Mongolia
Ministry of Energy (MOE)
National Power Transmission Grid State Own Stock Company（NPTGC）
Ulaanbaatar Electricity Distribution Network Company（UBEDN）

Preparatory Survey for Ulaanbaatar Transmission and Distribution Project

Final Report

March 2014

Japan International Cooperation Agency (JICA)
Tokyo Electric Power Company (TEPCO)

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Draft Terms of Reference of Consulting Services

Abbreviation

ACSR	Aluminum Conductor Steel Reinforced
ADB	Asian Development Bank
ALAGac	Administration of Land Affairs, Geodesy and Cartography
AMR	Automation Meter Reading
AUES	Altay Uliastay Energy System
CES	Central Energy System
DAS	Distribution Automation System
EA	Energy Authority
EBRD	European Bank for Reconstruction and Development
EES	Eastern Energy System
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EMP	Environmental Monitoring Plan
EPP	Environmental Protection Plan
ERC	Energy Regulatory Commission
FIRR	Financial Internal Rate of Return
F/S	Feasibility Study
GIS	Gas Insulated Switchgear
GOST	Gosudarstvenny Standart
HTLS	High Temperature Low Sag
IEC	International Electrotechnical Commission
IED	Intelligent Electronic Devise
ISO	International Organization for Standardization
ISP	Internet Service Provider
JICA	Japan International Cooperation Agency
MNS	Mongolia National Standard
MNT	Mongolian Togrog
MOE	Ministry of Energy
MOF	Ministry of Finance
MOED	Ministry of Economic Development
MEGD	Ministry of Environment and Green Development
NDC	National Dispatch Center
NPTGC	National Power Transmission Grid State Own Stock Company

O&M	Operation and Maintenance
ODA	Official Development Assistance
OPGW	Optical Ground Wire
SAS	Substation Automation System
SCADA	Supervisory Control And Data Acquisition
S/S	Substation
TEPCO	Tokyo Electric Power Company
T/L	Transmission Line
TPP	Thermal Power Plant
UBEDN	Ulaanbaatar Electricity Distribution Network Company
USD	United States Dollar
VHF	Very High Frequency
WES	Western Energy System
WTP	Willingness to Pay

Exchange Rate

1 MNT = 0.06 JPY

1 USD = 1,474.1 MNT

Chapter 1 Introduction

1.1 Background of the Survey

Power demand in Mongolia has recently increased, due to the country's high economic growth. It is forecasted that the power demand in Ulaanbaatar, which comprises more than 40 % of the country, will grow by 6-7 % per year. To respond to such a situation, the Government of Mongolia is aiming to install new power plants and other electric infrastructure. Based on this government policy, Ulaanbaatar No.5 Thermal Plant is planned to be one of the newly installed power resources, and rehabilitation of old power stations is planned in order to recover the rated capacity. Conversely, development and rehabilitation of transmission and distribution fields seems to lag behind the development of power stations.

Most of the transmission system in Ulaanbaatar has been in service for 30 years since its construction and deterioration and lack of capacity have become serious problems. However, in order to meet the high demand growth for power, transmission lines should be reinforced or renewed, and some substations also require replacement.

In Ulaanbaatar's distribution system, most of the underground cable system has reached its expected lifetime and frequent outages happen due to the aging facilities. Furthermore, because no distribution automation system has yet been installed, restoration time for outages is considerable, and the outage area is also difficult to minimize. In this context, a power supply of high quality and high reliability is crucial to maintaining the social and economic development of Ulaanbaatar. Thus, upgrade of the transmission and distribution system in Ulaanbaatar is a critical issue.

1.2 Objective and Target Area of the Survey

1.2.1 Objective

This survey (hereinafter the Survey) confirms the current situation and development plans for transmission and distribution fields in Ulaanbaatar; highlights needs for new construction or rehabilitation in these fields; and proposes candidate projects for a Japanese ODA loan, to realize a more efficient, stable and deliverable power supply.

1.2.2 Survey Area

Ulaanbaatar City and the surrounding area is the area of the Survey.

1.2.3 Counterpart

National Power Transmission Grid State Own Stock Company (hereinafter NPTGC) is the counterpart for the transmission project; Ulaanbaatar Electricity Distribution Network Company

(hereinafter UBEDN) is the counterpart for the distribution project.

1.2.4 Scope of Work

The content of the scope of work, as instructed by the Japan International Cooperation Agency (hereinafter JICA), is as follows. Tokyo Electric Power Company (hereinafter TEPCO) was assigned as the consultant for the Survey and dispatches the survey team (hereinafter the JICA Survey Team) 5 times during the survey period. A training program in Japan is also conducted to introduce Japanese technology relating to this Survey.

(1) Confirmation of Current Situation in the Power Sector

- Confirmation of development policy and plans
- Confirmation of current situation and issues in the power sector
- Confirmation of investment plans in the power sector

(2) Confirmation of the Current Situation of Power System Facilities around Ulaanbaatar

- Confirmation of power demand and supply, and future demand
- Confirmation of existing power supply facilities
- Confirmation of future plans for power supply facilities
- Confirmation of organizational information of NPTGC and UBEDN
- Confirmation of other related organizations

(3) Screening of Priority Projects for New Installations and Rehabilitations

- Screening and proposal of priority projects for a Japanese ODA loan

(4) Study of Priority Projects for New Installations and Rehabilitations

- Confirmation of project outline and feasibility
- Creation of implementation schedule
- Estimation of project costs
- Confirmation of project effects
- Review of implementation methods, implementation formation and O&M
- Proposal of scope of work for engineering services of the projects
- Identification of risks in project implementation and proposal of countermeasures
- Prediction and assessment of environmental and social impacts and examination of mitigation measures and monitoring plan

(5) Study of Cost Cutting Measures

- Consideration of optimum planning
- Consideration of optimum construction schedule

1.1 Flowchart of the Survey

The Survey is conducted as shown in the following flowchart.

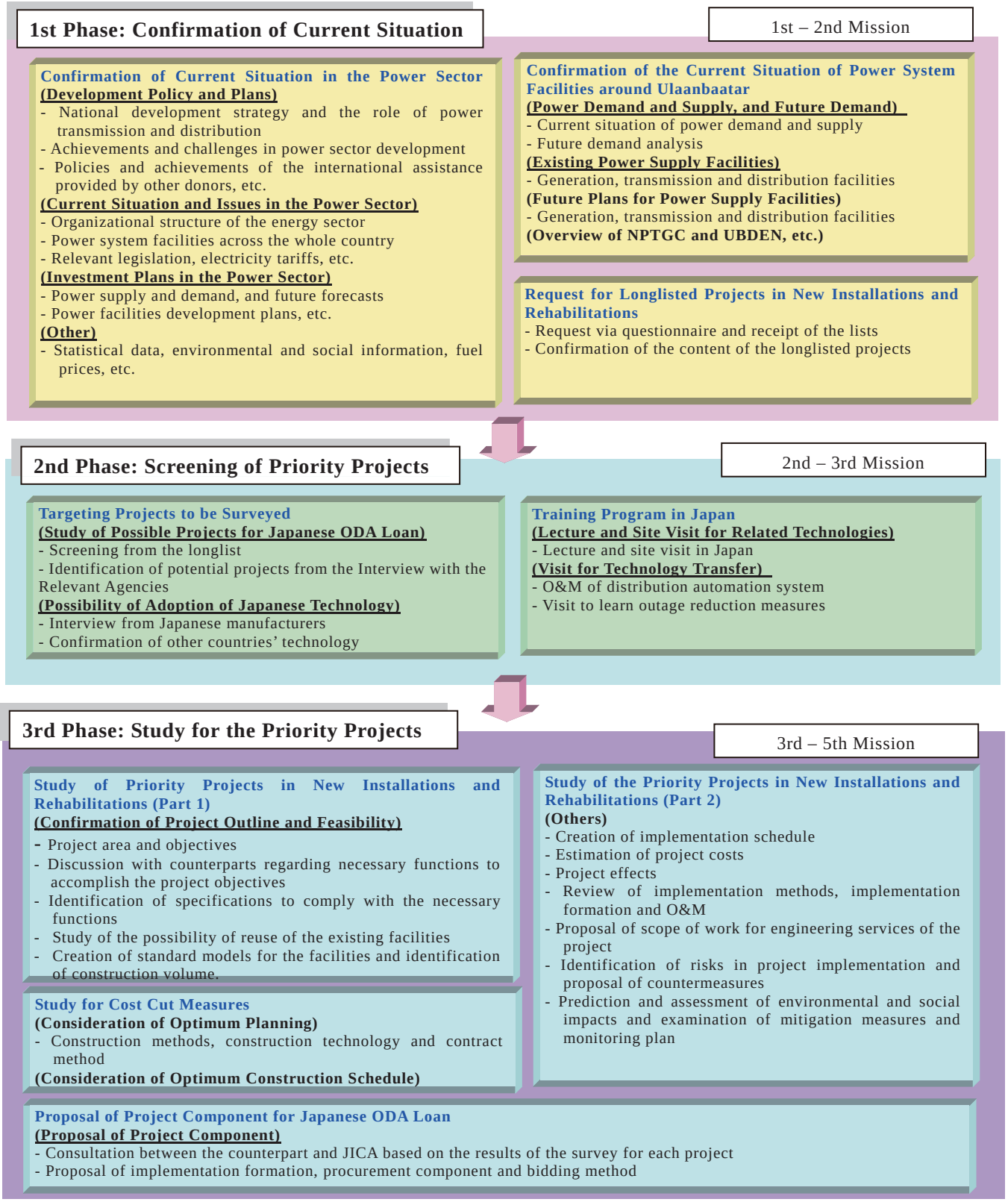
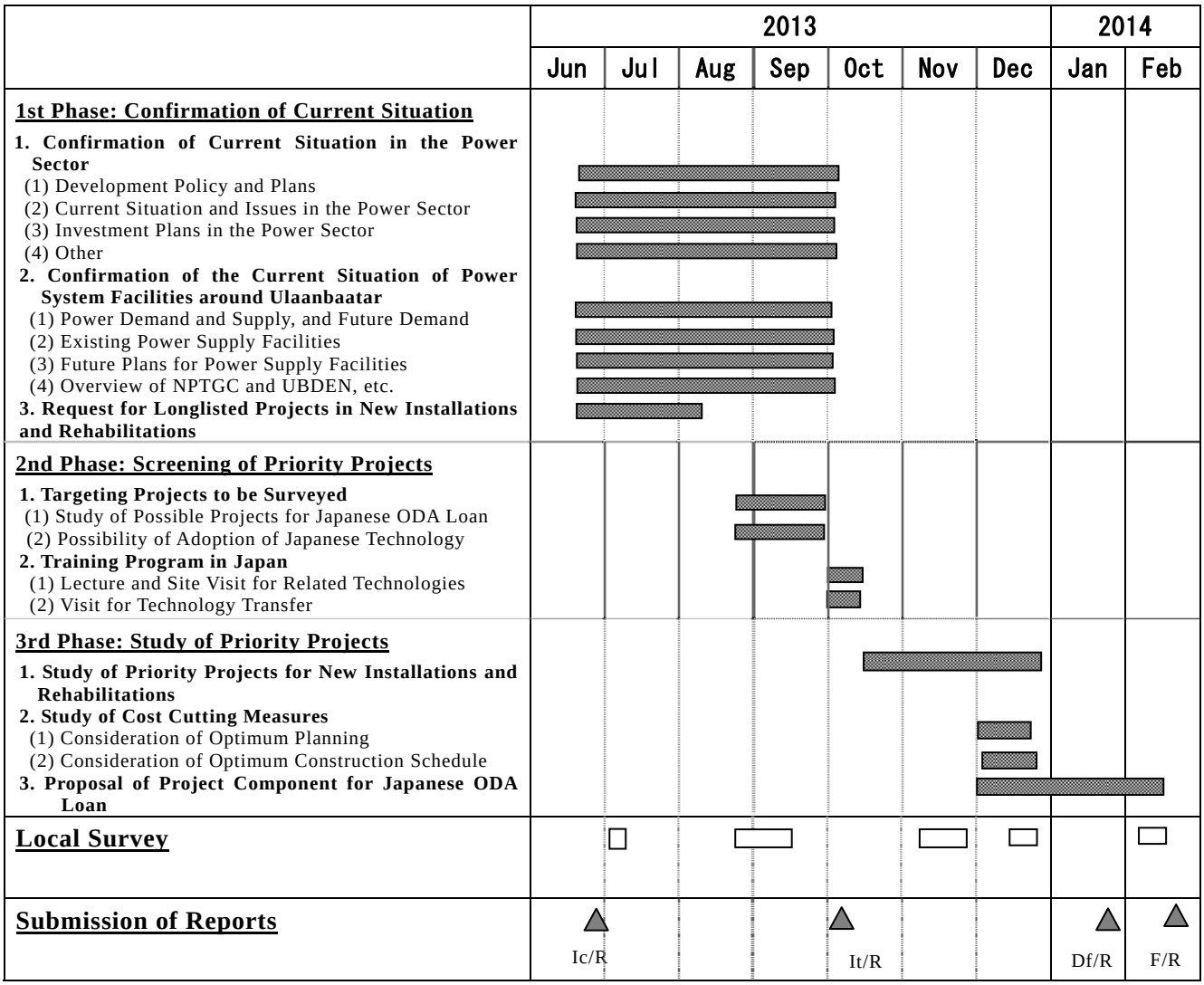


Figure 1-1 Flowchart of the Survey

1.4 Schedule of the Survey

The survey schedule is shown below.

Table 1-1 Schedule of the Survey



Ic/R: Inception Report
It/R: Interim Report
Df/R: Draft Final Report
F/R: Final Report

1.5 Implementation Formation of the Survey

The Survey targets transmission and distribution fields. To enable efficient discussion with the appropriate counterparts, technical committees for transmission and distribution are respectively established, and a steering committee, which includes all the stakeholders, is also established for coordination among the stakeholders. The steering committee is headed by the Ministry of Energy (hereinafter MOE).

The implementation formation is shown below.

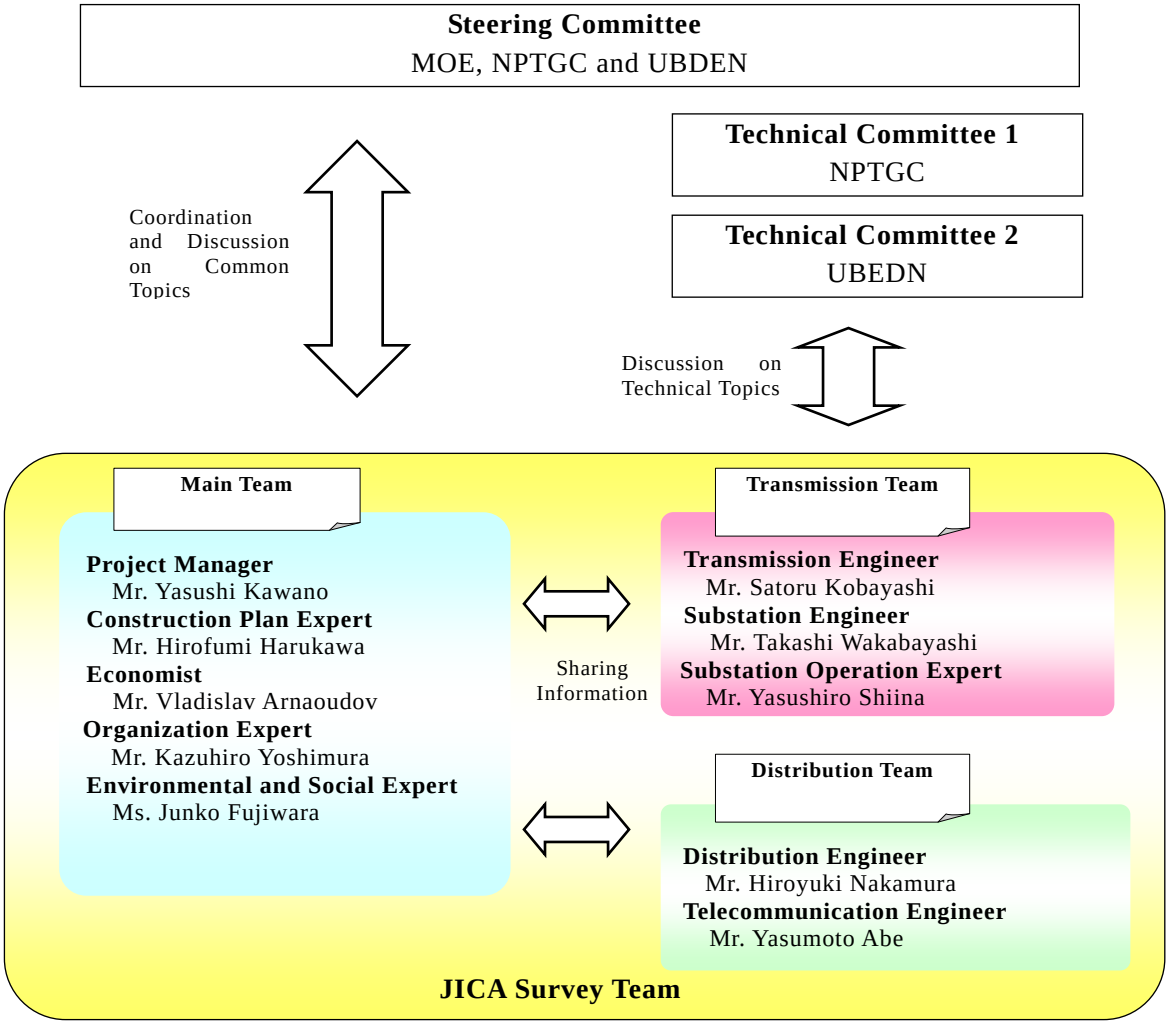


Figure 1-2 Implementation Formation of the Survey

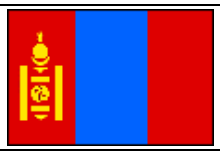
Chapter 2 General Information of Mongolia

2.1 General Information of the Country

2.1.1 General Information

General information is shown below.

Table 2-1 General Information

Nationality	Mongolia
Flag	
Year of Independence	1924
Area	1,564,000 km^2 (4 times the size of Japan)
Population	2,868,000 (2012, National Statistical Committee)
Capital	UlaanBaatar (Population: 1,318,100) (2012, NSC)
Ethnicity	Mongolian (95%), Kazakhs and others
Language	Mongolian, Kazakh
Religion	Tibetan Buddhism
Regime	Republic
Currency	Tugrik (MNT)
Exchange rate	1U.S.$=1,359.40 Tugrik (2012 full year average, NSC)

(Source: Ministry of Foreign Affairs, etc.)

2.1.2 Geography

Mongolia is located in the northwest area of East Asia, not only bordered by Russia in the northwestern area and northern areas but also bordered by China along the southwest stretching to the northeast. The land area is about 1,564,100 square kilometers, which is about four times that of Japan. Desert and steppe cover four-fifths of the country and the rest is mountainous terrain. As for geographical features, there are the Altai (about 4,300m) and the Khangai (about 3,905m) mountains in the west, followed by plateaus which spread easterly and the Gobi Desert in the southeast. There are rivers and inland lakes which pour into the Amur River and Lake Baikal in the northwest.

Ulaanbaatar, the capital of the country, is located 55 minutes north latitude 47 degrees, 55 minutes east longitude 106 degrees.

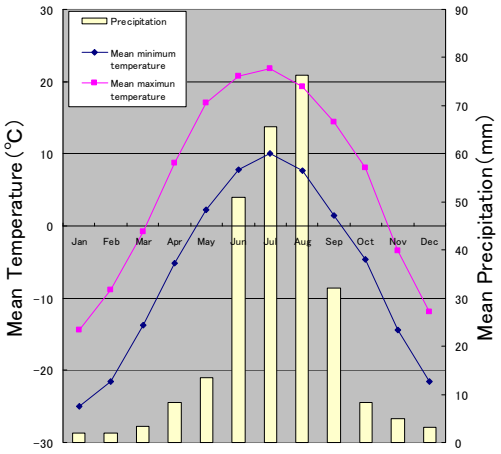
(Source: CENTRAL INTELLIGENVE AGENCY, World Fact Book)

Figure 2-1 Country of Mongolia

2.1.3 Climate

Mongolia has an inland climate with large temperature differences and is very dry. The temperature is low throughout the year (Minimum temperature in January is below minus 40 degrees). There are large temperature differences between day and night in the summer and winter season (Minimum average temperature in May is 2.3 degrees and the highest average temperature is 17.1 degrees).

In addition to its dry climate, precipitation is low in Ulaanbaatar. Its annual rainfall is 270mm which is about one fifth that of Tokyo. Moreover, 83 % of the annual rainfall is concentrated between June and



(Source: World Weather Information Service)

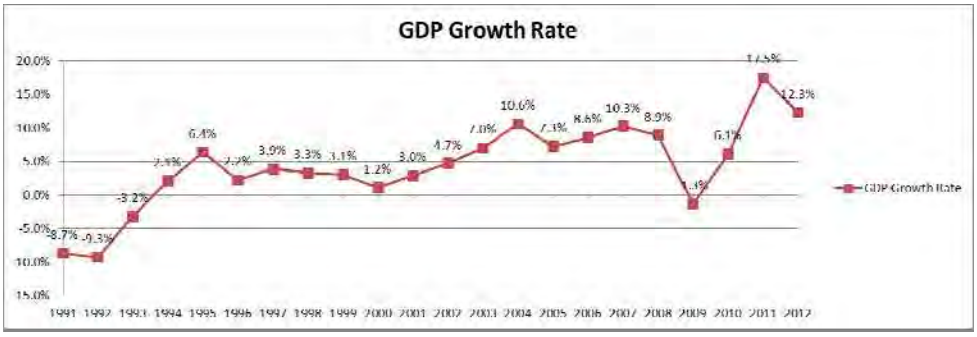
Figure 2-2 Precipitation and Temperature in Ulaanbaatar

September.

2.2 Mongolian Economy

2.2.1 Overall Economic Conditions

The Mongolian economy has been experiencing a period of two-digit economic growth in the past two years (2011: 17.5 %, 2012: 12.3 %) and is one of the fastest growing economies in the world. The GDP of the country has been growing steadily reaching 13,944,238.1 million MNT (app. 836 billion JPY) in 2012, mainly due to the strong mining sector. According to the World Bank data, Mongolia ranks 130th in the world in terms of nominal GDP (10,271 million USD). Due to the fast economic growth the per capita GDP more than doubled from 1,435 USD/capita (2007) to 3,335 USD/capita (2012).



(Source: Mongolian Statistical Yearbook 2012)

Figure 2-3 GDP Growth Rate

Although the Mongolian economy is projected to continue its growth at two digit levels, there are major issues that it is currently facing, including unreliable infrastructure and strong exposure to external economic shocks.

Mongolia started industrialization in the post-World War II period with vast financial and technical support from the neighboring Soviet Union. This resulted in the development of four industrial centers – the capital Ulaanbaatar, as well as Darkhan (steel manufacturing), Erdenet (copper ore mining) and Choibalsan (light industry), all three located close to the USSR border. After the collapse of the COMECON system in 1990, Mongolia could not sufficiently maintain the existing infrastructure and industrial facilities, which also negatively affected the economic and industrial development of the country in the last decade of the past century. Support from international donors in the following twenty years was vital to the maintenance and rehabilitation of some of the existing infrastructure, and construction of new facilities; however, insufficient infrastructure remains one of the main impediments to stable economic growth up to the present.

2.2.2 Economic Data

(1) Gross Domestic Product (GDP)

The Mongolian economy is characterized by its dependence on the international commodity prices, as more than 30% of the GDP results from mineral resources extraction and production of cashmere. A recent example of such economic vulnerability is the financial crisis of 2008 when the economic growth was reduced from 8.9% in 2008 to -1.3% in 2009. The Mongolian economy managed to recover successfully after that, mainly as a result of the high demand for mineral resources and the issuance of bonds in the international debt markets, yet this has not been able to solve the fundamental structural issues.

GDP growth and composition data are presented in the tables below.

Table 2-2 Mongolian GDP

Item	2007	2008	2009	2010	2011	2012
GDP, million MNT	**4,956,647.2**	**6,555,569.4**	**6,590,637.1**	**8,414,504.6**	**11,087,723.8**	**13,944,238.1**
GDP per capita, th. MNT	1,895.5	2,465.1	2,432.3	3,072.5	3,979.3	4,910.4
GDP per capita, USD	1,435.7	1,837.1	1,817.0	2,065.0	2,562.0	3,335.0

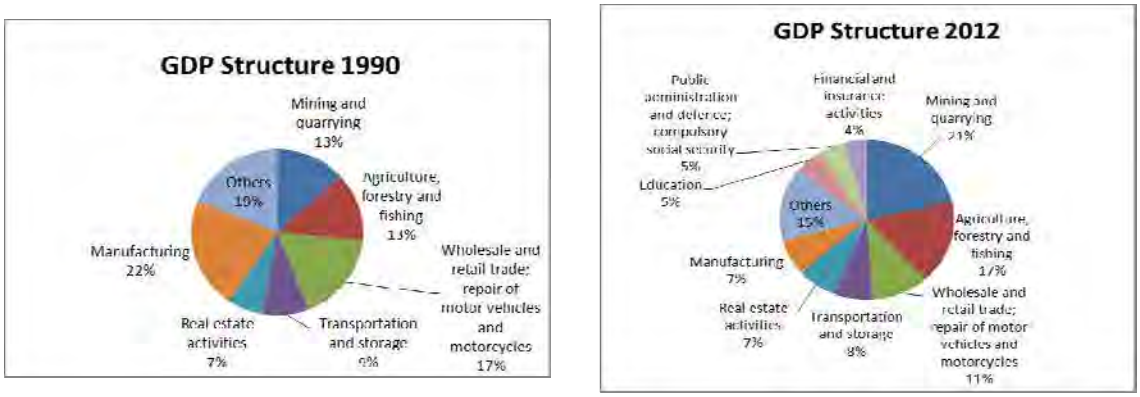
(Source: Mongolian Statistics Yearbook 2010, 2012)

Table 2-3 Composition of Mongolian GDP (million MNT)

Division	2007	2008	2009	2010	2011	2012
Mining and quarrying	1,340,854.4	1,324,247.7	1,285,899.7	1,913,040.1	2,329,330.6	2,600,202.9
Agriculture, forestry and fishing	913,409.2	1,259,660.8	1,177,380.3	1,202,155.6	1,365,115.0	2,066,952.9
Wholesale and retail trade; repair of motor vehicles and motorcycles	313,204.4	472,226.5	432,646.2	696,502.6	1,020,944.4	1,298,687.7
Transportation and storage	322,307.0	419,323.2	546,745.5	645,747.5	785,475.4	905,268.4
Real estate activities	186,823.5	345,984.2	479,635.3	554,498.9	768,719.9	880,848.0
Manufacturing	309,500.4	430,179.4	425,000.6	539,836.0	665,537.0	869,764.7
Others	1,103,272.4	1,547,334.3	1,451,221.0	2,255,234.2	2,963,740.6	1,818,939.3
Education	170,563.4	272,562.3	312,138.4	336,646.3	441,036.0	655,441.4
Public administration and defence; compulsory social security	141,514.3	247,723.6	267,246.3	303,036.1	366,762.8	593,715.3
Financial and insurance activities	155,198.1	236,327.4	212,724.0	239,607.2	381,098.0	502,630.4
Information and communication	166,189.0	221,339.0	215,504.0	245,884.3	295,315.0	369,089.5
Human health and social work activities	72,616.0	119,817.4	123,042.0	143,194.3	181,390.4	292,737.8
Electricity, gas, steam and air conditioning supply	97,309.1	119,968.0	157,422.9	190,211.6	211,955.5	239,747.4
Construction	106,421.1	122,051.0	86,238.7	107,201.6	173,272.4	226,110.7
Administrative and support service activities	51,218.0	98,499.8	88,804.4	88,090.4	128,534.2	163,769.5
Accommodation and food service activities	28,806.4	38,971.4	43,680.8	47,522.9	93,348.5	144,392.1
Professional, scientific and technical activities	36,068.4	76,694.6	65,655.8	69,976.0	101,074.3	127,745.0
Arts, entertainment and recreation	12,980.0	23,211.4	27,876.2	31,064.1	37,609.2	53,279.1
Other service activities	23,503.6	27,950.0	24,871.5	26,473.7	38,798.6	48,756.5
Water supply; sewerage, waste management and remediation activities	16,294.7	26,015.0	26,356.8	302,000.2	39,346.3	45,144.8

(Source: Mongolian Statistics Yearbook 2010, 2012)

Currently, mining and agriculture occupy the largest share of GDP. However, the structure of the GDP has changed dramatically over the past twenty years. While manufacturing has shrunk from 22 % (1990) to 7 % (2012), mainly due the loss of COMECON markets and lack of competitiveness, in 2012 the share of mining increased 1.6 times to 21 % and the share of agriculture increased 1.3 times to 17 %. The figure below shows a comparison in the GDP structure in the years 1990 and 2012.



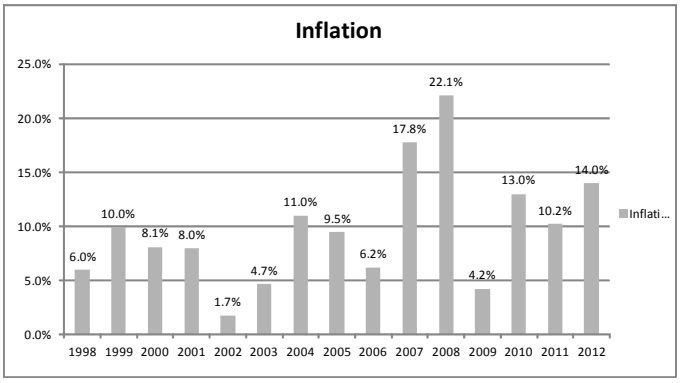
(Source: Mongolian Statistics Yearbook 2012)

Figure 2-4 GDP Structure

(2) Inflation

Although the changing of the GDP structure contributed to high economic growth, as explained above, it left Mongolia vulnerable to external economic shocks. The economic slowdown after the bankruptcy of Lehman Brothers Holdings Inc. is one example; however, the most recent slump in 2012 is also explained by the decreased demand for coking coal in China and the slowdown in Chinese economy, the main trading partner of Mongolia.

High economic growth is usually accompanied by rising prices and Mongolia is not an exception. Inflation peaked in 2008 at 21.1% during the onset of the global financial crisis. Although it has fallen since, the continuing economic growth contributed to its increase to 14% in 2012. There is little sign that the government plans to put inflation under control with any concrete policies, which might remain a mid- to long-term development issue.



(Source: Mongolian Statistical Yearbook 2012)

Figure 2-5 Inflation Rate in Mongolia

(3) Coal Prices

Coal prices in Mongolia, especially for power and heat generation are controlled by the Ministry of Energy. Coal prices directly influence electricity prices, thus influencing the entire economy of the country and inflation. Coal is domestically mined and predominantly lignite. The coal prices of the major mines are shown below.

Table 2-4 Coal Prices in Mongolia (MNT/ton)

MNT/tonne

Mine\Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Baganuuur	8,050	9,000	9,250	9,250	10,730	11,500	11,500	12,500	16,200	16,200	18,200	20,500
Sharyn gol	8,500	9,500	10,000	10,000	12,000	13,600	13,600	16,600	21,400	21,400	26,275	26,275
Shivee-Ovoo	5,500	5,800	5,800	5,800	7,200	7,500	7,500	8,500	11,400	13,960	13,960	15,560
Tavan Tolgoy	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000
Aduunchuluun	3,200	3,200	3,200	3,750	3,750	4,808	5,100	6,100	7,500	7,500	8,584	9,600

(Source: Energy Statistics of Mongolia 2011)

(4) National Currency

Compared to 2006, the national currency, Mongolian Togrog (MNT), has lost almost 15% against the USD and almost 70 % against the JPY. The table below shows the fluctuation of the MNT against the currencies of its major trading partners.

Table 2-5 MNT Exchange Rate against Major Currencies (MNT)

Currency	2006	2007	2008	2009	2010	2011	2012
USD	1,179.55	1,169.85	1,166.06	1,437.91	1,355.93	1,265.46	1,359.40
EUR	1,481.44	1,595.90	1,715.00	2,004.85	1,801.41	1,761.27	1,748.62
RUB	43.40	45.62	47.05	45.48	44.71	43.08	43.81
CNY	147.94	153.35	167.82	210.49	200.25	195.91	215.50
KRW	1.24	1.26	1.08	1.13	1.17	1.14	1.21
JPY	10.15	9.94	11.32	15.39	15.46	15.90	17.06
GBP	2,172.69	2,336.01	2,159.94	2,249.67	2,096.18	2,028.51	2,155.55

(Source: Mongolian Statistical Yearbook 2010, 2012)

(5) Trade

The structure of Mongolian imports and exports per country is shown in the table below. The major import commodities are vehicles, steel products, machinery and energy (fuel and electricity). The major export commodities are mainly mineral products (coking coal, copper, molybdenum, etc.).

Table 2-6 Imports and Exports of Mongolia by Country

IMPORT

mln.USD

By countries	2007	2008	2009	2010
Total	**2,061.80**	**3,244.50**	**2,137.67**	**3,200.05**
of which:				
Australia	18.60	17.70	15.25	38.62
Austria	5.40	6.30	9.10	3.57
USA	55.70	84.10	103.74	158.92
Belarus	7.40	8.90	11.43	15.21
Belgium	7.10	15.30	5.43	13.32
South Korea	119.60	194.80	155.10	181.78
China	568.90	898.70	538.58	970.98
Bulgaria	2.90	3.80	2.74	2.93
Vietnam	6.30	9.60	7.71	12.36
Denmark	2.80	4.00	2.20	4.56
Israel	5.90	3.80	2.71	2.16
Indonesia	3.90	6.80	5.05	6.38
Spain	8.40	9.50	2.70	5.96
Italy	9.80	14.80	16.46	23.09
United Kingdom	13.80	17.40	12.49	19.96
Kazakhstan	30.20	25.60	16.78	8.34
Canada	10.60	10.80	7.49	22.31
Kyrgyzstan	1.80	1.50	1.80	1.90
Malaysia	19.80	26.10	19.34	31.31
Netherlands	5.50	11.50	7.61	12.92
Russian Federation	745.00	1,242.30	772.82	1,046.70
Poland	24.30	32.60	17.47	29.37
Singapore	29.30	45.60	27.74	51.04
Taiwan	3.70	7.20	3.77	5.24
Thailand	6.60	16.90	15.89	18.35
Turkey	5.30	12.50	5.92	9.65
Ukraine	35.00	49.10	41.82	41.63
Hungary	3.90	5.50	3.13	4.53
Finland	7.50	6.70	3.60	12.96
France	24.00	33.70	59.43	52.77
Germany	76.50	92.60	70.29	87.24
Czech Republic	6.30	13.80	7.98	8.13
Sweden	7.50	11.60	19.22	16.73
Switzerland	1.10	3.00	3.11	4.21
India	8.40	18.90	11.54	16.81
Japan	140.20	238.50	97.00	196.49
Other	32.80	43.00	33.23	61.63

EXPORT

mln.USD

By countries	2007	2008	2009	2010
Total	**1,947.50**	**2,534.50**	**1,885.39**	**2,908.50**
of which:				
Australia	1.20	0.80	0.81	0.26
USA	99.90	114.20	13.89	6.02
United Arab Emirates	2.30	3.30	0.37	0.51
Belgium	0.50	0.50	0.19	0.51
South Korea	41.50	29.90	15.46	30.52
China	1,411.40	1,635.90	1,393.91	2,466.27
Italy	56.70	42.20	31.40	31.78
United Kingdom	22.10	165.80	126.89	67.39
Kazakhstan	0.80	1.20	3.22	1.51
Canada	178.60	174.60	147.48	141.62
Luxembourg	3.70	162.00	46.16	0.00
Mexico	0.10	0.00	0.04	2.25
Netherlands	7.20	6.00	0.21	0.25
Russian Federation	58.50	86.30	68.20	82.75
Poland	0.10	0.10	0.05	0.44
Singapore	0.40	0.40	0.66	2.47
Turkey	0.00	0.00	0.01	0.21
Uzbekstan	0.20	0.10	0.12	0.35
Ukraine	6.60	5.30	2.11	2.55
France	5.40	30.30	2.23	3.91
Germany	17.80	11.00	15.58	22.05
Czech Republic	0.10	3.10	0.12	0.16
Sweden	0.10	0.50	0.16	0.15
Switzerland	1.80	2.10	2.82	2.91
India	2.20	0.90	1.02	0.68
Japan	15.10	27.60	4.56	2.67
Other	13.20	30.40	7.72	38.32

(Source: Mongolian Statistical Yearbook 2010)

(6) Balance of Payments

The table below shows the changes in the balance of trade of Mongolia. After the start of the global financial crisis in 2008, the Balance of Payments went into deficit, but recovered in the following years. Although the current account deficit is increasing, this is compensated for by current and financial account surplus, mainly due to the growing inflow of direct and portfolio investments.

Table 2-7 Balance of Payments (million USD)

Indicators	2007	2008	2009	2010	2011	2012
I. Current account (A+B+C)	**171.78**	**-690.11**	**-341.80**	**-886.70**	**-2,758.60**	**-3,215.30**
A. Goods and services (a+b)	**57.02**	**-738.05**	**-332.01**	**-474.90**	**-2,153.40**	**-2,776.40**
a. Goods (1+2+3)	-52.39	-627.22	-188.78	-277.91	-992.90	-1,528.70
1. General merchandise (1.1-1.2)	-287.29	-1,213.25	-471.77	-428.13	-1,081.50	-1,651.70
1.1 Exports FOB	1,715.81	1,908.69	1,572.39	2,720.25	4,706.60	4,259.70
Of which: Copper concentrate	811.50	835.67	501.85	770.59	968.00	768.60
1.2 Imports FOB	2,003.10	3,121.94	2,044.17	3,148.38	5,788.20	5,911.40
Of which: Petroleum products		888.95	523.64	676.15	1,136.60	1,225.80
Food products		409.90	193.36	336.20	365.10	376.00
2. Non-monetary gold	234.90	599.88	308.47	178.32	109.80	121.70
3. Other	0.00	-13.85	-25.48	-28.10	-21.20	1.30
b. Services	109.42	-110.83	-143.23	-279.03	-1,160.50	-1,247.60
B. Net income	**-97.54**	**-172.80**	**-195.45**	**-598.80**	**-843.40**	**-678.00**
C. Current transfers (a+b+c)	**212.30**	**220.74**	**185.66**	**187.00**	**238.20**	**239.10**
a. General government /net/	108.20	32.51	59.52	49.42	17.70	29.20
b. Worker's remittances (1-2)	83.90	68.91	120.12	101.80	58.50	42.60
1. Credit	174.30	218.21	191.50	226.93	249.30	282.60
2. Debit	90.30	149.30	71.38	125.08	190.80	240.00
c. Other transfers /net/	20.10	119.32	6.01	34.67	162.00	167.30
II. Capital and financial account (A+B)	**328.70**	**1,232.13**	**768.83**	**1,743.70**	**2,864.20**	**4,793.80**
A. Capital account**		**84.06**	**160.50**	**152.20**	**113.90**	**120.40**
B. Financial account (a+b+c)	**328.70**	**1,148.07**	**608.33**	**1,591.50**	**2,750.30**	**4,673.40**
a. Direct investment /net/	360.00	838.46	569.80	1,573.65	4,620.10	3,835.10
b. Portfolio investment	74.90	-36.01	-82.10	878.65	77.00	2,335.20
1. Assets	-1.20	-51.21	-138.81	120.20	20.90	-26.00
2. Liabilities	76.10	15.20	56.71	758.45	56.00	2,361.20
c. Other investment (1+2+3+4)	-106.20	345.63	120.63	-477.97	-1,946.80	-1,497.00
1. Trade credits /net/	-13.20	0.00	14.42	53.02	-406.00	-72.20
2. Loans /net/ (2.1+2.2)	44.90	231.30	235.86	93.45	468.70	489.90
2.1 Long-term	75.50	225.79	201.99	167.35	320.50	433.60
2.2 Short-term	-30.60	5.51	33.87	-73.90	148.10	56.40
3. Currency and deposits /net/	-109.50	114.63	-205.77	-624.44	-2,011.60	-1,914.70
4. Other net assets	-28.40	-0.30	76.12	0.00	2.20	0.00
III. Net Errors and Omissions	**-212.50**	**-774.65**	**128.48**	**16.10**	**-77.80**	**-209.50**
IV. Overall Balance of Payments (I+II+III)	**287.98**	**-232.63**	**555.51**	**873.10**	**27.80**	**1,369.00**
V. Reserves and Related items	**-288.00**	**232.63**	**-555.53**	**-873.10**	**-27.80**	**-1,369.00**

(Source: Mongolian Statistical Yearbook 2010, 2012)

2.2.3 Economic Outlook

According to a World Bank report from April 2013, Mongolian GDP will grow by approximately 13 % in 2013 compared with a previous forecast of 16.2% made in 2012. Although Mongolia is expected to keep a two digit growth at least until 2015, the growing government spending and fiscal deficit leaves high uncertainty over the long term economic prospects of the country.

2.3 Social Circumstances

2.3.1 Overall Social Conditions

Mongolia spans a vast territory of 1,564 km2 making it the 19th largest country in the world. The population is 2.876 million people (2012). Approximately 48.5% of the population is male and 51.5% are female.

Mongolians are a traditionally nomadic society with more than half of the population leading a nomadic lifestyle until the middle of the 20th century. With the start of industrialization, the influx of rural population into the major industrial centers started. The trend became even stronger in the 1990s and as of 2012, approximately 67 % of the population lives in urban areas, predominantly Ulaanbaatar (46 %).

The inflow of rural population into urban areas poses significant social problems, including insufficient housing. Thus, in many cities, *ger* tent areas are formed where residents occupy a plot of land on which they set up their *ger* tents and build some auxiliary buildings. However, these *ger* tent areas have access to electricity, but no running water or heating, thus creating health and environmental problems.

2.3.2 Social Data

(1) Population Growth

Population growth by area and sex is presented below. As shown in the table below, the population of Mongolia increased by 8.8 % in the period 2006 – 2012, while the rural population kept decreasing. In the same period, the population of Ulaanbaatar increased by 20%, a clear sign of the increasing population concentration in the capital.

Table 2-8 Population Growth by Area and Sex (th. people)

Indicator	2007	2008	2009	2010	2011	2012
Resident population, by sex						
Total	**2 635.2**	**2 683.5**	**2 716.3**	**2 761.0**	**2 811.6**	**2 867.7**
Of which:						
Male	1 284.4	1 309.9	1 328.1	1 367.0	1 364.7	1 393.5
Female	1 350.8	1 373.6	1 388.1	1 394.0	1 446.9	1 474.3
Urban and rural population						
Urban	1 601.0	1 659.2	1 772.9	1 910.8	1 896.2	1 926.6
Of which:						
Ulaanbaatar	1 031.2	1 071.7	1 196.8	1 244.5	1 287.1	1 318.1
Rural	1 034.2	1 024.3	943.4	850.2	915.4	941.1

(Source: Mongolian Statistical Yearbook 2010, 2012)

According to projections by the World Bank, the population of Mongolia will reach 3,818 million people by 2014, an increase of 1.3 times compared to the 2012 level. The ADB additionally projects that the trend of population concentration in the urban and industrial areas will continue.

Table 2-9 Population Growth Projections (th. people)

Year	2015	2020	2025	2030	2035	2040
Population (th. people)	2,974	3,184	3,369	3,525	3,670	3,818

(Source: World Bank)

(2) Number of Households

In 2012, the number of households increased in urban areas by 19 % compared to 2007, while in the same period the increase in Ulaanbaatar was 35%.

Table 2-10 Number of Households

th. people

Aimags and Capital	2007	2008	2009	2010	2011	2012
TOTAL	**645.7**	**677.8**	**716.5**	**742.3**	**759.9**	**768.3**
Ulaanbaatar	**234.7**	**251.8**	**273.2**	**294.4**	**306.8**	**317.1**

(Source: Mongolian Statistical Yearbook 2010, 2012)

(3) Average Salary

In 2012, the average salary in the country was 557,600 MNT, as shown in the table below. In Ulaanbaatar, the average salary for the same year stayed at approximately 950,000 MNT, almost double the country average, making Ulaanbaatar one of the most attractive places for employment

in Mongolia.

Table 2-11 Average Monthly Salary

Year	2009	2010	2011	2012
Salary (th. MNT)	300.5	341.5	424.2	557.6

(Source: Mongolian Statistical Yearbook 2012)

(4) Unemployment Rate

The unemployment rate in Mongolia stayed below 10% for three consecutive years until 2012, when, due to the economic slowdown from the previous year, it increased again.

Table 2-12 Unemployment Rate

	2009	2010	2011	2012
TOTAL (%)	11.6	9.9	7.7	8.2
Ulaanbaatar (%)	14	8.7	5.6	7.1

(Source: Mongolian Statistical Yearbook 2012)

2.4 National Development Policy

2.4.1 National Development Plan

The Millennium Development Goals (MDGs)-based Comprehensive National Development Strategy of Mongolia (hereafter, NDS) was adopted by the Government in January 2008.

The NDS is based on the following principles:

- Ensure democracy, justice, human rights, freedom, equality, and national unity,
- Create conditions for each citizen's participation, contribution and leading role in the country's development,
- Build capacity and structure for the implementation of development policies and strategies,
- Ensure rapid and sustainable development based on market economy;
- Allocate funds in accordance with priorities and needs of a sector, monitor spending and ensure its efficiency,
- Develop adaptability to the changing environment,
- Promote accountability at all levels, ensure transparency and respect for law.

For the energy sector, the strategy sets the following goals:

Phase One (2007-2015)

Strategic objective 1: Establish an "Integrated Energy System of Mongolia," increase the profitability of the energy sector and create the most favorable conditions for its development. Build capacity to export energy abroad.

- Define the policy of supplying electricity to the Gobi region and provide mining plants to be built in the near future at Oyu Tolgoi, Tavan Tolgoi and Tsagaan Suvarga mining deposits with sources of energy supply.
- Connect power systems of Eastern and Western regions with the central power system.
- Enhance energy security, establish infrastructure links with two neighboring countries, and resolve the issue of exports and imports based on patterns of consumption.
- Build and use new sources of electric and thermal power in Ulaanbaatar City.
- Complete the "Integrated Energy System" Program and fully provide for the country's domestic energy needs.
- Build hydroelectric power plants on big rivers.
- Join regional energy integration initiatives, start exporting energy.
- Implement a step-by-step policy of utilizing nuclear energy, including working towards building a nuclear power plant. To this end, create legal framework allowing state ownership of uranium deposits and pursue a policy of cooperation with well-established state-owned foreign companies.
- Create a modern system of regulating energy flows.

Strategic Objective 2: Improve electric power supply to *soums*, settlements and herder households:

- Apart from connecting *soums* and settlements, which are not linked to the integrated energy system to electricity transmission air lines, ensure steady supply of electricity to *soums* and settlements through using renewable and other energy sources.
- Within the framework of a "100, 000 Solar *Gers*" Program, provide all herder households with solar and wind energy sources.
- In *soums* and settlements located in the vicinity of coal deposits, build small electric power plants, which operate on coal gas fuel.

Phase Two (2016-2021): Strategic objective 1. Increase the efficiency of Mongolia's integrated energy system and create favorable conditions for its development:

- Increase the efficiency of regional energy systems
- Create a modern system to regulate energy flows

2.4.2 Power Development Plan

The Energy Sector Development Plan of Mongolia (hereafter, the master plan) has been prepared by the Asian Development Bank (ADB). The final report was completed in December 2013 and submitted to the Ministry of Energy of Mongolia. The draft final report of the master plan covers the following topics:

- Energy sector policy assessment
- Macroeconomic analyses
- Electricity load forecasts
- Heat forecasts
- Primary and secondary energy resources
- CES electricity expansion plan
- *Aimag* heat expansion plans
- Electricity transmission expansion
- Financial Analyses

The energy master plan projects that by 2025 the total electricity generation capacity in the Central Energy System will increase to 2,779 MW, mainly due to the construction of new Combined Heat and Power Plants (CHP) (750 MW), new coal fired Thermal Power Plants (TPP) (600 MW), Hydro Power Plants (HPP) (170 MW) and Wind Power Plants (WPP) (400 MW). This

will allow the Mongolian reliable reserve margin to increase to 570 MW (currently it is -119 MW). The total installed capacity in the country is expected to reach 3,075 MW – 3,741 MW in the same period.

The master plan also analyzed the options of expanding the transmission network, especially around the big industrial centers, including the options for connecting the EES and CES, as well as extending a transmission line to South Gobi. It further assessed the needs for expansion of the existing transmission facilities, as well as their rehabilitation. It projected that in the period 2013 – 2025, additional transmission capacity of 1,800 MVA is needed for Ulaanbaatar City and 700 MVA for the rest of the country. In the same period, annual investments of approximately 230 million USD will be required for upgrading the transmission and distribution networks in Mongolia, with almost 50 % of this amount to be used in Ulaanbaatar City.

The master plan is intended as a guideline for policy makers in the Mongolian Government in selecting among various policy options.

Chapter 3 Power Sector Information

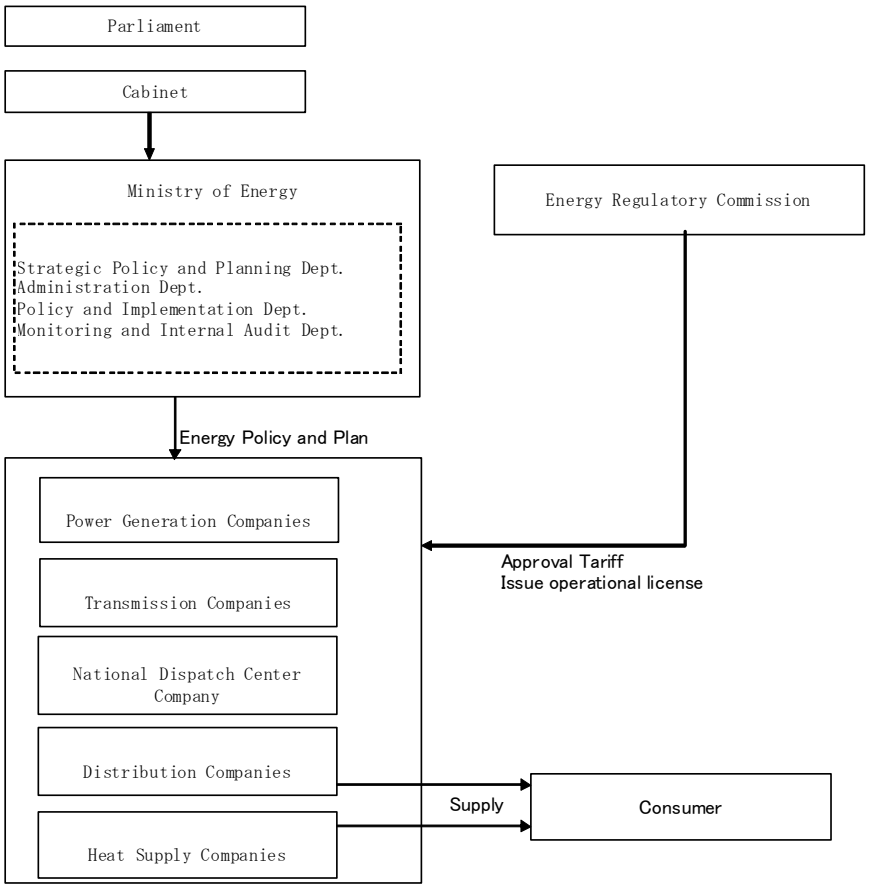
3.1 Implementation of Power Sector

3.1.1 Implementation Structure of Electricity Business

The Ministry of Energy (MOE) consists of 5 departments and they are responsible for the planning of energy policies for the power, master plans, and procurement of energy business by the national budgets. Important policies and budget procurement require approval by the Parliament and Cabinet.

Under the energy legislation of 2001, issuance of business licenses and authorization of electricity prices are implemented by the Energy Regulatory Commission (ERC).

From combined heat and power plants that generate both electricity and heat, transmission companies purchase electricity and wholesale to distribution companies. Distribution companies then sell electricity to general retail customers.



(Source: MOE Website, etc.)

Figure 3-1 Implementation Structure of Electricity Business

3.1.2 Role of Each Entity

(1) Ministry of Energy (MOE)

The MOE has decided basic energy policies and plans for the energy part. Moreover, the MOE performs procurement management and decide priority for individual projects.

(2) Energy Regulatory Commission (ERC)

The ERC issues the operational licenses and approve the tariffs to the generation, transmission, distribution, dispatching and supply of energy. .

(3) National Dispatch Center (NDC)

The National Dispatch Center is the organization that performs the power interchange and power generation command. The NDC is responsible for the provision of operation development standards. For adding or changing the provisions of the NDC, the following procedure is required.

- After creating a revised draft, the NDC must carry out consultation procedures with the distribution companies.
- Approval of MEGD (Ministry of Environment and Green Development) is required when necessary.

3.1.3 Other Related Entities

The section below provides a summary of the roles of the various entities to ODA project approval.

(1) Ministry of Environment and Green Development (MEGD)

The Ministry is responsible for the approval of Environmental Impact Assessments (hereafter, EIA) of investment projects. Under the existing environmental legislation, EIA is approved either under the environmental bureau of the relevant administrative unit, i.e. Ulaanbaatar City, or by MEGD. However, during the discussions of the survey team with the Property Relations Department of Ulaanbaatar City it was recommended that the projects targeted by this survey should apply with the MEGD. The department in charge at MEGD is the Division of Environmental Assessment and Auditing.

MEGD will be involved in another aspect of the project in the case of introduction of a Distribution Automated System. If such a system is introduced, changes will be required in the current regulations related to the emergency procedures in the case of accidents. The approval of such changes will be conducted by the Science and Technology Committee of MEGD.

(2) Ulaanbaatar City Administration

In the case of construction of underground substations or other major construction work on land managed by the city, application should be made by NPGTC or UNEDN to the Property Relations Department for transferring the land management rights. The approval process requires a few

weeks, as long as there is no reallocation of residents.

(3) Ministry of Economic Development (MED)

The Ministry of Economic Development is the entity that provides approval of new investment projects, including ODA projects..

(4) Administration of Land Affairs, Geodesy and Cartography (ALAGaC)

In 2003, the State Administration of Geodesy & Cartography (SAGC), Land Administration Authority (LAA) and Real Property Registration Authority (RPRA, since 2006 - State Registry of Titles) were merged into one organization. ALAGaC is under the Ministry of Construction and Urban Development and, based on the stipulations on the Land Law and other related laws, is in charge of land management and land use planning.

3.2 Energy Companies

Under the Energy Law of 2001, all energy companies in Mongolia must obtain licenses from the Energy Regulatory Commission. This section describes the existing licensing procedures.

