The main interviewees and a summary of the discussions are shown in the table below.

Table 9.11-4 Discussions with local stakeholders

	Subjects, month, date and place	Listening content
1	<Target> Lubango and Humpata Municipality officials (two administrators from each Municipality and one cultural property officer from Humpata Municipality, for a total of three) <Date> February 13 and 15, 2020 <Location> Lubango and Humpata Municipalities, Huíla.	There are many ethnic groups and many languages throughout Angola. The project area and its surroundings are no exception, and we conducted interviews specifically with the characteristic ethnic groups and languages. <About the Mumuiras> - A dance group called kamatemba exists and maintains its own culture. - They are mainly scattered throughout the Huíla Province. They are found mainly between Christ Statue and Humpata Municipality and south of the project area on the Lubango State side, and they live by moving in an east-west direction. <Mukhabar> - They are mainly found in Bibala Municipality, Namibe State, but because Namibe State receives less rainfall than Huíla State, they move to Humpata Municipality to graze during the dry season. - They do not assimilate and maintain their own culture. <The situation of the local people> - The ROW of the transmission route between the Lubango substation and the Lubango airport (Plan B) is informally inhabited by residents displaced during the civil war. They include a distinctive ethnic group, but have already assimilated into the local population. The living environment is not well developed and income levels are low.
2	<Target> Moçâmedes Municipality officials (Municipality Administrator, Social Welfare Officer, Cultural Heritage Officer, etc., 13 people in total) <Date> February 14, 2020 <Location> Moçâmedes Municipality, Namibe Province	- We welcome the implementation of the project. Moçâmedes Municipality is expected to experience rapid economic growth, and it is very gratifying that the supply of electricity will be able to meet the demand. - Although some residents are afraid of mines due to preconceived notions that mines are buried under power lines and poles due to the effects of the civil war, the residents living near the existing 60 kV area have been accustomed to them for a long time, and they view the new 220 kV TL as being emotionally acceptable to them. - It would be good if the Namibe substation site could be located near Namibe Port and the Special Economic Zone. Namibe officials will also be consulted by the Municipality.

[72] The joint field visit had been prepared to be conducted before the JICA survey team's field visit scheduled for April 2020, but was not carried out due to the delay in route study caused by many restrictions on the Angolan side, such as the lockdown caused by the CVID-19 pandemic, and the travel restrictions of the JICA survey team.

	Subjects, month, date and place	Listening content
3	<Target Bibala Municipality officials (5 total, including Municipality Administrator, Economic Officer, etc.) <Date> February 15, 2020 <Location> Bibala Municipality, Namibe Province	- We welcome the implementation of the project. We are very grateful that the supply of electricity will meet the demand for electricity. - When the MINEA Minister visited Bibala Municipality last year, he stated that the transmission line would pass through Bibala Municipality. It is my understanding today that whichever route is chosen, it will pass through Bibala Municipality. I think it does not matter which route it takes. If the line passes through the capital of Bibala Municipality (=Plan A), it will be more costly because the length of the line will be longer. - Most of the Bibala Municipality population is Nhaneca (Nhaneca). If Plan A is selected, it is possible that the transmission line may pass through one of the communities and they may be affected in some way, but since they do not live in clusters, the impact is viewed as very low and avoidable. - A distinctive ethnic group is found in the Mucubal people. Because Namibe Province receives less rainfall than Huíla Province, they move to Humpata Municipality to graze their cattle during the dry season. They have not assimilated and maintain their own culture. They have a wide migratory range, moving north to south between Bibala and Humpata, but there is no set route. - In addition to the Mucubal people, another distinctive ethnic group is the Khoisan people (San people), who live in Bibala Municipality, but their population size is very small and they are now assimilated into the local community after a long period of settlement.

Note: Specific plans for the "special economic zones" referred to in this preliminary consultation have not been formulated as of August 2022.

Source: JICA Survey Team

Table 9.11-5 Consultation with Local Residents

	Subjects, month, date and place	Listening content
1	<Target Residents of Humpata Municipality (17 in total, including 3 women) <Date> February 15, 2020 <Location> Humpata Municipality, Huíla (Kulbala Village on National Road 280)	- Most local residents are farmers. - They grow beans, potatoes, sweet potatoes, corn, etc. Rice does not grow due to insufficient water. - Most of the farm products are consumed by the farmers themselves, but when they have a surplus or need cash to purchase processed products, they go to the Humpata Municipality market to sell their products. In the past, farmers used to sell their products to moving vehicles on the roadside along Route 280, but since the opening of the market in Eunpata Municipality, the products of suburban residents are now concentrated in the market. A kilo of potatoes costs about 600 to 1,000 kwanza. - For the past three years, there has been no rainfall and rain-fed agriculture has made life very difficult. There used to be an irrigation system, but it broke down, and since then they have only been dependent on rainwater. - While the elderly did not have the opportunity to attend school, the younger generation is enrolled in school up to elementary school. A very small number go on to secondary school and beyond. - There is a nearby health center staffed by nurses on weekdays, but emergency patients are transported by ambulance to Lubango City. - Take a cab or motorcycle to Lubango City, or walk if you don't have cash. - The local population belongs to the Ovamuila people (Nhaneca-Umbi descent). They speak either Mumuila or Nhaneca-Umbi, the two most common local languages. The second language is Portuguese. Portuguese is not spoken in the interior. - Young people are willing to leave their hometowns to work for better incomes. - Relationships between local communities are good, especially within the community, and it is common for people to stay within the community and marry outsiders and have families. - It has been a long time since the 60 kV DL went through, so I don't see a problem with a new transmission line, but I have had several interviews like this in the past. I hope it will happen.

(Note) These discussions with local residents were informal, and the main purpose was to gather preliminary information for the preparation of the scoping plan and TOR, and to understand the situation of the local community, so no special consideration was given to socially vulnerable groups.

Source: JICA Survey Team

9.11.2. Stakeholder Meetings for the Scoping Stage (Phaase 1)

Stakeholder meetings during the scoping stage were postponed for a long period of time amidst lockdowns, other action restrictions and travel suspensions due to the COVID-19 pandemic. During this period, a series of workshops were held between the implementing agencies and the JICA survey team to discuss the route, which led to the implementation of the stakeholder consultations in February 2021. This was in line with the requirements of Angolan national law and the JICA Guidelines for Environmental and Social Considerations (April 2010), which are summarized as follows.

(1) Objective

- Provide an up-to-date project overview, gather stakeholder input, and obtain advice.
- Share anticipated impacts (proposed scoping) and discuss project implementation issues and how to address them.
- The needs on the part of stakeholders will be identified and reflected in subsequent surveys.
- Share the survey implementation schedule and content.

(2) Outline of the meetings

In order to obtain a wide range of opinions from a variety of people in a wide geographic area, the meeting was held in five locations in two Provinces. Participants expressed their support for the project and their expectations for the project. There was no opposition to the project. The outline of meetings is shown in the table below.

Table 9.11-6 Outline of stakeholder meetings of the Phase 1

#	Stakeholders	Date and Time		Venue	Number of participants		
					In place	Remote (Zoom)	Total
1	Huíla Province. officials	Feb 23	10:00 am - 11:30 am	Huíla Province Government Building	15 people	11 people	26 people (23 males, 3 females)
2	Humpata Municipality officials (Huíla)	Feb 24	8:30 am - 11:30 am	Humpata Municipality Government Office	17 people	11 people	28 people (23 males, 5 females)
3	Arimba commune officials, Lubango Municipality, Huíla	Feb 24	3:00 pm - 5:00 pm	Arimba Commune Town Hall	42 people	0 person*	42 people (Male 36, Female 6)
4	Namibe State Officials	Feb 25	10:00 am - 12:00 pm	Moçâmedes Amphitheatre	48 people	11 people	59 people (49 males, 10 females)
5	Bibala Municipality officials (Namibe Province)	Feb25	3:00 p.m. - 4:00 p.m.	Bibala Municipality Office	48 people	0 person*	48 people (45 males, 3 females)
Participant total					170 people	33 people	203 people

Note 1: All meetings were held in 2021.
Note 2: Consultations in Arimba Commune and Bibala Municipality were not able to obtain an Internet connection and thus remote participants were not available.

Source: JICA Survey Team

(3) Matters considered

- In consideration of the diversity of the local residents, in addition to explanations in Portuguese, interpreters in Nyaneka-Umbi, a language widely spoken in the region, were deployed to provide detailed explanations and question-and-answer sessions.
- To facilitate participants' understanding, visual presentation materials were created and prepared with extensive use of photographs and conceptual diagrams.
- Considering the impact of the COVID-19 pandemic, Zoom distribution was conducted to allow remote participation.
- In order to ensure the participation of a diverse population, including socially vulnerable groups (women, elderly, certain ethnic groups targeted for government assistance, etc.), information was disseminated through the local government (Municipality and commune). In addition to this, information was spread evenly through traditional leaders (sobas) and coordinators in each village, and participation in the consultation was encouraged through flyers distributed in villages and direct verbal explanations several days prior to the event. Residents who were unable to participate were asked to convey the content of the meeting to their families and neighbors.

(4) Summary of Discussions

A summary of each consultation is provided below.

1) Discussions with Huíla Province officials

- Participants: Huíla Provincial Government officials (Vice Governor, Director of Infrastructure

and Technical Services, Director of Environmental Waste Management and Community Services, and others), Municipality and commune municipal government officials, RNT (Ministry of Agriculture and Fisheries, CED, INAVIC, JICA survey team, participated remotely)

・ Main discussions: as follows

Participant Comments/Questions	Organizer's response
- What training is being considered for workers employed on construction projects? - What equipment will be used at the construction site during project implementation? Also, what technical assistance is planned? - Will compensation be secured for homes and farmland along the transmission line route that will be affected? (Director of Infrastructure and Technical Services, Provincial Government)	- It is envisioned that both skilled and unskilled workers will be hired, and training will be provided. - This project is still in the technical study stage, and detailed studies will be conducted in the future. - The transmission line route is intended to avoid impacts on residents as much as possible. If unavoidable, compensation will be provided in a transparent manner; JICA has very specific rules and criteria, and social surveys and consultations with affected residents will be conducted to ensure that compensation is fair. A resettlement plan will also be prepared.
- For the fieldwork, we propose to secure the participation of experts from the Namibe Academy of Fisheries and Marine Sciences and technicians from the State Department of Environment, Waste Management and Community Services (GPAGRSEC) to gain more experience and to be used for future monitoring. (Director of the State Department of Environment, Waste Management and Community Services)	- The project is classified as Category A under Angolan national law and is currently in the Pre-Environmental Feasibility Study and Scoping (EPDA) phase. - We believe that higher education institutions and GPAGRSEC engineers should consider participating in the JICA survey team.
- Is there a compensation process for affected residents and power supply to residents along the transmission line? (Deputy Municipality Manager Finance, Lubango Municipality)	- Compensation for the loss of farmland and fruit trees will be made fairly, transparently, and in good faith. - RNT's project involves only the transmission of electricity, while the distribution of electricity to the surrounding area will be carried out by ENDE in the future.
- Locations along the project route have been used for military operations. It is suggested to contact the CED to confirm the presence of mines and unexploded ordnance. (Head of Arimba Commune)	- Only after it is confirmed that the project route is free of mines and unexploded ordnance, and a certificate is also issued, will the project be implemented.

Source: JICA Survey Team

2) Discussions with Humpata Municipality officials

・ Participants: Humpata Municipality government officials (Deputy Municipality Mayor, Municipality Mayor's Advisor, Director General concerned, Municipality Assembly representatives), ADRA (Action for Rural Development and Environment), Soba, RNT (Ministry of Agriculture and Fisheries, INAVIC, and JICA survey team participated remotely)

・ Main discussions: as follows

Participant Comments/Questions	Organizer's response
- I want to know who is responsible for compensation. - We appreciate and welcome this project. (Municipality Energy and Water Resources Division Director)	- Compensation will comply with Angolan national law, JICA Guidelines, and World Bank safeguards, with the intention of avoiding impacts on the local population as much as possible, while confirming the extent of project impacts through social surveys. Where unavoidable, compensation will be provided in a transparent manner; JICA has very specific rules and standards, and social surveys and consultations with affected populations will be conducted to ensure that compensation is fair. A resettlement plan will also be prepared. - Regardless of how much or how little, we would like to emphasize that the impact on the population and endangered species is of great concern to the organizers.

Participant Comments/Questions	Organizer's response
- What is the size (budget) of this project? - The construction of new electric lines entails various environmental risks. Is the utilization of existing electric lines not being considered? - Will local needs be met by this project? (Municipality Advisor)	- This project is in the early stages of formation and it is too early to make cost estimates. - This project will enhance the supply of electricity to Namibe. Although high-voltage lines have little environmental impact, it is generally recommended that they pass through rural areas rather than urban areas to prevent vandalism. - In order to prevent impacts to flora and fauna due to habitat fragmentation, etc., the project is considering maintaining zones that are free of large trees and other vegetation. The project will be meticulously implemented for the communities affected by the project. Fairness, transparency, and integrity will be ensured in the compensation process for affected residents.
- Please keep in mind that project stakeholders are required to consistently listen to those interested in the project and those affected by the project, and to have a good understanding of how to reflect the information obtained from those directly affected by the project. - The background information for the project should be presented in plain language, and emphasis should be placed on making it understandable to all. (ADRA).	- All parties will be kept up-to-date. To this end, we intend to continue to hold stakeholder consultations. - The survey team includes experts and works with universities in Huíla. Information to affected communities is always consistent and transparent.
- What is the size of each tower and its impact on the population? (DMTTMU)	- The towers will be approximately 15 m x 15 m in area, and all routes will be equipped with electronic signs with distance indicators. Approximately 540 towers will be installed at 350 m intervals.
- Are there employment opportunities available? And how are they selected? (IMIP)	- With the issue of employment of local youth being discussed, it is recognized that the winning bidder must hire local talent and implement a training program.
- Are there any endangered species in the area? (Department of the Environment)	- The Tundavala area is well known and is home to several endangered bird species important for biodiversity, and the area has been designated as IBA0023; a careful survey will be conducted during March and April 2021 to confirm the biodiversity and the presence of endangered species.
- I appreciate this initiative. By the way, I would like to know when electricity will come to my area. (Soba)	- Angola has three companies in charge of the electricity sector, of which ENDE, which is in charge of electricity distribution, is specifically positioned for consultation.
- What is the capacity of the Arimba and Namibe substations? - There are municipalities on the route of the transmission line that have not been supplied with electricity in the past, is there any possibility of an extension to allow these municipalities to have access to electricity? (Deputy Mayor of Humpata Municipality)	- The existing 60 kV DL are unable to meet the demand of the city of Moçâmedes. Therefore, a 220 kV TL needs to be installed in the northern and central system of Lauca to connect it to Huambo, which will also strengthen the industrial base of Sacomar in the future. A study is still underway to determine capacity.
- The route will pass through a mountainous area at an elevation of approximately 2,000 m that separates Lubango and Namibe, and the topography of Humpata is characterized by irregular undulations. Will the height of the tower at the planned length pose any problems for air traffic control? - Who are the INAVIC experts involved in this project? (INAVIC)	- After discussing the tower height near the airport and working with INAVIC engineers, the proposed substation site is being moved away from the airport. Internationally, there are technical norms that specify safe distances from airport approaches (5-15 km). - INAVIC engineers who helped RNT in 2019 when they trudged to the location of the 220/60 kV New Namibe SS are also involved in this project.

3) Consultations with Arimba commune officials

・ Participants: Arimba commune administrator, commune leaders, sobas, RNTs

・ Main discussions are as follows:

Participant Comments/Questions	Organizer's response
- The project officials are to be thanked for their development in this area and for listening to the local people long before the construction phase began. - I would like to propose to provide employment opportunities for young people in Arimba commune, as it has a high unemployment rate. (Soba)	- The issue of hiring local youth is being discussed. It is understood that the contractor will hire and train local personnel according to the rules.
- We appreciate the fact that businesses are taking the initiative to develop businesses in this area. - I would like to know if the construction of a 400 kV transmission line between the Belem de Dango substation in Huambo and the Nombungo substation in Lubango is already underway. (Government official, Arimba Commune)	- The 400 kV transmission line connecting the provinces of Huambo and Huíla is part of a broader plan to connect other municipalities and provinces, as well as to connect the wire network in the southern region. - The project, which was scheduled to begin this year, has been postponed due to the COVID-19 pandemic.
- Is there electricity supply to the villages around Nombungo? (Head of Arimba Commune)	- The project is to facilitate the transport of electricity between Lubango and the 220/60 kV substation in Moçâmedes, but in addition, a project is underway to guarantee the supply of electricity to the communities around Nombungo.
- Will the Poiares area receive power supply from this project? (Resident of Poiares)	- Electricity supply to other municipalitiets in Arimba is under consideration.
- I would like an explanation of the involuntary resettlement and compensation process. - What happens in case of damage to infrastructure (houses, agricultural areas, etc.) caused by third parties? (Coordinator, Arimba Municipality Office)	- JICA takes resettlement and compensation issues very seriously and will not provide financing for this project until these issues are addressed in compliance with JICA regulations and standards. - The transmission and distribution lines to be installed will not pass over residences, schools, hospitals, or large trees. - The social survey to be conducted in this brief will map all infrastructure and economic activities that exist within the project's direct sphere of influence, and will consider avoiding them to the extent possible. If avoidance is not possible, a resettlement plan will be developed to ensure that the affected residents have the same or better conditions than before the project. - Compensation for the loss of farmland and fruit trees will be made with fairness, transparency, and integrity. Ensure that compensation is given to those who need it.

4) Discussions with Namibe State officials

- Participants: Namibe Provincial Government officials (Vice Governor, Deputy Governor for Technical Services and Infrastructure, Director General of Transportation, Director General of Public Relations, other directors), journalists, university faculty, students, Soba, Moçâmedes Municipality Government officials, PRODEL, ENDE, RNT (Ministry of Agriculture and Fisheries, INAVIC, and JICA survey team participated remotely).
- Main discussions are as follows:

Participant Comments/Questions	Organizer's response
- It is proposed that the transmission line route pass through Bibala Municipality and also through the Capangombe commune, which is slated for municipalization. To take advantage of the mining and industrial sectors in the area. - Also, please explain the schedule and start date for this project. (Director of Transportation of Province)	- The project's transmission line is part of a larger strategic plan to connect the country's northern and central/southern transmission systems. The study or assessment of Namibe's energy needs began in 2015, for which several agencies in the region were consulted and the Namibe Master Plan was provided by the Department of Research, Planning, and Statistics (GEPE). Due to topographical and physical problems, a route was chosen that avoided the Bibala Municipality Town Hall and Mt. Leba. The proposed route is technically and economically feasible. We would like to request continued support for other projects to supply electricity to other municipalities in Namibe Province. - After the project is completed, for example, electricity will be supplied from Arimba to Bibala and Humpata, but ENDE will be responsible for the distribution of electricity to households. - The current Bibala Municipality Town Hall is distributed from the Humpata substation, and Bibala Municipality will be the first to benefit from the 60/15 kV Arimba SS when it is put into service, and ENDE is planning to build a 60 kV substation in Bibala. - The overall proposed construction schedule for the project is 30 months*1 , but the process will begin after the funding agency (JICA) and MINAMB approve the Environmental and Social Impact Study. Once funding is secured, the construction phase of the project can begin during 2023. - The schedule and contractor for this project have not yet been selected. TEPSCO of Japan is currently in the process of conducting a technical study.
- The initiative of the project proponents to plan the project and hold stakeholder consultations in this area is gratefully acknowledged. - We propose to contract with an environmental consulting firm in Namibe Province for the preparation of an Environmental and Social Impact Assessment (ESIA) for this project. - Regarding the cost of preparing an ESIA, will an environmental consulting firm work with local environmental agencies and experts? - Was Holísticos directly selected, or did RNT conduct an open tender for the implementation of the ESIA? - Can the existing 60 kV tower be used for the 220 kV TL project? Also, please tell us about the project budget. (Social Welfare Officer, Moçâmedes Municipality)	- A technical study is currently being conducted by TEPSCO under JICA, and Holísticos has been selected as the consultant to prepare the ESIA for the project. - Holisticos conducts its research in partnership with local environmental agencies and professionals. Lubango resident Jose Luis, a member of the social team, is one example. - The current 60 kV tower cannot support a 220 kV TL. The budget for this project will be calculated in the future.
- Communities along the transmission line route have stated that they are unable to make a valuable contribution to the project. We suggest that stakeholder consultations be held at local universities where the scientific community and students of electrical and environmental engineering are located. (Director, Department of Culture, Tourism and Environment)	- This suggestion is important and we would consider holding stakeholder consultations at local universities in the future.
- Do you plan to replant the forest biomass that will be removed over 200 km along a 45 m buffer? - I would like to propose that the ESIA incorporate the Forest Wildlife Framework Act. (Director of Forest Development)	- Biomass lost along the route will be replaced by native vegetation or plants adapted to local climatic conditions. If vegetation regeneration is not feasible, the Namibe Province Department of Culture, Tourism and Environment will recommend offsets at alternative sites. - A working committee for the project should be established between RNT and the local government.
- Will the community around the transmission line	- No implementation is planned under the project for

Participant Comments/Questions	Organizer's response
be supported? - Are there any electromagnetic effects from the operation of 220 kV high voltage lines? (Lecturer, Faculty of Engineering and Technology, Namibe)	electricity supply in the Capangombe and Caraculo regions. - The management of ENDE Namibe intends to install a 25 MW power generation facility in Caraculo. - The electromagnetic radiation impact is negligible if the tower height is 30-35 m, and every effort will be made to ensure that the transmission line route does not cross residential areas.
- Although the holding of the stakeholder engagement meeting was delayed considerably, we appreciate the fact that the project was developed in this area and that the local people's voices were heard long before the project entered the construction phase. - Why does the project's transmission line not continue to the City of Tonbua? Also, which company will be in charge of maintenance at the time of service? (Sales Manager)	- ENDE is working on an interconnection project, and a 60/15 kV substation will be installed in Tombua. In addition, Tombua will be served by an actual generator. - The transmission system is maintained by RNT, and training is provided to transmission line maintenance technicians.
- We would like to involve the students of the Electrical Engineering Department of Namibe University in the project to give them the opportunity to acquire knowledge and skills. - Can Namibe Province's young graduates benefit from employment opportunities? (University Lecturer)	- The issue of employment of local youth has been discussed, and it is recognized that the awarded contractor must recruit local personnel and implement training programs in accordance with JICA and RNT standards. - The proposal for student participation will be considered and details will be shared with local RNT office officials.

Note *1: The construction schedule was assumed to be 30 months at the time of this consultation (February 2021) but was later finalized at 24 months.

5) Discussions with BibalaMunicipality officials

- Participants: Bibala Municipality government officials (Municipality mayor, commune government officials), Soba, RNT.
- Main discussions are as follows:

Participant Comments/Questions	Organizer's response
- We thank the project proponent and RNT for developing the project in the area and explaining it to the local people long before the construction phase. - The 60 kV towers between the Lubango and Moçâmedes substations are affected by strong gusts of wind, so more modern equipment should be used. (Bibala Municipality Government, Social Welfare)	- The project is in the mid-stage of technical studies to confirm whether natural phenomena occurring in the area will affect the project's towers.
- Could we run the 220 kV TL through the 60 kV tower that already exists between the substations in Lubango and Moçâmedes? Wouldn't this lead to cost savings? - In some areas of Mt. Leba, there may not be space for another transmission tower on the 60 kV DL route between Lubango and Moçâmedes. (Bibala Municipality Government Social Welfare Officer)	- In selecting the transmission line route, technical and financial factors were considered and it was concluded that the proposed route was the most feasible. - Restrictions regarding the passage of high-voltage towers in the Mt. Leba area were considered, and the project will pass 6 km away from the area to prevent potential impacts There is an old road behind Mt. leba that leads to the community of Ugra and is expected to be used for tower and power line passage. - The current towers for 60 kV DL cannot support 220 kV TL. In addition, the ease of access could pose a serious risk to residents living near the route, making it unfeasible. - The project will use new, more durable technology and only equipment that can withstand the local climatic conditions. The steel tower heights will also be commensurate. In some areas, the new transmission line will run parallel to the existing 60 kV DL to minimize the impact on the population and infrastructure.

Participant Comments/Questions	Organizer's response
- There have been many recent media reports of power cable thefts; do you plan to implement security measures to prevent future thefts and vandalism? (Social Welfare Officer, Bibala Municipality Government)	- There are various risks, including people destroying towers and high-voltage cables. In addition, transmission line maintenance requires technicians to periodically shut down transmission line.
- In closing, the Bibala Municipality Administrator confirmed that the distribution of electricity in the Capangombe and Caraculo areas will be left to future projects, and requested that during the field survey, attention be paid to the cattle and shifting pastoral areas in this region.	- Understood.

9.11.3. Stakeholder Meetings during ESIA Drafting Stage (Phase 2)

Based on the results of technical discussions with RNT/ENDE and the results of the environmental and social survey, stakeholder consultations were held in June 2022. This is in line with the requirements of the JICA Guidelines for Environmental and Social Considerations (April 2010). (Not required by Angolan national law).

In addition to government officials, the consultations were widely and openly attended by sobas, civil society organizations, NGOs, and residents.

For the proposed resettlement plan, the results of the initial baseline survey (November/December 2021) were explained and opinions were exchanged on the lost asset compensation policy, proposed livelihood restoration support measures, and other issues developed based on the results. A summary of the discussions focused on these issues is shown in the table below. The participants generally expressed support for the project, and there were no dissenting opinions.

(1) Objective

- Provide an overview of the project (draft final level) and construction plans
- Explain the results of the environmental and social studies and the environmental management and monitoring plans described in the draft ESIA
- Provide an overview of the resettlement plan
- Obtain feedback from local residents and relevant organizations

(2) Outline of the meetings

As in previous years, the meetings were held in five locations in two Provinces in order to obtain a wide range of opinions from a variety of people in the wide-area target regions. The outline of the meetings is shown in the table below.

Table 9.11-7 Outline of the stakeholder meetings in Phase 2

No.	Participantd	Date and Time		Venue	Number of participants
1	Arimba commune officials, Lubango Municipality, Huíla.	June 7	2:15 pm - 4:15 pm	Arimba Commune Town Hall Meeting Hall (Django Settlement)	37 people (Male 29, Female 7)
2	Humpata Municipality officials (Huíla.)	June 8	8:30 am - 11:30 am	Humpata Municipality Recreation and Cultural Center	53 people (Male 40, Female 13)
3	Bibala Municipality officials (Namibe Province)	June 9	10:00 am - 12:00 pm	Bibala Junior High School Auditorium	69 persons (58 males, 11 females)
4	Lubango Municipality officials, Huíla.	June 9	2:30 pm - 3:40 pm	Lubango Municipality Office	20 people (17 males, 3 females)
5	Moçâmedes Municipality officials (Namibe Province)	June 10	11:00 am - 1:00 pm	Namibe University Academy of Fisheries and Marine Sciences	39 people (31 males, 8 females)
Participant total					217 people (175 male, 42 female)

Note 1: All meetings were held in 2022.
Note 2: Zoom distribution was not conducted because behavioral and travel restrictions due to the COVID-19 pandemicr had already been eased.

Source: JICA Survey Team

(3) Matters considered

- In consideration of the diversity of the local residents, in addition to explanations in Portuguese, interpreters in Nyaneka-Umbi, a language widely spoken in the region, were deployed to provide detailed explanations and question-and-answer sessions.
- To facilitate participants' understanding, visual presentation materials were created and prepared with extensive use of photographs and conceptual diagrams.
- In order to ensure the participation of a diverse population, including socially vulnerable groups (women, elderly, certain ethnic groups targeted for government assistance, etc.), information was disseminated through the local government (Municipality and commune). In addition to this, information was spread evenly through traditional leaders (sobas) and coordinators in each village, and participation in the consultation was encouraged through the distribution of flyers and direct verbal explanations in the villages several days before the event. Residents who were unable to participate were asked to convey the content of the meeting to their families and neighbors.

(4) Summary of Discussions

A summary of each of the discussions is as follows. Participants generally expressed support for the project, and there were no objections.

1) Consultations with Arimba commune officials

- Participants: Arimba commune government officials, residents, RNT, ENDE
- Main discussions are as follows

Participant Comments/Questions	Organizer's response
・ I would like to know about compensation in case of damage caused by landmines and their impact on residents (residents)	・ Projects are planned to avoid social impacts as much as possible. In case of unavoidable impacts, compensation will be made in good faith and with transparency based on the agreement with the affected population, in accordance with Angolan law and JICA uidelines. ・ For crop compensation, the amount of compensation is specified after clarifying the types of crops affected, etc. ・ If structures or property in the ROW are eligible for compensation, a price assessment will be made based on market value. ・ There have been cases in the past where people were unable to rebuild their lives because they were looking for monetary compensation. The direction is to limit compensation to those who actually suffer damage, and in such cases, to provide compensation in kind.
・ In order to eliminate those who are looking for monetary compensation, it would be better to register the houses to be compensated as soon as possible. It would be better to discuss specific details of the damage with the affected residents. (Lola Village coordinator, resident of Chibia Village) ・ The Village of November 11 is willing to accept this project because of the benefits from the distribution of electricity. (November 11 Vllage resident)	・ A social survey is being conducted in November/December 2021 to conduct interviews in potentially affected villages Compensation payments under the ROW will be made in accordance with international standards. ・ The route will be finalized next year or later. It is also important to ensure that compensation is not too expensive. ・ Once the 60 kV DL and Arimba substation are operational, more communities in Arimba municipality and Lubango Municipality will be able to receive electricity. We would like to make this point known to the residents who were not present today.
・ My house is close to the proposed 220/60 kV East Lubango SS site and vegetation removal is underway at the site, do I need to provide my house as well? (Resident)	・ Vegetation removal marks the boundary parcel marker, and relocation at this time is premature. The route will be finalized next year or later, and will be discussed again when it becomes more concrete.

2) Discussions with Humpata Municipality officials

- Participants: Humpata Municipality government relations (deputy Municipality mayor), commune representatives, sobas, civil society organizations, residents, RNT, etc.
- Main discussions are as follows:

Participant Comments/Questions	Organizer's response
・ Please give consideration to preserving the Boer cemetery located on the Jamba farm (Jamba 2 settlement residents).	・ The Boer cemetery mentioned is also off the ROW, as is the Onkurvara Village Cemetery, and the route finalization will be done in a manner that avoids negative impacts as much as possible.
・ Young people in Onkulbara village are concerned that their agricultural and other employment may be threatened. It would be helpful if the affected villagers are provided with opportunities to be directly briefed when identifying and compensating them. ・ We are not opposed to the laying of the towers near the Onkurvala Village Cemetery, as long as Soba and resident families are consulted in advance and follow Angolan law. We also believe that if they share with us the final route and the planned layout, we will be able to eliminate those who build houses for compensation. (Onculuvala settlement leader)	・ Since the 220 kV TL route is planned to run parallel to the existing 60 kV DL, adverse impacts on local employment and agriculture are expected to be avoided. ・ The route will be finalized next year or later. Compensation will be provided for unavoidable workarounds.
・ I would like to know about compensation for relocation if a steel tower is built on my land (resident of Jamba 2 settlement)	・ Structures and property in the ROW are eligible for compensation, which is assessed based on market value; outside the ROW is not eligible for compensation. ・ Only if unavoidable and unavoidable, the affected population will be identified and compensated fairly in accordance with Angolan law and JICA Guidelines. For crop compensation, the amount of compensation is specified after clarifying the type of crops affected, etc.
・ Will the project provide employment opportunities (Onculuvala settlement residents)?	・ The bidding documents will specify that a minimum of 40% of the workers will be locally hired. There will be a bifurcation into skilled and unskilled labor, but the unskilled labor quota will have fewer qualifications required, allowing for the participation of young people.
・ Is there any benefit to the village of Onkurbala (residents of Onculuvala settlement)?	・ The residents of Humpata will also benefit in some way if the 60 kV DL between the 220/60 kV East Lubango SS and the 60/15 kV Arimba SS is built.

3) Discussions with Bibala Municipality officials

- Participants: Namibe Provincial Government officials (e.g., Director of Culture, Tourism and Environment), Bibala Municipality Government officials (e.g., Fire Chief, Education Director), municipal government officials, Soba, ADPP (Associacao Ajuda de Desenvolvimento de Povo para Povo), RNT, and others.
- Main discussions are as follows:

Participant Comments/Questions	Organizer's response
・ If the project crosses Tundavala, will there be a safe enough distance for houses, farmland, schools, etc.? (ADPP) ・ We would like to see the extra-high-voltage transmission line linked to other distribution line projects. We want neighboring villages to receive benefits. (Advisor) ・ I would like to see distribution line run through the communities that the route passes through. (Bibala Municipality Government Fire Chief)	・ Only structures under the ROW are eligible for coverage, all others are not. ・ If the business requires relocation, a price calculation based on market prices will be made and a replacement house of equal or better value will be provided in a safe location. ・ In the area in question, this is only the maintenance of the transmission line from Lubango to Namibe, and the distribution of electricity will be done locally by ENDE. ・ Tundavala and Mt. Leba are tourism resources as well as historical and cultural values, which are avoided by the project.
・ Is there any energization to areas such as Bibala Municipality, Muino and Caraculo? (Bibala Municipality Mayor)	・ As mentioned above, this is only the maintenance of the transmission line from Lubango to Namibe in the region concerned. ・ Electrification plans using solar power and other technologies are being developed in municipalities and

	suburban communities across the country, and demonstrations are underway in the province of Cabinda.
・ Is the scholarship for Angolan children included in the agreement between the Angolan government and JICA? Also, we would like to know if the Capangombe Agricultural Science High School will be electrified by the project. (Chief of Education Division, Bibala Municipality)	・ This project is a power transmission project and does not provide scholarships. ・ While contractors may offer scholarships and other financial aid as part of their CSR activities, RNT is not responsible for this.
・ I would like to know about the compensation process for affected residents and measures for environmental restoration in areas that may be affected by the project implementation. ・ In addition, the dust generated by the recent stone exploration project in the Caraculo area is affecting air quality and causing problems in the local community. We would like the project to consider measures to avoid the spread of particulate matter. (Director General of Culture, Tourism and Environment, Namibe Province)	・ The Project will be funded by JICA, and JICA takes the issues of involuntary resettlement and fair compensation very seriously. Funding for the project will not be provided unless these issues are properly analyzed, avoided or compensated for in accordance with Angolan law and JICA's applicable requirements. An abbreviated resettlement plan (ARAP) is being prepared to ensure that the affected population has the same or better standard of living and livelihood as before the project. ・ Compensation for lost farms and fruit trees will be based on the crop price list per m^2 or per ha prepared by the then Ministry of Agriculture and Fisheries (General Directorate of Agriculture of Namibe Province). To ensure that the relevant compensation is guaranteed to the potentially affected population, all terms and conditions are transparently and fairly agreed upon, signed and executed. ・ For vegetation to be removed along the project route, RNT envisions a budget for all negative impacts that the project may cause, including involuntary resettlement and compensation for environmental damage and third party property. For the vegetation biomass to be removed by the route, the scenario would compensate for the transplantation of native plants and plants adapted to local climatic conditions. ・ Thanks to the information about air pollution in the Caraculo area and its adverse effects on the health of the population, the Environmental and Social Impact Assessment (ESIA) has several measures to mitigate the work of EPC who may emit air pollutants (particulate matter) into the local air.
・ Is the amount of electricity transmitted by the project sufficient relative to the amount of energy required in Namibe State? Also, is the project in line with the Namibe Province Master Plan? (Director General of Culture, Tourism and Environment, Namibe Province)	・ A series of information was shared by the Namibe Provincial Department of Research, Planning and Statistics (GEPE) and was also shared during stakeholder consultations conducted in Namibe Province in February 2021. The project will be part of the transmission system reinforcement to connect the North and South of Angola.
・ Is there any way to prevent the affected residents from attempting to rebuild their houses, etc. on the project site? (Bibala Municipality Mobilizer)	・ RNT will form a monitoring team to oversee the route during project implementation. The route needs to be cleared for safety and maintenance reasons. Support from Municipality governments and national police is essential to limit land use and occupancy. Human health and welfare will be affected under the super-high voltage lines. Please give due consideration to the fact that family members and relatives of attendees will be at great risk if they do the same.

4) Discussions with Lubango Municipality officials

- Participants: Deputy Municipality Mayor of Lubango Municipaality, Chief of Energy and Water Resources Division, Chief of Agriculture Division, Arimba Municipality officials, department heads in charge, Soba, RNT, etc.
- Main discussions are as follows:

Participant Comments/Questions	Organizer's response
・ This project is indispensable for the development of Arimba Commune and the development of Lubango Municipality and Huíla Province. We highly appreciate the fact that compensation payments to affected residents and the creation of local jobs are being considered. ・ I would like the process to take into account the farming season, etc. (Deputy Municipality Mayor of Lubango Municipality)	・ Since there is a period of time before construction begins, farm work and other local activities can continue as before for the time being. We would like to discuss this at the earliest possible time.
・ I would like to know the route that was finalized to avoid residents taking advantage of the flight and going after compensation. We would also like to know the compensation process. (Director, Energy and Water Resources Division)	・ The route will be finalized next year or later. Only if unavoidable and unavoidable, the affected population will be identified and fairly compensated in accordance with Angolan law and JICA guidelines. For crop compensation, the amount of compensation will be specified after clarifying the types of crops affected, etc.
・ Can agricultural activities resume? (Chief, Agriculture Division)	・ Agricultural activities cannot take place under the ROW during the construction period, but after completion, agricultural activities can resume, although tall trees are not allowed.

5) Discussions with Namibe State officials

- Participants: Namibe vice governor, Moçâmedes Municipality government officials, local teachers, Namibe fishermen's union, residents, university students, Soba, church officials, Ida village officials, RNT, etc.
- Main discussions are as follows:

Participant Comments/Questions	Organizer's response
・ This project is essential to the economic development of Namibe Province. ・ During the construction and implementation of the project, a small amount of land with suitable conditions for agriculture should be preserved, and family farmers should be protected. ・ Rare farmland should be preserved, and if use is unavoidable, compensation should be provided. (Vice Governor of Namibe Province)	・ Projects are planned to avoid social impacts as much as possible. In the event of unavoidable impacts, the affected crops will be clearly identified, and compensation will be made in good faith and with transparency based on an agreement with the affected population, in accordance with Angolan law and JICA Guidelines.
・ The move to take advantage of the flight and receive compensation should be avoided. In addition, it is desirable to conduct an educational campaign for residents. (Resident of Moçâmedes Municipality)	・ The company is considering the possibility of compensating only those residents actually affected by the project, in which case the compensation would be in-kind.
・ The livelihood of the local community will deteriorate. (Namibe Fishermen's Association)	・ We have been in discussions with potentially affected communities, and sociology experts and others familiar with the ethnic situation of the local community have been interviewed and consulted to gain their understanding.
・ We would like to emphasize the importance of the social dimension in ESIA reporting. ・ I would also like to know about the air quality monitoring that has been done. (Namibe University official)	・ A monitoring study of environmental noise and air quality was conducted during this ESIA. The results are reflected in the ESIA report. They will also be used as baseline values for the contractor responsible for implementing the monitoring plan under the supervision of RNT.
・ If relocation is necessary, we need to start explaining to the residents now and make them aware of this (Aida village official).	・ The transmission route has not been finalized and concrete action will not be taken until next year.

10. Land Acquisition and Resettlement

10.1. Necessity for Land Acquisition and Resettlement

10.1.1. Land Acquisition

Among the project components, the sites for three substation totaling 5.65 ha are public land / belong to ENDE, and there is no temporary or permanent land acquisition anticipated.

On the contrary, the right of ways (ROWs) of the transmission and distribution lines will be cleared during the construction period. The ROW of the 220 kV TL and that of the 60 kV DL of the project are 45 m and 24 m, respectively, and approximately 300 ha of the transmission line ROW and 13 ha of the distribution line ROW will be subject to land use restrictions during the construction period, respectively, and tree clearing and impacts on agricultural and other production activities will be anticipated[73]. In addition, during the construction period, towers and their foundations and surrounding areas, access roads, material storage areas, and restricted access areas due to safety considerations will also be unavailable, and private lands and other used lands within such areas will be temporarily requisitioned. Land clearance within the tower footages and space required for maintenance will be permanently acquired.

10.1.2. Involuntary Resettlement

Since no inhabitants, occupants, or economic activities have been identified at the proposed substation construction sites, no economic impacts, such as loss or damage to the means of livelihood, are anticipated.

Of the 220 kV TL routes, no impact to land use and resettlement associated with land use are anticipated in Namibe Province (Moçâmedes and Bibala municipalities), but livelihood impacts and temporary resettlement are expected in Huíla Province (Lubango and Humpata municipalities) during the project period. In addition, livelihood impacts and temporary resettlement are anticipated to occur during the period, although on a very small scale, along the 60 kV DL route (in Lubango Municipality, Huíla Province).

10.2. Legal Framework for Land Acquisition and Resettlement

10.2.1. Relevant Ministries and Agencies

The government agencies involved in land acquisition and resettlement in Angola are listed in the table below. Land management is carried out in accordance with the urban and development plans of each province, and land acquisition is based on an understanding of the current status of land use and land use plans. Negotiations with residents are also conducted by municipality governments.

Table 10.2-1 Relevant ministries and agencies regarding land acquisition and resettlement

No.	Institutions	Roles and Responsibilities
1	National Institute for Territorial Administration	Identifies land boundaries with local government authorities
2	National Institute for Territorial Planning	Represents the Ministry of Territorial Planning and Housing, administers the Land Law, and formulates land management policies at the municipality level.
3	Ministry of Agriculture	Has jurisdiction over land administration in rural areas.
4	Ministry of Urban Affairs and Housing	Has jurisdiction over land administration and urban planning in urban areas.
5	National Inssisute of Geography and Cadastre (IGCA)	Develops national cadastrial maps and manages databases.
6	Municipality Administration	Has the authority to requisition land for development.

Source: JICA Survey Team

[73] When in operation, activities such as farming under the ROW will be possible, although with certain height restrictions.

10.2.2. Legal framework for land acquisition and resettlement

The major regulations regarding land acquisition and resettlement relevant to this project are listed in the table below.

Table 10.2-2 Major National Laws and Regulations on Land, Resettlement, and Compensation

No.	Name	Year of issuance / amendment
1	Constitution of the Republic of Angola, 2010	2010
2	Law no. 9/04, of 9 November - Land Law	2004
3	Law no. 3/04, of 25 June - Spatial Planning and Urbanism Law (SPUL)	2004
4	Law no. 1/21, of 7 January - Law on Expropriation for Public Utility (LEUP)	2021
5	Presidential Decree no. 216/11, of 8 August - National Policy for the Land Concession Rights	2011
6	Presidential Decision no. 14/18 of 19 February - creating the Inter-ministerial Commission whose objective is to promote the Inter-ministerial Commission whose objective is to promote the registration of Rural Land in favor of Local Communities	2018
7	Presidential Decree no. 117/16, of 30 May - Regulation on Resettlement	2016
8	Decree no. 58/07, of 13 July, General Regulation for Land Concession	2007
9	Decree no. 41/04, of 2 July, Regulation for the Licensing and Security of Electric Facilities	2004
10	Decree no. 01/01, of 5 January - Norms on the Resettlement of Displaced Populations	2001

Source: JICA Survey Team

Issues stipulated by each regulation that are related to this project are described below.

(1) Constitution of the Republic of Angola, 2010

It is the new Constitution of Angolan and establishes rights and obligations in broad terms regarding the use and acquisition of land. The state owns land, water, air, soil, and all other natural resources, but all citizens are guaranteed their private properties under the Constitution, and the state is obligated to respect and protect the properties and other rights of individuals, legal entities, and communities. In the case of temporary requisition and acquisition for public purposes, fair and prompt compensation is pre-conditioned. The rights of small-scale farmers to their agricultural land are stipulated under the Constitution, subject to productive use. In the event that the land is not used for any reason for three consecutive years or for a total of six years, or if the land is not used in a useful and effective manner as determined by the state government, their agricultural land right shall be extinguished.

(2) Law no. 9/04, of 9 November - Land Law

It is stated to ensure sustainable and economically efficient land use. It grants the transfer rights over land and stipulates the acquisition of land ownership rights to individuals and organizations. It refers to the concept of private ownership in urban areas and customary land tenure in rural areas, and allows for the conversion of customary rights to legal rights in order to guarantee ownership rights and protection against eviction. It also states that the state and local governments may acquire land for public works projects and allows for the extinguishment of land rights and their transfer to the state and local governments, while stipulating that they shall fulfill their obligation to provide adequate compensation to landowners (Article 12). It also stipulates that a distance of 30 m must be maintained from residential areas, power lines, roads, etc. when acquiring land for public works to protect nature, national defense and security, and to preserve monuments and historical sites[74].

(3) Law no. 3/04, of 25 June - Spatial Planning and Urbanism Law (SPUL)

It provides for measures for urban and rural spatial management, the establishment of a system for urban and regional planning and related policies, and the formulation of a planning system for the protection, occupation, and use of land. The law provides for the National Assembly to develop state-level strategies, provincial governments to formulate provincial-level plans, and municipality governments to implement municipality-level plans, respectively, and for municipality governments to be granted the authority to requisition land for development.

[74] The project defines the ROW for 220 kV TL and 60 kV DL as 45 m and 24 m, respectively. In addition, when in operation, the vertical distance between the power lines and buildings / trees must be maintained at 8 meters and 3 meters, respectively. This measure does not depend on the Land Law but on the MINEA guidelines (ESPECIFICAÇÃO TÉCNICA Projectos de Linhas Aéreas de MAT/AT Sector Eléctrico:(ET-E-119-Ed.A (31.07.2014)) as confirmed by RNT/ENDE.

(4) Law no. 1/21, of 7 January - Law on Expropriation for Public Utility (LEUP)

It covers public works in cases where the competent government authority intervenes with respect to national defense and national security interests, environmental protection and creation of biodiversity conservation areas, and the construction and maintenance of power stations, substations, and transmission lines under the public power system. While complying with the Land Law mentioned above, it imposes on stakeholders compensation in goods or lands with the same or similar socioeconomic values or cultural backgrounds in the acquisition of public purposes that affect the ownership of lands for which no title exists or lands based on local customs. In doing so, it ensures the participation of the affected stakeholders or their representatives, respects local customs, creates conditions that are consistent with economic, social, cultural, and environmental aspects, and benefits the improvement of the lives of stakeholders and the affected residents while harmonizing with other relevant laws and regulations.

(5) Presidential Decree no. 216/11, of 8 August - National Policy for the Land Concession Rights

It defines the mechanisms of access, use, and confiscation of land and provides the general basis for state policy on land title transfers. It also defines land uses such as agriculture, urban, mining, and tourism, and establishes regulations for such land use.

(6) Presidential Decision No. 14/18 of 19 February -Interministerial Commission

It is the decision to establish an inter-agency committee to promote the registration of agricultural land in a manner supportive of local communities. A land survey is to be conducted associated with land use analysis to promote the granting of land titles for land parcels that meet legal requirements.

(7) Presidential Decree no. 117/16, of 30 May - Regulation on Resettlement

It establishes rules, resettlement procedures, and criteria for the resettlement of groups of residents and households in an area due to natural disasters, redevelopment projects, public works projects, house fires, etc., in order to maintain the public interest and protect the rights and interests of citizens. It defines the roles and procedures of the central government and autonomous regions in the process of resettlement and housing reconstruction, and stipulates that the provincial government has the authority for resettlement and the municipal government is responsible for implementing it. Compensation for resettlement is negotiated among the province, the affected parties, and the operator, and monetary compensation or provision of real estate equivalent to the land or houses to be lost will be conducted.

(8) Decree no. 58/07, of 13 July, General Regulation for Land Concession

It establishs a legal framework for leasing freehold land within the country (this decision does not apply to private land). In the event of public use or temporary requisition or acquisition of land, fair and adequate compensation will be mandatory for owners and other affected property rights holders. Affected private parties may choose to participate in consultations related to compensation.

(9) Decree no. 41/04, of 2 July, Regulation for the Licensing and Security of Electric Facilities

It defines the obligation of the project proponent to compensate the owner, lessee, and beneficiary (both for immediate and future losses) in the event of losses due to the installation of transmission lines.[75]

(10) Decree no. 01/01, of 5 January - Norms on the Resettlement of Displaced Populations

It defines the settlement rights of resettled persons, including those displaced, and the provision of additional land allocation by the government. It defines the conditions under which the provincial government shall support the resettled population in coordination with provincial humanitarian coordination groups and NGOs when they resettle. The Article 4 a) stipulates that "all resettlement and return sites shall be mine-free."

10.2.3. JICA's Policy on Resettlement

The key principle of JICA policy on involuntary resettlement is summarized below.

- Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by

[75] Immediate losses: damage to crops, damage due to installation of access roads, damage due to material accumulation, tree cutting necessary to implement construction, etc. Permanent losses: damage to forests, aesthetic impact, partial loss of soil productivity, reduced building potential, radio interference (e.g. electromagnetic fields), etc. Future lossesLosses: operation of railroad tracks, losses resulting from alterations to land, residential neighborhoods, and roads in rural areas.

exploring all viable alternatives.

- When, after such an examination, avoidance is proved unfeasible, effective measures to minimize impact and to compensate for losses must be agreed upon with the people who will be affected.
- People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels.
- Compensation must be based on the full replacement cost as much as possible.
- Compensation and other kinds of assistance must be provided prior to displacement.
- For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. It is desirable that the resettlement action plan include elements laid out in the WB Safeguard Policy, OP 4.12, Annex A.
- In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people.
- Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans.
- Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.

Above principles are complemented by WB OP 4.12, since it is stated in the JICA Guidelines that "JICA confirms that projects do not deviate significantly from the WB's Safeguard Policies". Additional key principle based on WB OP 4.12 is as follows:

- Affected people are to be identified and recorded as early as possible to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits.
- Eligibility of Benefits include, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying.
- Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based.
- Provide support for the transition period (between displacement and livelihood restoration.
- Attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc.
- For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, ARAP is to be prepared.

In addition to the above core principles on the JICA policy, it also laid emphasis on a detailed resettlement policy inclusive of all the above points; project specific resettlement plan; institutional framework for implementation; monitoring and evaluation mechanism; time schedule for implementation; and, detailed Financial Plan etc.

10.2.4. Comparison between Angolan Laws and Regulations and JICA Guidelines

The differences from the JICA Guidelines are shown in the table below.

Table 10.2-3 Gaps between National Laws and JICA Guidelines

No	JICA Guidelines for Environmental and Social Considerations	Angolan domestic law	Gaps and Measures taken in the project
Land acquisition and involuntary resettlement			
1	・Involuntary resettlement and loss of means of livelihood are to be avoided by exploring all viable alternatives. ・When population displacement is unavoidable, effective measures to minimize impact and to compensate for losses should be taken. (Para 1, "Involuntary Resettlement," Appendix 1, JICA Guidelines,)	Not applicable	**(Gap)** ・There are no legal provisions regarding avoidance of involuntary resettlement and loss of livelihood means. ・There are no legal provisions regarding measures to minimize resettlement. ・There is no mechanism to monitor whether unnecessary acquisitions are actually being curtailed. **(**Mitigation Measures**)** ・Land acquisition and involuntary resettlement have been avoided to the extent possible when examining transmission and distribution line routes and substation locations. ・In cases where the impact is unavoided, alternatives that minimize negative impacts on communities located within the project area are considered. ・The same measures shall be taken in finalizing the transmission and distribution line routes and substation locations in the detailed design performed during the project implementation phase.
2	・People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels.. ・Compensation must be based on the full replacement cost as much as possible. (Para 2, "Involuntary Resettlement," Appendix 1, JICA Guidelines)	・Local governments are responsible for providing adequate compensation for loss of land rights (Land Law) ・Rural lands subject to acquisition and seizure for public works projects are considered subject to fair compensation. (Land Law) ・The obligation to compensate for the creation of an easement is not stipulated. (Land Law) ・In the event of public use, temporary confiscation or acquisition, there is always an obligation to provide fair and adequate compensation to the landowner and the owners of other property rights affected. (Decree No. 58/07) ・Compensation is provided for crops, trees, and physical structures. ・Compensation rates for crop and tree losses are set by the Ministry of Agriculture and Fisheries. ・It does not pay for loss of livelihood.	**(Gap)** ・Compensation while land rights are not acquired, and compensation for various losses associated with the land use is not obligatory. ・There is no provision to assess the impact on people's incomes, livelihoods, loss of jobs, and businesses, or to take mitigation measures. ・Socioeconomic recovery is not mandated. ・Compensation at the replacement cost or income restoration to pre-project level is not guaranteed. ・The timing for payment of compensation is not specified. **(**Mitigation Measures**)** ・In the event that resettlement becomes unavoidable, affected residents who lose their assets, livelihoods, and resources shall be fully compensated for their actual damages and assisted in improving or at least restoring their previous economic and social situation. ・ARAP has estimated the amount of compensation from a third-party perspective to ensure compensation at

No	JICA Guidelines for Environmental and Social Considerations	Angolan domestic law	Gaps and Measures taken in the project
			the replacement cost. ・RNT/ENDE shall not begin resettlement or construction until all affected residents have been compensated for their lost property.
3	Appropriate and accessible grievance mechanisms must be established for the affected people and their communities. (Para 3, "Involuntary Resettlement," Appendix 1, JICA Guidelines)	・Dispute resolution mechanisms are in place, including local judiciary, court systems (mediation and settlement), and arbitration systems. (Law on Expropriation for Public Utility)	(Gap) ・There is no provision for the establishment of a grievance mechanism. (Mitigation Measures) ・Appropriate grievance mechanisms shall be provided and implemented. ・RNT/ENDE shall assign a community liaison to the field office to handle grievances and make reportings. ・Ensure that grievance mechanisms are disclosed to and accessible by the local community.
4	・Appropriate and accessible grievance mechanisms must be established for the affected people and their communities. (Para 3, "Involuntary Resettlement," Appendix 1, JICA Guidelines) ・In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance.. ・When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people. (Para 4, "Involuntary Resettlement," Appendix 1, JICA Guidelines) ・Project proponents provide relevant draft resettlement instrument and makes it available at a place accessible to displaced persons and local NGOs, in a form, manner, and language that are understandable to them. (WG OP 4.12 Para.22)	・In the land concession process, interested parties are required to hold public hearings, consult with local residents through Soba, and disclose the details of their applications for land use and utilization. (Land Law) ・Local residents are to confirm in writing that the land is not vacant and occupied and is not included in the community's land area. (Land Law)	(Gap) ・The holding of consultations is required by law, but the structure of the consultations is not clearly defined. ・There are no specific requirements for prior information disclosure, language, or format. ・There is no clear requirement for disclosure and availability of relevant reports. (Mitigation Measures) ・Local people, including the affected residents, have been involved and consulted in the process of developing the ARAP in this Preparatory Survey. ・Based on the results of the initial baseline survey, establish appropriate mechanisms for communication and coordination among affected households, local representatives, and local government in the ARAP. ・The ARAP shall be provided in a form, manner, and language that is easily understood by the affected population and local NGOs.
5	・Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey, preferably at the project identification stage, to prevent a subsequent influx of encroachers who wish to take advantage of such benefits. (WG OP 4.12 Para.16) ・Persons who encroach on the area after the cut-off date are not entitled to compensation or any other form of resettlement assistance (WG OP 4.12	・As is customary, once a project has been approved and is certain to be implemented, a cutoff date for compensation is set, and the final rezoning, etc. takes place. ・Land distribution is based on traditional customary law. ・Compensation is provided to the landowner.	(Gap) ・No land is provided to prevent influx of people from outside. (Mitigation Measures) ・RNT/ENDE will declare the land use for the project as soon as tower locations and ROW are finalized in the detailed design or prior to the start of construction.

No	JICA Guidelines for Environmental and Social Considerations	Angolan domestic law	Gaps and Measures taken in the project
	Para.15)		
6	Eligibility of benefits includes: i) those with formal legal rights to the land (including customary and traditional land rights recognized under law); ii) those without formal legal rights to the land at the time of census but have a claim to such land or assets; and iii) those without recognizable legal right to the land they are occupying. (WG OP 4.12 Para.15)	・In order to make effective use of rural land, it is being promoted to quickly identify and register customarily owned land and buildings, and to grant land titles to owners of land parcels that meet legal requirements. (Presidential Decision No. 14/18). ・As is customary, land concessions in Angola are managed through two processes 1) Formal land transfer procedures under national law: applicable to private land and land with surface rights. (2) Informal procedures: mainly applied in the acquisition of land parcels with customary land rights or use rights. This process is usually carried out by Sobars or municipalities, with assistance from the municipality as needed.	(Gap) ・Customary land rights are considered but not explicitly stated. (Mitigation Measures) ・Ownership grants will be considered for those who have been evicted from their lands and for affected residents without formal documented legal rights. ・For the affected residents with customary rights, the rights are guaranteed by endorsement by Soba.
7	Provide support for the transition period (between displacement and livelihood restoration). (WG OP 4.12 Para.6 I (i))	Not applicable	(Gap) ・No provision is made for support during the resettlement and transition period. (Mitigation Measures) ・Resettlement assistance shall be provided not only for immediate losses, but also for the transition period necessary to restore the livelihoods and living standards of the affected population.
8	Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based. (WG OP 4.12 Para.11)	・In the case of physical resettlement, compensation is only an alternative to providing an alternative land (Regulation on Resettlement). ・The acquisition of land for public use provides for i) compensation for improvements made by the landowner on the land to be acquired, and ii) being offered a parcel of land in a similar situation for a similar use. (General Regulations for Land Concession)	(Gap) None. (Mitigation Measures) ・To compensate for the loss of land, alternative farmland of equal or similar condition and income-generating opportunities are offered, or monetary compensation is provided.
9	Appropriate consideration must be given to vulnerable social groups, such as women, children, the elderly, the poor, and ethnic minorities, all members of which are susceptible to environmental and social impacts and may have little access to decision-making processes within society. (Para 2, Sec 5, Appendix 1, JICA Guidelines)	No consideration is given to the socially vulnerable.	(Gap) ・There are no legal matters for the socially vulnerable people. (Mitigation Measures) ・Vulnerable households will be identified based on the initial baseline survey results and the vulnerability criteria discussed during the consultations conducted for the preparation of the ESIA and ARAP. ・Vulnerable households will be provided assistance in improving their standard of living and restoring their

No	JICA Guidelines for Environmental and Social Considerations	Angolan domestic law	Gaps and Measures taken in the project
			livelihoods through the livelihood restoration plan.
10	In cases where sufficient monitoring is deemed essential for appropriate social considerations, project proponents must ensure that project plans include feasible monitoring plans. (Para 2, Sec 8, Appendix 1, JICA Guidelines)	・Specific requirements for establishing monitoring and measurement procedures at a project are often set forth in the project's environmental license.	(Gap) There is no provision for monitoring requirements. (Mitigation Measures) ・Establish procedures to monitor and measure the effectiveness of the resettlement and compensation process and compliance with legal and regulatory requirements. ・Based on the results and analysis of the initial baseline study, monitoring requirements, including monitoring indicators, will be described and implemented in the ARAP.
11	The full costs of resettlement activities necessary to achieve the project objectives are included in the total project costs. (WG OP 4.12 Para.20)	Not applicable	(Gap) ・The costs required to support resettlement and transitional period support for the affected residents to rebuild their lives are not taken into account. ・There is no provision for the full cost of resettlement to be included in the project cost. (Mitigation Measures) ・The cost of resettlement and compensation shall be included in the total project cost.
12	・For projects with large-scale involuntary resettlement, a resettlement plan shall be prepared and made available to the public. ・For projects with land acquisition or involuntary resettlement of less than 200 people, an abbreviated resettlement plan shall be prepared (World Bank OP 4.12, Para 25)	・If government authorities (MINAMB / provincial authorities) identify the possibility of physical resettlement, the need to prepare a resettlement plan is at the discretion of the authorities. ・Resettlement is not a matter covered by the ESIA, but MINAMB may require the business owner to address it if it is identified prior to permitting.	(Gap) ・There are no legal provisions for resettlement planning requirements. (Mitigation Measures) ・A draft ARAP has already been prepared in this Preparatory Survey; RNT/ENDE is responsible for implementing the requirements set forth in the ARAP. ・If MINAMB / provincial authorities require processes / documents related to resettlement, RNT/ENDE will disclose and consult with them. ・RNT/ENDE will consult with stakeholders on the content of the ARAP and obtain feedback.

Source: JICA Survey Team

10.2.5. Guiding Principles under the Project

I. As shown in the table above, gaps are found between the Angolan laws and regulations and the JICA Guidelines and its policies. Taking into not only those stipulated in the Angolan domestic legislations, but also good practices found in other projects in the country, and JICA policies, the Government of Angola shall adopt the following basic policy regarding the entitlements of the project affected persons according to the nature and extent of the losses caused by the project implementation to bridge the gap, support the affected population, and restore their economic situation to at least the level it was before the project.

II. Examine alternatives and avoid or minimize resettlement. If resettlement cannot be avoided, provide adequate compensation and assistance to the project affected persons so that their livelihoods can be improved or at least restored.

In this Preparatory Survey, adverse social impacts such as land acquisition and involuntary resettlement have been avoided or minimized through a series of technical studies and examinations

of alternatives. This trend will be continued in the detailed design, preparation of bidding documents for contractors based on the detailed design, and construction supervision.

III. Compensation and assistance will be provided to all those affected by

- Negative impact on standard of living
- Negative impact on rights to houses, rights to land use, permanent and temporary rights to agricultural land, pasture land, commercial land, tenants, annual or perennial crops, trees, and other real property
- Temporary or permanent negative impacts, income-generating opportunities, business, occupation, location of residents' businesses, etc.
- Impact on social and cultural activities and relationships

IV. All affected persons, irrespective of tenure status or social or economic standing, shall be eligible for compensation and assistance. If a person loses part of his/her assets, he/she will be treated as eligible for resettlement if the remaining assets are not sufficient to support his/her subsequent livelihood. Temporary impacts will also be considered in the resettlement plan.

In the project site, land use is based on traditional customs. These rights are also taken into consideration in Angola, but are not explicitly stated and vary from region to region and case to case. In addition, due to the effects of the civil war and other factors, the demographics of the population are not known. In light of this situation, all project affected persons should be informed that they are entitled to compensation and restoration assistance regardless of whether they have legal rights or not. In identifying rights, seek endorsement and reconciliation by local traditional leaders at village level, known as "Sobas".[76]

V. A resettlement plan shall be developed in accordance with Angolan laws and regulations and JICA's policies on resettlement. The RAP will be translated into local languages and made available to the project affected persons and other interested parties.

Since the project will relocate less than 200 residents, an abbreviated resettlement plan (ARAP) will be developed.

VI. Compensation is provided based on the principle of replacement cost.

Regarding the impact on houses and buildings in this project, the basic policy is to provide a substitute for them. In doing so, as much as possible, the project will be based on an equivalent exchange without considering depreciation at a point close to the original ownership/use/occupancy site and the place of residence/business, and only in cases where it is difficult to provide a substitute, monetary compensation will be provided at the resettlement price.

VII. Compensation for the affected residents who depend on agricultural land will be made on a land basis to the extent possible, and consideration shall be given to ensure that the alternative land will be in the same location and with the same productivity as the land before resettlement.

If replacement land is not available, cash compensation will be taken into account, together with other assistance including skill development and training, wage employment, and other restoration and rehabilitation assistance.

VIII. Resettlement assistance shall be provided not only for immediate loss, but also for a transition period needed to restore livelihood and living standards of the project affected persons.

Those who work or cultivate land affected by the project will be entitled to compensation for their losses as proejct affected persons, and will receive assistance to restore or improve their living conditions to what they were before the project was implemented. Specifically, income compensation,

[76] In rural areas of Angola, traditional land practices persist in which local traditional leaders, called "sobas," manage the land of local communities, allocating land, establishing common land, negotiating rules for common land use, and making decisions on land disputes. These decisions are made independently of land laws.

special allowances, and short-term employment in the construction works under the project will be considered.

IX. The resettlement plan must consider the needs of those most vulnerable to the adverse impacts of resettlement, and assistance should be provided to help them improve their socio-economic status .

Vulnerable populations will include the poor, women, children, the elderly, the disabled, and the socially, economically, and culturally vulnerable.

X. Affected residents shall participate in the preparation and implementation of the resettlement plan. The project affected persons and their communities will be consulted on the project, their rights, mitigation measures for negative impacts being considered, etc., and will be involved in decision-making regarding resettlement to the greatest extent possible.

The involvement of the affected population has already been ensured during the process of preparing the ARAP and its implementation phase. During the implementation phase, affected people and communities will continue to be consulted on the nature of the project, their rights and options, and mitigation measures, and will be involved in decision-making as much as possible.

XI. All costs necessary for land acquisition, including compensation and income recovery measures, will be made available within the agreed implementation period. All costs necessary for resettlement activities will be borne by the Angolan government.

MINEA will make adequate budget allocations for the necessary period of time for land use, provision of alternative land and residential buildings, compensation payments, and implementation of income recovery measures.

XII. Physical resettlement will not take place prior to the provision of compensation and assistance for it. Infrastructure at the relocation site will be fully developed prior to resettlement. Acquisition of assets, payment of compensation, resettlement, and commencement of livelihood restoration activities will all be completed prior to construction, unless expropriation has been determined by the court.

XIII. An organizational and management structure for effective resettlement planning and implementation will be established prior to the start of the resettlement process. This includes the human resources needed to manage the community consultations, monitoring of land acquisition and livelihood restoration activities, etc.

XIV. Appropriate monitoring, evaluation, and reporting mechanisms shall be established as part of the transfer management structure. An external monitoring group will be hired for the project to evaluate the transfer process and final results.

10.3. Scope of Land Acquisition and Resettlement

The results of the initial baseline surveys (Population Census, Asset Inventory Survey, and Household Survey) conducted in November and December 2021 are summarized as below. The substations were not targeted in the survey because all three locations are publicly owned or ENDE-owned lands, and it was confirmed that there are no formal or informal residences, and there are no residents affected by economic displacement or other factors.

10.3.1. Population Census

The population census results indicate that the number of affected households and persons are as follows: for the 220 kV TL route (ROW 45 m), approximately 340 households (1,629 persons) in 9 settlements in Lubango and Humpata Municipalities, Huíla, which are the most populated areas, and for the 60 kV DL route (ROW 24 m) The 60 kV DL route (24 m) is expected to affect 15 households (72 people) in Lubango Municipality, Huíla.

Table 10.3-1 Affected Households and Number of Members

No	Category	Breakdown / Example	220 kV TL		60 kV DL	
			Number of households	Number of household members	Number of households	Number of household members
I. Residential Land and Buildings						
1	landowner	Land with legal rights	2	9	1	5
		Land with customary rights	40	192	2	9
		Public land (no legal basis)	19	91	3	15
	Subtotal 1		61	292	6	29
2-1	house owner	Housing with legal rights	5	24	1	5
		Housing with customary rights	199	955	2	9
		Public land (no legal basis)	21	100	0	0
2-2	Living Building/Structure Owner	Cowsheds, fences, gates, walls, etc.	0	0	0	0
2-3	Owners of personal property related to daily life	Personal property including livestock	0	0	0	0
	Subtotal 2		225	1,079	3	14
II. Agricultural Land and Crops						
3	Owner of agricultural land	-	-	-	-	-
4	Land user	-	-	-	-	-
III. Commercial and industrial buildings						
5-1	Owner	-	6	28	1	5
5-2	Employee	-	48	230	5	24
	Subtotal 5		54	258	6	29
Total			340	1,629	15	72

Source: JICA Survey Team

10.3.2. Asset Inventory Survey

The results of the asset inventory survey are shown in the following table: the 220 kV TL route is primarily in Lubango and Humpata Municipalities, Huíla. and the 60 kV DL route is primarily in Lubango Municipality, Huíla. The impact to land, residential buildings, livelihood-related buildings/structures, livelihood-related personal property, farmland/crops/trees, and commercial/industrial buildings are foreseen, respectively.

Table 10.3-2 Affected properties and area

No.	Category	Breakdown/Example	220 kV TL	60 kV DL
I. Residential Land and Buildings				
1	Lot	Land with legal rights	5.7 ha	1.2 ha
		Land with customary rights	184.6 ha	9.6 ha
		Use of public land (no legal basis)	94.4 ha	13.2 ha
Subtotal 1			284.7 ha	22.8 ha
2-1	Residential building	Housing with legal rights	5 houses	one house
		Housing with customary rights	199 houses	2 houses
		Housing on public land (no legal basis)	21 houses	0
2-2	Living-related buildings/structures	Cowsheds, fences, gates, walls, etc.	0	0
2-3	Lifestyle-related movable property	Personal property including livestock	0	0
Subtotal 2			225 houses	3 houses
II. Agricultural Land and Crops				
3	Agricultural land	Agricultural land based on legal rights	309 ha	8 ha
		Agricultural land based on customary rights		
		Use of public land (no legal basis)		
4	Crops & Trees	Crops & Trees	309 ha	8 ha
III. Commercial and industrial buildings				
5	Buildings and structures other than the above	Commercial facilities, factories, etc.	6 houses	one house

Source: JICA Survey Team

10.3.3. Local Livelihood and Living Conditions

The ROW of the 220 kV TL and the 60 kV DL are 45 m and 24 m, respectively, but the survey was conducted with the following points considered: (1) the route is expected to move to some extent as a result of topographical and geological survey to be conducted during the project implementation stage; (2) if the survey is conducted within a specific project area, people may suddenly claim land rights or other rights for the sake of receiving compensation; and (3) the standard characteristics and livelihoods of people in the project area should be understood as unbiasedly as possible. Total of 100 m on either side of the two power lines was set as the survey area, and the interview survey was conducted with a broader scope in mind, not limited to the above-mentioned affected residents and the affected properties and sites.

The survey results for 220 kV TL and 60 kV DL are shown separately as below, since the 220 kV TL and 60 kV DL are under the jurisdiction of RNT and ENDE, respectively.

(1) 220 kV TL

1) Survey Respondents and Household Members

Initial baseline of 225 households in a total of 12 settlements in three municipalities in Lubango and Humpata Municipalities in the Huíla Province, where social impacts are expected in the approximately 196 km ROW from the 220/60 kV New Namibe SS (Namibe Province) to the 220/60 kV East Lubango SS (Huíla Province) and its vicinity. The surveyed households were located in Poiares Muhaha (46 households), Figueira (26 households), Matena (24 households), and Nombungo (22 households) in Lubango Municipality, and Onculuvala (25 households) and Heva de Cima (23 households) in Humpata Municipality. In Humpata Municipality, the majority of households are in Onculuvala (25 households) and Heva de Cima (23 households).

Table 10.3-3 Number of households surveyed for 220 kV TL and their distribution

No	Municipality	Commune	Settlements/Villages	Number of households (number of houses)
1	Lubango	Arimba	Nombungo	22
2			Mateta.	24
3			Mavanda.	13
4			Poaires Muhaha	46
5			Km 14	5
6			Kapalanga	6
7			Figueira	26
8	Humpata	Humpata	Campones.	18
9			Jamba I	15
10			Onculuvala	25
11		Palanca	Heva de Cima	23
12			Palanca	2
Total				225

Note: Kapalanga is off the 220 kV transmission route ROW, but is included in the study because of its proximity.

Source: JICA Survey Team

Of the 225 households, 168 households were represented by the household head, of which 72 were women.[77] The reason for the large number of female respondents other than the household head is due to the fact that the male was away working outside the home. The average age of the household head was 42.1 years for males and 40.1 years for females; the youngest household head was 19 years for males and 17 years for females; and the oldest household head was 87 years for males and 90 years for females. 225 households had a total of 1,495 members (748 males and 747 females) and an average household size of 6.64 members.

[77] These households are often headed by one of several wives, with the husband living in a neighboring house. Although each "household" is separate, the husband provides livelihood support, etc.

Table 10.3-4 Attributes of survey respondents (220 kV TL)

Attribute	Male	Female	Total	Proportion
Household head	96	72	168	74.7%
Other than the household head	15	42	57	25.3%
Total	111	114	225	100.0%

Source: JICA Survey Team

Of the 225 survey respondents, the largest number (91, 40.4%) had an elementary school level of education, followed by middle school (43, 19.1%). Those who had no schooling but could read and write and those who were illiterate with no schooling numbered 35 (15.6%) and 41 (18.2%), respectively.

Table 10.3-5 Education of survey respondents (220 kV TL)

Educational Level	Number of people	Proportion
Higher eduation	2	0.9%
Middle education	13	5.8%
Secondary education	43	19.1%
Primary education	91	40.4%
Literate	35	15.6%
No education	41	18.2%
Total	225	100.0%

Source: JICA Survey Team

The table below shows the number of households with children under 5 years old and elderly persons 65 years old or older out of the 225 households surveyed, the population concerned, and the average number of persons per household. 76.4% of all households (172 out of 225 households) have children under 5 years old and 24.3% of the total household population (364 out of 1,495 persons) has children under 5 years old. While 21.8% (49 of 225 households) have an elderly person aged 65 years or older, and only 5.4% (81 of 1,495) of the total household population is aged 65 years or older. Angola has a short life expectancy[78] and a gentle-shaped population pyramid, which is common in sub-Saharan African countries[79]. In addition to these factors, the proportion of elderly people in the surveyed areas is relatively low, as they leave their villages to rely on their grown-up children and relatives living in urban areas. While the average household size is 6.64 persons, the average number of children under 5 years old and elderly persons over 65 years old per household is only 2.1 and 1.7 persons, respectively. With many caretakers and workers, the socioeconomic burden on households is relatively low.

Table 10.3-6 Households with children under 5 years old and elderly and their distribution (220 kV TL)

Presence of children under 5 years old and elderly		Number of households (Number of houses)	Proportion	Number of persons concerned (persons)	Average number of persons per household (persons)
Households with children under 5 and elderly persons		186	82.7%	-	-
1	Households with children under 5 years old	172	76.4%	364	2.1
2	Households with an elderly person aged 65 or older	49	21.8	81	1.7

Note: There are 35 households with both children under 5 years old and elderly persons over 65 years old.

Source: JICA Survey Team

Looking at the length of residence of the surveyed households, 219 households, or more than 97% of the total, have lived in the area for one year or longer, suggesting a relatively stable and long-resided environment.

[78] As of 2020, he is 64 years old. (https://data.worldbank.org/indicator/SP.DYN.LE00.FE.IN?locations=AO (accessed September 2022))

[79] The population pyramid of the Huíla and Namibe provinces is also Mt. Fuji-shaped (as noted in the EIA report).

Table 10.3-7 Years of residence (220 kV TL)

Length of one's residence	Number of households (number of houses)	Proportion
More than 1 year	219	97.3%
6-12 months	4	1.8%
3-6 months	1	0.4%
Less than 3 months	1	0.4%
Total	225	100.0%

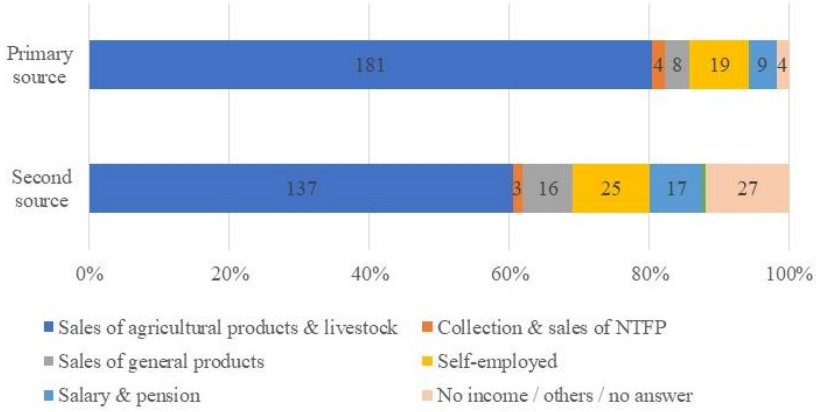
Source: JICA Survey Team

2) Household finances

Most of the surveyed households depend on agriculture for their livelihood. The production and sale of agricultural products account for 80% of their main source of income and 60% of their secondary income (the group blue area in the figure below). People selling fruits along Route 280 are a common sight during harvest season and are also sold at local markets.[80]

The next most common source of income is self-employment (yellow in the same figure) (bricklayers, electricians, carpenters, and craftsmen) (11.1% main income and 8.4% secondary income), followed by the sale of goods (gray) and salaried income and pension benefits (light blue) (each in the 7% range for main income and 3-4% for secondary income). Although people selling charcoal and firewood can be seen in the project area depending on the season, the percentage of people collecting and selling non-timber forest products as a source of income is small (orange), at 1-2% for both main and secondary income.

Households that depend on agriculture for their livelihood are largely self-sufficient in staple foods, and since many of them still procure and secure food and daily commodities through barter in this area, the level of cash income does not necessarily reflect their standard of living. Thirty-one households (13.7%) have savings, while a small number of households (33 households, 14.7%) have borrowings. Borrowing was most often "from relatives and friends".



Note: "Agricultural products" include wheat, vegetables, sugar cane, etc. Non-wood forest products" include charcoal, firewood, wild mushrooms, and fruit trees. Self-employed" includes bricklayers, electricians, carpenters, and other craftsmen, as well as motorcycle cab drivers.

Source: JICA Survey Team

Figure 10.3-1 Means of primary and secondary income among surveyed households (220 kV TL)

3) Agricultural land

When asked about access to cultivated land, 135 households (60.0%) responded "Yes" and 90 households (40.0%) responded "No." Of the 135 households that responded "Yes," the largest percentage (40 households: 34.1%) used 1-2 ha, with around 30% using less than 1 ha and 30% using 2-5 ha. The most common type of ownership was "privately owned" (120 of 135 households). When asked how long it takes them to travel from their homes, the most common response was "less than 10 minutes" (75 of 135 households), followed by "10-30 minutes" (53), "30-60 minutes" (6), and "more than 1 hour" (1). Due to the limited availability of transportation, cultivation was generally conducted

[80] However, due to the recent drought, crops have continued to fail and many people throughout the surveyed area are unemployed, and according to interviews conducted in the area, the unemployment rate appears to remain high at around 90%. The lack of satisfactory income under these circumstances has led to an accelerated increase in theft of animals and products from the fields, destruction of public property, especially the power supply for public lighting poles (solar panels) and electric pumps for wells for water consumption, etc. In addition, many young people are migrating to the provincial capital (Lubango) and other cities in search of employment.

within walking distance.

Table 10.3-8 Land use patterns (220 kV TL)

Availability of cultivated land	Number of houses	Proportion	Form of ownership		
			Private ownership	Rental	Leased land
Those with cultivated land	135	60.0%	120	3	12
Less than 1 ha	42		41	0	1
1-2 há	46		35	3	8
2 to 5 ha	40		37	0	3
More than 5 ha	7		7	0	0
Those wishout cultivated land	90	40.0%			
Total	225	100.0%			

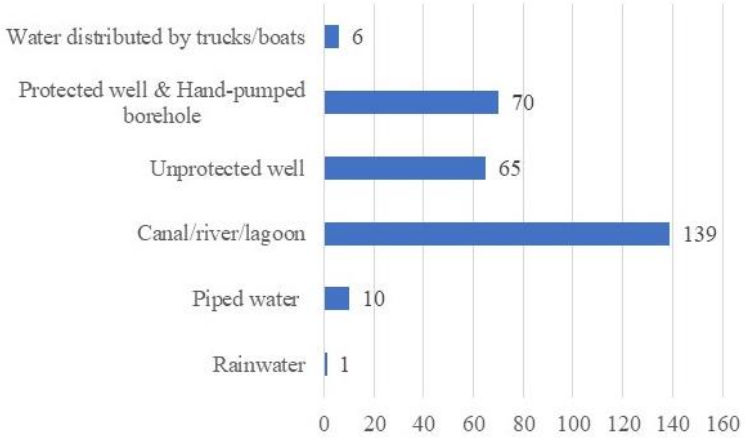
Source: JICA Survey Team

4) Living infrastructure conditions

i. Drinking water

Availability of drinking water is a serious problem throughout the project area. Surface water (canals, rivers, and lakes) is the most commonly used source among the surveyed households (139 households: 61.7%). Well water follows (total of 135 households: 60.0%), but the quality of water is not ensured in about half of them. Only 10 households (4.4%) have access to tap water.

Households spend a long time to obtain water: 137 households (60.9%) were able to obtain water within 30 minutes, 67 households (29.8%) spent between 30 minutes and one hour, and 20 households (8.9%) spent between one and two hours to obtain water. In this poor environment, 31 of 225 households (13.8%) boil or filter their water before drinking. It is possible that the households lack the energy necessary to boil the water, but it is also possible that the households are not well educated about sanitation.



Note: Multiple responses.