3.2.1 Licensing

(1) Types of Licenses

Licensing procedures were introduced in Mongolia with the Law on Licensing initially adopted on February 1, 2001. It specified in article 15.8.2 that “production of and transmission of energy, carrying out operations on dispatch coordination, distribution, providing and selling” in the area of fuel and energy is subject to licensing. The Energy Law of Mongolia, which was adopted the same year and revised in 2007, set up the exact process for obtaining a license for different energy categories.

1. Electricity generation
2. Heat generation
3. Electricity Transmission
4. Heat transmission
5. Dispatching
6. Electricity distribution
7. Heat distribution
8. Regulated supply of energy
9. Unregulated supply of energy
10. Importation and exportation of electricity
11. Construction of energy facilities

Figure 3-2 Types of Licenses

One entity can have licenses for multiple activities. Article 13 of the law sets up the procedures for electricity and heat generation, Article 14 – for electricity and heat transmission, Article 16 – for distribution of electricity and heat, and Article 20 – for construction of energy facilities.

Rights	Obligations
● Transmission of electricity ● Use of electricity transmission network	● Reliable transmission of generated electricity ● Reliable transmission of electricity to distribution companies and end users connected to the transmission network ● Operation, management and expansion of the transmission network ● Provision of fair conditions for access and connection to the transmission network

Figure 3-3 Power Transmission License (Based on Article 14 of the Energy Law)

Rights	Obligations
● Distribution of electricity within a defined area	● Distribution of electricity to end users within a defined area ● Establishment of rules for connection to the distribution network ● Supply and installation of electric meters at end users' location ● Reliable supply of electricity ● Operation, management and expansion of the distribution network ● Purchase of electricity from generators connected to the distribution network ● Provision of fair conditions for connection to the distribution network

Figure 3-4 Power Distribution License (Based on Article 16 of the Energy Law)

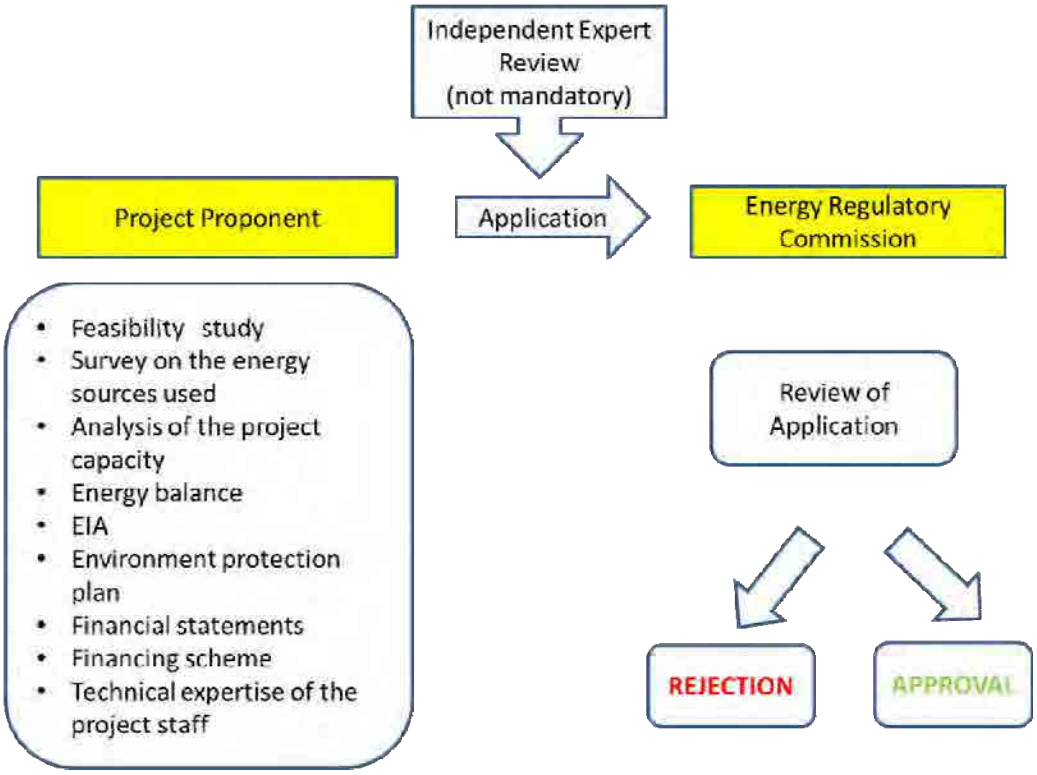
Licenses for construction of energy facilities are issued to legal entities fulfilling the following conditions:

- Financially stable entities interested in the construction of energy facilities
- Receipt of all necessary approvals
- Approval of EIA

Figure 3-5 Licenses for Construction of Energy Facilities (Based on Article 20 of the Energy Law)

(2) Licensing Process

The licensing process is described in article 21 of the Energy Law and summarized in the figure below.



(Source: Prepared by JICA Survey Team)

Figure 3-6 Licensing Process

Licenses are issued either by the ERC or the Regional Regulatory Boards and the Regulatory Board of Ulaanbaatar. The term of a license for energy generation and transmission is between 5 to 20 years; the term of a license for construction of energy facilities is up to 5 years; the terms of other licenses are up to 10 years. If the licensor considers that the licensee has been properly meeting the conditions and requirements of the license and that its normal operations can be

sustained further in terms of technical and technological requirements, the licensor shall extend the license for up to 20 years. An application for extension of the license shall be submitted no later than 180 days prior to the expiry of the term of the license.

Licenses can be revoked under the conditions described in article 25 of the Energy Law; however, interviews with the ERC confirmed that no licenses have been revoked up to the present. An important feature of the licensing procedure in Mongolia is that it focuses mainly on technical parameters.

3.2.2 Licensed Operators

An interview with the ERC confirmed that as of September 1, 2013 there are currently 168 companies that have obtained energy licenses. The list of the largest licensees is provided below. The companies targeted by this survey, NPTGC (VII) and UBEDC (XI) are also included. (The list is as of 2011.)

Table 3-1 List of the Largest Licensees

Rating	Licensees
I	Darkhan Thermal Power Plant State Owned Joint Stock Company
II	Thermal Power Plant # 4 State Owned Joint Stock Company
III	Thermal Power Plant #2 State Owned Joint Stock Company
IV	Darkhan - Selenge Electricity Distribution Network Company
V	Ulaanbaatar District Heating Network State Owned Joint Stock Company
VI	Baganuur & South-Eastern Regional Electricity Distribution Network State Owned Joint Stock Company
VII	Central Regional Electricity Transmission Grid State Owned Joint Stock Company
VIII	Darkah District Heating Network State Owned Joint Stock Company
IX	Erdenet-Bulgan Electricity Distribution Network State Owned Joint Stock Company
X	Eastern Energy System State Owned Joint Stock Company
XI	Ulaanbaatar Electricity Distribution Network State Owned Joint Stock Comnay
XII	Erdenet Thermal Power Plant State Owned Joint Stock Company
XIII	Baganuur Heating Plant State Owned Company
XIV	Thermal Power Plant #3 Stae Owned Joint Stock Company
XV	Altai Uliastai Energy System State Owned Joint Stock Company
XVI	Western Energy System State Owned Joint Stock Company
XVII	Nalaikh Heating Plant State Owned Joint Stock Company
XVII	Dalanzadgad Thermal Power Plant State Owned Joint Stock Company

(Source: Energy Regulatory Commission (Annual Report 2011))

3.3 Laws and Regulations Related to Electrical Power Industry

The most important law regulating the operation of the electrical power industry is the Energy Law. Other relevant laws include the Licensing Law and the Law of Mongolia on Renewable Energy, as well as various rules for electricity connection, tariff setting and others. The relevant laws and regulations are introduced below.

3.3.1 Energy Law

The Energy Law was initially adopted in February 2001 and amended in February 2007 and July 2009. The law is the fundamental document regulating the licensing procedure for the energy sector and sets up the prerogatives of the Government and Parliament of Mongolia, as explained in detail above. The energy policy is adopted by the Parliament and implemented by the Government.

3.3.2 Licensing Law

Based on the framework established by the Energy Law, the Licensing Law was adopted in 2001. The Licensing Law is the first law in Mongolia that introduces a licensing system for a wide range of activities. It stipulates that energy generation, transmission and distribution are subject to licensing; however, the exact requirements for licensing are detailed in the Energy Law.

3.3.3 Regulations on Electricity and Heat Consumption

The rules on electricity consumption are set up in Appendix 1 “Rules of Electricity Consumption” to Resolution No. 263/2001 of the Government of Mongolia. The rules specify the relations between customers of electricity and suppliers, including the procedure for connection of a particular supplier to the transmission and distribution networks.

Each new customer who wants to be connected to the transmission or distribution network should require technical conditions from the network supplier. The conditions should contain technical specifications of the connections, list of consumers connected, payment conditions, operation and safety requirements and others. The technical conditions are valid for a period of 1 to 3 years.

Based on the agreed technical conditions, the consumer and supplier enter into an Electricity Supply Contract. The contract regulates the electricity supply, capacity and other technical issues, as well as the electricity payment conditions and other obligations of the parties.

Finally, the rules specify the electricity measurement procedures, including requirements that each user should have an electric meter installed.

3.4 Legal Framework for Environmental Issues

Regime change in 2012 led the Mongolian government to reorganize its ministries and agencies. The Ministry of Nature, Environment and Tourism (MNET) was then separated into several bodies and the environmental divisions are now succeeded to the MEGD. It is the Division of Environmental Assessment and Auditing under MEGD which deals with environmental assessment and other related issues.

The Parliament of Mongolia also adopted a comprehensive revision of such environmental laws and standards in May 2012 as water quality, ambient air, noise and soil, in order to reduce duplication and improve the quality of regulations, ensure responsible, environmentally-friendly

and sustainable development, and introduce international standards in environmental auditing.

Some ministries and agencies share key roles with MEGD in environmental administration: community health and labor condition is handled by the Ministry of Health and Ministry of Labor; the Ministry of Mining shares such issues as soil and underground resources, and; land related issues are governed by ALAGaC, the capital city and *aimags*.

Environmental laws and land related laws concerned with electric transmission and distribution network projects are shown in the following table.

Table 3-2 Environmental Laws related to Transmission and Distribution Projects

	Name	Established year	Latest amendment	Contents	Responsible ministries & agencies
Environment					
1	Law on Environmental Impact Assessment	1998	2012	・ Address environmental impact assessment ・ Sets out the methodology of this EIA. Address public consultation and disclosure associated with the environmental impact assessment process.	・ MEGD ・ Local governments (*aimags* and the capital city)
2	Law on Environmental Protection	1995	2012	・ Overview all environmental and natural resources laws in Mongolia. ・ Regulate the inter-relations between the State, citizens, economic entities and organizations.	・ MEGD
Ambient Air					
3	Law on Air	1995	2012	・ Specify primary pollutants and secondary contaminations ・ Regulate activities for air quality protection.	・ MEGD
Water Resources					
4	Law on Water	2004	2012	・ Protect water resources. ・ Refer water resources territory (surface, underground and mineral waters) ・ Establish water protection zones (protected, sanitary and community protection zones)	・ MEGD ・ Ministry of Health
Land Use					
5	The Constitution			・ All land, subsoil, natural resources and water are the property of the State. ・ The Constitution allows the State to grant ownership of land to Mongolian citizens but they may not transfer such land to foreign entities. Land may be leased to foreign entities.	・ Government of Mongolia
6	Law on Land	1995	2003	・ Classify various types of land (agriculture land, forest resources land, reserve land, etc) ・ Specifically provide land conservation requirements.	・ ALAGaC ・ Local governments (*aimags* and the capital city)
7	Law on Underground Resources	1988	1994 & 1995	・ Regulate the exploration and protection of underground resources for present and future generations, and has served as a basis for the creation of many other environmentally related laws. ・ State ownership of underground resources is described, along with its mandate on management, possession, and protection, as well as the rights and responsibilities of users, and other issues.	・ MEGD ・ Ministry of Mining ・ Local governments (*aimags* and the capital city)
Waste Management					
8	Law on Protection from Toxic Chemicals	1995	2012	・ Establish a framework with fixed regulatory functions. ・ Provide definitions for 'toxic chemicals' depending on the direction of impact	・ MEGD (for the regulation of activities) ・ Ministry of

				(humans, livestock, wild animals and the environment) ・ Provide categories to toxic chemicals (highly toxic, toxic and mildly toxic).	Health ・ Local government
9	Law on Household and Industrial Waste	2003	2012	・ Improve solid waste management and hazardous waste management	・ MEGD ・ Ministry of Health ・ Local governments (*aimags* and the capital city)
Community Health, Safety and Security					
10	Law on Labor	1999	N/A	・ Determine the general rights and duties of employers and employees who are parties to a labor relationship. ・ Define and provide guidance for terms of training, social insurance, compensation, hours of work and rest, dispute resolution etc.	・ Ministry of Labor
11	Law on Sanitation	1998		・ Ensure the rights of individuals to healthy and safe living and working conditions ・ Define the rights and duties of individuals and businesses. ・ Requires such activities as waste disposal, disposal of radioactive and toxic chemicals, construction of facilities for public use to be carried out in accordance with relevant regulations	・ Ministry of Health

Note: The above table indicates the laws relating to the projects to be surveyed.

3.4.1 Environmental Protection

(1) Law on Environmental Protection

The Environmental Protection Law is the umbrella law for all environmental and natural resources laws in Mongolia, i.e., land, soil, underground resources, mining resources, water including underground water. It also introduces a 'polluter pays' principle, and aims at regulation of the inter-relations between the State, citizens, economic entities and organizations in order to guarantee human rights to live in a health and safe environment, prevent adverse impacts on natural environment, secure funds for environmental protection, and promote the ecological sustainable economic development, proper use of natural wealth through scientifically-sound means and public participation.

(2) Law on Environmental Impact Assessment

A person proposing a new project or renovation/expansion of an existing project which will have an impact on the environment must inform and report on the implementation of Environmental Management Plan (EMP) to the local population, local government and other stakeholders within the deadline specified by the MEGD. The procedure of conducting an EIA in Mongolia has been amended as of May 2012 as follows:

- SCREENING (general EIA)

  A project proponent is responsible for submitting to MEGD, or relevant departments of

aimags or the capital city if the project scale is not large[1], all the required documents including a technical and economic feasibility study, drawings, environmental baseline data and indices of the project location, opinion letters from heads of sub-district (*bag* or *khoroo*) or district (*soum* or *duureg*), and other related documents for screening.

After their applications appraised within 14 working days[2], the project proponent will be informed if

i) it is necessary to reverse the project which does not meet the requirements of the relevant legislations, the techniques and technology of which are harmful for the nature and environment, or which is not stated in the organizational plan;

ii) it is possible to implement the project with certain conditions[3] (without implementing a Detailed EIA), and;

iii) it is necessary to implement a Detailed EIA.

- Implementation of Detailed EIA

  A Detailed EIA is conducted by an economic entity[4] with budget borne by the project proponent[5]. The project proponent is responsible, prior to the implementation of the Detailed EIA, for getting a permit from the land owners to use the land for the project.

- Submission of Detailed EIA Report

  The economic entity develops a Detailed EIA report and distributes copies to the project proponent, MEGD, and the local government, and they keep one copy with them. Environmental viability of the project will be then assessed based on the results of the Detailed EIA.

[1] At what level screening will be conducted depends on the project scale: transmission lines with voltages up to 35kV, for instance, will be handled by the local government, whereas it will be the Ministry of Energy who deals with ones with voltage of 35kV and higher.

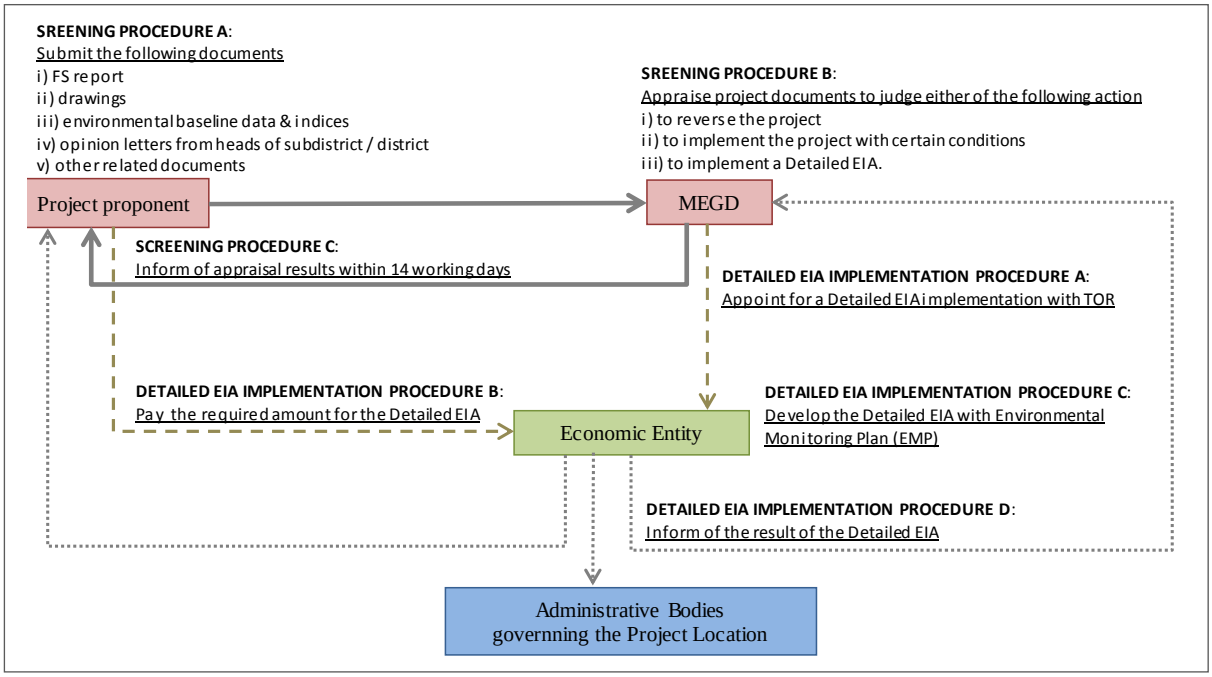
[2] Another 14 working days will be given if it requires more time for appraisal.

[3] The project proponents are allowed to conduct additional surveys by themselves to satisfy certain conditions. However, it depends on the survey results if they must further conduct a Detailed EIA prior to the project implementation.

[4] According to the statement in Article 12 of the Law on Environmental Impact Assessment, the economic entity must obtain a license which officially certifies their technical ability to implement a Detailed EIA.

[5] It is the Government of Mongolia (Ministry of Energy) who allocates the budget for the government's energy sector projects.

The following figure shows the flow of EIA implementation:



(Source: developed by the JICA Survey Team based on the Law on Environmental and Impact Assessment)

Figure 3-7 Workflow of EIA Implementation

The following are the contents which should appear in the Detailed EIA.

Table 3-3 Contents of Detailed EIA

1. Environmental baseline data and indices
2. Analysis and calculation which determined the amount, spreading and consequences of the project impact
3. Recommendations on measures to mitigate and eliminate potential significant adverse impact
4. Recommendations on environmental-friendly alternatives and technology
5. Risk assessment of impact on human health and environment
6. TOR of Environmental Monitoring Plan (EMP) (objectives, scope and target measurable indicators)
7. Exit strategy, restoration plan, scope, target measurable indicators and protection measures of the environment (for oil drilling, mining industry and radioactive mineral mining projects only)
8. Opinions of the local administrative bodies and residents in the project implementation areas and the minutes of such public meetings
9. Other issues with regard to the cultural strata of the locality in the project locations

(Source: Article 8, Law on Environmental Impact Assessment)

Violators of the Law will be subject to criminal or administrative penalties depending on the degree of harm and nature of the violation. Examples of violations are: i) implement a project without conducting an EIA and appropriate permission or decision on it; ii) implement a project which does not meet the requirements defined in the EIA report; and iii) implement a project

[11] The rate base is a function of net fixed assets. Multiplying the rate base by the costs of capital provides the profit margin.

without an Environmental Protection Plan (EPP) and an EMP, or which does not fulfill EPP and EMP.

At what level EIA will be conducted depends on the project scale. A few energy sector projects have been classified in the Annex to the Law which organizations screen as shown in the following table. Other projects which are not mentioned in the Law are subject to the decision by MEGD.

Table 3-4 Environmental Screening Criteria and Organizations in charge

At What Level Screening Conducted	Type of Project
MEGD	Power plants with installed capacity over 1MW High voltage (35 kV and higher) electric transmission lines Heat pipeline Hydroelectric power plant
Administrative bodies at project location (Aimags and the capital)	Power plants with installed capacity less than 1MW Electric transmission lines with voltage up to 35 kV Local heat pipelines within its border

(Source: Annex, Law on Environmental Impact Assessment)

3.4.2 Ambient Air

The Law on Air prohibits the pollution of urban air with toxic and infectious substances (such as (sulfur, nitrogen dioxide, reactive hydrocarbons, carbon monoxide, heavy metals, and organic compounds) and wastes with offensive odors, requires EIAs prior to engaging in commercial activities that discharge polluting substances, and regulates five specific activities for air quality protection (discharge and burning of wastes, construction activities, equipment emitting air pollutants, discharge of greenhouse gases and activities affecting ozone layer). This law allows the government to set limits on discharges of emissions into the atmosphere by stationary sources through the issuing of permits. It also includes provision for upper limits on emissions by all sources to be prescribed in standards. If emission limits in permits are exceeded by stationary sources, inspectors may suspend the activities of the emitter.

3.4.3 Water Quality

This legislation makes provision for the proper use, protection and restoration of water resources. One of the principal legal mechanisms in this law is the establishment of three types of water protection zones: i) Protected Zones (established with the purpose of preventing and reducing water pollution due to economic activities), ii) Sanitary Zone (applied to settled areas to protect the local water supplies from livestock, wastewater from *ger*s and other urban pollution sources), and iii) Community Protection Zone (*aimags*, the capital city, *soum* and *duureg khurals* may establish these zones around local water sources which have special ecological importance).

3.4.4 Land

(1) The Constitution of Mongolia

Under the Mongolian Constitution, all land, subsoil, natural resources and water are the property of the State. The Constitution allows the State to grant the land ownership only to Mongolian citizens, but not to foreign entities.

(2) Law on Land

The Mongolian Law on Land regulates 'possession' and 'use' of 'land'. 'Land' includes the land surface and airspace above but not minerals in the law, and to 'use land' means the right to use land in accordance with a contract granted by those who 'own' or 'possess' the land. Land must be monitored, protected, restored and used efficiently for its permitted use. Any activities that may cause damage to human health; nature and ecological balance; or national security are prohibited. Citizens' representatives *khurals* of *aimags*, the capital city, *soums* and districts shall take land for special needs of *aimags*, the capital city and *soums*, determine their size and boundaries, and make decisions on giving compensation for the land taken from private use for such needs prior to expiration of their contracts by corresponding level governors. They also shall make decisions on eviction of persons who possess or use land without appropriate authorization, or who caused significant degradation of land.

(3) Law on Underground Resources

Subsoil is the property of the state in accordance with the Constitution of Mongolia. The Law on Underground Resources regulates the use and protection of subsoil according to the principles of sustainable development. Subsoil may be leased for mining purpose and others with licenses obtained.

3.4.5 Waste Management

(1) Law on Protection from Toxic Chemicals

The law focuses on establishing a framework with fixed regulatory functions. It defines toxic chemicals as those with a toxic impact on humans, livestock, wild animals and the environment and further pose a risk of death or extinction. It addresses the import, export, transportation, storage, use, and control of toxic chemicals. It imposes measures to prevent the impact of toxic and hazardous substances on human health and the environment. Chemicals will be used at and transported to, from and within the project area. The Hazardous Materials Management Plan will help to ensure compliance with this law.

(2) Law on Household and Industrial Waste

This law regulates the collection, transportation, storage, reuse and disposal to landfill of household and industrial waste. Permission to landfill waste is granted by *soum* or district governors and organizations undertaking industrial activities that generate a significant amount of

waste must landfill that waste in a designated landfill that meets prescribed standards.

3.4.6 Community Health, Safety, and Security

(1) Law on Labor

The Law determines the rights and duties of employers and employees who are parties to a labor relationship including collective agreement, collective bargaining, collective / individual employee labor disputes, working condition, terms and conditions of work, liabilities for breach of the legislation, and to ensure gender equality.

(2) Law on Sanitation

The Law is stipulated to ensure the rights of individuals to healthy and safe living and working conditions and to define the rights and duties of individuals and businesses in this regards. Such activities as the supply of drinking and household water; air quality; soil sanitation, waste disposal, sewage facilities, water holes and lavatories; the disposal of hospital waste, radioactive and toxic chemicals; the construction of houses and facilities for public use shall be carried out in accordance with the legislation.

3.4.7 Environment Standards

Most of the national standards that were adopted before 1989 were largely copied from USSR standards. The majority of these standards define, provide the general requirements of, or specify the method of, environmental measurement. The environmental standards applicable to transmission and distribution projects are ambient air, groundwater, surface water, soil and others as shown in the following table.

Table 3-5 Relevant Mongolian Environment Standards

No of Environmental Standards	Contents
Ambient Air	
MNS (ISO) 4226: 2000	Air quality. General subject and general requirements.
MNS 4585: 2007	Air quality. Technical general requirements
MNS 0017-2-3-16: 1998	Environmental protection. Atmosphere. City and settled area air quality monitoring procedure.
MNS 3384: 1982	Atmosphere. General requirements for sampling.
MNS 3383: 1982	Atmosphere. Pollution source. Terms and definitions
Water Resources	
MNS 4586: 1998	Water environmental quality. General requirements.
MNS 900:2005	Environment. Human health protection. Security. Drinking water. Hygienic requirements and quality control
MNS (ISO) 5667-1:2002	Water quality. Sampling. Part 1. Guidance on the design of sampling programs.
MNS (ISO) 5667-2:2001	Water quality. Sampling. Part 2. Guidance on sampling techniques
MNS (ISO) 4867: 1999	Water quality. Sampling Part 3. Recommendation for sample preparation and storage.
MNS (ISO) 5667-10:2001	Water quality. Sampling. Part 10. Guidance on waste water sampling procedure.
MNS (ISO) 5667-11:2000	Water quality. Sampling. Part 11. Guidance on groundwater sampling.
MNS 4943: 2000	Water quality. Waste water.
MNS 4047: 1988	Environmental protection. Hydrosphere. Surface water quality monitoring procedures.
MNS 3342: 1982	General requirements for protection of groundwater from pollution / contamination
MNS 0017-1-1-10: 1979	Water use and protection. Terms and definition.
MNS 0017-1-1-14: 1980	Hydrosphere. Classification of water use. General requirements.
MNS 4079: 1988	Water quality terms and definition.
Soil and Land Use	
MNS 3297: 1991	Soil. Permissible level for hygienic characteristics.
MNS 3298: 1991	Soil. General requirements for sampling.
MNS 0017-0-0-06: 1979	Environmental protection standard system.
MNS 3473: 1983	Environment. Land. Land use. Terminology and determination.
MNS 4925:2000	Environment. Rehabilitation of disturbed lands during geological exploration. Technical requirements.
MNS 0017-5-1-18: 1983	Rehabilitation. Classification of disturbed lands.
MNS 0017-5-1-19: 1992	General requirements of rehabilitation of disturbed lands.
Community Health, Safety and Security (including Noise)	
MNS 4990: 2000	Occupational Health and Safety. Workplace environment. Hygienic requirements.
MNS 5002: 2000	Occupational Health and Safety. General requirements for noise norm and safe working procedure.
MNS 5003: 2007	Occupational Health and Safety. General requirements for noise measurement.
MNS 12.1.009: 1985	Occupational Safety. Noise. Noise accepted level in apartment and civil construction.
MNS 12.4.005: 1985	Occupational Health and Safety. Protection tools and methods against noise. Classification.
MNS 12.1.06: 1988	Occupational Safety standard system. Extreme high noise. General requirements for safety.
MNS 12.1.17: 1988	Occupational Safety standard system. Extreme high noise. Workplace noise pressure measure method.

(Source: developed by the JICA Survey Team)

Among the above, standards for air quality, water quality and noise are found in the following tables:

Table 3-6 Maximum Allowable Concentration of Quality Standard

	Mongolian Standards	Japanese Standards	WHO Guidelines
Sulfur dioxide (SO2)	0.02 mg/m3 (24-hour mean) 0.5 mg/m3 (10-min mean)	0.04 ppm (24-hour mean) 0.1 ppm (1-hour mean)	0.02 mg/m3 (24-hour mean) 0.5 mg/m3(10-min mean)
Nitrogen dioxide (NO2)	0.04 mg/m3 (24-hour mean) 0.085 mg/m3 (20-min mean)	0.04 ppm - 0.06 ppm (24-hour mean)	0.2 mg/m3 (1-hour mean) 0.04 mg/3 (annual mean)
Carbon dioxide (CO)	1.0 mg/m3 (24-hour mean) 3.0 mg/m3 (absolute limit)	10 ppm (24-hour mean) 20 ppm (8-hour mean)	-
O3	0.1 mg/m3 (8-hour mean)	0.06 ppm	0.1 mg/m3 (8-hour mean)
Suspended Particulate matter	0.15 mg/m3(24-hour mean) 0.5 mg/m3 (30-min mean)	0.10 mg/m3 (24-hour mean) 0.20 mg/m3 (1-hour mean)	0.15 mg/m3(24-hour mean)
PM10	0.1 mg/m3 (24-hour mean) 0.05 mg/3 (annual mean)	-	0.05 /m3 (24-hour mean) 0.02 mg/3 (annual mean)
PM2.5	0.05 mg/m3 (24-hour mean) 0.025 mg/3 (annual mean)	0.035 mg/m3 (24-hour mean) 0.015 mg/3 (annual mean)	0.025 mg/m3 (24-hour mean) 0.01 mg/3 (annual mean)

(Note) Weights are indicated in “mg/m3”, whereas volumes are in “ppm”. It is common in Japan that gases within a body of gas are expressed in volumes, and liquids and solids in a body of liquid and solid are in weights. “Ppm” stands for “parts per million”.
(Source) MNS 4585: 2007 (Mongolian Standards) “Environmental standards for air pollution”, 8 May 1973 (Notification No. 25 of the Environmental Agency), “Environmental standards for NO2”, 11 July 1978 (Notification No, 38 of the Environmental Agency), and “WHO Air quality guidelines - global update 2005”

Table 3-7 Maximum Allowable Concentration of Surface Water

	Mongolian Standards	Japanese Standards	WHO Guidelines
pH	6.5-8.5	6.5-8.5	
SS (Suspended Solid)		25mg/l	
BOD	3mg/l	1mg/l	
COD	10mg/l	-	
Dissolved Oxygen (DO)	6>4mg/l	>7.5mg/l	
Total Nitrogen			
Total Phosphorus			
Heavy Metals			
Hydrocarbons / Mineral Oils	0.05mg/l		
Phenols	0.001mg/l		
Cyanide			
Temperature			

(Note) Japanese Standards are based on the tap water supply (primary level), those listed for natural environmental conservation and level A (AA Type).
(Source) MNS 4586: 1998, “Environmental Standards on Water Contamination”, 28 December 1971 (Notification No. 59 of the Environmental Agency, Annex 2)

Table 3-8 Maximum Allowable Concentration of Noise

(Unit: dB(A))

Venue	Time	Maximum allowable noise limit (hourly measurement) 1 hr LA_{eq}	Japanese Standards	WHO Guidelines
Industrial / commercial:	Daytime (07:00-22:00)	60	60	70
	Nighttime (22:00-07:00)	45	50	70
Residential / Institutional / Educational:	Daytime (07:00-22:00)	60	50～55	50～55
	Nighttime (22:00-07:00)	45	40～45	30～45

(Source) MNS 5003:2007, "Environmental Standards on Noise", 30 September 1998 (Notification No. 64 of the Environmental Agency), "WHO Guidelines for Community Noise"

3.5 Balance of Electricity

The current power generation capacity in Mongolia is 922 MW, with a winter load of 93% and average summer load of 67.73%. Mongolian Electricity System consists of several independent grid companies. The National Development Strategy of Mongolia sets the establishment of a unified grid; however, ADB research concluded that due to the large territory of the country and concentration of population in only large industrial areas, full unification of the grid is not realistic at least until 2025.

The largest grid is the Central Electricity System (hereafter, CES) that covers Ulaanbaatar and the central part of the country. The grid has the biggest generation capacity as well as the highest number of consumers. The grid is connected to Russia through a 220 kV transmission line and imports electricity for meeting peak demand, especially in the winter.

The Eastern Electricity System (hereafter, EES) is formed around the Choilbalsan TPP. The system is independent and not connected to Russia. Although there is a 35 kV transmission line from the Russian Far Eastern Grid to Mardai, this line is used only for electricity supply to a uranium mine, not for connection between the two grids.

The Western Electricity System (hereafter, WES) originally consisted only of a large number of diesel generators and relied on heavy imports of electricity from Russia. However, in 2008 the Durgun HPP was put into operation, increasing the installed capacity of the system by 12 MW.

Figure 3-8 National Transmission Network

Besides the major grids, there are also several regional mini-grid systems. One of the largest ones is the Altai-Uliastai ES (hereafter, AUES) in South Western Mongolia. The biggest generation facility there is the Taishir HPP (11 MW) built in 2010. Additionally, there is an isolated grid in Omon-Govi Province centered around Dalanzadgad TPP (6 MW). This grid is not connected to any of the other grids and operates independently.

Finally, in each *aimag* center, town or *soum* center, there are diesel generators installed. The capacity ranges between 100 kV to 5,000 kV. There are also numerous small-scale renewable energy generation facilities, whose total capacity is shown in the table below.

Table 3-9 Small-Scale Renewable Generation Facilities

Power Plant Type	Capacity (MW)
Total HPP w/t Taishir HPP and Durgun HPP	4.5
Total solar and wind	0.65
Total solar	1.13
Total wind	0.15

(Source: Energy Statistics of Mongolia 2011)

3.5.1 Electric Power Balance Outlook

(1) Electricity Demand in Mongolia

Due to the high economic growth, demand for electricity has increased by almost 30% since 2007, reaching 3,772.6 GWh in 2012. Industry is the largest consumer of electricity, followed by the household sector.

Table 3-10 Balance of Electricity

GWh

Indicators	2007	2008	2009	2010	2011	2012
Resources- Total	**3,896.1**	**4,198.2**	**4,195.4**	**4,575.7**	**4,811.9**	**5,181.6**
Gross generation	3,700.7	4,000.6	4,038.8	4,312.8	4,536.4	4,815.6
Import	195.4	197.6	156.5	262.9	275.5	366.0
Distribution -Total	3,896.1	4,198.2	4,195.4	4,575.7	4,811.9	5,181.6
Consumption	2,829.1	3,093.3	3,034.1	3,375.9	3,453.0	3,772.6
Of which:						
Industry and construction	1,745.6	1,918.1	1,883.1	2,093.8	2,140.8	2,338.9
Transport and communication	117.3	128.7	126.2	140.4	143.7	156.8
Agriculture	26.1	32.6	32.1	35.6	36.4	39.8
Household and						
communal housing	694.6	742.3	727.6	809.7	829.5	906.7
Other	245.5	271.5	265.1	296.2	302.6	330.4
Losses in transmission						
and distribution	442.4	435.9	493.9	505.4	644.3	675.4
Station internal use	614.5	653.2	649.4	672.2	690.8	712.4
Export	10.1	15.9	18.1	22.2	23.8	21.2
Electricity produced per						
capita, kW.h	1,415.4	1,504.4	1,490.5	1,563.6	1,693.2	1,762.2

(Source: Mongolian Statistical Yearbook 2010, 2012)

(2) Coal Demand in Mongolia

The balance of coal is shown in the table below. Coal is the main fuel used in CHP plants. Its import has been increasing since 2009.

Table 3-11 Balance of Coal

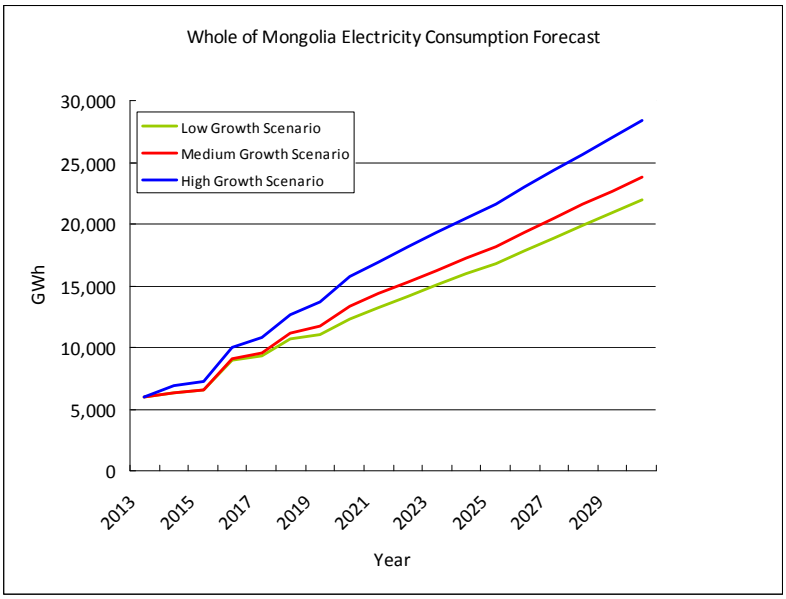
th. MNT

Indicators	2007	2008	2009	2010	2011	2012
Resources- Total	**9,555.5**	**10,453.7**	**14,883.5**	**26,506.1**	**39,903.9**	34,140.9
Stock at the begining of the year	317.3	381.3	441.2	1,344.0	2,874.1	4,214.5
Produced	9,237.6	10,071.9	14,442.1	25,161.9	32,029.7	29,926.1
State owned mining company	6,259.7	6,674.2	7,186.7	10,459.5	12,090.3	10,335.6
Private sector's mining company	2,977.9	3,397.7	7,255.4	14,702.4	19,939.4	19,590.5
Import	0.6	0.5	0.2	0.2	0.1	0.3
Consumption-Total	5,906.1	5,843.2	6,426.2	6,905.8	6,815.3	7,381.3
Consumed by thermal						
power stations	4,935.1	4,849.9	5,077.9	5,533.2	5,410.1	5,800.9
Distributed to economic sectorsand households	971.0	993.3	1,348.3	1,372.6	1,405.2	1,580.4
Of which:						
Industry & construction	203.0	190.1	226.3	179.6	221.9	336.6
Transport & communication	121.7	41.3	41.2	49.5	52.5	42.2
Agriculture	3.4	7.2	13.6	10.0	8.9	3.7
of which: household	375.2	406.6	596.5	612.3	639.7	626.0
Other	188.1	174.1	469.0	518.6	480.6	560.9
Export	3,268.1	4,169.3	7,113.2	16,726.2	21,296.0	20,915.5
Stock at the end of the year	381.3	441.2	1,344.0	2,874.1	4,214.5	2,030.7

(Source: Mongolian Statistical Yearbook 2010, 2012)

(3) Electric Power Demand Outlook

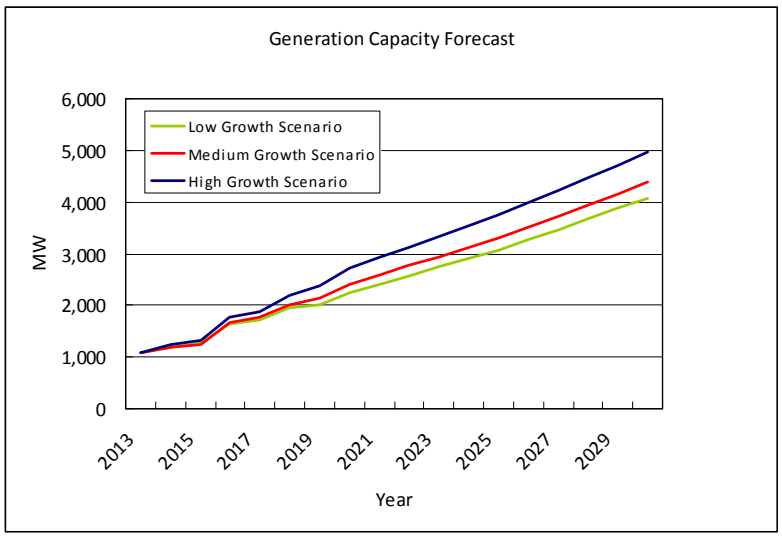
The ADB master plan developed three economic growth scenarios (Low Growth, Medium Growth and High Growth), based on which they prepared forecasts for electricity demand, as shown below.



(Source: ADB)

Figure 3-9 Energy Consumption Forecast (2013 - 2030)

According to the low growth scenario, installed generation capacity will reach 4,073 MW by 2030, while it is projected to increase to 4,961 MW under the high growth scenario.



(Source : ADB)

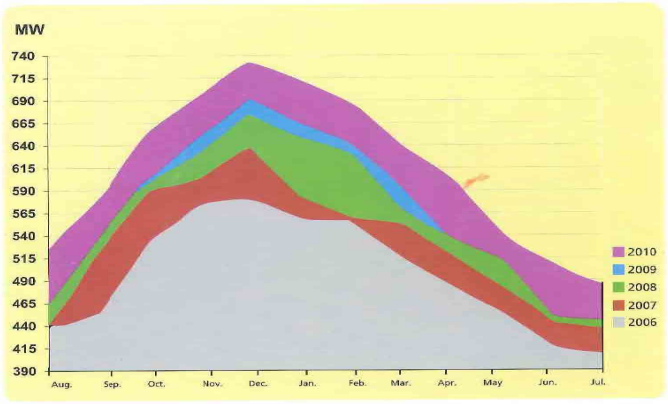
Figure 3-10 Generation Capacity Forecast (2013-2030)

The draft final report of the ADB master plan analyzes several possible compositions of the energy mix for meeting the increasing power demand. Even in the case of an energy mix

composition with lowest costs, it is estimated that additional new investments ranging between 113 – 682 million USD are required annually in the period up to 2030. The draft final report points out that the two main preconditions for attracting investments of such magnitude are the improvement of the financial stability of power companies and the reform of the tariff system.

(4) Electric Power Demand in the Central Electricity System

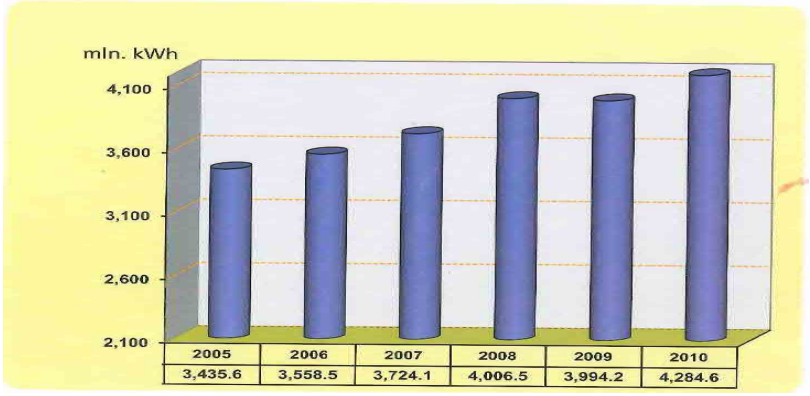
The figure below shows the changes in the electricity demand in the CES. Demand peaks in December and has been increasing every year.



(Source: NDC Brochure)

Figure 3-11 Monthly Electricity Demand in CES (2006-2010)

The next figure shows the annual changes in electricity demand. From 2005 to 2010 demand increased by an average of 4.6 % annually.

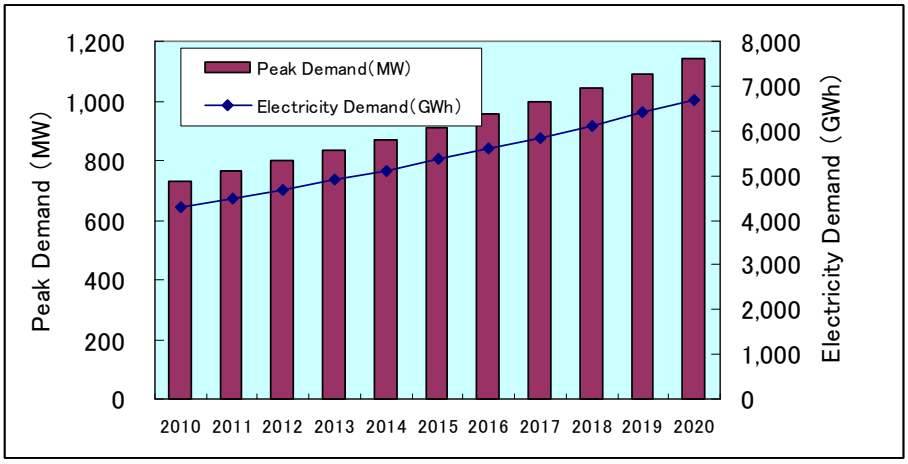


(Source: NDC Brochure)

Figure 3-12 Annual Electricity Demand in CES (2005-2010)

(5) Electric Power Demand Outlook for the CES

The figure below shows the forecast for electricity demand in the CES under the assumption that growth rates observed until 2010 will be sustained. Due to the lack of information on the rapid growth in mining and other industrial sectors, this has not been reflected in the projections.



(Source: JICA Survey Team)

Figure 3-13 Electricity Demand Outlook for CES

3.5.2 Power Plants and Power Generation

The table below shows the main performance parameters of the existing major power plants in Mongolia. Except for Taishir HPP and Durgun HPP, all other power plants are coal fired.

Table 3-12 Major Power Plants in Mongolia

Plant name	Installed capacity (MW)	Available Capacity (MW)	Year of Comissioning	Location	Efficiency (%)
CES					
CHP2	21.5	18	1961-1969	Ulaanbaatar	21.2
CHP3	136	105	1968-1982	Ulaanbaatar	37.8
CHP4	580	580	1983-1991	Ulaanbaatar	40.3
DARKHAN CHP	48	39	1965;1986	Darkhan City	40.5
ERDENET CHP	28.8	21	1986-1989	Erdenet City	28
EES					
DORNOD CHP	36		1969; 1982	Dornod Aimag	20.2
WES					
DURGUN HPP	12		2010	Hovd Aimag	-
GAUES					
TAISHIR HPP	11		2008	Govi-Altai Aimag	-
DALANZADGAD					
DALANZADGAD CHP	6		2000-2012	Umnogovi Aimag	-

(Source: Energy Statistics of Mongolia 2011)

Table 3-13 Power Generation by Major Power Plants in 2011

Item	CHP2	CHP3	CHP4	Darkhan CHP	Erdenet CHP	CES	Dornod CHP	Dal CHP	Total
Generation (mln kWh)	125.8	685.6	3,101.5	266.2	134.6	4,313.7	115.8	20.7	4,450.2
Dispatched (mln kWh)	106.6	540.8	2,690.8	216.5	106.0	3,660.7	94.3	15.5	3,770.5
Heat supply (th. Gcal), incl.	164.1	1,847.8	3,128.8	453.6	521.7	6,116.0	187.5	17.8	6,321.3
Hot Water	149.3	1,570.6	3,003.2	443.0	491.0	5,657.1	187.5	17.8	5,862.4
Industrial Steam	14.8	277.2	125.6	10.6	30.7	458.9	-	-	458.9
NCV (kcal/kg)	3,454.0	3,479.0	3,295.0	3,645.0	4,085.0	3,406.0	2,524.0	4,945.0	3,371.0
Coal consumption (th tonne)	191.5	1,067.5	2,899.7	351.9	222.4	4,733.0	270.6	39.4	5,043.0
HFO Consumption (tonne)	105.3	921.7	10,966.0	84.6	43.2	12,120.8	212.9	-	12,333.7

(Source: Energy Statistics of Mongolia 2011)

3.5.3 National Electricity Transmission System

As explained above, there are three major electricity systems in Mongolia, as well as a number of regional electricity systems. The largest transmission network exists in the CES, with two other smaller networks in the EES and WES. CES is connected via a 110 kV cable to the AUES; however, the line is not operating due to reactive load. The CES and EES are connected via a 110 kV line between Ondorkhaan and Baruun-Urt, but as no reliable electricity supply could be achieved, the line is not functioning.

There are three types of transmission lines in use in Mongolia, 220 kV, 110 kV and 35 kV. The major 220 kV transmission line forms a loop between Ulaanbaatar, Erdenet and Darkhan and serves power sourced from Russia in the north.

A 220 kV line was constructed between Baganuur and Choir in 1984. A double circuit 220 kV line has been put into operation between Oyun-Tolgoy and Mandalgovi in 2013.

The area transmission system consists of 110 kV lines used in CES, as well as in the WES and EES. There is also a 110 kV transmission loop being constructed around Ulaanbaatar.

The tables below show the length of transmission and distribution lines in Mongolia as well as the number of existing substations.

Table 3-14 Transmission and Distribution Lines Length (km)

Type	CES	WES	Altay-Uliastay	EES	South Gobi	Total
220 kv	1,044	-	-	-	-	1,044
110 kV	2,982	746	254	717	-	4,699
35 kV	5,875	902	929	755	93	8,554
15 kV	1,636	841	446	516	101	3,540
6-10 kV	8,637	991	368	617	183	10,796
0.22/0.4 kV	12,228	813	211	263	137	13,652
Total	**32,402**	**4,293**	**2,208**	**2,868**	**514**	**42,285**

(Source: Energy Statistics of Mongolia 2011)

Table 3-15 Number of Substations

Type	CES	WES	Altay-Uliastay	EES	South Gobi	Total
220 kv	6	-	-	-	-	6
110 kV	54	7	4	7	-	72
35 kV	196	18	12	13	6	245
15 kV	75	32	19	38	3	167
6-10 kV	3,724	332	69	237	71	4,433
Total	**4,055**	**389**	**104**	**295**	**80**	**4,923**

(Source: Energy Statistics of Mongolia 2011)

3.5.4 Electric Power Outages

The Mongolian electricity system is characterized by high duration and high occurrence of power outages. ERC has been collecting data on outages since 2005 and has been calculating the annual outage duration per customer served or SAIDI (System Average Interruption Duration Index), the average number of interruptions per customer served or SAIFI (System Average Interruption Frequency Index) and the average outage duration per customer served or CAIDI (Consumer Average Interruption Duration Index). The values for 2010 and 2011 for the different grid systems are provided below.

Table 3-16 Power Interruption Indices

(SAIDI : hours/consumer, SAIFI : times/consumer, CAIDI : hours/times)

	2010			2011		
	SAIDI	SAIFI	CAIDI	SAIDI	SAIFI	CAIDI
Central Region	61	14	4	57	12	5
Western Region	213	9	24	220	7	33
Eastern Region	4,012	12	332	654	3	205
Dalanzadgad	-	-	-	466	12	39

(Source: Energy Regulatory Commission Annual Report 2011)

3.6 Tariffs

The electricity tariff in Mongolia is determined by the ERC for all energy systems and users. This section describes the process of tariff setting, the existing tariff system and the future prospects for tariff setting.

3.6.1 Tariff System

Generally, tariffs are set separately for industrial consumers and household users. These tariffs are made public by the ERC through its website and other sources. The data below were obtained through discussions with the ERC officers.

Table 3-17 Tariffs of Generators Transmission Companies and Import

Company	Generators/Import	Transmission Companies
Tariff Level (MNT) Before August 5, 2013	54.78	58.71
Tariff Level (MNT) From August 5, 2013	68.82	75.50

(Source: ERC)

The tariffs for end users were also raised from August 5, 2013. There was an average increase in the tariff of 20 % (30 % for the mining industry, 15 % for other industries and 20% for households). Additionally, the preferential treatment of users in *ger* areas was abolished. The latest tariffs of CES and other energy systems are shown in the tables below.

Table 3-18 CES End-User Tariffs(MNT/kWh)

CES					
Industry		**MNT/kWh**	**Households**		**MNT/kWh**
1	Mining Industry		***1***	Simple Meter	
1.1	Simple Meters	130	***a***	Up to 150 kWh	79
1.2	3 tariff meters		***b***	Above 150 kWh	96.6
a	06:00-17:00	130	***2***	2 tariff meters	
b	17:00-24:00	210	***a***	06:00 -21:00	84
c	24:00-06:00	60	***b***	21:00-06:00	60
2	Other Industry		***3***	Basic charge	1000
2.1	Simple Meters	105.6			
2.2	3 tariff meters				
a	06:00-17:00	105.6			
b	17:00-24:00	178.6			
c	24:00-06:00	60			
2.3.	Ulanbaatar troleybus	60			
3	Ulaanbaatar City Common Areas and Street Lighting				
3.1.	October - March				
a	06:00 - 19:00	105.6			
b	19:00-06:00	60			
3.2	April-September				
a	06:00-22:00	105.6			
b	22:00-06:00	60			

(Source: ERC Website)

Table 3-19 Regional Grids Tariffs (MNT/kWh)

EES			WES		
Simple Meters					
1	Mining Industry	100	***1***	Industry	90
2	Other Industry	88	***2***	Individuals	60
3	Households		**Dalanzadgad ES**		
a	up to 50 kWh	74	***1***	Industry	90
b	51 - 100 kWh	79	***2***	Individuals	79.8
c	Above 101 kWh	84			
4	Khalkh Gol, Erdenetsagaan, Chuluunhoroot sums (import)	100			
Tariff Meters					
1	Mining Industry				
a	06:00-17:00	100			
b	17:00-22:00	179			
c	22:00-06:00	46			
2	Other industry				
a	06:00-17:00	88			
b	17:00-22:00	155.2			
c	22:00-06:00	46			
3	Individuals				
a	06:00 -21:00	84			
b	21:00-06:00	40			

(Source: ERC website)

3.6.2 Tariff Setting Process

The tariff setting policy is determined in the Energy Law, as well as in the Permanent Methodology for Tariff Setting. The methodology follows a rate base system[11], i.e. the tariff consists of per unit cost of product and a profit margin. The methodology strictly prohibits including in the tariff the depreciation of future investments, which is a method of keeping the tariff level low.

Electricity tariffs are calculated using the following formula:

$$T = \frac{RR - S}{TP}$$

T	Tariff
RR	Required Revenue
S	Subsidy
TP	Total Production

The main element of the tariff is the required revenue (RR), i.e. the sum of the total costs and return on investment based on data from the previous three years. The required revenue is calculated as follows:

$$RR = TC + RI$$

TC	Total Costs
RI	Return on Investment

The tariff is also adjusted to the subsidies (S) that each company received from the Mongolian Government, as shown above. Finally, if a particular energy company receives a loan after approval by the Mongolian Government, the loan repayment is included in the required revenue. However, the exact mechanism for adjusting the tariff for such cases is not publicly disclosed.

Based on the Energy Law, all tariffs for power companies are approved by the ERC.