Source: JICA Survey Team

Figure 10.3-2 Drinking water sources (220 kV TL) used by surveyed households

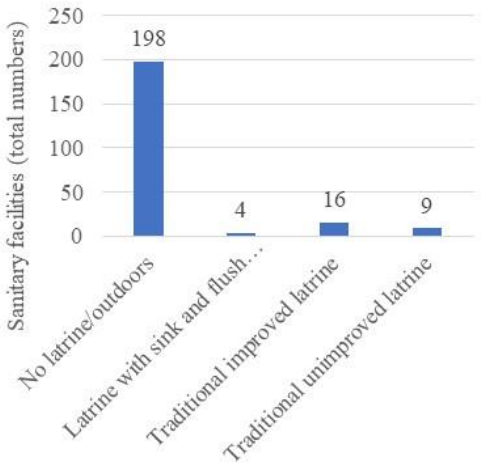
Table 10.3-9 Time spent for obtaining drinking water (220 kV TL)

Required time	Number of houses	Proportion
Within 30 minutes	137	60.9%
30 minutes to 1 hour	67	29.8%
1 to 2 hours	20	8.9%
2 to 4 hours	1	0.4%
Total	225	100.0%

Source: JICA Survey Team

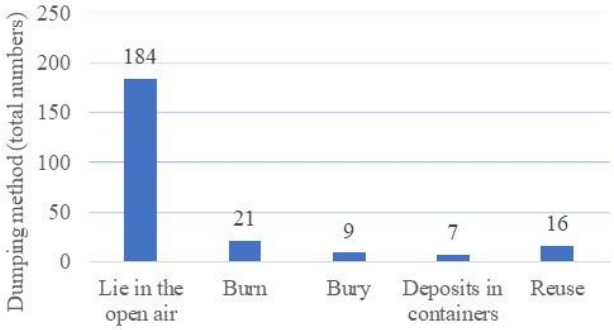
ii. Sanitation and waste disposal

The surveyed households had almost no access to sanitation facilities: 198 out of 225 households used open-air, and only 4 households had flush toilets. In addition, while there is no waste collection and disposal system in Lubango and Humpata municipalities, 184 households dumped their garbage in the community's dumping site (a depression), which is a problem that has led to the deterioration of hygiene and sanitation and the outbreak of infectious diseases in the area. The "reuse" is limited to agricultural products, such as fertilizers.



Note: Multiple responses.
Source: JICA Survey Team

Figure 10.3-3 Sanitary facility use (220 kV TL)

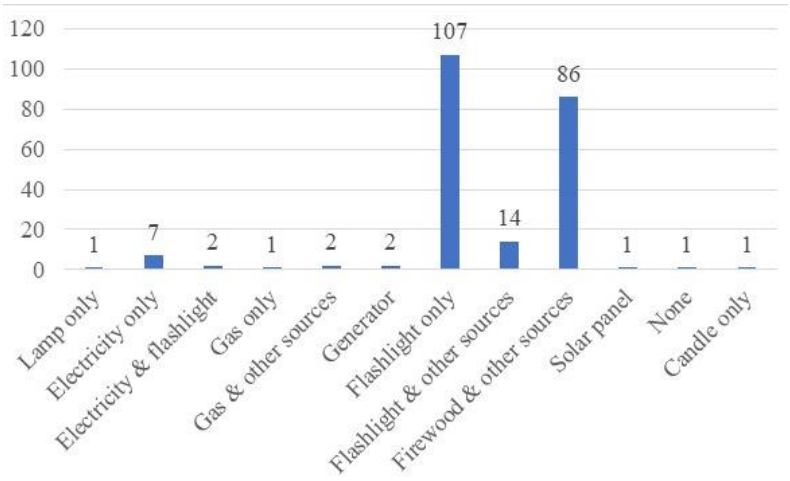


Note: Multiple responses.
Source: JICA Survey Team

Figure 10.3-4 Waste Disposal Methods (220 kV TL)

iii. Energy source

Surveyed households were asked what energy source they use for lighting. 107 of the 225 households use only flashlights for lighting, the most common, along with a combination of other means (14 households). This was followed by a combination of firewood and other means (86 households). Relatively few households used electricity, generators, gas, or other means that require supply contracts or bulk purchases.



Source: JICA Survey Team

Figure 10.3-5 Means of lighting for surveyed households (220 kV TL)

5) Education and health

i. Education

Of the 162 households (72.0%) that responded that their children "attend school," 63 (28.0%) responded that their children "do not attend school." Of the 162 households that responded that their children "go to school," 56 households responded that it takes 10 minutes or less, 79 households responded that it takes 10-30 minutes, 19 households responded that it takes 30-60 minutes, and 8 households responded that it takes 1 hour or more to get to school.

Table 10.3-10 School enrollment of children in surveyed households (220 kV TL)

Commuting time	Number of houses	Proortion
Child attends school	162	72.0%
Less than 10 minutes commuting time	56	
10-30 minutes commuting time	79	
30 to 60 minutes commuting time	19	
Commuting time more than 1 hour	8	
Child does not attend school	63	28.0%
Total	225	100.0%

Source: JICA Survey Team

(2) Health

When asked about diseases and infections they had contracted within the past year, malaria was by far the most common (200 cases) among residents of the surveyed areas. It was followed by cholera (25 cases) and typhoid fever (23 cases). No diseases such as hepatitis or HIV AIDS were identified.

When asked to list the medical facilities and referrals they use, 149 households (66.2%) indicated that they use the community health center/health post most often. This was followed by public and private hospitals (73 households: 32.4%) and traditional medicine (3 households: 1.3%). The second and third most frequently used medical facilities were one of these three.

Table 10.3-11 Frequently used health facilities and referrals (220 kV TL)

Health Facilities and Referrals	Most Frequently Used	Second most frequently used	Third most frequently used
Community health centers/health post	149	14	0
Traditional medicine	3	14	22
Public and private hospitals	73	32	8
Ngo	0	0	0
Pharmacist	0	0	0
Friends and relatives	0	0	0
Other	0	0	1
Total	225	60	30

Source: JICA Survey Team

"Cost" was cited by 157 households (69.8%) as the use of these choices. "Effectiveness/reliability" was next, cited by 55 households (24.4%), suggesting that this was a factor in their regular use of the service.

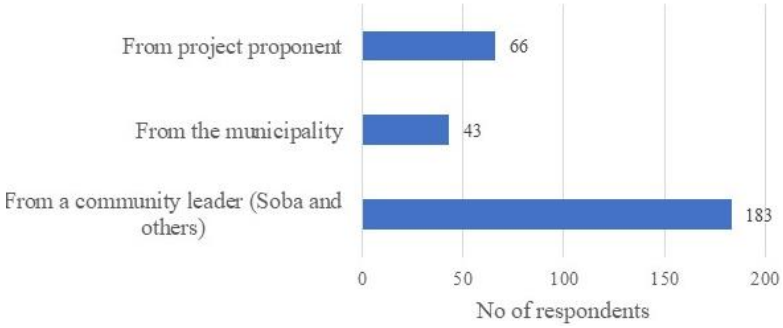
Table 10.3-12 Reasons for selection (220 kV TL)

Reason for selecting health institution	Number of respondent	Proportion
Cost	157	69.8%
Distance	7	3.1%
Religion/traditional beliefs	6	2.7%
Effectiveness / confidence	55	24.4%
Other	0	0.0%
Total	225	100.0%

Source: JICA Survey Team

6) Information sharing and communication regarding business

When asked from whom they would like to obtain information about the project, 183 households indicated that they would like to obtain information through community leaders such as Sobas. In rural areas of Angola, it is common that traditional leaders, i.e., Sobas, coordinate opinions and handle complaints, and it was confirmed during this social survey period that local government organizations have great trust in this role.



Note: Multiple responses.

Source: JICA Survey Team

Figure 10.3-6 Individuals/organizations wishing to share and communicate information about their projects (220 kV TL)

Regarding in which form they would like to receive information, 204 of 225 (90.7%) respondents (90.7%) would like to receive verbal explanations, while 21 (9.3%) would like to receive written notice. Some respondents were identified as being afraid to give their opinions to the local community coordinator for any reason (20 out of 225 houses).

(2) 60 kV DL

1) Survey Respondents and Household Members

An initial baseline survey was conducted with 102 households in a total of 8 settlements in Arimba commune, Lubango Municipality, Huíla Province, along the 9 km 60 kV DL between the 220/60 kV East Lubango SS and the 60/15 kV Arimba SS, where social impacts are expected.

Table 10.3-13 Number of households surveyed on 60 kV DL and their distribution

No.	Municipality	Commune	Settlements/villages	Number of households
1	Lubango	Arimba	Poaires Muhaha	6
2			Poiares Kapandi	54
3			Figueira	1
4			11 de Novembro	16
5			Gazeta	10
6			Lola.	5
7			Mupanda.	6
8			Arimba Headquarters	4
Total				102

Source: JICA Survey Team

Of the 102 households, 73 were represented by the household head, of which 18 were female.[81] The average age of the household head was 41.1 for males and 41.0 for females; the youngest head of the household was 24 years old for males and 19 years old for females; the oldest head of the household was 80 years old for males and 84 years old for females; the 102 households had 646 members (331 males and 315 females) with an average household size of 6.33 members.

Table 10.3-14 Attributes of survey respondents (60 kV DL)

Attribute	Male	Female	Total	Proportion
Household head	55	18	73	71.6%
Other than the household head	8	21	29	28.4%
Total	63	39	102	100.0%

Source: JICA Survey Team

The educational level of the 102 survey respondents differs largely from the settlements along the 220 kV TL. The largest number of respondents (39 or 38.2%) had secondary school level education, followed by elementary school (31 or 30.4%), and 17 respondents had high school and higher education, accounting for 17.7% of the total. Those who had no schooling but could read and write and those who were illiterate with no schooling accounted for less than 15% of the total, with 5 (4.9%) and 10 (9.8%), respectively.

Table 10.3-15 Education of Survey Respondents (60 kV DL)

Educational level	Number of people	Proportion
Higher eduation	6	5.9%
Middle education	11	10.8%
Secondary education	39	38.2%
Primary education	31	30.4%
Literate	5	4.9%
No education	10	9.8%
Total	102	100.0%

Source: JICA Survey Team

The table below shows the number of households with vulnerable populations such as children under 5 years old and elderly persons over 65 years old, the population concerned, and the average number of persons per household out of the 102 households surveyed.

[81] As with the survey respondents along the 220 kV transmission route, the wife is often alone, with the husband in a separate household providing livelihood support.

Table 10.3-16 Households with children under 5 and elderly persons and their distribution (60 kV DL)

Presence of children under 5 years old and elderly		Number of households (Number of houses)	Ratio	Number of persons concerned (persons)	Average number of persons per household (persons)
Households with children under 5 and elderly persons		78	76.5%	-	-
1	Households with children under 5 years old	71	69.6%	126	1.8
2	Households with an elderly person aged 65 or older	14	13.7%	21	1.5

Note: There are 7 households with both children under 5 years old and elderly persons over 5 years old.

Source: JICA Survey Team

The table below shows the number of households with children under 5 years old and elderly persons over 65 years old, the population, and the average number of persons per household out of the 225 households surveyed. The number of households with children under 5 years old is 69.6% (71 out of 102 households), accounting for 19.5% of the total household population (126 out of 646 persons), while the number of households with elderly persons 65 years old or older is 13.7% (14 out of 102 households), accounting for 3.3% (21 out of 646 persons) of the total household population. The average number of household members is 6.6. While the average household size is 6.33 persons, the average number of children under 5 and elderly persons over 65 per household is only 1.8 and 1.5 persons, respectively, and with many caretakers and workers, the socioeconomic burden on households is relatively low.

Looking at the length of residence of the surveyed households, 95.1% (97 households) of all households have lived in the area for one year or longer, indicating a relatively stable and long-resided environment.

Table 10.3-17 Years of residence (60 kV DL)

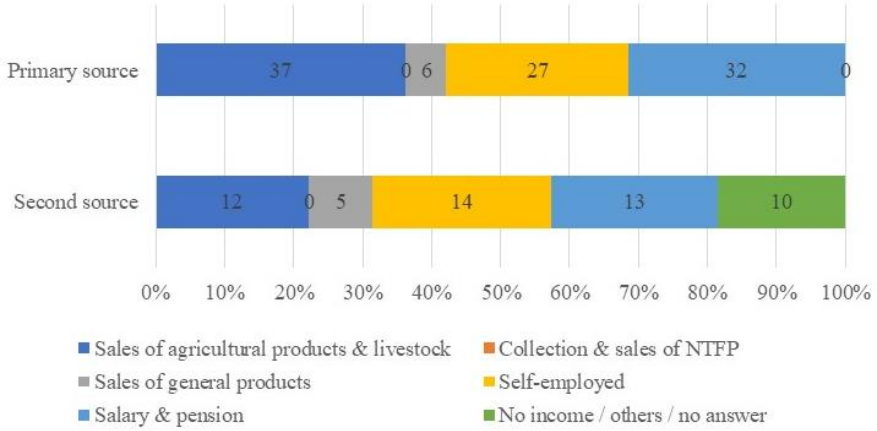
Length of one's residence	Number of households (number of houses)	Proportion
More than 1 year	97	95.1%
6-12 months	3	2.9%
3-6 months	0	0.0%
Less than 3 months	2	2.0%
Total	102	100.0%

Source: JICA Survey Team

2) Household finances

Agriculture is the main source of income for almost 40% of the surveyed households (the blue area in the figure below), followed by salaried/pension income (over 30%) and self-employment (over a quarter of the total). Looking at secondary income, self-employment, salaried workers/pensioners, and agriculture are almost equally represented, suggesting that the wide range of occupational choices along the 60 kV DL and the geographical advantage of being in a semi-urban area even outside of Lubango City are reflected in household income. The percentage of goods selling remained low, with zero collection or sale of non-timber forest products.

The study area is located in a semi-urban area near the city of Lubango and is more integrated into cash economy than the study population along the 220 kV TL route, but it is still customary to procure and secure food and other necessities of life through barter. Seventeen households (16.7%) had savings, and the same number of households had borrowing. Borrowing "from relatives and friends" was the most common response.



Note: "Agricultural products" are mostly staple foods such as wheat. The majority of "self-employed" are artisans such as bricklayers, electricians, and carpenters.

Source: JICA Survey Team

Figure 10.3-7 Means of primary and secondary income for surveyed households (60 kV DL)

3) Agricultural land

Although the percentage of respondents whose main income was from agriculture was lower than in the communities along the 220 kV TL, as mentioned above, 67 households (65.7%) had "access" to cultivated land. When asked about the area used by these 67 households, 1 ha was the most common (40 households: 59.7%), followed by 1-2 ha (25.4%) and 2-5 ha (14.9%), all of which were "privately owned". The time to travel from home was "less than 10 minutes" for 40 of the 67 households, "10-30 minutes" for 17, "30-60 minutes" for 4, and "more than 1 hour" for 6.

Table 10.3-18 Land use patterns (60 kV DL)

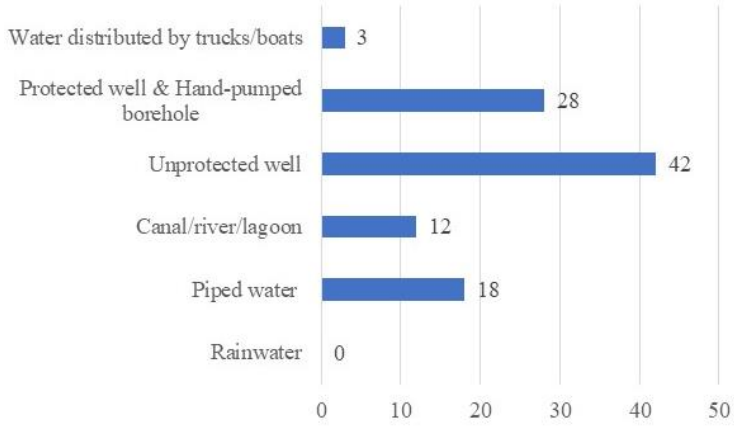
Availability of cultivated land	Number of houses	Proportion	Form of ownership		
			Private ownership	Rental	Leased land
Those with cultivated land	67	65.7%	67	0	0
Less than 1 ha	40		40	0	0
1-2 ha	17		17	0	0
2 to 5 ha	10		10	0	0
More than 5 ha	0		0	0	0
Those without cultivated land	35	34.3%			
Total	102	100.0%			

Source: JICA Survey Team

4) Living Infrastructure

i. Drinking water

Unlike the surveyed residents along the 220 kV TL, unprotected wells were the most commonly used among the surveyed households along the 60 kV DL (42 households: 41.2%). On the other hand, protected wells/drilled hole pumping and tap water were also relatively common (28 and 18 households, respectively). The proximity to urban areas and the planned development of some urban areas suggest that the basic infrastructure is relatively well developed.



Note: Multiple responses.

Source: JICA Survey Team

Figure 10.3-8 Drinking water sources used by surveyed households (60 kV DL)

The time spent to obtain water was better than along the 220 kV TL, with 75 households (73.5%) spending "within 30 minutes" and 21 households (20.6%) spending "30 minutes to 1 hour".

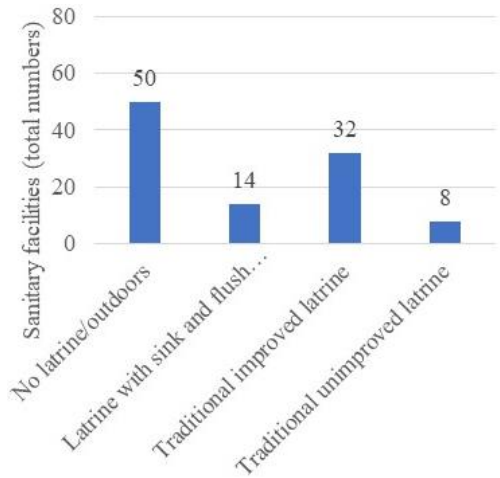
Table 10.3-19 Time spent for obtaining drinking water (60 kV DL)

Required Time	Number of houses	Proportion
Within 30 minutes	75	73.5%
30 minutes to 1 hour	21	20.6%
1 to 2 hours	4	3.9%
2 to 4 hours	2	2.0%
Total	102	100.0%

Source: JICA Survey Team

ii. Sanitation and waste disposal

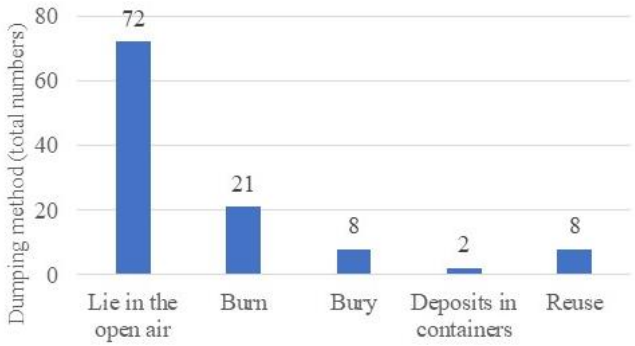
Fifty of the 102 surveyed households used open-air toilets, but the use of flush toilets was high (14 households). In addition, conventional and improved toilets were used by many households (32 households). On the other hand, since there is no waste collection and disposal system in Lubango Municipality, 72 households disposed of their garbage directly at the community's dumping site (depression), while 21 households "burned" (21 households), 8 households "buried" (8 households), and 8 households "reused" (8 households), respectively.



Note: Multiple responses.

Source: JICA Survey Team

Figure 10.3-9 Sanitation facility use (60 kV DL)



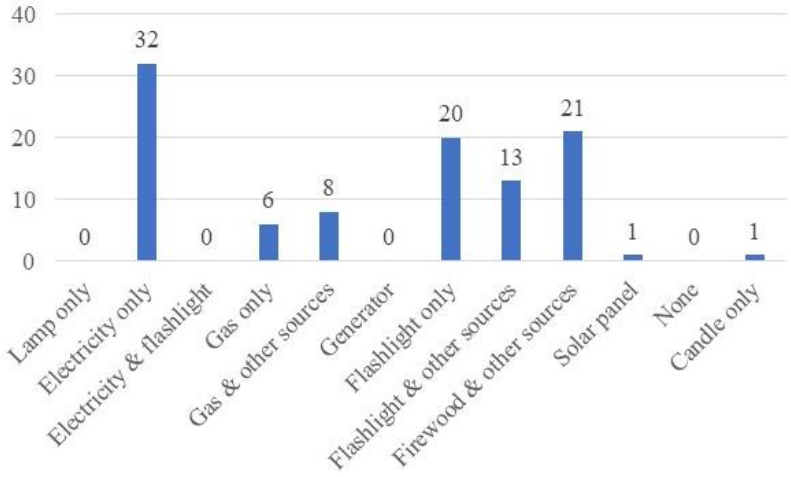
Note: Multiple responses.

Source: JICA Survey Team

Figure 10.3-10 Waste Disposal Methods (60 kV DL)

iii. Energy source

The households were asked about the energy source they use for lighting. 32 households used only electricity because the area along the 60 kV DL is semi-urban near Lubango, while a total of 33 households used only flashlights or a combination of flashlights and other means. In addition, 21 households used both firewood and other means.



Source: JICA Survey Team

Figure 10.3-11 Means of lighting for surveyed households (60 kV DL)

5) Education and healthcare

i. Education

When asked how long it takes their children to get to school, 27 households answered "10 minutes or less," 43 households answered "10 to 30 minutes," and 4 households answered "30 to 60 minutes" and "more than 1 hour," indicating that the convenience of educational facilities is relatively good.

Table 10.3-20 Enrollment of children in surveyed households (60 kV DL)

Commuting time	Number of houses	Proportion
Child attends school	78	76.5%
Less than 10 minutes commuting time	27	
10-20 minutes commuting time	43	
30 to 60 minutes commuting time	4	
Commuting time more than 1 hour	4	
Child does not attend school	24	23.5%
Total	102	100.0%

Source: JICA Survey Team

(2) Health

When asked about the status of diseases and infections, malaria was by far the most common among the residents of the surveyed area, at 88 out of 102 homes. Cholera and typhoid fever were reported by 2 and 1 household, respectively, while diseases such as hepatitis, HIV AIDS, and cancer were not identified. This situation can be attributed in part to the high prevalence of tap water, flush toilets, and improved toilets.

The most frequently used medical facilities and referral sources were community health centers/health posts (98 households, 96.1%), indicating their accessibility. Public/private hospitals (32 out of 39) stood out as the second most frequently used facility. While traditional medical care remained low, "friends/relatives" and "pharmacists" were the most frequently cited sources of referrals, indicating a greater number of options and information in areas close to urban areas.

Table 10.3-21 Frequently used health facilities and referrals (60 kV DL)

Health institutions and inquiries	Most Frequently Used	Second most frequently used	Third most frequently used
Community health centers/health post	98	1	0
Traditional medicine	0	0	3
Public and private hospitals	3	32	3
Ngo	0	0	0
Pharmacist	0	0	0
Friends and relatives	1	6	6
Other	0	0	0
Total	102	39	12

Source: JICA Survey Team

Sixty-nine households (67.6%) cited "cost" as the use of these choices. “Effectiveness/reliability” was next, followed by 28 households (27.5%), suggesting that this was a factor in their regular use of the service.

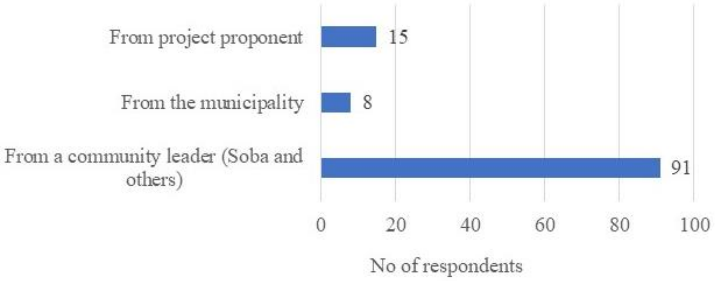
Table 10.3-22 Reasons for selection (60 kV DL)

Reason for selecting health institution	Number of houses	Proportion
Cost	69	67.6%
Distance	4	3.9%
Religion/traditional beliefs	1	1.0%
Effectiveness/trust	28	27.5%
Other	0	0.0%
Total	102	100.0%

Source: JICA Survey Team

6) Information sharing and communication regarding business

When asked from whom they would like to obtain information about the project, 91 households indicated that they would like to obtain information through community leaders such as Soca. This result confirms that the presence of Soba as a traditional leader is strong not only in rural areas but also in areas close to urban areas. However, some respondents (12 out of 102 households) were afraid to freely express their opinions to the local community coordinator. Therefore, it is necessary to disseminate information on the project from various angles and to elicit the frank opinions of residents.



Note: Multiple responses.

Source: JICA Survey Team

Figure 10.3-12 Individuals/organizations wishing to share information and communicate about their business (60 kV DL)

When asked in what form they preferred to receive information, 89 of the 102 respondents (87.3%) preferred to receive verbal explanations, while 13 (12.7%) preferred written communication, indicating the importance placed on the reliability of obtaining information directly, both in urban and rural areas.

10.3.4. Vulnerability

As a result of discussions with RNT/ENDE and local government officials to minimize negative impacts on the local population and to consider alternatives, the number of affected residents, movable and immovable properties on the transmission and distribution line routes were avoided and minimized to the extent possible. The initial baseline survey identified that the number of children under 5 years old per household is around 2 although their population is relatively large compared to other generations, and that the population of elderly persons over 65 years old is small, with less than 2 persons per household (see 10.3.3). At an average household size of more than 6 persons, the study confirmed the availability of personnel to take care of these people. A small number of female household heads were identified, but they received livelihood support from other households, and cooperation among multiple households was a prerequisite. Regardless of the presence or absence of blood relations, the local community was observed to be mutually supporting each other.

In terms of household economy, the average monthly cash income per household for all surveyed households was 52,580 Kwanza (equivalent to US$88 at the end of 2021 conversion rate). However, since bartering for food and daily necessities is very common among the residents of the project-affected areas, and households whose main occupation is farming, mainly along the 220 kV TL route, are self-sufficient in staple foods, it was determined that it would not be appropriate to determine the household income level based on cash income expenditure alone.

In light of the survey results, it was difficult to objectively measure the socio-economic vulnerability of the affected population, so the Multidimentional Poverty Index[82], an index adopted by the United

[82] http://hdr.undp.org/en/content/multidimensional-poverty-index-mpi

Nations in place of the Human Poverty Index , was used as a reference to verify whether the affected population includes socially vulnerable people who need special assistance.

The MPI reflects the extent to which multiple forms of poverty overlap at the household level, and in the survey[83] in Angola, analysis was conducted in terms of health, education, quality of life, and employment, in which nutrition, maternal and child health, neonatal mortality, resident registration, years of education, school attendance, cooking fuel, electrification, housing, assets, water, sanitation, child labor, adult unemployment rate, youth unemployment rate, and dependency were used as indicators for the study. The results reported that 54.0% of the population nationwide, 35.0% in urban areas, and 87.8% in rural areas were living in multidimensional poverty. In Huíla and Namibe provinces, 10 and 3 municipalities, respectively, had MPIs above 90%, but these municipalities above 90% were not among the initial baseline survey area. In terms of the situation of the surveyed population, physical access to health care and education is good, although there is significant room for improvement regarding water and sanitation. In rural areas, particularly along the 220 kV TL route, there is a high dependence on land as a source of livelihood and income, but barter, which is a popular activity in rural areas, supplements cash income and supports household economy. No disabled residents or widows were identified in the surveyed households, and as noted above, women were supported beyond the household, children and the elderly were supported by their families, and no single household members were found to be living alone.

Based on the above, no "socially vulnerable groups" requiring special assistance were identified among the affected households. However, if the severe drought seen for the past several years continues, the situation may worsen. When topographic survey and detail design are conducted during the project implementation period, tower locations and power line routes will be finalized. Land boundaries will be clarified by the authorization of local government and Sobas, following which the project affected people will be identified more precisely when updating ARAP than this Preparatory Survey. When doing so, socioeconomic vulnerability of the project affected people shall be grabbed objectively by referring MPI and other indicators. In addition, it is desirable to create job opportunities and local business opportunities during the construction period, and develop local infrastructures which are associated with the project, based on the assumption that they will be utilized in local life, for example, making permanent access road during the construction period.

10.4. Compensation and Assistance Measures

Specific details of compensation and assistance are described below. The initial baseline results are only preliminary results as of the time of this Preparatory Survey. Once the transmission and distribution line routes and tower construction points are finalized based on the contractor's geological and topographical surveys, the information on affected residents will be updated and a Detailed Measurement Survey (DMS) will be conducted. The objectives of the DMS are: a) to identify structures, crops, and trees to be compensated, detailed information on the affected households to be affected by the loss, and the amount of compensation; b) to secure land for replacement sites and structures; and c) to collect socio-economic data on all affected households to identify losses of livelihoods and their recovery needs.

Based on the results of the loss assessment study, the exact nature of the impacts will be clarified and detailed compensation rates and restoration measures will be prepared. Livelihood restoration activities will be discussed again with the affected population during the finalization of the affected population and the plan will be fixed. This information will be reflected in the updated ARAP.

The Portuguese version will be made available at the project office since the local population has learned to read and write in Portuguese through schooling. On the other hand, translation into the languages which local ethnic groups speak will not likely made as they are not used for reading or writing. The illiterate will be informed through family members or neighbors.

[83] The National Statistics Office (Instituto Nacional de Estatística), the United Nations Development Program (UNDP), and the Oxford Poverty and Human Development Initiative (OPHDI) conducted the survey in 2015-16.
https://www.ine.gov.ao/Arquivos/arquivosCarregados//Carregados/Publicacao_637494425092204878.pdf

10.4.1. Compensation for Losses

The three substations in the project (totaling 5.65 ha) are publicly owned and ENDE, and no private land will be acquired. No habitation, illegal occupation, or economic activities have been confirmed in the proposed substation construction sites. Therefore, no compensation for economic losses, such as resettlement or loss of means of livelihood, is envisaged.

On the other hand, since clearance of the transmission and distribution line ROW will be conducted during the construction period, approximately 300 ha of the transmission line ROW and 13 ha of the distribution line ROW will be subject to land use restrictions as the ROW of the 220 kV TL and the 60 kV DL of the project is 45 m and 24 m, respectively. Compensation will be required for tree clearing and impacts on agriculture and other productive activities, residences, and commerce associated with the clearance. In addition, since the land use for towers, their foundations and surroundings, access roads, material storage areas, and restricted access areas will not be available during the construction period due to safety considerations, and compensation is expected for the temporary acquisition of private and used lands included in these areas. In light of the fact that there is no confirmed provision in the Angolan national law (Land Law) that makes compensation for the establishment of easements an obligation, that the payment of land use fees is rare, and that the AfDB and UK supported projects have not provided compensation for the establishment of easements, as described in Tables 10.2-3 and 10.2.5. Compensation for actual damages associated with the negative impacts on permanent and temporary rights to land use of the affected residents of tower locations and ROW shall be provided. As a result, the land for the towers and the ROW maintenance site shall be assumed to be acquired on a permanent basis. In addition, while the land under the ROW will be available for private use when the project is in service, the height of buildings and tree crops will be restricted in order to maintain a vertical separation distance[84] from the lines. For this reason, compensation for the difference in value compared to the building/tree crop before construction is assumed.

Since alternative plans (transmission and distribution routes and substation construction sites) were considered during the technical study process and a project plan based on these plans was developed to minimize social impacts, land use impacts and resettlement along the transmission route in Moçâmedes and Bibala Municipalities are not anticipated. However, land use impacts and associated livelihood impacts in the more populated Lubango and Humpata municipalities may occur. Losses and compensation for them resulting from the project are as follows

(1) Land

Agricultural lands in the ROW will be affected, mainly in Humpata Municipality along the 220 kV TL route. ROW clearance during construction and access restrictions will be in place for a certain period of time. The same applies to non-agricultural land.

RNT/ENDE have shown their intensions to provid alternative land whenever possible, based on past cases where problems occurred when cash compensation was provided to residents in other projects. In such cases, it is necessary to provide alternative land in close proximity with equivalent or similar conditions and productivity, or to reclaim the land for agricultural operations, etc. Residents have the freedom to choose whether to receive compensation in kind or in cash, and both parties are required to discuss and agree at the project implementation stage. Some activities require monetary provisions such as crop compensation and transitional support.

Initial baseline surveys have identified residents who do not necessarily have ownership rights, and have also confirmed the importance of the role of Sobas and other community leaders in rural areas. In coordinating with the local government and community leaders in the form of compensation, assessment and local coordination, the intervention of the local government and community leaders will ensure appropriate and fair handling of the situation.

(2) Residential buildings and other structures

ROW clearance during construction, as well as buildings such as residences and other structures will be affected by height restrictions during service.

As with the land, RNT/ENDE are considering taking action in the direction of providing alternative structures whenever possible, but it is necessary for the two parties to discuss at the project implementation stage and reach an agreement with the residents on which type of compensation will be provided.

[84] For separation distances between power lines and structures/trees, see 7.2.6 (220 kV TL) and 7.3.5 (60 kV DL), respectively.

(3) Crops and trees

Crops and trees would be removed as land located within the ROW would be impacted and ROW clearance would take place during construction. Compensation for these crops and trees will be monetary compensation based on the replacement cost. Since height restrictions associated with securing the separation distance will be imposed when the land is restored to service, the difference in value between the two is also subject to compensation.

Since few local residents depend on the collection of non-timber forest products as a source of income (see "Household and Livelihood Survey" results above), and because of the proximity of alternative forest lands, no long-term negative impacts on livelihoods from tree harvesting under the ROW are anticipated.

(4) Cutoff date

RNT/ENDE state that no cut-off date declaration will be made prior to project implementation. This is due to the fact that the national law stipulates that the compensation requirements for land acquisition will be materialized only after the official decision to implement the public works, and also because the transmission and distribution routes and tower locations will be finalized after detailed design and geological survey by the contractor, which is likely to result in changes in the number and location of affected residents identified in the Preparatory Survey. By the time the cut-off date is declared, there may be new population inflows other than those identified in this Preparatory Survey, and those people will also be included in the compensation coverage.

In this project, the route and substation construction site will be finalized at the stage of detailed design or after contractor selection, and the location of material storage and access road will be fixed, depending on the contractor procurement method. Around this time, RNT/ENDE will declare a cut-off date and hold another round of consultations with the affected population to provide compensation in advance or alternatives. Information on the affected population will be updated prior to the actual compensation payment.

10.4.2. Livelihood Restoration Measures

Those to be resettled because of the project will likely remain within the village where they originally belong to, and the same is true for alternative land. Soba in each of the villages interviewed in this survey indicated that there is sufficient land available for this purpose, and the need for livelihood restoration assistance is expected to be relatively limited.

Since agriculture is the primary livelihood and means of subsistence for the affected households, the primary objective of the Livelihood Restoration Plan is to assist the target population to quickly resume and improve their agricultural activities. Households that do not have access to suitable alternative farmland due to financial hardship, lack of nearby farmland, or the farmland available is not suitable for the farming methods they have been using, will require special additional support in line with agricultural assistance programs. In implementing livelihood restoration activities, the following activities are envisaged:[85] .

(1) Agricultural Assistance Program

The Agricultural Assistance Program provides basic agricultural inputs to help households recover crops on new land or increase their income on existing land even if new land is not available. Each household will be provided with high quality seeds at the time of contract signing.

(2) Additional support for livelihood recovery

If necessary, additional livelihood restoration activities will be considered to assist the affected and vulnerable households that are not likely to earn their livings. Specific activities will be determined in consultation with the target population, but in consultation with the Ministry of Agriculture and other relevant agencies, activities to support livelihood restoration will be considered, while for households living in peri-urban areas, training to increase the productivity of local commerce and small commercial activities will be considered.

(3) Transitional period support

Households in need of assistance during the transition period, such as farm work on alternative farmland or relocation of commercial facilities, will be provided with assistance to restore their livelihoods for a period of approximately six months.

[85] See 6.5 of the ARAP for more information.

(4) Local employment opportunities

The project is expected to employ skilled and semi-skilled workers mainly from urban areas in Luanda, Humpata, Lubango, Bibala, and Moçâmedes municipalities, while unskilled positions such as construction workers, foresters, security guards, cooks, and cleaners will be recruited from the local community. Local employment during the construction period is expected to compensate for the loss of livelihood due to temporary disruption of land acquisition and agricultural work during the construction period.

RNT/ENDE are responsible for implementing the livelihood restoration measures (see Table 10.6-1). Support will be provided by local government departments as needed. The cost will be allocated by MINEA/Ministry of Finance, including the difference between Angolan national law and JICA GL (see Table 10.6-1). See 10.7 for the duration. In the case of resettlement of the affected people, the policy is to relocate them within the settlements where they live as much as possible (see 10.4.2), and the implementation of assistance measures will be carried out in or near these settlements. See 10.6 and 10.9.1 for monitoring methods and systems.

10.4.3. Entitlement Matrix

The types of losses, entitlements of compensation and assistance, compensation details, and responsible agencies are listed in the table below.

Table 10.4-1 Entitlement Matrix

No.	Type of Loss	The Eligible	Compensation	Implementation Issues and Guidelines	Responsible Organization
Housing Land and Buildings					
1	Land lot	• Residents with legal land ownership rights	Provision of alternatives or monetary compensation *1 • Provide alternative land with equivalent or similar conditions in close proximity or • Monetary compensation based on replacement cost	• Coordination and provision of alternative land by local government and RNT/ENDE. • In the case of monetary compensation, verification by a third party (Land Department, etc.) shall be conducted when assessing land value. • The existence of any impact of the project, such as a decline in the assessed value of the land formerly owned under the transmission and distribution lines, will be confirmed, and if anticipated, will be appropriately reflected in the compensation cost.	• MINEA • RNT/ENDE • local government
		• Residents with customary rights • Residents occupying public lands without legal basis		• Coordination and provision of alternative land by local government, RNT/ENDE and Soba. • In the case of monetary compensation, verification by a third party (Land Department, etc.) shall be conducted when assessing land value. • In selecting and securing alternative	• MINEA • RNT/ENDE • local government • Soba

No.	Type of Loss	The Eligible	Compensation	Implementation Issues and Guidelines	Responsible Organization
				sites, ensure Soba involvement. • Endorsement of customary ownership is obtained from Soba.	
2-1	Residential building	• Building owners with legal rights (urban and semi-urban)	Provision of alternative structures or monetary compensation[*1] • Provide structures based on replacement cost[*2] or • Monetary compensation based on replacement cost	• Alternative structures shall be the provision of an equivalent or better structure. It shall also be secured at a location that is as close and nearby as possible. Since residential buildings will need to be relocated from under the transmission and distribution lines, any reduction in convenience or value resulting from the relocation from the previous location will be identified and, if anticipated, reflected in the compensation cost. • RNT/ENDE will assist in the process of acquiring ownership of the replacement structure. • In the case of monetary compensation, verification by a third party (Land Department, real estate appraiser, etc.) when assessing real estate value.	• MINEA • RNT/ENDE • local government
			Nuisance or annoyance charge • Provide a nuisance fee equal to 10% of the replacement cost[*3]	• Only one offer shall be made, even if the recipient is eligible for more than one entitlement.	
		• Dwelling owners with customary rights (rural areas) • Dwelling owners who reside without legal basis on public lands	Provision of alternative structures or monetary compensation[*1] • Provide structures based on replacement cost[*2] or • Monetary compensation based on replacement cost	• Support the rebuilding of self-built housing, providing equivalent or better structures and securing alternative structures at nearby/neighboring locations where possible. Any reduction in convenience or value caused by moving from the previous location will be identified and, if	• MINEA • RNT/ENDE • local government • Soba

No.	Type of Loss	The Eligible	Compensation	Implementation Issues and Guidelines	Responsible Organization
				foreseeable, reflected in compensation costs. • Coordination and provision of alternative land by local government, RNT/ENDE and Soba. • In selecting and securing alternative land, ensure Soba involvement. • Endorsement of customary ownership is obtained from Soba.	
			Nuisance or annoyance charge • Provide a nuisance fee equal to 10% of the replacement cost*3	• Only one offer shall be made, even if the recipient is eligible for more than one entitlement.	
2-2	Living-related buildings/structures*4	Owner	Monetary compensation • The monetary compensation shall be based on the replacement cost.	• In assessing the price, verification by a third party (e.g., Land Department, facility maintenance personnel, etc.) shall be conducted.	
			Nuisance or annoyance charge • Provide a nuisance fee equal to 10% of the replacement cost*3	• Only one offer shall be made, even if the recipient is eligible for more than one entitlement.	
2-3	Livelihood-related movable property*5	Owner of movable property	Provide assistance with transportation (approx. 100 USD / house*6)		• MINEA • RNT/ENDE • local government • Soba
Agricultural Land and Crops					
3	Agricultural land	• Residents with legal land ownership rights	Compensation or monetary compensation by alternative location*1 • Provide alternative agricultural land with equivalent or similar conditions in close proximity • Provide assistance in moving farmland (approx. 100 USD/house*6) • Provide costs required for land preparation*7 or • Monetary compensation based on replacement cost • Participation in Livelihood Restoration Programs	• Coordination by local government and RNT/ENDE and implementation of alternative farmland provision. • In the case of monetary compensation, verification by a third party (e.g., Agriculture Department, Land Department, etc.) shall be conducted at the time of land value assessment. • The existence of any impact of the project, such as a decline in the assessed value of the land formerly owned under the transmission and distribution lines, will be confirmed, and if any impact is anticipated, it will be appropriately reflected	• MINEA • RNT/ENDE • local government

No.	Type of Loss	The Eligible	Compensation	Implementation Issues and Guidelines	Responsible Organization
				in the compensation cost.	
		• Residents occupying land based on customary rights • Residents occupying public lands without legal basis		• Coordination and provision of alternative farmland by local government, RNT/ENDE and Soba. • In the case of monetary compensation, verification by a third party (e.g., Agriculture Department, Land Department, etc.) shall be conducted at the time of land value assessment. • In selecting and securing alternative farmland, ensure the involvement of Soba. • Endorsement of customary ownership is obtained from Soba.	• MINEA • RNT/ENDE • local government • Soba
4	Crops & Trees	• Owner with legal basis • Owners with customary rights • Peasants and laborers	Monetary compensation • Crop and tree compensation based on replacement cost • Provision of cost for land preparation*7 • Participation in Livelihood Restoration Programs	• In assessing the price, a third party (Land Department, Agriculture Department, etc.) shall perform verification. • Consideration will also be given to the cost of making up for any reduction in yield or value of replacement crops/trees due to cultivation at the alternative land, and support for the transition period and until fruit trees are obtained. • When resuming agricultural operations under transmission and distribution lines, the impact of height restrictions (e.g., whether or not crops equivalent to the previous monetary compensation can be cultivated) should be confirmed in advance and, if so, reflected in compensation costs.	• MINEA • RNT/ENDE • local government • Soba

No.	Type of Loss	The Eligible	Compensation	Implementation Issues and Guidelines	Responsible Organization
				• Cash crops and fruit trees should be acquired after the harvest season whenever possible.	
Commercial and industrial buildings					
5	Commercial/Industrial Facilities[*8]	Owner/employer	Monetary compensation • The monetary compensation shall be based on the replacement cost.	• Third-party verification (e.g., Land Department, Economic Development Department, Labor Department, real estate appraisers, etc.) shall be performed when assessing the value. • Assessment based on traditional profits, subject to agreement with RNT/ENDE. • The cost of demolishing the building and rebuilding the business in an alternative location will also be considered.	• MINEA • RNT/ENDE • local government • Soba
			Nuisance or annoyance charge • Amount equal to opportunity cost loss for 6 months [*9]		
		Employee	Monetary compensation • Amount equal to opportunity cost loss for 3 months [*10] • Participation in Livelihood Restoration Programs		

Note 1: Any permanent or temporary loss is acceptable. RNT/ENDE basically allow to continue using the alternative structures / agricultural lands provided as a temporary use after the completion of the construction. When the alternative land is returned, discussions will be held with the local government and Soba to determine how it can be used afterwards.
Note 2: Depreciation is not taken into account.
Note 3: In line with the AfDB financing case, the nuisance fee was estimated at 10% of the replacement cost.
Note 4: Cowsheds, fences, gates, and walls.
Note 5: Includes livestock.
Note 6: Payment of taxes and other costs associated with agricultural land transfers and other transfers, as well as the preparation of documents such as land registration and application fees will be required. These are estimated to be approximately 100 USD; the same amount is quoted as a cost estimate for projects financed by AfDB and WB.
Note 7: Cost of labor and other expenses such as land clearing.
Note 8: Commercial buildings and factories.
Note 9: The time frame was set at 6 months, taking into account the time needed to find new property, work on relocating stores and factories, and return profits to prerelocation levels.
Note 10: It is assumed that there is no other means of livelihood or source of income during the period (set as 3 months) before returning to work at the new store/factory.

Source: JICA Survey Team

10.5. Grievance Redress Mechanism

The grievance mechanism is an important system as it is an opportunity for each RNT/ENDE and the community to identify issues related to social impacts associated with project implementation and to find solutions and remedies together.
At the project site, a framework for responding to complaints will be established, and investigations will be conducted based on the intent and purpose of the complaint, which will then be addressed to the affected residents.

Figure 10.5-1 Grievance Redress Mechanisms for Social Impact

Source: JICA Survey Team

The grievance mechanism will be formally established during the implementation of the project, although it will be a reasonable mechanism involving the traditional community leaders of Soba and others. The grievance mechanism will handle all issues related to the project, including those related to construction, land acquisition, and compensation. The roles of the parties involved in the grievance mechanisms at each level are described below.

10.5.1. Individual-Level Grievance

Disputes may arise among residents due to the receipt of compensation or the provision of alternatives, and various other problems related to the construction work may arise. Project officials will receive local complaints related to the project, provide painstaking and continuous explanations, and work to resolve misunderstandings and unfairness before attempting to resolve the issues.

The grievance handling contact on the project side will be the local office of RNT/ENDE or the project office, and RNT/ENDE will assign a community liaison officer to ensure fair and effective implementation of the grievance procedure while ensuring access by local residents. On the other hand, as the social survey results show, residents mainly trust community leaders, such as Soba, and want to be informed through them, and expect verbal explanations. In addition, in some villages and settlements, transportation means are not easily accessible, and it is not practical for individual residents to visit the project office on their own. Therefore, in order to ensure that the grievance mechanism is disclosed to and accessible by the local community, Soba and other community leaders will serve as local contact points to collect individual residents' grievances, serve as liaisons with the project office, and provide feedback to the residents. The local government office (commune office) will also receive complaints and ensure that they are reported to the grievance office on the project side. These grievances will be recorded there and immediately shared among project stakeholders.

The project office's community liaison will visit the community on a regular basis to provide information on construction progress and other ongoing communication. Contractors station on site during construction period, and they join RNT/ENDE to handle grievances when needed.

10.5.2. Community-Level Grievance

In the case of a rather complicated problem that cannot be resolved on site, or a problem involving many affected residents, a joint verification will be conducted by the project office, Soba, municipality office, and representatives of the residents, after which a solution will be discussed and agreed upon by the affected residents. The progress of the verification will be communicated to the residents, and minutes of the discussions will be kept, and the communication with the residents will be documented in addition to verbal communication. Contractors station on site during construction period, and they join RNT/ENDE to handle grievances when needed.

10.5.3. Municipality-Level Grievance

If the project is not addressed or resolved to the satisfaction of the affected residents, it will be taken out of the hands of the project officials and referred to the Grievance Redress Committee for review.

The Grievance Redress Committee will make the final decision under the grievance mechanism specific to the project. The committee is composed of leaders at the municipality level (Lubango, Humpata, etc.), RNT/ENDE headquarters (Luanda), and civil society organizations.

10.5.4. Provincial-Level Grievance

If the grievance is not resolved by the Grievance Redress Committee, the affected residents will seek reconciliation, settlement, or arbitration under the local judicial system, in accordance with the law. In this case, involvement by the provincial government will take place.

10.6. Implementation Arrangements

Compensation for resettlement will be discussed among MINEA, RNT/ENDE, Yen loan consultants, provincial and municipality governments, and local officials (commune governments and resident representatives), and will be made either through monetary compensation or by providing alternatives equivalent to the land and houses to be lost. The roles of each party are shown in the table below, and implementation mechanism is shown in the diagram below.

Table 10.6-1 Implementing Parties and their Roles

Institution	Duties and roles
Ministry of Finance	• Budget allocation for ARAP implementation
MINEA	• Budget allocation for ARAP implementation
RNT/ENDE	• Promoting the conclusion of compensation agreements • Implementation of agreed compensation and payment of all costs associated with in-kind provisions Coordination and monitoring of ARAP updates and implementation • Contract for all goods and services necessary to implement the ARAP • Participate in meetings of resettlement coordination groups at the provincial, municipality, commune, and village levels upon request • Participation in the public participation process for land acquisition and resettlement, as well as facilitation and support of this process • Identification and allocation of alternative agricultural lands and monitoring of the land clearing process • Coordinate with government authorities (as needed) for delivery of alternative land (including issuance of land titles) • Monitoring of alternative structure construction • Assistance in transferring assets prior to the start of construction activities • Monitoring and evaluation of the transfer process • Implement livelihood recovery plans and ensure participation of residents • Monitoring for livelihood recovery and re-establishment of social networks • Management of grievance mechanisms, monitoring and assistance to affected households on their effective use (If necessary, part of the above is envisaged to be carried out by local organizations commissioned by RNT/ENDE)
Loan consultant	• Assistance for updating ARAP • Monitoring of ARAP implementation • Participate in meetings of resettlement coordination groups at the provincial, municipality, commune, and village levels upon request • Participate in the public participation process for land acquisition and resettlement, as needed • Implementation monitoring and evaluation of the resettlement process • Monitoring of grievance mechanisms
Provincial government	• ARAP content review and implementation monitoring • Approval of resettlement plan • Coordinate and promote active participation of municipality administrations in resettlement activities and ARAP implementation process • Participation in the grievance process
Municipality government	• Monitoring of ARAP implementation • Encouraging community leaders and resident representatives, including commune offices and Sobas, to participate in ARAP implementation. • Participate in activities of the resident participation process • Participation in property and site surveys and assessments • Facilitate identification of alternative land • Issuance of property certificates for the transfer of homes and farmland • Participation in the grievance process

Institution	Duties and roles
	• Monitoring the implementation of livelihood restoration activities
Commune office, Soba, resident representative	• Represent the affected community. • Participate in all activities of the resettlement process in the community. • Provide community residents with information about the resettlement process. • Ensure that all affected residents participate in the population census and property and site surveys.

Source: JICA Survey Team

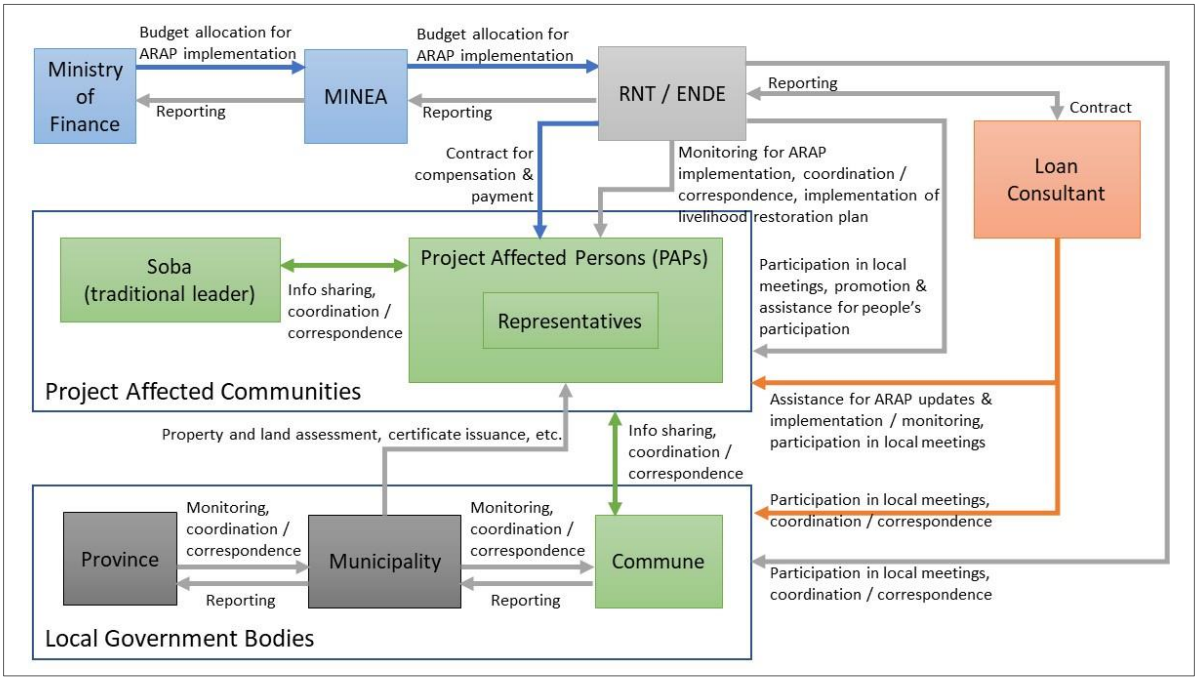


Figure 10.6-1 Implementation Mechanism with Roles and Responsibilities

Source: JICA Survey Team

10.7. Implementation Schedule

Undislosed Information.

10.8. Budget and Financial Sources

Undislosed Information.

10.9. RNT/ENDE's Monitoring Mechanism and Monitoring Form

10.9.1. Internal Monitoring

Internal monitoring will begin prior to construction work. Once the routes are almost finalized based on the completion of the basic design, land survey for temporary and permanent land acquisition will be started, and consultation on compensation, support for acquisition procedures and movement during the construction period, and documentation of livelihood restoration activities will be conducted periodically to manage the progress.

RNT/ENDE will conduct the land survey in cooperation with the provincial department of land management, district, municipality and commune government officials, Soba and others. In addition, monetary compensation will be provided on the premise that MINEA will intervene.

The participation of the affected population in these monitoring processes is ensured based on the intervention of Sobas and local coordinators. Soba and other traditional leaders are the intermediaries between the residents and the local government, and they are trusted by the residents and are essential in building relationships with them. It is necessary to share progress on a regular and irregular basis to gain their cooperation.

Internal monitoring by RNT/ENDE will continue on a quarterly basis until two years after the completion of livelihood restoration activities, and their results and effects will be verified at the end of the project. In addition, the return status of residents who have temporarily relocated their place of livelihood or residence will be verified, and the status of their resettlement at the original location or directly at the relocation site will be verified. Information obtained from the main indicators will be used for internal monitoring as described below. Monitoring results will be submitted to JICA quarterly.

Table 10.9-1 Indicators, Information Sources, and Monitoring Frequency

Information/data types and indicators to be collected	Sources/methods of information collection	Monitoring and reporting frequency	Executing body
• Compensation (e.g., status of securing alternative land, status of construction of alternative housing, status of moving to alternative land, status of grievance redress, etc.) • land acquisition of ROW, farm and buildings, and households • Description of livelihood restoration support activities, status of local employment provision and income	• Census, Asset and Property Survey, and Socioeconomic Survey results at time of ARAP update • land survey • Records of completion of construction of alternative housing and related buildings • Documentation of the acquisition process and the process of moving to an alternative land • Record of utilization of grievance system • Livelihood Restoration Activity Record • Monitoring and evaluation records • Project Progress Meeting • Project Progress Report	• Once a quarter	RNT/ENDE

Source: JICA Survey Team

The proposed monitoring form for progress is attached as Attachment 10-1. The form will be reviewed at the time of the ARAP update and revised as necessary.

10.9.2. External Monitoring

According to the JICA Environmental Guidelines, monitoring may be outsourced to third parties such as NGOs and survey/research institutions to ensure neutrality and objectivity in land acquisition and resettlement. This project will not establish an external monitoring system by such an independent organization.

The background and reasons are as follows

(i) The project is based on temporary and permanent land acquisition, and no land title will be acquired.

(ii) RNT/ENDE are considering compensation to right holders to be made upon temporary land acquisition during the construction period, based on compensation in kind (provision of alternative housing or farmland) while leaving monetary compensation as an option.

(iii) In securing alternative land, the involvement of local government and traditional leaders such as Soba is a prerequisite, along with land survey. In addition, monetary compensation assumes the intervention of MINEA. Therefore, there is almost no room for arbitrary initiative by RNT/ENDE, and accountability will be required. Furthermore, RNT/ENDE are in a position to monitor the actions and decisions of the local governments and Soba and others.

(iv) Although compensation for resettlement is a matter of budget allocation and implementation by RNT/ENDE, there are many parties involved as described in (iii) above. In managing progress, therefore, sharing of monitoring forms and other materials is a prerequisite to ensure transparency.

(v) In the consulting services, the project plans to allocate the cost of activities such as resident consultation separately from the budget allocation on RNT/ENDE side. In addition to RNT/ENDE, the fairness and legitimacy of the compensation procedure for resettlement and the functioning of the grievance redress mechanism can be confirmed from the residents' perspective, thereby ensuring transparency.

10.10.Local Consultation

10.10.1. Dissemination of Project and Exchange of Opinions

Stakeholder consultations were held in February 2021 (a summary of the consultations is provided in 9.11.2) and explained the project outline to the local governments in the project area, while consultations were held with local residents in April of the same year. A summary of the consultations with local residents is as follows.

(1) Purpose

- Provide an up-to-date overview of the project and obtain opinions and insights from the local community side
- Share anticipated impacts and discuss possible mitigation measures.
- The needs on the part of local residents will be identified and reflected in subsequent surveys.
- Share the survey implementation schedule and content.

(2) Outline of the event

In order to understand the situation of local communities in the vast project area, and to ensure access to a wide variety of residents, including vulnerable groups such as women and the elderly, and to obtain a broad range of opinions, the consultations were held in nine locations in two provincials along the project route. A summary of the consultations is shown in the table below.

Table 10.10-1 Summary of Local Consultation

No.	Settlements	Provincial / Municipality	Date and Time		Number of participants (persons)		
					Male	Female	Total
1	Poaires Kapandi and Poaires Muhaha settlements	Lubango, Huíla.	April 19	10:00 - 11:50 a.m.	39	38	77
2	Tchiwaya Settlement	Lubango, Huíla	April 19	2:00 - 3:50 p.m.	12	18	30
3	Kapalanga Settlement	Lubango, Huíla	April 20	8:30 - 10:00 a.m.	28	14	42
4	Heva settlement, Kamba Cristo settlement, Palanca settlement	Humpata, Huíla	April 21	9:00 - 11:00 a.m.	44	8	52
5	Jamba Settlement	Humpata, Huíla	April 21	2:00 - 4:00 p.m.	45	19	64
6	Camponês Settlement	Humpata, Huíla	April 21	4:00 - 5:45 p.m.	35	21	56
7	Calmune Settlement	Humpata, Huíla	April 22	8:30 - 10:30 a.m.	30	6	36
8	Onculuvala Settlement	Humpata, Huíla	April 22	10:30 a.m. - 2:30 p.m.	41	31	72
9	Aída Settlement	Moçâmedes, Namibe	April 23	9:00 - 11:00 a.m.	39	10	49
Total					313	165	478

Note: All implementation years are 2021.

Source: JICA Survey Team

(3) Matters to be considered

- In addition to explanations in Portuguese, interpretation was provided in Nyaneka-Humbi, the language spoken locally, to ensure a thorough explanation and question-and-answer session.
- Since many areas at the village level are not yet electrified, maps and project outlines were prepared on banners and posters printed in advance.
- The information was disseminated through the local government (municipality and commune). In addition to this, the participation of residents, including women and the elderly, was ensured by calling for participation in the consultation through traditional leaders (Sobas) and coordinators in each village, distributing flyers in villages a few days before the event, and providing direct explanations even orally.
- In consideration of the ease of participation of the residents (especially women), the meeting was held in each village, choosing a time that took into account the situation of the residents as much as possible. After the meeting was adjourned, the women were approached individually to see if

there was anything they could not say at the meeting.

(4) Outline of the Consultation

A summary of each consultation is provided below.

1) Poaires Kapandi and Poaires Muhaha settlements (Arimba commune)

- Participants: deputy head of government of Arimba Commune, head of social section, traditional leaders, settlement coordinators, local residents, RNT, survey team (local consultant)
- Main Discussions

Poaires Resident Side Comments/Questions	Organizer's response
- Please explain the involuntary resettlement and compensation process. - What happens if there is damage to residential, agricultural, or livestock land? - There is a project (cultivated land) that has affected some of the residents in the past and has not been compensated to this day.	- JICA takes resettlement and compensation issues very seriously and will not provide loans until these issues are resolved in accordance with JICA rules and standards. - If houses, farmlands, cemeteries, large trees, etc. cannot be avoided, a resettlement plan will be developed to ensure that the affected residents receive compensation equal to or greater than what they received before the project was implemented. - Compensation for the loss of farmland and fruit trees will be assessed based on the government's agricultural commodity price list to ensure that compensation is given to those in need. The entire process will be handled with fairness, transparency, and integrity. Lubango Municipality Government and the Huíla Provincial Government would like to be involved in the process. - If there are houses affected by the project, a valuation assessment will be made and the parties may receive houses with equivalent or better specifications. In order to avoid or minimize the impact on the residents' lives, several studies are being conducted, including geographical, topographical, environmental, social, and cultural studies.
- Will all areas that the transmission line passes through be supplied with power or just Namibe?	- RNT will construct a transmission line between Lubango and Moçâmedes through this project. Local electricity supply will be provided by ENDE, a power distribution company, in consultation with the provincial and local governments of Huíla and Namibe.
- The local population is suffering from food shortages due to the drought; will food assistance to the Poiares community be provided by this project?	- The Angolan government is seeking community support and CSR activities by contractors working on national projects. Local needs, such as food aid, will be shared with contractors who receive orders.
- We were told that the staff of a previous project near this settlement had been harassing the girls.	- The awarded contractor will be required to present a policy that includes an EHS (environment, health & safety) training program. It is assumed that staff will be prohibited from harassing local women, that local customs and traditions will be respected, that unethical practices will be prohibited, and that alcohol consumption and other illegal activities during work will be prohibited.

2) Tchiwaya settlement (Arimba commune)

- Participants: deputy head of government of Arimba Commune, head of social section, traditional leaders, settlement coordinators, local residents, RNT, survey team (local consultant)
- Main Discussions

Tchiwaya Resident Side Comments/Questions	Organizer's response
- We commend the government's initiative regarding the implementation of the project. - However, people in the region are currently suffering from food shortages. They seek food aid and infrastructure improvements such as water, schools, and medical facilities.	- The Angolan Government is seeking community support and CSR activities by contractors working on national projects. We would like to share and advise the awarded contractors on local needs such as food aid.
- Please explain the involuntary resettlement and compensation process. - What happens if there is damage to residential, agricultural, or livestock land?	- JICA takes resettlement and compensation issues very seriously and will not provide loans until these issues are resolved in accordance with JICA rules and standards. - If houses, farmlands, cemeteries, large trees, etc. cannot be avoided, a resettlement plan will be developed to ensure that the affected residents receive compensation equal to or greater than what they received before the project was implemented.

Tchiwaya Resident Side Comments/Questions	Organizer's response
	- Compensation for the loss of farmland and fruit trees will be assessed based on the government's agricultural commodity price list to ensure that compensation is given to those in need. The entire process will be handled with fairness, transparency, and integrity. The Lubango Municipality Government and the Huíla Provincial Government would like to be involved in the process. - If there are houses affected by the project, a valuation assessment will be made and the parties may receive houses with equivalent or better specifications. In order to avoid or minimize the impact on the residents' lives, several studies are being conducted, including geographical, topographical, environmental, social, and cultural studies.
- If local youth do not have ID cards, how does this affect their employment opportunities in the business?	- Young people in Tchiwaya settlement will be given employment opportunities, but everyone is required by law to present an ID card; if they do not have an ID card, they should obtain one with the assistance of the Tchiwaya settlement coordinator and traditional leaders. - Salaries are basically paid by bank transfer to[86], and social security contributions and withholding taxes are also paid according to the amount of salary.

3) Kapalanga settlement (Arimba commune)

- Participants: deputy head of government of Arimba Commune, head of social section, traditional leaders, settlement coordinators, local residents, RNT, survey team (local consultant)
- Main Discussions

Kapalanga Resident Side Comments/Questions	Organizer's response
- We commend the government's initiative on the implementation of the project and would like to express our gratitude for the associated benefits. - I would like to know about the project schedule.	- The construction schedule is approximately 30 months. Once financing is finalized based on the environmental assessment approval, the project is expected to begin in 2023. Demining work will also be done in advance of the project. The contractor for this project has not yet been determined.
- People in the area are currently suffering from food shortages. - They seek food aid and infrastructure improvements such as water, schools, and medical facilities.	- The Angolan government is seeking community support and CSR activities by contractors working on national projects. Local needs, such as food aid, will be shared and advised to contractors who receive orders.
- Please explain the involuntary resettlement and compensation process. - What happens if there is damage to residential, agricultural, or livestock land? - Please provide employment opportunities to improve the social and economic situation of the youth in Kapalanga settlement.	- JICA takes resettlement and compensation issues very seriously and will not provide loans until these issues are resolved in accordance with JICA rules and standards. - If houses, farmlands, cemeteries, large trees, etc. cannot be avoided, a resettlement plan will be developed to ensure that the affected residents receive compensation equal to or greater than what they received before the project was implemented. - Compensation for the loss of farmland and fruit trees will be assessed based on the government's agricultural commodity price list to ensure that compensation is given to those in need. The entire process will be handled with fairness, transparency, and integrity. The Lubango Municipality Government and the Huíla Provincial Government would like to be involved in the process. - If there are houses affected by the project, a valuation assessment will be made and the parties may receive houses with equivalent or better specifications. In order to avoid or minimize the impact on the residents' lives, several studies are being conducted, including geographical, topographical, environmental, social, and cultural studies. - The contractor will be selected through a competitive bidding process. The specifications stipulate that the contractor will contract up to 40% of the labor force with local workers. To ensure that everyone has access to the information, the jobs will be announced in advance in newspapers and on local radio, and job postings will be made in front of business-related facilities and at general professional training centers in both Huíla

[86] For those who do not have a bank account, cash will be hand-delivered (with their signatures on receipts).

Kapalanga Resident Side Comments/Questions	Organizer's response
	and Namibe provinces. Contractors must disclose these job openings through such means and platforms as the Jornal de Angola, local radio stations, safety displays in worker camps, and general professional training centers in the capitals of the provinces of Huíla and Namibe.

4) Heva, Kamba Cristo and Palanca settlements (Humpata commune)

- Participants: the Mayor of Humpata Municipality, the Deputy Administrator for Technical Infrastructure of Humpata City, the Administrator of Palangka Commune, traditional leaders, settlement coordinators, local residents, farmers, RNT, survey team (local re-contractor).
- Note: Kamba Cristo is not included in the project area and no project impact is foreseen. However, the three settlements are governed by a single traditional leader, and based on the leader's request, the Humpata Municipality and Humpata City took into consideration the request and held a joint event for the residents of the three settlements.
- Main Discussions

Residents' comments and questions	Organizer's response
- We would like to thank the government for planning this project and hope to benefit from it in terms of growth in the south-central region. - We believe that the presence of the transmission line has the potential to facilitate future power distribution projects and benefit the communities of Humpata Municipality.	- The project team appreciates the contributions of the residents.
- Please explain the involuntary resettlement and compensation process. - What happens if there is damage to residential, agricultural, or livestock land?	- JICA takes resettlement and compensation issues very seriously and will not provide loans until these issues are resolved in accordance with JICA rules and standards. - If houses, farmlands, cemeteries, large trees, etc. cannot be avoided, a resettlement plan will be developed to ensure that the affected residents receive compensation equal to or greater than what they received before the project was implemented. - Compensation for the loss of farmland and fruit trees will be assessed based on the government's agricultural commodity price list to ensure that compensation is given to those in need. The entire process will be handled with fairness, transparency, and integrity. The Lubango Municipality Government and the Huíla Provincial Government would like to be involved in the process. - If there are houses affected by the project, a valuation assessment will be made and the parties may receive houses with equivalent or better specifications. In order to avoid or minimize the impact on the residents' lives, several studies are being conducted, including geographical, topographical, environmental, social, and cultural studies.
- The electricity distributed by ENDE is currently inadequate and does not meet the consumption needs of the Palanca area. They are also using illegal and unsafe methods to obtain electricity. - This district has not had electricity for many years and other communities are waiting for power distribution. The quality of electricity is not good. - It is questionable whether this project will improve this situation.	- RNT will install a transmission line between Lubango and Moçâmedes to energize Namibe Province through this project. Distribution of electricity to the area will follow. - The local power supply will be carried out by ENDE, a power distribution company, in consultation with the provincial government and local authorities. Electricity will be supplied to the Palanca area from the Humpata substation.
- I would like an explanation of the risks that 220 kV TL pose to neighboring communities.	- From a safety standpoint, the tower height is 30 to 35 m above the ground, so the effects of electromagnetic fields are negligible. In addition, we are making the utmost effort to ensure that the transmission line will not cross residential areas. - The transmission lines are fitted with smart sensors for safety, warning, and emergency purposes, and the transmission system is automatically shut down if the cables are damaged or weather conditions become

Residents' comments and questions	Organizer's response
	extremely severe. - It is recommended that no permanent infrastructure such as houses, schools, hospitals, churches, etc. be built in the vicinity of the transmission line (45 m) after the project is completed.
- Will the 220 kV TL route parallel the existing 60 kV DL or will there be another crossing point? - The identification and disposal of unexploded ordnance may delay the project execution schedule.	- The 220 kV TL will run parallel to the 60 kV line whenever possible, but the route is subject to change. - The demining process is critical to the project because Angola has experienced years of intense conflict and the transmission line route passes through areas not yet used by the population. Unless a demining certificate is issued, contractors are reluctant to bid on the project, and demining will alleviate any safety concerns. - The construction schedule is approximately 30 months. Once financing is finalized based on the environmental assessment approval, the project is expected to begin in 2023. A contractor will be selected after preliminary unexploded ordnance disposal and other work. - Stakeholder consultations and meetings with residents of the villages and communities surrounding the proposed transmission line site will be held continuously throughout the implementation phase of the project, and information sharing will continue.

5) Jamba settlement (Humpata commune)

- Participants: the Mayor of Humpata Municipality, the Deputy Administrator for Technical Infrastructure of Humpata City, the Administrator of Humpata Commune, traditional leaders, settlement coordinators, local residents, RNT, survey team (local consultant)
- Main Discussions

Jamba Resident Side Comments/Questions	Organizer's response
- Is the power supplied from the Laúca dam? - Will there be power distribution to the Jamba area? Will the project support the local community? - Is there any benefit to the residents from having the transmission line pass nearby?	- The project will send power from the Laúca dam, which is already connected to the Belem do Dango substation in the province of Uambo; a 400 kV transmission line will be installed at the Nombungo substation, which will enable the installation of the 60/15 kV Arimba SS and the development of this project. - The transmission line planned for the project will not facilitate the supply of electricity in the Jamba area. The local power supply will be carried out in the future by ENDE, a power distribution company, in consultation with the provincial and local governments.
- We would like to know the risks that 220 kV power lines pose to neighboring communities.	- From a safety standpoint, the tower height is 30 to 35 m above the ground, so the effects of electromagnetic fields are negligible. In addition, we are making the utmost effort to ensure that the transmission line will not cross residential areas. - The transmission lines are fitted with smart sensors for safety, warning, and emergency purposes, and the transmission system is automatically shut down if cables are damaged or weather conditions become extremely severe. - It is recommended that no permanent infrastructure such as houses, schools, hospitals, churches, etc. be built in the vicinity of the transmission line (45 m) after the project is completed.
- Can't the existing 60 kV tower be used for the 220 kV TL project? - What is the project budget?	- The existing 60 kV line tower cannot support a 220 kV TL. - The project budget will be calculated in the future.
- Please explain the involuntary resettlement and compensation process. - What happens if there is damage to residential, agricultural, or livestock land?	- JICA takes resettlement and compensation issues very seriously and will not provide loans until these issues are resolved in accordance with JICA rules and standards. - If houses, farmlands, cemeteries, large trees, etc. cannot be avoided, a resettlement plan will be developed to ensure that the affected residents receive compensation equal to or greater than what they received before the project was implemented. - Compensation for the loss of farmland and fruit trees will be assessed based on the Government's agricultural commodity price list to ensure that compensation is given to those in need. The entire process will be handled with fairness, transparency, and integrity. The Lubango Municipality Government and the Huíla Provincial Government would like to be involved in the process. - If there are houses affected by the project, a valuation assessment will be made and the parties may receive houses with equivalent or better

Jamba Resident Side Comments/Questions	Organizer's response
	specifications. In order to avoid or minimize the impact on the residents' lives, several studies are being conducted, including geographical, topographical, environmental, social, and cultural studies.

6) Campones settlement (Humpata commune)

- Participants: the Mayor of Humpata Municipality, the Deputy Administrator for Technical Infrastructure of Humpata City, the Administrator of Humpata Commune, traditional leaders, settlement coordinators, local residents, RNT, survey team (local re-contractor)
- Main Discussions

Campones Residents Comments/Questions	Organizer's response
- I live in my own house very close to the Humpata substation[87] . I am thinking of moving for safety reasons.	- The Humpata substation is under ENDE control. It is recommended that the need to relocate homes near the substation for safety reasons be referred to ENDE.
- Please explain the involuntary resettlement and compensation process. - What happens if there is damage to residential, agricultural, or livestock land?	- JICA takes resettlement and compensation issues very seriously and will not provide loans until these issues are resolved in accordance with JICA rules and standards. - If houses, farmlands, cemeteries, large trees, etc. cannot be avoided, a resettlement plan will be developed to ensure that the affected residents receive compensation equal to or greater than what they received before the project was implemented. - Compensation for the loss of farmland and fruit trees will be assessed based on the government's agricultural commodity price list to ensure that compensation is given to those in need. The entire process will be handled with fairness, transparency, and integrity. The Lubango Municipality Government and the Huíla Provincial Government would like to be involved in the process. - If there are houses affected by the project, a valuation assessment will be made and the parties may receive houses with equivalent or better specifications. In order to avoid or minimize the impact on the residents' lives, several studies are being conducted, including geographical, topographical, environmental, social, cultural, and historical studies. Grazing areas are also being avoided.
- I would like an explanation of the risks that 220 kV TL pose to neighboring communities. - There are many homes under the existing 60 kV DL; would they be allowed under the 220 kV TL?	- From a safety standpoint, the tower height is 30 to 35 m above the ground, so the effects of electromagnetic fields are negligible. In addition, we are making the utmost effort to ensure that the transmission line does not cross residential areas. - The transmission lines are fitted with smart sensors for safety, warning, and emergency purposes, which automatically shut down the transmission system if the cables are damaged or weather conditions become extremely severe. - It is recommended that no permanent infrastructure such as houses, schools, hospitals, churches, etc. be built in the vicinity of the transmission line (45 m) after the project is completed.
- Can we build a market in the Camponês district? (Question to the administrative officer of the municipality of Humpata)	- Under the Program of Integrated Intervention by Municipalities (PIIM), Humpata is also developing important infrastructure that will cover a wide area. The new Humpata substation is one of them, and we are also planning canal projects that will benefit communities in both Chibia and Bibala municipalities. First, I would like you to come to the Humpata Municipality Office to learn about the projects under PIIM.

7) Calmune Settlement (Humpata Commune)

- Participants: the Mayor of Humpata Municipality, the Deputy Administrator for Technical Infrastructure of Humpata City, the Administrator of Humpata Commune, traditional leaders, settlement coordinators, local residents, RNT, survey team (local re-contractor)
- Main Discussions

[87] Some households were relocated during the construction of the Humpata substation and others were compensated. The process was conducted in a transparent and straightforward manner. According to the deputy head of Humpata Municipality, there have been no complaints from the affected residents since then.

Calmune Resident Side Comments/Questions	Organizer's response
- The final route of the 220 kV TL is.	- The 220 kV TL would run parallel to the 60 kV lines whenever possible, but have not been finalized.
- While we appreciate the implementation of the project, ENDE's electricity distribution is currently insufficient and does not meet the consumption needs of the Calumue area. - Will the electricity provided by the project improve this situation?	- RNT will install a transmission line between Lubango and Moçâmedes to energize Namibe Province through this project. Distribution of electricity to the area will follow. - The Calmune area will be supplied with power from the Humpata substation.
- Where I live, I currently have no access to potable water or public power grid.	- The Angolan government is seeking community support and CSR activities by contractors working on national projects. Local needs, such as food aid, will be shared and advised to contractors who receive orders. - Under the Program of Integrated Intervention in Municipalities (PIIM), Humpata is also developing important infrastructure that will cover a wide area. The new Humpata substation is one of them, and we are also planning canal projects that will benefit communities in both Chibia and Bibala municipalities. First, I would like you to come to the Humpata Municipality Office to learn about the projects under PIIM.
- Please explain the involuntary resettlement and compensation process. - What happens if there is damage to residential, agricultural, or livestock land? - Has a resettlement area already been designated after the resettlement? If so, are they suitable for resettlement?	- JICA takes resettlement and compensation issues very seriously and will not provide loans until these issues are resolved in accordance with JICA rules and standards. - If houses, farmlands, cemeteries, and large trees cannot be avoided, resettlement plans and livelihood restoration support activities will be developed to ensure that affected residents receive compensation equal to or greater than what they received prior to project implementation. In order to avoid or minimize the impact on the livelihoods of the residents, several studies are being conducted, including geographical, topographical, environmental, social, cultural, and historical studies. - Compensation for the loss of farmland and fruit trees will be assessed based on the government's agricultural commodity price list to ensure that compensation is given to those in need. All processes are handled with fairness, transparency, and integrity. - Agricultural land, housing, and other infrastructure affected will be thoroughly registered. This is also to prevent those who seek to take advantage and get compensation money. - Since the final route of the transmission line has not been determined, a detailed survey of affected households' houses has not yet been conducted. Therefore, no resettlement areas have been designated. - If there are houses affected by the project, a valuation assessment will be made and the parties may receive houses of equal or better specifications. We expect the Lubango Municipality Government and the Huíla Provincial Government to be involved in the process.
- Stakeholder consultations/meetings should continue to be held during the project implementation phase to ensure the well-being of the neighboring community and the long-term viability of the project.	- Stakeholder consultations and meetings with residents of the villages and communities surrounding the proposed transmission line site will be held continuously throughout the implementation phase of the project, and information sharing will continue.

8) Onculuvala settlement (Humpata commune)

- Participants: the Mayor of Humpata Municipality, the Deputy Administrator for Technical Infrastructure of Humpata City, the Administrator of Humpata Commune, traditional leaders, settlement coordinators, local residents, RNT, survey team (local re-contractor)
- Main Discussions

Onculuvala residents side comments/questions	Organizer's response
- Please explain the involuntary resettlement and compensation process. - What happens if there is damage to residential, agricultural, or livestock land? - When the current 60 kV DL were	- JICA takes resettlement and compensation issues very seriously and will not provide loans until these issues are resolved in accordance with JICA rules and standards. - If houses, farmlands, cemeteries, and large trees cannot be avoided, resettlement plans and livelihood restoration support activities will be developed to ensure that affected residents receive compensation equal to or greater than what they received prior to project implementation. In order

Onculuvala residents side comments/questions	Organizer's response
laid during the colonial period, there was no room for negotiation with the parties.	to avoid or minimize the impact on the livelihoods of the residents, several studies are being conducted, including geographical, topographical, environmental, social, cultural, and historical studies. - Compensation for the loss of farmland and fruit trees will be assessed based on the government's agricultural commodity price list to ensure that compensation is given to those in need. All processes are handled with fairness, transparency, and integrity. - Affected farmland, housing, and other infrastructure will be thoroughly registered. This is also to prevent those who seek to take advantage and get compensation money. - Since the final route of the transmission line has not been determined, a detailed survey of affected households' houses has not yet been conducted. Therefore, no resettlement areas have been designated. - If there are houses affected by the project, a valuation assessment will be made and the parties may receive houses of equal or better specifications. We expect the Lubango Municipality Government and the Huíla Provincial Government to be involved in the process.
- Will the community of Onculuvala benefit in terms of power supply when the transmission line is laid in this area?	- RNT will install a transmission line between Lubango and Moçâmedes to energize Namibe Province through this project. Distribution of electricity to the area will follow. - Onculuvala settlement and other settlements in Humpata Commune will also benefit in the future from the electricity supply from the Humpata substation.
- We appreciate the government's efforts regarding the implementation of the project. However, droughts are frequent in the region and local people suffer from food shortages. In addition to this, critical infrastructure needs to be installed and improved, including drinking water, schools, and health care. - He said that food assistance programs offered to several communities in the area should also take into consideration the residents of the Onculuvala neighborhood.	- The Angolan government is seeking community support and CSR activities by contractors working on national projects. Local needs, such as food aid, will be shared and advised to contractors who receive orders. - The Huíla Provincial Government is providing food assistance only to communities in the Bata-Bata area as part of the Lubango migration of young sexually exploited children. in Onculuvala settlement, there are several projects for infrastructure development within the scope of the PIIM, such as a waterfall for the benefit of the local community We hope that residents will visit the Humpata Municipality Office more often to learn about the various projects that are recommended for the community under the PIIM.
- Will this project provide employment opportunities? 50% of the youth in the region are unemployed.	- The specifications will stipulate that the contractor will contract up to 40% of the workforce with local workers. To ensure that everyone has access to the information, the jobs will be announced in advance in newspapers and on local radio, and job postings will be made in front of project-related facilities and at general professional training centers in both Huíla and Namibe provinces. Contractors must disclose these job openings through such means and platforms as the Jornal de Angola, local radio stations with high ratings, safety displays in worker camps, and general professional training centers in the capitals of the provinces of Huíla and Namibe.