3.6.3 Tariff Outlook

As discussed in the previous sector, energy tariffs in Mongolia continue to be kept at low levels. The sustainable development sector from now will require a fundamental reform in the tariff setting system. The energy sector, after undergoing unbundling and corporatization, needs to become economically viable in view of possible future privatization. Yet, in order to achieve such commercialization of the sector, tariffs have to reflect the actual costs of energy companies.

ADB's analysis as part of the "Updating Energy Sector Development Plan" also showed that unless tariffs are increased by 59% - 72% (depending on the expansion scenario) in the period 2012 – 2015, the energy sector development cannot be funded. Additionally, the analysis assumes that most of the demand in the energy sector comes from industrial consumers and the tariff reform would be possible while keeping the household prices at affordable levels.

3.7 Non-Japanese International Donor Activities in the Mongolian Energy Sector

3.7.1 Asian Development Bank

Among international donors, the most active support to the energy sector in Mongolia was provided by ADB. Its projects include rehabilitation of district heating systems, energy efficiency in buildings, rural electrification and others. A list of the most recent projects conducted by ADB is presented below.

Table 3-20 Projects Supported by ADB (Energy Sector)

Project Title	Type	Date of Approval	Closing Date	Size (th. USD)	Summary
Updating the Energy Sector Development Plan	Technical Assistance	2010/10/19	2013/12/30	1,000	Update of the energy sector master plan
Ulaanbaatar Low Carbon Energy Supply Projects Using a Public-Private Partnership	Technical Assistance	2010/2/26	2012/5/31	3,200	Feasibility Study development for CHP 5.
Ulaanbaatar Clean Air	Technical Assistance	2009/12/14	2012/6/1	500	Heat only Boilers (HOB) replacement and development of a mechanisms for reduction of winter-time emissions in ger areas
Demonstration project for Improved Electricity Services to the Low-Income Communities in Rural Areas	Grant	2009/9/9	2013/12/5	2,400	The project aims to improve the quality of life of the residents of bag centers (smallest administration units) in Mongolia by providing reliable electricity supply to remote communities and construction of transmission and distribution lines using Single Wire Earth Return (SWER) technology in selected demonstration bag centers.
Energy Conservation and Emission Reduction from Poor Households	Grant	2008/9/23	2013/3/15	2,000	Energy Improvement in the ger areas through the addition of highly insulated ger blankets for about 4,000 households in the ger district in Ulaanbaatar.
Community-Based Heating Supply in Rural Remote Areas	Grant	2007/6/29	2012/8/22	2,000	Rehabilitation of district heating boilers in 12 soums.

(Source: ADB Website)

The ADB project that currently attracts most attention is the development of the energy sector development plan. The draft report was finalized in June 2013 and submitted for review and comments to the Mongolian government. As of October 2012, ADB and the Mongolian side are deliberating over the final version, but once finalized the master plan is expected to become an important policy making tool.

Additionally, in the period 2010-2011, ADB conducted a feasibility study on the construction of CHP-5 in Ulaanbaatar. As of September 2013, the Mongolian side was still in the process of negotiations with the successful bidder.

3.7.2 World Bank

The World Bank has a limited number of projects in the energy sector. In 2001 it started working on the Energy Sector Project, its biggest project in terms of funding. The project aims at promoting reforms in the power sector through various activities, such as improvement of the financial sustainability of the UBEDN, reform in the billing system, and others. As a result of the implementation of the WB project, UBEDN started generating profit in 2010, which is an example of the successful activities of the World Bank in the power sector.

The main projects funded by the WB are shown below.

Table 3-21 Projects Supported by the World Bank (Energy Sector)

Project Title	Type	Date of Approval	Closing Date	Size (th. USD)	Summary
Ulaanbaatar Clean Air Project	Loan	2012/4/3	2017/6/30	21,890	Enable Consumers in ger areas to access heating appliances producing less particulate matter emissions; develop emission abatement measures in Ulaanbaatar
MN-Energy sector Project	Loan TA	2001/5/3	2013/9/30	Loan: 43,000 TA: 400	Reduce losses and improve reliability and financial sustainability of electricity distribution companies.
Renewable Energy for Rural Access	Loan Grant	2006/12/19	2012/6/30	Loan: 15,000 Grant: 3,500	Provision of access to electricity to nomadic families and soum centers

(Source World Bank Website)

3.7.3 Other Donors

Besides the above donors, the largest investor in Mongolia is the European Bank for Reconstruction and Development (hereafter, EBRD). In 2009 it decided to get actively involved in renewable energy generation and participate in the construction of the Salkhit wind power plant (50 MW) with 5,000,000 USD of equity investment in addition to a 40,000,000 USD credit line.

Other donors mainly provide technical assistance on energy efficiency, as well as perform advisory roles.

The list of the most recent projects supported by other donors is provided in the table below.

Table 3-22 Activities of Other Non Japanese Donors (Energy Sector)

Donor	Project Title	Type	Date of Approval	Closing Date	Size (th. USD)	Summary
EBRD	Salkhit Wind Farm Project	Loan	2009/11/3	N/A	Development 2,800	Development, construction and operation of a 50 MW wind farm
GIZ	Efficiency of Grid-Based Energy Supply Systems	TA	2010	2013	-	Advisory in the area of energy policy Analysis of the inefficiency in the electricity supply and demand sides Training
	Integrated Urban Development	TA	2006	2012	-	Building insulation; Construction of energy efficient homes; Standards Development
KfW	Energy Efficiency programme II	TA	2013	N/A	-	Modernization of Darkhan CHP and Choibalsan CHP
UNDP	Building Energy Efficiency Project	TA	04/2009	12/2013	3,815	Improvement of the energy utilization efficiency in Mongolian buildings by improving the energy efficiency levels of new construction sector buildings and by improving the efficiency of new and existing *ger* and private houses.

(Source: Donors' Websites)

3.8 General Conditions of Construction Procurement

3.8.1 General Information on Tender of Power-Related Facility Construction and Contracting Practice

(1) Tendering

Tender for electricity facilities and purchases planned by the electricity sector is carried out by the government agencies and cities with the budget. In the case that the Ministry of Energy has the budget, the Ministry tenders a bid, while the City of Ulaanbaatar tenders a bid if the budget is allocated to the City of Ulaanbaatar. If WB, ADB or other foreign donors are fund suppliers, however, the Ministry of Energy tenders all the bids.

(2) Loan Contract

According to a survey, there was a case of a loan contract in which a transmission company or a distribution company concluded the contract with a donor while the Ministry of Energy put down their name as a guarantor.

Regarding the loan contract, it is expected that flexible response is possible depending on the conditions of the donor.

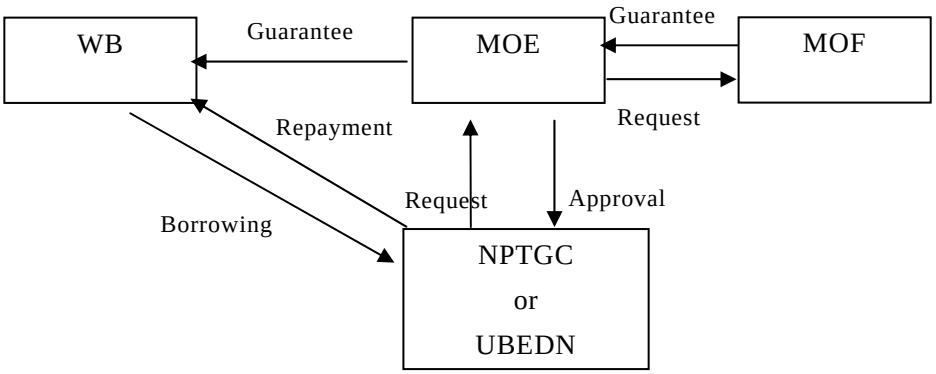


Figure 3-14 Fund Flow in the Past World Bank Projects

(3) Project Implementation Method

There are two types of tenders. One is to select the consultant who carries out design and construction supervision of the project on behalf of the owner. The other one is to select the contractor who carries out construction works or procurement of materials/equipment. In the case of the construction works, the contract is generally concluded on turnkey-basis (i.e the contract method which covers all the contractors required for the completion of the plant.).

As described below, the official counterparty of the contractor is the Ministry of Energy in the implementation of the Project. The transmission or distribution company, however, is in charge of substantive negotiation, and takes responsibility of project management including technical guidance and troubleshooting.

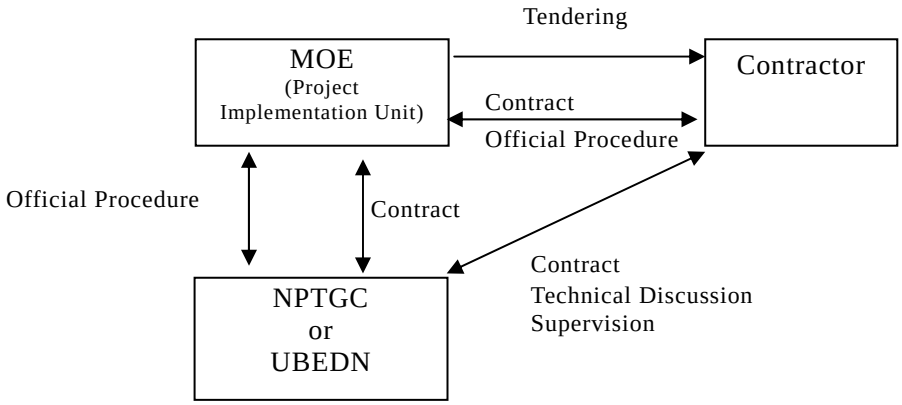


Figure 3-15 Project Implementation System (in the case of Government Projects)

3.8.2 General Information on Local Consultants

An interview survey was conducted for a local consultant. The company profile and results of the interview survey are shown below.

Table 3-23 Profile of Local Consultant

Study item / Company name	Business category	Company profile	Business description	Major track records	Procurement of materials/equipment, etc.
Electroset Project LLC	Consulting service	Established in 2007.	Design of power-related facilities	Design and construction supervision of distribution rehabilitation project by WB	Purchase of software capable of designing a transmission tower up to 700kV from Russia
		Number of employees is 10.	(0.4 to 220kV)	Design and construction supervision of Songino 220kV substation	
		The number of employees is increased depending on the project.			

＜Result of the Interview Survey＞

Regarding the source of materials and equipment, the local consultant procures materials and equipment generally from China and Russia, but they understand that Chinese products are low in quality.

With the tight budget, however, they seem to have no choice but to procure the products from China.

When quality is given priority, the local consultant mainly procures European products, especially German products, but the transmission companies and the distribution companies seem to be interested in using Japanese products.

3.8.3 General Information on Local Constructors

(1) Contents of the Interview Survey

(a) Local Constructors

An interview survey was conducted for local constructors. The company profile and results of the interview survey are shown as follows.

Table 3-24 Profile of Local Constructors

Study item / Company name	Business category	Company profile	Business description	Major track records	Procurement of materials/equipment, etc.
Energy Construction Company	Construction work of power-related facilities	Established in 1966.	Construction of transmission line and substation, and distribution line	Construction of major trunk transmission lines in Mongol	Procurement of main equipment for power facilities from China, etc.
	Construction work	2 departments and 6 sections	(0.4 to 220kV)	Recent record is construction of 220kV transmission line between OT and Chinese border.	
		Number of employees is 160.		Construction record of 110kV-substations at 12 locations in UB.	Other necessary materials/equipment are also procurable by the company.
			Building construction	Recently accepted an order of construction of Songino substation (220kV).	
					Owns many equipment such as trucks, heavy machinery for civil engineering, cranes, pillar-erecting vehicles, aerial vehicles, carrying trailers and others.
					Owns a fresh concrete factory, an aluminum electric wire factory, a board production plant, and a steel plate folding factory.
Tsagaan Horol LLC	Construction work of power-related facilities	Established in 2007.	Construction of substation and distribution line	Construction record of 110kV-substations at 4 locations in UB.	Procurement of main equipment for power facilities from China, etc.
		Number of employees is 20.	(0.4 to 220kV)	Owns adjustment technology of relay test. (technology transfer from the transmission company)	
		The number of employees is increased depending on the project.			Other necessary materials/equipment are also procurable by the company.
					Owns cranes, aerial vehicles and back hoes.

<Result of the survey>

Most orders come from the transmission company and the distribution company, but development of new customers is going on for building construction and other construction projects.

Regarding new construction work for transmission line for 200 km, about 2 years are expected for completion, including preparation work.

EIA for substation is required for land for nomad area or environmental protection area. Normally, it takes 1 year for completion of EIA.

(b) Japanese-Affiliated Constructors

An interview survey was conducted for Japanese-affiliated constructors. The result of the interview survey is shown as follows.

Table 3-25 Result of Hearing Survey of the Japanese-affiliated Constructors

Study item / Company name	Business category	Major track records	Description		Notes
Dai Nippon Construction	Civil engineering work, construction work	ODA grant aid	The bedrock is 20 meters below ground in Ulan Bator.	Information on fresh concrete available on site	
		The Project for Improvement of Water Supply Facilities in Ulaanbaatar, etc.	No local constructors have a track record of excavating approx. 20 meters below ground.	・There was a case in which aggregates were changed without confirmation.	
		Construction of elementary schools, etc.	Safety measures are important for road excavation in yurt areas.	・Not transported on time	
				・Confirmation of road recovery might be difficult in some cases.	
Iwata Chizaki Incorporation	Civil engineering work, construction work		Groundwater level is high in Ulan Bator. The groundwater possibly discharges at approx. 3m below ground.	Information on civil engineering materials available on site	
				・Reinforcing bars are mostly made in Russia.	
				・Formwork is poor in quality and only available for one time.	

(2) Impressions on Constructors

The local constructors interviewed by the JICA Survey Team were subcontractors for the transmission and distribution companies. The constructors have substantial track records in transmission line, distribution line and substation construction.

Such construction work requires high construction ability in civil foundation work, electrical work and test and adjustment work at the same time.

Construction of an underground substation and foundation work for equipment are very important to secure the stability of structures because the temperature greatly varies by season. There are some Japanese-affiliated companies in Mongolia and it is expected that these companies provide technical guidance, including quality control and process control, to local constructors.

3.8.4 Procurement Conditions of General Materials/Equipment

An interview survey was conducted for collection of information on domestic procurement conditions of steel, cement, wood and electrical materials, as well as procurement conditions of construction heavy machinery. The result of the interview survey is shown below.

Table 3-26 Procurement Information of Materials and Heavy Machinery

	Materials/equipment	Mongol	Source of import	Notes
Civil engineering/construction	Aggregate	○		
	Formwork	○		
	Reinforcing bar	○(Darkhan-made is compliant with JIS)		
	Iron frame	○(Mostly Russian-made)		
	Fresh concrete	○		Quality control is important.
	Cement	○(Mostly Chinese-made)		
	Concrete block	○		
	Concrete secondary products (manholes, ducts)	○		
	Steel door, duct	○		
	Fence	○		
	Window frame and glass	○(Mostly Chinese-made)		
	Lighting apparatus	○(Mostly Chinese-made)		
	Air-conditioning and ventilating apparatus	○(Mostly Chinese-made)		
	Sanitary apparatus	○(Mostly Chinese-made)		
Electricity materials	Electric wire	○(Aluminum electric wire is available only for thin materials)	Russian-made, Chinese-made	
	Electric cable/control cable	×	Russian-made, Chinese-made	European-made and the US-made are also available.
	Insulator	×	Russian-made, Chinese-made	
	Conduit	×	Chinese-made	
	Flexible conduit	×	Chinese-made	
	Steel stock (transmission tower, stands for the transforming apparatus)	○(Without zinc plating)	Zinc plating Chinese-made and Russian made	
	Major transforming apparatus (transformers, breakers and switches)	×	Chinese-made, Russian-made, and European-made	
	Other transforming apparatus	×	Chinese-made, European-made	
	Distribution board, control board, etc.	○(Simple equipment)	Chinese-made, European-made	
Construction heavy machinery, etc.	Crane	○		
	Trucks (flat body, 10t, Unic crane)	○		
	Bulldozer	○		
	Grader	○		
	Back hoe	○		
	Low platform trailer	○		
	H steel	○		
	Steel plate	○		
	Aerial vehicle	○		
	Pillar-erecting vehicle	○		
	Mobile generator	○		
Note 1	Regarding the construction heavy machinery, various kinds of heavy machinery are imported and sold, or leased in large quantity for the recent mine development. Therefore, there seems to be no problem for implementation of any kind of construction work.			
Note 2	Materials/equipment are mostly Chinese-made.			

Electric wires and cables for transmission/distribution lines are generally procured from Russia, China, Europe and the United States. Only thin steel aluminum electric wire is produced in Mongolia.

The main equipment of a substation, such as transformers, switch, breakers, distribution boards, and control boards, is procured from China and Europe. Existing old facilities were mainly procured from Russia. Regarding the SCADA of transmission and distribution, European products are partially adopted.

Chapter 4 Company Information of NPTGC

4.1 Company's Profile

The National Power Transmission Grid State Own Stock Company (NPTGC) was founded in 1967, and supplies electricity to 16 states, including Mongolia's capital, Ulaanbaatar, and its neighboring areas, which account for 60 % of Mongolia's land. NPTGC consists of its headquarters and five branch offices, and holds 876 employees as of 2012. NPTGC mainly provides a transmission operation service, which connects electric power generators to large-scale customers and distribution companies. Also, NPTGC 1) imports/exports electricity from/to the neighboring countries, 2) develops expansion and refurbishment plans of transmission power system's machinery and relevant metering systems from 400 V up to 220 kV, and 3) maintains transmission power system facilities by conducting maintenance, inspections, and meter calibrations. The study team found it noteworthy that NPTGC is approved by the Mongolian government as a public electric facility constructor of transmission system machines up to 220 kV, and has been providing their construction services to other IPPs' and public sectors' projects including GIS transmission facilities of recently-built wind-power generation plants.

As a TSO of the Mongolian power system, NPTGC purchases electricity from 6 thermal power plants and one wind-power plant, and supplies 10 distribution companies, and also exports/imports electricity from Russia and China as interconnection services.

Figure 4-1 Transmission System of NPTGC

4.2 Existing Transmission Lines and Substation Facilities

4.2.1 Transmission Lines

The transmission line voltages which NPTGC owns are 220 kV, 110 kV and 35 kV. The following table shows the transmission line length of NPTGC by voltage as well as the number of circuits.

Table 4-1 Transmission Line Length of NPTGC

	220 kV	110 kV	*35 kV*
Single circuit	382.8 km	2480.1 km	*6.0 km*
Double circuit	*661.3 km*	*503.9 km*	*6.8 km*

The supports of the above mentioned transmission lines consist of towers and concrete poles and 65% of the supports are concrete poles.

Figure 4-2 Overhead Transmission Lines near the 4th TPP

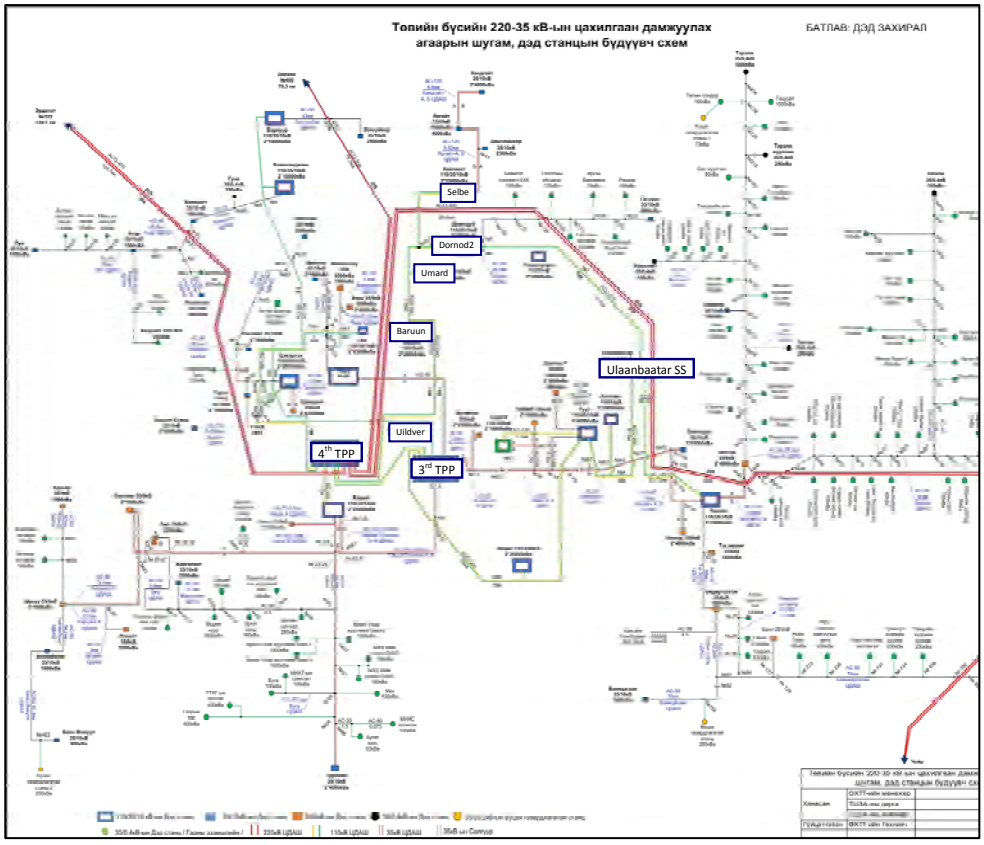
The type of the existing conductors are conventional ACSR (Aluminum Conductor Steel Reinforced) and the sizes of the conductors are mainly 240~400 mm^2 for 220 kV system and 70~150 mm^2 for 110 kV system.

Regarding the insulators, Russian and Chinese glass insulators are used. But contamination by coal smoke is noticeable and it causes insulation degradation problems. In addition, some broken insulators are left without replacement.

Figure 4-3 Glass Insulators (left: Russian-made, right: Chinese-made)

Figure 4-4 110 kV Insulators of the Incoming Tower for Baruun Substation

The following shows the NPTGC's existing system map near Ulaanbaatar.



(Source: NPTGC)

Figure 4-5 NPTGC's System Map near Ulaanbaatar

4.2.2 Substation Facilities

NPTGC owns 14 substations in Ulaanbaatar, all of which are connected to either a 220 kV or 110 kV Transmission network to deliver electricity to 35 kV or 10kV distribution networks. The survey team conducted substation visits and engineer interviews, and found that persistent outages occurred because of the inferior quality of the supply facility and the lack of alternative supply

capabilities. More precisely, the loading rates of 110 kV/35 kV or 10 kV substations reach almost 100% during the wintertime with no supply reserve margin for machine trouble, and facility failure occurs because of the deterioration of aged equipment made in Russia and inferior quality of newly-replaced machinery made in China.

During the 2nd visit of the survey team, the average loading rate of a substation with two transformers was 65 %, which is quite high considering the fact that the electricity demand in summer is the lowest during the year, and a fault in one transformer results in the overloading operation (130 %) of the remaining transformer.

The substation facilities are obsolete and have deteriorated mainly due to age, for example, mechanical protection relays are still operated with no replacement parts supply. For the improvement of obsolete substation facilities, NPTGC has already introduced a remote operation system in Umnard substation and plans to install Substation Automation Systems (SASs), and has started to replace aged mechanical relays, that consist of distance relays for main transmission line protection, and over-current relays for backup protection with Intelligent Electronic Device (IED) for current differential protection scheme,. the majority of which are supplied from ABB and SEL. According to the protection relay project interviewee, IED devices are not manufactured in Mongolia, and are procured with international bidding from foreign countries by a Ministry of Energy department, based on NPTGC's specifications. The interviewee also noted that quality assurance of the procured relays becomes problematic, because NPTGC owns no testing equipment for IED and inferior quality IED relays are sometimes supplied.

For relay replacement which is planned for the next five years, 25 to 26 types of IED have already been purchased from foreign manufacturers, and NPTGC suffers limited interoperability of these IEDs because of the language and programs used. So far, 6 to 7% of protection relays have been replaced with IEDs and the remaining are aged mechanical relays.

In terms of substation design for future expansion, most substations are equipped with future bays for system expansion and refurbishment, but no reactive power sources have been considered.

Aged Substation (Transformer and Busbar)

Cubicle of Russian Manufacturer

Relay Panels and Mechanical Relays

Specification for Machine's Ambient Operational Temperature

Figure 4-6 NPTGC's Substation Equipment

The JICA Survey Team found that the 33 kV and 10 kV protection system, which mainly covers distribution line faults, can be improved by introducing better relays. The current protection scheme is designed for an insulated grounding scheme, but the protection system employs neither zero-sequence voltage transformer nor directional-grounding fault relays, which results in an inability to identify faulty distribution lines in the case of grounding fault.

4.3 Power Demand and Forecast

The power demand and forecast of Mongolia's power system has not been disclosed to the survey team yet. NPTGC plans to review their own plan with the forthcoming ADB power system master plan, and offered to hold a discussion with the survey team in the next mission based on

ADB's report.

The NPTGC's internal investigation found heavy loadings on 110 kV transmission lines in the center of Ulaanbaatar city, and urgent needs for transmission system expansion. In particular, the transmission line No.109 and No.110 and Umard substation operate with exceeding their planned operation loadings, and the risk for sustained outage is identified in the case of single fault of the power system components.

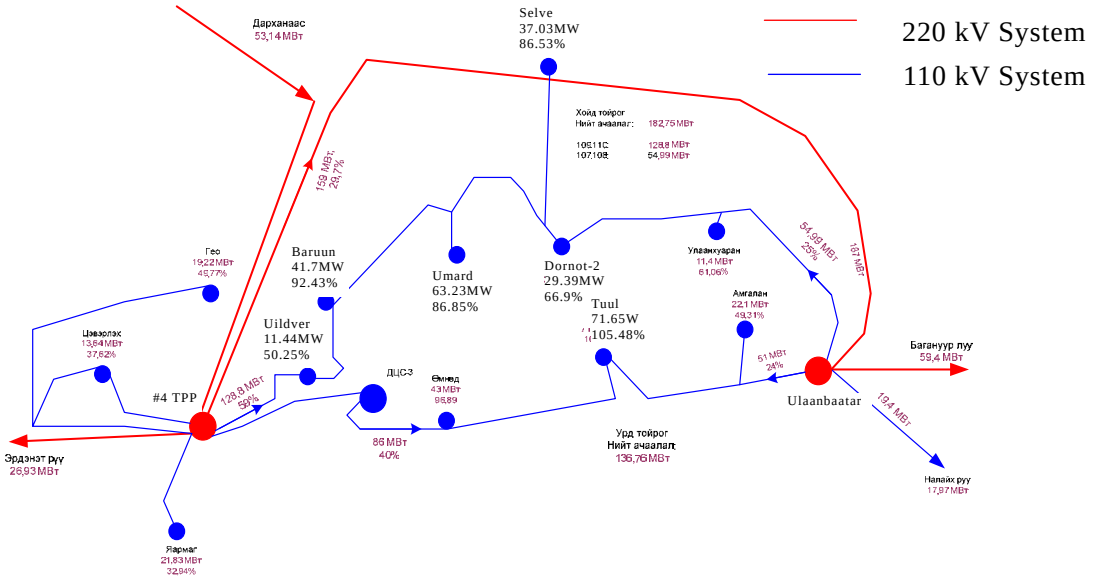


Figure 4-7 NPTGC's Internal Investigation on Heavy Loading Lines in Ulaarnbaatar System (2012)

Also the internal investigation forecasts 10.7 % annual grow in electricity demand, and suggests urgent need for facility expansion to catch up with the steeply increasing demand.

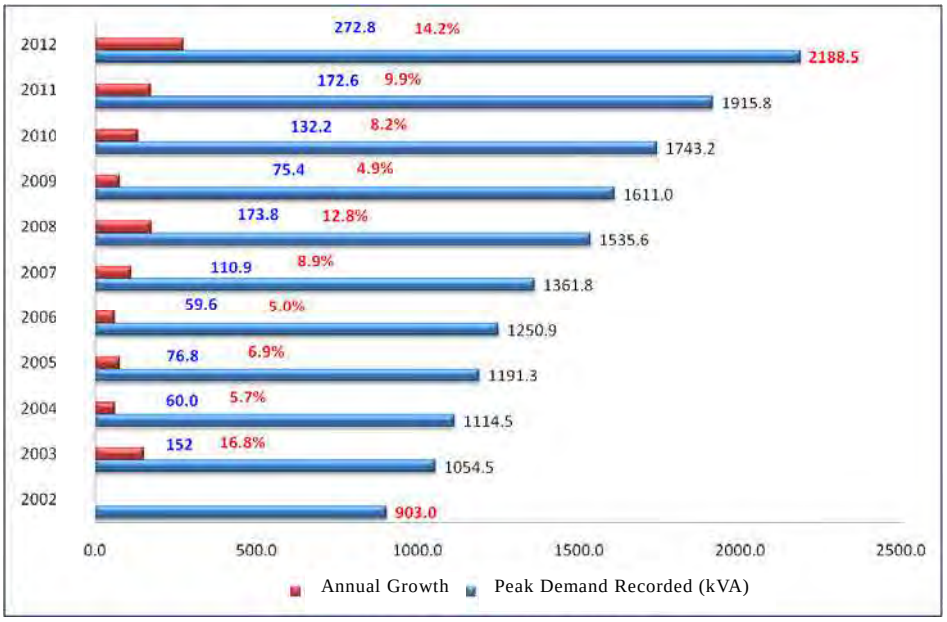


Figure 4-8 NPTGC's Demand Forecast (Internal Study)

The JICA Survey Team's interviews with relevant engineers found one current technical challenge - voltage stability of the Mongolian power system. The survey team confirmed that system operators currently increase terminal voltages at power plants to maintain some busbar voltages at the lowest permissible level, and are now planning to analyze the necessary reactive power sources in the system to consult with NPTGC.

4.4 Planning Standards

NPTGC owns a group for demand forecasting, and the power system expansion plan is developed by the demand forecast. An interviewee commented that the precision of the demand forecast is far from satisfactory and that there is room for improvement. Since the person in charge of demand forecasting was not available during the 1st and 2nd visits of the JICA Survey Team, discussions will be arranged in the coming visit about system planning.

4.5 Technical Standards and Specifications

4.5.1 Transmission Lines Specifications

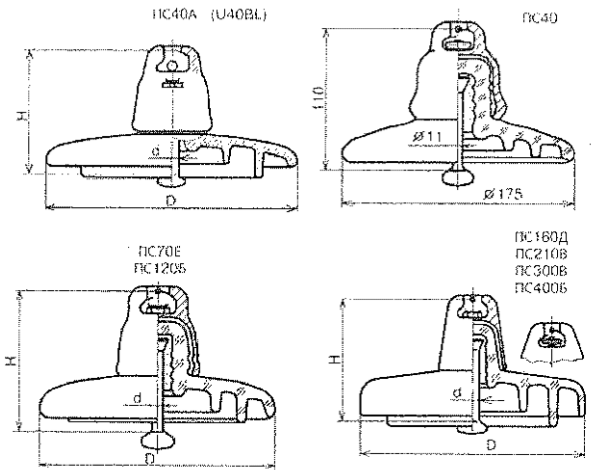
The following shows the specifications for the existing conductors and insulators.

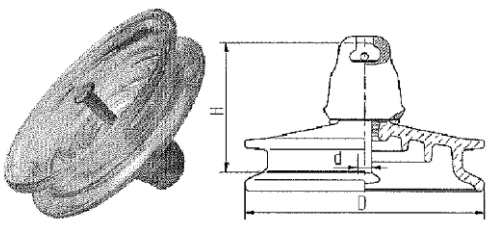
Table 4-2 Technical Specifications of the Existing Conductors

Type	Construction [mm]		Cross sectional area [mm^2]			Nominal Diameter [mm]	DC Resistance [ohm/km]	Ampacity [A]	Nominal weight [kg/km]
	AL	Core	AL	Core	Total				
ACSR70	6/3.8	1/3.8	68.0	11.3	79.3	11.4	0.46	265	175
ACSR120	28/2.3	7/2.0	115.0	22.0	137.0	15.2	0.27	380	492
ACSR150	28/2.6	7/2.2	148.0	26.6	174.6	17.0	0.21	445	617
ACSR240	28/3.0	7/2.8	238.0	43.1	281.1	21.6	0.132	610	997
ACSR300	28/3.7	7/3.2	295.0	56.3	315.3	24.2	0.107	690	1257
ACSR400	28/4.2	19/2.2	395.0	72.2	467.2	28.0	0.080	835	1660

Table 4-3 Technical Specifications & Figures of the Existing Insulators

Type	Electromechanical Failing Load	Nominal Creepage distance	D [mm]	H [mm]	d [mm]	Net weight [kg]
ПС40	40 kN	185 mm	175	100	11	1.7
ПС40А	40 kN	190 mm	175	110	11	1.7
ПС70Е	70 kN	303 mm	255	127; 146	16	3.4
ПС120Б	120 kN	320 mm	255	127; 146; 170	16	4.9
ПС160д	160 kN	370 mm	280	146; 170	20	6.0
ПС210В	210 kN	370 mm	300	170; 195	20	7.1





4.5.2 Specifications for Substation Machinery

The primary voltage of NPTGC's substations is selected from 35 kV, 110 kV, or 220 kV, and they supply electricity to distribution companies with 35 kV or 10 kV. The survey team has not received the system planning standard for machinery capacities, such as transformer capacities, but the current options for transformer unit capacity are 25 MVA and 40 MVA, and 60 MVA for the near future. The short circuit current (SCC) is currently set to be 40kA in a 110 kV transmission system, but NPTGC engineers indicated that review of the SCC is necessary based on the actual power system expansion plan to capture future network configuration. For a 220kV substation, the unit capacity of transformers is 63 MVA, and two transformers are installed at Baganur substation, which the survey team visited.

NPTGC's is now reviewing their technical standards for equipment to accommodate the relevant IEC standards requirements for the purpose of the enhancement of international competitive equipment procurement. However, specific technical requirements are necessary to assure machines' operational reliability under Mongolia's high altitude and low operational ambient temperature. NPTGC requires an ambient temperature from -55 deg Celsius to 40 deg Celsius for outdoor transmission system equipment, and -40 deg Celsius to 40 deg Celsius for indoor or distribution system equipment, while the operational altitude specified exceeds 1,000 m. Thus special considerations are necessary in insulation characteristics under the fairly low ambient temperature of gas insulated switchgears.

4.6 Financial Status

4.6.1 Financial Statements

The JICA Survey Team reviewed the financial statements of NPTGC for the period 2010-2012. The Balance Sheet, Income Statement and Cash Flow Statement are presented below.

Table 4-4 Balance Sheet (Units: MNT)

	2009	2010	2011	2012
Assets				
Current Assets				
Cash	122,164,226.19	413,748,687.78	2,112,268,797.00	2,543,395,469.49
Receivables	31,767,679.22	86,204,581.18	30,193,262.48	78,579,491.17
Doubtful Receivables				
Other Receivables	1,221,788,942.61	191,627,430.87		1,035,721,718.06
Inventory	1,682,333,040.42	1,618,605,458.91	2,406,808,938.17	2,834,213,350.22
Prepaid expenses	698,691,985.59	951,071,630.53	713,172,601.40	453,837,516.55
Total current assets	**3,756,745,874.03**	**3,261,257,789.27**	**5,262,443,599.05**	**6,945,747,545.49**
Non-current Assets				
Fixed Assets	190,653,720,733.55	192,565,416,716.36	226,690,517,115.34	237,281,060,706.35
Less Accumulated Depreciation Cost	-118,713,195,468.85	-125,577,100,334.02	-132,243,893,058.56	-138,815,458,440.71
Other Fixed Assets	5,228,708,616.87	6,201,632,924.81	9,203,819,084.24	10,806,331,728.43
Less Accumulated Depreciation Cost	-2,653,835,649.45	-3,025,577,463.34	-3,377,708,575.09	-4,155,557,919.67
Construction in Progress		846,597,636.74	85,438,396.62	275,796,409.09
Intangible assets	42,846,836.97	46,673,200.61	49,091,353.08	55,900,443.99
Less Accumulated Depreciation Cost	-15,251,683.69	-26,109,558.21	-35,235,758.40	-43,735,312.20
Investment and Other Assets	931,549,662.65	811,680,855.05	1,647,892,220.11	1,616,014,012.55
Total non-current Assets	**75,474,543,048.05**	**71,843,213,978.00**	**102,019,920,777.34**	**107,020,351,627.83**
Total Assets	**79,231,288,922.08**	**75,104,471,767.27**	**107,282,364,376.39**	**113,966,099,173.32**
Liabilities and Owner's equity				
Liabilities				
Short Term Liabilities				
Accounts Payable	2,277,908,285.42	707,414,498.67	763,753,749.24	1,429,329,884.93
Corporate tax Payable		1,518,241.31	202,935.15	3,511,217.46
Withholding Personal Income Tax Payable	27,404,590.31	1,663,291.20		3,344,636.89
VAT Payable	153,297,625.64			31,124,636.14
Other taxes payable	269,504,030.86	126,973,019.77	2,050,524.11	344,216,830.00
Social Insuarance Payable	85,633,783.49	184,927.97	46,520.00	1,724,639.00
Other taxes				
Short-term Bank Loan	200,000,000.00			
Oter payables	48,411,370.00	333,682,866.72	157,132,551.37	30,450,522.62
Prepaid Income (from small customers)			5,831,488.00	
Total short-term liabilities	**3,062,159,685.72**	**1,171,436,845.64**	**929,017,767.87**	**1,843,702,367.04**
Long-term liabilities				
Long-term loan	7,914,453,854.61	6,896,047,746.02	24,975,558,274.04	26,300,812,382.05
Other long term payables	155,185,050.00	155,185,050.00	155,185,050.00	155,185,050.00
Total long term liabilities	**8,069,638,904.61**	**7,051,232,796.02**	**25,130,743,324.04**	**26,455,997,432.05**
Total liabilities	**11,131,798,590.33**	**8,222,669,641.66**	**26,059,761,091.91**	**28,299,699,799.09**
Ownwer's equity				
Equity (state)	31,499,880,245.05	31,499,880,245.05	31,499,880,245.05	49,831,637,341.81
Equity (private)				
Total Equity	**31,499,880,245.05**	**31,499,880,245.05**	**31,499,880,245.05**	**49,831,637,341.81**
Additionally paid capital				
Assets revaluation reserve	43,647,726,304.80	43,622,940,936.45	43,693,988,743.41	43,619,079,914.70
Other parts of Owner's equity	2,448,431,318.36	3,802,569,421.36	18,331,757,096.76	6,648,754,999.93
Accumulated Profit (Loss)		-12,043,588,477.25	-12,303,022,800.74	
Current period				-2,120,894,815.09
Previous Preiods	-9,496,574,536.46			-12,312,178,067.11
Total Owner's equity	68,099,463,331.75	66,881,802,125.61	81,222,603,284.48	85,666,399,374.24
Total Liabilities and Owner's Equity	79,231,261,922.08	75,104,471,767.27	107,282,364,376.39	113,966,099,173.33

(Source: NPTGC)

Table 4-5 Income Statement (Units: MNT)

	2009	2010	2011	2012
Revenues from Main Activities				
Sales revenues	8,567,924,758.83	10,793,719,872.90	15,291,427,840.09	17,963,622,718.29
Total revenues	8,567,924,758.83	10,793,719,872.90	15,291,427,840.09	17,963,622,718.29
Cost of Product Sold	13,573,817,377.03	14,402,608,257.56	16,139,817,877.14	18,605,313,857.52
Gross Profit (Loss)	-5,005,892,618.20	-3,608,888,384.66	-848,390,037.05	-641,691,139.23
Operating Expenses				
Salaries and Wages	-603,895,829.01	-729,790,196.69	-1,058,664,251.36	-1,324,923,373.93
Social Insuarance	-81,971,879.56	-100,937,232.40	-142,221,080.99	-176,396,449.90
Service costs	-29,216,507.99	-22,847,000.00	-33,089,399.99	-53,787,600.00
Repair and Maintenance	-15,445,853.54	-22,755,770.82	-29,562,649.84	-30,615,763.61
Rent		-4,912,000.00	-4,677,000.00	-5,557,636.36
Business travle expenses	-34,629,855.94	-54,122,737.05	-66,601,239.12	-87,269,008.40
Transportation Expenses	-62,685,069.95	-68,957,677.66	-85,786,218.45	-106,569,390.28
Raw Material Expenses	-16,381,079.30	-23,122,911.99	-19,870,168.22	-33,037,088.99
Depreciation Expenses	-129,521,093.78	-131,109,390.63	-128,856,063.92	-275,685,033.72
Advertisement	-6,776,063.41	-4,725,819.10	-14,509,716.92	-38,543,111.25
Post and Communication Expenses	-25,272,202.51	-26,852,538.63	-29,383,368.96	-31,839,454.75
Fuel for Vehicles				
Doubtful Receivable Expenses				
Awards/Bonuses	-1,989,612.00	-2,841,789.00	-8,018,785.50	-15,131,990.91
Loan Interest				
Other Expenses	-179,067,784.56	-193,678,077.71	-197,261,409.19	-364,461,760.94
Total Operating Expense	-1,186,852,831.55	-1,386,653,141.68	-1,818,501,352.46	-2,543,817,663.04
Main Activities Profit (Loss)	-6,192,745,449.75	-4,995,541,526.34	-2,666,891,389.51	-3,185,508,802.27
Non-main Activities Profit (Loss)				
Revenues from Non-main activities sections	-31,753,257.42	-28,050,577.06	-26,043,266.89	
Penalties and loss from discounts	-137,877,720.85	15,423,413.35	140,104,711.63	-165,987,085.36
Dividend				
Currency exchange rate effective profit (loss)	21,603,693.26	-15,813,678.62	3,309,220.84	-39,376,203.20
Currency exchange rate profit (loss)	-843,284,749.42	873,690,223.36	-725,923,743.56	-47,994,211.12
Income form joint ventures	184,404,595.82			
Other	-93,269,401.12	1,642,325,304.51	1,592,880,704.14	1,317,971,486.86
Total Non-main Activities profit (loss)	-900,176,839.73	2,487,574,685.54	984,327,626.16	1,064,613,987.18
Profit (loss) before Tax	-7,092,922,289.48	-2,507,966,840.80	-1,682,563,763.35	-2,120,894,815.09
Corporate Income Tax				
Profit/Loss after Tax	-7,092,922,289.48	-2,507,966,840.80	-1,682,563,763.35	-2,120,894,815.09

(Source: NTGPC)

Table 4-6 Cash Flow Statement (Units: MNT)

	2009	2010	2011	2012
Cash Flow from Operations (CFO)				
Cash inflow	*17,656,906,186.81*	*27,520,959,683.82*	*39,456,414,086.40*	*53,349,902,504.14*
From sales and customers	17,438,071,896.58	27,236,257,035.13	37,194,118,037.18	52,168,342,569.91
From non-main activities	82,792,750.45	149,694,713.52	98,877,800.00	79,632,130.00
Insurance	19,057,654.00	19,660,573.52	19,177,408.00	3,232,120.00
Others	116,983,885.78	115,347,361.65	2,144,240,841.22	1,098,695,684.23
Cash outflow	*-17,514,471,522.00*	*-28,187,052,513.90*	*-39,744,091,504.70*	*-53,456,259,015.72*
Salaries and bonuses	-4,437,478,467.60	-5,298,507,239.60	-6,859,521,110.01	-8,674,620,443.15
Social insurance	-1,047,242,588.55	-1,340,498,842.62	-1,688,867,765.87	-2,052,151,276.10
Raw materials	-265,820,822.47	-385,073,759.75	-447,234,960.09	-528,006,543.34
Maintenance costs	-236,267,575.97	-304,085,085.81	-174,690,330.22	-182,926,979.45
Fuel, transportation and spare parts	-387,207,644.56	-785,813,549.92	-727,415,626.87	-913,783,367.51
Payments to suppliers	-10,437,905,656.15	-18,399,224,741.34	-25,622,213,873.57	-37,280,581,126.13
Interst paid	-53,452,071.62	-4,288,127.66	-76,021.79	0.00
Taxes Paid	-496,984,156.45	-1,478,897,917.69	-4,021,689,935.65	-2,717,765,650.34
Insurance Payments	-11,772,576.00	-15,091,185.00	-6,869,961.00	-13,704,329.00
Others	-140,339,962.63	-175,572,064.51	-195,511,919.63	-1,092,719,300.70
Net CFO	**142,434,664.81**	**-666,092,830.08**	**-287,677,418.30**	**-106,356,511.58**
Cash Flow from Investing (CFI)				
Disposal of fixed assets				
Fixed assets purchased	-500,687,431.99	-478,019,094.00	-773,162,411.04	-75,275,305.00
Disposal of capital assets				
Purchase of capital assets	-2,009,900.00	-350,000.00	-950,000.00	-4,828,900.00
Total CFI	**-502,697,331.99**	**-478,369,094.00**	**-774,112,411.04**	**-80,104,205.00**
Cash Flow from Financing (CFF)				
Bank loan	200,000,000.00			
Loan repayment	-800,000,000.00	-200,000,000.00		
Grants		1,644,000,000.00	2,660,000,000.00	980,000,000.00
Long Term Loan		-	-	-400,000,000.00
Interest and Capital Gains	30,333,784.47	24,776,141.86	143,723,795.34	126,920,521.00
Exchange rate variation	8,101,077.11	-32,729,756.11	-43,413,856.78	-89,333,132.87
Net CFF	**-561,565,138.42**	**1,436,046,385.75**	**2,760,309,938.56**	**617,587,388.13**
Total net cashflow	**-921,827,805.60**	**291,584,461.67**	**1,698,520,109.22**	**431,126,671.55**
Cash and Cash equivalents at the beginning of the year	1,067,446,891.79	122,164,226.19	413,748,687.86	2,112,268,797.08
Cash and cash equivalents at the end of the year	122,164,226.19	413,748,687.86	2,112,268,797.08	2,543,395,468.63

(Source: NTGPC)

4.6.2 Observations

Based on the financial statements, indicators for profitability, financial soundness and efficiency were calculated.

Table 4-7 Financial Indicators

		2009	2010	2011	2012
1. Profitability					
	Return on assets	-8.95%	-3.34%	-1.57%	-1.86%
	Return on equity	-10.42%	-3.75%	-2.07%	-2.48%
	Sales cost ratio	158.43%	133.44%	105.55%	103.57%
	Gross profit ratio	-58.43%	-33.44%	-5.55%	-3.57%
	Operating profit ratio	-72.28%	-46.28%	-17.44%	-17.73%
	Net profit ratio	-82.78%	-23.24%	-11.00%	-11.81%
	Working capital ratio	8.61%	29.64%	17.24%	19.29%
	Operating ratio	13.85%	12.85%	11.89%	14.16%
2. Financial soundness					
	Current ratio	122.68%	278.40%	566.45%	376.73%
	Quick ratio	44.93%	59.04%	230.62%	198.39%
	Fixed assets to equity ratio	110.83%	107.42%	125.61%	124.93%
	Fixed assets to long-term capital ratio	99.09%	97.17%	95.93%	95.45%
	Debt ratio	14.05%	10.95%	24.29%	24.83%
	Debt service coverage ratio	22.95%	N/A	N/A	-
	Interest coverage ratio	N/A	N/A	N/A	-
	Equity to total assets ratio	85.95%	89.05%	75.71%	75.17%
3. Efficiency					
	Average Electricity Revenue (USD/kWh)	N/A	N/A	0.0022	0.0027
	Average Electricity Expenses (USD/kWh)	N/A	N/A	0.0003	0.0003
	Average Operating Profit (USD/kWh)	N/A	N/A	-0.0005	-0.0003
	Electrical Energy per Employee (MWh/employ	N/A	N/A	4,384	4,772

(Source: JICA Survey Team)

The following observations are made.

Profitability

Despite the increase in the revenue and the sales cost ratio, the company continues to run at a deficit.

Financial Soundness

The current ratio exceeds 100% and has been significantly improving since 2011. One of the reasons is the decrease of short-term debt in 2010 and the increase of cash and deposits in 2011. Fixed assets to long-term capital ratio remains below 100% in all periods, i.e. fixed-assets remain supported by long term capital. Debt ratio has been increasing, but remains below 30%. As there is plenty of equity capital available, no significant issues are perceived. Asset revaluation reserve forms a significant part of the total owner's equity, in addition to the equity owned by the state, allowing them to keep own capital at high levels and maintain the financial soundness of the company. However, the aging of the existing infrastructure will call for regular maintenance, requiring increasing cash outlays. In the case that profitability is not improved, these expenses are expected to continue being covered by borrowings and grants, thus jeopardizing the mid to

long-term financial soundness of the company.

Efficiency

Efficiency of the NPGTC has been improving, but continuous deficits are reflected in the efficiency indicators.

The table below provides further international comparison of financial indicators among NPTGC and three non-Mongolian power companies from Japan (Chugoku Electric Power), Australia (Power Link) and India (Tata Power Company). (All data are for year 2012.)

Although NPTGC has much lower efficiency and profitability compared to another transmission-only company like Power Link (Australia, Queensland), no major issues are identified regarding financial soundness.

Table 4-8 International Comparisons of Various Financial Indicators

	NPTGC	Chugoku Electric	Power Link	Tata Power Company
1. Profitability				
Return on assets	-1.86%	-0.76%	6.17%	4.38%
Return on equity	-2.48%	-3.57%	19.14%	8.36%
Sales cost ratio	103.57%	48.76%	19.36%	78.85%
Gross profit ratio	-3.57%	51.24%	80.64%	21.15%
Operating profit ratio	-17.73%	-0.33%	52.76%	17.80%
Net profit ratio	-11.81%	-1.83%	49.26%	10.71%
Working capital ratio	19.29%	-13.43%	-1.23%	-29.41%
Operating ratio	14.16%	51.58%	27.88%	17.21%
2. Financial soundness				
Current ratio	376.73%	57.71%	82.07%	81.99%
Quick ratio	198.39%	36.02%	69.29%	20.80%
Fixed assets to equity ratio	124.93%	420.92%	299.41%	69.24%
Fixed assets to long-term capital ratio	95.45%	112.76%	100.82%	36.30%
Debt ratio	33.03%	371.01%	210.49%	238.91%
Equity to total assets ratio	75.17%	21.23%	32.21%	29.51%
3. Efficiency				
Average Electricty Revenue (USD/kWh)	0.0027	0.2046	0.0202	0.0971
Average Electricty Expenses (USD/kWh)	0.0003	0.1055	0.0056	0.0765
Average Operating Profit (USD/kWh)	-0.0003	-0.0007	0.0107	0.0279
Electrical Energy per Employee (MWh/employee)	4,772	5,976	42,910	3,822

(Source：JICA Survey Team)

Finally, it is noted that in the updated energy sector master plan, ADB proposed a set of benchmark financial indicators for energy sector companies, as shown in the table below. NTGPC, as of now, is not able to reach any of the benchmark levels for the short to mid-term.

4.7 Organization Structure

The following shows the organization structure of NPTGC.

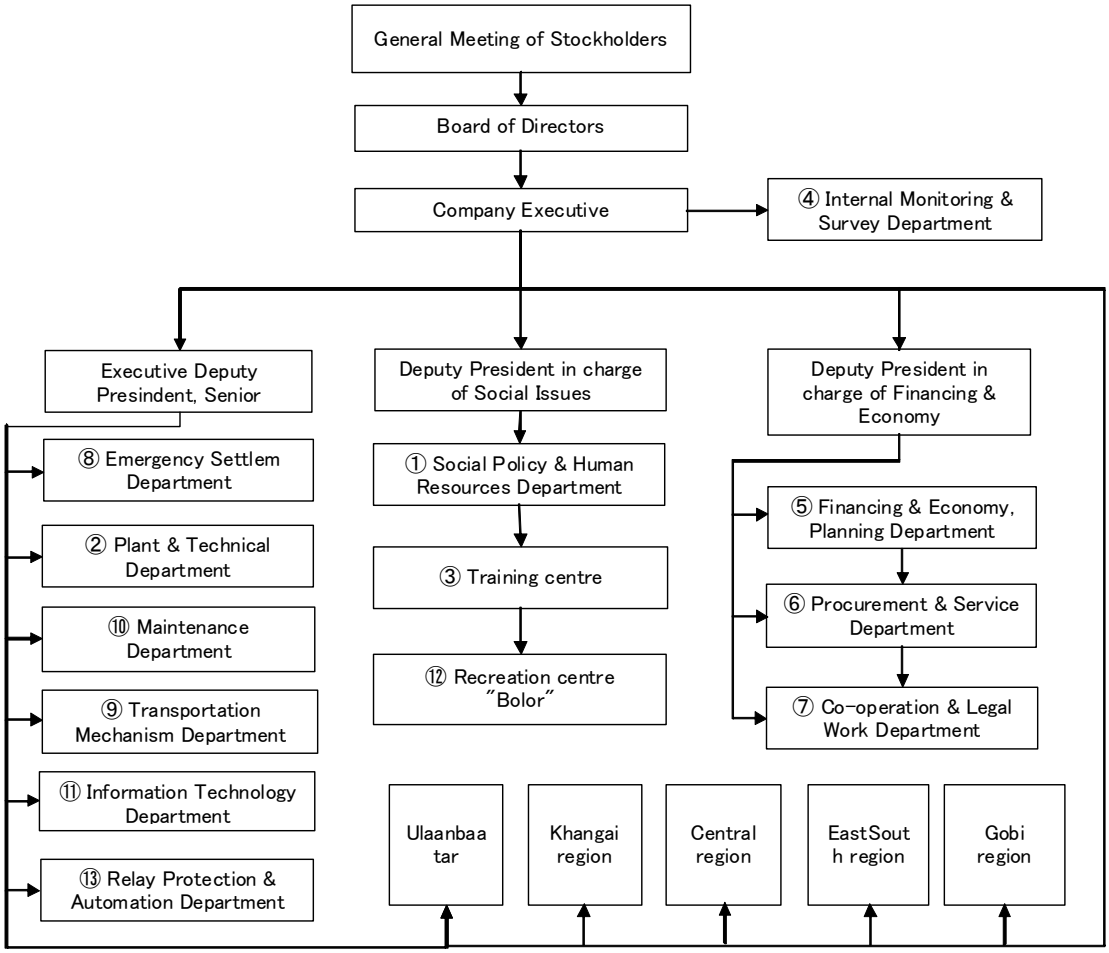


Figure 4-9 Organization Structure of NPTGC

The following shows the headquarters' functions (as of 2013).