9) Aída Settlement (Forte Santa Rita Commune)

- Participants: head of the municipality of Forte Santa Rita, representatives of the Municipal Administration of Moçâmedes, traditional leaders, village coordinators, local residents, RNT, survey team (local consultant)
- Main Discussions

Aída **Resident Side Comments/Questions**	Organizer's response
- If the 220/60 kV New Namibe SS is built, will the Aída area benefit from the electricity converted at the substation?	- The construction of the 220/60 kV New Namibe SS will benefit the entire city of Moçâmedes by meeting the power needs for the development of Namibe Province. - Aída area may also benefit from the project due to its proximity to the substation, but the project is intended only for transmission of electricity.
- Will the current condition of the access road to the Aída area be improved as a result of the implementation of this project?	- The Angolan Government is seeking community support and CSR activities by contractors working on national projects. Local needs, such as road maintenance, will be shared with and advised to the awarded contractors. However, since the local government is responsible for repairing and improving road infrastructure, the contractors' CSR efforts

Aída **Resident Side Comments/Questions**	**Organizer's response**
	may focus on other areas. - The Municipal Integrated Intervention Program (PIIM) is implementing various projects in Moçâmedes Municipality, under which the access road to the Aída area will be rehabilitated. Note that at this stage, only sediment movement and soil compaction are being carried out.
- Please explain the involuntary resettlement and compensation process. - What happens if there is damage to a residence, farmland, livestock property, etc.? Will compensation be paid for crops that are damaged?	- JICA takes resettlement and compensation issues very seriously and will not provide loans until these issues are resolved in accordance with JICA rules and standards. - If houses, farmlands, cemeteries, and large trees cannot be avoided, resettlement plans and livelihood restoration support activities will be developed to ensure that affected residents receive compensation equal to or greater than what they received prior to project implementation. In order to avoid or minimize the impact on the livelihoods of the residents, several studies are being conducted, including geographical, topographical, environmental, social, cultural, and historical studies. - Compensation for the loss of farmland and fruit trees is determined using an agricultural commodity price list, and the entire process is conducted fairly, transparently, and in good faith. The amount of crop compensation is not based on the annual production a farmer claims to be producing, but rather on the amount of agricultural products produced by the species he or she presents.
- I would like to know about starting the process of recruiting workers for the project.	- The specifications will stipulate that the contractor will contract up to 40% of the workforce with local workers. To ensure that everyone has access to the information, the jobs will be announced in advance in newspapers and on local radio, and job postings will be made in front of project-related facilities and at general professional training centers in both Huíla and Namibe provinces. Contractors must disclose these job openings through such means and platforms as the Jornal de Angola, local radio stations with high ratings, safety displays in worker camps, and general professional training centers in the capitals of the provinces of Huíla and Namibe.
- I control the area and know the potential route areas that will not cause physical resettlement or damage. - The Aída Settlement Residents Committee can assist in mitigating the occurrence of conflicts over land use and rights of way due to the project.	- We appreciate the support of the Residents' Committee of Aída Settlement. - The 220 kV TL will be laid in parallel with the 60 kV lines whenever possible. The proposed route is not final and may be subject to change in the future. We are continuing to investigate ways to finalize the route and avoid/minimize impacts on residents' lives.
- We commend this project. The Residents' Committee of the Aída Settlement is pleased to support the project team.	- All contributions are gratefully acknowledged.

10.10.2. Explanation and Exchange of Opinions Regarding the Development of a Simplified Resettlement Plan

In September and November 2021, when the land acquisition and resettlement were minimized in the process of the preparatory study for the project and the transmission and distribution line route was almost finalized at the preparatory study level through the study of alternatives, a series of studies were conducted, including an abbreviated resettlement action planand an initial baseline study for this purpose. Consultations were held with the respective provincial municipality governments and local residents regarding the

(1) Purpose

・ Explanation of business overview (update)
・ Explanation of the framework of resettlement planning and compensation requirements based on the JICA Guidelines for Environmental and Social Considerations
・ Explanation of planned social survey implementation

(2) Outline of the event

A summary of the consultations held with local governments and residents is shown in the two tables below.

Table 10.10-2 Summary of Government Consultations on the Implementation of Resettlement Planning Work

No.	Party to a conference	Provincial / municipality	Date	Venue
1	Namibe Provincial Government and Moçâmedes Municipality Government	Namibe Province	September 6.	Namibe Provincial Government Office
2	Bibala Municipality Government	Namibe Province	September 7	Bibala Municipality Office
3	Huíla Provincial Government	Huíla Province	September 16	Huíla Provincial Government Office
4	Humpata Municipality Government	Huíla Province	September 9	Humpata Municipality Office
5	Lubango Municipality Government	Huíla Province	September 9	Lubango Municipality Office

Note: All implementation years are 2021.

Source: JICA Survey Team

Table 10.10-3 Summary of Resident Consultation on Resettlement Plan Development

No.	Settlement	Provincial / Municipality	Date		Number of participants (persons)		
					Male	Female	Total
1	Poaires Muhaha Settlement	Lubango, Huíla	September 14	9:40 -10:50 a.m.	29	10	39
2	Figueira Settlement	Lubango, Huíla	September 14	2:00 - 4:00 p.m.	25	0	25
3	Onculuvala Settlement	Lubango, Huíla	September 16	9:30 - 11:00 a.m.	25	12	37
4	Jamba II settlement, Sames settlement, Campones settlement	Humpata, Huíla.	September 16	2:00 - 4:00 p.m.	43	22	65
5	Heva de Cima Settlement	Humpata, Huíla.	September 17	9:00 - 10:30 a.m.	18	7	25
6	Jango Settlement	Humpata, Huíla.	November 18	9:15 - 10:40 a.m.	12	6	18
Total					152	57	209

Note: All implementation years are 2021.

Source: JICA Survey Team

(3) Summary of discussions with local government

A summary of each of the discussions follows. There were no specific comments in opposition to the project or on compensation policies that require new action, and they were received favorably.

Table 10.10-4 Consultations with Local Governments

Party to a conference	Participant comments
Namibe Provincial Government and Moçâmedes Municipality Government Participants: Namibe Province: Advisor to the Vice Governor, Director of the Geography and Land Registry Department, Moçâmedes Municipality: Director of the Urban Planning Department (3 people in total)	・ We welcome the implementation of the project and are willing to support it. We look forward to keeping in close contact. ・ Residents are very sensitive about compensation, including confiscation and permanent acquisition of private property during construction. Based on past experience, it is imperative that residents be treated fairly. ・ Concerned that presenting a power transmission ROW would risk residents being influxed.
Bibala Municipality Government Participants: 8 people in total, including the deputy Municipality mayor, executive director, department managers in charge, and advisors	・ We welcome the implementation of the project and will spare no effort to support it. We look forward to keeping in close contact. ・ The Kapangombe area, through which the transmission line passes, is short of electricity and would like to benefit from the project. ・ The airport in Caraclos is not normally used, but is intended for emergency/emergency use. We would like to see a power line installed on the north side of the National Highway in the vicinity of this location. ・ The Kapangombe area, including Caraculo, is subject to seasonal migration of Mumuila and Mucubal, which should be taken into consideration when conducting the project. This should also be taken into consideration when conducting social surveys.
Huíla Provincial Government	・ We participated in the consultations held in February 2020 with the Namibe and Huíla provincial governments. Based on the exchange of views at that time, we very much appreciate the decision to plan a route that avoids the Lubango urban area.

Party to a conference	Participant comments
Participants: Lieutenant Governor (1 total)	・ The citizens of Lubango are also suffering from power shortages and are looking forward to the distribution of electricity through this project. ・ We are closely monitoring the social impact of this project. We look forward to continued discussions. ・ Stakeholder engagement and social surveys should be accompanied and participated by government officials from Humpata and Lubango Municipalities.
Humpata Municipality Government Participants: Deputy Municipality Manager, General Manager, and the section managers of the departments in charge (3 people in total)	・ We are willing to support and cooperate with the project. ・ The route presented is fine because it avoids Tundavala. ・ I understand that mainly agricultural lands will be affected by the 220 kV TL route. We appreciate the fact that you plan to confirm these impacts in the social survey. ・ The stakeholder consultation conducted in April 2021 was with the help of Soba. Soba bridges the gap between the Municipality government and the residents, and we always strongly promote their involvement in social surveys. Even in the case of compensation payments, Soba will intervene to assist in the screening process, checking for land rights and occupancy status. Soba's intervention can help avoid conflicts among local residents.
Lubango Municipality Government Participants: Deputy Municipality mayor and department managers in charge (2 people in total)	・ We understood that many technical studies were conducted after February 2020. We welcome the implementation of the project and are willing to support it. We also agree with the study process. The Municipality Water and Power Authority will be the focal point and will keep in touch. ・ We would like to see a map in the future showing which structures, if any, will be affected by the project component in Lubango Municipality, particularly the installation of the 60 kV DL, and how they will be affected by the installation of the 60 kV DL to residences and other structures. We understand that there will be a certain long period of time after this study until construction begins, and if a development plan is developed under Lubango Municipality during this time, we would like to coordinate with them by avoiding this project component. We would like to be kept informed as needed.

Source: JICA Survey Team

(4) Summary of Local Consultation

A summary of each consultation is provided below. Note that since the time of the first community consultation (April 2021), the transmission route was slightly changed and an additional distribution route was added, resulting in several changes and reductions in the number of affected communities, and the community consultations were held in six locations in two provinces. In addition, as with the April 2021 community consultation, the following considerations were taken into account before holding the consultation.

- In addition to explanations in Portuguese, interpretation was provided in Nyaneka-Humbi, the language spoken locally, to ensure a thorough explanation and question-and-answer session.
- Since many areas at the village level are not electrified, maps and project outlines were prepared on banners and posters printed in advance.
- Information was disseminated through the local government (Municipality and commune). In addition to this, the participation of residents, including women and the elderly, was ensured by calling for participation in the consultation through traditional leaders (sobas) and coordinators in each village, distributing flyers in villages a few days before the event, and providing direct explanations even orally.
- In consideration of the ease of participation of the residents (especially women), the meeting was held in each village, choosing a time that took into account the situation of the residents as much as possible. After the meeting was adjourned, the women were approached individually to see if there was anything they could not say at the meeting.

1) Poaires Muhaha Settlement (Arimba Commune)

- Participants: deputy head of Arimba Commune, traditional leaders, settlement coordinator, local residents, RNT, survey team
- Location: No. 24 Primary School
- Main Discussions

Residents' comments and questions	Organizer's response
・ When an irrigation dam was built in this area before, some of the residents in our district suffered crop damage, but we received no compensation. Will they really compensate us this time? ・ If my land is taken, I will not be able to maintain my livelihood. I want some assurance that I will be compensated in some way.	・ JICA takes the resettlement and compensation process very seriously and will not provide financing until such issues are properly addressed by the RNT and implemented in accordance with existing national laws and JICA requirements. A study will be conducted to prepare a simplified resettlement plan, assuming impacts are unavoidable. ・ Only infrastructure located within the ROW (45 m) is eligible for compensation; anything outside of this zone is not. ・ An assessment of the affected houses and other properties will be made, and the affected residents will receive houses of equal or better specifications. Only the parties concerned are eligible for this program, and juniors seeking compensation are excluded. ・ Residents who suffer some damage under the line are eligible for compensation. Compensation cannot be demanded when there is no damage. Compensation can be either monetary or in-kind, but we assume that in-kind payments are preferable; based on lessons learned from other RNT-supported projects, we believe that monetary compensation payments are not preferable for affected residents, except in unavoidable cases, such as crop compensation. There are people who preferred to purchase electrical appliances and consumer goods and later became unable to build their houses. ・ I want the residents themselves to think first about what they want us to do. Please calculate all the losses and consult with us. Cultivation after the operation is possible, and if space is needed elsewhere, alternative land will be secured in the presence of the commune office. We would like you to consider how to use the compensation money, such as leaving it as payment for the purchase of seeds. ・ We would like the residents who do not attend this meeting to be made widely aware of the discussions that take place at this meeting.

2) Figueira Settlement (Arimba Commune)

- Participants: deputy head of Arimba Commune, traditional leaders, settlement coordinator, local residents, RNT, survey team
- Location: Under the tree at Nambungula Primary School
- Main Discussions

Residents' comments and questions	Organizer's response
・ When a brewery was built in the area, the company promised to help provide water, electricity, fertilizer, and seeds, but no promises were kept. ・ The previous project explained that they would build a clinic, but in the end they did not. We welcome this project if it provides employment opportunities for young people, but we hope they will keep their promise. ・ The Angolan government plans to attach priorities among the projects. Compensation recipients should understand that they are expected to spend their compensation money thoughtfully. (Vice Administrator)	・ Residents who suffer some damage under the line are eligible for compensation. Please understand that residents who do not suffer any damage are not eligible for compensation. ・ JICA takes the resettlement and compensation process very seriously and will not provide financing until such issues are properly addressed by the RNT and implemented in accordance with existing national laws and JICA requirements. A study will be conducted to prepare a simplified resettlement plan, assuming impacts are unavoidable. ・ Only infrastructure located within the ROW (45 m) is eligible for compensation; anything outside of this zone is not. ・ An assessment of the affected houses and other properties will be made, and the affected residents will receive houses of equal or better specifications. Only the parties involved are eligible, and juniors who are looking for compensation are excluded. ・ Compensation is either in money or in kind, but we considered supplying electricity to households that provided money for house compensation, but they ended up spending the compensation money and did not build houses, and therefore could not supply electricity. Please think carefully and hope for the best. ・ RNT is a public corporation and we ask that you consider not tying the main purpose of this consultation to promises made by other political leaders or business people. ・ There are examples of similar projects that RNT has undertaken in other parts of the country, and we are willing to compensate.

3) Onculuvala settlement (Humpata commune)

- Participants: Humpata community officials, settlement coordinators, local residents, RNT, survey team
- Location: Outdoor
- Main Discussions

Residents' comments and questions	Organizer's response
・ What kind of compensation can be expected when houses, farmland and grazing land are affected? Also, what are the risks posed by the power lines? ・ The residents are exhausted due to repeated droughts. We would like you to provide drinking water, health centers, road construction, agricultural support, etc. ・ We look forward to the success of the project.	・ JICA takes the resettlement and compensation process very seriously and will not provide financing until such issues are properly addressed by the RNT and implemented in accordance with existing national laws and JICA requirements. A study will be conducted to prepare a simplified resettlement plan, assuming impacts are unavoidable. ・ Infrastructure and crops located within the ROW (45m) are eligible for compensation, and anything outside of this zone is not. ・ Overhead power lines are at least 35 m above the ground, so electromagnetic and other influences are negligible. We intend to avoid crossing residential areas as much as possible. We have a system in place to automatically turn off the power if there is a safety issue, but we ask that residents refrain from engaging in any new activities near the tower construction site. ・ The affected houses are considering offering alternative buildings. ・ Based on lessons learned from other RNT-supported projects, we believe that payments through monetary compensation are undesirable for the affected population, except in unavoidable cases such as crop compensation. There are people who preferred to purchase electrical appliances and consumer goods and later became unable to build their homes. ・ We would like the residents who do not attend this meeting to be made widely aware of the discussions that take place at this meeting.

4) Sames settlement, Jamba II settlement, Campones settlement (Humpata commune)

- Participants: Humpata commune officials, Humpata Municipality Energy and Water Resources Department officials, village coordinators, local residents, RNT, survey team
- Location：Jamba II Settlement
- Main Discussions

Residents' comments and questions	Organizer's response
・ We applaud RNT's efforts to once again hold participatory meetings with residents. ・ Will the settlement be electrified by this project (will the distribution lines go through?). ・ What kind of compensation can be expected when houses, farmland and grazing land are affected? Also, what are the risks posed by the power lines?	・ The locations of the towers near the three settlements have not yet been identified and will be finalized after the completion of the topographical and geological survey. Electrification in the settlements will be carried out by ENDE in the future after the project is implemented. ・ JICA takes the resettlement and compensation process very seriously and will not provide financing until such issues are properly addressed by the RNT and implemented in accordance with existing national laws and JICA requirements. A study will be conducted to prepare a simplified resettlement plan, assuming impacts are unavoidable. ・ Infrastructure and crops located within the ROW (45m) are eligible for compensation, while those outside of this zone are not. ・ Overhead power lines are at least 35 m above the ground, so electromagnetic and other influences are negligible. We intend to avoid crossing residential areas as much as possible. We have a system in place to automatically turn off the power if there is a safety issue, but we ask that residents refrain from engaging in any new activities near the tower construction site. ・ The affected houses are considering offering alternative buildings. ・ Based on lessons learned from other projects supported by RNT, we believe that payments through monetary compensation are undesirable for the affected population, except in unavoidable cases such as crop compensation. There are people who preferred to purchase electrical appliances and consumer goods and later became unable to build their homes. ・ We would like the residents who do not attend this meeting to be made widely aware of the discussions that take place at this meeting.

5) Heva de Cima settlement (Humpata commune)

- Participants: Palanca commune government officials, Humpata commune government officials, traditional leaders, village coordinators, local people, RNT, survey team
- Location: Heva de Cima settlement
- Main Discussions

Residents' comments and questions	Organizer's response
・ The village already has distribution lines running through it, and poles with pole transformers were built near the houses, but more than three	・ I would like the electrification to be done individually by ENDE. ・ What is planned near this village in this project is a high-voltage power line, and the plan will be finalized based on the topographical and geological survey. While there may have been projects in the past that were not successful or did not receive compensation, this project will receive support from the

Residents' comments and questions	Organizer's response
years later, the village is still not electrified at all. If this situation continues, I do not want the power lines to go through the village. I am not saying that I am against this project, but I do hope that the compensation process and other issues will be handled in good faith with the residents. ・ From the route illustrated on the poster, this village would not be affected. ・ We learned that they would compensate us for any business impact. The business plan was also explained to me and I understood it.	Japanese government, which will ensure transparency. If space is needed elsewhere, an alternative land will be secured in the presence of the commune office. ・ JICA takes the resettlement and compensation process very seriously and will not provide financing until such issues are properly addressed by the RNT and implemented in accordance with existing national laws and JICA requirements. A study will be conducted to prepare a simplified resettlement plan, assuming impacts are unavoidable. ・ Infrastructure and crops located within the ROW (45m) are eligible for compensation, while those outside of this zone are not. ・ There is a possibility that the route may move slightly until the start of construction. We are carefully explaining to the communities that we believe will be affected by the project in a broad sense.

6) Jango settlement (Arimba commune)

- Participants: deputy head of Arimba Commune, settlement coordinator, local people, ENDE, survey team
- Location：Jango settlement
- Main Discussions

Residents' comments and questions	Organizer's response
・ There is considerable concern regarding the issue of compensation and resettlement of affected residents. This is due to the fact that some people have not received compensation in the past for other projects. ・ There are many unemployed young people in the local community; are there opportunities for them to be employed as laborers during the construction period? ・ In order to bring energy to the residents, a detour for substation construction would be needed. Will this energy benefit residents in populated areas? If the residents do not benefit from the power, there is no point in compensating or relocating them.	・ Compensation costs are estimated in a simplified resettlement plan. In developing this plan, initial baseline surveys and asset surveys are being conducted with local residents. ・ The goal is to work with government authorities so as to promote the employment of local personnel in the construction. The specifications will require that 40% of the workforce be local workers. Training of young people is required. ・ Without adequate power supply and transmission, electrification is impossible. Specifically, electrification is contingent on the installation of a substation in the area currently being studied by ENDE, followed by the installation of low voltage poles and connection to end users. There are many un-electrified areas, and we have received complaints at the provincial level from 14 local governments about areas that have been electrified for over 20 years but have never received steady electricity. We hope you understand these situations.

10.10.3. Dissemination and Opinion Exchange Regarding Site Compensation and Other Impacts on Local Lives

Based on the results of the technical consultation with RNT/ENDE and the environmental and social study, second-round stakeholder consultation was held in June 2022. In the said consultation, the project outline (draft-final level) and construction plan were explained, as well as the results of the environmental and social study, the environmental management monitoring plan, and the resettlement plan. A summary of the consultations is provided in Table 9.11-3 in the previous chapter.

In addition to government officials, the consultations were widely open to local community, including traditional leaders (sobas), civil society organizations, NGOs, and residents. Participants generally expressed support for the project, with no opposition. During the meeting, the draft resettlement plan was explained and opinions were exchanged on the results of the initial baseline survey conducted from November to December 2021, the policy on compensation for lost assets and

livelihood restoration support measures developed based on the results of the survey. RNT/ENDE reiterated their intention to provide fair and transparent compensation based on JICA's Environmental Guidelines, which was well understood by the participants.

11. Utilization of Japanese Technology

11.1. Consideration of the use of Japanese technology

11.1.1. Low-Loss Conductor

The new 220 kV TL (approx. 196 km) is expected to be heavily loaded at all times when the planned future thermal power station in Namibe (CCGT750MW) comes into service (scheduled from 2036). Therefore, low-loss conductors (LL-ACSR/SA 728mm^2 or LL-ACSR/UGS 724mm^2) will be applied, which are 13% to 15% less transmission loss than conventional ASCR or AAAC conductors and have long-term cost advantages.

Assuming that the Low-Loss conductor will be applied to the 220 kV TL and CCGT750MW comes into service from 2036, it will be estimated that the initial investment cost can be offset in about 15 years, and the 30-year life cycle cost will yield a cumulative benefit of 40 to 43 Million USD.

In the application of this technology, the handling and maintenance of the conductor will not differ greatly from those of conventional conductor, and there should be no problem in procurement through international bidding.

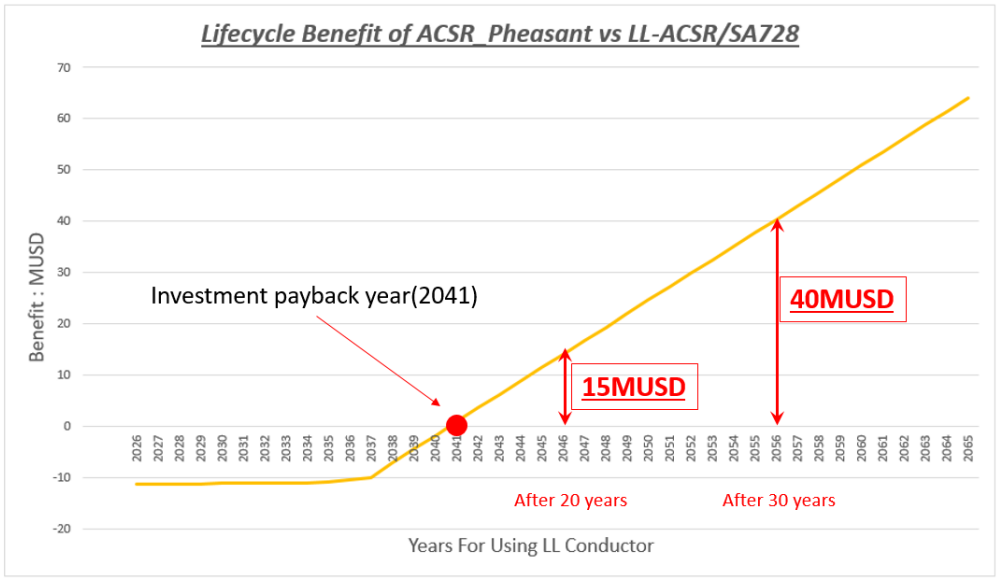


Figure 11.1-1 Life Cycle Cost Characteristics when Low-Loss Conductor is applied (1)

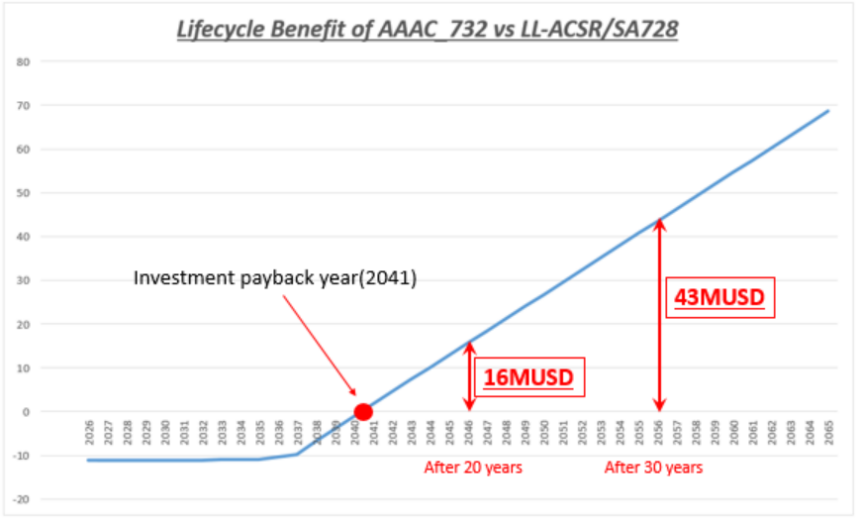


Figure 11.1-2 Life Cycle Cost Characteristics when Low-Loss Conductor is applied (2)

11.1.2. Attachments and Spare Parts for Demining Equipment

The demining machine to be used in this project will be a Nikken Type-V33, and necessary attachments, spare parts and consumables will be procured. All attachments, spare parts and consumables that can be connected to the existing equipment and genuine parts will be Japanese products.

11.2. PQ Conditions for Utilization of Japanese Technology

Undislosed Information.

11.2.1. Low-Loss Conductor

Undislosed Information.

11.3. Need for Technical Assistance

The low-loss conductor to be adopted in the project will be installed for the first time in Angola.

This low-loss conductor is an ACSR-type conductor consisting of aluminum and steel-core strands. The standard conductors used in Angola are AAAC-type conductors consisting entirely of aluminum strands, but the low-loss ACSR conductor is more resistant to moisture penetration inside due to the trapezoid-shaped wire of the aluminum strands and has better corrosion resistance than AAAC-type conductors. Therefore, there is no need to change maintenance methods such as inspection methods, inspection intervals, and deterioration diagnosis. In addition, since the same conventional tools, conductor clamps, sleeves, spacers, and other conventional products can be applied to low-loss ACSR conductors, there are no special aspects of installation and maintenance.

The integrally molded polymer insulators are also not unique in terms of installation and maintenance, only different in their fabrication methods from other standard types of insulators.

On the other hand, as shown in the operation maintenance and management plan in chapter 7.6, regarding transmission line facilities, there is room for improvement in terms of maintenance and management of the transmission line facilities, such as rust and corrosion of the tower in the Namibe area and bird nests left on top of the tower, and according to information from RNT, there are also concerns about corrosion of the insulator equipment and corrosion inside the conductors. In addition, while maintenance items such as patrols and inspections have been established to some extent for substation equipment, these items have not been established for GIS equipment, and there is a need to establish an abnormality diagnosis method to detect and respond to abnormalities in equipment as soon as possible when they occur.

Therefore, the technology transfer of RNT to ENDE is very effective in terms of methods for diagnosing the degradation of transmission line facilities and methods for patrolling and inspecting GIS equipment

12. Plan of Project Implementation

12.1. Project Implementation Structure

12.1.1. Project Implementation Structure

Undislosed Information.

12.1.2. Flow of Approval and Fund Procedures in the Project

Undislosed Information.

12.2. Project Implementation Structure of Implementing Agencies

12.2.1. Project Implementation Structure of Implementing Agencies

Undislosed Information.

12.2.2. Technical Level and Experience of Maintenance Agencies

Undislosed Information.

12.3. Planning of Construction and Procurement

12.3.1. Special Methods of Construction and Procurement

Undislosed Information.

12.3.2. Methods of Bidding and Contracting

Undislosed Information.

12.3.3. Selection of Consultants

Undislosed Information.

12.3.4. Selection of Contractors

Undislosed Information.

12.4. Schedule of Project Implementation

Undislosed Information.

12.5. Estimation of Approximate Project Cost

12.5.1. Composition of Project Cost

Undislosed Information.

12.5.2. Conditions of Estimation

Undislosed Information.

12.5.3. Project Costs of Transmission Line and Distribution Line

Undislosed Information.

12.5.4. Project Costs of Substation Facilities

Undislosed Information.

Undislosed Information.

12.5.5. Costs for Exploration and Clearance of Mine and UXO

Undislosed Information.

12.5.6. Summary of Project Cost

Undislosed Information.

12.5.7. Annual disbursement Costs of the Project

Undislosed Information.

12.6. Financing Plan

Undislosed Information.

12.7. Proposed Consulting Services

Undislosed Information.

12.8. Safety Measures

The following safety measures shall be taken to prevent highly hazardous accidents during the construction of this project.

- The construction work related to the 220/60 kV East Lubango SS will take place near the existing transmission line and it is expected to conduct works of outage and live line, and the safety measures must be taken to prevent personal injury, damage to existing facilities, power outages, and electric shocks to workers, and to give due consideration to safety management. For near the construction site of the 220/60 kV New Namibe SS is expected to be subjects to ground subsidence and deformation due to weather conditions (heavy rains strong winds, etc.), and it is necessary to warn workers and take protective measures during the construction period. For transmission and distribution line construction work, sufficient consideration must be given to safety management during construction, as a wide variety of work will be performed, including work at high positions on tower/conductor over wide areas, work over existing power lines, railroads and major roads, work to use crane with heavy objects and work to use special tools.
- The project implementation will comply with Angolan laws and regulations pertaining to occupational safety.
- The contractor will prepare an occupational safety plan, including safety education and training, and obtain approval from RNT. Before starting work on this project, workers must receive an introductory lecture and training to ensure that they fully understand the safety considerations before starting work. The same training will be conducted for any significant changes in work content.
- A system of safety management whereby an experienced safety officer constantly checks the safety situation on the job site will be established. The safety officer will carefully examine the work on this project and always act with the prediction of hazards in mind.
- Safety checklists should be fully utilized to ensure safety checks. Since overhead wire work is the most dangerous work, all workers should be aware of and understand the day's work at the Tool Box Meeting before starting the work. As for the stringing work, team that consists of only skilled workers will be formed. When working on towers, safety belts must be worn and safety ropes must be used to secure the body at all times.
- Establishing mitigation measures will be considered to deploy safety protective equipment such as helmets, safety shoes, earplugs, and electric shock protection, and, if necessary, mobile medical facilities, in accordance with the occupational safety plan.
- Before starting work, carefully inspect the condition of safety equipment and remove any

inadequate equipment from the site.

- Always strive to be organized and tidy, and maintain an environment in which work can be performed smoothly.
- Signs should be placed in areas where hazardous or noxious materials are stored. Manuals and other information on the proper use of cranes and other heavy equipment should be prepared and maintained as necessary, and approved by the RNT and ENDE. Safety personnel will carefully assess the skills of operators of heavy equipment before allowing them to operate it.
- Construction companies shall comply with occupational health and safety regulations in accordance with international standards to avoid accidents and ensure safety during the construction period. The actions to be taken in the event of an accident and the communication system shall be clearly documented, and all persons in charge of each site shall be informed to act accordingly.
- Access to the work site will be via permitted roads only, and only permitted areas below the line will be used between towers.
- Since the construction area of this project is in an area where unexploded mines may be buried, the construction process will be carried out after the completion of the mine exploration and removal work.
- Periodic safety meetings with the participation of the employer's representative and consultants should be held to discuss and confirm site safety measures and their effectiveness.

13. Project Evaluation

13.1. Financial Assessment of Angolan Government

As described in Chapter 2, the financial strength of the Angolan government, which shall repay the ODA loan, is important because the implementing bodies, RNT and ENDE, do not bear the financial burden and because CND, the implementing body of Package 4 (demining portion), is a governmental organization.

Angola experienced negative economic growth (negative GDP growth) from 2016 to 2020 due to the slump in oil prices in recent years. The government debt to GDP ratio has also increased, reaching 136.5% in 2020. However, since then, GDP has also turned to growth, and the government debt ratio is showing an improvement trend, reaching 86.3% in 2021 and 57.9% in 2022 (forecast).

Table 13.1-1 Financial Situation of Angola

	2015	2016	2017	2018	2019	2020	2021	2022 (est)
GDP（billion USD）	116.19	101.12	122.02	101.35	84.52	58.25	74.50	124.86
Government Gross Debt (% of GDP)	57.1	75.7	69.3	93.0	113.6	136.5	86.3	57.9

Source: IMF Country Data, Angola, as of April 2022

Under these circumstances, the World Bank and AfDB continue to provide financial cooperation. In 2018, the government of Angola requested financial support from the International Monetary Fund (IMF), and in December 2018, the IMF loan program (36 months) for the country was launched. A total of approximately $3.7 billion in loans was planned to be disbursed over the life of the program, with $990 million disbursed at the time of program approval. The rest is planned be provided when it is confirmed in the half-yearly review that the Angola government is smoothly implementing programs such as fiscal reform. The first review in June 2019 and the second review in December 2020 both determined that the reform program was on track, and the Angolan government was able to receive about 250 million USD in loans respectively. After that, the 3rd review in September 2020, the 4th review in January 2021, and the 5th review in September 2021 were conducted. The 6th review in January 2022, IMF judges, “The economy is gradually recovering from various economic shocks, including the spread of the COVID-19, partly due to the world-level surge in oil prices. The governmental policy is sound, and is in line with its economic program that is prerequisite of IMS additional loan,” and Angola was able to receive a loan of 750 million dollars. In this review, the IMF evaluates the financial policies of the government and central bank of Angola to curb inflation.

According to the Embassy of Japan in Angola, Fitch, a credit rating agency, raised Angola's long-term issuer default rating (IDR) from “CCC" to “B-" in January 2022, and evaluated its rating outlook as “stable.” In February of the same year, Standard & Poor's also upgraded the rating from "CCC+" to "B-" with a "stable" outlook. Both institutes are said to have appreciated the economic reforms by the Angolan government as well as the benefits of soaring oil prices. (From Monthly Report, January and February 2022 published by the Embassy of Japan in Angola.)

13.2. Economic and Financial Analysis

Undislosed Information.

13.2.1. Economic Internal Rate of Return (EIRR)

Undislosed Information.

13.2.2. Financial Internal Rate of Return (FIRR)

Undislosed Information.

13.2.3. Sensitivity Analysis

Undislosed Information.

13.3. Project Risk Assessment

The risks assumed during the implementation of the project, including the construction safety measures in Section 12.8, are systematically assumed, classified, and evaluated, and the results are summarized together with the supervision methods, mitigation measures, and their implementation methods. Table 13.3-1 shows the results of the classification and evaluation. These risks were examined and evaluated by category and finally aggregated. The categories used in the analysis are listed below.

- Stakeholder Risk
- Risks to the implementing agency, including risks to implementation and supervisory capacity, as well as fraud and corruption risks
- Project risks (including design risks, risks associated with implementation plans and donors, risks associated with delivery quality, risks associated with construction, etc.)
- Other Risks

As a result of the risk assessment, it is assumed that the risk level associated with the implementation of this renovation project is low, but it is desirable to implement preventive measures such as monitoring as indicated in the risk analysis when the project is implemented.

Table 13.3-1 Risk Management Framework for the Project

Potential Project risks	Mitigation Measures
1. Stakeholder risk	Probability: H/M/(L)
(Details of risk)	Impact: (H)/M/L
Low commitment of government ministries and agencies to the power transmission and distribution line construction project (policy priorities, assurance of financial support), inconsistencies caused by the different ministries in charge of power facilities and mines, and confusion caused by the overthrow of the administration.	Analysis of probability and impact:
	The ministries in charge of mines are related to all projects, and there are currently no cases of obstacles. In addition, the current government is solid and the possibility of a change of government is extremely low, and even if a change of government were to occur, the importance of the power business is high, so there is little likelihood of major policy changes.
	Mitigation Measures:
	Monitoring and coordination of the situation through regular policy meetings at the high level.
	Actions during the implementation:
	Continued monitoring
	Contingency plan (if applicable):
	None
(Details of risk)	Impact: H/M/(L)
Opposition to the project by residents' movements, media, etc.	Analysis of probability and impact:
	Currently, no opposition to improving the power supply capacity has been heard, but the project could be delayed if large-scale opposition arises.
	Mitigation Measures:
	Monitoring of the absence of opposition movements among the residents of Namibe, Ouila, especially those living near the areas where the transmission and distribution lines are in transition and where the substation is located.
	Actions during the implementation:
	Continued monitoring
	Contingency plan (if possible):

	Explaining the advantages of the project to local institutions and residents.
Implementing agency risk	
2.1. Capacity risk	Probability: H/M/(L)
(Details of risk)	Impact: H/M/(L)
Lack of human management capacity and financial implementation capacity and authority of the project implementing agency	Analysis of probability and impact: This is the first yen loan project in the power sector in Angola, but the project structure is planned to be similar to that of the AfDB-supported transmission line project that preceded it. RNT/ENDE itself will not bear the financial burden of the project, and plans to repay the loan from the national budget. Mitigation Measures: Check the responsibility structure of each department of the implementing agencies, including MINEA, the regulatory authority for the power project, and encourage the establishment of an appropriate governance structure. Monitoring the status of cooperation with ministries and agencies related to mines. Actions during the implementation: Continued monitoring for trouble Contingency plan (if possible): Confirmation of facts and discussion of remedial measures by bringing together relevant institutional parties
(Details of risk)	Impact: H/M/(L)
Delays, etc. due to lack of technical implementation capacity of the executing agency	Analysis of probability and impact: The agencies has experience in implementing transmission and distribution projects similar to this project, and understands the necessary technologies. JICA's procurement guidelines will be basically applied to the implementation of this project. Mitigation Measures: Implementing managed procurement with a full understanding of the JICA guidelines Actions during the implementation: Monitoring the adequacy of processes, procedures, timing, etc. during project execution Contingency plan (if possible): Provide technical assistance and risk avoidance recommendations.
(Details of risk)	Impact: H/(M)/L
Delay in government allocation of Angola's own expenses delays the process.	Analysis of probability and impact: Since the self-funded costs will be allocated from government funds, not from the implementing departments (MINEA/RNT /ENDE and CND), lack of coordination between the implementing departments and MINFIN could result in funds not being allocated when necessary and the process coming to a halt.