Table 4-9 Headquarters Functions of NPTGC

name	number	function
1. Social Policy & Human Resources Department	10	✧ Ensure corporate compliance ✧ Implementation of human resource development policy ✧ Recommendations and correspondence related to treatment and staff ✧ Basic operations for the realization of the overall goal and objectives of the company
2. Plant & Technical Department	15	✧ Ensure the operation and repair and stability of the technical equipment of the entire company ✧ Command and organization of facilities management ✧ Management of performance and planning of the business in summer / winter ✧ Compilation of finance ✧ Grant of technical conditions and payment and signing of power import and export contracts ✧ Long-term planning; the development of projects and programs ✧ Reporting and operation management of relay automatic protection equipment ✧ Investigation of the cause of failure and power outages, summarizing of problems ✧ Establishment and implementation of facility planning
3. Training centre	3	✧ Introduction and implementation of tools to improve productivity of the entire company ✧ Continuing efforts for the training of engineers/technicians/workers and professional capacity building
4. Internal Monitoring & Survey Department	4	✧ Management of compliance with internal regulations of the company ✧ Processing of violations and problems; the implementation of the internal audit
5. Financing & Economy, Planning Department	11	✧ Revenue and cost management ✧ Disposal and asset management ✧ Improvement of the economic effects
6. Procurement & Service Department	13	✧ Purchase of necessary goods, parts and equipment ✧ Storage and supply of goods
7. Co-operation & Legal Work Department	4	✧ Efforts to expand cooperation domestically and abroad ✧ Customer acquisition ✧ Environmental improvement for contracts of energy import / export
8. Emergency Settlement Department	13	✧ Coordination and supervision for smooth transmission business of the entire company ✧ The command and supervision of the staff in the substations
9. Transportation Mechanism Department	39	✧ Equipment maintenance of the branches and the central office
10. Maintenance Department	9	✧ Maintenance service of the entire company
11. IT Department	4	✧ Establishment of information technology policy ✧ Introduction of automatic control systems and advanced ICT
12. Recreation Centre "Bolor"	9	✧ A Facility of recreation for all employees
13.Relay Protection & Automation Department	11	✧ Policy making and management of protection relay, automation system, high voltage testing, and metering in NPTGC's system. ✧ Introduction of new technologies for 220kV/110kV/35kV system including secondary circuits of transmission line, substation, Protection co-ordination, and lightning protection design.
Total	144	

4.8 Operation & Maintenance of the Transmission Lines and Substations

4.8.1 Transmission Lines

The aforementioned 5 branch offices maintain the transmission lines of each area. The following figure shows a high place maintenance vehicle of NPTGC. It seems that the workability of this vehicle would not be good because the bucket can move only in a vertical direction.

Russian-made High Place Maintenance Vehicle of BAGANUUR Branch Office

Repair Work on a Transmission Line Accident

Figure 4-10 Operation & Maintenance of the Transmission Lines

4.8.2 Substation Facilities

Similar to transmission line maintenance, branch offices are in charge of substation maintenance. The interview with NPTGC's engineers of the headquarters and a branch office found that NPTGC plans to introduce condition based maintenance, in which each piece of equipment is diagnosed for aging deteriorations, and the repair and/or replacement plan for the machine is tailor-made based on its operational condition and expected lifetime. The interview also revealed the shortage of on-field tools for maintenance. Many necessary on-field tools, such as an infrared camera, of which NPTGC currently owns one set and rents another; insulation oil diagnostic machine; on-site withstanding testing equipment, which are currently incapable of 110kV machine test; relay testing equipment for IEDs; are aged and do not operate properly, and are also few in number. Thus, the survey team confirmed NPTGC's urgent need of the redistribution of these fundamental diagnostic tools.

Withstand Testing Tools (Not Operating Property)

Current Testing Machines

Figure 4-11 Aged Testing Equipment for Substations

4.9 Transmission Losses

NPTGC decreased the transmission loss to 3.19 % in 2013 compared to 4.25 % in 2002. According to NPTGC's explanation, renewal of the substation facilities as well as reduction of the electric power interchange from Russia contribute to the loss reduction.

4.10 Project Plan

To coincide with the Survey, the Asian Development Bank (ADB) is conducting a Mongolian energy sector study for power system planning: Updating Energy Sector Development Plan TA No.: 7619-MON. However, NPTGC has not disclosed any project planning yet, and the survey team expects little information from ADB's project, which mainly covers power generation and covers little on transmission system planning.

4.11 Planning, Operation an Maintenance Performance

According to the interview with the chief engineer of the national dispatching center, development of detailed power system planning and introduction of countermeasures against system voltage drop are necessary. These studies shall be done by NPTGC based on the master plan from the Ministry of Energy, and demand forecast and recommendations from the national dispatching center. The engineer also acknowledged the necessity of existing 110kV transmission line and substation upgrades in Ulaanbaatar city, which are currently operated at their maximum operational transmission capacities. The survey team also concluded that detailed study of future power system planning is necessary to utilize existing facilities, such as the transmission line to Baganur, which are built for 300 kV transmission but are currently operated at 220 kV with lower capability.

4.12 Accident Records of Transmission System, and an Example of the Application of Mobile Substation

Based on interviews with NPTGC, regarding the transmission lines, there were several accidents with tower collapses caused by ice & snow accretion. In addition, there were some conductor disconnection accidents before now and this may be caused by the inhomogeneous quality of the Russian-made conductors before the 1970s or shoddy workmanship. According to the interview with Baganuur Substation, NPTGC implements accident restoration by itself, gathering manpower and necessary equipment from the branch offices. The following pictures are the accident samples occurred in Darkhan.

Figure 4-12 Tower Collapse Accident due to Ice & Snow Accretion

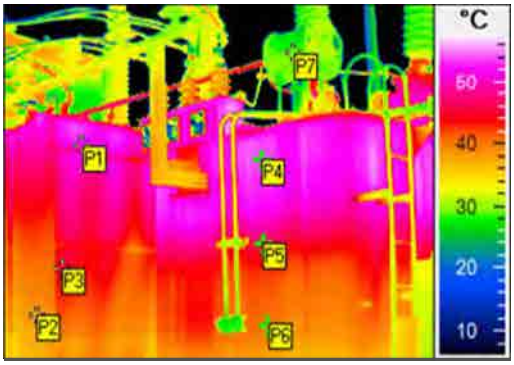
The JICA Survey Team accordingly gathered facility trouble history to evaluate the current situation of NPTGC'S power system and NPTGC reported the followings statistics of substation facility troubles. The statistics shows NPTGC experienced five transformer troubles and four circuit breaker troubles occurred on average during 2009-2013. NPTGC also informed that two transformers' breakdown incidents in 110 kV substations (Umard, Umnd) after 2010, and shortage of replacement parts for 10 kV Cubicles, and concluded that machine failures will constantly occur in existing substations if the majority of aged and problematic equipment is not replaced.

Table 4-10 Past Records of Faults of Transformers and Circuit Breaker

	Transformer Fault per Year	Circuit breaker Fault per year	Accumulated fault duration (hour/year)	Accumulated fault duration (days/year)	Frequency (days/once)	
					Transformer	Circuit Breaker
2013	52	55	252.10	10.50	7	7
2012	72	104	201.80	8.41	5	4
2011	84	86	285.80	11.91	4	4
2010	75	119	320.40	13.35	5	3
2009	84	132	358.50	14.94	4	3
Average	73	99	283.72	11.82	5	4

The JICA Survey Team also confirmed the necessary maintenance programs and relevant tools to identify the conditions of existing facilities, and necessary machines, such as mobile substation equipment, for emergency troubleshooting of faulty equipment and restoration of electricity supply, both of which NPTGC is now struggling to develop.

The following picture shows the 100 kV/10kV/6kV, 25 MVA China transformer trouble as an example of substation machine trouble. This transformer started its operation in 2009, and after 3 years of operation, NPTGC identified overheat and increase of dissolved gas in the insulation oil due to the partial discharge of main windings with fast deterioration of insulation paper in July 2012, and removed the faulty transformer from the power system. To maintain the substation's supply capacity, NPTGC transported aged Russian transformer as the replacement.



Diagnosis with Infrared Camera (Overheating)

Faulty Portion of Transformer

Figure 4-13 Example of Substation Trouble

Chapter 5 Company Information of UBEDN

5.1 Company Overview

UBEDN's main business content is the planning, construction, maintenance, and management of distribution and transformation facilities under 35 kV. And UBEDN purchases electricity from NPTGC via 16 substations (168 watt-hour meters) and sells it to customers.

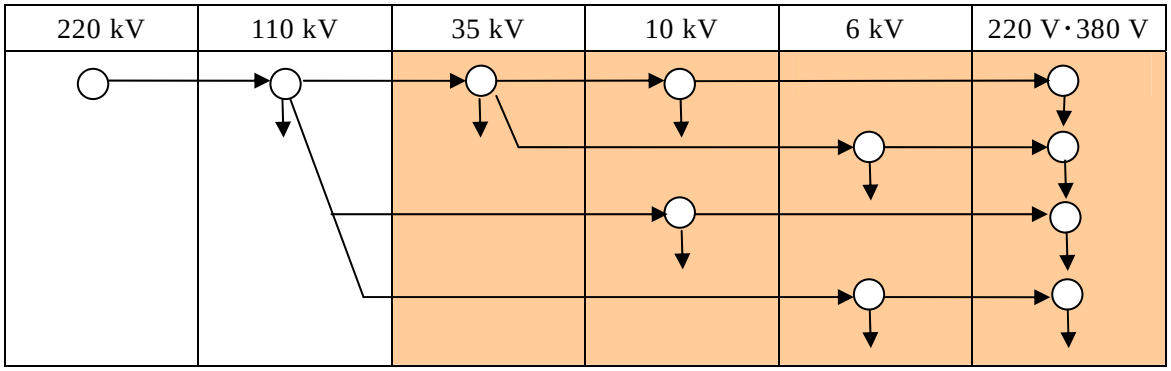
Scope of business: 8 wards and 16 states in Ulaanbaatar City
(The range of about 230 km of east and west, and about 163 km of north and south)
Maximum peak demand: 409 MW (growth rate from 2011 to 2012: 18.6%)
Number of shareholders: About 210,000
Number of employees: About 1,600

5.2 Existing Distribution Facilities

5.2.1 Voltage Classes and Number of Facilities

(1) Voltage Classes

Voltage classes of MV in UBEDN are 6 kV, 10 kV and 35 kV, and the MV system is no-grounded. LV are 220 V and 380 V. An underground system (UG) is installed in the city area of UB, and an overhead system (OH), on the other hand, is in the suburbs of UB.



(Source: developed by the JICA Survey Team)

Figure 5-1 Voltage Classes of UBEDN's Facilities

(2) Number of Facilities

The following is the number of UBEDN's facilities. Some customers themselves install their facilities on the grid, which is operated by UBEDN.

Table 5-1 Number of UBEDN's Facilities (at the end of 2011)

Facility	Voltage class	Number	UBEDN's	Customers'
Substation	35 kV	78	46	32
Distribution Tr.	10 kV,6 kV / 0.4 kV	3,007	1,414	1,593
Switching Sta.	10 kV, 6 kV	49	30	19
Wire length (km)	35 kV	1,065	1,039	25
	10 kV, 6 kV (OH)	1,993	1,417	576
	10 kV, 6 kV (UG)	849	754	95

(Source: UBEDN)

(3) Overhead Distribution System

By way of example, the following is a picture of two poles at the feeding points. The right wood pole is for the existing feeder, and left concrete one is for a new feeder.

Figure 5-2 Overhead Distribution System

(4) Underground Distribution System

The following is a picture of MV UG cables. Cables across a road are in ducts, but cables generally are buried directly. An old cable is mostly an "OF cable (Oil-Filled cable)", but a new one is recommended to be "XLPE cable (Cross-Linked Polyethylene cable)".

Figure 5-3 Underground Distribution System

The JICA Survey Team conducted interviews about UBEDN's problems with existing facilities. The problems UBEDN recognized are as follows:

1. Replacement of overage facilities was not going smoothly.
2. Amount of load current was about to reach the capacity limit of facilities because of rapid increase in demand: 16%
3. The customers' facilities on the grid were not easy to manage.
4. 40%-80% of facilities operated now are over lifetime.

   [Lifetime] Wood pole: 30 years

   Concrete pole: 60 years (installed since 2006)

   Transformer: 30 years (the manufacturers' estimation: 25-30 years)

5.2.2 Distribution Facilities in Ulaanbaatar City

(1) Overview of Distribution network

The following is overview of the distribution network in Ulaanbaatar city. Electricity is supplied through distribution substations, switching stations and distribution towers.

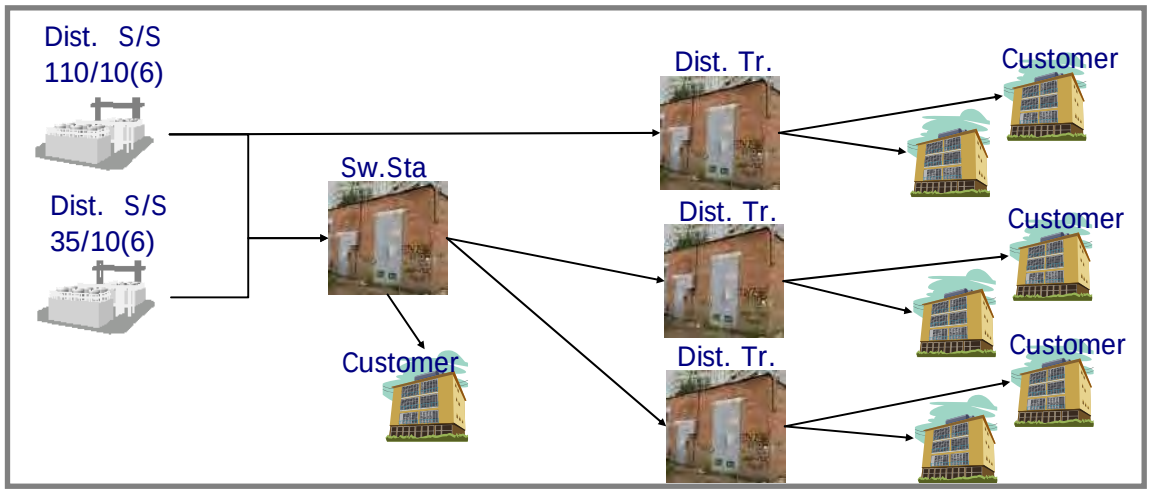


Figure 5-4 Overview of Distribution Network（image）

(2) Distributing Substation

The following is a picture of a 110 kV distribution substation, namely, Umard S/S. Most of the facilities in this substation belong to NPTGC, and only the distribution cables belong to UBEDN, although circuit breakers (CB) and cables of feeders are under the control of UBEDN. However, in the current situation, because the CB's are installed in substations of NPTGC, the facility management is also made by NPTGC. In addition, NPTGC staff implements the operation through requests of UBEDN.

Figure 5-5 Exterior of Umard Substation (110/10/6kV)

Figure 5-6 Inside of Substation and Distributing Circuit Breaker (Made in China. Right: 10kV, Left: 6kV. There are some heaters.)

Figure 5-7 Protective Relay (Manufactured by SEL (USA)(Some of these relays have DGR. -40 degree Celsius specification 10 year guarantee)

Figure 5-8 A panel in S/S (Measure of voltage to ground and interphase voltage on each feeder)

Figure 5-9 Cable Termination of Feeders (Made in Russia)

(3) Switching Station

The following is pictures of a switching station, namely, РП13. The switching station divides a feeder into 5-10 sections and has a CB, which has an auto reclosing functional system (ARCS). There is only an over current relay (OCR), and no direction ground fault relay (DGR). The ARCS is set available for OH, but unavailable for UG based on NDC's regulation "The guideline for fault restoration in wide power network". The OCR in the switching station (РП13) is made in the former Soviet Union and doesn't work well in winter for overage, so there is a heater system.

Every feeder has a watt-hour meter manufactured by ABB (SUI) and measuring kWh and kVarh. The distribution system is a formed ladder-type; a distribution transformer is able to be supplied from both of 2 parallel lines (A system, B system). In the switching sta. there are two type meters. One is for large consumers and the other is for a sum of apartments which is used for checking the metering of each customer in the apartments. UBEDN measures the meters once a month. РП13 supplies power to the project area (the 4th ward) by 4 feeders.

Figure 5-10 Exterior of Switching Sta. (РП13)

Figure 5-11 Circuit Breakers

(4) Distribution Transformer

The distribution transformer (DT) consists of the following 3 rooms.

i. MV room: disconnecting switches (DC) or lord breakers (LBS), MV fuses

ii. Transformer room: transformers which change 10 kV (or 6 kV) into 380 V

iii. LV room: LV panels, watt-hour meters

UBEDN has 4 types transformers: 400 kVA, 630 kV, 800 kVA, 1 MVA. The 630 kVA transformer is the most popular. The transformers have MV fuses on the primary side for protection. The equipment in the DT is too old and in a dangerous situation; some live parts are exposed. The meters in the LV room measure kWh of the sum demand of an apartment or a large user. Because some DTs belong to customers, UBEDN has the following problems:

- Customers' DTs are difficult to maintain and replace.
- When a fault happens in a customer's DT, it will affect another DT.

Right: Each side of the cubicles is connected with different distribution cables (A system, B system).

Figure 5-12 Exterior of Distribution Transformer

Figure 5-13 Load breakers (A system/B system)

Figure 5-14 Disconnector (unavailable as a load breaker)

Figure 5-15 Transformation Protection Fuse

Figure 5-16 Watt-Hour Meter

UBEDN has experimentally installed 20-30 Ring Main Units (RMU) lately in DTs of UB city. Ring Main Unit is a kind of switches installed for underground system. It is consisted of switches,

disconnecting switches, transformer protection fuses, and earthing. The above equipments are assembled in one unit. The unit is added when the member of the feeder increases.

The equipment in the following picture is an LBS manufactured by SIEMENS (GER) which is insulated by SF6 gas. As per the results of the experiment, the insulation performance of the CBs gets worse in winter because of liquefaction of the SF6 gas, so UBEDN utilizes them as disconnectors. The Ring main unit of UBEDN cannot break the fault current.

Figure 5-17 Distribution Transformer with Ring Main Unit (RMU)

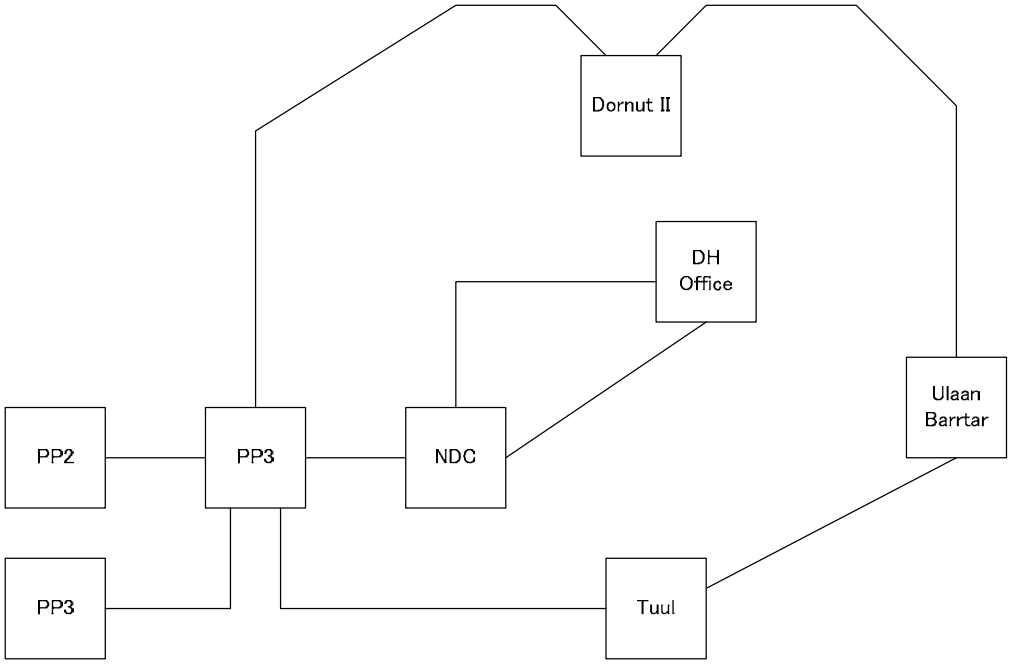
At the time of DAS installation, the CBs in S/S and Switching Sta., and LBSs in DT have to be replaced with automatic ones. The JICA Survey Team also recommends replacement of distribution cables because those overage cables will cause faults and massive blackout.

5.2.3 Telecommunication System

The communication network owned by UBEDN is made up of twenty-four core optical fiber cable which was installed at the beginning of this year, running from the head office through NDC to the No.3 power plant. That fiber cable is managed and maintained by the Ministry of Energy through NDC. Moreover, it is capable of connecting to the OPGW (see figure below) which is managed by NDC. OPGW is looped with twenty-fore core optical fiber cable and works with a telecommunication network located in a substation owned by the Transmission Company.

Another telecommunication network is an optical fiber that connects the east and west branches to the head office. This telecommunication network is used for Internet mainly and contracted by the ISP. Only the VHF network connects the head office, east and west branches, substations, switch stations, and distribution transformers. Therefore, when metering data is required in the substations, switch stations, and distribution transformers, an employee must go there.

As for future planning, by NDC, fiber optical cable will be installed between east and west branches to the Dornut substation. Construction by NPTGC has been completed, connecting each of the eleven substations to the OPGW at the end of September.



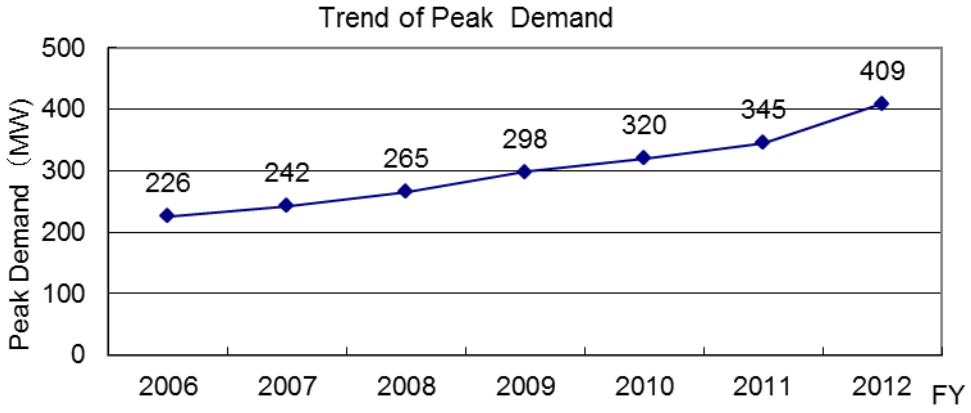
(Source: NDC)

Figure 5-18 OPGW Diagram (Image)

5.3 Power Demand Performance and Forecast

(1) Power Demand Performance

The following graph shows the trend of peak demand in UBEDN. The Peak in Jan 2012 was 409 MW, and the growth from 2012 to 2013 was 18.5%. The JICA Survey Team expects that UB city will continue growing at the same rate.



(Source: UBEDN)

Figure 5-19 Trend of Peak Demand in UBEDN

(2) Power Demand Forecast

The following graph shows the demand forecast to 2020 based on the assumption that recent demand growth (10.4 % / year) will continue. The center of UB city might be developed more than

expected, so it is important to get accurate information about city planning / the trend of constructions for large consumers.

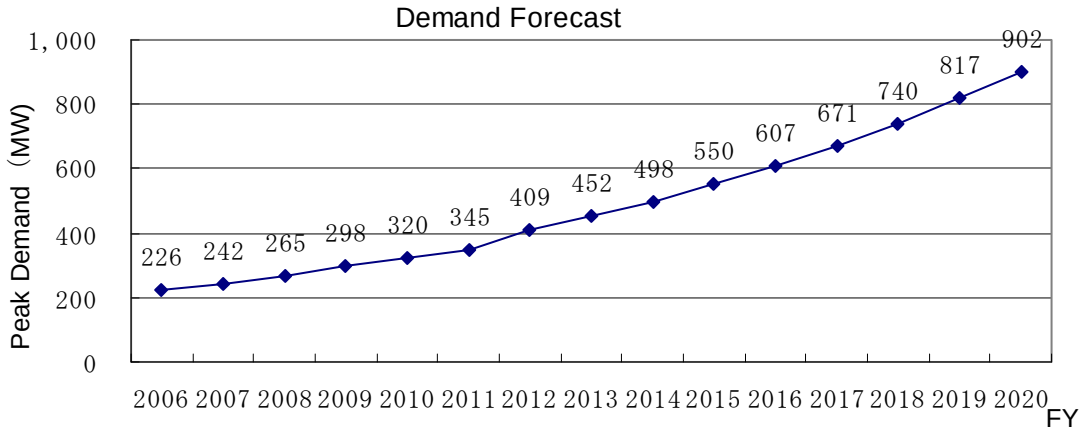
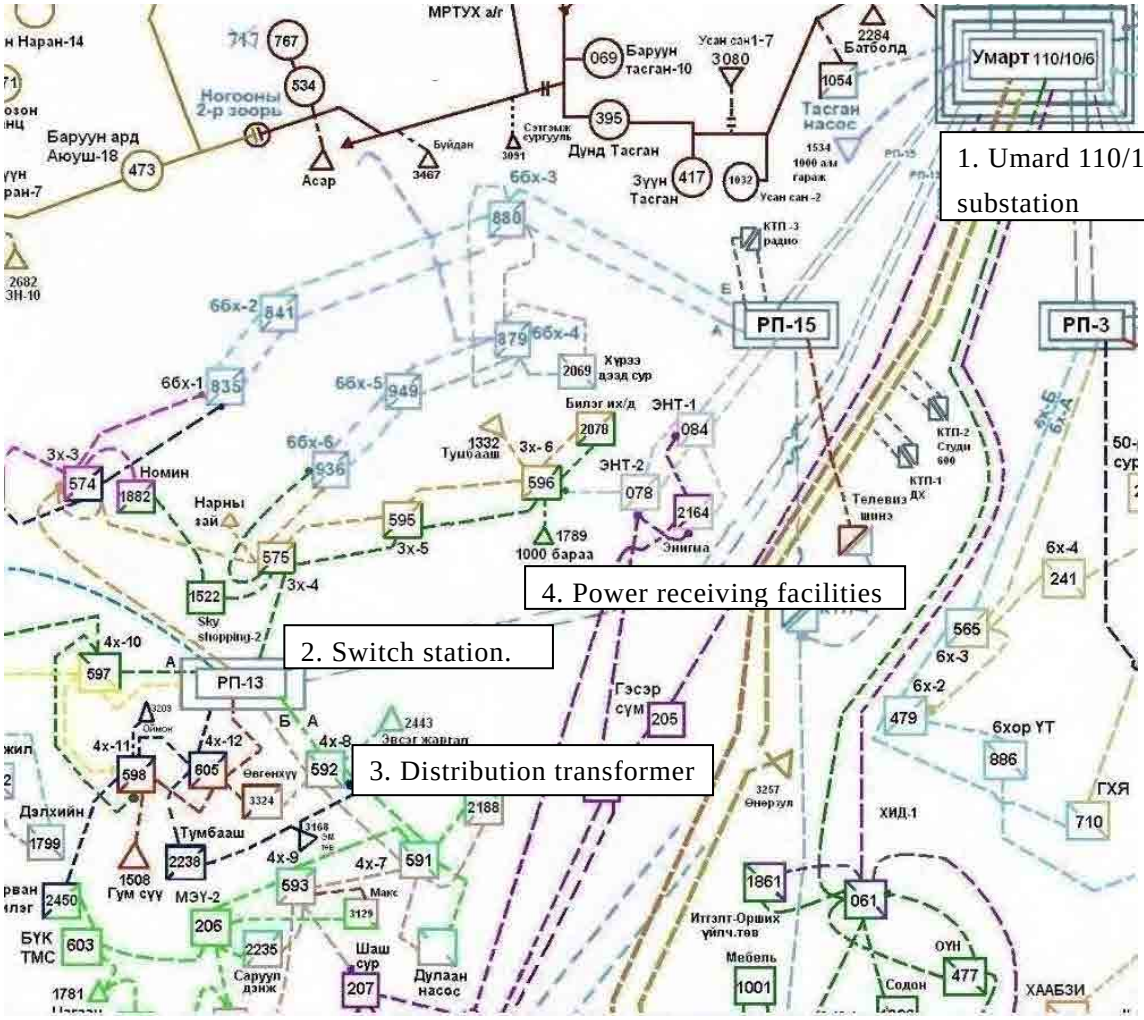


Figure 5-20 Forecast of Power Demand

5.4 Planning Standard

5.4.1 Structure of Distribution System

The power grid map in Ulaanbaatar is shown below (Ulaanbaatar No.4 district).



（Source: UBEDN）

（Legend）

Solid line; overhead line, dot line; underground line, one feeder is described as the same color.

1. Umard 110/10/6 kV substation
2. Switch station. Power source; Umard substation.
3. Distribution transformer (□; underground facilities, ○; Overhead facilities)
4. Distribution transformer with iron box. (99% of the facilities are customers own)

Figure 5-21 Distribution Grid Map in No.4 District of Ulaanbaatar City

Most of the Distribution grid system in UB city consists of underground line, and the system outside UB, on the other hand, is overhead line. Normally, each feeder of underground line is interconnected with each other but the overhead line, in contrast, is sometimes not interconnected.

5.4.2 Supply Reliability

The climate in the winter season is extremely cold, therefore if customers lose heat during an outage, their lives may sometimes be in danger. From this viewpoint, customers are categorized by 3 types based on the priority to restore electricity.

Category 1. Most significant customers, such as hospitals.

Category 2. Customers which use electricity for heating.

Category 3. Customers which use firewood for heating.

Customers categorized as 1 and 2 are obliged to receive electricity from two different systems (A system and B system) so that they can quickly recover electricity when a fault happens. Customers categorized as 3, on the other hand, are not covered by this rule. They have only to receive from one system.

Theoretically, the maximum system utilization factor is 50% in the case that customers have such duplicate services, but actually, some of the distribution system is operated at more than 50%. Therefore it is difficult to operate the distribution system especially in the winter season.

The following shows the typical power supply structures. Between the A & B system, there are bypass lines like ladders, which is a typical of an underground distribution system.

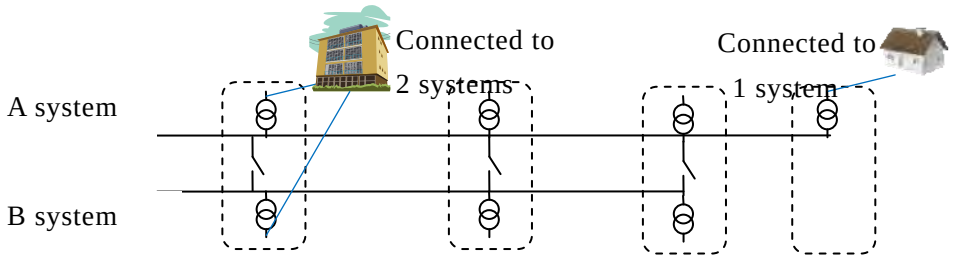


Figure 5-22 Customer's Power Receiving System in Underground Distribution Line

5.5 Technical Standard

In the past, technical standard is based on the Russian national standard (Gosudarstvennyy Standart: GOST) but now, it is based on the International Electrotechnical Commission (IEC).

Ulaanbaatar city is located 1,300m above sea level, and the temperature falls below -40 in winter. If a power fault happens, the temperature inside substations, switch stations and distribution transformers sometimes reaches the same level as the outside temperature. The devices used for power facilities must work under such low temperatures. According to the interview from UBEDN, products made by SEL (American company) or Russian products can

work under such conditions.

5.6 Financial Status

5.6.1 Financial Statements

The JICA Survey Team reviewed the financial statements of UBEDN for the period 2010-2012. The Balance Sheet, Income Statement and Cash Flow Statement are presented below.

Table 5-2 Balance Sheet (Units: MNT)

		2009	2010	2011	2012
1	**Assets**				
1.1	**Non-current Assets**				
1.1.20	**Total non-current assets**	62,382,436,000	65,683,510,000	73,774,107,700	82,383,432,600
1.2	**Current Assets**				
1.2.20	**Total Current Assets**	11,462,485,000	12,531,583,000	16,585,153,200	16,707,737,100
1.3	**Total Assets**	73,844,921,000	78,215,093,000	90,359,260,900	99,091,169,700
2	**Liabilities and Owner's equity**				
2.3	**Ownwer's equity**	25,295,950,000	28,163,838,000	33,954,236,000	44,469,965,500
2.1	**Liabilities**				
2.1.1	**Short Term Liabilities**	15,184,793,000	15,206,998,000	14,609,607,000	12,593,036,000
2.1.2	**Long-term liabilities**	33,364,178,000	33,844,257,000	41,795,417,000	42,028,168,200
2.2.20	**Total liabilities**	48,548,971,000	49,051,255,000	56,405,024,000	54,621,204,200
2.5.20	**Total Liabilities and Owner's Equity**	73,844,921,000	77,215,093,000	90,359,260,000	99,091,169,700

(Source: UBEDN)

Table 5-3 Income Statement (Units: MNT)

	2009	2010	2011	2012
Main Activities Profit (Loss)				
Revenue	79,422,693,000	99,285,195,000	120,862,430,279	143,794,145,800
Cost of Product Sold	69,114,190,000	88,500,663,505	105,137,098,344	124,015,756,900
Gross Profit (Loss)	10,308,503,000	10,784,531,495	15,725,331,934	19,778,388,900
Operating Expenses	16,059,837,000	13,570,341,381	15,348,385,021	19,990,475,600
Operating Profit (Loss)	-5,751,334,000	-2,785,809,886	376,946,913	-212,086,700
Non-main Activities Profit (Loss)	3,558,281,000	6,444,884,818	821,152,880	977,702,400
Profit (loss) before Tax	-2,193,053,000	3,659,074,932	1,198,099,793	765,615,700

(Source: UBEDN)

Table 5-4 Cash Flow (Units: MNT)

	2010	2011	2012
Cash Flow from Operations (CFO)			
Cash inflow	119,537,523,774	130,693,353,622	157,179,920,000
Cash outflow	-87,561,716,966	-29,377,125,996	-39,926,594,300
Net CFO	**31,975,806,808**	**101,316,227,626**	**117,253,325,700**
Cash Flow from Investing (CFI)			
Total CFI	**0**	**15,432,180**	**0**
Cash Flow from Financing (CFF)			
Net CFF	**-31,286,211,897**	**-98,765,773,505**	**-119,406,373,900**
Total net cashflow	**689,594,910**	**2,565,886,301**	**-2,153,048,200**
Cash and Cash equivalents at the beginning of the year	803,278,646	1,492,873,556	4,058,759,857
Cash and cash equivalents at the end of the year	1,492,873,556	4,058,759,857	1,905,711,657

(Source: UBEDN)

5.6.2 Observations

Based on the financial statements, indicators for profitability, financial soundness and efficiency were calculated.

Table 5-5 Financial Indicators

		2009	2010	2011	2012
1. Profitability					
	Return on assets	-2.97%	4.68%	1.33%	0.77%
	Return on equity	-8.67%	12.99%	3.53%	1.72%
	Gross profit ratio	12.98%	10.86%	13.01%	13.75%
	Operating profit ratio	-7.24%	-2.81%	0.31%	-0.15%
	Net profit ratio	-2.76%	3.69%	0.99%	0.53%
	Working capital ratio	-11.16%	-7.91%	4.73%	9.79%
	Operating ratio	20.22%	13.67%	12.70%	13.90%
2. Financial soundness					
	Current ratio	75.49%	82.41%	113.52%	132.67%
	Quick ratio	-	-	-	-
	Fixed assets to equity ratio	246.61%	233.22%	217.28%	185.26%
	Fixed assets to long-term capital ratio	106.35%	105.93%	97.39%	95.24%
	Debt ratio	65.74%	62.71%	62.42%	55.12%
	Debt service coverage ratio	-	-	-	-
	Interest coverage ratio	-	-	-	-
	Equity to total assets ratio	34.26%	36.47%	37.58%	44.88%
3. Efficiency					
	Average Electricty Revenue (USD/kWh)	0.0354	0.0435	0.0528	0.0500
	Average Electricty Expenses (USD/kWh)	0.0072	0.0059	0.0067	0.0069
	Average Operating Profit (USD/kWh)	-0.0026	-0.0012	0.0002	-0.0001
	Electricity Energy per Employee (MWh/employee)	1,066	1,152	1,236	1,447

(Source: JICA Survey Team)

The following observations were made.

Profitability

UBEDN has been showing an increase in revenues, while operating ratio has been decreasing. In some years, operating deficits occur, but they are compensated for by non-operating revenues, resulting in an overall surplus. Return on assets went above the ADB long to mid-term benchmark (See Chapter 4) in 2010, but deteriorated after that. The return on equity reached close to the short to mid-term level of the benchmark proposed by ADB in 2012.

Financial Soundness

The current ratio went above 100 % in 2011, showing improving financial soundness. The main reasons for this are the increase in current assets and the decrease in short-term liabilities. At the same time, fixed assets to equity ratio remains significantly above 100 %, a sign that fixed capital investments highly depend on borrowed capital. Fixed assets to long-term ratio is below 100%, showing fixed assets' dependence on long term capital. Debt ratio fluctuated between 50-60%, indicating no specific problems.

Efficiency

The efficiency remains low, although showing improvement.

The table below provides further international comparison of various profitability, financial soundness and efficiency of UBEDN and three non-Mongolian power companies from Japan (Chugoku Electric Power), Australia (Power Link) and India (Tata Power Company). (All data is for 2012.)

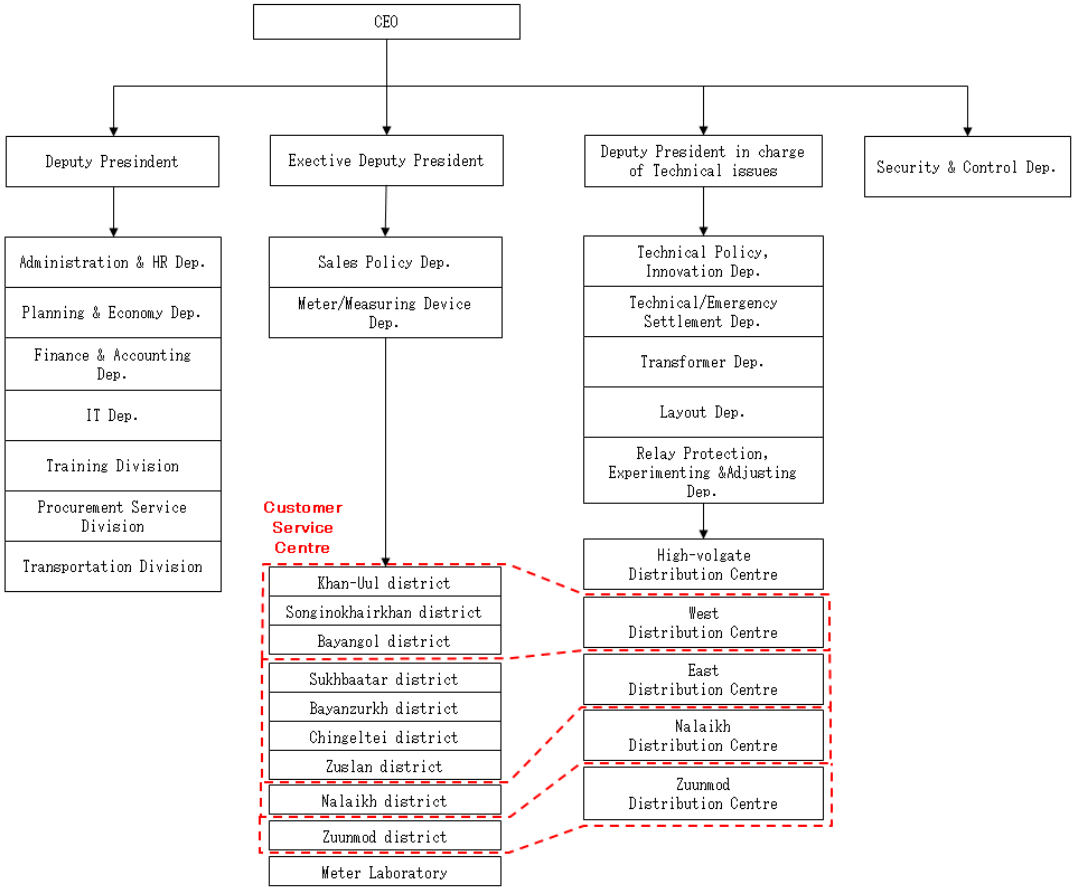
UBEDN exhibits low levels of efficiency and profitability compared to the other three companies, mainly due to the low power tariffs.

Table 5-6 International Comparison of Various Financial Indicators

		UBEDN	Chugoku Electric	Power Link	Tata Power Company
1. Profitability					
	Return on assets	0.77%	-0.76%	6.17%	4.38%
	Return on equity	1.72%	-3.57%	19.14%	8.36%
	Gross profit ratio	13.75%	51.24%	80.64%	21.15%
	Operating profit ratio	-0.15%	-0.33%	52.76%	17.80%
	Net profit ratio	0.53%	-1.83%	49.26%	10.71%
	Working capital ratio	9.79%	-13.43%	-1.23%	-29.41%
	Operating ratio	13.90%	51.58%	27.88%	17.21%
2. Financial soundness					
	Current ratio	75.49%	57.71%	82.07%	81.99%
	Quick ratio	-	36.02%	69.29%	20.80%
	Fixed assets to equity ratio	246.61%	420.92%	299.41%	69.24%
	Fixed assets to long-term capital ratio	106.35%	112.76%	100.82%	36.30%
	Debt ratio	65.74%	371.01%	210.49%	238.91%
	Equity to total assets ratio	34.26%	21.23%	32.21%	29.51%
3. Efficiency					
	Average Electricty Revenue (USD/kWh)	0.0027	0.2046	0.0202	0.0971
	Average Electricty Expenses (USD/kWh)	0.0003	0.1055	0.0056	0.0765
	Average Operating Profit (USD/kWh)	-0.0003	-0.0007	0.0107	0.0279
	Electrical Energy per Employee (MWh/employ	4,772	5,976	42,910	3,822

5.7 Organization Structure

UBEDN is composed of mainly 3 departments, as shown in the following organization chart. The service area of UBEDN is divided into 4 by region. Each area has distribution centers and customer services centers.



(Source: UBEDN)

Figure 5-23 Organization Chart of UBEDN

5.8 Operation and Maintenance of Distribution Facilities

5.8.1 Headquarters

The role of the headquarters is to supervise and manage many kinds of work. It has a call center inside the building, in which staff responds to telephone calls from customers. Its business hours are 8:00-21:00 from Monday to Saturday. It has a dispatching center as well, whose role is to operate a 35kV distribution system and the interconnection between 6 -10 kV distribution systems. All the information regarding distribution power faults is accumulated at the dispatching center.

Figure 5-24 Call Center

Figure 5-25 35 kV Dispatching Center

5.8.2 Distribution Center

UBEDN has 5 distribution centers, four of which are in charge of construction, operation, and maintenance of 10 kV- 220 V distribution systems. The rest of them are in charge of 35 kV distribution systems.

Four distribution centers have a control center, in which technical staff regularly works. Their work is to switch distribution systems in normal / accident conditions. It has also on-site workers who go to the distribution facilities and manually operate switches.

To recover from power faults is one of the functions of the control center, as shown below.

- In the case that a power fault happens, the system operator in the control center refers to the information from the customer services center, and then orders technical staff to go and manually operate switches.
- A grid map is published once a year, and the historical operation record is described in the “notebook.” In order to know the latest grid system situation, the system operator has to remember both grid map and operation record in his memory. Their work deeply depends on their experience and memory. The control center does not have a remote control system so they make orders to staff via telephone.

Figure 5-26 Distribution Center in Western Area

Figure 5-27 Control Center in the **Distribution Center**

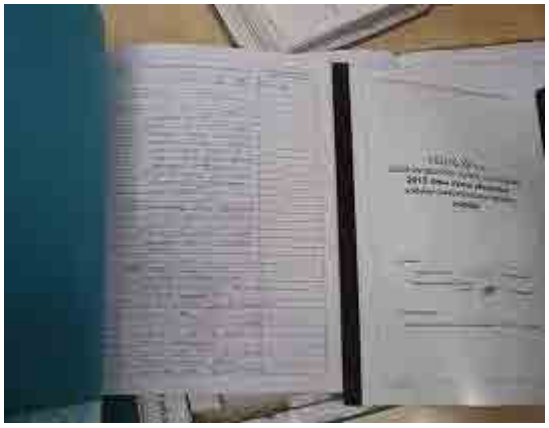


Figure 5-28 Notebook with System Operation Record

Customer Services Center

A customer services center is located in the distribution services area. Their work covers tasks such as meter reading, payment, supply contracts, management of meters, and consultation about in-house facilities.

Figure 5-29 Customer Services Center in Eastern Area

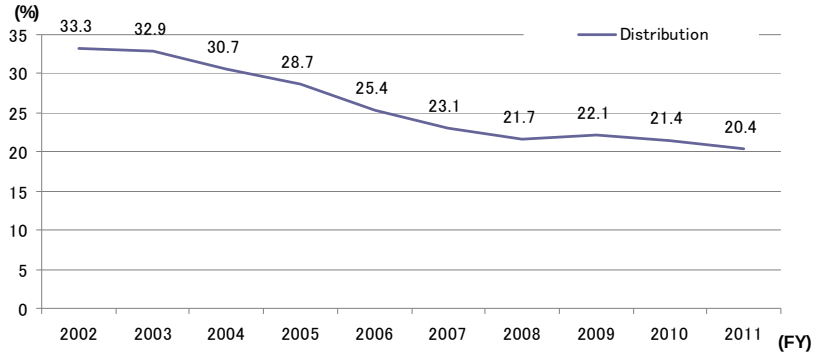
Figure 5-30 Meter for Time of Use(1 phase 2 wires)

5.9 Distribution Loss

The distribution loss of UBEDN has reduced year by year, but it is still over 20%, which means there is some room for improvement.

The high distribution loss is due to improper load controls, which have surged in recent years, and long span distribution lines installed in the suburbs of UB city.

It is estimated that the loss includes substantially nontechnical losses, such as power theft and errors of meter reading.



（Source: UBEDN）

Figure 5-31 Distribution loss of UBEDN

5.10 Current Situation of Outage and Countermeasures

Supply reliability in FY2011 is, SAIFI: 13.3 times, SAIDI: 2117 min respectively.
Customer Average Interruption Duration Index (CAIDI) is 200min, which includes planned outages due to construction work. According to the interview from UBEDN, the cause of the faults is aged cables. Details and cause of the faults are recorded in the notebook but not systematically summarized as a database.

Table 5-7 Trend of supply Reliability of UBEDN (SAIFI, SAIDI)

	2008	2009	2010	2011
SAIFI (times)	17.2	17.2	18.6	13.3
SAIDI (min)	2,698	2,557	2,233	2,117

（Source: UBEDN）

5.11 Fault Restoration

(1) Guideline for fault restoration

A flowchart of fault restoration is shown as per the guideline regulated by NDC.

<How to restore when single phase ground fault happens>

Measures taken at substation

- Alarm of the fault rings.
- Staff at substation checks the kind of fault at the control panel. (The sign which represents ground fault lights when ground fault happens)
- Check the voltage to the ground of each feeder, manually open and close circuit breakers, and then identify the fault feeder.

  In case there are switch stations owned by the distribution company at the load side of substation, UBEDN identify the fault feeder by the same procedures.

◆ Measures taken by distribution company

- Check the voltage to the ground of each feeder at the switch station, manually open and close circuit breakers, and then identify the fault feeder (same steps as taken at substation).
- After disconnecting the circuit breaker at the fault feeder, staff measures the insulation resistance using a 5 kV meggar and then opens/closes the disconnecting switch at the distribution transformers in order to identify the fault area. Finally, disconnect the area from sound area.
- Switch the network (System “A” and “B”) in order to restore power connected to the fault system.

  Close the circuit breaker at the substation.
- Locate the fault point using special vehicle. Fault point is identified by listening to the sound reflected at the fault point.
- The device used for fault location is mad in Germany. It collects the noise of electric discharge. In case the plumbings are installed near the cable, it requires a lot of experience for fault location. The LUPIN, which is fault location devices used by TEPCO, is shown below.

Table 5-8 Comparison of Fault Location Devices

	Baur (German products)	Lupin (TEPCO)
Theory of Fault Location	Identify the fault point from the discharge noise from the Input the pulse signals to the cable, and receive the discharge noise which is generated at the fault point. At the fault pint, discharge noise can be received immediately after the pulse signals are generated.	Identify the fault point from the magnetic field generated at the fault current. Fault current flows from the fault point to the ground. Therefore, scale of magnetic field changes nearly to zero at the downstream of fault point.
Characteristics	This device is applicable if the locations of the cables are already known. The sounds of the discharge noise are sometimes difficult to receive because some underground structures disturb the noise.	This device can detect the location of cable, so this can be applicable unless there are no drawing maps of the cables. This method cannot be easily influenced by the condition of the underground structures.

(2) Procedure of How to Recover from a Fault

From the UBEDN interview, the survey team found out the following measures taken by UBEDN to recover from a fault.

(Initial response: 30 min – 2 hours)

- Estimate the fault area by summarizing the telephone call from the customers regarding outage (in the case of manned substation, the operator of the substation notifies of the fault). Staff hurries to the estimated switch station and checks the voltage to identify the fault feeder.

(Disconnect fault area: 30 min – 2 hours)

- To identify the fault area, measure the insulation resistance using a meggar from the switch station to the distribution transformers. After identification, disconnect it from the sound area.

(Power restoration: About 30 min)

- To restore power at the downstream of the fault area, distribution systems are switched and interconnect with another feeder.

(Repair of the fault point: one-few days)

- Locate the fault point from within the fault area by using fault locating device, cut off the cables at the fault point and replace with new ones.

Cable Fault Location. Made in Germany

Emergency

Line Works

Digging Ground

5 kV Meggar Used for Fault Location

Multi-Meter
Measure Voltage Currency Resistance

Figure 5-32 Special Vehicles Used in UBEDN

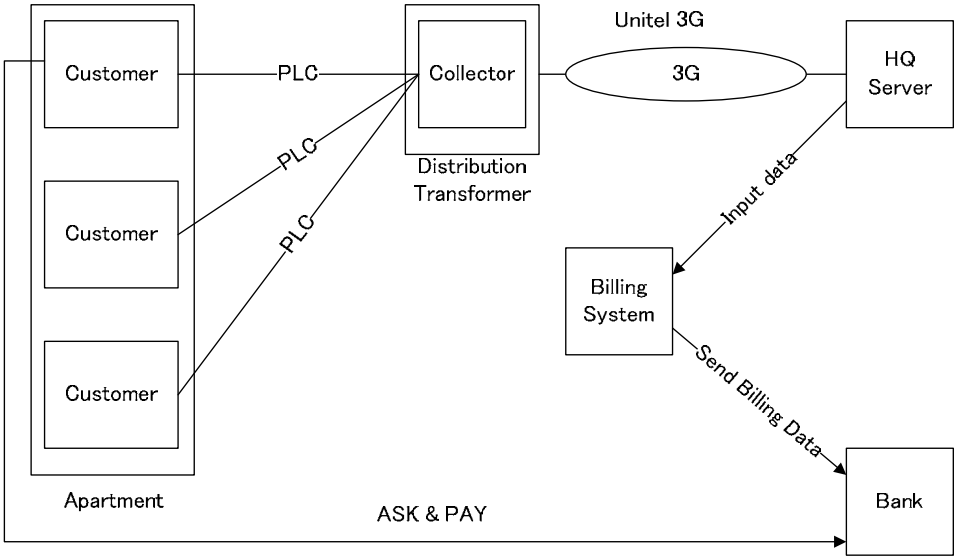
5.12 Smart Meter

Analog and digital meters are installed to UBEDN customer for power usage measurement now. Employee belonged to meter department check customer's meters for gathering usage of electricity.

Then employees input customer's data and customer will be charged via bank. AMR (Automation Meter Reading) has been installed in seven apartment buildings which are inhabited by 1,034 households in the 11th district, as a test trial from September 2012. The cost of equipment and 3G wireless usage is covered by CHINT, which is a Chinese company. CHINT is currently testing its devices under minus forty degree conditions. In the AMR system, PLC is used to gather data from the customer and deliver it to a concentrator which is installed in the distribution transformer for data transmission. From the distribution transformer to the server in the head office, UNITEL 3G is used to transmit the metering data. In the head office, the employee in charge is to transfer the information via manual input to the billing system from the information that has been aggregated. The user can check his bill based on usage at the bank, where he can then pay as well.

Collector with 3G in the distribution transformer

AMR by Chinese company, CHINT



(Source: Prepared by JICA Survey Team)

Figure 5-33 AMR Concentrator, Meter, and Diagram

5.13 Competency on Planning and Operation and Issues

The current issues regarding the current fault recovery are summarized as follows.

1. Protection relay at the substations do not have the Directional Ground Fault Relay.
   Therefore, it takes a lot of times to identify the fault feeder in case of fault. Some of the substations have the ground potential transformers (GPT) and zero current transformers (ZCT), but even at such substation, fault feeder is identified manually because technical staffs have little skill of relay setting. Improper construction is the cause of the manual operation as well.
2. Reclosing switches and energizing the fault point is basically prohibited.
   Guidelines for restoration from faults are regulated by NDC. The guidelines show that in order to avoid damage to the aged cables or electrical shock, power must be charged after the fault point is disconnected from the system. For this reason, the whole distribution line with fault point is discharged until the technical staff disconnects the fault point. In the case that the distribution line has no interconnection with other systems, such as overhead line or the terminal of the system, this regulation is not applied.
3. There are power faults caused by the customers' facilities.
   Approximately half of the distribution transformers are owned by customers, which are aged facilities. Power failure is sometimes caused by such customers' facilities. Therefore, some transfers owned by customers need to be transferred to UBEDN.
4. Management of underground cables is not appropriate
   Most of the distribution networks in Ulaanbaatar city are consisted of underground line. Location of underground cables can be seen at the drawing map made with AUTOCAD, but it's location is sometimes incorrect. Underground cables are sometimes damaged by the other construction companies because they do not consult with UBEDN before the construction work. Underground cables are normally directory buried under the ground unless they are not constructed under the roadway. In the winter season, staffs have to heat the frozen ground with burner to identify the fault point.
5. Record of fault recovery is not enough.
   The results of the fault recovery by technical staff are recorded in the notebook, but it is not systematically summarized. Duration and cause of the fault is self-reported by staff, which means the report is sometimes different from what it actually is.
6. System management is not enough.
   The drawing of the distribution network is revised twice a year. When the network is changed after the revision, the staff records it to the notebook. The staff needs to refer both notebook and the system drawing if the he has to know the latest situation of the network system. The staff at the system operator required experience and good memory. But such work is not sometimes safe because sometimes cause operation mistake from the human error.

Chapter 6 Identification of Priority Projects to be Surveyed

6.1 Identification of Priority Projects

6.1.1 Targeting Projects to be Surveyed

Projects to be surveyed are identified in the transmission and distribution fields in Ulaanbaatar and the surrounding area through this screening process. The process is shown below.

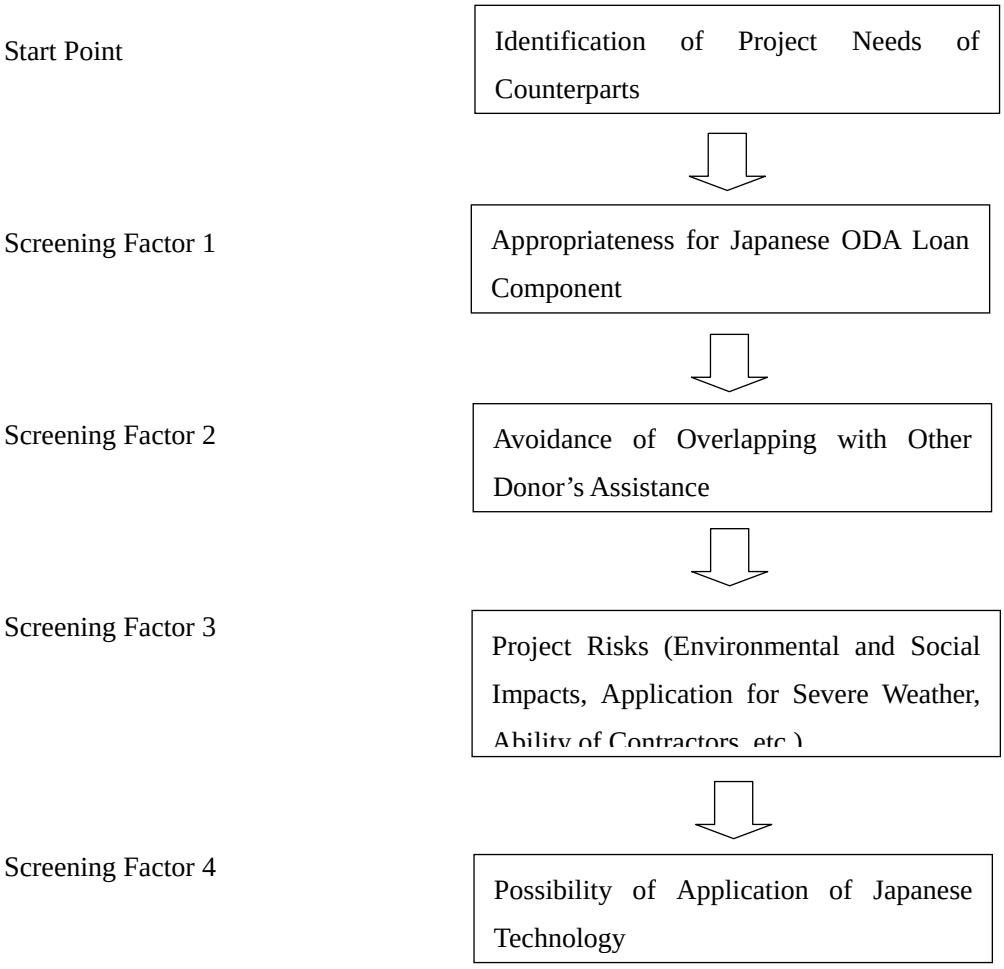


Figure 6-1 Screening Process to Identify Projects to be Surveyed

6.1.2 Study for Packaging Japanese ODA Loan Project

Projects, which are screened through the above process, are studied in detail for selection of required functions and their specifications, cost analysis, environmental and social impacts and so on. After the detailed study for each project, the JICA Survey Team proposes packaging a Japanese ODA loan project through discussion with the counterparts and JICA.

6.2 Screening Results

6.2.1 Identification of Project Needs of Counterparts

(1) Submission of Project List

At the first local survey, the JICA Survey Team requested the counterparts (NPTGC and UBEDN) to submit project lists which are expected for the Japanese ODA Loan. In response, only NPTGC submitted 1 project as shown below.

Table 6-1 Request List from NPTGC

Name	Component	Estimated Cost
Diagnosis Laboratory for Transmission Line and Substation	Establishment of Diagnostics United System	US$ 670 000
	Establishment of Diagnostics Laboratory	US$ 230 000
	Establishment of High Voltage Laboratory	US$ 250,000
	Establishment of Relay Protection and Automation Laboratory	US$ 150,000
	Establishment of Electrics and Technical Oil Tester Laboratory	US$ 80 000

At the second local survey, the JICA Survey Team re-confirmed potential projects other than the above project and found the following projects. NPTGC and UBEDN requested the JICA Survey Team to include these potential projects in the scope of the survey.

Table 6-2 Additional List from NPTGC (Potential Projects)

Name	Outline
Expansion of Existing 110 kV Substations (GIS Substations)	・ Increase of existing substation's capacity to meet forecasted demand increase ・ Due to difficulty of expansion of the substation site, 4 existing substations were proposed to study the possibility of GIS substation.
Mobile Substation	・ Mobile substations for emergency response. The station consists of switchgears and transformer and vehicle parts for transportation.
Replacement of Existing Transmission Line Conductors	・ Replacement of existing transmission line with high capacity cables between the No. 4 power station and Domod 2 substation (15 km x 2 circuits).
Study for 500 kV Transmission Line Project	・ Master plan study for 500 kV transmission line in the national grid.

* GIS: Gas Insulated Switchgear

Table 6-3 Additional List from UBEDN (Potential Projects)

Name	Outline
Distribution Network Information Management System	・ Database system compiling distribution facility information, distribution status, map information, etc. ・ It contributes to work efficiency of UBEDN staff.
Master Plan of Distribution Network	・ Master plan study for mid term plan (5 years) and long term plan (20 years). ・ The study targets compiling the government's plan, UB city's plan and UBEDN's plan.
Distribution Automation System	・ Introduction of distribution automation system including tele-communications system for No.4 district of Ulaanbaatar city. ・ The target area is a residential area (apartment and ger) to reduce outage time.
Automatic Meter Reading System	・ Installation of automatic meter reading and smart meters in 35 kV distribution substations, 10 kV and 6 kV distribution facilities and customers. ・ The project targets the whole UBEDN area and installations from the upstream side step by step.
35 kV Underground Substation （GIS Substation）	・ New installation of 35 kV substation at the center of UB city to meet increase in power demand in the area. ・ Due to the difficulty of land acquisition in the area, an underground substation with GIS is expected.
Relay Protection and Remote Control	・ Installation of digital relay and remote control between distribution substations and upstream dispatching centers.

6.2.2 Screening

The requested project and potential projects mentioned above are evaluated by the following factors.

- Appropriateness for Japanese ODA Loan Component
- Avoidance of Overlapping with Other Donor's Assistance
- Project Risks (Environmental and Social Impacts, Application for Severe Weather, Ability of Contractors, etc.)
- Possibility of Application of Japanese Technology

Table 6-4 Screening Projects to be Surveyed (NPTGC Projects)

	Appropriateness for Japanese ODA Loan Component	Avoidance of Overlapping with Other Donor's Assistance	Project Risks	Possibility of Application of Japanese Technology	Rating
Weight	30%	20%	30%	20%	
Diagnosis Laboratory for Transmission Line and Substation	**2** It contributes to prevention of accidents and facilities. However, it is a small amount for a Japanese ODA loan.	**2** Some diagnosis equipment has been already introduced by Swiss assistance. It should be selected effectively to avoid overlapping.	**3** No risks are expected. To effectively utilize the diagnosis equipment, some training programs and assistance for establishment of diagnosis program are required.	**2** It will be procured by international shopping. Japanese products are not necessarily selected.	**2.3**
Expansion of Existing 110 kV Substations	**2** It is expected to be a project that will help meet the increase in power demand. However, consistency with the whole development plan for the system should be confirmed.	**3** This plan does not overlap with other donor's assistance. .	**3** Environmental and social impacts are not expected if the project is implemented within the existing land. Substation above ground might be possible to avoid underground substation.	**3** In the case that 110 kV GIS equipment is introduced, Japanese products seem competitive.	**2.7**
Mobile Substation	**2** It is expected to be an emergency response project. However, it might be a small amount for a Japanese ODA loan if several numbers are expected to be purchased.	**3** Mongolian Government has a plan to purchase 2 mobile stations. NPTGC wishes to have their own stations other than the government ones.	**3** No risks are expected. To effectively utilize mobile substations, some training programs are required.	**2** Japanese products might be competitive if more compact one is required.	**2.5**
Replacement of Existing Transmission Line Conductors	**2** It should be confirmed whether replacement of conductors can be met for the forecasted power demand. Besides, consistency with the whole development plan for the system should be confirmed.	**3** It has been confirmed that the project does not overlap.	**2** It should be confirmed whether existing towers have the ability to bear the new conductors, and environmental and social impacts.	**3** Some Japanese products have competitiveness in high capacity conductors.	**2.4**
Study for 500 kV Transmission Line Project	**1** The transmission master plan seems not to match the loan component. Another scheme is advisable.	**2** It should be confirmed that a national grid master plan study, which is expected to be implemented, does not overlap with it.	**3** No risks are expected for the study implementation.	**3** Some Japanese consultants have prior experience in plans for 500 kV transmission line.	**-**

Legend: 3: Promising, 2: Possible, 1: Difficult

Note: If an evaluation "1" is included, the project is out of scope of the survey.

Table 6-5 Screening Projects to be Surveyed (UBEDN Projects)

	Appropriateness for Japanese ODA Loan Component	Avoidance of Overlapping with Other Donor's Assistance	Project Risks	Possibility of Application of Japanese Technology	Rating
Weight	30%	20%	30%	20%	
Distribution Network Information Management System	**2** It seems inevitable equipment to improve work efficiency. However, it is a small amount for a Japanese ODA loan.	**3** An Indian firm implemented an initial study for it (completed in Sep 2013). Through a review of the results, overlapping can be avoided.	**3** No risks are expected.	**2** There is no special competiveness for Japanese products. It expects to link the database of distribution automation system.	**2.5**
Master Plan of Distribution Network	**1** The distribution master plan seems not to match the loan component. Another scheme is recommendable.	**3** It has been confirmed that the project does not overlap.	**3** No risks are expected.	**3** Some Japanese consultants have prior experience in planning system improvement projects such as distribution automation systems.	**-**
Distribution Automation System	**3** It is expected to be a project that will help decrease outage times if outages happen often.	**3** It has been confirmed that the project does not overlap.	**2** There are sentences in a technical regulation that state that re-close to the fault point is prohibited. That is a critical point in the case that voltage sensing method is introduced.	**2** Voltage sensing method, which has been developed by Japan, is to be approved. Otherwise, new generation Japanese system (circuit breaker with sensor) is to be introduced.	**2.5**
Automatic Meter Reading System	**2** It expects to a project effect on decrease of distribution loss. However, it is a small amount for a Japanese ODA loan.	**3** It has been confirmed that the project is not overlapped.	**3** No risks are expected.	**2** There is few competitiveness of Japan for meter itself. However, a total system package might have competitiveness of Japan.	**2.7**
35 kV Underground Substation	**2** It expects to a project effect on meeting increase of power demand. However, it should confirm a consistency with a whole development plan for the system.	**3** It has been confirmed that the project is not overlapped.	**2** In case that underground substation is adopted, a detailed survey to obtain geological conditions is necessary. In addition, detailed EIA might be obliged to be done.	**3** If underground substation is introduced, some Japanese contractors have competitiveness.	**2.4**
Relay Protection and Remote Control	**2** It is a small amount for a Japanese ODA loan if this project is only adopted for a loan component.	**3** It has been confirmed that the project does not overlap.	**3** No risks are expected.	**2** Japanese products do not have competitiveness in the project.	**2.5**

Legend: 3: Promising, 2: Possible, 1: Difficult

Note: If an evaluation "1" is included, the project is out of scope of the survey.

6.2.3 Scoping the Survey Area

(1) Selection of Projects to be Surveyed

As a result of the above screening, the score was rated within 2.3 – 2.7 points. However, most of the projects to be surveyed are still at concept level and there is little information to be decided. Thus, it was difficult to screen furthermore.

Through discussions with the Steering Committee and JICA, all the projects including the potential projects were decided to be surveyed except for the master plan studies of NPTGC and UBEDN. The feasibility of these projects is to be considered in each company after the completion of the Survey. However, some individual projects require further investigation for more detailed study even after the completion of the Survey (e.g. projects which include more civil work such as underground excavation).

(2) Scoping the Survey Area in Individual Projects

(a) Scoping the Survey Area for NPTGC's Requested Project

Out of the potential projects requested from NPTGC, "Expansion of Existing 110 kV Substations" proposed 4 potential sites to be surveyed. However, the JICA Survey Team adopted 2 sites (Baruun Substation and Umard Substation) which had higher priority. These substations supply electricity to No. 4 District in which UBEDN's project (Distribution Automation System) is planned. Because the project, Distribution Automation System, links distribution substation facilities, the survey area also includes substation area. From this reason, these 2 substations should be included in the survey scope.

(b) Scoping the Survey Area for UBEDN's Requested Projects

Out of the potential projects requested from UBEDN, the following 3 projects are surveyed limited to the same area (No.4 District).

◆ Distribution Automation System

◆ Automatic Meter Reading System

◆ Relay Protection and Remote Control

UBEDN wishes to implement a pilot project of the Distribution Automation System targeted at No.4 District. These 3 projects use common facilities so they should be limited to the same area to efficiently utilize each other. From these reasons, the survey area was decided to be limited to No. 4 District.

Besides, "Automatic Meter Reading System", which consists of meters for (i) 35 kV distribution substations, (ii) 10 kV and 6 kV distribution facilities and (iii) customers, also limited the survey area to (i) and (ii), because (iii) was not clarified as a promising future plan at this moment.

Chapter 7 Transmission Projects

In this chapter, each transmission project is studied in detail. According to the discussion results, the titles of the projects in this chapter may change from the ones which are described in the Chapter 6, to accurately express the project features.

7.1 Diagnosis Laboratory

7.1.1 Overview of the Project

This project organizes technical test laboratories and deploys testing equipment to improve technical quality in the commissioning and maintenance of substation equipment such as transformers, circuit breakers, and protection relays. This diagnosis laboratory component consists of the following four subcomponents.

Table 7-1 Overview of the Project

Category	Objective
Oil Analysis Laboratory	This laboratory is equipped with a dissolved gas analyzer to monitor machine condition of oil-insulated power equipment by identifying precursory phenomenon of enclosed parts' breakdown.
High-Voltage Testing Laboratory	Insulation Strength testing machine will be procured to apply IEC-based insulation testing voltage to high-voltage (over 110kV) equipment.
Relay Laboratory	Power system simulator will be introduced to confirm compatibility of different manufacturers' relays, co-ordination of relay settings, and protection schemes. Relay testing machines to conform IEC-standards and extreme ambient conditions for relay operation in Mongolia, such as air pollution level and extreme low temperature in winter.
Mobile Laboratory	Mobile tools for machine tests conducted as a part of machine commissioning, troubleshooting and routine inspections. Mobile testing laboratory to enhance engineering flexibility.

7.1.2 Rationale of the Project

Laboratories equipped with testing tools and machines are essential to maintain proper quality of power system components by examining their mechanical and electrical conditions. IEC and other internationally accepted technical standards accordingly define acceptable machine quality and the system to confirm this quality by standardizing necessary tests and thresholds for diagnosis. Currently NPTGC doesn't own sufficient tools and machines to perform necessary quality assurance activities to confirm a facility's

operational capacity in its installation, maintenance, and troubleshooting.

Table 7-2 Current Situation of NPTGC's Laboratories

Category	Objective
Oil Analysis Laboratory	One Russian machine for dissolved gas analysis is installed in a substation's building, but not operated because of the lack of consumables and some missing parts. Instead, NPTGC currently outsources necessary chemical diagnosis of insulation oil to another private company.
High-Voltage Testing Laboratory	NPTGC owns one 150kV high-voltage testing machine on a vehicle, but the machine doesn't work properly. Voltage application is limited below 40kV compared to its designed capacity of 150kV, and the vehicle itself has already deteriorated. Accordingly, NPTGC is currently unable to perform necessary insulation tests, which are mandated by the Mongolian electricity law.
Relay Laboratory	Only one Omicron relay testing equipment without current booster is stored in the headquarters. There's no organization capable of relay conformance testing to IEC standards, and NPTGC doesn't own any of the necessary testing machines. The number of NPTGC's relay specialists is quite limited especially in digital relay settings and testing activities.
Mobile Laboratory	One infrared camera is stored in the headquarters, letting necessary branch offices use it when equipment trouble occurs. Oil testing machines and insulation testing machines are quite aged and deteriorated.

By managing statistics obtained by various tests enabled by the laboratory, NPTGC becomes capable of monitoring equipment deterioration condition and identifying precursory abnormalities that may result in large-scale blackouts. And this condition monitoring will help NPTGC to take necessary actions, such as detailed inspections, maintenance, and replacements, in a planned and efficient way. Also this will help to develop NPTGC's Condition Based Maintenance (CBM) program, which optimize maintenance, technically services and equipment renewal, after obtaining sufficient data on equipment deterioration to reduce the lifetime cost of facilities.

Especially, introduction of the relay laboratory is quite urgent not only to provide sufficient testing machines but also to develop sufficient human resources throughout the testing, since NPTGC is now planning to replace deteriorated machine-type and static-type protection relays to numerical type relays, such as current differential relay with optical fiber, which increases reliability in the electricity supply of the power system. To increase the technical capability of engineers, it is recommended to provide necessary testing tools and to purchase a power system simulator, with which engineers can learn the protection scheme in simulated characteristics of the Ulaanbaatar system, and confirm the validity of relay settings.

By analyzing the root cause of equipment trouble, and the power system's electric phenomena in the case

of equipment trouble as a part of human resource development, NPTGC can improve their technical competency in preventive maintenance which enables engineers to select the most technically sound specifications for all parts of the power system including main equipment and protection relays. And the progression to the preventive maintenance will help NPTGC to decrease unnecessary power system supply interruption caused by equipment trouble and relays with unsatisfactory quality.

7.1.3 Necessary Components

(1) Selection Criteria

The numbers and specifications of each project's tools and machines will be determined as follows by considering NPTGC's system of facility's quality assurance.

a) Specifications for testing tools and machines

IEC testing standards shall be satisfied in all types of facilities.

b) Distribution

This project distributes a variety of tools and machines, and some machines require skilled operators and particular engineering knowledge. Thus, headquarters will be designated to store high-level diagnosis and tests and the special test equipment that is not used on a regular basis. On the contrary, field offices store portable and inexpensive tools and machines, which are usually used frequently in regular maintenance and inspections. With this distribution scheme, field engineers are supposed to be knowledgeable enough to operate field tools and machines skillfully.

For example, a high-voltage testing machine installed on a vehicle will be distributed to every field office so that machine troubleshooting and commissioning test after the restoration can be quickly conducted with it. Also the headquarters owns one high-voltage testing machine for the commissioning tests of newly built facilities, for which the Maintenance workforce in the headquarters are responsible. For another example, the oil-testing lab requires special techniques in treating quite a small amount of gas dissolved in insulation oil under a controlled ambient temperature and humidity. In addition, the lab treats flammable, explosive, and toxic gases, and special ventilation and preventive measures are necessary in the oil testing lab to maintain public, occupational and environmental safety in the facility. Thus the survey team concluded that one centralized laboratory will be appropriate to satisfy these requirements. The location is also determined to be the upper floor of existing PCB treatment facilities, so that the control of PCB contaminated goods can be easily conducted.

(2) Necessary Components

The following tables show the necessary tools and machines for the project. The detail specification and example pictures are attached in Appendix.

Table 7-3 Dissolved Gas Analysis Laboratory

Items	Major Component	Specification	number
Laboratory Room Preparation	Area : 10 m×10 m air-conditioned with ventilation and gas density monitoring.	Designed to avoid any occupational injuries due to flammable gases	1 room
Dissolved Gas Analysis Facility	DGA analysis machines	(Installed in Tuul SS)	(1 unit) Already installed*
Acidity measurement	-	IEC62021,IEC61125	1 unit
Moisture measurement tool	-	IEC60814	1 unit
Electric tangent measurement tool	-	IEC60247	12 units
Automatic flashing point measurement	-	ISO2719	1 unit
Density hydrometer	-	ISO3675	1 unit
Volume resistivity meter	-	IEC60666	1 unit
Viscausity measurement tool	-	ISO3104,ISO3016	1 unit
DGA machine	Automatic DGA analysis machines Hydrogen Generator Terminal heater accessories	IEC60422,IEC60296 IEC60970	1 unit*
PCB detector	PCB preprocessing tools Gas Chromatography Hydrogen generator Data processing Unit	-	Already installed
Accessories	Washing Solvent Recoverer, Electronic scale, Gas containers and holders, Electric burette	Accessories and tools for DGA	1 lot
Consumable materials	Solvent、Gas containers of Argon, helium	Consumables for DGA	1 lot
Office tools	Tables and chairs	-	1 lot

* The utilization of existing Russian DGA machine and necessity of additional purchase of DGA machine will be reviewed.

Table 7-4 High Voltage Testing Laboratory

Items	Major Component	Specification	number
High Voltage Testing Equipment	Receiving Unit Testing transformer Voltage Regulator Resistors Compensation Reactor Standard High Voltage Transformer Control Panel	220kV.100kVA Rated Operation for 30 min IEC60076 IEC6227 IEC60060	1 unit
Vehicle	Base vehicle for testing equipment	Weight capacity over 15,000kg	1 unit

Table 7-5 Relay Laboratory

Items	Major Component	Specification	number
Power System Simulator	Power system simulator with necessary software Interface unit A/D converter Amplifiers (Voltage and Current 8 units)	Necessary components: generator, induction motor, inductive load, synchronous motor Capable of analog output IEC60255	1 set
Temperature and humidity tester	Temperature and humidity	IEC60068	1 unit
Electronic components insulation diagnosis device (tanδ)	-	IEC60255,IEC62321	1 unit
Radio test equipment	-	IEC60255,IEC61010	1 unit
Voltage and current Amplifier	For power system simulator	IEC60255	8 units
Protection relay tester	Capable for primary test with booster	IEC60255	6 unit
Primary current injection test set		IEC60255	1 unit
Battery Testing Machine	Impedance measurement	IEC60095	6 unit
Battery Testing Machine	Battery Capacity Tester	IEC60095	6 unit

Table 7-6 Mobile Testing Laboratory and Tools

Items	Major Component	Specification	number
Transformer diagnostic instrument	-	IEC60076	5 units
Low resistance meter	-	IEC60076	5 units
Winding resistance measuring instrument	-	IEC60076	3 units
Digital low resistance meter	-	IEC60076	2 units
Insulation resistance tester	-	IEC60076	3 units
Gas leak tester	-	IEC62271	6 units
10kV insulation resistance tester	-	IEC60076,IEC60060	5 units
Earth resistance meter	-	IEC60076	1 unit
sweep frequency response analyzer	-	IEC60076	1 unit
Insulation diagnostic analyzer	-	IEC60076,IEC60071	1 unit
Gas circuit breaker diagnostic equipment	-	IEC62271	1 unit
Vacuum circuit breaker diagnostic instrument	-	IEC62271	1 unit
reflective cable fault point diagnostic equipment	-	IEC60055	1 unit
Mobile testing transformer	-	IEC60076	4 unit
Infrared temperature measuring instrument with conversion lense	-	IEC60076	1 unit
Oil’s breakdown voltage tester	-	IEC60156	1 unit
Vibration measurement machine	-	IEC60095	1 unit
Surveying Instrument	-	IEC60095	1 unit

7.1.4 Estimation of the Total Project Costs

The total project costs are estimated as shown below. The costs include the equipment costs (base cost), price escalation (1.3 %/year for foreign currency and 6.0 %/year for local currency), physical contingency (5 % of the base cost including price escalation), administration cost (5 % of the base cost), VAT (10 % for the local currency portion), and customs duty (5 % for the foreign currency portion).

Table 7-7 Estimation of the Total Project Costs

Item	Cost		Total
	Foreign	Local	
	JPY	MNT	JPY
Oil Diagnostic Laboratory	73,327,100	0	73,327,100
High Voltage Testing Laboratory	141,073,900	0	141,073,900
Mobile Testing Laboratory &	3,818,100	2,505,424,167	154,143,550
Relay Testing Laboratory	0	977,368,333	58,642,100
Base Cost	**218,219,100**	**3,482,792,500**	**427,186,650**
Consulting Costs	0	0	0
Escalation	7,457,227	430,473,153	33,285,616
Physical Contingency	11,283,816	195,663,283	23,023,613
VAT	0	410,892,894	24,653,574
Import Tax	0	197,466,786	11,848,007
Administration Costs	0	205,446,447	12,326,787
TOTAL	**236,960,143**	**4,922,735,062**	**532,324,247**

7.1.5 Implementation Schedule

The following chart shows the implementation schedule of the project. With no consultancy service, the procurement starts from 2015.

Table 7-8 Implementation Schedule

7.1.6 Expected Effects

(1) Expected Benefits from the Project

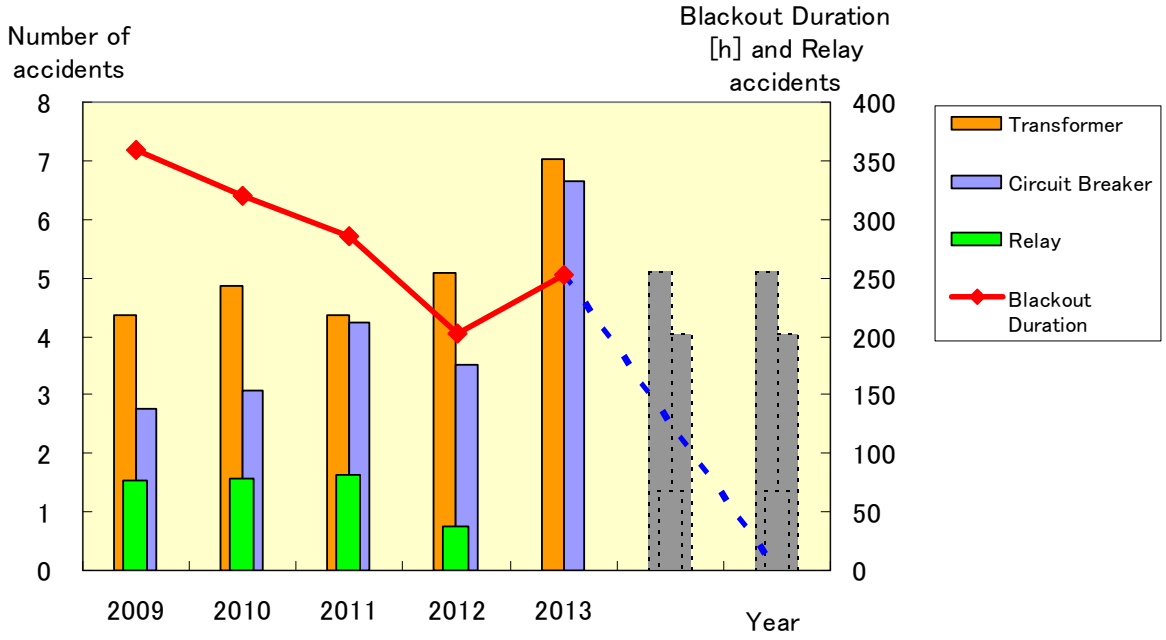
(a) Benefits

The laboratory is expected to decrease the number and duration of power supply interruptions, in other words, to improve power supply reliability due to facility trouble by enhancing NPTGC's facility maintenance capability. Also, the laboratory enables NPTGC to develop system expansion and restoration plans based on actual facility condition.

In terms of the reduction of facility trouble that causes power supply interruption, the average frequency of transformer trouble is 5 times a year, and 4 times for circuit breakers based on the statistics in 2009 to 2013 as shown in Chapter 4, and the average duration of the interruption is 283.7 hours per year. The root cause of the trouble covers a variety of machine trouble, such as malfunction of protection relays and internal breakdown of insulation parts in machines, most of which may be caused by inferior quality in production and maintenance of apparatus. By introducing suggested laboratories and applying equipment condition diagnosis as a part of a preventive maintenance program, the survey team expects that the frequency of trouble can be reduced by one per year both in transformer and circuit breaker, and evaluated the economic benefits of them.

Trouble, Interruption, and Blackout by Each Accident

Year	Outage Frequency			Outage Duration
	Transformer	Circuit Breaker	Relays	(h/year)
2013	7	7	---	252.1
2012	5	4	38	201.8
2011	4	4	81	285.8
2010	5	3	78	320.4
2009	4	3	77	358.5
Average	5	4	69	283.7



(Source: NPTGC's Statistics)

Figure 7-1 Accidents by Year in NPTGC

In addition, since NPTGC currently outsources dissolved gas analysis to an outer service company, the introduction of a laboratory will reduce the cost for the gas analysis. Also, the preventive maintenance programs will reduce the duration of supply interruption, and electricity sales will be increased and enable NPTGC to reduce facility repair costs and prolong the lifetime of machines, which results in the postponement of replacement investment.

(b) Summary of the Benefits

The following table summarizes the financial and economic benefits of the project.

Table 7-9 Summary of Financial and Economic Benefits

（Annual Benefits：US$/year）

Financial Benefit		
1	Reduction of outsourcing =Number of gas analyses per year×（outsourcing price – actual cost for Gas analysis laboratory） = 300 part/year×（450 US$ – 150US$）	90,000
2	Increase of electricity sales by preventing urgent replacement of transformer =Outage × Duration of outage× unit sales of electricity = 9 MW*×24 h×28 day×6,890 MNT/MWh /1,474.1 US$/MNT * outage: Excessive load in case of one bank fault of 2-banked substation = (number of transformers×capacity×loading rate－remaining capacity)×power factor = (2×25MVA×0.7－25MVA)×0.9=9 MW	28,268
3	Reduction of repair cost by preventing large-scale fault of transformer（assuming one transformer repair / year） = Replacement cost of transformer×Ratio of repair work (50 %) = 600,000 US$/unit ×0.5	300,000
4	Investment optimization by postponing 2 transformers for 2 years. = Replacement cost × Number of transformers replaced × Interest = 600,000 US$/unit×2 units×（1.07^2-1)	173,800
Economic Benefit		
1	Reduction of outsourcing =Number of gas analyses per year×（Outsourcing price – Actual cost for gas analysis laboratory） = 300 part/year×（450 US$ – 150US$）	90,000
2	Increase of electricity sales by preventing urgent replacement of transformer =Average duration of transformer outage × Unit capacity × Annual loading rate × power factor × diesel generation cost*1 = 283.7 hr×1/9×25,000 kVA×0.25 US$/kWh * assuming one transformer fault can be reduced per year	197,000
3	Reduction of repair cost by preventing large-scale fault of transformer（assuming one transformer repair / year） = Replacement cost of transformer×Ratio of repair work(50 %) = 600,000 US$/unit ×0.5	300,000
4	Investment optimization by postponing 2 transformers for 2 years. = Replacement cost × number of transformers replaced × Interest = 600,000 US$/unit×2 units×（1.07^2-1)	173,800

*1: The alternative diesel generation cost uses 0.25 US$/kWh

(2) Results of IRR Calculation

Based on the benefits summarized in the above, the internal rates of return were calculated as follows.

Table 7-10 IRR Calculation

	Result
FIRR	7.5 %
EIRR	13.0 %

7.1.7 Items to be Further Studied

(1) Capacity Development in Preventive Maintenance of Power System Facilities

Although the distribution and replenishment of necessary tools and machines are a necessary condition for better facility maintenance, the development of engineering capabilities in NPTGC is another indispensable aid to be provided. In the capability building program, engineers will learn how to use this new equipment and how to analyze facility condition based on the variety of analysis. In particular, the manufacturers of testing tools and equipment shall be well considered by the provider of capacity development aid so that detailed technical know-how, such as treatment of testing equipment and analysis ambient condition, can be well explained to the counterparts.

- Capacity building in dissolved gas analysis
  Selection of gases and quality control of gas analysis procedure
  Diagnosis and criteria for identifying abnormalities in facility based on analytical results
- Data management of inspection and analysis data
- Establishment of inspection and maintenance rules based on the acquired inspection results
- Effective program for the introduction of preventive maintenance program based on the actual sampling of existing facility condition.

(2) Recommendation in Machine Specification

Dissolved gas analysis shall be done with software aid that offers effective criteria for identifying abnormalities systematically (currently this software cost is not included in the project package). This introduction of the software package minimizes errors in gas analysis which are usually caused by human factors, and also effectively manages a variety of analysis data. Thus, the software aid shall be sought in accordance with the introduction of gas analysis.

7.2 Construction of Park Underground Substation

7.2.1 Overview of the Project

This project builds a new underground substation beneath a public park owned by Ulaanbaatar city to satisfy the increasing electricity demand of the center of the city. At the same time, the project employs more reliable transmission line design, namely underground cable from Tuul substation, and Substation Automation System for future remote control of NPTGC's substations. Although distribution network re-configuration will be necessary after commissioning this substation, this project component consists of no distribution line installation / reconnection due to the distinction in business ownership between electric power transmission and distribution businesses in Mongolia.

Initially, this project component was requested by UBEDEN as a 30kV underground substation, and the discussion among the survey team, representatives of MOE, NPTGC, and UBEDEN concluded that a transmission substation with a higher voltage: 110kV and capacity will be more beneficial, considering the steep electricity demand expected at the center of the Ulaanbaatar city in accordance with the city's development plan.

Figure 7-2 Proposed Location of Park Substation and Transmission Line Route

Table 7-11 Overview of the Project

Substation	Transformers	Specification	Power Cable (Tuul-Park)	Note
Park	60 MVA x 3	110 kV GIS 10 kV 10 cct per bank (future extension) 6 kV x 20cct per bank (initial form)	110 kV XLPE 1,200 mm2 cable 8 km x 3 phases	With reactors

7.2.2 Rationale of the Project

This project has a greater importance on catching up to the steeply increasing electricity demand in the center of Ulaanbaatar City due to the development of high-rise buildings, redevelopment of business districts, and development of residential areas for current gel residents. Also, this project will ease the lack of stand-by capacities of existing substations, which are now being operated over their planning operational loadings: over 70 %, and yields no flexibility in switching lower-voltage side distribution lines. In addition to the necessity of the project component, the project must be urgently started to build new substations as soon as possible to solve the imbalance between current substations of limited supply capacity and the steeply increasing electricity demand, since the land acquisition for the new substation and new underground transmission lines, and the geological surveys for the target sites necessitates longer detailed consultants' studies. The survey team confirmed that the current loading rates of main transformers in Tuul Substation exceeds 98 % of their capacity, and this indicates that NPTGC is now unable to maintain necessary electricity supply reliability because single contingency on these power system components can result in the loss of electricity supply almost equivalent to half of Tuul substation's capacity. The following NPTGC internal study also identifies the urgent need for additional supply capacity of the transmission system to solve the current overloading operations of existing substations.

Table 7-12 Overloading Substations in Ulaanbaatar City

Substation	Demand Record (MVA)			Loading Rate
	2010	2011	2012	
Umard	55.5/80.0	58.0/80.0	59.3/80.0	74%
Tuul	48.5/80.0	55.4/80.0	59.3/80.0	74%
Baruun	31.3/50.0	34.6/50.0	39.1/50.0	78%
Tsmntsd	30.8/50.0	34.2/50.0	40.8/50.0	82%
Khaipaast	26.6/50.0	32.8/50.0	34.8/50.0	70%

In terms of site selection, the substation is considered to be an underground one because the survey team confirmed stakeholder concerns that there is no sufficient area available on ground in the center of Ulaanbaatar city, and building an indoor-form substation may increase risks of public objections. Thus the team concluded that the most probable way to install a 110kV substation is to utilize publicly-owned land and migrate most of the equipment underground.


Figure 7-3 Around Park substation

7.2.3 Optimization of the Project Design

(1) Underground Substation

The survey team investigated the geological conditions of the candidate sites for the underground substation and the underground transmission lines with the help of Japanese construction companies stationed in Ulaanbaatar city, and found that the water table of the site is quite shallow (Ground level: -3 meters), and permafrost ground and hard soil exists (Ground level: -20m). These unfavorable soil conditions may result in extra civil work and building constructions.

The availability of a substation site is also problematic; the original site (40m x 20m), which was requested to Ulaanbaatar city administration, is not ideal for a 110kV underground substation, and requires more floors beneath the ground (up to B4 floors) to accommodate all necessary facilities, and increases civil excavation work. Also, these limited spaces necessitate the application of compact machines, such as gas-insulated transformer, switchgear, and cooling towers, all of which require special studies for application.

To solve these technical difficulties, the survey team explained the necessary space for 110kV to the grand manager of Ulaanbaatar city with the representatives of NPTGC, and requested to move the site to the edge of a park facing a wide road, and expand the site to 50 x 90 m maximum. Also, the team studied a compact design of the substation (35m x 50m) based on the team's historical operation experiences of underground substations.

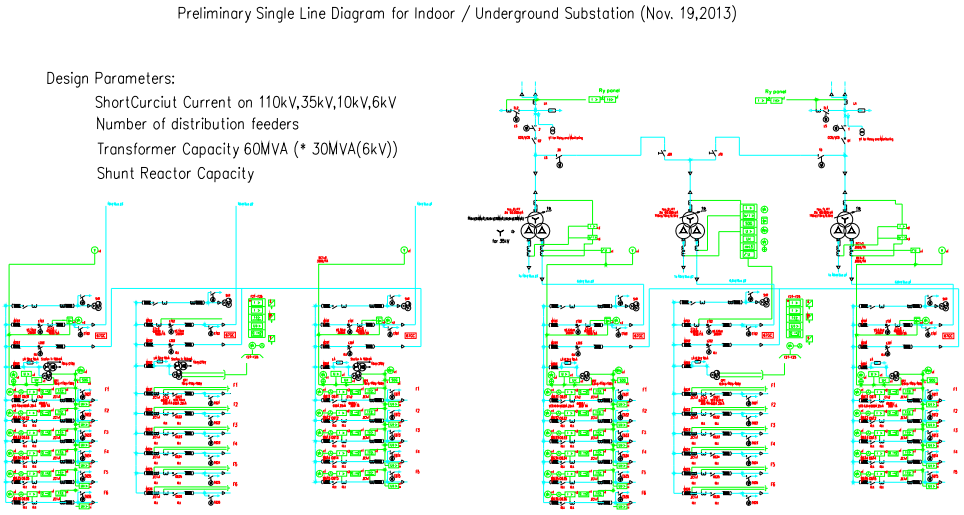


Figure 7-4 Single Diagram of Park Substation

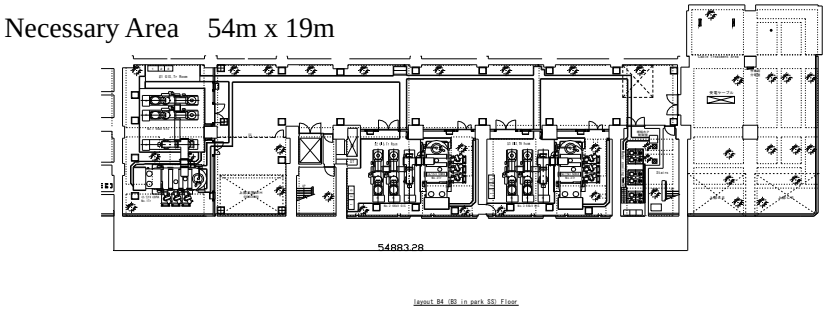


Figure 7-5 Example of Compact Underground Substation (B3 Floor)

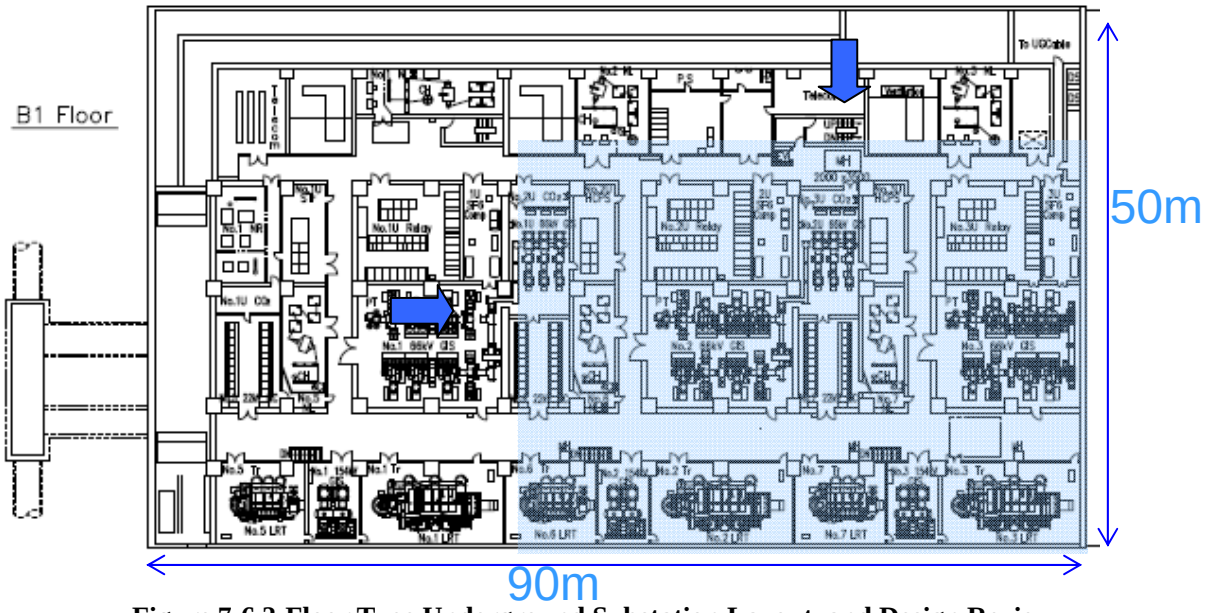


Figure 7-6 2-Floor Type Underground Substation Layout, and Design Review for More Compact Design.

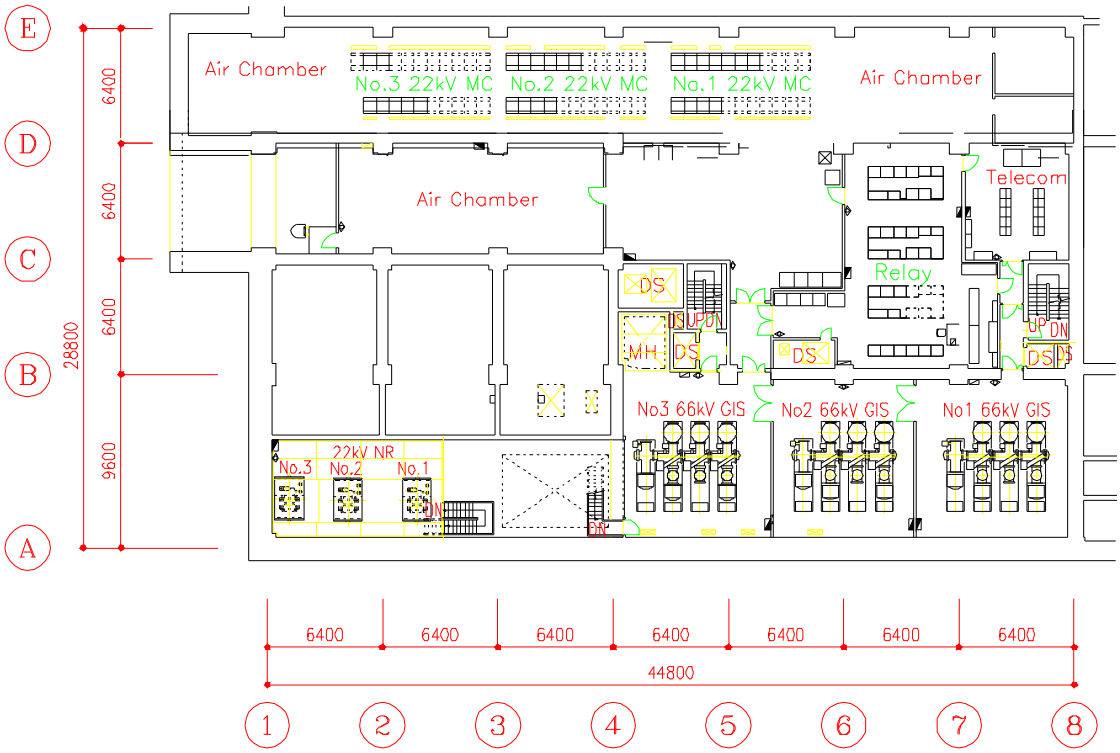


Figure 7-7 2-Floor Type Underground Substation Layout

This compact layout design of the substation employs gas-insulted transformers and switchgears so that the depth of digging civil work can be minimized. To design the underground substation optimally, NPTGC and Ulaanbaatar City must specify the location and available area of the site, and conduct further feasibility study for technical constraints from the viewpoint of power system planning, such as the necessity of reactive power sources and neutral current limiting facility, and for the utilization of various compact machines such as water-cooling system, and water-stopping design of the substation building based on actual land surveys and geological testing.

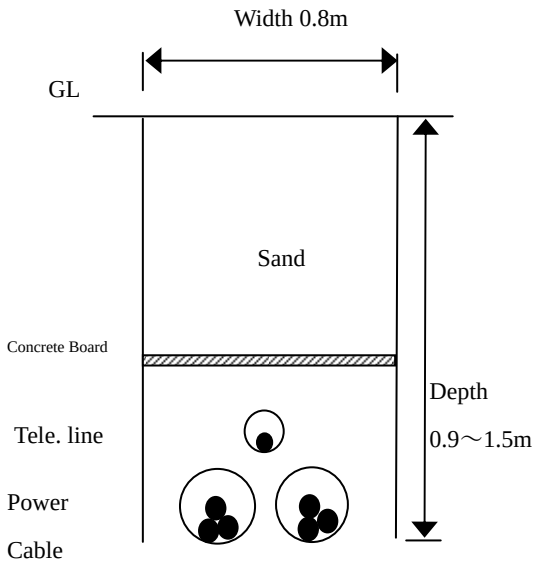
(2) New Underground Transmission Line Connected

Theoretically, part of the newly built transmission line can be conventional overhead & air-insulted type, but the survey team concluded that at least, the southern part from the river crossing of the proposed route shall be done with underground cables because difficulties in securing insulation distances to existing high-rise buildings are expected even though there's plenty of free space.

The installation of the underground power cable employs duct conduits and provides man-holes at necessary points. In this project component, the land acquisition will be the most difficult work in both cases for underground or overhead transmission line, and co-ordination among other utility companies, such as heat supply, water, gas, and sewage companies, is necessary as one universal project of city development with the help of Ulaanbaatar City.

Table 7-13 Project Component of the Transmission Line

Installation Design	Transmission Route	Cable Specification
Installation Depth of ducts Road: -1,500 mm Walkway: - 900 mm Reinforced Vinyl Pipe ϕ 200 mm x2 for power cable Reinforced Vinyl Pipe ϕ 75 mm x1 for telecommunication manhole for joints and cable laying 1.4m x 1.5m x 4.5m x 15 sets	From Tuul – Park Substation : 8 km (road 0.5 km, walkway 7.5 km)	110kV XLPE 1200mm2 8,500 m, double circuit Optical Cable 14c 8,500 m, single circuit Cable terminals for air insulated bushing and gas-insulated switchgear



7.2.4 Necessary Component

(1) Substation

The following equipment is necessary as a part of the substation component.

Table 7-14 Necessary Project Components

Component	Specification	Note
110kV switchgears	Gas insulated switchgear and short-circuit current is tentatively set to be 40kA.	Includes installation of power receiving bus protection relays, automatic switching function in case of inner trouble.
Transformers	60MVA 110/10/6.6 KV with Online Tap Changer	Automatic voltage control relays will be installed
10kV and 6.6kV cubicles	capable of DAS connection, short-circuit current rating is tentatively set to be 25kA, single bus with bus sections	zero-sequence voltage shall be monitored to enable selective distribution line protection, expansion spaces for 10kV cubicle
Substation Automation System	Based on ABB's SAS conforming to IEC relevant standards. Periodic recording features and automatic reporting to other servers shall be equipped.	Vary alarming categories and warnings for future remote control
Station Power sources	battery capacity is set to 4 hours of a possible operation sequence. Chargers and maintenance-free type batteries.	
Reactive power sources	to compensate distribution lines	
Substation building	with fire alarming and fire fighting system	

(2) Underground Transmission Line

The following components are expected for the underground transmission line construction.

Table 7-15 Necessary Components for Underground Transmission Line

Component	Specification	Note
Duct for underground cable	Reinforced vinyl pipe	Enclose power cable and telecommunication cable
Manhole	Precast Concrete Box with earthing bar & conductor, Bell mouth, and steel lid	
110kV XLPE Power Cable	1200 mm2 (single core / triplex) with cable termination kit	
Telecommunication Cable	Optical fiber 14c	For remote control

7.2.5 Estimation of the Total Project Costs

The total project costs are estimated as shown below. The costs include the construction costs (base cost), price escalation (1.3 %/year for foreign currency and 6.0 %/year for local currency), physical contingency (5 % of the base cost including price escalation), consulting costs (7 % of the base cost), administration cost (5 % of the base cost and the consulting costs), VAT (10 % for the local currency portion), and customs duty (5 % for the foreign currency portion).

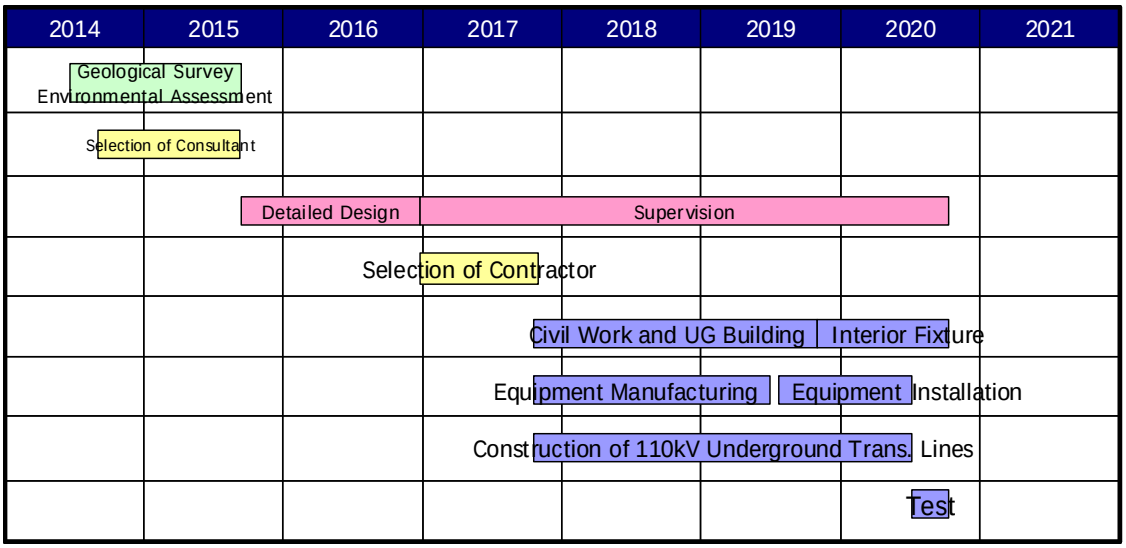
Table 7-16 Estimation of the Total Project Costs

Item	Cost		Total
	Foreign	Local	
	JPY	MNT	JPY
Park Substation			
Transformer	894,000,000	0	894,000,000
Gas Insulated Switchgear 110kV	335,000,000	0	335,000,000
6.6kV Circuit Breaker	0	0	0
10KV,6.6kV Cubicle	288,000,000	0	288,000,000
Substation SCADA (SAS+HMI)	75,000,000	0	75,000,000
Relay Panel	90,000,000	0	90,000,000
Substation Power Supply	12,000,000	0	12,000,000
Shunt Reactors	30,000,000	0	30,000,000
Telecom, Firefighting, Misc	20,000,000	0	20,000,000
Structures	2,000,000	0	2,000,000
Power Cables, Conductors	8,000,000	0	8,000,000
Insulators, Power Ducts	4,000,000	0	4,000,000
Lightning Arrestors	2,000,000	0	2,000,000
Earthings	10,000,000	166,667,000	20,000,020
Underground Substation Floors	68,600,000	980,000,000	127,400,000
Equipment Installation	0	83,334,000	5,000,040
Civil and Architecture Work	15,000,000	19,500,000,000	1,185,000,000
Transportation	50,000,000	0	50,000,000
Sub-Total	1,903,600,000	20,730,001,000	3,147,400,060
Underground Transmission Line			
Equipment	175,282,000	0	175,282,000
Construction Costs	0	3,424,289,847	205,457,391
Transportation	0	846,023,688	50,761,421
Sub-Total	175,282,000	4,270,313,535	431,500,812
Base Costs	**2,078,882,000**	**25,000,314,535**	**3,578,900,872**
Consulting Costs	167,015,374	1,391,794,784	250,523,061
Escalation	170,586,804	9,034,550,782	712,659,851
Physical Contingency	120,824,209	1,771,333,005	227,104,189
VAT	0	4,023,406,299	241,404,378
Import Tax	0	1,962,620,162	117,757,210
Administration Costs	0	1,859,899,655	111,593,979
TOTAL	**2,537,308,387**	**45,043,919,221**	**5,239,943,540**

7.2.6 Implementation Schedule

The following chart shows the implementation schedule of the project. The schedule considers consulting services including detailed design and creation of tender documents and construction supervision.

Table 7-17 Implementation Schedule



7.2.7 Expected Effects

(1) Expected Benefits from the Project

(a) Benefits

The new substation will increase the transmission power system's capacity, and accordingly increase sales as the demand increases to the enhanced capacity. Also, the new substation is equipped with a new power system protection scheme on the primary and the secondary side of busbars, which results in higher supply reliability by limiting the area of blackout and restoring the blackout quickly with remote operation of switchgears.

In the calculation of the benefits, the loading pattern of transformers are assumed as shown in the following figure, and unit price of power supply for distribution companies and purchasing price from the generation companies are multiplied to the expected sales as the increase of economic benefit. Also, the new Park substation can supply a part of Tuul substation's load, which is currently overloaded, and increase the supply reliability of Tuul substation as well.

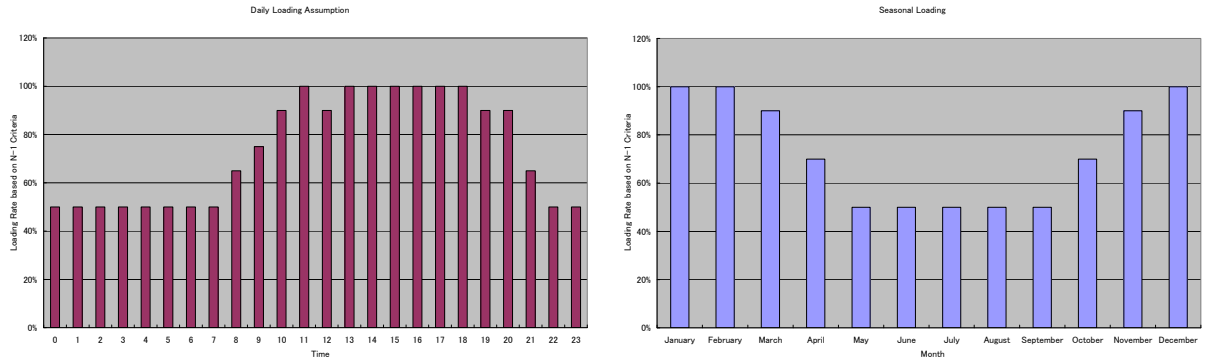


Figure 7-8 Daily and Seasonal Loading Patterns

(b) Summary of the Benefits

The following table summarizes the financial and economic benefits of the project.