	Mitigation Measures:
	Regular liaison between MINFIN and project implementation divisions
	Actions during the implementation:
	Monitoring of liaison meetings held
	Contingency plan (if possible):
	None in particular
(Details of risk)	Impact: H/M/(L)
Possible delays in payments to contractors, etc.	Analysis of probability and impact:
	Since the company has no experience with yen loans, rework of procedural documents and approval procedures could result in payment delays, etc.
	Mitigation Measures:
	Holding workshops on yen loan procedures. Monitoring payment status and provide guidance for improvement when delays occur.
	Actions during the implementation:
	Monitoring
	Emergency plan (if possible):
	None in particular
2.2. Governance risk	Probability of occurrence: H/M/(L)
(Details of risk)	Impact: H/M/(L)
Delays in decision-making by the implementing agencies due to lack of division of responsibilities and consultation systems	Analysis of probability and impact:
	The RNT/ENDE, which will be the implementing arm of the project, is under the supervision of the higher-ranking organization, MINEA, so consultations and coordination are possible. On the other hand, the CND coordinates landmine-related matters, so cooperation between the power and landmine sectors is necessary.
	Mitigation Measures:
	Establishing a liaison system to ensure appropriate cross-ministry collaboration
	Actions during the implementation:
	Monitoring that information sharing and supervision are properly implemented
	Contingency plan (if possible):
	None in particular
(Details of risk)	Impact: H/(M)/L
Delays in financial approvals due to reasons such as the need for approval from the ministry or agency in charge of the project implementation or borrowing	Analysis of probability and impact:
	The approval procedures required for the implementation of the project and the yen loan agreement will be carried out by MINEA and MINFIN, but since prior agreement is reached and the approval procedures are carried out in accordance with the necessary timing, this is not usually a critical path.
	Mitigation Measures:
	Monitoring the progress of the approval process
	Actions during the implementation:
	None in particular
	Contingency plan (if possible):

	None in particular
2.3. Fraud and corruption risk	Probability: H/M/(L)
(Details of risk)	Impact: H/M/(L)
Delays in procurement or projects due to lack of or inadequate systems for procurement financial management, anti-corruption, etc.	Analysis of probability and impact:
	Although there is no experience in the yen loan business, the AfDB support project is ahead of the others, and there is no information of any scandalous incidents such as fraud or corruption.
	Mitigation Measures:
	The existence of issues will be reconfirmed during the implementation phase, and specific measures to seek improvements will be discussed if necessary.
	Actions during the implementation:
	Monitoring
	Contingency plan (if possible):
	None in particular
3. Project risk	
3.1. Design risk	Probability: H/M/(L)
(Details of risk)	Impact: H/M/(L)
Issues arise because the technology required to implement the project is too advanced compared to the level of local technology.	Analysis of probability and impact:
	Although the application of low-loss conductors is included as a Japanese technology, construction and maintenance work can be performed at the same level of technology as conventional products, and there is little likelihood of any problems occurring.
	Mitigation Measures:
	Checking the contents and consider countermeasures when a problem occurs.
	Actions during the implementation:
	Monitoring
	Contingency plan (if possible):
	None in particular
(Details of risk)	Impact: H/M/(L)
Lack of components necessary to achieve project objectives and development effectiveness	Analysis of probability and impact:
	In order to ensure the implementation of the surveying and activities of the transmission and distribution line construction project and the removal of mines before the start of construction, the provision of necessary equipment and technical support is incorporated in this project, and since prior discussions have been held with CND and others on the implementation method, smooth implementation is expected.
	Mitigation Measures:
	Implementation and monitoring of the work plan prior to the start of the project
	Actions during the implementation:
	Monitoring
	Contingency plan (if possible):
	None in particular
(Details of risk)	Impact: H/M/(L)

Lack of timely confirmation of project implementation status (budget, construction) delays identification of issues and countermeasures	Analysis of probability and impact:
	Since the project implementation is divided into transmission (RNT), distribution (ENDE), and mine (CND), the status of the entire project, confirmation of issues, and discussion of countermeasures will be a challenge, but RNT will be responsible for overall supervision to reduce risk.
	Mitigation Measures:
	Monitoring of management status by RNT
	Actions during the implementation:
	None in particular
	Contingency plan (if possible):
	None in particular
(Details of risk)	Impact: H/M/(L)
Is there too much procurement package division? Is there a lack of contractor capacity?	Analysis of probability and impact:
	The procurement package is expected to be divided into transmission, substation, distribution, and mines, depending on the content of the project. In addition, since similar projects have already been implemented earlier in Angola, there is little likelihood of problems due to lack of technical capacity of contractors.
	Mitigation Measures:
	None in particular
	Actions during the implementation:
	None in particular
	Contingency plan (if possible):
	None in particular
(Details of risk)	Impact: H/(M)/L
Is there a high likelihood that international market conditions and foreign exchange factors will cause project costs to rise?	Analysis of probability and impact:
	Prices are rising worldwide due to the war in Ukraine and Russia.
	Mitigation Measures:
	(Difficult to take measures)
	Actions during the implementation:
	Monitoring international
	Contingency plan (if possible):
	None in particular
(Details of risk)	Impact: H/M/(L)
External factors eliminate the expected project effect.	Analysis of probability and impact:
	In the event of delays in the following projects, the realization of the effects of this project may be delayed. 1) Delay in the service of the Umbo-Lubango transmission line project, an AfDB-supported project. 2) Delay of the project to construct a distribution line from the new Namibe substation to be built under the project to connect to the existing distribution facilities (to be carried out by ENDE).
	Mitigation Measures:

	Obtain confirmation by memorandum of understanding, etc. with the project implementer.
	Actions during the implementation:
	If delays are anticipated, discuss response measures
	Contingency plan (if possible):
	None in particular
3.2. Program/donor risk	Probability: H/M(L)
(Details of risk)	Impact: H/M/(L)
Inconsistencies among donors on development assistance measures	Analysis of probability and impact:
	The project boundary with Nombungo SS (AfDB support), which will be the transmission line connection for this project, has been discussed.
	Mitigation Measures:
	None in particular
	Actions during the implementation:
	None in particular
	Contingency plan (if possible):
	None in particular
(Details of risk)	Impact: H/M(L)
Cooperation system with AfDB, which is closely related to this project	Analysis of probability and impact:
	Since the AfDB-supported project and the project's Angolan counterpart share the same implementing agency, it is expected that they will work in tandem to support the project.
	Mitigation Measures:
	Ongoing collaboration and information sharing
	Actions during the implementation:
	Ongoing collaboration and information sharing
	Contingency plan (if possible):
	none in particular
3.3 Delivery quality risk	Probability of occurrence: H/M/(L)
(Details of risk)	Impact: H/M/(L)
Unable to measure the improvement effect of project implementation	Analysis of probability and impact:
	Indicators can be set to check the quantity of transmission lines and power supply to Namibe area.
	Mitigation Measures:
	Measurement and the evaluation and management of measurement results are important. In order to arouse and establish this awareness, it is necessary to obtain understanding prior to project implementation.
	Actions during the implementation:
	None in particular
	Contingency plan (if possible):
	None in particular
(Details of risk)	Impact: H/M(L)
Inadequate O&M prevents continued improvement effects	Analysis of probability and impact:
	Both RNT and ENDE have O&M systems in place and have a track record of managing them. Challenges occur, but they are being resolved on their own.

	Mitigation Measures:
	None in particular
	Actions during the implementation:
	None in particular
	Contingency plan (if possible):
	None in particular
(Details of risk)	Impact: H/M/(L)
Potential impact on project implementation due to natural disasters, local security conditions, etc.	Analysis of probability and impact:
	Since there is a rainy season and a dry season, risk can be reduced by taking the rainy season into account in the work process. Since the end of the civil war, there have been no violent crimes such as terrorism, and the country is stable.
	Mitigation Measures:
	It is desirable to consider the reduction in work efficiency during the rainy season when developing and approving work plans.
	Actions during the implementation:
	None in particular
	Contingency plan (if possible):
	None in particular
(Details of risk)	Impact: H/M/(L)
Improper or unlawful use of project	Analysis of probability and impact::
	The project will be managed by RNT (transmission and substation) and ENDE (distribution) after completion, but both are state-owned companies and it is unlikely that the project will be used for any other purpose.
	Mitigation Measures:
	None in particular
	Actions during the implementation:
	None in particular
	Contingency plan (if possible):
	None in particular
(Details of risk)	Impact: H/M/(L)
Soaring maintenance costs due to inappropriate use of roads, etc.	Analysis of probability and impact:
	The roads to be used for the mine clearance and transmission and distribution line construction projects will be limited in their use, as the majority of roads will be newly constructed in conjunction with the work, although some existing roads will be used, and the potential for an extreme increase in maintenance costs is assumed to be small.
	Mitigation Measures:
	When using existing roads, take measures to prevent accidents and problems in consultation with the local community and businesses in the vicinity of the project area.
	Actions during the implementation:
	Promoting accident and trouble prevention measures
	Contingency plan (if possible):

	None in particular
(Details of risk)	Impact: H/M/(L)
Potential for unbalanced benefits to specific segments of the population and narrow scope of development benefits	Analysis of probability and impact:
	The primary objective of the project is to increase power supply to Lubango and Mosamedes, where electricity is in short supply, and the beneficiaries are expected to be local residents and businesses.
	Mitigation Measures:
	None in particular
	Actions during the implementation:
	None in particular
	Contingency plan (if possible):
	None in particular
3.4 Construction risk	Probability: H/M/(L)
(Details of risk)	Impact: H/M/(L)
Prevention of high-risk accidents	Analysis of probability and impact:
	Referring section 13.2
	Mitigation Measures :
	Referring section 13.2
	Actions during the implementation:
	Referring section 13.2
	Contingency plan (if possible):
	Promptly report to JICA and gather relevant institutional parties to confirm facts and discuss countermeasures
(Details of risk)	Impact: H/M/(L)
Unexpected accidents, such as explosions during the search and disposal of mines and unexploded ordnance.	Analysis of probability and impact:
	The new transmission lines are located in close proximity to existing transmission lines, roads, and homes, making it unlikely that new mines or unexploded ordnances will be discovered. In addition, since CND specializes in mine countermeasures, it can take all possible measures to deal with the situation.
	Mitigation Measures:
	None in particular
	Actions during the implementation:
	Close consultation and progress with CND
	Contingency plan (if possible):
	None in particular
4. Other risk	Probability: H/M/(L)
(Details of risk)	Impact: H/M/(L)
Not specified	Analysis of probability and impact:
	Mitigation Measures:
	Actions during the implementation:
	Contingency plan (if possible):
5. Overall risk rating	Probability: H/M/(L)
(Overall comments)	Impact: H/M/(L)

No significant risks are recognized. However, it is advisable to monitor the implementation of the project to identify changes in the situation in advance and take measures as necessary

13.4. Operation and Effectiveness Indicators

This project aims to reinforce power facilities and stabilize power supply in southern Angola by constructing a new 220 kV TL, various SSs, and 60 kV DL, thereby improving the living environment of local residents and stimulating industrial activities.

Therefore, the indexs after the project commencement should be evaluated that the power facilities between Lubango and Namibe will be connected to the Angolan backbone transmission system as planned, and that the level of stable power supply will be improved by increasing power supply capacity, etc.

For the above reasons, its operation and effectiveness indicators are recommended as the following Table.

An evaluation after two years of project completion through the established operational and effectiveness indicators will be desired.

Table 13.4-1 Operation and Effectiveness Indicators

	Name of Indicator	Baseline (2021)	Target. (2030)	Objective/Calculation
Operation Indicator	(1) Quantity of annual transmission power from Lubango to Namibe by the new 220 kV TL	-	692 GWh	The new 220 kV TL has increased power demand in the Namibe area, contributing to a stable supply.
	(2) Quantity of annual power generation by diesel PSs in Namibe district	305GWh	More than 90% reduction	Sufficient power supply is available due to the new 220 kV TL
	(3) Maximum utilization rate*1 of 220/60 kV new Namibe SS	-	43%*2 (64%)	Sufficient power supply is available in the area due to the construction of the new substation.
	(4) Maximum utilization rate of 220/60 kV East Lubango SS	-	17%	Ditto
	(5) Maximum utilization rate of 60/15 kV Arimba SS	-	38%	Ditto
	(6) Number of accidents by mine/UXO in the construction occupied area during the project construction period	-	0 case	The mine/UXO exploration and clearance work in this project is being conducted safely.
Effect Indicator	(a) Annual total time of outage at 220/60 kV new Namibe SS	-	0 hr*3	The construction of a reliable power facilities for to the area will avoid outages.
	(b) Annual total time of outage at 220/60 kV East Lubango SS	-	0 hr*3	Ditto
	(c) Annual total time of outage at 60/15 kV Arimba SS	-	0 hr*3	Ditto
	(d) O&M situations of equipment for mine/UXO exploration and clearance	-	- Equipment is properly maintained. - Utilizing appropriate records of equipment.	O&M ability is established by capacity building training in this project.

*1: Maximum utilization rate (%) = annual maximum load (MW) / {rated capacity of equipment (MVA) x power factor}

*2: RNT has a plan to install additional transformers in 2030, and if it is installed as planned, 120MVA x 3 units, it will be 43%, and if it is not, 120MVA x 2 units, it will be 64%.

*3: Excluding outages caused by the upper system accidents

The concept of determining operational and effective indicators is as follows

1. Power facilities
   - Since the transmission capacity of the new 220 kV TL becomes the genaration capacity of the Namibe thermal power station in the future (after 2036), it is not appropriate to apply the maximum utilization rate of the transmission line as an evaluation indicator in 2030. Therefore, as an alternative, the quantity of annual transmission power to the Namibe area by the new 220 kV TL, which is assumed based on demand assumptions, is used as the operating index.
     The assumptions and calculations for the quantity of annual transmission power from Lubango to Namibe by the new 220 kV TL and the maximum utilization index at 2030 for each substation are shown in Appendex 13-2.
   - For the Namibe area, MP assumes that existing diesel generators in the Namibe area and elsewhere will be phased out as power supply development progresses and transmission facilities are expanded in MP. Therefore, since it is realistic to assume that the existing diesel generators will be shut down when the new 220 kV TL starts operation, the rate of decrease in diesel generation in the Namibe area will be used as an operational index.
   - On the other hand, in the Lubango area, there is a plan to construct a new diesel power station, and it has not yet been determined whether the diesel power station will be shut down after the start of operation of the project, so operational index will not be determined as the assumption that the plant will be shut down.
   - The maximum utilization rate of each of the New Namibe, East Lubango, and Arimba substations to be constructed will be used as an operational index as the power supply capacity to each region.
   - The main objective of this project is to eliminate the current rotating power outages in the Namibe and Lubango areas and to provide a stable power supply to the area. The power facilities of the project are designed and planned based on the N-1 standard, which has a high level of facility reliability. Therefore, the time of power outage caused by the facilities will be basically zero, and the absence of power outages at each substation will be defined as an effective indicator of the outage elimination in the area. In addition, outages caused by the upper system accidents are excluded.

2. Demining Related
   - Since explorement and clearance activties of mine/UXO in the project area must be conducted safely, the operational index was set to be the absence of any accidents caused by mine/UXO during the work.
   - Since the goal of this project is to improve the maintenance and management capacity of the equipment as well as the installation of equipment for demining, the results of the capacity building are defined as an effectiveness indicator.

13.5. Greenhouse Gas Emission Reduction Effect

This project is to replace the 60 kV DL currently being constructed between Lubango and Namibe (the amount of power distribution is extremely limited) with a 220 kV TL. (At the same time, necessary substations will be constructed and power distribution facilities will be repaired.) By replacing the existing 60 kV DL, which are currently unused, with 220 kV trunk transmission lines, it is expected that a large amount of electricity in the national system will be transferred from the Lubango region to Namibe. In addition, part of the Lubango region will also be able to enjoy electricity from the national grid as a result of the strengthening of the distribution system.

In considering the effects of climate change countermeasures from the above perspective, the form “Energy/Heat and Electricity Generation Facility/Fuel Switch” in JICA Climate-FIT, JICA’s climate change measure support tool, would fit better than “Transmission System Efficiency Improvement” because the expected effect of this Project is to replace power source from diesel generation to hydro-based national average source, rather than simply system loss reduction. However, since it does not fit

the definition of the JICA Climate-FIT itself, JICA Survey Team considered the following while adopting the specification data in line with the JICA Climate-FIT as much as possible.

1. Comparison of Greenhouse Gas Emission Reduction per MWh between "With Project Implementation" and "Without Project Implementation"

- As a greenhouse gas, the target is CO_2 associated with power supply.
- Electricity demand in the Namibe region, which is the target area, is currently satisfied almost entirely with diesel power generation.
- After the project is implemented ("with Case"), i.e. after the transmission lines of this Project are constructed, electricity with a national average CO_2 emission will replace electricity generated by diesel generation.
- To this end, it is necessary, first, to calculate the CO_2 emissions per MWh of diesel power generation and the average CO_2 emissions of the nationwide grid power system.

(1) Without project implementation: All electricity will be supplied by diesel power generation.

- As a premise, 1 cal = 4.186 J and electricity 1 kWh = 860 kcal. Therefore, electric power 1 kWh = 860 x 1,000 x 4.186 J.
- The thermal efficiency of diesel power generation is assumed to be 51%. (For details, refer to the item of economic and financial evaluation in Chapter 13.)
- According to Appendix 2 "Fuel CO_2 Emission Factor" of JICA Climate-FIT (Version 3.0, September 2019), the CO_2 emission factor of Gas/Diesel Oil is 74,100 kg = 74.1 tons per 1 TJ.
- From the above, 1MWh = 860 x 4.186 x 1,000,000/0.51J=860 x 4.186 ÷ (0.51 x 1,000,000) x 74.1 = 0.523 tons can be led.

(2) With project implementation: National average power (weighted average of hydro, natural gas, and diesel power) will be supplied.

- First, calculate the CO_2 emissions per MWh of natural gas-fired power generation.
- The thermal efficiency of natural gas-fired power is assumed to be 55%.
- According to Table 2 above, the CO_2 emission factor of Natural Gas is 56,100 kg per 1 TJ = 56.1 tons.
- By the same calculation as in (1) above, 1 MWh = 860 x 4.186 ÷ (0.55 x 1,000,000) x 56.1 = 0.367 tons can be led.
- Next, since the nationwide power system is assumed to consist of 67% hydroelectric power, 21% natural gas-fired power, and 12% diesel-fired power, the national average CO_2 emissions from electric power is as follows:
  CO_2 emissions per 1MW = 0 ton x 67% + 0.367 ton x 21% + 0.523 ton x 12% =0.1398→ 0.140 ton.

(3) Difference in CO_2 Emission per unit between "With" and "Without" Project Implementation

- From (1) and (2) above, the implementation of the project will have the effect of reducing CO_2 emissions (0.523 ton – 0.140 ton) = 0.383 ton per 1 MWh of supply.

2. Target Power Supply

- The power demand that will be replaced by the nationwide grid power system from diesel power generation through this project is the Namibe region and a part of the Lubango region, which is the same as the beneficiary area in 13.2 Economic and Financial Analysis.
- It should be noted that the benefits of the Namibe thermal power station, which will start operation in Year 14 and Year 16, were also taken into consideration in the economic evaluation; however, the period for consideration of the greenhouse gas reduction effect is set from Year 6 (2028), when the project will start operation, up to Year 13 (2035), immediately before the start of operation of the Namibe thermal power station. (Once the Namibe thermal power station starts operation, the main consideration should be mainly on thermal power generation, which is not the scope of this Project.)

3. Effect on Climate Change Measure through Implementation of the project

- By multiplying the electricity supply amount subject to 2 above with the CO_2 emission intensity of 1 above, the difference in CO_2 emissions with and without project implementation is calculated, that is, the effect as a climate change countermeasure can be derived.
- As summarized in Table 13.5-1, if the project is not implemented, the total CO_2 emissions for Years 6 to 13 (2028 to 2035) will be about 5.1 million tons, while if implemented, CO_2 emission will be 1.36 million tons; a reduction of about 3.73 million tons is expected.

Table 13.5-1 Reduction of CO_2 Emission due to the Project Implementation

			Target Amount as Climate Change Mechanism					Without Project		With Project		Reduction Effect
Year		Huila Prov (Lubango area) (in GWh)	Namibe Prov. (Namibe area) (in GWh)	Total (Reference only)	Direction of Current (Reference)	25% of Demand in Lubango area (in GWh)	GWh as Target for Climate Change Mechanism (in GWh)	Per unit CO2 Emission	CO2 Emission in tons (in tons)	Per unit Cos Emission	CO2 emission in tons (in tons)	Reduction Effect of CO2 Emission with Project n tons (in tons)
(Reference)		(a)	(b)	(c) = (a) + (b)		(e) = (a) x 25%	(f) = (b) + (e)	(0.523 ton/MWh)		(0.140 ton/Mwh)		
2028	Year 6	1,328	741	2,069	to Nmb	332	**89**	0.523	**46,765**	0.140	**12,518**	**34,247**
2029	Year 7	1,437	791	2,228	to Nmb	359	**1,150**	0.523	**601,581**	0.140	**161,035**	**440,546**
2030	Year 8	1,546	841	2,387	to Nmb	387	**1,228**	0.523	**641,983**	0.140	**171,850**	**470,133**
2031	Year 9	1,678	884	2,562	to Nmb	420	**1,304**	0.523	**681,757**	0.140	**182,497**	**499,260**
2032	Year 10	1,810	927	2,737	to Nmb	453	**1,380**	0.523	**721,531**	0.140	**193,144**	**528,387**
2033	Year 11	1,943	970	2,913	to Nmb	486	**1,456**	0.523	**761,305**	0.140	**203,791**	**557,514**
2034	Year 12	2,075	1,013	3,088	to Nmb	519	**1,532**	0.523	**801,079**	0.140	**214,438**	**586,641**
2035	Year 13	2,207	1,056	3,263	to Nmb	552	**1,608**	0.523	**840,853**	0.140	**225,085**	**615,768**
Total									**5,096,853**		**1,364,358**	**3,732,495**
Note:	The benefit for Year 6 is one month only (because the Project is to be completed in November, and is to start operation in December.)											

Attachment 8-1. Operator Comparison Chart

Undislosed Information.

Attachment 8-2: List of Equipment

Undislosed Information.

Attachment 8-3: Map of Proposed Project Site

Undislosed Information.

Attachment 8-4. Images of Mine Clearance Work

Undislosed Information.

Attachment 9-1: Monitoring Form for 220 kV TL

- Monitoring will be conducted by the project proponent by submitting to JICA on a regular basis the measured values, etc., of items that have been determined by the environmental review to require monitoring by JICA, and the following monitoring form will be referred to for submission as necessary.
- In determining the monitoring items, frequency and methods, etc., the project phase or life cycle (e.g., construction phase and operation phase) should be taken into consideration.

<Pre-construction Phase>

1. Air pollution

- Monitoring item: PM10, PM2.5
- Record: measurements are taken once every three months before and after felling and clearing, at 10 tower locations and at the boundaries of neighboring dwellings and other structures

(Date)
(Location)

(Data) Item (Unit.)	Baseline value	Measured value (Average value)	Measured value (Max. value)	Local standard	Referred to. international standards	Remarks. (e.g. location, frequency and method of measurement)
PM10. ($\mu g/m^3$)				-	0.150 (Interim target-1) 0.100 (Interim target-2) 0.075 (Interim target-3) 0.050 (guideline)	Measured by PM meter for 30 minutes
PM2.5 ($\mu g/m^3$)				-	0.075 (Interim target-1) 0.050 (Interim target-2) 0.0375 (Interim target-3) 0.025 (guideline)	Measured by PM meter for 30 minutes

2. Water pollution

(1) Wastewater treatment records

- Monitoring item: wastewater treatment status
- Record: once a week at the workers' camp
- Check the operator's (CND) record ledger

Date	Point	Monitoring item	Status during the reporting period.
		Wastewater treatment status	

(2) Water quality items

- Monitoring item: items in the table below
- Record: record every three months before and after felling and clearing, measurements are taken at 10 river/stream points in the vicinity of the tower location

(Date)
(Location)

Item (unit)	Baseline value	Measured value (Average value)	Measured value (Max. value)	Local standard (Surface water)	Local standard (Drinking water)	Remarks. (e.g. location, frequency and method of measurement)
pH (measure of acidity)				5.0-9.0	6.5-8.5 5.5-9.0	Portable pH meter
Water temperature (°C)				30	22 25	Water thermometer
Conductivity (μS/cm at 20°C)				-	1000	Conductometer
Transparency (cm)				-	-	Transparency meter

3. Soil pollution

- Monitoring item: fuel, lubricating oil and other leaks
- Record: record once a week at the construction site and at the workers' camp
- Check the operator's (CND) record ledger

Date	Point	Monitoring item	Status during the reporting period
		Fuel, lubricating oil and other leaks	

4. Noise and vibration

(1) Noise levels

- Monitoring item: noise levels
- Record: measurements are taken once every three months before and after felling and clearing, at 10 tower locations and at the boundaries of neighboring dwellings and other structures

(Date)
(Location)

Item (unit)	Baseline value	Measured value (Average value)	Measurement (Max. value)	Local standard	Referred to international standards	Remarks. (e.g. location, frequency and method of measurement)
Noise level (dB A)				-	Daytime: 55 dBA Nighttime: 45 dBA Industrial zone: 70 dBA	Measured with sound level meter for 30 minutes

(2) Complaints

- Monitoring item: complaints from municipalities, communes and settlements about noise and vibration
- Record: record as needed

Date	Point	Complaint details	Action	Remarks (resolution status)

5. Offensive odors

(1) Odors

- Monitoring item: presence or absence of odors by sensory examination
- Record: once a week at the workers' camp
- Check the operator's (CND) record ledger

Date	Point	Monitoring item	Status during the reporting period
		Odors (sensory)	

(2) Complaints

- Monitoring item: complaints from municipalities, communes and settlements
- Record: record as needed
- Check the operator's (CND) record ledger

Date	Point	Complaint details	Action	Remarks (resolution status)

6. Waste

- Monitoring item: waste storage and transport conditions
- Record: once a week, at the construction site and workers' camp, the amount of waste collected and disposed of by item by the waste collection and disposal contractor
- Check the operator's (CND) record ledger

Date	Point	Monitoring item	Status during the reporting period
		Amount collected by contractors	

7. Ecosystems

(1) Flora and fauna

- Monitoring item: plant species and distribution in the clearing and rooting areas and animal occurrence species in the vicinity
- Record: observation of plant and animal occurrence species at eight sites once every six months before and after felling and clearing

Date	Point	Monitoring item	Status during the reporting period
		Plant species	
		Fauna species	

(2) Birds

- Monitoring item: birds
- Record: once every 6 months before and after logging and clearing, observation of bird occurrence species by random census in Ivantala swamp, Poiares, Humpata, Tchivinguilo, Bruco, Capangombe, Caraculo and Moçâmedes

Date	Point	Monitoring item	Status during the reporting period
		Bird species present	

(3) Threatened species

- Monitoring item: Threatened species
- Record: record once every three months before and after felling and clearing, random census observations are made twice a.m. and twice p.m. from the road within a 20 km radius near Caraculo, focusing on Ludwig's bustard (*Neotis ludwigii*)

Date	Point	Monitoring item	Status during the reporting period
		Ludwig's bustard (*Neotis ludwigii*)	
		Other species	

8. Hydrology

- Monitoring item: trace of erosion
- Record: observation and photography at 10 fixed points, once three months, on tower sites within the slope area of felling of trees and root extrication

Date	Point	Monitoring item	Status during the reporting period

9. Topography and geology

- Monitoring item: status of vegetation recovery and soil erosion
- Record: Observe and photograph and record within the clearing and rooting area on the slopes, once every three months, by setting up 10 towers

Date	Point	Monitoring item	Status during the reporting period

10. Land acquisition and resettlement

- Monitoring item: impacts on land, residential structures, and places of livelihood due to land acquisition; provision of alternative land and structures; compensation process
- Record: avoid social impacts by plotting private land/uses and residential and other structures on a map during the geological & topological survey and detailed design. If unavoidable, record the status of resettlement and demolition/removal of existing structures due to acquisition, using the following format. See also ARAP Monitoring Form (Annex 10-1).

date	Record	Outline	Notes (e.g. maps)
	Private land / used land		
	Residential structure		
	Place of livelihood		

(Note) Monitoring points are tower locations and ROW.

Date	Point	Objects to be acquired and actions (e.g. status of demolition and removal of existing structures)	Notes (e.g. maps)

(Note) Monitoring points are where land is to be acquired out of tower locations and ROW.

11. Existing social infrastructures and services

- Monitoring item: impact of mine exploration and clearance operations on social services
- Record: record as needed, the location of social service facilities (hospitals, churches, schools, community facilities, etc.) should be plotted on a map to confirm the extent of demining work, while avoiding impacts where possible. If unavoidable, record the nature of the impact (e.g. closure or not, time period affected, number of people affected, etc.) using the following format.

Date	Point	Impact details	Notes (e.g. maps)

(Note) Monitoring points are tower locations, ROW and surrounding settlements and facilities.

12. Cultural heritage

- Monitoring item: recognized cultural and historical values
- Record: plotting and avoidance of Boer cemeteries and other nearby cultural heritage sites on maps during geomorphological survey and detailed design

Date	Date of discovery	Detection point	Contents	Action	Notes (e.g. maps)

(Note) Monitoring points are tower locations and ROW.

13. Working environment (including occupational safety)

- Monitoring item: Casualties among operators due to mine and UXO explosions
- Record: record the situation, etc., of accidents, as needed, at tower locations and ROW using the following format as a reference.

Date	Point of accident	Circumstances and details of accident	Notes (e.g. maps)

14. Accidents

- Monitoring item: Accidents occurred due to mine and UXO explosions
- Record: record the circumstances, etc., of any accidents, as needed, at tower locations, ROW and workshop using the following format as a reference.

Date	Point of accident	Circumstances and details of the accident	Notes (e.g. maps)

<Construction Phase>

1. Air pollution

- Monitoring item: PM10, PM2.5
- Record: measurements are taken once every three months before and after the construction of the towers, at 10 tower locations and at the boundaries of neighboring dwellings and other structures

(Date)
(Location)

(Data) item (Unit)	Baseline value	Measured value (Average value)	Measured value (Max. value)	Local standard	Referred to international standards	Remarks (e.g. location, frequency and method of measurement)
PM10 ($\mu g/m^3$)				-	0.150 (Interim target-1) 0.100 (Interim target-2) 0.075 (Interim target-3) 0.050 (guideline)	Measured by PM meter for 30 minutes
PM2.5 ($\mu g/m^3$)				-	0.075 (Interim target-1) 0.050 (Interim target-2) 0.0375 (Interim target-3) 0.025 (guideline)	Measured by PM meter for 30 minutes

2. Water pollution

(1) Wastewater treatment records

- Monitoring item: wastewater treatment status
- Record: record at the workers' camp, as required
- Check contractor's record ledgers

Date	Point	Monitoring item	Status during the reporting period
		Wastewater treatment status	

(2) Water quality items

- Monitoring item: items in the table below
- Record: measurements are taken at 10 river/stream points in the vicinity of the tower location once every three months before and after the tower construction works

(Date)

(Location)

Item (unit)	Baseline value	Measured value (Average value)	Measured value (Max. value)	Local standard (Surface water)	Local standard (Drinking water)	Remarks (e.g. location, frequency and method of measurement)
pH (measure of acidity)				5.0-9.0	6.5-8.5 5.5-9.0	Portable pH meter
Water temperature (°C)				30	22 25	Water thermometer
Conductivity (µS/cm at 20°C)				-	1000	Conductometer
Transparency (cm)				-	-	Transparency meter

3. Soil pollution

- Monitoring item: fuel, lubricating oil and other leaks
- Record: as needed, at construction site, workers' camp
- Check contractor's record ledgers

Date	Point	Monitoring item	Status during the reporting period
		Fuel, lubricating oil and other leaks	

4. Noise and vibration

(1) Noise level

- Monitoring item: noise level
- Record: measurements are taken once every three months before and after the construction of the towers, at 10 tower locations and at the boundaries of neighboring dwellings and other structures

(Date)

(Location)

Item (unit)	Baseline value	Measured value (Average value)	Measurement (Max. value)	Local standard	Referred to international standards	Remarks (e.g. location, frequency and method of measurement)
Noise level (dB A)				-	Daytime: 55 dBA Nighttime: 45 dBA Industrial zone: 70 dBA	Measured with sound level meter for 30 minutes

(2) Complaints

- Monitoring item: complaints from municipalities, communes and settlements about noise and vibration

- Record: record as needed

Date	Point	Complaint details	Action	Remarks (resolution status)

5. Offensive odors

(1) Odors

- Monitoring item: presence or absence of odors by sensory examination
- Record: once a week at the workers' camp
- Check contractor's record ledgers

Date	Point	Monitoring item	Status during the reporting period
		Odors (sensory)	

(2) Complaints

- Monitoring item: complaints from municipalities, communes and settlements
- Record: record as needed
- Check contractor's record ledgers

Date	Point	Complaint details	Action	Remarks (resolution status)

6. Waste

- Monitoring item: waste storage and transport conditions
- Record: once a week, at the workers' camp and construction site, the amount of waste collected and disposed of by item by the waste collection and disposal contractor
- Check contractor's record ledgers

Date	Point	Monitoring item	Status during the reporting period
		Amount collected by contractors	

7. Ecosystems

(1) Flora and fauna

- Monitoring item: plant species and distribution before and after construction of the towers, and animal occurrence species in the vicinity
- Record: once every 6 months after the start of construction, the occurrence of plant and animal species will be observed at eight sites

Date	Point	Monitoring item	Status during the reporting period
		Plant species	
		Fauna species	

(2) Birds

- Monitoring item: birds
- Record: observation of bird occurrence species by random census once every 6 months after the start of construction in Ivantala Swamp, Poiares, Humpata, Tchivinguilo, Bruco, Capangombe, Caraculo, and Moçâmedes.

Date	Point	Monitoring item	Status during the reporting period
		Bird species present	

(3) Threatened species

- Monitoring item: valuable species
- Record: once every three months after the start of construction, random census observations will be carried out twice a day, in the morning and afternoon, from roads within a 20 km radius near Caraculo, focusing on Ludwig's bustard (*Neotis ludwigii*)

Date	Point	Monitoring item	Status during the reporting period
		Ludwig's bustard (*Neotis ludwigii*)	
		Other species	

8. Topography and geology

- Monitoring item: status of vegetation recovery and soil erosion
- Record: record once every three months, observations and photographs are made and recorded at 10 points on the towers within the sloping openings and felling rooting areas

Date	Point	Monitoring item	Status during the reporting period

9. Land acquisition and resettlement

- Monitoring item: livelihood level and means of the affected population, resident relations (e.g. grievance redress), site management (e.g. entry restrictions and boundary management), etc.
- Record: record once every three months using the following format; record as needed for resident relations. See also ARAP Monitoring Form (Annex 10-1)

Date	Point	Livelihood level and means of the affected population	Remarks

(Note) Monitoring points are where the affected population lives and places of livelihood means.

Date	Point	Complaint details	Action	Remarks (resolution status)

(Note) Monitoring points are where the affected population lives and places of livelihood means.

Date	Point	Site management status	Remarks

(Note) Monitoring points are tower locations and ROW.

10. The Poor

- Monitoring item: resident relations (e.g. complaint handling), employment in construction, etc.
- Record: record as needed for resident relations, at places of local people’s living and livelihood means, using the following format. For employment, query the contractor's employment register, etc. once every three months.

Date	Point	Complaint details	Action	Remarks (resolution status)

Date	Record	Review period and details	Remarks
	Employment registration ledger		

11. Local economies, such as employment and livelihood, etc.

- Monitoring item: livelihood level and means of the affected population, resident relations (e.g. grievance redress, etc.), employment in construction works, etc.
- Record: record once every three months, at places of the affected population and livelihood means using the following format. Record as needed for resident relations; For employment, query the contractor's employment register, etc. once every three months.

Date	Point	Livelihood level and means of the affected population	Remarks

Date	Point	Complaint details	Action	Remarks (resolution status)

Date	Record	Review period and details	Remarks
	Employment registration ledger		

12. Land use and utilization of local resource

- Monitoring item: resident relations (e.g. complaint handling), site management (e.g. entry restrictions and boundary management)
- Record: record as needed for resident relations using the following format as a reference for recording; once every three months for site management. See also ARAP Monitoring Form (Annex 10-1)

Date	Point	Complaint details	Action	Remarks (resolution status)

(Note) Monitoring points are where the affected population lives and places of livelihood means.

Date	Point	Site management status	Remarks

(Note) Monitoring points are tower locations and ROW.

13. Existing social infrastructures and services

- Monitoring item: construction plans (e.g. time, number and frequency of vehicle operations), vehicle operation records, number of traffic accidents, etc.
- Record: record as needed. Query contractor vehicle operation records and accident records

Date	Point	Review period and details	Remarks
	Construction work plan	e.g. time, number and frequency of vehicle operations	
	Vehicle operation record		
	Accident record	Location, number of accidents and work when accident occurred, etc.	

14. Misdistribution of benefits and damages

- Monitoring item: livelihood level and means of the affected population, resident relations (e.g. grievance redress), etc.
- Record: record once every three months, at concerned villages, using the following format as a reference for recording; record as needed for resident relations.

Date	Point	Livelihood level and means of the affected population	Remarks

Date	Point	Complaint details	Action	Remarks (resolution status)

15. Local conflicts of interest

- Monitoring item: livelihood level and means of the affected population, resident relations (e.g. grievance redress), etc.
- Record: record once every three months, at concerned villages, using the following format as a reference for recording; record as needed for resident relations.

Date	Point	Livelihood level and means of the affected population	Remarks

Date	Point	Complaint details	Action	Remarks (resolution status)

16. Cultural heritage

- Monitoring item: recognized cultural and historical value
- Record: record, as needed, any discoveries made at and around tower locations and construction site, and share them with cultural property department.

Date	Date of discovery	Detection point	Contents	Action	Month and date of resumption of construction

17. Landscape

- Monitoring item: trees, harmony between hardscape and natural landscapes
- Record: record every three months, visual fixed-point observations and photography are conducted and documented at ROW/ tower locations and at labor camp/materials yard installations

Date	Point	Monitoring item	Status during the reporting period

18. Gender

- Monitoring item: resident relations (e.g. handling of complaints), number and content of instructions to contractors and subcontractors' employees, their participants, etc.
- Record: record resident relations, as needed at concerned villages, using the following format as a reference.

Date	Point	Complaint details	Action	Remarks (resolution status)

Instruction records of contractor and subcontractor employees shall be queried once every three months

Date	Record	Review period and details	Remarks
	Records of instructions and guidance	Number, content and participants, etc.	

19. Children's rights

- Monitoring item: resident relations (e.g. handling of complaints), employment in construction works, etc.
- Record: record resident relations, as needed at concerned villages, with reference to the following format. Employment records by contractors are queried every three months as to whether they are employed on construction work.

Date	Point	Complaint details	Action	Remarks (resolution status)

Date	Record	Review period and details	Remarks
	Employment registration ledger		

20. Infectious diseases such as HIV/AIDS

- Monitoring item: number of diseases and infections, standing medical supplies, number and type of vaccinations, number and content of instructions to contractor and subcontractor employees and number of participants
- Record: refer to contractor health records, equipment ledgers, immunization record and instruction / guidance record every three months

Date of occurrence	Record	Number of occurrences	Remarks
	Health management record	Number of occurrences, etc.	
	Equipment ledger	Number of equipment, etc.	
	Immunization record	Number of immunization, etc.	
	Records of instructions and guidance	Number, content and participants, etc.	

21. Working environment (including occupational safety)

- Monitoring item: Casualties among workers due to mines and UXO explosions; demining work; time, content and number of participants in safety training for contractor and subcontractor employees; availability of PPE; work contents; health status of workers; number of accidents; working hours, etc.
- Record: Record as needed, for accidents due to mine and UXO explosions and demining works, using the following format; Refer to contractor instruction / guidance record, equipment ledgers, work record, health check-up record, accidents and working hours once every three months.

<Record of casualties among workers due to mine and UXO explosions>

Date	Point of accident	Details of accident	Notes (e.g. maps)

(Note) Monitoring points are in the construction site.

<Records of demining work>

Date	Date of discovery	Detection point	Types of mines and unexploded ordnance, etc.	Date(s) (e.g. for processing, finishing, etc.)	Month and date of resumption of construction

(Note) Monitoring points are in the construction site.

<Work safety and health>

Date	Record	Review period and details	Remarks
	Records of instructions and guidance	Number, content and participants, etc.	
	Equipment ledger	Number of PPE, etc.	
	Work record		
	Health check-up record		
	Accident record	Location, number of accidents and work when accident occurred, etc.	
	Working hour record		

22. Accidents

- Monitoring item: occurrence of accidents due to mines and UXO explosions, demining work, work contents, vehicle operation records, number of accidents, etc.
- Record: Record as needed accidents due to mine and UXO explosions and demining work using the following format as a reference. The status of vehicle operations and accidents occurring as a result of construction work shall be monitored, as needed, and the contractor's records shall be queried.

<Record of casualties among workers due to mine and UXO explosions>

Date	Point of accident	Details of accident	Notes (e.g. maps)

(Note) Monitoring points are in the construction site.

<Records of demining work>

Date	Date of discovery	Detection point	Types of mines and unexploded ordnance, etc.	Date(s) (e.g. for processing, finishing, etc.)	Month and date of resumption of construction

(Note) Monitoring points are in the construction site.

<Accident record>

Date	Record	Review period and details	Remarks
	Vehicle operation record		
	Accident record	Location, number of accidents and work when accident occurred, etc.	

<Operation Phase>

1. Water pollution

- Monitoring item: items in the table below
- Record: measurements are taken once every three months at 10 points on rivers/streams in the vicinity of the tower location and the controlled road

(Date)
(Location)

Item (unit)	Baseline value	Measured value (Average value)	Measured value (Max. value)	Local standard (Surface water)	Local standard (Drinking water)	Remarks (e.g. location, frequency and method of measurement)
pH (measure of acidity)				5.0-9.0	6.5-8.5 5.5-9.0	Portable pH meter
Water temperature (°C)				30	22 25	Water thermometer
Conductivity (μS/cm at 20°C)				-	1000	Conductometer
Transparency (cm)				-	-	Transparency meter

2. Noise and vibration

(1) Noise level

- Monitoring item: noise levels
- Record: measurements are taken once every three months at representative points under the line/administrative road, at locations where wind noise is likely to occur and in neighboring settlements

(Date)
(Location)

Item (unit)	Baseline value	Measured value (Average value)	Measurement (Max. value)	Local standard	Referred to international standards	Remarks (e.g. location, frequency and method of measurement)
Noise level (dB A)				-	Daytime: 55 dBA Nighttime: 45 dBA Industrial zone: 70 dBA	Measured with sound level meter for 30 minutes

(2) Complaints

- Monitoring item: complaints from municipalities, communes and settlements about noise and vibration
- Record: record as needed

Date	Point	Complaint details	Action	Remarks (resolution status)

3. Ecosystems

(1) Flora and fauna

- Monitoring item: flora and fauna
- Record: observations are made once every three months at 10 tower positions

Date	Ppoint	Monitoring item	Status during the reporting period
		Plant species	
		Fauna species	

(2) Birds
- Monitoring item: birds
- Record: observations are made every three months in Ivantala swamp, Humpata, Tchivinguilo and Bruco

(3) Threatened species
- Monitoring item: Threatened species
- Record: once every three months, random census observations are made twice a.m. and twice p.m. from the road within a 20 km radius near Caraculo, focusing on Ludwig's bustard (*Neotis ludwigii*)

Date	Point	Monitoring item	Status during the reporting period
		Ludwig's bustard (*Neotis ludwigii*)	
		Other species	

4. Hydrology
- Monitoring item: presence or absence of erosion scars and scale of erosion if present
- Record: once every three months, observation and photography will be carried out and recorded at 10 points on the towers at within the felling and felling rooting area on the slope

Date	Point	Monitoring item	Status during the reporting period

5. Topography and geology
- Monitoring item: status of vegetation recovery and soil erosion
- Record: once every three months, observations and photographs are made and recorded at 10 points on the towers in the sloping area within the felling and felling rooting area

Date	Point	Monitoring item	Status during the reporting period

Attachment 9-2: Monitoring Form for 60 kV DL

- Monitoring will be conducted by the project proponent by submitting to JICA on a regular basis the measured values, etc., of items that have been determined by the environmental review to require monitoring by JICA, and the following monitoring form will be referred to for submission as necessary.
- In determining the monitoring items, frequency and methods, etc., the project phase or life cycle (e.g., construction phase and operation phase) should be taken into consideration.