Table 7-18 Financial and Economical Benefits

（Annual Benefit：US$/year）

Financial Benefit		
1	Increase in electricity sales income =Electricity sales*×Unit price = 498.4 GWh×6.89 million MNT/kWh / 1,474.1 US$/MNT * Electricity sales =Substation Capacity×Planned loading criteria×power factor×(1-transmission loss)×annual average loading rate =180MVA*(2/3)*0.9*(1-0.01)*0.532*24h*365day = 498.4 GWh	2.33 million
Economic Benefit		
1	Reduction of alternative power generation by electricity supply increase = Electricity sales × Generation cost of alternative diesel generators*1 =498.4 GWh×0.25 million (US$/kWh)	124.6 million

*1: The alternative diesel generation cost uses 0.25 US$/kWh

(2) Results of IRR Calculation

Based on the benefits summarized in the above, the internal rates of return were calculated as follows.

Table 7-19 IRR Calculation

	Results
FIRR	N/A
EIRR	122 %

7.2.8 Items to be Further Studied

Although this project has a great impact on recovering electricity supply reliability of Ulaanbaatar power system by constructing a large substation into the very center of the growing demand by utilizing available land space, NPTGC itself can't fully handle this project without the help of stakeholders, such as Ulaanbaatar City, UBEDN, MOE, other utilities for designing transmission line routes, distribution system expansion, co-ordination of existing facilities of other utilities based on the suggested route of the transmission line and substation site. Thus, once the agreement is made between the Mongolia government and Japanese government, stakeholders shall immediately organize the handling working group to timely construct this important power network by considering other stakeholders' development plans.

In the actual implementation stage, the following studies are indispensable to optimize the investment:

(1) Geological Surveys

The Ulaanbaatar authority requested electric utilities to maintain the park's environment by installing most of the necessary equipment underground, and minimize the size of the substation. In addition, the availability of the site is already limited to accommodate a 110 kV substation. Thus the application of gas-insulated switchgear and multi-floor design of substation building will be necessary.

As reported in the previous section, the shallow water table and hard soil condition including permafrost is expected. Thus, the contradicting design objectives: water proof design of the substation building, substation's impact on watertable, and cost for land excavation shall be satisfied based on the detailed study of the actual site's conditions.

(2) Review of Operational Rules and Technical Standard for Extreme Operational Conditions in Mongolia

This project necessitates NPTGC to review their operational rules to newly-introduced remote control of substation, and application of extreme ambient temperature of outdoor equipment to the indoor equipment. Also, standards and rules for the connection between the distribution company's system to NPTGC's substation shall be clarified. Also, operational rules for underground substations shall be developed by referring to other power utilities' examples such as the case in Tokyo, especially the selection of cooling method and ventilation control based on the actual Mongolian conditions.

(3) Survey on Existing Underground Facilities along the Transmission Line Route.

The route of newly built underground cables shall be closely studied based on the existing facilities of other utilities. The survey team found there is no map of existing facilities available now. Thus, immediate survey will be necessary once the project is approved.

(4) Revision of Substation voltage

Due to the high costs for underground substation and difficulty in securing 110 kV underground cable, it might not be a feasible and reasonable option for current Ulaanbaatar system expansion. Although NPTGC

and the study team tried to curtail the construction cost by studying its optimum substation design and feasible underground transmission line routes, the design of the substation shall be further reviewed by considering the possibility of the downgrade of primary-side voltage level (down to 35 kV), change of substation's form (outdoor/indoor/underground) to reduce the project cost to a feasible level.

7.3 Expansion of Baruun and Umard Substations

7.3.1 Overview of the Project

This project upgrades transformers and circuit breakers of both Baruun and Umard substations to supply the increasing electricity demand in Ulaanbaatar, and introduces better protection schemes for transmission and distribution lines and better remote control schemes such as DAS and SAS for the sake of higher supply reliability.

Table 7-20 Overview of the Project

Substation	Transformer Spec.	Feeders	Notes
Baruun	60MVA*1 x 3	6kV x 20 cct per bank	With reactors
Umard	60MVA*1 x 3	10kV 10cct per bank 6kV x 10cct per bank	With reactors

7.3.2 Rationale of the Project

The project satisfies the steeply increasing electricity demand in the center of Ulaanbaatar city due to the development of high-rise buildings, redevelopment of business districts, and development of residential areas for current gel residents. Also, this project will renew the aged equipment and introduce better system protection schemes, and operates with DAS to minimize the duration of distribution line faults. Currently, the Ulaanbaatar system lacks the stand-by capacities of existing substations, which are now being operated over their planning operational loadings: over 70 %, and yields no flexibility in switching lower-voltage side distribution lines.

Thus, this project has a significant impact on the stability of Ulaanbaatar's supply by expanding NPTGC's supply capacity by upgrading facilities on the existing substation sites. In addition, this project must be completed in accordance with UBEDN's distribution automation system integration so that the current heavy load on existing distribution lines can be switched to newly built distribution lines with larger capacities.

Table 7-21 Excessive Loading Rates of NPTGC's Substations

Substation	Loading Records (MVA)			Average Loading Rates
	2010	2011	2012	
Umard	55.5/80.0	58.0/80.0	59.3/80.0	74%
Tuul	48.5/80.0	55.4/80.0	59.3/80.0	74%
Baruun	31.3/50.0	34.6/50.0	39.1/50.0	78%
Tsmntsd	30.8/50.0	34.2/50.0	40.8/50.0	82%
Khaipaast	26.6/50.0	32.8/50.0	34.8/50.0	70%

7.3.3 Optimization of the Project Design

This upgrading project of Baruun and Umard substations must be designed to satisfy public needs for the re-developed area from gel resident areas, and to be capable of supplying enough electricity flexibly in accordance with the authority's development plan. In particular, this machine replacement must minimize the supply interruption of operating machines so as to secure sufficient supply reliability during the construction period, and to also secure sufficient future expansion area for reactive power sources by utilizing compact machine technologies, such as GIS based on the observations of recent supply voltage drop in the urban system. In essence, these requirements for the upgrading project favor an indoor-form substation with multi-floor design installed on the available space of the existing substations.

Figure 7-9 Layout of the New Substation and Existing Facility (Image)

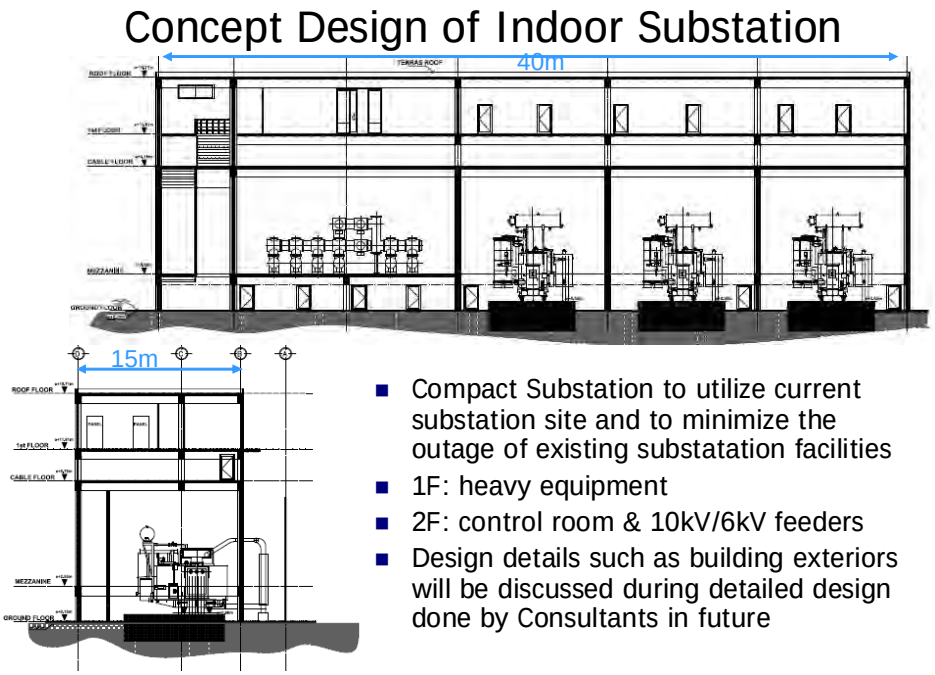


Figure 7-10 Preliminary Design of the Indoor Substation (Image)

7.3.4 Necessary Component

The following equipment is necessary as a part of the substation component.

Table 7-22 Necessary Component

Component	Specification	Note
110kV switchgears	Gas insulated switchgear and short-circuit current is tentatively set to be 40kA.	Includes installation of power receiving bus protection relays, automatic switching function in case of inner trouble.
Transformers	60MVA 110/10/6.6 KV with Online Tap Changer	Automatic voltage control relays will be installed
10kV and 6.6kV cubicles	capable of DAS connection, short-circuit current rating is tentatively set to be 25kA, single bus with bus sections	zero-sequence voltage shall be monitored to enable selective distribution line protection, expansion spaces for 10kV cubicle
Substation Automation System	Based on ABB's SAS conforming to IEC relevant standards. Periodic recording features and automatic reporting to other servers shall be equipped.	Vary alarming categories and warnings for future remote control
Station Power sources	battery capacity is set to 4 hours of a possible operation sequence. Chargers and maintenance-free type batteries.	
Reactive power sources	to compensate distribution lines	
Substation building	with fire alarming and fire fighting system	

7.3.5 Estimation of the Total Project Costs

The total project costs are estimated as shown below. The costs include the construction costs (base cost), price escalation (1.3 %/year for foreign currency and 6.0 %/year for local currency), physical contingency (5 % of the base cost including price escalation), consulting costs (6 % of the base cost), administration cost (5 % of the base cost and the consulting costs), VAT (10 % for the local currency portion), and customs duty (5 % for the foreign currency portion).

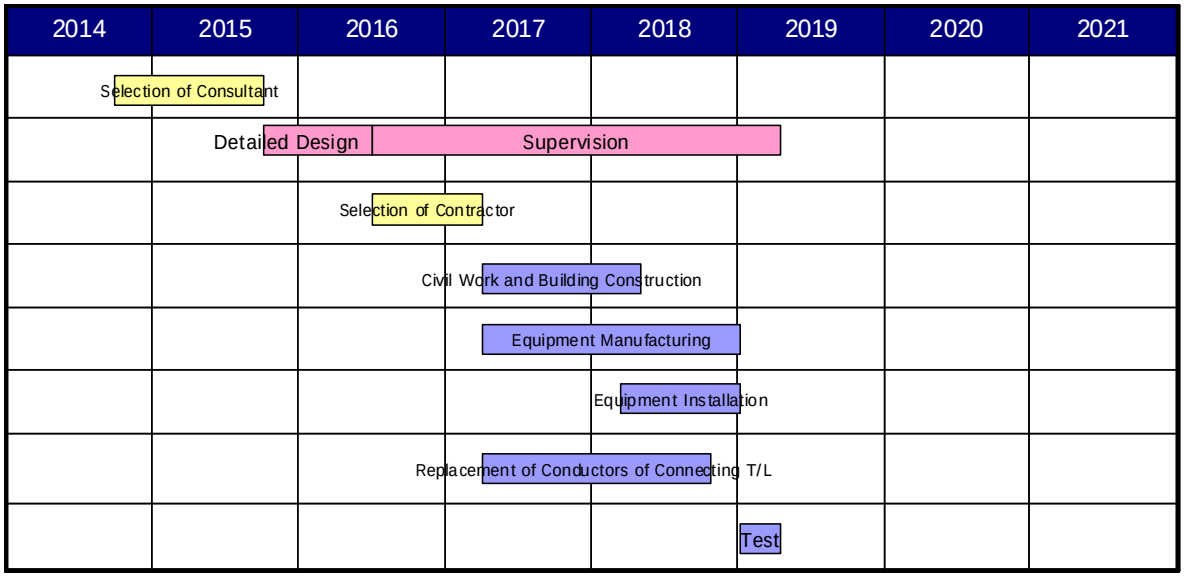
Table 7-23 Estimation of the Total Project Costs

Item	Cost		Total
	Foreign	Local	
	JPY	MNT	JPY
Umard Substation			
Transformer	594,000,000	0	594,000,000
Gas Insulated Switchgear 110kV	335,000,000	0	335,000,000
Transmission Line Section	134,000,000	0	134,000,000
10KV,6.6kV Cubicle	288,000,000	0	288,000,000
Substation SCADA (SAS+HMI)	75,000,000	0	75,000,000
Relay Panel	60,000,000	0	60,000,000
Substation Power Supply	12,000,000	0	12,000,000
Shunt Reactors	30,000,000	0	30,000,000
Telecom, Firefighting, Misc	10,000,000	0	10,000,000
Structures	2,000,000	0	2,000,000
Power Cables, Conductors	8,000,000	0	8,000,000
Insulators, Power Ducts	4,000,000	0	4,000,000
Lightning Arrestors	2,000,000	0	2,000,000
Earthings	10,000,000	166,667,000	20,000,020
Indoor Substation Building	64,680,000	2,450,000,000	211,680,000
Equipment Installation	5,000,000	83,334,000	10,000,040
Civil Work, Replacement	15,000,000	250,000,000	30,000,000
Transportation	50,000,000	0	50,000,000
Sub-Total	1,698,680,000	2,950,001,000	1,875,680,060
Baruun Substation			
Transformer	594,000,000	0	594,000,000
Gas Insulated Switchgear 110kV	335,000,000	0	335,000,000
Transmission Line Section	0	0	0
10KV,6.6kV Cubicle	288,000,000	0	288,000,000
Substation SCADA (SAS+HMI)	75,000,000	0	75,000,000
Relay Panel	60,000,000	0	60,000,000
Substation Power Supply	12,000,000	0	12,000,000
Shunt Reactors	30,000,000	0	30,000,000
Telecom, Firefighting, Misc	10,000,000	0	10,000,000
Structures	2,000,000	0	2,000,000
Power Cables, Conductors	8,000,000	0	8,000,000
Insulators, Power Ducts	4,000,000	0	4,000,000
Lightning Arrestors	2,000,000	0	2,000,000
Earthings	10,000,000	166,667,000	20,000,020
Indoor Substation Building	64,680,000	2,450,000,000	211,680,000
Equipment Installation	5,000,000	83,334,000	10,000,040
Civil Work, Replacement	15,000,000	250,000,000	30,000,000
Transportation	50,000,000	0	50,000,000
Sub-Total	1,564,680,000	2,950,001,000	1,741,680,060
Base Costs	**3,263,360,000**	**5,900,002,000**	**3,617,360,120**
Consulting Costs	144,694,405	1,205,786,707	217,041,607
Escalation	209,750,570	2,170,269,579	339,966,745
Physical Contingency	180,890,249	463,802,914	208,718,424
VAT	0	1,236,530,070	74,191,804
Import Tax	0	3,034,307,378	182,058,443
Administration Costs	0	486,993,060	29,219,584
TOTAL	**3,798,695,224**	**14,497,691,708**	**4,668,556,726**

7.3.6 Implementation Schedule

The following chart shows the implementation schedule of the project. The schedule considers consulting services including detailed design and creation of tender documents and construction supervision.

Table 7-24 Implementation Schedule



7.3.7 Expected Effects

(1) Expected Benefits from the Project

(a) Benefits

The new substation will increase the transmission power system's capacity, and accordingly increase sales as the demand increases to the enhanced capacity. Also, the new substation is equipped with a new power system protection scheme on the primary and the secondary side of busbars, which results in higher supply reliability by limiting the area of blackout and restoring the blackout quickly with remote operation of switchgears.

In the calculation of the benefits, the loading pattern of transformers are assumed as shown in the following figure, and unit price of power supply for distribution companies and purchasing price from the generation companies are multiplied to the expected sales as the increase of economic benefit. Also, with the introduction of DAS in UBEDN, automatic switching of distribution lines in the case of transformer fault can be provided, and up-rating of loading limit of transformers are possible. This will lead to the increase of electricity sales and efficient investment on machines.

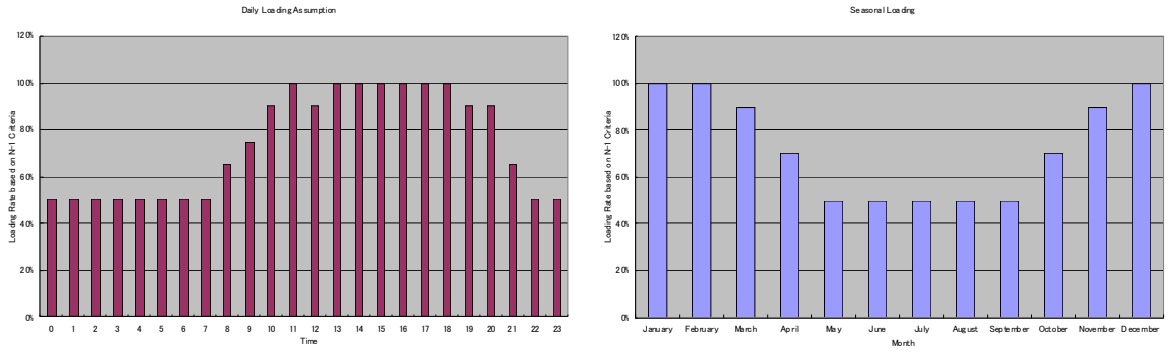


Figure 7-11 Daily and Seasonal Loading Patterns

(b) Summary of the Benefits

The following table summarizes the financial and economic benefits of the project.

Table 7-25 Financial and Economic Benefits

（Annual Benefit：US$/year）

Financial Benefit		
1	Increase in electricity sales income = Electricity sales*×Unit price = 456.9 GWh×6.89 million MNT/kWh / 1,474.1 US$/MNT * electricity sales =Substation capacity × Planned loading criteria × Power factor×(1-Transmission loss)× Annual average loading rate =((180*2/3-50)+(180*2/3-80) *0.9*(1-0.01)*0.532*24h*365day = 456.9 GWh	2.13 million
Economic Benefit		
1	Reduction of alternative power generation by electricity supply increase = Electricity sales × Generation cost of alternative diesel generators*1 =456.9 GWh×0.25 million US$/kWh	114.22 million

*1: The alternative diesel generation cost uses 0.25 US$/kWh

(2) Results of IRR Calculation

This project is closely related to the project, “Conductor Replacement of Existing 110 kV Transmission Lines (No.109 & No.110)” described later, with the same objective. Thus decisions of the investment on these projects shall be made as if one combined project. Accordingly, IRRs are calculated as a combined project for substation and transmission line replacement based on the benefits summarized in the previous section; the internal rates of returns were calculated as follows by taking the minimum number of the projects.

Table 7-26 IRR Calculation

	Results
FIRR	N/A
EIRR	93 %

7.3.8 Items to be Further Studied

(1) Operational Rule for Remote Control and Distribution Automation

The JICA Survey Team concluded that the review of operational rules and Technical Standard for extreme operational conditions in Mongolia will be beneficial to this project. Also, this project necessitates that NPTGC review their operational rules for the newly-introduced substation remote control, and standards and rules for the connection between the distribution company's system to NPTGC's substation.

This project currently installs disconnecting switches at the HV side of Umard substation to control electricity flow to avoid overloading of 109 and 110 transmission lines. To avoid human errors on this switching function on the HV side, clear operational rules shall be agreed by NPTGC and UBEDEN during the construction period of this project.

(2) Re-use of Replaced Transformers and Switchgears

In addition, the operating 40MVA transformers and LV cubicles in Umard substation shall be reused after upgrading of the substation as stand-by troubleshooting materials or for other substations. In case of reuse of the equipment, quality check on the re-used machines is strongly encouraged.

(3) Revision of Implementation Schedule

NPTGC strongly requested to complete the substation project as soon as possible (up to 2017). Some countermeasures, such as possible design consultancy services and project cost arrangements, should be further studied to shorten the schedule.

7.4 Conductor Replacement of Existing 110 kV Transmission Lines (No.109 & No.110)

7.4.1 Outline of the Project

The target transmission lines are double circuits of No.109 and No.110, 110 kV transmission lines between the 4th TPP and the Dornod 2 SS. The target transmission lines connect to the Baruun SS and the Umard SS that would be expanded in the JICA project.

As for a conductor replacement, conductor type and size should be selected based on the power demand in future generally, but it is difficult because the demand forecast is uncertain at this moment. On the other hand, the surrounding area of the target transmission lines is a dense Yurt built-up area and there are many illegal occupants below the transmission lines; rehabilitation of the existing transmission lines by using a

temporary route or building a new route are not realistic.

Considering the above situation, NPTGC requested to strengthen the target transmission lines applying the HTLS (high temperature low sag) conductor which has approx. double the transmission capacity of the existing conductor.

The outline of the conductor replacement is as below.

- ✧ Target facilities: No.109 & No.110 transmission lines (4th TPP ~ Dornod2 SS) and their branch lines to Uildver SS, Baruun SS, Umard SS and Selbe SS.
- ✧ Transmission line length: The length of No.109 & No.110 is approx. 15 km.
- ✧ Supports: The existing supports are towers and concrete poles and they will be reused with reinforcement as necessary.
- ✧ Conductors: HTLS conductor of the same size as the existing conductors will be applied.
- ✧ Insulators: Porcelain insulators will be applied.

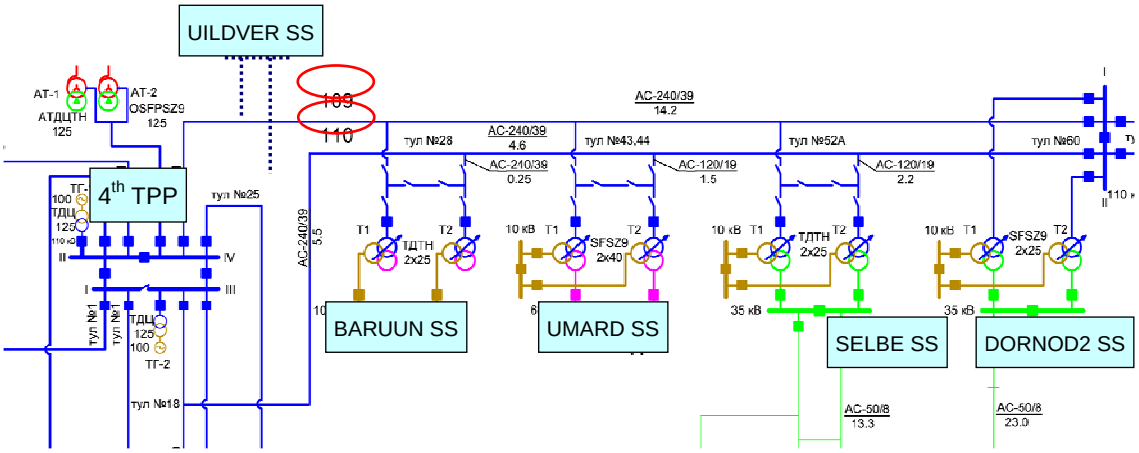


Figure 7-12 Target Transmission Lines

Gantry in the 4th TPP

Crossing of 220kV T/L (No.1~No.2)

Branch Point of Umard SS (The 4th TPP side)

Branch Point of Umard SS (Dornod2 side)

Branch Point of Selbe SS

Branch Line to Selbe SS

Figure 7-13 Target Transmission Lines of the conductor replacement

7.4.2 Rationale of the Project

According to the report by NPTGC, load factors of the five 110 kV substations in Ulaanbaatar City have exceeded 70 % during the winter peak. And also the load factor of No.109 & No.110 transmission lines which are the 110 kV circularly-connected northern transmission lines between the 4th TPP and Dornod 2 SS has reached 56 % during the winter peak of 2012, and it is expected to reach 59 % during the winter peak of 2013. The above mentioned situation might cause supply interference when transformer trouble or single circuit transmission line trouble happens.

In addition, the power supply area of No.109 & No.110 transmission lines will be urbanized based on the city planning of Ulaanbaatar City in future, therefore a large increase in power demand by electrification is expected. Then renewal of the facilities considering the future power demand as well as the facilities' aging degradation would be the urgent issue.

The conductor replacement selected in this survey aims at resolution of the cause of power supply interference and preparation against the urgent demand increasing by renewal of the high loaded 110 kV facilities.

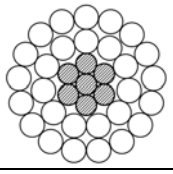
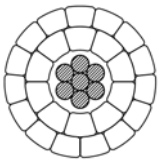
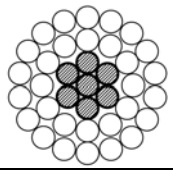
7.4.3 Necessary Component

(1) Selection of the Conductor

Under the terms of reusing supports of the existing transmission lines, it is necessary to increase the transmission capacity securing the present ground clearance. Then the JICA Survey Team introduced two types of HTLS conductors such as GAP type conductor and Invar core conductor which have almost double the transmission capacity of the same size existing conductor. After the discussion, NPTGC indicated their intention to adopt the GAP type conductor for No.109 & No.110 transmission lines.

The technical characteristics of ACSR, GAP type conductor and Invar core conductor which are equivalent to the existing conductor are shown in the following tables. (The calculation condition for ampacity: ambient temp.: 40 deg.C, wind velocity: 0.5 m/s, wind direction: 45 deg., solar radiation: 0.1 W/cm^2, Absorptivity of conductor surface: 0.9).

Table 7-27 Technical Characteristics of the HTLS Conductors (equivalent to ACSR 240mm^2)

Description		Unit	ACSR 240/43mm^2	GZTACSR 240mm^2	ZTACIR/AS 230mm^2
Construction		Nos/mm	28/2.8 – AL 7/2.8 – St	15/TW- ZTAL 10/TW-ZTAL 7/2.4-Est	30/3.1- ZTAL 7/3.1-IR/AS
Nominal Diameter		Mm	21.6	20.6	21.7
Min. breaking load		kN	85.5	87.1	83.8
Cross sectional area	AL	Mm^2	238.0	253.4	226.5
	Core		43.11	31.67	52.84
Nominal weight		Kg/km	997	971.4	1,002
DC Resistance at 20 deg. C		Ω/km	0.132	0.1167	0.1229
Modulus of electricity	AL	GPa	61.8	78.1	78.9
	Core		-	205.9	152.0
Co-efficient of linear expansion	AL	/deg. C	18.7 x 10^{-6}	19.6 x 10^{-6}	16.0 x 10^{-6}
	Core		-	205.9 x 10^{-6}	3.7 x 10^{-6}
Current capacity	Maximum		574A at 90℃	1193A at 210℃	1185A at 210℃
Cross sectional view		-			

TW: Trapezoid wire, ZTAL: Super thermal resistant aluminum alloy
Est: Extra high strength galvanized steel, IR/AS: Aluminum clad invar alloy

Table 7-28 Technical Characteristics of the HTLS Conductors (equivalent to ACSR 185mm2 and ACSR 120mm2)

Description		Unit	GTACSR 120mm^2	G(Z)TACSR 185mm^2
Construction		Nos/mm	14/TW-TAL 9/TW-TAL 7/1.6-Est	14/TW-(Z)TAL 10/TW-(Z)TAL 7/2.0-Est
Nominal Diameter		mm	14.4	17.8
Min. breaking load		kN	41.7	63.7
Cross sectional area	AL	mm^2	120.3	187.4
	Core		14.1	22.0
Nominal weight		kg/km	455	708
DC Resistance at 20 deg. C		Ω/km	0.245	0.158
Modulus of electricity	AL	GPa	76.9	76.9
	Core		205.9	205.9
Co-efficient of linear expansion	AL	/deg.C	19.8 x 10^{-6}	19.8 x 10^{-6}
	Core		11.5 x 10^{-6}	11.5 x 10^{-6}
Current capacity	Max		584A at 150℃	778A at 150℃ (975A at 210℃)
Cross sectional view		-	Same as GZTACSR 240mm^2	

TW: Trapezoid wire, ZTAL: Super thermal resistant aluminum alloy
Est: Extra high strength galvanized steel

(2) Selection of the Insulator

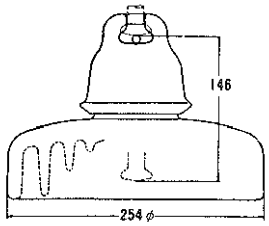
As described in the Chapter 4, the insulators of the target transmission lines are seriously contaminated with smoke and soot and some broken insulators have been left as they are, and this might cause grounding faults. In addition, NPTGC has a policy to implement insulators cleaning twice a year but they cannot implement the cleaning, they said.

Considering the above mentioned situation, NPTGC requested the JICA Survey Team to replace insulators of No.109 and No.110 transmission lines the same as the conductor replacement, and indicated their intention to adopt Japanese porcelain insulator.

In this survey, the JICA Survey Team proposed applying fog type porcelain suspension insulator with ball & socket which has good anti-contamination performance to NPTGC.

The technical characteristics of the fog type porcelain insulator are shown in the following table.

Table 7-29 Technical Characteristics of the Insulator

Electromechanical Failing Load		Unit	80	120
IEC Designation		-	-	U120BP
Shell Diameter, D		mm	254	254
Unit Spacing, H		mm	146	146
Nominal Creepage Distance		mm	455	455
Mechanical Routine Test Load		kN	40	60
Dry Lightning Impulse Withstand Voltage	1 unit	kV	125	125
	1 SS (5units string)	kV	445	445
Wet Power-frequency Withstand Voltage	1 unit	kV	45	45
	1 SS (5units string)	kV	160	160
Power-frequency Puncture Voltage		kV	130	130
Ball & Socket Coupling			16mmA	16mmA
Net Weight (approx.)		kg	6.5	6.5
Sectional View		-		

Standard Testing Specification: IEC Pub. 60383-1:1993

(3) Necessary Component

(a) Conductor

The necessary components of the conductors are as shown in the following table.

Table 7-30 Components of the Conductors

Conductor/Ground wire type	No. of bundles	No. of phases	No. of circuits	Line length [km]	Conductor length [km]
GZTACSR 240 mm^2	1	3	2	15.0	94.5
GZTACSR 120 mm^2	1	3	2	3.0	18.9

(b) Insulator

The necessary components of the insulators are as shown in the following table.

Table 7-31 Components of the Insulators

120 kN Insulator for Tower

Tower type	Assembly type	No. of insulators per set [pcs]	No. of strings per tower [set]	No. of towers [unit]	Sub total of strings [set]	Sub total of insulators [pcs]
Tension	Single	9	12	35	420	3,780
Total					420	3,780

70 kN Insulator for Concrete Pole

Tower type	Assembly type	No. of insulators per set [pcs]	No. of strings per tower [set]	No. of towers [unit]	Sub total of strings [set]	Sub total of insulators [pcs]
Suspension	Single	9	6	46	276	2,484
Jumper support	Single	9	6	35	210	1,890
Total					486	4,374

7.4.4 Estimation of the Total Project Costs

The total project costs are estimated as shown below. The costs include the construction costs (base cost), price escalation (1.3 %/year for foreign currency and 6.0 %/year for local currency), physical contingency (5 % of the base cost including price escalation), consulting costs (6 % of the base cost), administration cost (5 % of the base cost and the consulting costs), VAT (10 % for the local currency portion), and customs duty (5 % for the foreign currency portion).

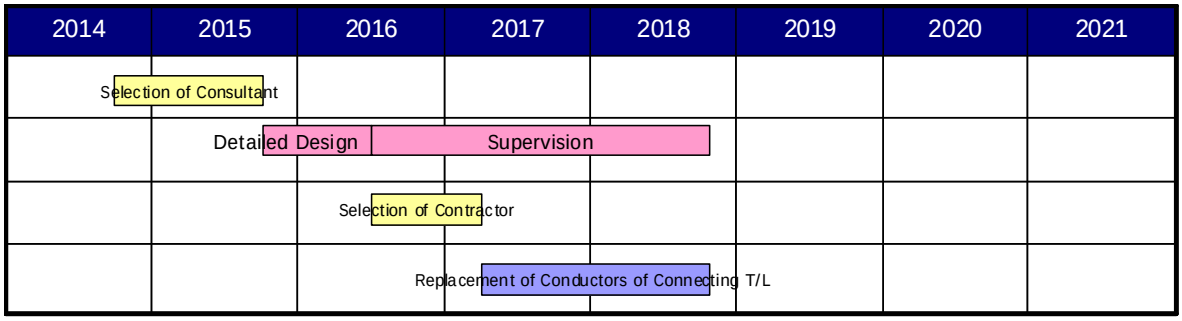
Table 7-32 Estimation of the Total Project Costs

Item	Cost		Total
	Foreign	Local	
	JPY	MNT	JPY
Transmission Conductor Replacement			
Tower Member	5,684,000	0	5,684,000
Conductor (GZTACSR 240mm2)	57,645,000	0	57,645,000
Conductor (GZTACSR 180mm2)	7,089,000	0	7,089,000
Conductor (GZTACSR 120mm2)	5,670,000	0	5,670,000
Single Tenstion String (120kN)	29,808,000	0	29,808,000
Single Suspension String (70kN)	14,256,000	0	14,256,000
Jumper Support String (70kN)	10,584,000	0	10,584,000
Accessories	13,073,600	0	13,073,600
Spare Parts	28,761,920	0	28,761,920
Tower Reinforcement	0	34,220,000	2,053,200
Stringing	0	208,443,800	12,506,628
Advisory Service for Stringing	10,000,000	0	10,000,000
Inland Transportation	0	287,619,200	17,257,152
Miscellaneous	500,000	26,514,150	2,090,849
General Expenses	1,050,000	55,679,715	4,390,783
Base Costs	**184,121,520**	**612,476,865**	**220,870,132**
Consulting Costs	8,834,805	73,623,377	13,252,208
Escalation	11,859,025	206,864,354	24,270,886
Physical Contingency	10,240,768	44,648,230	12,919,661
VAT	0	109,791,790	6,587,507
Import Tax	0	171,198,178	10,271,891
Administration Costs	0	46,880,641	2,812,838
TOTAL	**215,056,118**	**1,265,483,436**	**290,985,124**

7.4.5 Implementation Schedule

The following chart shows the implementation schedule of the project. The schedule considers consulting services including detailed design and creation of tender documents and construction supervision.

Table 7-33 Implementation Schedule



7.4.6 Expected Effects

(1) Expected Benefits from the Project

(a) Benefits

The transmission capacity will be increased due to the conductor replacement from the existing conductor to the HTLS conductor. Therefore the highly-loaded condition during the winter peak will be improved and sound power transmission will be secured even when a single circuit trouble happens.

The following table shows the expected peak power flow with 5 % demand increment per year during the winter peak. The upper half is the peak power flow without the conductor replacement and the lower half is the peak power flow without the conductor replacement. The values of 2012 and 2013 are based on the operation plan between 2013 and 2020 of NPTGC.

Table 7-34 Peak Power Flow Comparison

without Project

ACSR 240	N-1 criteria applied	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Voltage [kV]	110													
Allowable Current Capacity [A]	610													
Load Factor (at Winter Peak)	50%	56%	59%	62%	65%	68%	72%	75%	79%	83%	87%	92%	96%	101%
Peak Current [A]	305	342	360	378	397	417	437	459	482	506	532	558	586	616
Power Factor	0.95	0.94	0.95	0.95										
Peak Power Flow per Circuit [MW]	55.2	61.2	65.1	68.4	71.8	75.4	79.2	83.1	87.3	91.7	96.2	101.1	106.1	111.4

with Project

GZTACSR 240	N-1 criteria applied	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Voltage [kV]	110													
Allowable Current Capacity [A]	1193													
Load Factor (at Winter Peak)	50%	28%	30%	32%	33%	35%	37%	39%	40%	42%	45%	47%	49%	52%
Peak Current [A]	597	342	360	378	397	417	437	459	482	506	532	558	586	616
Power Factor	0.95	0.94	0.95	0.95										
Peak Power Flow per Circuit [MW]	108.0	61.2	65.1	68.4	71.8	75.4	79.2	83.1	87.3	91.7	96.2	101.1	106.1	111.4

[Assumptions]

- Power Factor (2015~):	0.95
- Increment of the peak power flow per circuit per year:	5%

Additionally, improvement of the anti-contamination performance and maintenance efficiency would be expected by replacing the glass insulators to the porcelain insulators.

(b) Summary of the Benefits

The following table summarizes the financial and economic benefits of the project.

Table 7-35 Financial and Economic Benefits

（Annual Benefit：US$/year）

Financial Benefit		
1	Increase in electricity sales income = Electricity sales* x Transmission profit margin = 461.21 GWh x 6.89 million MNT/kWh / 1,474.1 US$/MNT * Electricity sales = Transmission capacity increment（= √3 x Voltage x Current value Increment x Expected power factor x (1 - Transmission loss) x Annual mean load factor x 24hours x 365days = 1.732 x 110 kV x (1,193-610) A x 0.9 x (1-0.01) x 53.2% x 24 x 365 = 461.21 GWh	2.16 million
Economic Benefit		
1	Reduction of alternative power generation by electricity supply increase = Electricity sales x Generation cost of alternative diesel generators*1 = 461.21 GWh x 0.25 million US$/kWh	115.3 million

*1: The alternative diesel generation cost uses 0.25 US$/kWh

(2) Results of IRR Calculation

The JICA Survey Team regards this conductor replacement as the combined project with the aforementioned expansion of Baruun and Umard Substations, therefore the calculation result of IRR would be regarded as the same.

7.4.7 Items to be Further Studied

Prior to the conductor replacement, confirmation of the existing supports' strength should be implemented in the detailed design stage. It may be needed to reinforce the supports in some cases.

7.5 Mobile Substation

7.5.1 Outline of the Project

In this project, one mobile substation was requested to be purchased to respond to an emergency accident at the 110 kV substation managed by NPTGC. Since the National Emergency Management Agency (NEMA) has a plan to purchase two mobile substations, NPTGC is going to purchase one mobile substation car in this project. NPTGC, which owns many superannuated substations, can rapidly recover electricity at the time of an accident by shortening the power outage time as much as possible, and secure the supply reliability.

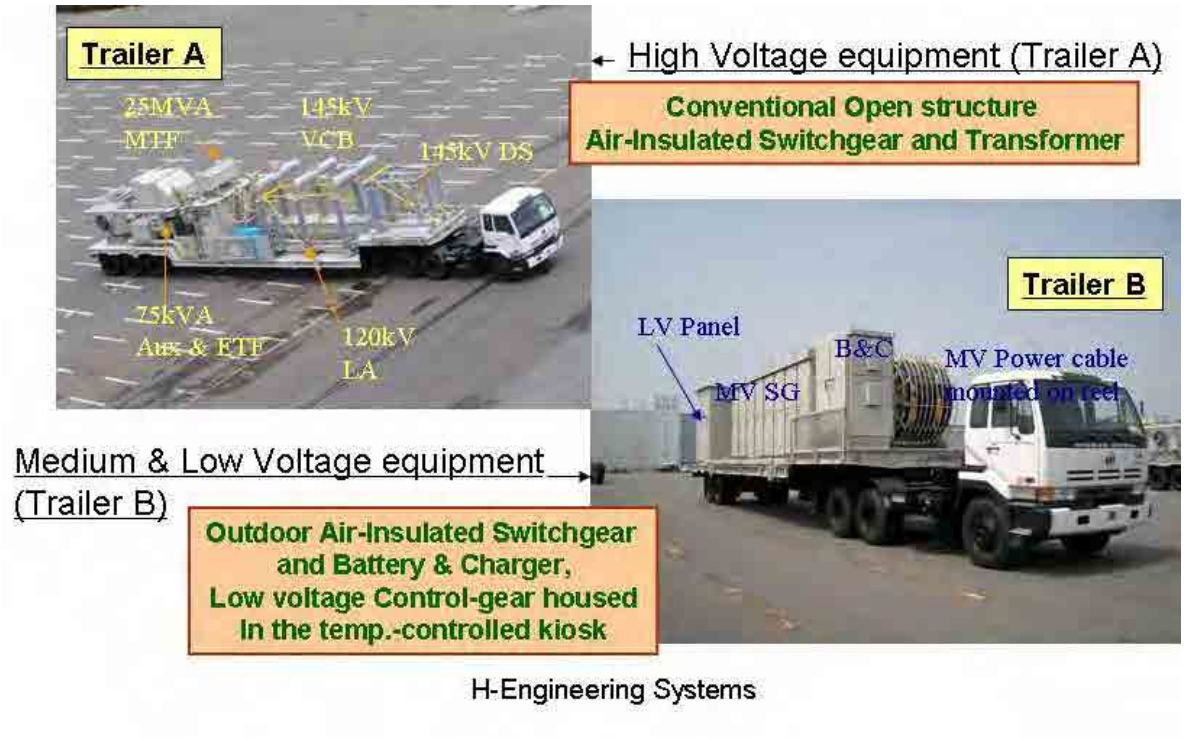


Figure 7-14 Image of Mobile Substation (2 units for 1 set)

7.5.2 Rationale of the Project

As described in Chapter 4, there have been 5 transformer accidents and 4 breaker accidents occurring on average every year recently. Taking into account that it takes 1 to 2 months to recover from those accidents, it is significant that the mobile substation car is prepared. It takes 3 to 7 days to install the mobile substations depending on the site conditions.

7.5.3 Necessary Component

(1) Selection of the Specifications

Local natural conditions and road conditions need to be adequately taken into account when selecting the specifications of the mobile substation.

Natural conditions	Retaining of performance against the lowest temperature (lower than – 40 degrees Celsius)
Road conditions	Maximum width, maximum load, maximum ground height and minimum ground clearance
Remote area conditions	Maximum fuel tank capacity

Among the in-car equipment, breakers and transformers are of great importance, which require unique

specifications according to the extreme cold area in Mongolia.

Specifications of Japanese mobile substation for cold area guarantee operation under -20 degrees Celsius, but in Mongolia, operation guarantee under -40 degrees Celsius (-50 degrees Celsius in rural areas) is required for the extreme cold area.

Since the road conditions are not good, the car should be robust and have considerable minimum ground clearance.

(2) Car Component

Car component is not designated, but it is considered reasonable to combine several vehicles such as a transformer vehicle, switching equipment vehicle and a distribution board vehicle.

Table 7-36 Car Component (Example)

In-car equipment	Main transformer Switches Control board・distribution board Cables Accessories	110/10kV 40MVA 110kV DS, DS-E, LA, etc. 110kVcontrol board, 10kVCB, etc. Power cables, control cables	1 unit 1 set 1 set 1 set 1 set
Vehicles	Trailer type or a truck type	Decide climbing angle and inclination angle and the minimum ground height according to the local conditions.	1set
Spare parts			1set

Table 7-37 Feature of Each Car Component

Car component type	Example	Notes
Towing tractor + trailer	A + B (2 cars for 1 set) A. (switch＋breaker＋transformer)  B. (Distribution feeder panel＋control board etc.) 	Suited for comparatively flat roads.
Truck type	A + B + C (3 cars for 1 set) A. (switch＋breaker)  B. (transformer)  C. (Distribution feeder panel＋control board) 	Car components are mounted individually, therefore this type is capable of driving on rough roads.

7.5.4 Estimation of the Total Project Costs

The total project costs are estimated as shown below. The costs include the equipment costs (base cost), price escalation (1.3 %/year for foreign currency and 6.0 %/year for local currency), physical contingency (5 % of the base cost including price escalation), administration cost (5 % of the base cost), VAT (10 % for the local currency portion), and customs duty (5 % for the foreign currency portion).

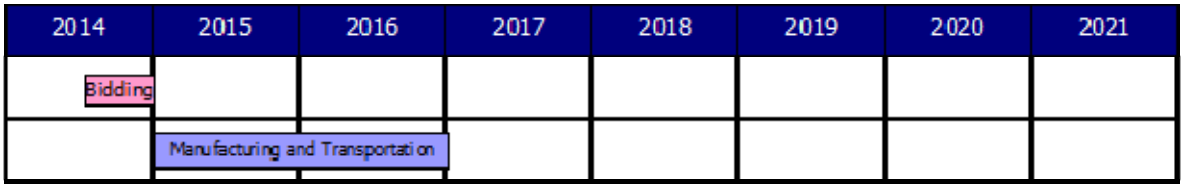
Table 7-38 Estimation of the Total Project Costs

Item	Cost		Total
	Foreign	Local	
	JPY	MNT	JPY
Mobile Substation	600,000,000		600,000,000
Transportation		846,023,688	50,761,421
Base Costs	**600,000,000**	**846,023,688**	**650,761,421**
Consulting Costs	0	0	0
Escalation	19,703,459	191,832,893	31,213,433
Physical Contingency	30,985,173	51,892,829	34,098,743
VAT	0	10,378,566	622,714
Import Tax	0	542,240,527	32,534,432
Administration Costs	0	55,006,399	3,300,384
TOTAL	**650,688,632**	**1,697,374,902**	**752,531,126**

7.5.5 Implementation Schedule

The following chart shows the implementation schedule of the project. With no consultancy service, the procurement starts from 2015.

Table 7-39 Implementation Schedule



7.5.6 Expected Effects

It is possible to prevent an emergency situation such as long power outages at the time of substation accidents, for example, multiple accidents in which the existing facility cannot properly handle the situation.

However, it is difficult to make forecasts on the frequency of emergency situations at this facility; therefore, IRR is not calculated.

7.5.7 Items to be Further Studied

It is desired to implement the following training programs for NPTGC staff members to efficiently utilize the equipment. Those programs are assumed to be implemented by suppliers.

①	O&M of in-car equipment of the mobile substation car	Approx. 7 days
②	O&M of the mobile substation car	Approx. 3 days
③	Assembling/dismantling training of the mobile substation car	Approx. 7 days
④	Driving training	Approx. 5 days
⑤	Operation recording method	Approx. 2 days
⑥	Others	Approx. 2 days

Chapter 8 Distribution Projects

In this chapter, each distribution project is studied in detail. According to the discussion results, the titles of the projects in this chapter may change from the ones which are described in the Chapter 6, to accurately express the project features.

8.1 Distribution Network Information Management System (DNIMS)

8.1.1 Outline of the Project

(1) Background of the Project

The characteristic of the distribution business is managing a large amount of equipment, customers, and routine tasks. And for a distribution company, it is essential to handle and manage them properly.

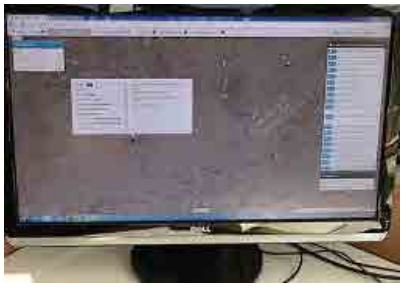
UBEDN spends enormous effort for this because UBEDN manages almost all of them manually. Therefore, UBEDN is considering the installation of enterprise systems in order to optimize/improve its business and update its data quickly. Furthermore, the migration to a more advanced business is expected by installation/integration of the systems.

UBEDN has surveyed the needs of the enterprise systems by commissioning the Indian IT consultancy service Infotech. Inc. in 2013. The JICA Survey Team reviews Infotech's report. Moreover, the Team implements the prioritization of the systems and studies feasibility/cost-benefit.

(2) The Contents of Infotech's Report

Infotech's report makes the technical requirements clear as it mainly describes the 'as is'/'to be' of UBEDN carefully. Some parts of this report are, however, so ideal that the realization of all this report does not seem realistic. The outline of the result of Infotech's survey is as follows.

Firstly, Infotech surveyed the present situation about the enterprise system and data management in UBEDN. According to this, UBEDN has installed the Power Factory* for the analysis of distribution network and Call Center System.



(*)Power factory: would be general software by Germany company DIgSILENT. This enables the analysis/simulation of distribution network.

Figure 8-1 Call Center System

No other systems such as distribution facility management system, Outage Management System, SCADA, etc. have been installed yet. With regard to the data of the distribution facilities, UBEDN has problems in terms of accuracy and management since the data are managed by several formats which are not coordinated.

The data which should be consolidated by constructing database are described below.

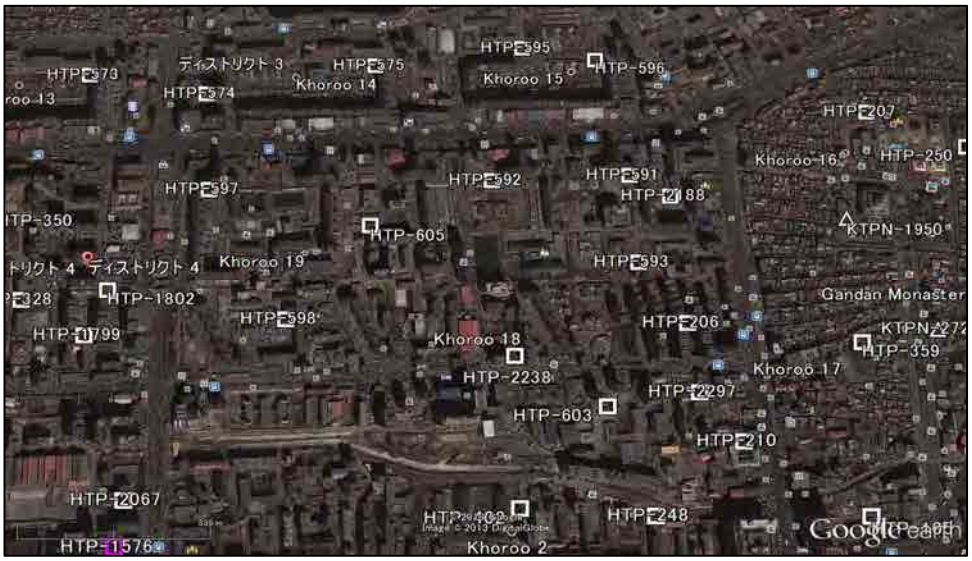


Figure 8-2 Location Map of S/S, Switching Stations, Distribution Towers（based on Google earth）

35 кВ-ын цахилгаан дамжуулах агаарын шугамын тоноглол

Маягт№14

д/д	Эх үүсвэрийн дэд станц	Фидерийн нэр	Тоноглолын нэр	Тип марк	Хэвийн гүйдэл /А/	Тоноглол суурилуулсан №	Тоо /ш/
1			Салгуур				
			Цэнэг шавхагч				
			Изолятор				
			Дэгээ				
2			Салгуур				
			Цэнэг шавхагч				
			Изолятор				
			Дэгээ				
3			Салгуур				
			Цэнэг шавхагч				
			Изолятор				
			Дэгээ				
4			Салгуур				
			Цэнэг шавхагч				
			Изолятор				
			Дэгээ				
5			Салгуур				
			Цэнэг шавхагч				
			Изолятор				
			Дэгээ				
6			Салгуур				
			Цэнэг шавхагч				
			Изолятор				
			Дэгээ				
	Дүн						

Гүйцэтгэсэн: Техникч .....
Шалгасан: Ахлах инженер .....

Figure 8-3 Equipment Management List（based on MS Excel）

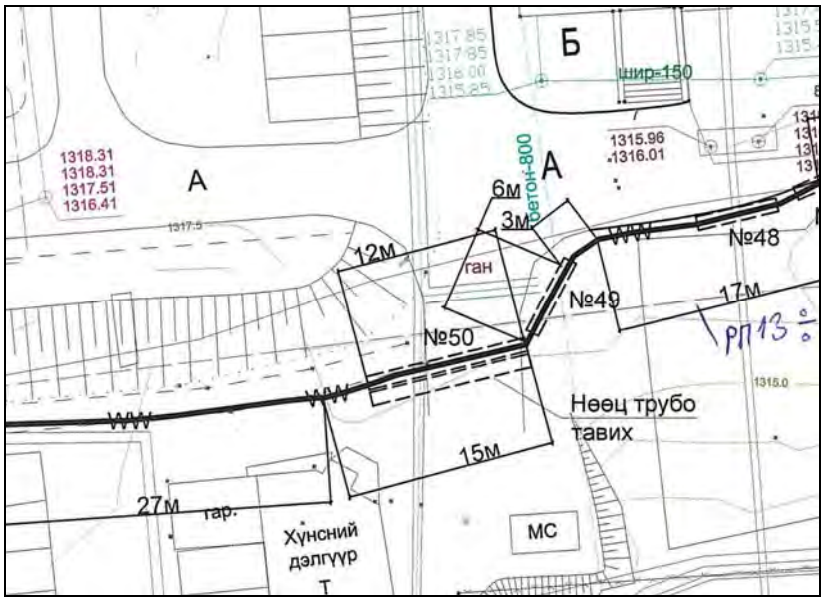


Figure 8-4 Construction Drawing（based on AUTO CAD）

Secondly, Infotech surveyed the needs of UBEDN and described the necessity of 7 new systems. Infotech suggested that UBEDN would install them in 3 steps. Infotech especially recommends that UBEDN firstly develops DNIMS: Distribution Network Management System, which includes equipment/construction database.

Table 8-1 System needs of UBEDN

Step	Name	Main functions	Status
0	Power Factory	○ Dist. Network Analysis & Optimization	Existing
0	Call Center & Customer Service Centers	○ Customer Details ○ Technical Service ○ Billing & Payments request	Existing
1	DNIMS (Distribution Network Information Management System)	○ Design Drawings ○ GIS Mapping ○ Add/Edit/Delete Asset Details ○ Network planning ○ Query/Search ○ Report Generation ○ View analysis	None
1	ERP (Enterprise Resource Planning)	○ financial accounting & controlling ○ Asset accounting ○ material management ○project system ○ work order schedule and management	None
2	OMS (Outage Management System)	○ Outage Report ○ Trouble Call Mgmt ○ Assist crew Team on fault repair	None
2	Mobile Solutions	○ Reading Update attributes ○ coordinates using GPS ○ Work Order updates	None
3	SCADA (Supervisory Control and Data Acquisition System)	○ Data Acquisition from Field Devices ○ Alarm/event processing ○ Fault Level Analysis	None
3	DMS (Distribution Management System)	○ Intelligent Switching Mgmt ○ Load Flow Application	None
3	AMI (Advanced Metering Infrastructure)	○ Automatic Meter Reading ○ Load Profiling ○ Outage Event Mgmt ○ Smart Payment ○ Time of Use based Billing	None

（Source：Infotech report “Master Document for Consultancy Report”）

8.1.2 Rationale of the Project

As power demand in Ulaanbaatar city is growing at a rate of 10% over the previous year, equipment and the efforts of UBEDN to manage them are increasing notably. The continuation of manual management would cause the degradation of operational quality. This is why a distribution enterprise system, especially equipment/construction database, should be installed immediately.