<Pre-construction Phase>

1. Air pollution

- Monitoring item: PM10, PM2.5
- Record: measurements are taken once every three months before and after felling and clearing, at the two tower locations and at the boundaries of neighboring dwellings and other structures

(Date)
(Location)

(Data) item (Unit)	Baseline value	Measured value (Average value)	Measured value (Max. value)	Local standard	Referred to international standards	Remarks (e.g. location, frequency and method of measurement)
PM10 (μg/m^3)				-	0.150 (Interim target-1) 0.100 (Interim target-2) 0.075 (Interim target-3) 0.050 (guideline)	Measured by PM meter for 30 minutes
PM2.5 (μg/m^3)				-	0.075 (Interim target-1) 0.050 (Interim target-2) 0.0375 (Interim target-3) 0.025 (guideline)	Measured by PM meter for 30 minutes

2. Water pollution

(1) Wastewater treatment records

- Monitoring item: wastewater treatment status
- Record: record once a week at the construction site and at the workers' camp
- Check the operator's (CND) record ledger

Date	Point	Monitoring item	Status during the reporting period
		Wastewater treatment status	

(2) Water quality items

- Monitoring item: items in the table below
- Record: once every three months before and after felling and clearing, measurements are taken if there is running water at two stream points in the vicinity of the tower location

(Date)
(Location)

Item (unit)	Baseline value	Measured value (Average value)	Measured value (Max. value)	Local standard (Surface water)	Local standard (Drinking water)	Remarks (e.g. location, frequency and method of measurement)
pH (measure of acidity)				5.0-9.0	6.5-8.5 5.5-9.0	Portable pH meter
Water temperature (°C)				30	22 25	Water thermometer
Conductivity (μS/cm at 20°C)				-	1000	Conductometer
Transparency (cm)				-	-	Transparency meter

3. Soil pollution

- Monitoring item: fuel, lubricating oil and other leaks
- Record: record once a week at the construction site and at the workers' camp
- Check the operator's (CND) record ledger

Date	Point	Monitoring item	Status during the reporting period
		Fuel, lubricating oil and other leaks	

4. Noise and vibration

(1) Noise level

- Monitoring item: noise levels
- Record: measurements are taken once every three months before and after felling and clearing, at the two tower locations and at the boundaries of neighboring dwellings and other structures

(Date)
(Location)

Item (unit)	Baseline value	Measured value (Average value)	Measurement (Max. value)	Local standard	Referred to international standards	Remarks (e.g. location, frequency and method of measurement)
Noise level (dB A)				-	Daytime: 55 dBA Nighttime: 45 dBA Industrial zone: 70 dBA	Measured with sound level meter for 30 minutes

(2) Complaints

- Monitoring items: complaints from municipalities, communes and settlements
- Record: record as needed

Date	Point	Complaint details	Support	Remarks (resolution status)

5. Offensive Odors

(1) Odors

- Monitoring item: presence or absence of odors by sensory examination
- Record: once a week at the workers' camp
- Check the operator's (CND) record ledger

Date	Point	Monitoring item	Status during the reporting period
		odors (sensory)	

(2) Complaints

- Monitoring item: complaints from municipalities, communes and settlements
- Record: record as needed
- Check the operator's (CND) record ledger

Date	Point	Complaint details	Action	Remarks (resolution status)

6. Waste

- Monitoring item: waste storage and transport conditions
- Record: once a week, at the workers' camp and construction site, the amount of waste collected and disposed of by item by the waste collection and disposal contractor
- Check the operator's (CND) record ledger

Date	Point	Monitoring item	Status during the reporting period
		Amount collected by contractors	

7. Ecosystems

(1) Flora and fauna

- Monitoring item: flora and fauna
- Record: observations are made once every 6 months before and after clearing and rooting, at two points at the location of the towers in the clearing and rooting area

Date	Point	Monitoring item	Status during the reporting period
		plant species	
		animal species	

(2) Birds

- Monitoring item: birds
- Record: observations are carried out once every 6 months before and after felling and clearing, at two points at the location of the towers in the felling and clearing area

Date	Point	Monitoring item	Status during the reporting period
		bird species present	

8. Land acquisition and resettlement

- Monitoring item: impacts on land residential structures, and places of livelihood due to land acquisition; provision of alternative land and structures; compensation process.
- Record: avoid social impacts by plotting private land/uses and residential and other structures on a map during the geological & topological survey and detailed design. If unavoidable, record the status of resettlement and demolition/removal of existing structures due to acquisition, using the following format; see also ARAP Monitoring Form (Annex 10-1)

Date	Record	Outline	Notes (e.g. maps)
	Private land / used land		
	Residential structure		
	Place of livelihood		

(Note) Monitoring points are tower locations and ROW.

Date	Point	Objects to be acquired and actions (e.g. status of demolition and removal of existing structures)	Notes (e.g. maps)

(Note) Monitoring points are where land is to be acquired out of tower locations and ROW.

9. Existing social infrastructure and social services

- Monitoring item: impact of mine exploration and clearance operations on social services.
- Record: arecord s needed, the location of social service facilities (hospitals, churches, schools, community facilities, etc.) should be plotted on a map to confirm the extent of demining work, while avoiding impacts where possible. If unavoidable, record the nature of the impact (e.g. closure or not, time period affected, number of people affected, etc.) using the following format.

Date	Point	Impact details	Notes (e.g. maps)

(Note) Monitoring points are tower locations, ROW and surrounding settlements and facilities.

10. Working environment (including occupational safety)

- Monitoring item: Casualties among operators due to mines and UXO explosions.
- Record: record the situation, etc., of accidents, as needed, at tower locations and ROW using the following format as a reference.

Date	Point of accident	Circumstances and details of the accident	Notes (e.g. maps)

11. Accidents

- Monitoring item: Accidents occurred due to mine and UXO explosions
- Record: record the circumstances, etc., of any accidents, as needed, at tower locations, ROW and workshop using the following format as a reference.

Date	Point of accident	Circumstances and details of the accident	Notes (e.g. maps)

<Construction Phase>

1. Air pollution

- Monitoring item: PM10, PM2.5
- Record: measurements are taken once every three months before and after the construction of the towers, at two tower locations and at the boundaries of neighboring dwellings and other structures

(Date)
(Location)

(Data) item (Unit)	Baseline value	Measured value (Average value)	Measured value (Max. value)	Local standard	Referred to international standards	Remarks (e.g. location, frequency and method of measurement)
PM10. ($\mu g/m^3$)				-	0.150 (Interim target-1) 0.100 (Interim target-2) 0.075 (Interim target-3) 0.050 (guideline)	Measured by PM meter for 30 minutes
PM2.5 ($\mu g/m^3$)				-	0.075 (Interim target-1) 0.050 (Interim target-2) 0.0375 (Interim target-3) 0.025 (guideline)	Measured by PM meter for 30 minutes

2. Water pollution

(1) Wastewater treatment records

- Monitoring item: wastewater treatment status
- Record: record at construction sites and workers' camp as required
- Check contractor's record ledgers

Date	Ppoint	Monitoring item	Status during the reporting period
		Wastewater treatment status	

(2) Water quality items

- Monitoring item: items in the table below
- Record: measurements are taken once every three months before and after the construction of the tower, when there is running water in the stream near the tower construction site

(Date)
(Location)

Item (unit)	Baseline value	Measured value (Average value)	Measured value (Max. value)	Local standard (Surface water)	Local standard (Drinking water)	Remarks (e.g. location, frequency and method of measurement)
pH (measure of acidity)				5.0-9.0	6.5-8.5 5.5-9.0	Portable pH meter
Water temperature (°C)				30	22 25	Water thermometer
Conductivity (µS/cm at 20°C)				-	1000	Conductometer
Transparency (cm)				-	-	Transparency meter

3. Soil pollution

- Monitoring item: fuel, lubricating oil and other leaks
- Record: record at construction sites and workers' camp as required
    - Check contractor's record ledgers

Date	Point	Monitoring item	Status during the reporting period
		Fuel, lubricating oil and other leaks	

4. Noise and vibration

(1) Noise level

- Monitoring item: noise level
- Record: measurements are taken once every three months before and after the

construction of the towers, at two tower locations and at the boundaries of neighboring dwellings and other structures

(Date)
(Location)

Item (unit)	Baseline value	Measured value (Average value)	Measurement (Max. value)	Local standard	Referred to international standards	Remarks (e.g. location, frequency and method of measurement)
Noise level (dB A)				-	Daytime: 55 dBA Nighttime: 45 dBA Industrial zone: 70 dBA	Measured with sound level meter for 30 minutes

(2) Complaints

- Monitoring item: complaints from municipalities, communes and settlements about noise and vibration
- Record: record as needed

Date	Point	Complaint details	Support	Remarks (resolution status)

5. Offensive Odors

(1) Odors

- Monitoring item: presence or absence of odors by sensory examination
- Record: once a week at the workers' camp
- Check contractor's record ledgers

Date	Point	Monitoring item	Status during the reporting period
		Odors (sensory)	

(2) Complaints

- Monitoring item: complaints from municipalities, communes and settlements
- Record: record as needed
- Check contractor's record ledgers

Date	Point	Complaint details	Support	Remarks (resolution status)

6. Waste

- Monitoring item: waste storage and transport conditions
- Record: once a week, at the workers' camp and construction site, the amount of waste collected and disposed of by item by the waste collection and disposal contractor
- Check contractor's record ledgers

Date	Point	Monitoring item	Status during the reporting period
		Amount collected by contractors	

7. Ecosystems

(1) Flora and fauna

- Monitoring item: flora and fauna

- Record: observations are made once every 6 months before and after the construction of the towers, at two points at the location of the towers

Date	Point	Monitoring item	Status during the reporting period
		Plant species	
		Animal species	

(2) Birds

- Monitoring item: birds
- Record: observations are made once every six months before and after the construction of the towers, at two points at the location of the towers

Date	Point	Monitoring item	Status during the reporting period
		Bird species present	

8. Land acquisition and resettlement

- Monitoring item: resident relations (e.g. grievance redress), site management (e.g. entry restrictions and boundary management), etc.
- Record: record once every three months using the following format; record as needed for resident relations. See also ARAP Monitoring Form (Annex 10-1)

Date	Point	Livelihood level and means of the affected population	Remarks

(Note) Monitoring points are where the affected population lives and places of livelihood means.

Date	Point	Complaint details	Action	Remarks (resolution status)

(Note) Monitoring points are where the affected population lives and places of livelihood means.

Date	Point	Site management status	Remarks

(Note) Monitoring points are tower locations and ROW.

9. Land use and local resource use

- Monitoring item: resident relations (e.g. complaint handling), site management (e.g. entry restrictions and boundary management)
- Record: record as needed for resident response using the following format for recording; once every three months for site management. See also ARAP Monitoring Form (Annex 10-1)

Date	Point	Complaint details	Action	Remarks (resolution status)

(Note) Monitoring points are where the affected population lives and places of livelihood means.

Date	Point	Site management status	Remarks

(Note) Monitoring points are tower locations and ROW.

10. Existing social infrastructure and social services

- Monitoring item: construction plans (e.g. time, number and frequency of vehicle operations), vehicle operation records, number of traffic accidents, etc.
- Record: record as needed. Query contractor vehicle operation records and accident records

Date	Point	Review period and details	Remarks
	Construction work plan	e.g. time, number and frequency of vehicle operations	
	Vehicle operation record		
	Accident record	Location, number of accidents and work when accident occurred, etc.	

11. Misdistribution of benefits and damages

- Monitoring item: livelihood level and means of the affected population, resident relations (e.g. grievance redress), etc.
- Record: record once every three months, at concerned villages, using the following format as a reference for recording; record as needed for resident relations.

Date	Point	Livelihood level and means of the affected population	Remarks

Date	Point	Complaint details	Action	Remarks (resolution status)

12. Local conflicts of interest

- Monitoring item: livelihood level and means of the affected population, resident relations (e.g. grievance redress), etc.
- Record: record once every three months, at concerned villages, using the following format as a reference for recording; record as needed for resident relations.

Date	Point	Livelihood level and means of the affected population	Remarks

Date	Point	Complaint details	Action	Remarks (resolution status)

13. Landscape

- Monitoring item: trees, harmony between hardscape and natural landscapes
- Record: record every three months, visual fixed-point observations and photography are conducted and documented at ROW/ tower locations and at labor camp/materials yard installations

Date	Point	Monitoring item	Status during the reporting period

14. Gender

- Monitoring item: resident relations (e.g. handling of complaints), number and content of instructions to contractors and subcontractors' employees, their participants, etc.

- Record: record resident response, as needed at concerned villages, using the following format as a guide.

Date	Point	Complaint details	Action	Remarks (resolution status)

Instruction records of contractor and subcontractor employees shall be queried once every three months.

Date	Record	Review period and details	Remarks
	Records of instructions and guidance	Number, content and participants, etc.	

15. Children's rights

- Monitoring item: resident relations (e.g. handling of complaints), employment in construction works, etc.
- Record: record resident relations, as needed at concerned villages with reference to the following format. Employment records by contractors are queried every three months as to whether they are employed on construction work.

Date	Point	Complaint details	Action	Remarks (resolution status)

Date	Record	Review period and details	Remarks
	Employment registration ledger		

16. Infectious diseases such as HIV/AIDS

- Monitoring item: number of diseases and infections, standing medical supplies, number and type of vaccinations, number and content of instructions to contractor and subcontractor employees and number of participants.
- Record: refer to contractor health records, equipment ledgers, immunization records and instruction / guidance records every three months.

Date of occurrence	Record	Number of occurrences	Remarks
	Health management record	Number of occurrences, etc.	
	Equipment ledger	Number of equipment, etc.	
	Immunization record	Number of immunization, etc.	
	Records of instructions and guidance	Number, content and participants, etc.	

17. Working environment (including occupational safety)

- Monitoring item: Casualties among workers due to mines and UXO explosions; demining work; time, content and number of participants in safety training for contractor and subcontractor employees; availability of PPE; work contents; health status of workers; number of accidents; working hours, etc.
- Record: Record as needed, for accidents due to mine and UXO explosions and demining works, using the following format; Refer to contractor instruction / guidance record, equipment ledgers, work record, health check-up record, accidents and working hours

once every three months by the contractor.

<Record of casualties among workers due to mine and UXO explosions>

Date	Point of accident	Details of accident	Notes (e.g. maps)

(Note) Monitoring points are in the construction site.

<Records of demining work>

Date	Date of discovery	Detection point	Types of mines and unexploded ordnance, etc.	Date(s) (e.g. for processing, finishing, etc.)	Month and date of resumption of construction

(Note) Monitoring points are in the construction site.

<Work safety and health>

Date	Record	Review period and details	Remarks
	Records of instructions and guidance	Number, content and participants, etc.	
	Equipment ledger	Number of PPE, etc.	
	Work record		
	Health check-up record		
	Accident record	Location, number of accidents and work when accident occurred, etc.	
	Working hour record		

18. Accidents

- Monitoring item: occurrence of accidents due to mines and UXO explosions, demining work, work contents, vehicle operation records, number of accidents, etc.
- Record: Record as needed accidents due to mine and UXO explosions and demining work using the following format as a reference. The status of vehicle operations and accidents occurring as a result of construction work shall be monitored, as needed, and the contractor's records shall be queried.

<Record of casualties among workers due to mine and UXO explosions>

Date	Point of accident	Details of accident	Notes (e.g. maps)

(Note) Monitoring points are in the construction site.

<Records of demining work>

Date	Date of discovery	Detection point	Types of mines and unexploded ordnance, etc.	Date(s) (e.g. for processing, finishing, etc.)	Month and date of resumption of construction

(Note) Monitoring points are in the construction site.

<Accident record>

Date	Record	Review period and details	Remarks
	Vehicle operation record		
	Accident record	Location, number of accidents and work when accident occurred, etc.	

<Operation Phase>

1. Noise and vibration

(1) Noise level

- Monitoring item: noise levels
- Record: measurements are taken once every three months at two representative points under the line and on the administrative road, at locations where wind noise is likely to occur and in neighboring settlements

(Date)

(Location)

Item (unit)	Measured value (Average value)	Measured value (Max. value)	Local standard	Referred to international standards	Remarks (e.g. location, frequency and method of measurement)
Noise level				Daytime: 55 dBA Nighttime: 45 dBA Industrial zone: 70 dBA	

(2) Complaints

- Monitoring item: complaints from municipalities, communes and settlements
- Record: record as needed

Date	Point	Complaint details	Support	Remarks (resolution status)

2. Ecosystems

(1) Flora and fauna

- Monitoring item: flora and fauna
- Record: once every three months, observations are made at two representative towers

Date	Point	Monitoring item	Status during the reporting period
		Plant species	
		Animal species	

(2) Birds

- Monitoring item: birds
- Record: observations are made at two representative towers every three months

Date	Point	Monitoring item	Status during the reporting period
		Bird species present	

Attachment 9-3: Monitoring Form for 220/60 kV New Namibe SS

- Monitoring will be conducted by the project proponent by submitting to JICA on a regular basis the measured values, etc., of items that have been determined by the environmental review to require monitoring by JICA, and the following monitoring form will be referred to for submission as necessary.
- In determining the monitoring items, frequency and methods, etc., the project phase or life cycle (e.g., construction phase and operation phase) should be taken into consideration.

<Pre-construction Phase>

1. Air pollution

- Monitoring item: SO2, NO2, O3, PM10, PM2.5
- Record: before and after clearing and rooting Once every six months for one consecutive week, SO_2, NO_2, O_3, once every three months at the proposed site of the 220/60 kV New Namibe SS, PM10 and PM2.5 measurements at the boundaries of the substation and adjacent dwellings, etc., and at access roads, respectively.

(Date)
(Location)

(Data) item (Unit)	Baseline value	Measured value (Average value)	Measured value (Max. value)	Local standard	Referred to international standards	Remarks (e.g. location, frequency and method of measurement)
SO_2					0.125 (Interim target-1) 0.050 (Interim target-2) 0.020 (guideline)	24-hour average
NO_2					0.04	annual average
O_3					0.160 (Interim target-1) 0.100 (guideline)	8-hour average
PM10. ($\mu g/m^3$)				-	0.150 (Interim target-1) 0.100 (Interim target-2) 0.075 (Interim target-3) 0.050 (guideline)	Measured by PM meter for 30 minutes
PM2.5 ($\mu g/m^3$)				-	0.075 (Interim target-1) 0.050 (Interim target-2) 0.0375 (Interim target-3) 0.025 (guideline)	Measured by PM meter for 30 minutes

2. Water pollution

- Monitoring item: wastewater treatment status
- Record: once a week at the proposed construction site of the 220/60 kV New Namibe SS and at the workers' camp
- Check the operator's (CND) record ledger

Date	Point	Monitoring item	Status during the reporting period
		Wastewater treatment status	

3. Soil pollution

- Monitoring item: fuel, lubricating oil and other leaks
- Record: once a week at the proposed construction site of the 220/60 kV New Namibe SS and at the workers' camp
- Check the operator's (CND) record ledger

Date	Point	Monitoring item	Status during the reporting period
		Fuel, lubricating oil and other leaks	

4. Noise and vibration

(1) Noise level

- Monitoring item: noise levels
- Record: measurements are taken once every three months before and after clearing and rooting, at the proposed construction site of the 220/60 kV New Namibe SS, at the boundaries of neighboring dwellings and other structures, and at the access road

(Date)

(Location)

Item (unit)	Baseline value	Measured value (Average value)	Measurement (Max. value)	Local standard	Referred to international standards	Remarks (e.g. location, frequency and method of measurement)
Noise level (dB A)				-	Daytime: 55 dBA Nighttime: 45 dBA Industrial zone: 70 dBA	Measured with sound level meter for 30 minutes

(2) Complaints

- Monitoring item: complaints from municipalities, communes and settlements about noise and vibration
- Record: record as needed

Date	Point	Complaint details	Action	Remarks (resolution status)

5. Offensive odors

(1) Odors

- Monitoring item: presence or absence of odors by sensory examination
- Record: once a week at the proposed construction site of the 220/60 kV New Namibe SS and at the workers' camp
- Check the operator's (CND) record ledger

Date	Point	Monitoring item	Status during the reporting period
		Odors (sensory)	

(2) Complaints

- Monitoring item: complaints from municipalities, communes and settlements
- Record: record as needed
- Check the operator's (CND) record ledger

Date	Point	Complaint details	Action	Remarks (resolution status)

6. Waste

- Monitoring item: waste storage and transport conditions

- Record: once a week, at the workers' camp and at the proposed construction site of the 220/60 kV New Namibe SS, the amount of waste collected and disposed of by item by the disposal contractor
- Check the operator's (CND) record ledger

Date	Point	Monitoring item	Status during the reporting period
		Amount collected by contractors	

7. Ecosystems

(1) Flora and fauna

- Monitoring item: flora and fauna
- Record: observations are carried out every six months before and after cutting and clearing, and at the proposed site of the 220/60 kV New Namibe SS

Date	Point	Monitoring item	Status during the reporting period
		Plant species	
		Fauna species	

(2) Birds

- Monitoring item: birds
- Record: observations are carried out every six months before and after cutting and clearing, and at the proposed site of the 220/60 kV New Namibe SS

Date	Point	Monitoring item	Status during the reporting period
		Bird species present	

8. Topography and geology

- Monitoring item: topographic and vegetation changes and soil erosion
- Record: observation and photography will be carried out and recorded at the 220/60 kV New Namibe SS once each before and after felling and clearing

Date	Point	Monitoring item	Status during the reporting period

9. Working environment (including occupational safety)

- Monitoring item: Casualties among operators due to mines and UXO explosions.
- Record: record the situation, etc., of accidents, as needed, at new Namibe substation using the following format as a reference.

Date	Point of accident	Circumstances and details of the accident	Notes (e.g. maps)

10. Accidents

- Monitoring item: Accidents occurred due to mine and UXO explosions
- Record: record the circumstances, etc., of any accidents, as needed, at new Namibe substation and workshop using the following format as a reference.

Date	Point of accident	Circumstances and details of the accident	Notes (e.g. maps)

<Construction Phase>

1. Air pollution

- Monitoring item: SO2, NO2, O3, PM10, PM2.5
- Record: once every six months for one consecutive week, SO2, NO2 and O3 at the proposed site of the 220/60 kV New Namibe SS; once every three months, PM10 and PM2.5 measurements at the boundaries of the substation and adjacent dwellings and on access roads.

(Date)
(Location)

(Data) item (Unit)	Baseline value	Measured value (Average value)	Measured value (Max. value)	Local standard	Referred to international standards	Remarks (e.g. location, frequency and method of measurement)
SO_2					0.125 (Interim target-1) 0.050 (Interim target-2) 0.020 (guideline)	24-hour average
NO_2					0.04	annual average
O_3					0.160 (Interim target-1) 0.100 (guideline)	8-hour average
PM10. ($\mu g/m^3$)				-	0.150 (Interim target-1) 0.100 (Interim target-2) 0.075 (Interim target-3) 0.050 (guideline)	Measured by PM meter for 30 minutes
PM2.5 ($\mu g/m^3$)				-	0.075 (Interim target-1) 0.050 (Interim target-2) 0.0375 (Interim target-3) 0.025 (guideline)	30-minute measurements with PM meter

2. Water pollution

- Monitoring item: wastewater treatment status
- Record: record at construction sites and workers' camp as required
- Check contractor's record ledgers

Date	Point	Monitoring item	Status during the reporting period
		Wastewater treatment status	

3. Soil pollution

- Monitoring item: fuel, lubricating oil and other leaks
- Record: record at construction sites and workers' camp as required
- Check contractor's record ledgers

Date	Point	Monitoring item	Status during the reporting period
		Fuel, lubricating oil and other leaks	

4. Noise and vibration

(1) Noise level

- Monitoring item: noise levels
- Record: measurements are taken once every three months at the boundaries of dwellings and other structures in close proximity to the 220/60 kV New Namibe SS, and at access roads

(Date)
(Location)

Item (unit)	Baseline value	Measured value (Average value)	Measurement (Max. value)	Local standard	Referred to international standards	Remarks (e.g. location, frequency and method of measurement)
Noise level (dB A)				-	Daytime: 55 dBA Nighttime: 45 dBA Industrial zone: 70 dBA	Measured with sound level meter for 30 minutes

(2) Complaints

- Monitoring item: complaints from municipalities, communes and settlements about noise and vibration
- Record: record as needed

Date	Point	Complaint details	Action	Remarks (resolution status)

5. Offensive Odors

(1) Odors

- Monitoring item: presence or absence of odors by sensory examination
- Record: record once a week at the construction site and at the workers' camp
- Check contractor's record ledgers

Date	Point	Monitoring item	Status during the reporting period
		odors (sensory)	

(2) Complaints

- Monitoring item: complaints from municipalities, communes and settlements
- Record: record as needed
- Check contractor's record ledgers

Date	Point	Complaint details	Action	Remarks (resolution status)

6. Waste

- Monitoring item: waste storage and transport conditions
- Record: once a week, at the workers' camp and construction site, the amount of waste collected and disposed of by item by the waste collection and disposal contractor
- Check contractor's record ledgers

Date	Point	Monitoring item	Status during the reporting period
		Amount collected by contractors	

7. Ecosystems

(1) Flora and fauna

- Monitoring item: flora and fauna
- Record: observations are made every three months at the 220/60 kV New Namibe SS

construction site

Date	Point	Monitoring item	Status during the reporting period
		Plant species	
		Fauna species	

(2) Birds

- Monitoring item: birds
- Record: observations are made every three months at the 220/60 kV New Namibe SS construction site

Date	Point	Monitoring item	Status during the reporting period
		Bird species present	

8. Topography and geology

- Monitoring item: topographical and vegetation changes and soil erosion
- Record: observations and photography are carried out and recorded at the 220/60 kV New Namibe SS once every six months

Date	Point	Monitoring item	Status during the reporting period

9. Existing social infrastructures and services

- Monitoring item: construction plans (e.g. time, number and frequency of vehicle operations), vehicle operation records, number of traffic accidents, etc.
- Record: record as needed. Query contractor vehicle operation records and accident records

Date	Point	Review period and details	Remarks
	Construction work plan	e.g. time, number and frequency of vehicle operations	
	Vehicle operation record		
	Accident record	Location, number of accidents and work when accident occurred, etc.	

10. Landscape

- Monitoring item: trees, harmony between hardscape and natural landscapes
- Record: record every three months, visual fixed-point observations and photography are conducted and documented at the 220/60 kV New Namibe SS and at the workers' camp and material storage installation

Date	Point	Monitoring item	Status during the reporting period

11. Gender

- Monitoring item: resident relations (e.g. handling of complaints), number and content of instructions to contractors and subcontractors' employees, their participants, etc.
- Record: record resident relations, as needed at concerned villages, using the following format as a guide.

Date	Point	Complaint details	Action	Remarks (resolution status)

Instruction records of contractor and subcontractor employees shall be queried once every three months.

Date	Record	Review period and details	Remarks
	Records of instructions and guidance	Number, content and participants, etc.	

12. Children's rights

- Monitoring item: resident relations (e.g. handling of complaints), employment in construction works, etc.
- Record: record resident relations, as needed at concerned villages, with reference to the following format. Employment records by contractors are queried every three months as to whether they are employed on construction work.

Date	Point	Complaint details	Action	Remarks (resolution status)

Date	Record	Review period and details	Remarks
	Employment registration ledger		

13. Infectious diseases such as HIV/AIDS

- Monitoring item: number of diseases and infections, standing medical supplies, number and type of vaccinations, number and content of instructions to contractor and subcontractor employees and number of participants.
- Record: once every three months. Query contractor health records, equipment ledgers, immunization record and instruction / guidance record.

Date of occurrence	Record	Number of occurrences	Remarks
	Health management record	Number of occurrences, etc.	
	Equipment ledger	Number of equipment, etc.	
	Immunization record	Number of immunization, etc.	
	Records of instructions and guidance	Number, content and participants, etc.	

14. Working environment (including occupational safety)

- Monitoring item: Casualties among workers due to mines and UXO explosions; demining work; time, content and number of participants in safety training for contractor and subcontractor employees; availability of PPE; work contents; health status of workers; number of accidents; working hours, etc.
- Record: Record as needed, for accidents due to mine and UXO explosions and demining works, using the following format; Refer to contractor instruction / guidance record, equipment ledgers, work record, health check-up record, accidents and working hours once every three months.

<Record of casualties among workers due to mine and UXO explosions>

Date	Point of accident	Details of accident	Notes (e.g. maps)

(Note) Monitoring points are in the construction site.

<Records of demining work>

Date	Date of discovery	Detection point	Types of mines and unexploded ordnance, etc.	Date(s) (e.g. for processing, finishing, etc.)	Month and date of resumption of construction

(Note) Monitoring points are in the construction site.

<Work safety and health>

Date	Record	Review period and details	Remarks
	Records of instructions and guidance	Number, content and participants, etc.	
	Equipment ledger	Number of PPE, etc.	
	Work record		
	Health check-up record		
	Accident record	Location, number of accidents and work when accident occurred, etc.	
	Working hour record		

15. Accidents

- Monitoring item: occurrence of accidents due to mines and UXO explosions, demining work, work contents, vehicle operation records, number of accidents, etc.
- Record: Record as needed accidents due to mine and UXO explosions and demining work using the following format as a reference. The status of vehicle operations and accidents occurring as a result of construction work shall be monitored, as needed, and the contractor's records shall be queried.

<Record of casualties among workers due to mine and UXO explosions>

Date	Point of accident	Details of accident	Notes (e.g. maps)

(Note) Monitoring points are in the construction site.

<Records of demining work>

Date	Date of discovery	Detection point	Types of mines and unexploded ordnance, etc.	Date(s) (e.g. for processing, finishing, etc.)	Month and date of resumption of construction

(Note) Monitoring points are in the construction site.

<Accident record>

Date	Record	Review period and details	Remarks
	Vehicle operation record		
	Accident record	Location, number of accidents and work when accident occurred, etc.	

<Operation Phase>

1. Water pollution

- Monitoring item: Status of disposal of wastewater, garbage, fuel, oil, etc. and education implementation
- Record: once every three months at the 220/60 kV New Namibe SS

Date	Point	Monitoring item	Status during the reporting period
		Status of disposal of wastewater, garbage, fuel, oil, etc. Status of education implementation	

2. Noise and vibration

(1) Noise level

- Monitoring item: noise levels
- Record: measurements are taken once every three months at the boundaries of dwellings and other structures in close proximity to the 220/60 kV New Namibe SS, and at access roads

(Date)

(Location)

Item (unit)	Baseline value	Measured value (Average value)	Measurement (Max. value)	Local standard	Referred to international standards	Remarks (e.g. location, frequency and method of measurement)
Noise level (dB A)				-	Daytime: 55 dBA Nighttime: 45 dBA Industrial zone: 70 dBA	Measured with sound level meter for 30 minutes

(2) Complaints

- Monitoring item: complaints from municipalities, communes and settlements about noise and vibration
- Record: record as needed

Date	Point	Complaint details	Action	Remarks (resolution status)

3. Offensive odors

(1) Odors

- Monitoring item: presence or absence of odors by sensory examination
- Record: record as needed at the 220/60 kV New Namibe SS.

Date	Point	Monitoring item	Status during the reporting period
		odors (sensory)	

(2) Complaints

- Monitoring item: complaints about odors at the 220/60 kV New Namibe SS
- Record: record as needed

Date	Point	Complaint details	Action	Remarks (resolution status)

4. Waste

- Monitoring item: waste storage and transport conditions
- Record: record as needed at the 220/60 kV New Namibe SS

Date	Point	Monitoring item	Status during the reporting period
		Amount collected by contractors	

5. Ecosystems

(1) Flora and fauna

- Monitoring item: flora and fauna
- Record: observations are carried out at the 220/60 kV New Namibe SS once every three months.

Date	Point	Monitoring item	Status during the reporting period
		Plant emergent species	
		Zoonosis (disease transmissible from animals to humans or vice versa)	

(2) Birds

- Monitoring item: birds
- Record: observations are carried out at the 220/60 kV New Namibe SS once every three months.

Date	Point	Monitoring item	Status during the reporting period
		Bird species present	

6. Topography and geology

- Monitoring item: topographical and vegetation changes and soil erosion
- Record: observations and photography are carried out and recorded at the 220/60 kV New Namibe SS once every six months.

Date	Point	Monitoring item	Status during the reporting period

Attachment 9-4: Monitoring Form for 220/60 kV East Lubango SS

- Monitoring will be conducted by the project proponent by submitting to JICA on a regular basis the measured values, etc., of items that have been determined by the environmental review to require monitoring by JICA, and the following monitoring form will be referred to for submission as necessary.
- In determining the monitoring items, frequency and methods, etc., the project phase or life cycle (e.g., construction phase and operation phase) should be taken into consideration.

<Pre-construction Phase>

1. Air pollution

- Monitoring item: SO2, NO2, O3, PM10, PM2.5
- Record: before and after clearing and rooting once every six months for one consecutive week, SO_2, NO_2, O_3 , at the 220/60 kV East Lubango SS construction site, every three months , PM10 and PM2.5 measurements at the substation and the boundaries of nearby dwellings and access roads, respectively.

(Date)
(Location)

(Data) item (Unit)	Baseline value	Measured value (Average value)	Measured value (Max. value)	Local standard	Referred to international standards	Remarks (e.g. location, frequency and method of measurement)
SO_2					0.125 (Interim target-1) 0.050 (Interim target-2) 0.020 (guideline)	24-hour average
NO_2					0.04	annual average
O_3					0.160 (Interim target-1) 0.100 (guideline)	8-hour average
PM10. ($\mu g/m^3$)				-	0.150 (Interim target-1) 0.100 (Interim target-2) 0.075 (Interim target-3) 0.050 (guideline)	Measured by PM meter for 30 minutes
PM2.5 ($\mu g/m^3$)				-	0.075 (Interim target-1) 0.050 (Interim target-2) 0.0375 (Interim target-3) 0.025 (guideline)	Measured by PM meter for 30 minutes

2. Water pollution

- Monitoring item: wastewater treatment status
- Record: once a week at the 220/60 kV East Lubango SS construction site and at the workers' camp
- Check the operator's (CND) record ledger

Date	Point	Monitoring item	Status during the reporting period
		Wastewater treatment status	

3. Soil pollution

- Monitoring item: fuel, lubricating oil and other leaks
- Record: once a week at the 220/60 kV East Lubango SS construction site and at the workers' camp
- Check the operator's (CND) record ledger

Date	Point	Monitoring item	Status during the reporting period
		Fuel, lubricating oil and other leaks	

4. Noise and vibration

(1) Noise level

- Monitoring item: noise levels
- Record: measurements are taken once every three months before and after clearing and rooting, at the boundary of the 220/60 kV East Lubango SS construction site and adjacent dwellings, and at the access road

(Date)
(Location)

Item (unit)	Baseline value	Measured value (Average value)	Measurement (Max. value)	Local standard	Referred to international standards	Remarks (e.g. location, frequency and method of measurement)
Noise level (dB A)				-	Daytime: 55 dBA Nighttime: 45 dBA Industrial zone: 70 dBA	Measured with sound level meter for 30 minutes

(2) Complaints

- Monitoring item: complaints from municipalities, communes and settlements about noise and vibration
- Record: record as needed

Date	Point	Complaint details	Action	Remarks (resolution status)

5. Offensive odors

(1) Odors

- Monitoring item: presence or absence of odors by sensory examination
- Record: once a week at the 220/60 kV East Lubango SS construction site and at the workers' camp
- Check the operator's (CND) record ledger

Date	Point	Monitoring item	Status during the reporting period
		Odors (sensory)	

(2) Complaints

- Monitoring item: complaints from municipalities, communes and settlements
- Record: record as needed
- Check the operator's (CND) record ledger

Date	Point	Complaint details	Action	Remarks (resolution status)

6. Waste

- Monitoring item: waste storage and transport conditions
- Record: once a week, at the workers' camp and at the 220/60 kV East Lubango SS construction site, the amount of waste collected and disposed of by item by the waste collection and disposal contractor
- Check the operator's (CND) record ledger

Date	Point	Monitoring item	Status during the reporting period
		Amount collected by contractors	

7. Ecosystems

(1) Flora and fauna

- Monitoring item: flora and fauna
- Record: observations are made every six months before and after felling and clearing, at the proposed East Lubango SS construction site

Date	Point	Monitoring item	Status during the reporting period
		Plant species	
		Fauna species	

(2) Birds

- Monitoring item: birds
- Record: observations are made every six months before and after felling and clearing, at the proposed East Lubango SS construction site

Date	Point	Monitoring item	Status during the reporting period
		Bird species present	

8. Topography and geology

- Monitoring item: topographical and vegetation changes and soil erosion
- Documentation: fixed-point observation and photography of the terrain at the 220/60 kV East Lubango SS before and after each logging opening and rooting, to be recorded

Date	Point	Monitoring item	Status during the reporting period

9. Working environment (including occupational safety)

- Monitoring item: Casualties among due to mines and UXO explosions.
- Record: record the situation, etc., of accidents, as needed, at the 220/60 kV East Lubango SS using the following format as a reference.

Date	Point of accident	Circumstances and details of accident	Notes (e.g. maps)

10. Accidents

- Monitoring item: Accidents occurred due to mine and UXO explosions
- Record: record the circumstances, etc., of any accidents, as needed, at the 220/60 kV East Lubango SS and workshop using the following format as a reference.

Date	Point of accident	Circumstances and details of the accident	Notes (e.g. maps)

<Construction Phase>

1. Air pollution

- Monitoring item: SO2, NO2, O3, PM10, PM2.5
- Record: once every six months before and after the construction of the tower, for one consecutive week; SO_2, NO_2 and O_3 at the 220/60 kV East Lubango SS construction site; once every three months; PM10 and PM2.5 measurements at the substation, at the boundaries of dwellings and other structures in the vicinity of the substation and at access roads, respectively.

(Date)
(Location)

(Data) item (Unit)	Baseline value	Measured value (Average value)	Measured value (Max. value)	Local standard	Referred to international standards	Remarks (e.g. location, frequency and method of measurement)
SO_2					0.125 (Interim target-1) 0.050 (Interim target-2) 0.020 (guideline)	24-hour average
NO_2					0.04	annual average
O_3					0.160 (Interim target-1) 0.100 (guideline)	8-hour average
PM10. ($\mu g/m^3$)				-	0.150 (Interim target-1) 0.100 (Interim target-2) 0.075 (Interim target-3) 0.050 (guideline)	Measured by PM meter for 30 minutes
PM2.5 ($\mu g/m^3$)				-	0.075 (Interim target-1) 0.050 (Interim target-2) 0.0375 (Interim target-3) 0.025 (guideline)	Measured by PM meter for 30 minutes

2. Water pollution

- Monitoring item: wastewater treatment status
- Record: record at construction sites and workers' camp as required
- Check contractor's record ledgers

Date	Point	Monitoring item	Status during the reporting period
		Wastewater treatment status	

3. Soil pollution

- Monitoring item: fuel, lubricating oil and other leaks
- Record: record at construction sites and workers' camp as required
- Check contractor's record ledgers

Date	Point	Monitoring item	Status during the reporting period
		Fuel, lubricating oil and other leaks	

4. Noise and vibration

(1) Noise level

- Monitoring item: noise levels
- Record: measurements are taken once every three months at the boundary of the 220/60 kV East Lubango SS and neighboring dwellings, etc., and at access roads.