According to Japanese system integrators, it is realistic that each system will be made from package software and this software will be customized to suit UBEDN’s needs. The package software for distribution business except DAS is not Japanese original technology. Since DNIMS has the same basic database that DAS has, the JICA Survey Team recommends that both systems be developed considering

affinity with each other.

(2) Priority of the Enterprise Systems for Distribution Business

The JICA Survey Team prioritizes the 7 new enterprise systems for the distribution business which Infotech has suggested. The Team estimates that the developments of DNIMS and ERP are the most important as both systems are essential for distribution business activities. In particular, the first priority is DNIMS, which is an enterprise database linked among all the systems.

Table 8-2 Priority Order of Distribution Enterprise Systems by the JICA Survey Team

Name	Functions and importance / Assessment	Priority
DNIMS	【Functions】 ・Uniform mgmt of detail of equip./construction/customers ・Auto report generation ・making and auto-update of the facility map with GIS【Importance / Assessment】 ・The base of all systems. ・Much labor is necessary in order to prepare data The Usage of design companies/construction companies should be considered.	1
ERP	【Functions】 ・Asset/financial accounting 【Importance / Assessment】 ・Very important for business operation ・Installation of DNIMS is precondition.	2
OMS	【Functions】 ・Outage Reporting Trouble Call Management ・Assist crew Team on fault repair 【Importance / Assessment】 ・similar to Customer Center System: less important	5
Mobile Solutions	【Functions】 ・Reading Update attributes on the site ・Work Order updates 【Importance / Assessment】 It is effective in the DB construction, but this alone is low priority because it can not obtain large economic benefits	4
SCADA DMS AMI	【Functions】 ・Supervision & control of network, optimization of network ・Automatic meter reading 【Importance / Assessment】 ・3 systems should be installed together with DAS ・Early installation is better because the reduction of outage duration/distribution loss/labor cost is expected.	3

The following are cautions in terms of the system installation.

・The cost of the systems depends on how much the customization of the package software is.

・UBEDN needs to discipline IT staff for system maintenance by UBEDN itself.

・The staff of UBEDN should prepare/input the data itself from the point of view of data accuracy.

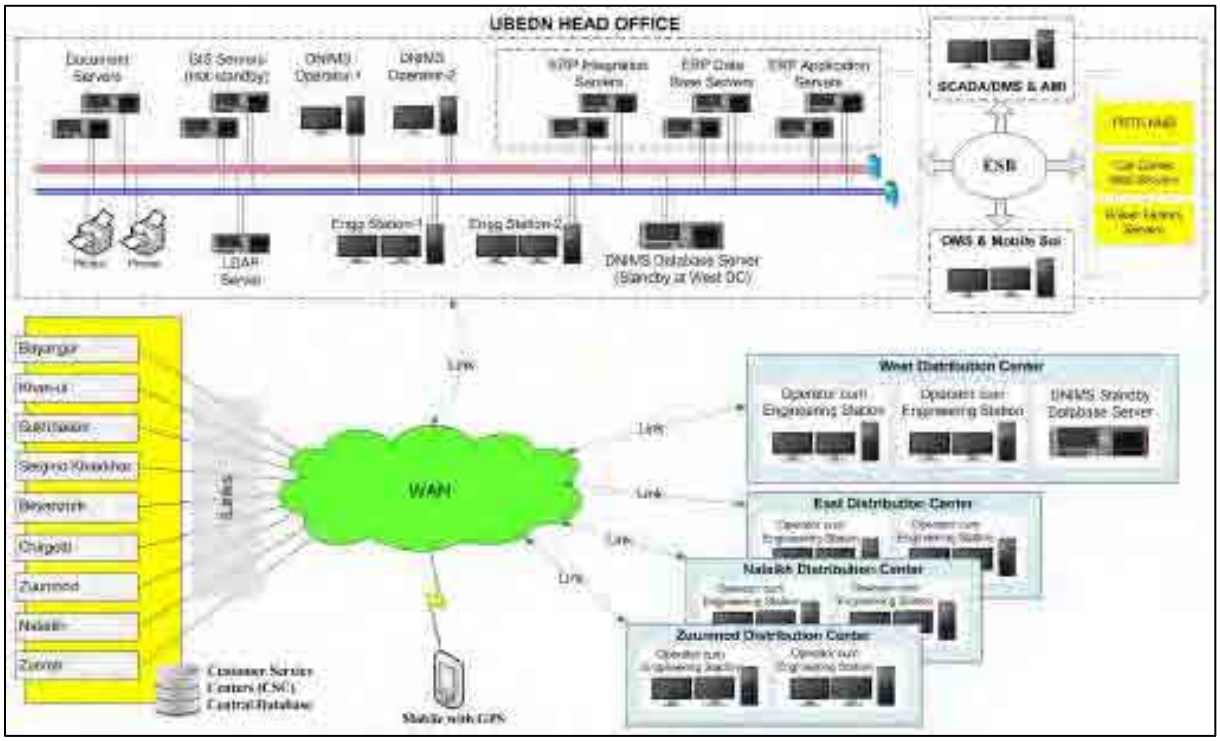
(3) Proposed Contents of the Systems

The development of distribution enterprise systems requires huge time and cost. And much of the effect of the systems will not occur until each system is installed and integrated. Therefore the JICA Survey Team recommends strongly that only the development of DNIMS is the target of this project.

Sufficient time is required to fix the operation with the systems in UBEDN, which has hardly any enterprise systems now. And so the JICA Survey Team expects that the systems other than DNIMS will be installed step by step after the start of DNIMS's operation and completion of data preparation.

8.1.3 Necessary Component

DNIMS requires the below components.



（Source：Infotech Report "Master Document for Consultancy Report"）

Figure 8-5 Conceptual Diagram of DNIMS

【Hardware】

The JICA Survey Team recommends UBEDN to have an Uninterruptible Power Supply since a distribution enterprise system is a part of power infrastructure systems.

- An application server

  A server computer on a network to run the application software that implements the business logic, or middleware to assist the management of the application running

  The JICA Survey Team estimates that the number of servers will be one for UBEDN in comparison

with TEPCO's case.

Recommended specification: CPU 4 Core, Memory 6GB x 3

- A database server

A server which has a database inside, and where the database management system is running.

The JICA Survey Team estimates that the number of servers will be one for UBEDN in comparison with TEPCO's case.

Recommended specification: CPU 4 Core, Memory 10GB x 3

- Storage

An external memory device which records programs and data connected to a computer.

Recommended specification: 1,000GB for 5 years

- Network

DNIMS requires a network among the head office, 5 distribution centers, 10 customer service centers, and substations of 35kV. As UBEDN already has a network between the head office and 2 distribution centers, it will be necessary to construct a new network between distribution centers and customer service centers.

- Uninterruptible Power Supply：UPS

A private power supply system for continuing the power operation in the case that power supply is lost through disasters or accidents

【Software】

（Required functions）

- Equipment management on the GIS mapping (input/edit/delete etc.)
- Upload and update of construction drawing which is made by AutoCAD
- Input/output of equipment attributes
- Data update（real time/daily/monthly/quarterly/yearly）
- Automatic generation of a regular report

8.1.4 Estimation of the Total Project Costs

The total project costs are estimated as shown below. The costs include the equipment costs (base cost), price escalation (1.3 %/year for foreign currency and 6.0 %/year for local currency), physical contingency (5 % of the base cost including price escalation), administration cost (5 % of the base cost), VAT (10 % for the local currency portion), and customs duty (5 % for the foreign currency portion).

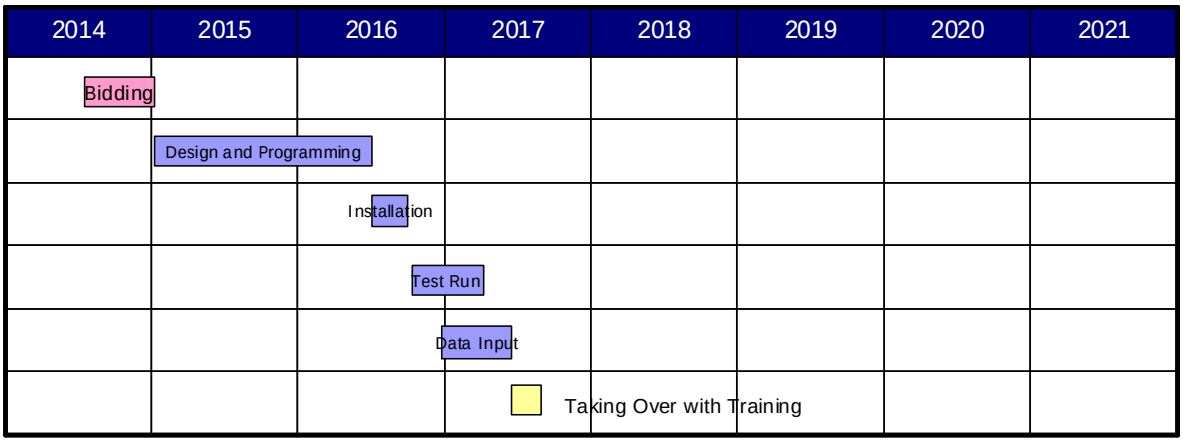
Table 8-3 Estimation of the Total Project Costs

Item	Cost		Total
	Foreign	Local	
	JPY	MNT	JPY
Hardware - Sever, Storage, UPS	0	5,010,000,000	300,600,000
Software (Development Cost Incl.)	700,000,000	0	700,000,000
Base Costs	**700,000,000**	**5,010,000,000**	**1,000,600,000**
Consulting Costs	0	0	0
Escalation	23,933,322	823,915,021	73,368,224
Physical Contingency	36,196,666	291,695,751	53,698,411
VAT	0	612,561,077	36,753,665
Import Tax	0	633,441,657	38,006,499
Administration Costs	0	306,280,539	18,376,832
TOTAL	**760,129,988**	**7,677,894,045**	**1,220,803,631**

8.1.5 Implementation Schedule

The following chart shows the implementation schedule of the project. With no consultancy service, the procurement starts from 2015.

Table 8-4 Implementation Schedule



8.1.6 Expected Effects

(1) Expected Benefits from the Project

(a) Operation Efficiency

The database constructed will contribute to reduction of burden for site survey, data search/consolidation, and making reports.

Table 8-5 Expected Effectiveness of Operation Efficiency

Affiliation	Business Contents	Occupation	Labor Cost(MNT/h)	People	Reduction Time (h/person)	Times (time/year)	Reduction Cost (mil MNT /year)	Reduction Cost (mil US $/year)
HQ	data search/summary	manager	5,657	16	10	12	10.9	0.007
		engineer		61	25	12	103.5	0.070
	report making	manager		16	5	12	5.4	0.004
		engineer		61	15	12	62.1	0.042
DC	site survey	engineer		30	1	200	33.9	0.023
	data search/summary	master, engineer		80	2	200	181.0	0.123
	data preparation	master, electrician		240	2	200	543.1	0.368
Total							**940.0**	**0.638**

(b) Reduction of Outage Duration

At the time of a fault, a UBEDN lineman checks the specification of faulty equipment on site firstly. Next, the lineman calls his office to engage the same equipment and replaces the faulty one when he is back on site again. If UBEDN has the database, reduction of outage duration would be expected because the lineman's dispatching to the site for checking the specifications will be not required.

(Assumption reduction of outage duration yearly per household)

＝(Assumption reduction of outage duration per time)

×(Frequency of outage yearly per household: SAIFI)

＝ 0.5 h/time × 13.3 times/year ＝ 6.65 h/year

(c) Other Indirect Effects

If UBEDN allows design/construction companies to share the usage of DNIMS, DNIMS will contribute the operation efficiency of them. Thus administration costs for the companies can be expected to be reduced.

【Indirect Effects】

The installation of DNIMS enables operation/management decisions which are based on data.

ⅰ. Asset management

ⅱ. Quality management of design/construction

ⅲ. Accuracy improvement of expansion planning (Improvement of capacity utilization)

ⅳ. Installation of other enterprise systems

(2) Summary of the Benefits

The following table summarizes the financial and economic benefits of the project.

Table 8-6 Summary of Financial and Economic Benefits

（Annual Benefits：US$/year）

Financial Benefit		
1	Reduction of costs for data searching/report making = Salary × Reduction time of data search/ report making × Frequency per year (note) see Figure 8-5	0.64 mil.
2	Electricity sales increase by reduction of outage = Increase of electricity sales × (Unit sales price – Unit purchase price) = 2,118.2 mil. kWh × (6.65h/8760h) × (88.4 MNT/kWh-70.6 MNT/kWh) / 1,474.1 (US$/MNT)	0.02 mil.
Economic Benefit		
1	Generation of new additional value by reduction of data searching/report making work (The value is regarded as 2 times as valuable as above Financial Benefit No.1) *1	1.28 mil.
2	Reduction of alternative power generation by reduction of outage time = Increase of electricity sales x Generation cost of alternative diesel generators*2 = 2,118.2 mil. kWh × (6.65 h/8,760 h) × 0.25 US$/kWh	0.4 mil.

*1: 2.04 = Economic value of electricity sales per employee (the economic value is evaluated by the differential cost (sales-purchase) 17.8 MNT/kWh)) / salary per employee

*2: The alternative diesel generation cost uses 0.25 US$/kWh

(2) Results of IRR Calculation

.Based on the benefits summarized in the above, the internal rates of return were calculated as follows.

Table 8-7 IRR Calculation

	Results
FIRR	N/A
EIRR	10.3 %

8.1.7 Items to be Further Studied

(1) Consideration for System Maintenance

The cost of DNIMS is estimated at 10 million US$ in this report. However there is a possibility that the cost will change because it depends on the amount of customization and organization for system maintenance.

The JICA Survey Team has examined 3 options below and recommends option No.2, which is the most

reasonable for the project life per 15 years.

Table 8-8 Options which are Considered About Initial Cost / Maintenance Cost

Option 1 (Maintenance by only UBEDN)	
Initial cost	15 mil. US$
Mentenance cost per year	0.03 mil. US$
Lifecycle cost (for 15years)	**15.4 mil. US$**
Option 2 (Maintenance by a local IT Co. & UBEDN)	
Initial cost	10 mil. US$
Mentenance cost per year	0.1 mil. US$
Lifecycle cost (for 15years)	**11.4 mil. US$**
Option 3 (Install & maintenance by System Integrator Co.)	
Initial cost	5 mil. US$
Mentenance cost per year	0.5 mil. US$
Lifecycle cost (for 15years)	**12.0 mil. US$**

Option 2 is on the assumption that the Mongolian human resource will maintain the system by itself without completely depending on a foreign supplier. The JICA Survey Team recommends that UBEDN should train internal IT staff and local IT suppliers for maintenance of DNIMS.

(2) System linking to DAS

UBEDN had better develop DNIMS and DAS considering each other because both systems need to share the information of equipment/network/customers. However the JICA Survey Team doesn't recommend that the two systems are constructed on the same server from the point of view of security of the power supply. Therefore, the Team recommends strongly that the two systems are constructed on different servers, linked to DAS.

8.2 Introduction of Distribution Automation System

8.2.1 Overview of the Project

(1) Overview

The overview of the project is to introduce the Distribution Automation System (DAS) to the western part of Ulaanbaatar No.4 district (Khoroo 16-19) to improve the supply reliability. The project includes replacement of equipment, installation of protection relay (OCR, DGR) to substation and switching station, and introduction of smart meter (substation, switching station, and distribution transformers).

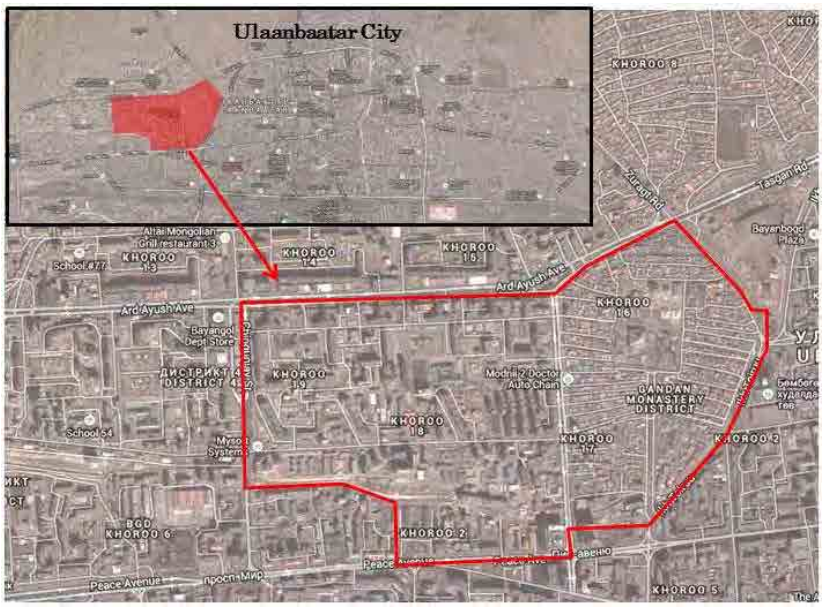


Figure 8-6 Project Area

Replacement of the facilities is planned as follows.

1. Buildings of switching stations and distribution transformers:

Construction of the new buildings to reduce the outage in accordance with the construction work. New buildings must have heat insulation.

2. Power cables:

Aged oil filled cables which were installed over 30 years ago are still remaining in Ulaanbaatar city. Three conductors of the cables are covered with the same sheath. In case of one phase ground fault, such cables can lead to two phase ground fault.

3. Cable pipe:

Reduction of the recovery time in case cable is damaged.

4. Load break switches, disconnected switches, transformers:

Many of them are aged facilities. Some of the Distribution transformers have disconnecting switches which cannot break the load current. It is recommended to replace disconnecting switches with load

break switches (LBS). Replace transformers and low voltage distribution panels accordingly.

5. Install telecommunication line:

Introduce optical communication to deal with a lot of data from the sensor switches and smart meters. Install optical fibers in accordance with the new power cables.

(2) Distribution Network of Project Site

The project site consists of 5 feeders. Among them, 4 feeders are derived from ＰΠ13 switching station (4x-8-A･B, 4x-12-A･B feeder). The remaining feeder is derived from Umard substation (Geser feeder).

Four feeders supply to apartments and commercial areas. The remaining 1 feeder supplies to geser area. Geser feeder is interconnected with other feeders (4x-8-A･B feeder) at 3 connection points so that each feeder can exchange power with each other.

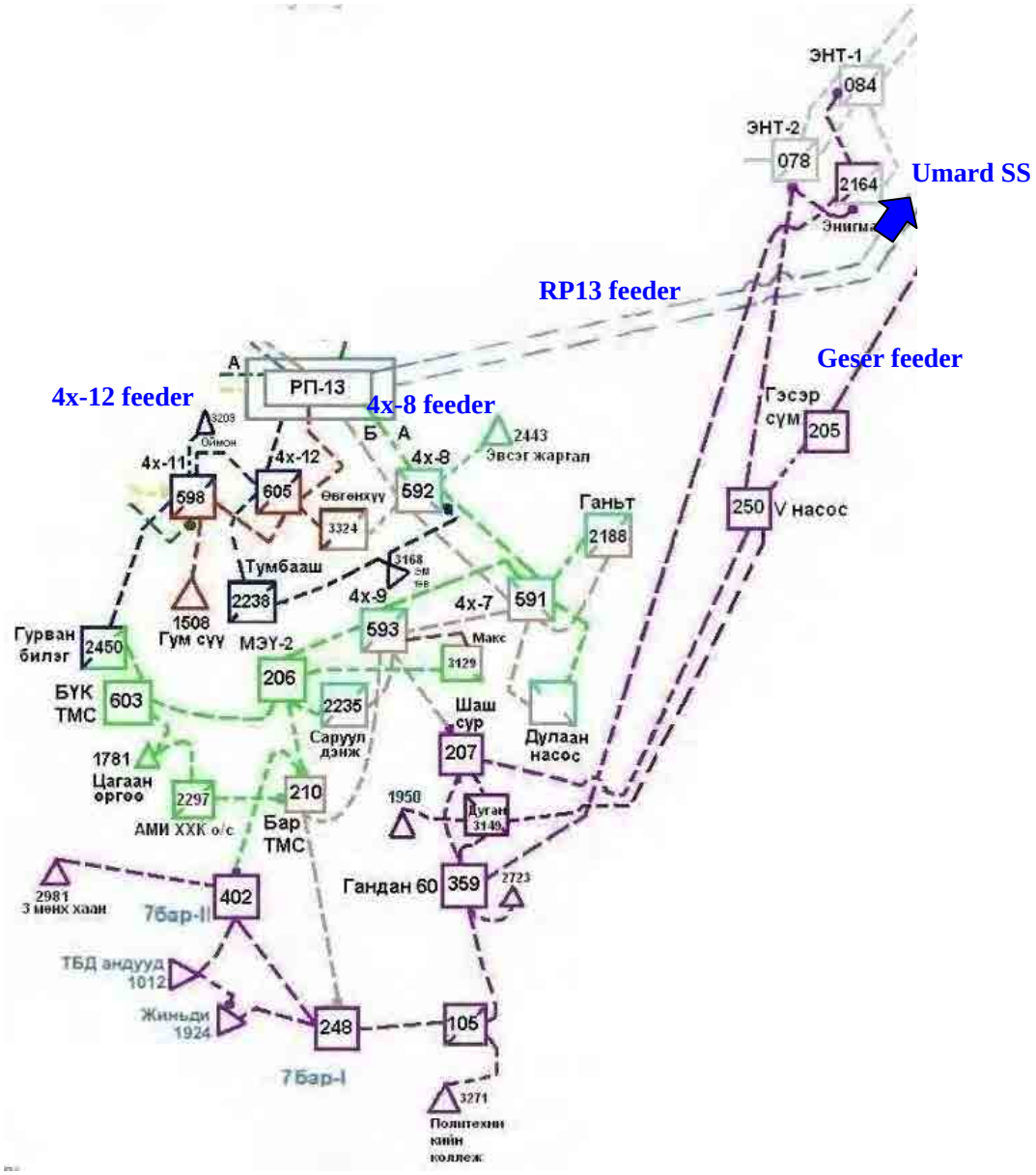


Figure 8-7 Target Feeders of DAS

(3) Current Power Supply for the Project Area

Number of distribution transformers, number of customers, and power sales are shown below. The area has 7,467 customers and total power sales are 38,787 MWh.

Table 8-9 Power Supply Status of Project Area

	10/0,4 kV substation Name	10/0,4 kV substation type	10/0,4 kV substation ID	Number of customers	Annual energy sales in 2010, thous.kW*h			Annual energy sales in 2011, thous.kW*h			Annual energy sales in 2012, thous.kW*h		
					Entities	Households	Total	Entities	Households	Total	Entities	Households	Total
1	Гум с??	КТПН	КТПН-1508	1	153	0	153	140	0	140	177	0	177
2	Цагаан ?рг??	КТПН	КТПН-1781	2	497	0	497	571	0	571	560	0	560
3	ЭМ т?в	КТПН	КТПН-3168	1	0	0	0	0	0	0	30	0	30
4	Оймон	КТПН	КТПН-3209	1	0	0	0	0	0	0	4	0	4
5	Эвсэг жаргал	КТПН	КТПН-2443	1	19	0	19	231	0	231	190	0	190
6	М?Э	ХТП	ХТП-206	28	113	49	162	990	46	1036	412	50	461
7	Бар ТМС	ХТП	ХТП-210	30	441	5	446	540	5	545	460	1	461
8	Ганьт	ХТП	ХТП-2188	273	335	236	571	605	251	856	633	305	938
9	Саруул дэнж	ХТП	ХТП-2235	461	262	532	794	443	703	1145	342	861	1202
10	Тумбааш	ХТП	ХТП-2238	160	149	189	337	150	234	384	130	271	401
11	Ами	ХТП	ХТП-2297	192	162	156	318	148	323	470	156	337	492
12	Гурван билэг	ХТП	ХТП-2450	127	170	0	170	181	139	320	375	223	598
13	Макс	ХТП	ХТП-3129	1	0	0	0	0	0	0	634	0	634
14	?вг?нх??	ХТП	ХТП-3324	4	2	0	2	44	0	44	166	0	166
15	4 хороолол ТП-7	ХТП	ХТП-591	492	1218	835	2053	1707	813	2520	1812	829	2642
16	4 хороолол ТП-8	ХТП	ХТП-592	508	1661	738	2399	2172	973	3145	4056	976	5032
17	4 хороолол ТП-9	ХТП	ХТП-593	667	772	1210	1981	755	1186	1941	769	1248	2017
18	4 хороолол ТП-10	ХТП	ХТП-597	666	1308	1339	2647	1259	1320	2579	1225	1359	2584
19	4 хороолол ТП-11	ХТП	ХТП-598	816	1787	1517	3304	951	1470	2420	914	1531	2446
20	Б?К ТМС	ХТП	ХТП-603	489	1148	226	1374	1433	258	1691	2037	260	2296
21	4 хороолол ТП-12	ХТП	ХТП-605	814	1527	1096	2623	873	1193	2066	1400	1350	2750
22	Дулааны насос-5	ХТП		1	343		343	478		478	411		411
23	ТБД Андууд	КТПН	КТПН-1012	1	197	0	197	375	0	375	426	0	426
24	Жинди	КТПН	КТПН-1924	1	344		344	320		320	183		183
25	3 м?нх хаан	КТПН	КТПН-2981	1	218	0	218	235	0	235	228		228
26	Эрдэнэбаатар	КТПН	КТПН-3388	1	2	0	2	1	0	1	32	0	32
27	КТПН-5	КТПН	КТПН-1950	170	185	421	606	361	512	873	367	679	1046
28	КТПН-6	КТПН	КТПН-2723	242	160	616	776	259	618	877	416	769	1186
29	Барилга коллеж	ХТП	ХТП-105	29	691	33	725	810	52	862	906	45	951
30	Гэсэр	ХТП	ХТП-205	70	397	172	569	522	176	697	475	211	686
31	Шашны сургууль	ХТП	ХТП-207	147	380	455	835	444	505	949	845	563	1408
32	7 барилга 1	ХТП	ХТП-248	290	455	463	918	395	469	864	482	502	984
33	7 барилга 2	ХТП	ХТП-402	168	318	313	631	328	308	636	370	329	699
34	5-р насос	ХТП	ХТП-250	195	658	674	1333	663	694	1356	622	868	1490
35	Дуган	ХТП	ХТП-3149	1	0	0	0	0	0	0	60	0	60
36	Гандан	ХТП	ХТП-359	339	661	831	1492	685	874	1559	869	1035	1904
37	Энигма	ХТП	ХТП-2164	76	653	122	775	44.19	135	180	840	158.591	998
38	Политех.Коллеж	КТПН	3271	1							12		12
	Total			7,467	17386.4	12227.8048	29614.2	19112.3	13255.898	32368.2	24026.5	14760.2121	38,787

8.2.2 Rationale of the Project

(1) Propose

(a) Reduction of Outage

Many of the power faults in Ulaanbaatar city are caused by the aged facilities. Duration of each power fault is long because distribution facilities are operated manually. So it takes a lot of time to change the network connection. In addition, it takes time to remove the fault point because power cables are installed under the ground.

Directional Ground Fault Relay (DGR) is not installed. As a result, it takes time to identify the fault feeder in case of ground fault. Ground fault continues for a certain time until it is identified.

(b) Distribution Network Switching

In the expansion project of Umard and Baruun substation, it is necessary to share loads with another substation by switching distribution networks. Network switching will be implemented easily and smoothly if the DAS is introduced to distribution networks.

(2) Selection of No.4 District

The No.4 District is selected for the project site for the following reasons

- The area has many aged power facilities over 30 years old.
- Compared to other areas, supply reliability is not so high due to aged facilities.
- The buildings of the project area consist of apartment and geser. They will not be renewed with high buildings. According to the development plan of the Ulaanbaatar city, the geser area will be redeveloped in the future but the structure of the building will not be the same. For that reason, it is easy to plan the future development plan of distribution power facilities.

Table 8-10 Supply Reliably by Region

FY2012 Actual

	District No.															
	1	2	3	4West	4East	5	6-1	6-2	10	11	13	15	16	19	220	120
Number of feeder Fault	23	2	17	18	43	9	3	4	27	5	17	17	11	3	14	7
SAIDI(minutes)	176	7	221	286	847	71	33	84	94	33	243	151	435	145	172	385
SAIFI(times)	2.36	0.15	4.93	6.55	12.15	1.9	1.39	1.93	2.46	0.97	2.1	2.71	2.85	3	4.14	7

The data include only unplanned outage caused by distribution facilities

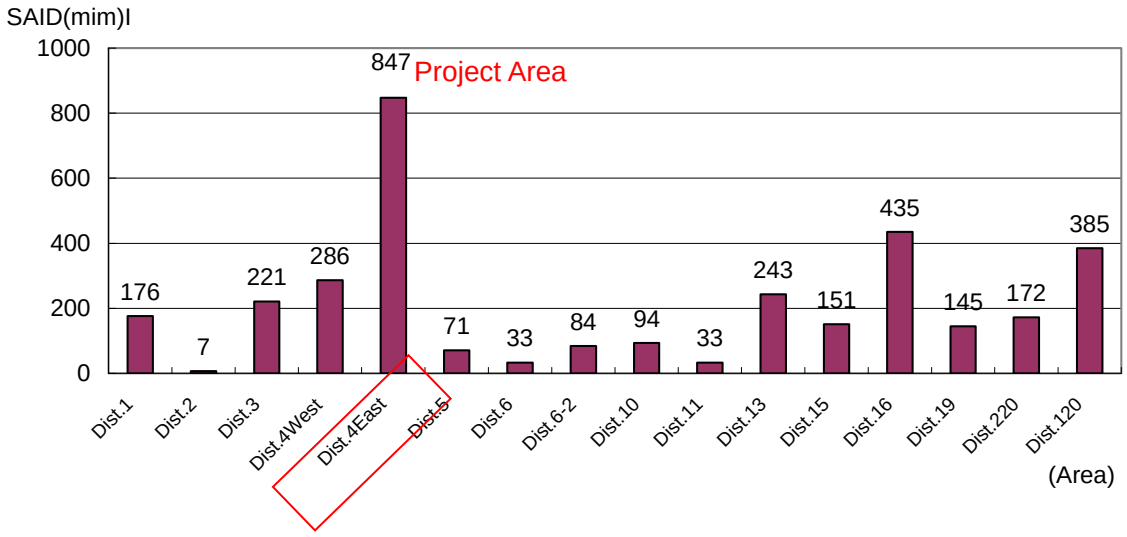


Figure 8-8 SAIDI by Region

8.2.3 Necessary Component

(1) Functions

Required functions of DAS are identified as follows.

- Identify the fault feeder and disconnect from the sound feeders in case the ground fault happens at the non grounded neutral network.
- Identify the fault section from among the fault feeder, and quickly charge the sound section.

The neutral point of 6.6kV distribution network is not connected to the ground. (Non neutral grounded system). The system is the same as Mongolia. The Japanese DAS has long experience and can satisfy such functions.

- 50 % of distribution transformers will be automated in this project. At the detailed design, select the transformers which will be automated.
- Establish the control center at headquarters of UBEDN.
- Install the automatic switches with sensor which can measure currency and voltage.
- Use optical fiber for telecommunication
- There are 2 options for DAS:

Option 1.

(a) Equipment; Switches with sensor + Supervisory Remote Control Device + Remote Terminal Unit

(b) Software; Software currently used in Japan. This type needs to energize the fault point one time to identify the fault section and we call it “Conventional DAS” hereafter.

Option 2.

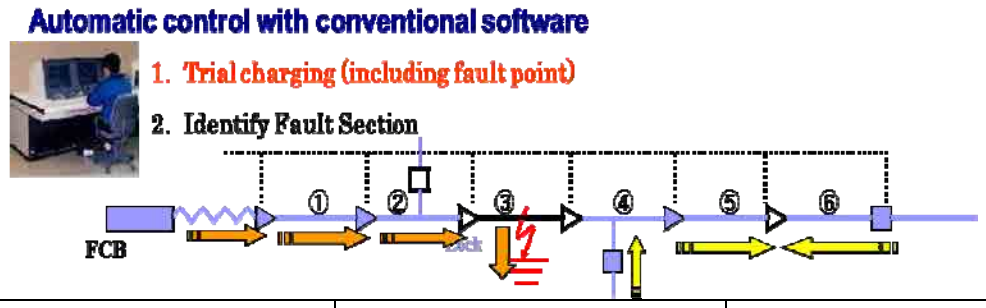
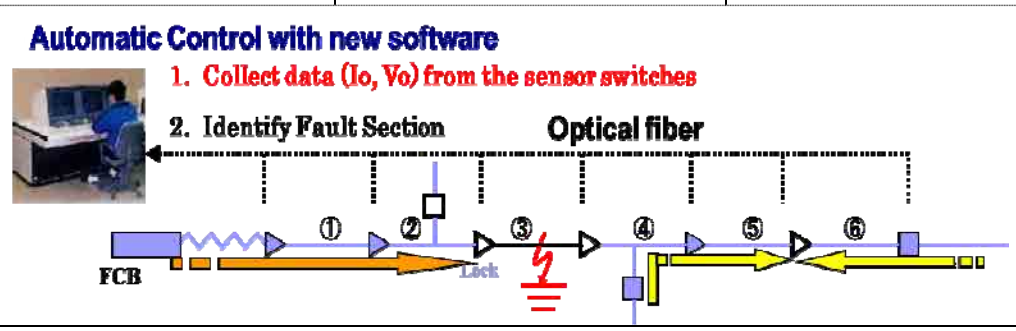
(a) Equipment; The same as above

(b) Software; Software applied in the future. This type does not need to energize the fault point one time to identify the fault section and we call it “New DAS” hereafter.

The software of new DAS is now under development. For that reason, DAS will be operated with conventional type. Conventional type will be installed on the premise that it will replaced with “new type” in the future.

Conventional type needs to energize the fault point to identify the fault section, which is not permitted by the network operation rule. So the rule needs to be changed tentatively.

Table 8-11 Function of DAS

	Function	Advantage or Disadvantage	Requirement
1	**Automatic switches with sensor＋ Conventional software** ・Detection of the accident area by Supervisory device with fault current data at switches ・Charge the fault point once. ・Automatic isolation of the accident area ・Automatic restoration to all sound areas	<Reliability> ○ Restoration of sound areas △ Charge the fault point once × Outage of sound areas（twice）; Cut-off of the fault current by breaker in SS	- Automatic Switch Controllers - Supervisory Remote Control Device - Telecommunication network - Data link between customer and equipment - Current data at a source of feeder
			
2	**Automatic switches with sensor＋ New software** - Detection of the accident area by Supervisory device with fault current data at switches - Automatic isolation of the accident area without charging the fault point. - Automatic restoration to all sound areas	<Reliability> ○ Restoration of sound areas ○ No charge of the fault point ○ Acquisition of correct data of voltage and current × Outage of sound areas (One time） Cut-off of the fault current by breaker in SS	- Automatic Switch Controllers - Supervisory Remote Control Device - Telecommunication network - Data link between customer and equipment - Current data at a source of feeder
			

New DAS can avoid energizing the fault point to identify the fault section. Other expected effects (including ideas) are shown below.

- Quick restoration; New DAS can detect the fault section, calculate the power flow and control the switches right after the power fault happens. It can restore sound area quickly because new DAS need not energize the fault point to identify the fault section.
- Network operation using correct data of voltage and current and grasping some singes of accidents.
- Monitoring of the voltage measured at the sensor switches; Voltage control of the network will be

possible by voltage monitoring. Detection of the symptom of the fault will be made possible by monitoring.

- Quick disconnection of the fault section; In case of ground fault, sensor switch can independently and quickly isolate the fault section before the circuit breaker at the substation detects the fault.

Conventional DAS cannot collect the correct current of each section. It estimates the current of each section using the current at the starting point of the feeder and the contract capacities of each section.

In contrast, New DAS can get the correct current because sensor switches can measure actual current. Power demand growth in Mongolia is remarkably high, so acquisition of current correctly with sensor is desirable. Conceptual diagram of the New DAS is shown as follows.

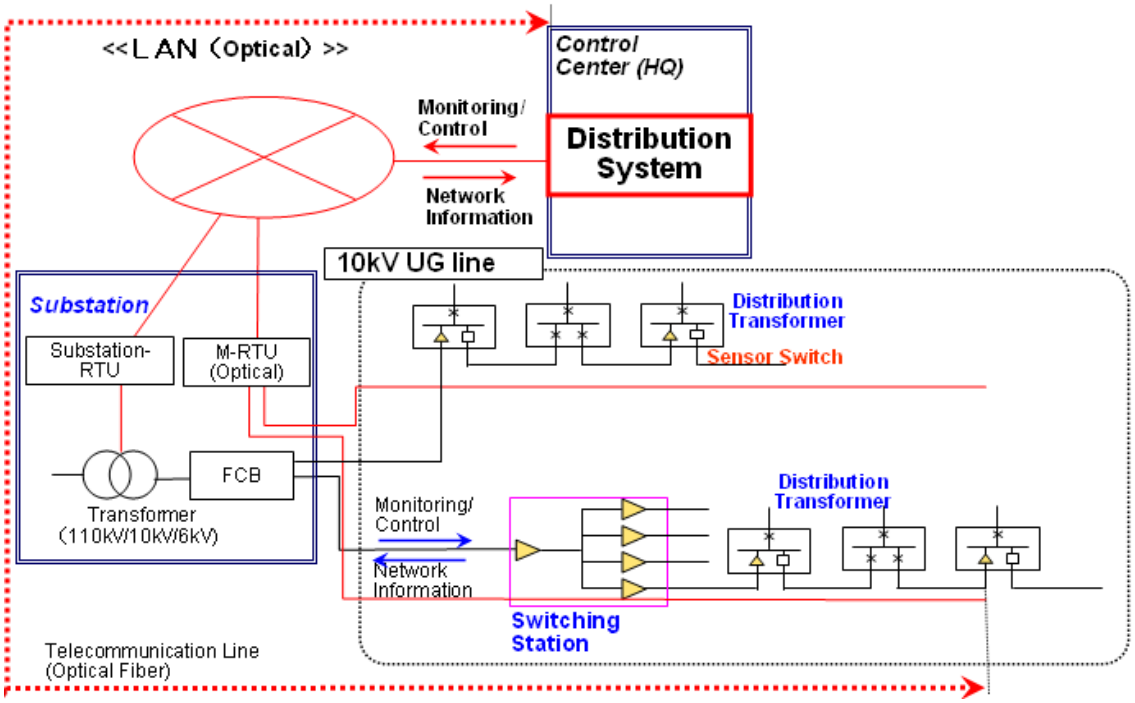


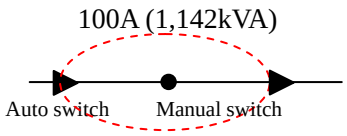
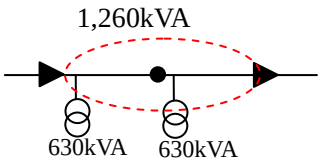
Figure 8-9 Conceptual Diagram of New DAS（Option 2）

(2) Ratio of the Automated Distribution Transformers.

50 % of all the distribution transforms are automated in this project. This assumption is based on the distribution network in TEPCO. One feeder is divided by automated switches so that the current of each section comes to 80 A-100 A. (In this case, capacity of each section is 1,100kVA.)

If 50 % of transformers are automated, the capacity of each section comes to 1,260 kVA (Transformer 630 kVA x 2). This is nearly the same capacity as TEPCO.

Table 8-12 Image of the Capacity of One Section

	TEPCO	UBEDN（1/2 automation）
Load of each section	Approx. 100 A（1,142 kVA） 100（A）×6.6（kV）×√3＝1,142	1,260 kVA （630 kVA×2）
Network configuration		

(3) DAS Component

The necessary component is shown below.

(a) Supervisory Remote Control Device

1. Function of conventional DAS	
1	Automatic restoration in case of fault
2	Monitoring and control of automatic switches
3	Indicate the current status of the network
4	Automatic programming of the network operation prior to the construction work.
5	Management of load record
6	Simulator training
7	Data maintenance
8	Indication of the operation status of distribution substation
9	Operation of substation equipment
2. Additional function of new DAS	
10	Collection of sensor information of switches (Voltage, Current, Zero phase voltage, Zero phase current)
11	Monitoring and remote control of automatic switches based on the sensor information

※One or two computer servers are enough if the DAS is introduced to No.4 District.

Figure 8-10 Image of the Supervisory Remote Control Device (Monitor)

(b) Automatic Switches with Sensor

- Apply pad mount type equipment which is used for underground distribution lines in Japan. Install this type of switches inside the building of the distribution transformers.
- Sensors which can measure current and voltage are attached inside the switch
- In case gas insulated switches are used, performance of the insulation under low temperature should be considered because gas might liquefy.

Figure 8-11 Image of Pad Mount Type Automatic Switch

(c) Remote Controller

- Data processing

  Measure currency, voltage, zero phase voltage, zero phase currency, poser factor
- Detection of fault

  Detect the ground fault / over current fault, capture the sing of the fault from the current

(d) Protection Relay

Directional Ground Fault Relay (DGR) will be installed at the Umard substation (owned by NPTGC) and switching station (owned by UBEDN) in order to identify the fault feeder automatically.

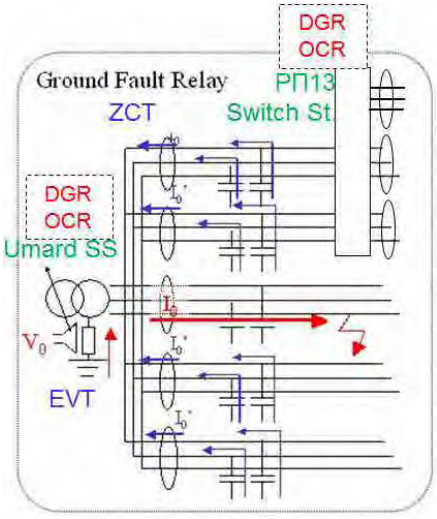


Figure 8-12 Ground Fault Relay

At Umard Substation and switching station, ground potential transformers and zero current transformers will be installed. Ground fault current of non ground neutral system is small compared with ground neutral

system. For that reason, it is recommended to install the equipment above which can detect the fault precisely, and which has an operating history in Japan.

Table 8-13 Outline of Protection Relay

	Umard S/S		Switching Station（PⅡ13）	
	Current status	Future	Current status	Future
Over Current Relay (OCR)	Not Existing	Existing	Existing	Existing
Directional Ground Fault Relay (DGR)	Existing	Newly install	Not Existing	Existing
Zero Phase Transformer（ZCT）	Existing	Use the current equipment	Not Existing	Newly install
Ground Potential Transformer（GPT）	Existing	Use the current equipment	Not Existing	Newly install

Regarding the ownership and operation, the following points should be considered.

- It is desirable that circuit breakers related to DAS are owned by NPTGC because it is installed inside the substation.
- The circuit breaker can be remotely operated by UBEDN.
- Relay coordination should be calculated as follows

  Relay setting time at Umard Substation > Relay setting time at Switching Station (PⅡ13)
- Operation and maintenance rule of the circuit breaker should be discussed between UBEDN and NPTGC

(e) Cable and Cable Pipe

- Install the cable pipe. In winter, frost penetration depth becomes 3m. In designing the cable pipe, stress caused by the frost penetration should be well considered.
- Install manhole approximately every 0.4km of the cables. Scale of the manhole should be wide enough for the construction of the cable.
- Each cable pipe should be set so that width of the excavation width can be minimized.
- Use the XLPE cable which can be applicable at the temperature of -40℃.Copper conductor is recommended because of the following characteristics. 1. Maximum allowable current is larger than that of aluminum conductor. 2. Cable termination treatment is easy.

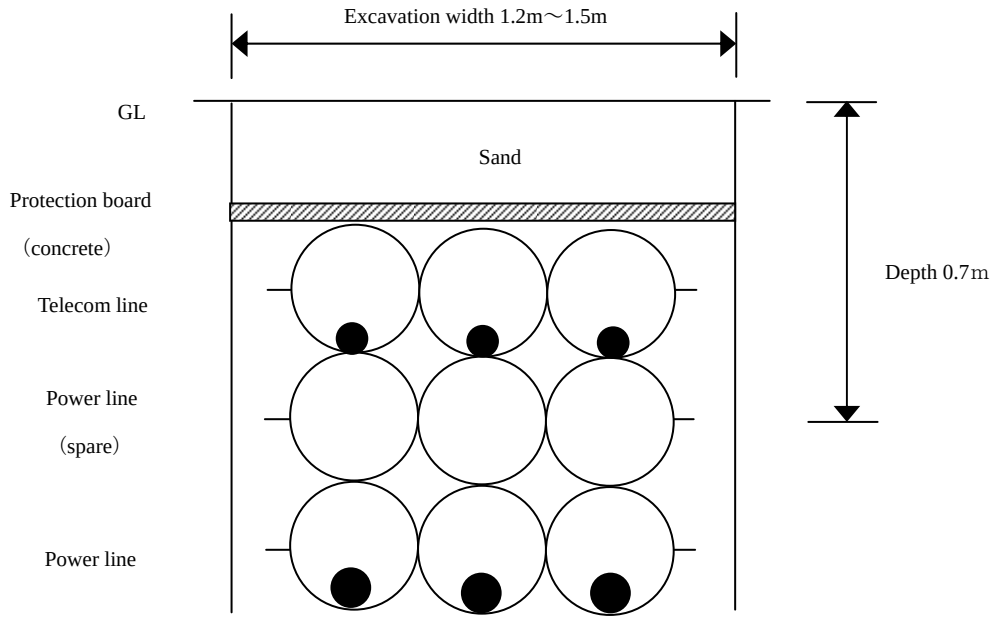


Figure 8-13 Image of the Underground Line

(f) Telecommunication Equipment

In order to transfer data from DAS, substation, switching station, and distribution transformer, telecommunication equipment should be installed as per the following image. For wired transmission, fiber cable should be installed and the OPGW which already exists should be used. To increase transmission reliability, wireless transmission can be used as secondary route. Equipment can transmit data without any delay even in the severe climate of the winter season in Mongolia. Also, equipment can be selected as the best one at the detailed design.

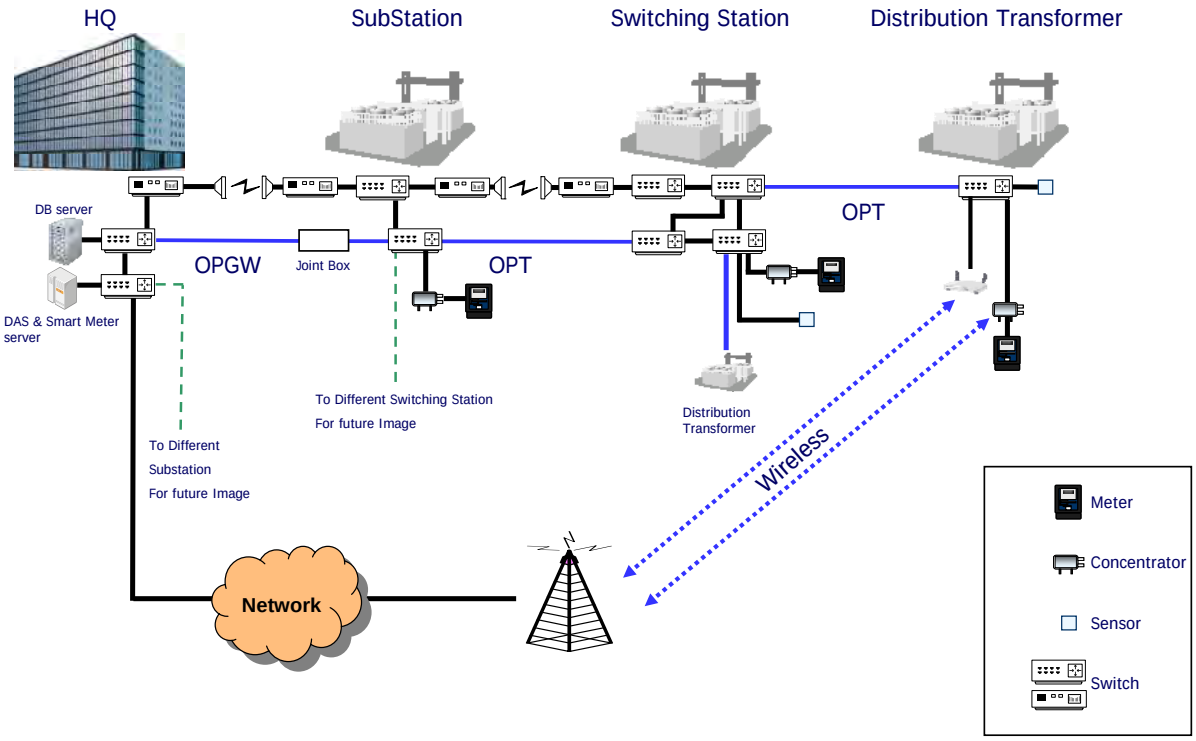


Figure 8-14 Telecommunication Equipment

- Transmission Line
  - ○ From headquarters to substation

    From headquarters to substation, blank cores in the OPGW should be used. For connecting the OPGW and fiber cables, a joint box in substation should be used.
  - ○ From substation to distribution transformer

    Fiber cable should be installed with the following requirements when power line cable updates.
    - ・Single mode with 4 cores or more
    - ・1.31 μ m, 1.55 μ m wavelength
    - ・Connector type is SC or SC2
    - ・Cable should be installed in the cable pipe (See section 8.2.3)

- Wireless Transmission Line

  Wireless transmission line is used as a secondary line and its requirement is mentioned in each section below.

- Equipment for Headquarters and Substation

  For headquarters, equipment is installed for DAS, DB, and Smart meter. For substation, transmission equipment and smart meters are installed.
  - ○ Transmission equipment for wired
    - ・10Gbps BR 2 ports

- 1Gbps BX 2 ports
- SFP SX 2 ports
- RJ45 4 ports
- 10Gbps switching capacity
- Can send and receive data by using one core of fiber
- Works in AC220V

○ Transmission Equipment for Wireless

- 100Mbps transmission rate for wireless
- 100Base-TX/1000Base 2ports
- Works in AC220V

➢ Equipment for Switching Station

Equipment is installed for through data from distribution transformer to substation. Also smart meters are installed.

○ Transmission equipment for wired (To substation)

- 10Gbps BR 2 ports
- 1Gbps BX 2 ports
- SFP SX 2 ports
- RJ45 4 ports
- 10Gbps switching capacity
- Can send and receive data by using one core of fiber
- Works in AC220V

○ Transmission equipment for wired (To distribution transformer)

- 1Gbps BX 2 ports
- SFP SX 1 port
- RJ45 4 ports
- 1Gbps switching capacity
- Can send and receive data by using one core of fiber
- Works in AC220V

○ Transmission equipment for wireless

- 100Mbps transmission rate for wireless
- 100Base-TX/1000Base 2ports
- Works in AC220V

- Equipment for Distribution Transformer

  For transmitting data from DAS and smart meters, equipment is installed.

  ○ Transmission equipment for wired

  - 1Gbps BX 2 ports
  - SFP SX 2 ports
  - RJ45 4 ports
  - 1Gbps switching capacity
  - Can send and receive data by using one core of fiber
  - Works in AC220V

  ○ Transmission equipment for wired

  - Can connect to (1) equipment
  - Has wireless transmission system such as 3G, GPRS and so on.
  - Works in AC220V

- Smart Meter

  ○ Server

  - Installed in headquarters or similar place
  - Can analyze data from smart meter
  - Installed in the DAS server

  ○ Meter

  - Can measure V, I, cos ϕ , W, var, kWh
  - Set up in the secondary of transformer in substation, switching station, and distribution transformer.

- Concentrator

  Concentrators gather data from meters installed in substation, switching station, and distribution transformer. After that, by using wired transmission line, concentrators send those data to server. For secondary route, concentrators have wireless function.

(g) Summary

The equipment of switching station and distribution transformers before and after introduction of DAS is summarized as follows. In accordance with the renewal of the buildings, all the equipment will be replaced.

Distribution transformers without DAS are also recommended to be replaced because they are aged facilities.

Table 8-14 Equipment of Switching Station

	Current situation	Future
10kV equipment	Circuit breaker	Circuit breaker with sensor
	OCR relay	OCR relay
	—	DGR relay
	Meter	None (Collect Data from the sensor switch)
Transformers	10 kV/0.4 kV Transformer	10 kV/0.4 kV Transformer
0.4 kV equipment	LV distribution panel	LV distribution panel
	Meter －Meter for apartments －Meter for enterprises	Automatic Meter Reading (AMR) －Meter for apartments －Meter for enterprises

Table 8-15 Equipment of Distribution Transformer

	Current situation	Future	
	Distribution transformers	Automated distribution transformers	Distribution transformers
10 kV equipment	Disconnection switches or Load break switches	Automatic switches with sensor	Manual switches
			Automatic Meter Reading (AMR)
Transformers	10 kV/0.4kV Transformers	10 kV/0.4kV Transformers	10 kV/0.4kV Transformers
0.4kV equipment	LV distribution panel	LV distribution panel	LV distribution panel
	Meter －Meter for apartments －Meter for enterprises	Automatic Meter Reading (AMR) －Meter for apartments －Meter for enterprises	Meter －Meter for apartments －Meter for enterprises

8.2.4 Estimation of the Total Project Costs

The total project costs are estimated as shown below. The costs include the construction costs (base cost), price escalation (1.3 %/year for foreign currency and 6.0 %/year for local currency), physical contingency (5 % of the base cost including price escalation), consulting costs (5 % of the base cost), administration cost (5 % of the base cost and the consulting costs), VAT (10 % for the local currency portion), and customs duty (5 % for the foreign currency portion).