(Date)
(Location)

Item (unit)	Baseline value	Measured value (Average value)	Measurement (Max. value)	Local standard	Referred to international standards	Remarks (e.g. location, frequency and method of measurement)
Noise level (dB A)				-	Daytime: 55 dBA Nighttime: 45 dBA Industrial zone: 70 dBA	Measured with sound level meter for 30 minutes

(2) Complaints

- Monitoring item: complaints from municipalities, communes and settlements about noise and vibration
- Record: record as needed

Date	Point	Complaint details	Action	Remarks (resolution status)

5. Offensive odors

(1) Odors

- Monitoring item: presence or absence of odors by sensory examination
- Record: record once a week at the construction site and at the workers' camp
- Check contractor's record ledgers

Date	Point	Monitoring item	Status during the reporting period
		Odors (sensory)	

(2) Complaints

- Monitoring item: complaints from municipalities, communes and settlements
- Record: record as needed
- Check contractor's record ledgers

Date	Point	Complaint details	Action	Remarks (resolution status)

6. Waste

- Monitoring item: waste storage and transport conditions
- Record: once a week, at the workers' camp and construction site, the amount of waste collected and disposed of by item by the waste collection and disposal contractor
- Check contractor's record ledgers

Date	Point	Monitoring item	Status during the reporting period
		Amount collected by contractors	

7. Ecosystems

(1) Flora and fauna

- Monitoring item: flora and fauna
- Record: observations are made every three months at the 220/60 kV East Lubango SS

construction site

Date	Point	Monitoring item	Status during the reporting period
		Plant emergent species	
		Zoonosis (disease transmissible from animals to humans or vice versa)	

(2) Birds

- Monitoring item: birds
- Record: observations are made every three months at the 220/60 kV East Lubango SS construction site.

Date	Point	Monitoring item	Status during the reporting period
		Bird species present	

8. Topography and geology

- Monitoring item: topographic and vegetation changes and soil erosion
- Record: observations and photography are carried out and documented at the 220/60 kV East Lubango SS once every six months.

Date	Point	Monitoring item	Status during the reporting period

9. Existing social infrastructures and services

- Monitoring item: construction plans (e.g. time, number and frequency of vehicle operations), vehicle operation records, number of traffic accidents, etc.
- Record: carried out as required. Query contractor vehicle operation records and accident records.

Date	Point	Review period and details	Remarks
	Construction work plan	e.g. time, number and frequency of vehicle operations	
	Vehicle operation record		
	Accident record	Location, number of accidents and work when accident occurred, etc.	

10. Landscape

- Monitoring item: trees, harmony between hardscape and natural landscapes
- Record: record every three months, visual fixed-point observations and photography are conducted and documented at the 220/60 kV East Lubango SS and at the workers' camp/materials yard installation

Date	Point	Monitoring item	Status during the reporting period

11. Gender

- Monitoring item: resident relations (e.g. handling of complaints), number and content of instructions to contractors and subcontractors' employees, their participants, etc.
- Record: record resident relations, as needed at concerned villages, using the following format as a guide.

Date	Point	Complaint details	Action	Remarks (resolution status)

Instruction records of contractor and subcontractor employees shall be queried once every three months .

Date	Record	Review period and details	Remarks
	Records of instructions and guidance	Number, content and participants, etc.	

12. Children's rights

- Monitoring item: resident relations (e.g. handling of complaints), employment in construction works, etc.
- Record: record resident relations, as needed at concerned villages, with reference to the following format. Employment records by contractors are queried every three months as to whether they are employed on construction work.

Date	Point	Complaint details	Action	Remarks (resolution status)

Date	Record	Review period and details	Remarks
	Employment registration ledger		

13. Infectious diseases such as HIV/AIDS

- Monitoring item: number of diseases and infections, standing medical supplies, number and type of vaccinations, number and content of instructions to contractor and subcontractor employees and number of participants
- Record: refer to contractor health records, equipment ledgers, immunization records and instruction / guidance records every three months.

Date of occurrence	Record	Number of occurrences	Remarks
	Health management record	Number of occurrences, etc.	
	Equipment ledger	Number of equipment, etc.	
	Immunization record	Number of immunization, etc.	
	Records of instructions and guidance	Number, content and participants, etc.	

14. Working environment (including occupational safety)

- Monitoring item: Casualties among workers due to mines and UXO explosions; demining work; time, content and number of participants in safety training for contractor and subcontractor employees; availability of PPE; work contents; health status of workers; number of accidents; working hours, etc.
- Record: Record as needed, for accidents due to mine and UXO explosion and demining works, using the following format; refer to contractor instruction / guidance record, equipment ledgers, work record, health check-up record, accidents and working hours every three months.

<Record of casualties among workers due to mine and UXO explosions>

Date	Point of accident	Details of accident	Notes (e.g. maps)

(Note) Monitoring points are in the construction site.

<Records of demining work>

Date	Date of discovery	Detection point	Types of mines and unexploded ordnance, etc.	Date(s) (e.g. for processing, finishing, etc.)	Month and date of resumption of construction

(Note) Monitoring points are in the construction site.

<Work safety and health>

Date	Record	Review period and details	Remarks
	Records of instructions and guidance	Number, content and participants, etc.	
	Equipment ledger	Number of PPE, etc.	
	Work record		
	Health check-up record		
	Accident record	Location, number of accidents and work when accident occurred, etc.	
	Working hour record		

15. Accidents

- Monitoring item: occurrence of accidents due to mines and UXO explosions, demining work, work contents, vehicle operation records, number of accidents, etc.
- Record: Record as needed accidents due to mine and UXO explosions and demining work using the following format as a reference. The status of vehicle operations and accidents occurring as a result of construction work shall be monitored, as needed, and the contractor's records shall be queried.

<Record of casualties among workers due to mine and UXO explosions>

Date	Point of accident	Details of accident	Notes (e.g. maps)

(Note) Monitoring points are in the construction site.

<Records of demining work>

Date	Date of discovery	Detection point	Types of mines and unexploded ordnance, etc.	Date(s) (e.g. for processing, finishing, etc.)	Month and date of resumption of construction

(Note) Monitoring points are in the construction site.

<Accident record>

Date	Record	Review period and details	Remarks
	Vehicle operation record		
	Accident record	Location, number of accidents and work when accident occurred, etc.	

<Operation Phase>

1. Water pollution

- Monitoring item: Status of disposal of wastewater, garbage, fuel, oil, etc., and education implementation
- Record: once every three months at the 220/60 kV East Lubango SS

Date	Point	Monitoring item	Status during the reporting period
		Status of disposal of wastewater, garbage, fuel, oil, etc. Status of education implementation	

2. Noise and vibration

(1) Noise level

- Monitoring item: noise levels
- Record: measurements are taken once every three months at the boundary of the 220/60 kV East Lubango SS and neighboring dwellings, etc., and at access roads.

(Date)

(Location)

Item (unit)	Measured value (Average value)	Measured value (Max. value)	Local standard	Referred to international standards	Remarks (e.g. location, frequency and method of measurement)
Noise level				Daytime: 55 dBA Nighttime: 45 dBA Industrial zone: 70 dBA	

(2) Complaints

- Monitoring item: complaints from municipalities, communes and settlements about noise and vibration
- Record: record as needed

Date	Point	Complaint details	action	Remarks (resolution status)

3. Offensive odors

(1) Odors

- Monitoring item: presence or absence of odors by sensory examination
- Record: record as needed at the 220/60 kV East Lubango SS

Date	Point	Monitoring item	Status during the reporting period
		Odors (sensory)	

(2) Complaints

- Monitoring item: complaints about odors at the 220/60 kV East Lubango SS
- Record: record as needed

Date	Point	Complaint details	Action	Remarks (resolution status)

4. Waste

- Monitoring item: waste storage and transport conditions
- Record: record as needed at the 220/60 kV East Lubango SS

Date	Point	Monitoring item	Status during the reporting period
		Amount collected by contractors	

5. Ecosystems

(1) Flora and fauna

- Monitoring item: flora and fauna
- Record: observations are carried out at the 220/60 kV East Lubango SS once every three months

Date	Point	Monitoring item	Status during the reporting period
		Plant emergent species	
		Zoonosis (disease transmissible from animals to humans or vice versa)	

(2) Birds

- Monitoring item: birds
- Record: observations are carried out at the 220/60 kV East Lubango SS once every three months

Date	Point	Monitoring item	Status during the reporting period
		Bird species present	

6. Topography and geology

- Monitoring item: status of vegetation recovery and soil erosion
- Record: fixed-point observation and photography of the terrain at the 220/60 kV East Lubango SS every six months and record the results

Date	Point	Monitoring item	Status during the reporting period

Attachment 9-5: Monitoring Form for 60/15 kV Arimba SS

- Monitoring will be conducted by the project proponent by submitting to JICA on a regular basis the measured values, etc., of items that have been determined by the environmental review to require monitoring by JICA, and the following monitoring form will be referred to for submission as necessary.
- In determining the monitoring items, frequency and methods, etc., the project phase or life cycle (e.g., construction phase and operation phase) should be taken into consideration.

<Pre-construction Phase>

1. Air pollution

- Monitoring item: SO2, NO2, O3, PM10, PM2.5
- Record: once every 6 months before and after logging and root removal, for one week in a row; SO_2, NO_2, O_3 at the construction site of the 60/15 kV Arimba SS; once every 3 months; PM10 and PM2.5 measurements at the boundaries of the substation and neighboring dwellings and on access roads

(Date)
(Location)

(Data) item (Unit.)	Baseline value	Measured value (Average value)	Measured value (Max. value)	Local standard	Referred to international standards	Remarks (e.g. location, frequency and method of measurement)
SO_2					0.125 (Interim target-1) 0.050 (Interim target-2) 0.020 (guideline)	24-hour average
NO_2					0.04	annual average
O_3					0.160 (Interim target-1) 0.100 (guideline)	8-hour average
PM10. ($\mu g/m^3$)				-	0.150 (Interim target-1) 0.100 (Interim target-2) 0.075 (Interim target-3) 0.050 (guideline)	Measured by PM meter for 30 minutes
PM2.5 ($\mu g/m^3$)				-	0.075 (Interim target-1) 0.050 (Interim target-2) 0.0375 (Interim target-3) 0.025 (guideline)	Measured by PM meter for 30 minutes

2. Water pollution

- Monitoring item: wastewater treatment status
- Record: once a week at the 60/15 kV Arimba SS construction site and at the workers' camp
- Check the operator's (CND) record ledger

Date	Point	Monitoring item	Status during the reporting period
		Wastewater treatment status	

3. Soil pollution

- Monitoring item: fuel, lubricating oil and other leaks
- Record: once a week at the construction site of the 60/15 kV Arimba SS and at the workers' camp
- Check the operator's (CND) record ledger

Date	Point	Monitoring item	Status during the reporting period
		Fuel, lubricating oil and other leaks	

4. Noise and vibration

(1) Noise level

- Monitoring item: noise levels
- Record: measurements are taken once every three months before and after felling and clearing, at the boundary of the 60/15 kV Arimba SS construction site and neighboring dwellings, and at the access road

(Date)

(Location)

Item (unit)	Baseline value	Measured value (Average value)	Measurement (Max. value)	Local standard	Referred to international standards	Remarks (e.g. location, frequency and method of measurement)
Noise level (dB A)				-	Daytime: 55 dBA Nighttime: 45 dBA Industrial zone: 70 dBA	Measured with sound level meter for 30 minutes

(2) Complaints

- Monitoring item: complaints from municipalities, communes and settlements about noise and vibration
- Record: record as needed

Date	Point	Complaint details	Support	Remarks (resolution status)

5. Offensive Odors

(1) Odors

- Monitoring item: presence or absence of odors by sensory examination
- Record: once a week at the 60/15 kV Arimba SS construction site and at the workers' camp
- Check the operator's (CND) record ledger

Date	Point	Monitoring item	Status during the reporting period
		Odors (sensory)	

(2) Complaints

- Monitoring item: complaints from municipalities, communes and settlements
- Record: record as needed
- Check the operator's (CND) record ledger

Date	Point	Complaint details	Support	Remarks (resolution status)

6. Waste

- Monitoring item: waste storage and transport conditions
- Record: once a week, at the workers' camp and at the construction site of the 60/15 kV

Arimba SS, the amount of waste collected and disposed of by item by the waste collection and disposal contractor

- Check the operator's (CND) record ledger

Date	Point	Monitoring item	Status during the reporting period
		Amount collected by contractors	

7. Ecosystems

(1) Flora and fauna

- Monitoring item: flora and fauna
- Record: observations are made at the 60/15 kV Arimba SS construction site once every 6 months before and after felling and clearing

Date	Point	Monitoring item	Status during the reporting period
		Plant species	
		Animal species	

(2) Birds

- Monitoring item: birds
- Record: observations are made at the 60/15 kV Arimba SS construction site once every 6 months before and after felling and clearing

Date	Point	Monitoring item	Status during the reporting period
		Bird species present	

8. Topography and geology

- Monitoring item: topographical and vegetation changes and soil erosion
- Record: fixed-point observation and photography of the terrain at the 60/15 kV Arimba SS before and after each felling and rooting should be carried out and recorded

Date	Point	Monitoring item	Status during the reporting period

9. Existing social infrastructures and services

- Monitoring item: impact of mine exploration and clearance operations on social services
- Record: record as needed, the location of social service facilities (hospitals, churches, schools, community facilities, etc.) should be plotted on a map to confirm the extent of demining work, while avoiding impacts where possible. If unavoidable, record the nature of the impact (e.g. closure or not, time period affected, number of people affected, etc.) using the following format

Date	Point	Impact details	Notes (e.g. maps)

(Note) Monitoring points are Arimba substation, surrounding settlements and facilities.

10. Working environment (including occupational safety)

- Monitoring item: Casualties among operators due to mines and UXO explosions.
- Record: record the situation, etc., of accidents , as needed, at Arimba substation, using the following format as a reference

Date	Point of accident	Circumstances and details of the accident	Notes (e.g. maps)

11. Accidents

- Monitoring item: Accidents occurred due to mine and UXO exploration and clearance activities
- Record: record the circumstances, etc., of any accidents, as needed, at Arimba substation and workshop using the following format as a reference.

Date	Point of accident	Circumstances and details of the accident	Notes (e.g. maps)

<Construction Phase>

1. Air pollution

- Monitoring item: SO2, NO2, O3, PM10, PM2.5
- Record: measurements of SO2, NO2 and O3 at the construction site of the 60/15 kV Arimba SS once every 6 months before and after the construction of the tower; measurements of PM10 and PM2.5 once every 3 months at the boundaries of the substation and neighboring dwellings and on access roads.

(Date)
(Location)

(Data) item (Unit.)	Baseline value	Measured value (Average value)	Measured value (Max. value)	Local standard	Referred to international standards	Remarks (e.g. location, frequency and method of measurement)
SO_2					0.125 (Interim target-1) 0.050 (Interim target-2) 0.020 (guideline)	24-hour average
NO_2					0.04	annual average
O_3					0.160 (Interim target-1) 0.100 (guideline)	8-hour average
PM10. ($\mu g/m^3$)				-	0.150 (Interim target-1) 0.100 (Interim target-2) 0.075 (Interim target-3) 0.050 (guideline)	Measured by PM meter for 30 minutes
PM2.5 ($\mu g/m^3$)				-	0.075 (Interim target-1) 0.050 (Interim target-2) 0.0375 (Interim target-3) 0.025 (guideline)	Measured by PM meter for 30 minutes

2. Water pollution

- Monitoring item: wastewater treatment status
- Record: record at construction sites and workers' camp as required
- Check contractor's record ledgers

Date	Point	Monitoring item	Status during the reporting period
		Wastewater treatment status	

3. Soil pollution

- Monitoring item: fuel, lubricating oil and other leaks
- Record: record at construction sites and workers' camp as required

- Check contractor's record ledgers

Date	Point	Monitoring item	Status during the reporting period
		Fuel, lubricating oil and other leaks	

4. Noise and vibration

(1) Noise level

- Monitoring item: noise levels
- Record: measurements are taken once every three months at the boundaries of dwellings and other structures in close proximity to the 60/15 kV Arimba SS, and at access roads

(Date)

(Location)

Item (unit)	Baseline value	Measured value (Average value)	Measurement (Max. value)	Local standard	Referred to international standards	Remarks (e.g. location, frequency and method of measurement)
Noise level (dB A)				-	Daytime: 55 dBA Nighttime: 45 dBA Industrial zone: 70 dBA	Measured with sound level meter for 30 minutes

(2) Complaints

- Monitoring item: complaints from municipalities, communes and settlements about noise and vibration
- Record: record as needed

Date	Point	Complaint details	Support	Remarks (resolution status)

5. Offensive Odors

(1) Odors

- Monitoring item: presence or absence of odors by sensory examination
- Record: record once a week at the construction site and at the workers' camp
- Check contractor's record ledgers

Date	Point	Monitoring item	Status during the reporting period
		Odors (sensory)	

(2) Complaints

- Monitoring item: complaints from municipalities, communes and settlements
- Record: record as needed
- Check contractor's record ledgers

Date	Point	Complaint details	Action	Remarks (resolution status)

6. Waste

- Monitoring item: waste storage and transport conditions
- Record: once a week, at the workers' camp and construction site, the amount of waste

collected and disposed of by item by the waste collection and disposal contractor
- Check contractor's record ledgers

Date	Point	Monitoring item	Status during the reporting period
		Amount collected by contractors	

7. Ecosystems

(1) Flora and fauna
- Monitoring item: flora and fauna
- Record: observations are made every three months at the 60/15 kV Arimba SS construction site

Date	Point	Monitoring item	Status during the reporting period
		Plant species	
		Animal species	

(2) Birds
- Monitoring item: birds
- Record: observations are made every three months at the 60/15 kV Arimba SS construction site

Date	Point	Monitoring item	Status during the reporting period
		Bird species present	

8. Topography and geology
- Monitoring item: topographic and vegetation changes and soil erosion
- Record: observations and photography are carried out and recorded at the 60/15 kV Arimba SS once every six months

Date	Point	Monitoring item	Status during the reporting period

9. Existing social infrastructure and social services
- Monitoring item: construction plans (e.g. time, number and frequency of vehicle operations), vehicle operation records, number of traffic accidents, etc.
- Record: record as needed. Query contractor vehicle operation records and accident records

Date	Point	Review period and details	Remarks
	Construction work plan	e.g. time, number and frequency of vehicle operations	
	Vehicle operation record		
	Accident record	Location, number of accidents and work when accident occurred, etc.	

10. Landscape
- Monitoring item: trees, harmony between hardscape and natural landscapes
- Record: once every three months, visual fixed-point observations and photography are conducted and documented at the 60/15 kV Arimba SS and at the workers' camp/materials yard installation

Date	Point	Monitoring item	Status during the reporting period

11. Gender

- Monitoring item: resident relations (e.g. handling of complaints), number and content of instructions to contractors and subcontractors' employees, their participants, etc.
- Record: record resident relations, as needed at concerned villages, using the following format as a reference

Date	Point	Complaint details	Action	Remarks (resolution status)

Instruction records of contractor and subcontractor employees shall be queried once every three months.

Date	Record	Review period and details	Remarks
	Records of instructions and guidance	Number, content and participants, etc.	

12. Children's rights

- Monitoring item: resident relations (e.g. handling of complaints), employment in construction works, etc.
- Record: record resident relations, as needed at concerned villages, with reference to the following format. Employment records by contractors are queried every three months as to whether they are employed on construction work.

Date	Point	Complaint details	Action	Remarks (resolution status)

Date	Record	Review period and details	Remarks
	Employment registration ledger		

13. Infectious diseases such as HIV/AIDS

- Monitoring item: number of diseases and infections, standing medical supplies, number and type of vaccinations, number and content of instructions to contractor and subcontractor employees and number of participants
- Record: once every three months. Query contractor health records, equipment ledgers, immunization records and instruction / guidance records

Date of occurrence	Record	Number of occurrences	Remarks
	Health management record	Number of occurrences, etc.	
	Equipment ledger	Number of equipment, etc.	
	Immunization record	Number of immunization, etc.	
	Records of instructions and guidance	Number, content and participants, etc.	

14. Working environment (including occupational safety)

- Monitoring item: Casualties among workers due to mines and UXO explosions; demining work; time, content and number of participants in safety training for contractor and subcontractor employees; availability of PPE; work contents; health status of workers; number of accidents; working hours, etc.
- Record: Record as needed, for accidents due to mine and UXO explosions and demining works, using the following format. Refer to contractor instruction / guidance record, equipment ledgers, work, health check-up record, accidents and working once every three months by the contractor

<Record of casualties among workers due to mine and UXO explosions>

Date	Point of accident	Details of accident	Notes (e.g. maps)

(Note) Monitoring points are in the construction site.

<Records of demining work>

Date	Date of discovery	Detection point	Types of mines and unexploded ordnance, etc.	Date(s) (e.g. for processing, finishing, etc.)	Month and date of resumption of construction

(Note) Monitoring points are in the construction site.

<Work safety and health>

Date	Record	Review period and details	Remarks
	Records of instructions and guidance	Number, content and participants, etc.	
	Equipment ledger	Number of PPE, etc.	
	Work record		
	Health check-up record		
	Accident record	Location, number of accidents and work when accident occurred, etc.	
	Working hour record		

15. Accidents

- Monitoring item: occurrence of accidents due to mines and UXO explosions, demining work, work contents, vehicle operation records, number of accidents, etc.
- Record: Record as needed accidents due to mine and UXO explosions and demining work using the following format as a reference. The status of vehicle operations and accidents occurring as a result of construction work shall be monitored, as needed, and the contractor's records shall be queried

<Record of casualties among workers due to mine and UXO explosions>

Date	Point of accident	Details of accident	Notes (e.g. maps)

(Note) Monitoring points are in the construction site.

<Records of demining work>

Date	Date of discovery	Detection point	Types of mines and unexploded ordnance, etc.	Date(s) (e.g. for processing, finishing, etc.)	Month and date of resumption of construction

(Note) Monitoring points are in the construction site.

<Accident record>

Date	Decord	Deview period and details	Remarks
	Vehicle operation record		
	Accident record	Location, number of accidents and work when accident occurred, etc.	

<Operation Phase>

1. Water pollution

- Monitoring item: Status of disposal of wastewater, garbage, fuel, oil, etc. and education implementation
- Record: once every three months at the 60/15 kV Arimba SS

Date	Point	Monitoring item	Status during the reporting period
		Status of disposal of wastewater, garbage, fuel, oil, etc. Status of education implementation	

2. Noise and vibration

(1) Noise level

- Monitoring item: noise levels
- Record: measurements are taken once every three months at the boundaries of dwellings and other structures in close proximity to the 60/15 kV Arimba SS, and at access roads

(Date)

(Location)

Item (unit)	Baseline value	Measured value (Average value)	Measurement (Max. value)	Local standard	Referred to international standards	Remarks (e.g. location, frequency and method of measurement)
Noise level (dB A)				-	Daytime: 55 dBA Nighttime: 45 dBA Industrial zone: 70 dBA	Measured with sound level meter for 30 minutes

(2) Complaints

- Monitoring item: complaints from municipalities, communes and settlements about noise and vibration
- Record: record as needed

Date	Point	Complaint details	Support	Remarks (resolution status)

3. Offensive Odors

(1) Odors

- Monitoring item: presence or absence of odors by sensory examination
- Record: record as needed at the 60/15 kV Arimba SS

Date	Point	Monitoring item	Status during the reporting period
		Odors (sensory)	

(2) Complaints

- Monitoring item: complaints about odors at the 60/15 kV Arimba SS
- Record: record as needed

Date	Point	Complaint details	Support	Remarks (resolution status)

4. Waste

- Monitoring item: waste storage and transport conditions
- Record: record as needed at the 60/15 kV Arimba SS

Date	Point	Monitoring item	Status during the reporting period
		Amount collected by contractors	

5. Topography and geology

- Monitoring item: topographic and vegetation changes and soil erosion
- Record: fixed-point observation and photography of the terrain at the 60/15 kV Arimba SS every six months and record the results

Date	Point	Monitoring item	Status during the reporting period

Attachment 9-6: Environmental Checklist (Power Transmission and Distribution Lines)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and environmental permits	"(a) Have EIA reports been already prepared in official process?	(a) Y	(a) Prepared and submitted to the Angolan Ministry of Environment in October 2022.
		(b) Have EIA reports been approved by authorities of the host country's government?	(b) N	(b) Under review as of January 2023. The system states that approval is granted within 30 days of submission, but it could normally take a few months.
		(c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied?	(c) Y	(c) Conditions for deforestation and installation of markers for bird protection may be attached, but it is considered possible to meet the conditions.
		(d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?"	(d) N	(d) One of the documents that must accompany the ESIA is a Waste Management Plan (already prepared), which must be approved by the Agência Nacional de Resíduos (National Waste Agency) after the ESIA is submitted.
	(2) Explanation to local stakeholders	"(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders?	(a) Y	(a) Stakeholder consultations during the scoping phase and the preparation of the EIA report have already been held in February 2021 and early June 2022, respectively, to gain support and understanding for the project. In addition, preliminary consultations (February 2020) and community consultations (April and September 2021) have already been held respectively.
		(b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?"	(b) Y	(b) The opinions obtained through previous consultations are reflected in the project plan (route selection and candidate substation sites).
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) Based on the opinions of the stakeholders, several alternatives were intercompared for the transmission and distribution routes and the candidate substation sites, and the one with the highest superiority was selected.
2 Pollution Control	(1) Water Quality	(a) Is there any possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas? If the water quality degradation is anticipated, are adequate measures considered?	(a) N	(a) No rivers are expected to be directly affected on the route, and in principle, it is our policy to avoid construction work during the rainy season on sloping land, so the possibility of water quality deterioration in rivers due to soil runoff is low. After the route is finalized, measures to prevent soil runoff will be taken if the impact on surface water is expected to be healthy.

3 Natural Environment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) N	(a) The new Namibe substation will be built in the desert about 10 km from the boundary of the nationally designated Namibe Partial Protected Area and several steel towers will be constructed, but it is assumed that there will be little impact on terrestrial flora and fauna, and little impact on birds due to its distance from the coastline and the desert area.
	(2) Ecosystem	"(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)?	(a) Y	(a)-1 The Tundavala area, approximately 15 km west of Lubango City, has been designated an internationally recognized Important Bird and Biodiversity Area (IBA) and impacts to this area need to be minimized. (a)-2 A wetland (swamp) exists in a cultivated area 7 km south of the Nombungo substation, and waterfowl and other flying birds have been observed there, so the transmission line route has been rerouted.
		(b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions?	(b) Y	(b) The Nan Acheunogan (Ludwig's Bustard), listed as Critically Endangered IB by the IUCN, has been identified and conservation measures are needed.
		(c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem?	(c) Y	(c) In view of the lack of data and information, the policy is to continuously monitor the situation, consider the application of measures that can be expected to be effective in the current situation, and make improvements based on the results of monitoring.
		(d) Are adequate measures taken to prevent disruption of migration routes and habitat fragmentation of wildlife and livestock?	(d) Y	(d) Although the clearing of vegetation for demining measures and to secure the ROW will cause temporary habitat fragmentation, it is not expected to block migration routes, but measures to promote vegetation recovery as soon as possible will include backfilling of detached topsoil, planting, and protection works.
		(e) Is there any possibility that the project will cause the negative impacts, such as destruction of forest, poaching, desertification, reduction in wetland areas, and disturbance of ecosystem due to introduction of exotic (non-native invasive) species and pests? Are adequate measures for preventing such impacts considered?	(e) Y/N	(e) By following the route of the existing 60 kV DL, along with the direct impact, especially in forested areas, the project is considered to minimize secondary impacts such as poaching and illegal logging due to the new entry route, etc. During construction and when the line is in service, the project is designed to educate construction workers and local residents and to work with the government for continuous conservation. On the other hand, it is assumed that there will be little impact on desertification, marshland drying, etc.
		(f) In cases where the project site is located in undeveloped areas, is there any possibility that the new development will result in extensive loss of natural environments? "	(f) N	(f) Basically, all of the areas have been developed, but it is also well understood that they are border areas where nature and people coexist. In areas with abundant forests, which are considered the most natural, we took a route along the existing 60 kV DL to minimize the impact and have confidence in the future restoration of nature, and in desert areas, we gave priority to areas along roads to minimize excavation, consolidation, and erosion of the desert, and in the Angola highlands of Tundabara, we took a route with the least impact on bird flight and land animal migration. In the Angolan highlands of Tundavala, we took the route that would have the least impact on bird flight and the movement of land animals.
	(3) Topography and geology	"(a) Is there any soft ground on the route of power transmission and distribution lines that may cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides, where needed?	(a) N	(a) The area is basically stable ground, and there are no particular concerns based on the topography and geological survey results. (b) The steep slope is composed of stable bedrock, so the possibility of landslides or landslides is extremely small. The foundation will be stabilized by a method of anchoring into the bedrock.
		(b) Is there any possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are	(b) N	(b) The steep slopes are stable bedrock and no landslide or landslide prevention work is currently anticipated. No other slopes that would require civil works such as fill or cut are found. For the

		adequate measures considered to prevent slope failures or landslides?		river crossing, the tower location is selected on a flat area, and the ground is to be carefully checked and the foundation is to be carefully selected.
		(c) Is there a possibility that soil runoff will result from cut and fill areas, waste soil disposal sites, and borrow sites? Are adequate measures taken to prevent soil runoff?"	(c) N	(c) The plan emphasizes early recovery from demining activities, and topsoil preservation is a top priority. The foundation frame is small and the excavated soil will be backfilled and compacted, so basically no excess soil will be generated. For this reason, no soil dumping site is planned. Foundation construction during rain is to be avoided as much as possible, and measures to prevent collapse of the excavated area and soil runoff are to be taken as necessary.
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement?	(a) N	(a) When multiple alternatives for the transmission and distribution route and the proposed substation sites were intercompared and the superior alternative was selected, the alternative with permanent involuntary resettlement was avoided and the social impact was minimized. In addition, when implementing public works projects in Angola, easements are created, and therefore there is no acquisition of private land. For safety reasons, access to the area will be restricted and temporary evictions may occur during the construction period due to safety considerations associated with the construction of the tower and overhead lines.
		(b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement?	(b) Y	(b) The project has already been explained during the September 2021 community consultation. In addition, compensation and other support measures were explained at the second stakeholder consultation held in June 2022.
		(c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement?	(c) Y	(c) Compensation estimates based on reacquisition prices and livelihood restoration assistance measures are considered in the ARAP prepared during the preparatory study period.
		(d) Are the compensations going to be paid prior to the resettlement?	(d) Y	(d) Payment in kind (provision of replacement farmland/house) or monetary compensation will be made prior to the start of construction.
		(e) Are the compensation policies prepared in document?	(e)	(e) An entitlement and compensation policy (entitlement matrix) has been developed in the ARAP developed during the preparation study period.
		(f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples?	(f) N/A	(f) An initial baseline survey of 325 households living in the project area, including affected residents, confirmed that no ethnic minorities or indigenous peoples were identified as meeting the requirements of the World Bank OP 4.10. In addition, it was confirmed that the elderly population was small and there were no poor people in the target population.
		(g) Are agreements with the affected people obtained prior to resettlement?	(g) Y	(g) During the community consultation for the feasibility study, residents in the project area expressed their opinion that if relocation occurs, it will be contingent on compensation payments. Access to the area will be restricted due to safety considerations associated with the construction of the tower and the laying of overhead lines during the construction implementation phase, and temporary evictions may occur. The ARAP will be updated during the implementation phase of the project to identify the affected residents and finalize the impact, after which a consensus will be reached.
		(h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan?	(h) Y	(h) The project implementation structure is being considered and will be supported by RNT/ENDE as part of contracted employment or consultancy services. The implementation budget will be allocated by MINEA/Ministry of Finance of the Angolan Government.

		(i) Are any plans developed to monitor the impacts of resettlement?	(i) Y	(i) A monitoring plan has been developed in the ARAP prepared during the preparation study period.
		(j) Is the grievance redress mechanism established?"	(j) Y	(j) A grievance mechanism has been developed in the ARAP prepared during the preparatory study period.
	(2) Living and livelihoods	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary?	(a) Y	(a) The project is being formed in a manner that avoids or minimizes adverse impacts of the project on the livelihoods of the residents. When the affected residents are identified through the geological and topographical survey and detailed design, consideration is given to mitigate the adverse impacts, if they become unavoidable. A relocation policy and entitlement and compensation policy (entitlement matrix) are developed in the ARAP prepared during the preparatory study period.
		(b) Is there a possibility that diseases, including infectious diseases, such as HIV will be brought due to immigration of workers associated with the project? Are adequate considerations given to public health, if necessary?	(b) Y	(b) There is a possibility of outbreaks of infectious diseases due to influx of population from outside, etc. Hygiene training and medical examinations for workers are envisaged, as well as guidance on local codes of conduct.
		(c) Is there any possibility that installation of structures, such as power line towers will cause a radio interference? If any significant radio interference is anticipated, are adequate measures considered?	(c) N	(c) No radio interference is expected.
		(d) Are the compensations for transmission wires given in accordance with the domestic law?"	(d) Y	(d) Under Angolan national law, when public use or temporary or permanent acquisition takes place, there is always an obligation to provide fair and adequate compensation to landowners and owners of other affected property rights, and compensation is provided for crops, trees, and physical structures. However, no provisions for easement compensation were identified in national law. In this project, based on the domestic law and JICA Environmental Guidelines, as well as actual examples from AfDB and UK-supported projects, compensation will be provided at the reacquisition price for actual damage during construction, and compensation for the decline in the assessed value of the land.
	(3) Cultural Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	(a) In considering transmission and distribution route alternatives, archaeological, historical, cultural, and religious sites and heritage sites of historical value are avoided. As a point to be noted at the implementation stage, the Boer cemetery (not designated as a historic site in Japan, but considered to be of high historical importance) is located near the power transmission route (300 m), so installation of a steel tower near the cemetery will be avoided.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) In comparing transmission route alternatives, decisions were made in consideration of natural and cultural landscapes, and adverse impacts on the landscape were avoided.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples?	(a) N/A	(a) An initial baseline survey of 325 households living in the project area, including affected residents, did not identify any ethnic or indigenous minorities that meet the requirements of the World Bank OP 4.10.
		(b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?"	(b) N/A	(b) Ibid.
	(6) Working environment	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the	(a) Y	(a) New General Labour Law No. 7/15 of 15 June 2015 prohibits children under 14 years of age from working; 14 to 16 year olds require parental consent; workers under 18 years of age are subject to restrictions on working hours and hours per day and per week; employers are also be

		country which the project proponent should observe in the project?		required to provide care and support for school-aged children. Implementing agencies will comply with the law and will not allow children under the age of 14 to work.
		(b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials?	(b) Y	(b) The contractor will prepare an occupational safety plan, which will be submitted to and approved by the implementing agency. A manual on occupational accident prevention (including safety education and training) will be thoroughly implemented, and the company will be required to organize and store hazardous materials in an isolated area. Protective clothing, etc. will be provided to workers.
		(c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.?	(c) Y	(c) The contractor will prepare an occupational safety plan, which will be submitted to and approved by the implementing agency. The plan will include mitigation measures related to safety training, and will include a manual on occupational accident prevention (including safety education and training) and thorough occupational health and safety training.
		(d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?"	(d) Y	(d) Prevent and strictly respond to safety violations of project personnel and local residents by security personnel through mutual monitoring and grievance mechanisms among implementing agencies, contractors, and local communities.
5 Others	(1) Impact during construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)?	(a) Y	(a) Waste will be strictly managed in accordance with a waste management plan to be approved by the government, and other matters of particular concern in terms of the level and continuity of impact, particularly noise and dust, will be monitored and complaints received on a regular basis, in addition to measures to address the sources of generation and training and guidance for workers.
		(b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts?	(b) Y	(b) Although adverse impacts on the natural environment associated with mine exploration and clearance activities and securing the ROW of the transmission line are considered unavoidable, consideration has been given to route selection and mitigation measures to minimize such impacts. In addition, an education and awareness plan will be defined to address the possible impacts of deforestation and wildlife capture by workers.
		(c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?"	(c) Y	(c) Temporary seizure measures, such as restricting access to the area surrounding the construction and blocking traffic, may be taken, but measures will be taken by setting up enclosures (temporary fences). If temporary eviction is necessary, compensation in kind or monetary compensation will be provided. There is a possibility of increased traffic and congestion in the surrounding area, increased traffic accidents, fire, accidents during construction such as falls and electric shock, and possible disease transmission. Child labor by construction companies will be prohibited. Regular patrols are conducted to check for the presence of child laborers. Regular health checkups will be conducted for outside employees before and after employment.
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts?	(a) Y	(a) An environmental monitoring plan and its implementation will be mandatory, with monitoring by the implementing agency for any negative impact items.
		(b) What are the items, methods and frequencies of the monitoring program?	(b) Y	(b) The ESIA and SES reports contain detailed environmental management and monitoring plans.

		(c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)?	(c) Y	(c) Based on the ESIA report and the SES report description, necessary actions will be taken for monitoring.
		(d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?"	(d) Y	(d) They are based on the information in the ESIA report and the SES report.
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Road checklist should also be checked (e.g., projects including installation of electric transmission lines and/or electric distribution facilities).	(a) N/A	(a) N/A
	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed, (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) N	(a) All waste is planned to be disposed of within the region, and there is no concern about pollution of international rivers. (b) Although vegetation clearing due to mine exploration and clearance activities is inevitable, its extent is limited and no impact on global warming is anticipated, as consideration and measures for early vegetation recovery will be taken.

(Note 1) Regarding "standards of the country concerned" in the table, if there is a significant deviation from internationally accepted standards, countermeasures will be considered as necessary. Items for which regulations are not currently established in the country concerned will be considered by comparison with appropriate standards outside the country concerned (including experience in Japan).
Note 2: The environmental checklist is only a standardized list of environmental check items; items may need to be deleted or added depending on the project and regional characteristics.

Attachment 10-1: ARAP Monitoring Form

Date (DD/MM/YYYYYY)

(1) Progress Monitoring

Activities/indicators				Unit	Plan	Quarterly progress		Progress (%)			Scheduled completion Time	Implementation Body
						Up to Previous Quarter	This Quarter	Up to Previous Quarter	This Quarter	Up to this Quarter		
1	Land survey	1	Prior notice	Frequency								Provincial Land Administration (in cooperation with district, municipalities, municipalities, Sobas, etc.)
		2	Land survey	Frequency								
		3	Updating the status of private land ownership, land status by customary right, actual status of public land occupation, actual area owned and used, and boundary lines	Number of households								
				Area								
		4	Mapping	Area								
2	Compensation	1	Consultation	Frequency								RNT/ENDE
		2	Identification of movable and immovable property values	%								MINEA
		3	Establishment of Grievance Redress Committee	Number of Committee Houses								RNT/ENDE
		4	Grievance processing	Number of cases received								RNT/ENDE
				Number of cases processed								
		5	Provision of alternative farmland/house or monetary compensation	Number of beneficiary right holders								MINEA RNT/ENDE

Activities/indicators				Unit	Plan	Quarterly progress		Progress (%)			Scheduled completion Time	Implementation Body
						Up to Previous Quarter	This Quarter	Up to Previous Quarter	This Quarter	Up to this Quarter		
				Number of recipients								
				Amount of payment								
3	Land acquisition (temporary and permanent)	1	Agricultural land	Area								RNT/ENDE
			Progress	%								
		2	Land and buildings	Number of building eaves								
			Progress	%								
		3	Eligible households	Number of households								
			Progress	%								
6	livelihood recovery assistance	1	Assistance Programs	Number of activities								RNT/ENDE
				Number of recipients								
		2	Locally-employed workers at construction sites	Number of employees								

(2) Consultation Details

No.	Date	Location and number of participants	Contents	Participant's Statement	Response / action
1					
2					

(local consultation consultations, stakeholder consultations, etc.)

(3) Details of Complaint

No.	Date of receipt	Contents	Response / action	Resolved/unresolved
1				
2				

(4) Livelihood restoration support activities implemented

No.	Activities	Results (number of activities, number of participants, etc.)	Location
1			
2			
3			

(5) Livelihood recovery status

Date of survey: (date of survey)

No.	Survey Area	Number of households surveyed	Increase in income (number of households)	Decrease in income (number of households)	No change in income (Number of households)	Problems and issues, and response / action	Needs for additional support
1							
2							
3							

(6) Others

No.	Contents	Factors and Responses / Actions to the Issues

Attachment 12-1: Project Implementation Schedule

Undislosed Information.

Attachment 13-1: Details of Sensitivity Analyses

Undislosed Information.

Attachment 13-2: Prerequisites and Calculation Results for Quantity of Annual Transmission Power of New 220kV TL and Maximum Utilization Rate of New SSs (In 2030)

Undislosed Information.