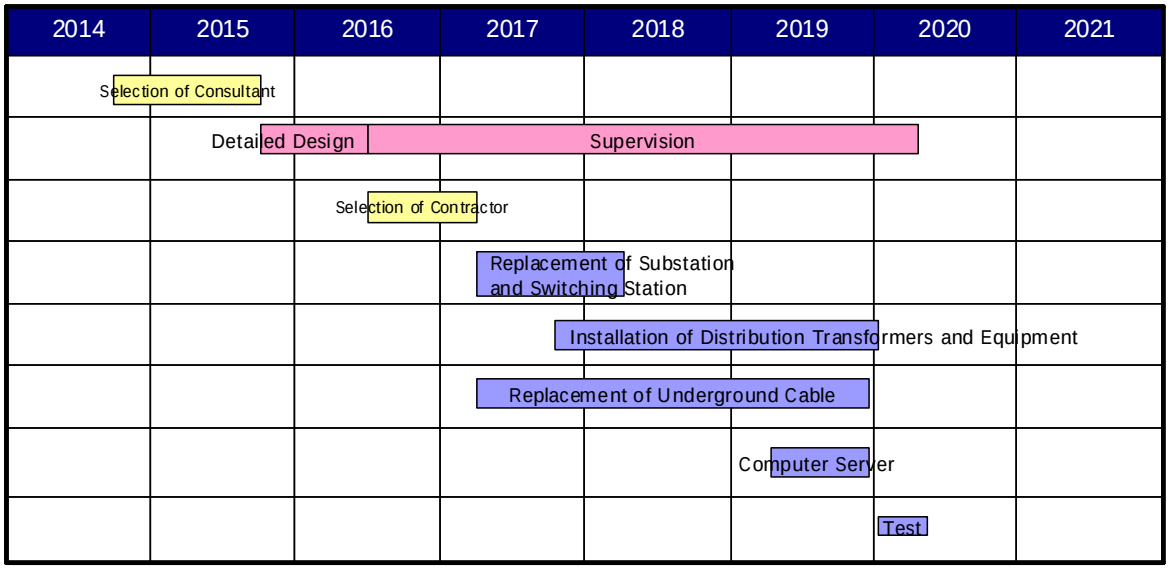
Table 8-16 Estimation of the Total Project Costs

Item	Cost		Total
	Foreign	Local	
	JPY	MNT	JPY
Cable Replacement	420,290,000	3,841,420,000	650,775,200
- Power Cable	294,460,000	0	294,460,000
- Telecommunication Cable	6,420,000	0	6,420,000
- Other Equipments, Earthing Device	0	1,540,000	92,400
- Cable Pipe	86,860,000	0	86,860,000
- Manhole	8,550,000	0	8,550,000
- Construction of Cable Installation	0	417,000,000	25,020,000
- Construction of Cable Pipe	0	2,953,680,000	177,220,800
- Construction of Manhole & Handhole	0	469,200,000	28,152,000
- Cable Expansiont to Baruun SS	24,000,000	0	24,000,000
Distribution Automation System Software	125,000,000	0	125,000,000
- Conventional System	25,000,000		25,000,000
- New System	100,000,000		100,000,000
Switching Station & Protection Relay (OCR DGR)	150,000,000	0	150,000,000
Automated Distribution Equipment	897,500,000	1,796,024,000	1,005,261,440
-1 Building	0	950,000,000	57,000,000
-2 Automatic Switch with Densor	247,000,000	0	247,000,000
-3 LV Distribution Panel	142,500,000	0	142,500,000
- 4 Transformer	108,000,000	0	108,000,000
- 5 Telecommunication Equipment			
Meter Equipment	110,000,000	0	110,000,000
Telecom Equipment	290,000,000	0	290,000,000
-110kV Substation	40,000,000	0	40,000,000
-Switch Station	130,000,000	0	130,000,000
-Distribution Transformer	50,000,000	0	50,000,000
-HQ	30,000,000	0	30,000,000
-Software	40,000,000	0	40,000,000
-NMS	15,000,000	0	15,000,000
-Maintainance	25,000,000	0	25,000,000
- Construction of Equipment Installation	0	846,024,000	50,761,440
Distribution Equipment	307,500,000	1,796,024,000	415,261,440
-1 Building	0	950,000,000	57,000,000
-2 Switches	57,000,000	0	57,000,000
-3 LV Distribution Panel	142,500,000	0	142,500,000
-4 Transformer	108,000,000	0	108,000,000
- Construction of Equipment Installation	0	846,024,000	50,761,440
Shipping Cost	100,000,000	0	100,000,000
Base Costs	**2,000,290,000**	**7,433,468,000**	**2,446,298,080**
Consulting Costs	81,543,269	679,527,244	122,314,904
Escalation	157,861,608	3,771,608,012	384,158,089
Physical Contingency	111,984,744	594,230,163	147,638,554
VAT	0	1,399,147,413	83,948,845
Import Tax	0	1,884,100,983	113,046,059
Administration Costs	0	623,941,671	37,436,500
TOTAL	**2,351,679,622**	**16,386,023,485**	**3,334,841,031**

8.2.5 Implementation Schedule

The following chart shows the implementation schedule of the project. The schedule considers consulting services including detailed design and creation of tender documents and construction supervision.

Table 8-17 Implementation Schedule



8.2.6 Expected Effects

(1) Expected Benefits of the Project

(a) Reduction of Interruption Duration

(i) Interruption Reduction Model

The JICA Survey Team simulated the fault restoration work and estimated time before and after introduction of DAS. The simulation is based on actual network as follows.

- Model: 4x-8 –A feeder
- Location of automation: 4 distribution transformers are automated
- Fault point: One phase ground fault in the cable between 593-206 distribution transformer

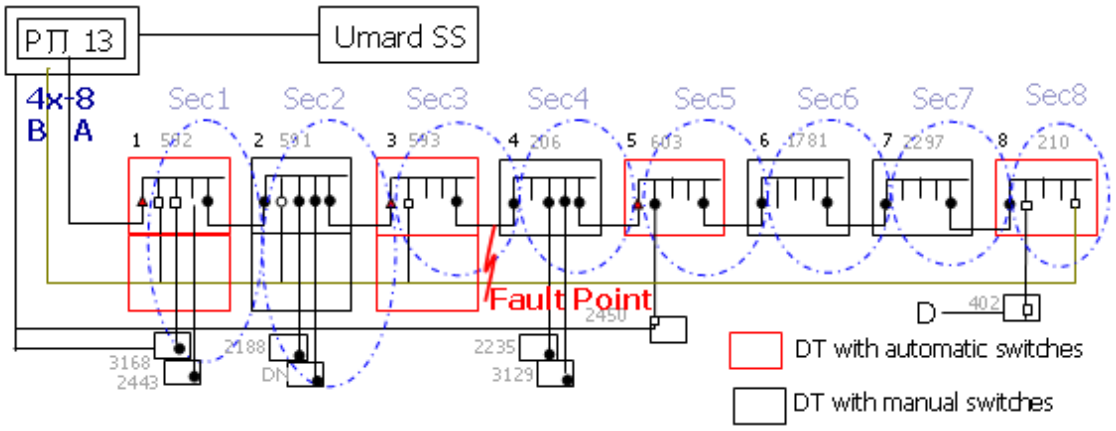


Figure 8-15 Simulation Model

(ii) Quick Fault Recovery by DAS

The following table is the fault recovery procedure before and after the introduction of DAS.

【Before】

	Time, minutes	Site	Procedure	Number of de-energized customers	Number of re-energized customers
1	0	592-591B Cable	Fault	1980	
2	5	—	Customer call to Call Center	1980	
3	10	—	Call transfer to WDC dispatcher	1980	
4	40	—	to drive to RP13	1980	
5	45	RP13	to Identify fault feeder	1980	
6	60	DT-592	Megger, fault direction	1980	
7	70	RP13	Restore 1st part	1725	255
8	90	DT-591	Megger, fault direction	1725	
9	100	DT-206	to open load-breaker to DT-593	1725	
10	110	DT-2450	Restore 2nd part	718	1007
11	130	DT-591	Restore 3rd part	0	718

【After】

	Time, minutes	Site	Procedure	Number of de-energized customers	Number of re-energized customers
1	0	592-591B Cable	Fault	1980	
2	1	—	Locate fault section (DAS)	1980	
3	1	—	Restore 1st Part (DAS)	1341	639
4	2	—	Restore 2nd Part (DAS)	594	747
5	30	DT-593	to drive to 593	594	
6	35		Megger, fault direction	594	
7	45	DT-206	Megger, fault direction, Identify fault point	594	
8	60	DT-591	Restore 3rd Part	0	594

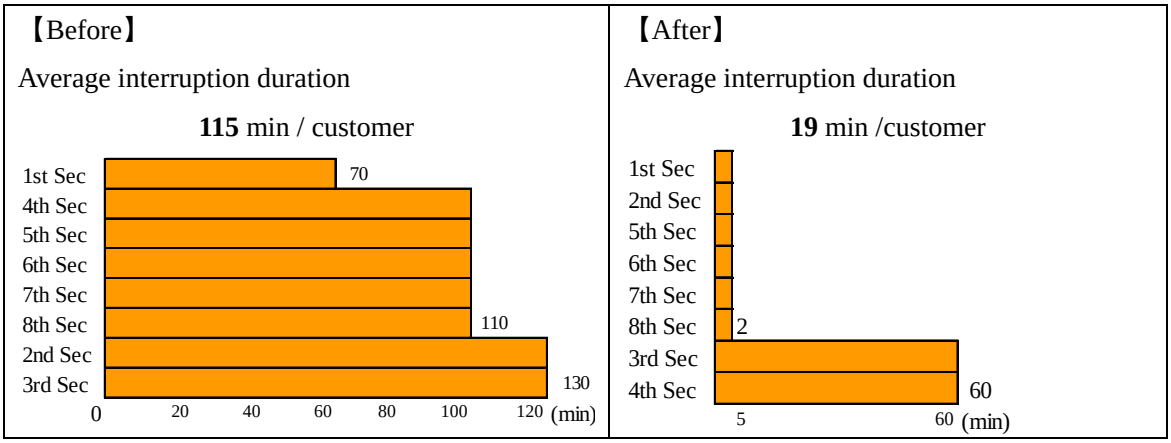


Figure 8-16 Effect of DAS (before and after)

Quick fault recovery by DAS will be realized by the following reasons.

- Currently, when the ground fault happens, the fault feeder is identified by manual operation of the circuit breaker at switching station. This procedure can be shortened by introducing the protection relay.
- Traffic jams in Ulaanbaatar city are serious, so it takes a lot of time to go to the site from the office. After introduction of DAS, sound section can be automatically recovered within a few minutes
- Network switching is now calculated by the staff at the control center based on the current feeder load. DAS can automatically calculate optical network switching instead of the staff.

(b) Improvement of Capacity Factor at Substation by DAS

Umard Substation has two transformers, and in this case, ideal capacity factor is 50 %. This is because one transformer must have reserve capacity in case of fault.

If the DAS is introduced, some of the loads of Umard Substation can be switched to Baruun Substation automatically and quickly through distribution network Therefore, Umard Substation can reduce the reserve capacity (improve the capacity factor). This effect can be increased if the DAS is expanded to other districts.

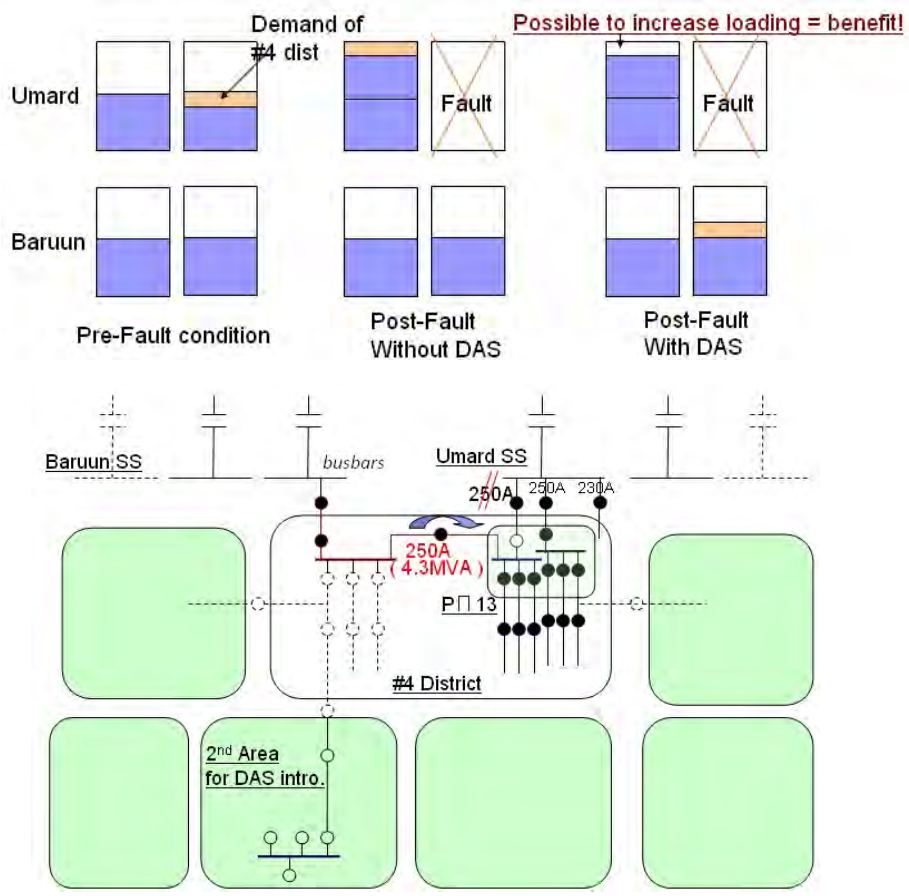


Figure 8-17 Improvement of Capacity Factor of S/S Using DAS

(b) Summary of the Benefits

The following table summarizes the financial and economic benefits of the project.

Table 8-18 Financial and Economic Benefits

（Annual Benefit：US$/year）

Financial Benefit		
1	Increase of electricity sales by reduction of outages =Increase of Electricity sales ×(Unit sales price - Unit purchase price) See the detail below	627
2	Reduction of fault recovery work = Salary of workers × Reduction of interruption (hour) ×Frequency of annual interruption (times) See the detail below	2,247
Economic Benefit		
1	Reduction of alternative power generation by reduction of outage time =Increase of electricity sales × Generation cost of alternative diesel generators*1 See the detail below	13,016
2	Increase of electricity sales by the increase of capacity factor of distribution substation = Increase of electricity sales × Generation cost of alternative diesel generators*1 See the detail below	2.84 million

*1: The alternative diesel generation cost uses 0.25 US$/kWh

1. Increase of electricity sales by reduction of outages

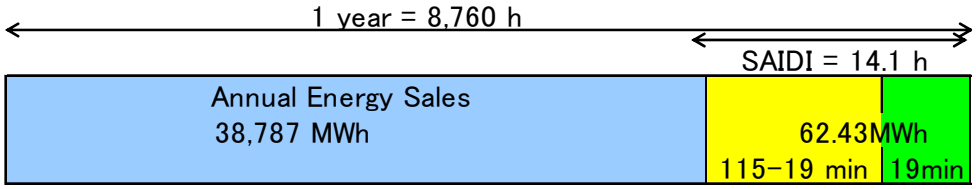
Electricity sales equivalent to the outage duration

＝38,787 MWh ×14.1 hours / 8,760 hours = 62.43 MWh

Electricity sales equivalent to the reduction of the outage duration

＝62.43 MWh × (115 – 19) min / 115 min×（88.4－70.6）MNT/kWh

＝924 thousand MNT = 627 US$

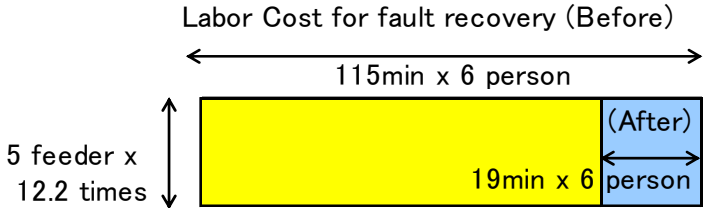


2. Reduction of fault recovery work

Reduction of fault recovery work by reduction of outage duration

＝（115 - 19）min / 60 hour× 6 person× 5 feeders × 12.15 times ×5,657 MNT/h

＝ 3,313 thousand MNT= 2,247 US$



3. Reduction of alternative power generation by reduction of outage time

＝Increase of electricity sales (kWh) ×Generation cost of alternative diesel generators (US $ /kWh)

＝62.43 MWh ×（115 – 19）min / 115 min× 0.25 US $ / kWh

＝13,016 US$

4. Increase of electricity sales by the increase of capacity factor of distribution substation

Peak load of the No.4 District from the Umard Substation through PΠ13 switching station is 500A. Assume that some of the load, in this case 250 A (50 % of the load), is switched to the Baruun Substation.

This means that 4.7 MVA (equivalent to 250 A) can be regarded as the increase of capacity factor at substation

Benefit can be calculated as follows,

Increase of electricity sales by the increase of capacity factor of distribution substation

= 1.73×250 A×10 (kV×8,760 hours×0.3（load factor） ×0.25 US$/kWh

= 2.84 mil US$

Table 8-19 Condition of Calculation

SAIDI	847	min
SAIFI	12.15	times
Energy Sales (No4. District)	38,787	MWh
Number of customers	7,467	customers
Energy sales per unit	88.4	MNT/kWh
Diesel generation cost	0.25	US$/kWh
Distribution loss rate	20.0	%
UBEDN human cost	5,657	MNT/h
Outage duration per fault （simulation）		
CAIDI（Before DAS）	115.0	min
CAIDI（After DAS）	19.1	min

(2) Results of IRR Calculation

The total project cost includes the replacement of some aged facilities, which should be implemented regardless of DAS introduction. For that reason, the JICA Survey Team subtracted such replacement cost from total project cost, and then regards 1,397 million JPY as the DAS project cost. Result of IRR calculation, in which project period is regarded as 20 years, is shown below.

Table 8-20 IRR Calculation

	Result
FIRR	N/A
EIRR	14.8 %

(3) Other Expected Effects

In addition to the effects which can be calculated as monetary value, there are general effects as follows.

Table 8-21 Other Qualitative Effects

Subject	Factors	Reason
Reduction of Outage Time	Improvement of Quality of Life(QOL) in the area	- Reduction of outage can improve the quality of life of people in No4. district
	Risk Reduction for People's Panic	- If a long outage lasts, it might cause more crimes. - People in underground areas might feel scared. In hospitals, or other important customers some accidents might occur even if an emergency generator is installed.
	Promotion of the foreign and domestic investment	- Supply reliability is the key factor for investors and visitors.
	Risk Reduction for Heavy Traffic Jam	- If traffic signals stop, it might lead to a more congested traffic jam.
	Decrease of Claims to UBEDN Call System	- Some claimants call UBEDN when an outage lasts a long time.
	Reduction of CO2 Emission by Diesel Generators	- Some important customers have DGs for outage.
Saving of O/M Work	Saving of Emergency Car	- Due to shortening fault detection time, an emergency car might be removed.
	Prevention of fault	- The sign of fault can be predicted by supervising the current and voltage of the network.
Optimum Planning and Operation	Leveling off the Feeder Load	- Optimum link line can reduce feeder load. - DAS data can feedback to optimum planning and operation of feeder load.
New Technology	Promotion of Mongolian IT Industry	- DAS project might give IT technology advantage.

8.2.7 Items to be Further Studied

The following items should be considered in introducing DAS.

1. Weather Resistance under Cold Temperature
2. Development of New DAS
3. Effect of the Cables by Energizing the Fault Point. (In case of conventional DAS)
4. Distribution Transformers Owned by Customers
5. Selection of the Automated Distribution Transformers
6. Selection of Equipment Based on the Future Power Demand
7. Option for Specification of Automatic Switches

(1) Weather Resistance under Cold Temperature

The following problems, which may happen in cold weather conditions, should be tackled.

- Electronic devices do not work under cold temperature (Especially cold start)
- SF6 gas insulator liquefies under cold temperature, and performance of insulation deteriorates as a result.
- Gas leaks due to the transformation of gum parts at low temperature.
- Insulation of oil in the transformer deteriorates

Among them, effect on the electronic devices is considerably the most severe condition. At the moment, Japan does not have equipment which can resist under -40℃ (Control unit used by TEPCO can resist up to -20℃. The unit owned by other Japanese company ensures performance up to -35℃.) MIL standard can ensure performance at -40℃, but it is expensive.

For these reasons, the JICA Survey Team recommends to study the countermeasures for mitigation of the weather resistance conditions as follows.

<Items to be studied>

- Set thermometer inside the buildings of distribution transformers and switching station. If temperature falls to the degree which Japanese products cannot resist, install thermostat beside the equipment.
- For comparison, set the thermometer outside the building. Temperature inside the buildings can be estimated if the relation of the temperature between inside and outside is found.
- Build thermal insulated buildings in accordance with the replacement of distribution transformers
- If gas insulation switches are used, pressure of the gas should be lower than standard level. Another option is to use the air insulated, or vacuum insulated switches.

(2) Development of New DAS

Until the new DAS system is developed, conventional DAS are tentatively applied. Conventional DAS needs to energize the fault point to identify the fault section. Basically this is not permitted under current operation rule. Therefore the current rule needs to be changed using the following procedure.

1. NDC create the tentative revision rule and consult with UBEDN
2. Propose the revised rule to technical committee

The committee consists of NDC, NPTGC, UBEDN, and professors. Members do not discuss technical topics at the committee. UBEDN are supposed to discuss such topics.

(3) Effect on the Cables by Energizing the Fault Point

Many of the aged oil filled cables are made in Russia. Three phase conductors are covered with the same sheath; therefore one phase ground fault might lead to other phase fault.

If triplex type cable is used, such risk can be mitigated because three conductors are covered with different sheathes. Replacement to new cables might be a condition to allow re-energizing the fault point.

(4) Distribution Transformers Owned by Customers

Many of the customer owned distribution transformers are connected with the network at the terminal point. But some of them are connected in the middle of the network. (e.g. DT1781, 1924)

Fault recovery might be delayed because operation of customer owned equipment needs permission from the customers. It is recommended that such distribution transformers are replaced as a priority, and they transfer ownership to UBEDN.

(5) Selection of the Automated Distribution Transformers

In selecting the automated distribution transformers at detailed design, actual load at each transformer should be considered. It is desirable that load of the feeder is divided by automated switch equally. If necessary, consider the interconnection with other feeders.

Currently, ladder system is applied in UBEDN distribution network. This network configuration is used when reliability of one network is not so high.

If the reliability is improved by replacing the facilities, UBEDN does not necessarily adopt ladder system.

(6) Selection of Equipment Based on the Future Power Demand

It is necessary to consider the future power demand in selecting the capacity of the equipment. According to UBEDN demand growth of the target feeders except geser feeder are expected at 10 % per year. Growth of geser feeder is estimated at 30% per year until 2019 because the area will be redeveloped.

Table 8-22 Future Power Demand（Unit：Ampere）

Feeder Name	Actual		Future										
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Umard-PП13A	—	348	360	396	436	479	526	580	637	702	774	853	940
Umard-PП13B	—	253	396	436	479	527	578	638	701	772	851	939	1,034
4x-8A	90	80	170	187	206	226	248	274	301	332	366	403	444
4x-8B	55	55	185	204	224	246	270	298	327	361	398	438	483
4x-12A	20	58	65	72	79	86	95	105	115	127	140	154	170
4x-12B	30	60	70	77	85	93	102	113	124	137	151	166	183
Geser	215	180	230	299	389	506	658	856	1,113	1,224	1,346	1,481	1,628

Some of the feeders are estimated to be overloaded in the future. Countermeasures for the overload are as follows.

- Install reserve cable pipe between Umard Substation and switching station
- Switch network between 4x-8 and 4x-12 to share some of the loads of 4x-8. In the future, build new swathing station to share the load of the project area, and interconnect each switching station with Umard and Baruun substations.

(7) Option for Specification of Automatic Switches

As an option, the combination of overhead line switches shown below may also be possible.

In this option, some remote control units are necessary and require comparatively large space considering the space for the remote control units, and transformers used for them. In addition, it might be difficult to deal with the power cables with enough space compared with the pad mount type switches. This option might be applicable if these issues were solved.

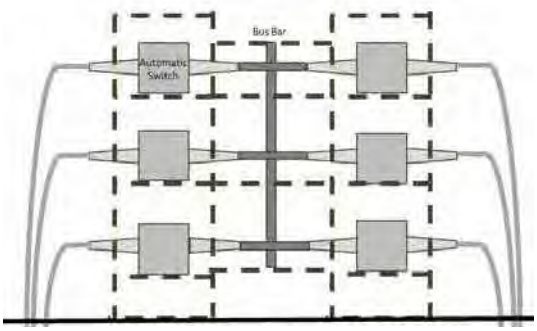
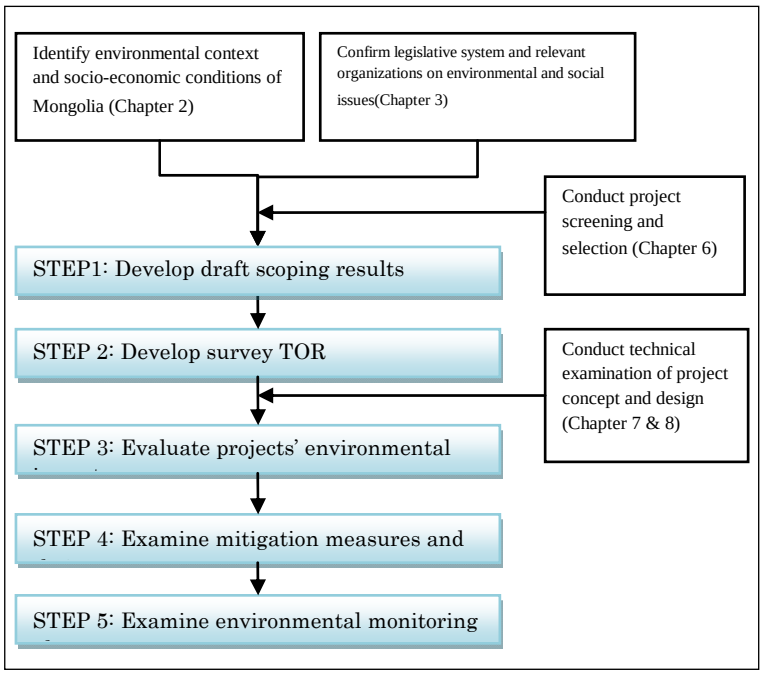


Figure 8-18 Image of Combination of OL Type Switches（6 Circuits）

Chapter 9 Environmental and Social Considerations

9.1 Survey Flow

The JICA Survey Team conducted an environmental and social survey with five steps as shown in Figure 9-1:



(Source: Developed by the JICA Survey Team)

Figure 9-1 Survey Flow of Environmental and Social considerations

STEP 1: The Team first conducted a "scoping" for the candidate projects prior to the examination of technical designs based on the present environmental context and socio-economic conditions of Mongolia, legislative systems and relevant organizations;

STEP 2: The Team then developed the terms of reference (TOR) for the survey, collected and analyzed relevant data, and had a series of discussions with the implementing agencies and relevant organizations;

STEP 3: Based on the survey results, the JICA Survey Team evaluated the environmental impact during construction and operation stages;

STEP 4: Examined mitigation measures and their cost, and;

STEP 5: Environmental monitoring plan.

The details of each survey step are described as below.

9.2 Transmission Projects

9.2.1 Scoping

"Scoping" aims at making decisions on which environmental items are surveyed and their survey methods. The JICA Survey Team evaluated each environmental item, assuming no avoidance or mitigation measures for adverse impacts are taken at all, to classify as A (Significant positive/negative impact is expected), B (Positive/negative impact is expected to some extent), C (Extent of impact is unknown (Further examination is needed, and the impact could be clarified later at the time of detailed design stage)) or D (No impact is expected) to screen particular items to be further surveyed.

The impacts examined in the survey included not only direct or immediate ones but also indirect, secondary, accumulative ones and those caused by inseparable projects. The examined items were selected based on *the environmental checklist* attached to *the JICA Guidelines for Environmental and Social Considerations* issued in April 2010, and other particular items were also added in accordance with the specific issues to each project.

The scoping results for each transmission project are given below. There was no item evaluated as A (Significant positive/negative impact is expected) in any project.

(1) Diagnosis Laboratory

The Project will provide laboratory equipment which enables NPTGC to conduct periodic inspection and monitoring, maintenance and repair for preventing accidents or operation failures. It will bring drastic changes in the routine maintenance work of NPTGC which currently responds only when accidents occur. There is no major negative impact anticipated in the project implementation.

Table 9-1 Scoping Results (Diagnosis Laboratory)

category	No	Item	Construction stage		Operation stage	
			Rate	Evaluation	Rate	Evaluation
Permits & Consultation	1	EIA and Environmental Permits	D	Not required.	D	Not required.
	2	Consultation with the Local Stakeholders	D	Not required.	D	Not required.
Pollution Management	3	Air Quality	D	No specific impact is anticipated.	B-	Discharge of exhaust fumes by operating the equipment.
	4	Water Quality	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	5	Wastes	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	6	Soil	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	7	Noise, Vibration and Low Frequency Sound	B-	Noise and vibration will occur when the equipment is transported.	D	No specific impact is anticipated.

category	No	Item	Construction stage		Operation stage	
			Rate	Evaluation	Rate	Evaluation
	8	Subsidence	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	9	Offensive Odor	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	10	Bottom Sediment	D	No specific impact is anticipated.	D	No specific impact is anticipated.
Natural Environment	11	Nature Reserves (Protected Area)	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	12	Biota and Ecosystem	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	13	Hydrometeor	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	14	Topography and Geology	D	No specific impact is anticipated.	D	No specific impact is anticipated.
Social Environment	15	Involuntary Resettlement	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	16	Poor People	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	17	Ethnic Minorities and Indigenous Peoples	D	Not applicable.	-	Not applicable.
	18	Local Economy such as Employment and Livelihood Means	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	19	Land Use and Utilization of Local Resources	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	20	Water Usage	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	21	Existing Social Infrastructure and Services	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	22	Social Institutions such as Social Infrastructure and Local Decision-Making Institutions	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	23	Misdistribution of Benefits and Damages	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	24	Local Conflicts of Interest	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	25	Cultural Heritages	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	26	Landscape	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	27	Gender	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	28	Children's Rights	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	29	Infectious Diseases such as HIV/AIDS	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	30	Work Environment (including Work Safety and Public Health)	D	No specific impact is anticipated.	D	No specific impact is anticipated.
Others	31	Electromagnetic Field	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	32	Right of Way (ROW)	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	33	Accidents	B-	Accidents may occur when equipment is transported.	D	No specific impact is anticipated.
	34	Global Warming / Climate Change	D	No specific impact is anticipated.	D	No specific impact is anticipated.

(Note) A+/-: Significant positive/negative impact is expected. B+/-: Positive / negative impact is expected to some extent. C: Extent of impact is unknown (Further examination is needed, and the impact could be clarified later at the time of detailed design stage). D: No impact is expected.

(Source: developed by the JICA Survey Team)

(2) Construction of Park Underground Substation

The substation is planned to be the first underground station constructed in Mongolia. NPTGC intends to acquire public land which is presently used as a public park managed by Ulaanbaatar City. The construction work may affect underground water flow, vein and level, and the impact caused by the Project on the citizens of Ulaanbaatar may not stay small-scale as their underground water use can be affected. Although the EIA Law in Mongolia does not include substations as those subject to the Detailed EIA, NPTGC is advised to consult with MEGD for further instruction when the basic design is completed.

NPTGC, together with Ulaanbaatar City, will hold a series of consultation meetings with local residents as stipulated in the EIA Law if the Project requires a Detailed EIA.

There will be no involuntary resettlement caused by the construction of the underground substation. The land use right will be transferred to the Ministry of Energy, which will take only a few weeks. It is anticipated that the Project will bring positive social impacts such as reduction of number and hours of power outage, and stable power supply to meet the demand.

Table 9-2 Scoping Results (Construction of Park Underground Substation)

category	No	Item	Construction stage		Operation stage	
			Rate	Evaluation	Rate	Evaluation
Permits & Consultation	1	EIA and Environmental Permits	C	Relevant Mongolian laws should be referred to as soon as the design is drafted.	C	Environmental protection plan and Environmental monitoring plan should be conducted if the Project requires a detailed EIA.
	2	Consultation with the Local Stakeholders	C	Consultation with local residents should be conducted if the Project requires a detailed EIA by law.	D	Not required by law
Pollution Management	3	Air Quality	B-	Discharge of exhaust fumes will occur from the operation of heavy machinery and trucks, production and diffusion of dust from treatment of the excavated soils and development of disposal yards.	D	No specific air pollution is anticipated.
	4	Water Quality	B-	Water turbidity will be caused by sludge treatment, from the temporary site of earth dig out, and by waste water in the construction work.	D	No specific water pollution is anticipated.
	5	Wastes	B-	Excavated soil and sludge will be produced in the construction work.	B-	Wastes will be created through the operation.
	6	Soil	B-	Soil pollution from sludge by the excavation work and waste water will occur.	D	No soil pollution is anticipated.
	7	Noise, Vibration and Low Frequency Sound	B-	Noise and vibration is predicted by the operation of heavy machinery and trucks, and the transportation of materials and equipment.	D	No specific impact is anticipated.
	8	Subsidence	B-	Outflow of groundwater during construction period can cause land subsidence.	D	No specific impact is anticipated.
	9	Offensive Odor	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	10	Bottom Sediment	D	No specific impact is anticipated.	D	No specific impact is anticipated.
Env.	11	Nature Reserves (Protected Area)	D	Not applicable.	D	Not applicable.

category	No	Item	Construction stage		Operation stage	
			Rate	Evaluation	Rate	Evaluation
	12	Biota and Ecosystem	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	13	Hydrometeor	B-	Change of groundwater level and water veins, and water flow inhibition can be caused by the construction work.	B-	Groundwater flow regime can stay changed.
	14	Topography and Geology	B-	Soil runoff may occur from the exposed soil of the embankments and earth cuts. There may be certain impact from excavation work and construction of disposal yard. And foundation strength may become deteriorated.	B-	Impact can stay even after back-filling work ends.
Social Environment	15	Involuntary Resettlement	D	The proposed site is public land and managed by Ulaanbaatar City as a public park. No resettlement is thus required.	D	No impact is anticipated.
	16	Poor People	D	No impact is anticipated.	D	No impact is anticipated.
	17	Ethnic Minorities and Indigenous Peoples	D	Not applicable.	D	Not applicable.
	18	Local Economy such as Employment and Livelihood Means	B+	Job opportunities will be created during construction period.	D	No impact is anticipated.
	19	Land Use and Utilization of Local Resources	B-	Temporary adverse impact on the land use will occur. Land value may decline due to less demand.	B-	Land value may remain declined due to less demand.
	20	Water Usage	B-	Change of groundwater level and water veins, and water flow inhibition can be caused by the construction work.	B-	Water quality can stay changed.
	21	Existing Social Infrastructure and Services	B-	Traffic volume will increase during construction period	B+	Stable power supply by coping with the increasing power demand
	22	Social Institutions such as Social Infrastructure and Local Decision-Making Institutions	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	23	Misdistribution of Benefits and Damages	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	24	Local Conflicts of Interest	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	25	Cultural Heritages	D	Not applicable.	D	Not applicable.
	26	Landscape	B-	View inhibition can be caused by the ventilating station.	B-	View inhibition can be caused by the ventilating station.
	27	Gender	D	No specific impact is anticipated.	D	No impact is anticipated.
	28	Children's Rights	D	No specific impact is anticipated.	D	No impact is anticipated.
	29	Infectious Diseases such as HIV/AIDS	B-	A temporary influx of migrant labor during construction period may increase infectious diseases.	D	No specific impact is anticipated.

category	No	Item	Construction stage		Operation stage	
			Rate	Evaluation	Rate	Evaluation
	30	Work Environment (including Work Safety and Public Health)	B-	High risk rate of accidents is predicted in the construction work	B-	Accidents of employees may occur.
Others	31	Electromagnetic Field	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	32	Right of Way (ROW)	B-	Impact on the surrounding area is anticipated.	D	No specific impact is anticipated.
	33	Accidents	B-	Accidents of workers, traffic accidents due to traffic volume increase, and involvement of passers-by near the construction site can occur.	D	No specific impact is anticipated.
	34	Global Warming / Climate Change	D	No specific impact is anticipated.	B+	Decrease in number and hours of power outages.

(Note) A+/-: Significant positive/negative impact is expected. B+/-: Positive / negative impact is expected to some extent. C: Extent of impact is unknown (Further examination is needed, and the impact could be clarified later at the time of detailed design stage). D: No impact is expected.

(Source: developed by the JICA Survey Team)

(3) Expansion of Baruun and Umard Substations

The Project will replace the existing transformers and related facilities of Baruun Substation and Umard Substation with advanced ones. The EIA Law in Mongolia does not include substations as those subject to the Detailed EIA. It is anticipated that the Project will bring positive social impacts such as reduction of number and hours of power outage, and stable power supply by reinforcing the capacity of substation facilities.

Table 9-3 Scoping Results (Expansion of Baruun and Umard Substations)

category	No	Item	Construction stage		Operation stage	
			Rate	Evaluation	Rate	Evaluation
Permits & Consultation	1	EIA and Environmental Permits	D	Not required.	D	Not required.
	2	Consultation with the Local Stakeholders	D	Not required.	D	Not required.
Pollution Management	3	Air Quality	B-	Discharge of exhaust fumes will occur from the operation of heavy machinery and trucks, production and diffusion of dust from treatment of the excavated soils and development of disposal yards.	D	No specific impact is anticipated.
	4	Water Quality	B-	Water turbidity will be caused by sludge treatment, from the temporary site of earth dig out, and by waste water produced in the construction work	B-	Outflow of rain water, waste water and cooling water may affect the water quality.
	5	Wastes	B-	Excavated soil and sludge will be produced in the construction work.	B-	Wastes can be created through the operation.

category	No	Item	Construction stage		Operation stage	
			Rate	Evaluation	Rate	Evaluation
	6	Soil	B-	Soil pollution from sludge by the excavation work and waste water will occur.	B-	Soil contamination can be caused by discharged water and waste water.
	7	Noise, Vibration and Low Frequency Sound	B-	Noise and vibration will occur from the operation of heavy machinery and trucks, and the transportation of materials and equipment.	C	Low frequency sound may occur
	8	Subsidence	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	9	Offensive Odor	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	10	Bottom Sediment	D	No specific impact is anticipated.	D	No specific impact is anticipated.
Natural Environment	11	Nature Reserves (Protected Area)	D	Not applicable.	D	Not applicable.
	12	Biota and Ecosystem	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	13	Hydrometeor	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	14	Topography and Geology	D	No specific impact is anticipated.	D	No specific impact is anticipated.
Social Environment	15	Involuntary Resettlement	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	16	Poor People	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	17	Ethnic Minorities and Indigenous Peoples	D	Not applicable.	D	Not applicable.
	18	Local Economy such as Employment and Livelihood Means	B+	Job opportunities will be created.	D	No specific impact is anticipated.
	19	Land Use and Utilization of Local Resources	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	20	Water Usage	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	21	Existing Social Infrastructure and Services	B-	Traffic volume will increase during construction period	B+	Stabler power supply with increased capacity of substation facilities.
	22	Social Institutions such as Social Infrastructure and Local Decision-Making Institutions	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	23	Misdistribution of Benefits and Damages	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	24	Local Conflicts of Interest	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	25	Cultural Heritages	D	Not applicable.	D	Not applicable.
	26	Landscape	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	27	Gender	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	28	Children's Rights	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	29	Infectious Diseases such as HIV/AIDS	B-	A temporary influx of migrant labor during construction period may increase infectious diseases.	D	No specific impact is anticipated.

category	No	Item	Construction stage		Operation stage	
			Rate	Evaluation	Rate	Evaluation
	30	Work Environment (including Work Safety and Public Health)	B-	High risk rate of accidents is predicted in the construction work	B-	Accidents of employees may occur.
Others	31	Electromagnetic Field	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	32	Right of Way (ROW)	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	33	Accidents	B-	Accidents of workers, and involvement of substation employees.	D	Accidents of employees may occur.
	34	Global Warming / Climate Change	D	No specific impact is anticipated.	B+	Decrease in number and hours of power outage supply.

(Note) A+/-: Significant positive/negative impact is expected. B+/-: Positive / negative impact is expected to some extent. C: Extent of impact is unknown (Further examination is needed, and the impact could be clarified later at the time of detailed design stage). D: No impact is expected.

(Source: developed by the JICA Survey Team)

(4) Conductor Replacement of Existing 110 kV Transmission Lines (No. 109 & No. 110)

The Project will replace two existing transmission line conductors (No.109 and No.110) with new advanced ones of a total length of 15km to increase transmitted electricity volume. Project owners who intend to extend new electric transmission lines of 35kV and higher voltage are required to consult with MEGD for the Detailed EIA implementation. Compensation to the land owners has to be examined if the Project needs to acquire land in the right of way.

It is anticipated that the Project will bring positive social impacts such as reduction of number and hours of power outage, and stable power supply by reinforcing the capacity of transmission line conductors.

Table 9-4 Scoping Results (Conductor Replacement of Existing 110 kV Transmission Lines (No. 109 & No. 110))

category	No	Item	Construction stage		Operation stage	
			Rate	Evaluation	Rate	Evaluation
Permits & Consultation	1	EIA and Environmental Permits	C	Relevant Mongolian laws should be referred to as soon as the replacement route is drafted.	C	Environmental Protection Plan and Environmental Monitoring Plan should be conducted if the Project requires a detailed EIA.
	2	Consultation with the Local Stakeholders	C	Consultation with local residents should be conducted if the Project requires a detailed EIA by law.	D	Not required by law
Pollution Management	3	Air Quality	B-	Discharge of exhaust fumes will occur from the operation of heavy machinery and trucks, production and diffusion of dust from the treatment of the excavated soils.	D	No specific impact is anticipated.
	4	Water Quality	B-	Water turbidity will be caused by sludge treatment, by soil runoff from the exposed soil of the embankments and earth cuts, and by waste water produced in the construction work	B-	Outflow of rain water, waste water and cooling water

category	No	Item	Construction stage		Operation stage	
			Rate	Evaluation	Rate	Evaluation
	5	Wastes	B-	Construction wastes will be created.	D	No specific impact is anticipated.
	6	Soil	B-	Soil pollution from sludge by the excavation work and waste water will occur.	D	No specific impact is anticipated.
	7	Noise, Vibration and Low Frequency Sound	B-	Noise and vibration will occur by the operation of heavy machinery and trucks, and the transportation of materials and equipment.	D	No specific impact is anticipated.
	8	Subsidence	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	9	Offensive Odor	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	10	Bottom Sediment	D	No specific impact is anticipated.	D	No specific impact is anticipated.
Natural Environment	11	Nature Reserves (Protected Area)	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	12	Biota and Ecosystem	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	13	Hydrometeor	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	14	Topography and Geology	C	Soil runoff may occur from the exposed soil of the embankments and earth cuts where new transmission towers are erected. Collapses of towers may occur if geological features are not suitable.	C	Soil runoff may occur from the exposed soil of the embankments and earth cuts where new transmission towers are erected. Collapses of towers may occur if geological features are not suitable.
Social Environment	15	Involuntary Resettlement	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	16	Poor People	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	17	Ethnic Minorities and Indigenous Peoples	D	Not applicable.	D	Not applicable.
	18	Local Economy such as Employment and Livelihood Means	B+	Job opportunities will be created during construction period.	D	No specific impact is anticipated.
	19	Land Use and Utilization of Local Resources	B-	Temporary adverse impact on the land use will occur. Land value under ROW may decline due to less demand.	B-	Land value under ROW may decline due to less demand.
	20	Water Usage	B-	Sludge treatment, soil runoff from the exposed soil of the embankments and earth cuts, and waste water from the construction work may deteriorate water quality in the surrounding area.	B-	Water quality can stay changed.
	21	Existing Social Infrastructure and Services	B-	Traffic volume will increase during construction period, and temporary adverse impact by planned power outage during construction period.	B+	Stabler power supply with increased capacity of transmission facilities.
	22	Social Institutions such as Social Infrastructure and Local Decision-Making Institutions	D	No specific impact is anticipated.	D	No specific impact is anticipated.

category	No	Item	Construction stage		Operation stage	
			Rate	Evaluation	Rate	Evaluation
	23	Misdistribution of Benefits and Damages	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	24	Local Conflicts of Interest	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	25	Cultural Heritages	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	26	Landscape	B-	Impact on landscape may occur depending on locations of towers and transmission lines replacing the existing ones.	B-	Impact on landscape may occur depending on locations of towers and transmission lines replacing the existing ones.
	27	Gender	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	28	Children's Rights	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	29	Infectious Diseases such as HIV/AIDS	B-	A temporary influx of migrant labor during construction period may increase infectious diseases.	D	No specific impact is anticipated.
	30	Work Environment (including Work Safety and Public Health)	B-	High risk rate of accidents is predicted in the construction work	D	No specific impact is anticipated.
Others	31	Electromagnetic Field	D	No specific impact is anticipated.	B-	Negative impact of electromagnetic fields on human health is anticipated.
	32	Right of Way (ROW)	B-	Impact on the surrounding area is anticipated.	D	No specific impact is anticipated.
	33	Accidents	B-	Accidents of workers, traffic accidents due to traffic volume increase, and involvement of passers-by and local residents near the construction site can occur during construction period.	B-	Electric shock and accidental falls during maintenance work may occur.
	34	Global Warming / Climate Change	D	No specific impact is anticipated.	B+	Decrease in number and hours of power outages.

(Note) A+/-: Significant positive/negative impact is expected. B+/-: Positive / negative impact is expected to some extent. C: Extent of impact is unknown (Further examination is needed, and the impact could be clarified later at the time of detailed design stage). D: No impact is expected.

(Source: developed by the JICA Survey Team)

(5) Mobile Substation

The Project will help cope with emergency needs of substations when the transformers of the existing substations are broken down, and power demand surpluses the supply volume. There is no major negative impact anticipated by the project implementation.

Table 9-5 Scoping Results (Mobile Substation)

category	No	Item	Construction stage		Operation stage	
			Rate	Evaluation	Rate	Evaluation
Permits & Consultation	1	EIA and Environmental Permits	D	Not required.	D	Not required.
	2	Consultation with the Local Stakeholders	D	Not required.	D	Not required.

category	No	Item	Construction stage		Operation stage	
			Rate	Evaluation	Rate	Evaluation
Pollution Management	3	Air Quality	D	No specific impact is anticipated.	B-	Discharge of exhaust fumes will occur by transporting and operating the mobile substation.
	4	Water Quality	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	5	Wastes	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	6	Soil	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	7	Noise, Vibration and Low Frequency Sound	B-	Noise and vibration will occur when the equipment is transported.	B-	Low frequency sound may occur
	8	Subsidence	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	9	Offensive Odor	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	10	Bottom Sediment	D	No specific impact is anticipated.	D	No specific impact is anticipated.
Natural Environment	11	Nature Reserves (Protected Area)	D	Not applicable.	D	Not applicable.
	12	Biota and Ecosystem	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	13	Hydrometeor	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	14	Topography and Geology	D	No specific impact is anticipated.	D	No specific impact is anticipated.
Social Environment	15	Involuntary Resettlement	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	16	Poor People	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	17	Ethnic Minorities and Indigenous Peoples	D	Not applicable.	D	Not applicable.
	18	Local Economy such as Employment and Livelihood Means	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	19	Land Use and Utilization of Local Resources	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	20	Water Usage	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	21	Existing Social Infrastructure and Services	D	No specific impact is anticipated.	B+	Stabler power supply by coping with emergency cases.
	22	Social Institutions such as Social Infrastructure and Local Decision-Making Institutions	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	23	Misdistribution of Benefits and Damages	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	24	Local Conflicts of Interest	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	25	Cultural Heritages	D	Not applicable.	D	Not applicable.
	26	Landscape	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	27	Gender	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	28	Children's Rights	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	29	Infectious Diseases such as HIV/AIDS	D	No specific impact is anticipated.	D	No specific impact is anticipated.

category	No	Item	Construction stage		Operation stage	
			Rate	Evaluation	Rate	Evaluation
	30	Work Environment (including Work Safety and Public Health)	D	No specific impact is anticipated.	D	No specific impact is anticipated.
Others	31	Electromagnetic Field	D	No specific impact is anticipated.	B-	Negative impact of electromagnetic fields on human health is anticipated depending on the operation venue.
	32	Right of Way (ROW)	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	33	Accidents	B-	Accidents may occur when equipment is transported.	B-	Accidents may occur when equipment is transported.
	34	Global Warming / Climate Change	D	No specific impact is anticipated.	B+	Decrease in number and hours of power outages.

(Note) A+/-: Significant positive/negative impact is expected. B+/-: Positive / negative impact is expected to some extent. C: Extent of impact is unknown (Further examination is needed, and the impact could be clarified later at the time of detailed design stage). D: No impact is expected.

(Source: developed by the JICA Survey Team)

9.2.2 Survey Terms of Reference (TOR)

Based on the above scoping results of each project, the JICA Survey Team developed the terms of reference by short-listing the items to be surveyed. The items for which all five projects are not likely relevant (rated as "D") were excluded from the survey target.

Table 9-6 Survey Terms of Reference of Transmission Projects

Item	Survey Item	Survey Method	Project No. and Survey to be Conducted or not*				
			1	2	3	4	5
Examination of Alternatives	Examination of construction plan and schedule	Examination of construction plan and schedule in order to reduce environmental impact and traffic congestions during construction period.	Y	Y	Y	Y	Y
EIA and Environmental Permits	・ Identify relevant laws and standards ・ Consultation with relevant authorities	・ Collect secondary data and references, and information at relevant authorities ・ Site visit ・ Interview with relevant authorities	N	Y	N	Y	N
Consultation with the Local Stakeholders	・ Identify relevant laws and standards ・ Consultation with relevant authorities	・ Collect secondary data and references, and information at relevant authorities ・ Site visit ・ Interview with relevant authorities	N	Y	N	Y	N
Air Quality	・ Identify relevant laws and standards ・ Identify traffic volumes and socio-economic conditions of surrounding area ・ Consultation with relevant authorities ・ The degree of impact during	・ Collect secondary data and references, and information at relevant authorities ・ Site visit ・ Interview with relevant authorities ・ Construction method, component, period, and schedule ・ Specifications, operation frequency	Y	Y	Y	Y	Y

Item	Survey Item	Survey Method	Project No. and Survey to be Conducted or not*				
			1	2	3	4	5
	construction period	and period, and storage venues of construction equipment ・ Number of construction vehicles and transporting routes					
Water Quality	・ Identify relevant laws and standards ・ Identify present underground water use in Ulaanbaatar City	・ Collect secondary data and references, and information at relevant authorities ・ Site visit ・ Interview with relevant authorities	N	Y	Y	Y	Y
Wastes	・ Identify relevant laws and standards ・ Treatment method of construction wastes	・ Collect secondary data and references, and information at relevant authorities ・ Study on similar cases ・ Interview with relevant authorities	N	Y	Y	Y	N
Soil	・ Identify relevant laws and standards ・ Prevention measures of oil leakage during construction period	・ Collect secondary data and references, and information at relevant authorities ・ Construction method, component, period, and schedule ・ Specifications, operation frequency and period, and storage venues of construction equipment	N	Y	Y	Y	N
Noise, Vibration and Low Frequency Sound	・ Identify relevant laws and standards ・ Distance from the origin to residential areas and public facilities ・ The degree of impact during construction period	・ Collect secondary data and references, and information at relevant authorities ・ Site visit ・ Interview with relevant authorities ・ Construction method, component, period, and schedule ・ Specifications, operation frequency and period, and storage venues of construction equipment ・ Number of construction vehicles and transporting routes	Y	Y	Y	Y	Y
Subsidence	・ Identify relevant laws and standards ・ The degree of impact during construction period and operation period	・ Collect secondary data and references, and information at relevant authorities ・ Site visit ・ Interview with relevant authorities ・ Construction method, component, period, and schedule ・ Specifications, operation frequency and period, and storage venues of construction equipment ・ Number of construction vehicles and transporting routes	N	Y	N	N	N
Hydrometeor	・ Identify relevant laws and standards ・ The degree of impact during construction period and operation period	・ Collect secondary data and references, and information at relevant authorities ・ Site visit ・ Interview with relevant authorities ・ Construction method, component,	N	Y	N	N	N

Item	Survey Item	Survey Method	Project No. and Survey to be Conducted or not*				
			1	2	3	4	5
		period, and schedule ・ Specifications, operation frequency and period, and storage venues of construction equipment ・ Number of construction vehicles and transporting routes					
Topography and Geology	・ Identify relevant laws and standards ・ The degree of impact during construction period and operation period	・ Collect secondary data and references, and information at relevant authorities ・ Site visit ・ Interview with relevant authorities ・ Construction method, component, period, and schedule ・ Specifications, operation frequency and period, and storage venues of construction equipment ・ Number of construction vehicles and transporting routes	N	Y	N	N	N
Poor People	Socio-economic conditions of people living at and around the project sites	・ Collect secondary data and references (demographic data, and etc.) ・ Site visit ・ Interview with relevant authorities	N	N	N	Y	N
Ethnic Minorities and Indigenous Peoples	Socio-economic conditions of the local society and present land use	・ Collect secondary data and references (demographic data and current land use), and information at relevant authorities ・ Site visit ・ Interview with relevant authorities ・ Collect satellite photos	N	N	N	Y	N
Local Economy such as Employment and Livelihood Means	Socio-economic conditions of people living at and around the project sites	・ Collect secondary data and references (socio-economic indicators) ・ Site visit ・ Interview with relevant authorities	Y	Y	Y	Y	Y
Land Use and Utilization of Local Resources	Land use and local resources utilization in the local society	・ Collect secondary data and references (land use plan, city planning and current land use), and information at relevant authorities ・ Site visit ・ Interview with relevant authorities ・ Collect satellite photos	N	Y	N	Y	N
Water Usage	Present water use in the local society (surface water and underground water)	・ Collect secondary data and references (on river water and underground water use and relevant information), and information at relevant authorities ・ Site visit ・ Interview with relevant authorities	N	Y	N	N	N
Existing Social Infrastructure and Services	Public facilities (school and medical institutions) and residences	・ Collect secondary data and references, and information at relevant authorities	N	Y	Y	Y	Y

Item	Survey Item	Survey Method	Project No. and Survey to be Conducted or not*				
			1	2	3	4	5
		・ Site visit ・ Interview with relevant authorities					
Landscape	Present land use	・ Collect information at relevant authorities ・ Site visit ・ Interview with relevant authorities	N	Y	N	N	N
Infectious Diseases such as HIV/AIDS	・ HIV/AIDS infection rate at project sites ・ Relevant authorities	・ Collect secondary data and references and information at relevant authorities ・ Interview with relevant authorities	N	Y	Y	Y	N
Work Environment (including Work Safety and Public Health)	・ Identify relevant laws and standards ・ Measures for labor safety and security	・ Collect secondary data and references and information at relevant authorities ・ Study on similar cases	N	Y	Y	Y	N
Electromagnetic Field	Identify relevant laws and standards	・ Collect secondary data and references and information at relevant authorities ・ Study on similar cases	N	N	N	Y	Y
Right of Way (ROW)	Identify relevant laws and standards, current land use and living environment of the local society	・ Collect secondary data and references (demographic data and current land use) and information at relevant authorities ・ Site visit ・ Interview with relevant authorities ・ Collect satellite photos	N	N	N	Y	N
Accidents	・ Increase in number of traffic accidents during construction period ・ Accidents at construction sites	・ Collect secondary data and references and information at relevant authorities ・ Site visit ・ Construction method, component, period, and schedule ・ Specifications, operation frequency and period, and storage venues of construction equipment ・ Number of construction vehicles and transporting routes	Y	Y	Y	Y	Y
Global Warming / Climate Change	・ Identify relevant laws and standards ・ The degree of impact during construction period	・ Collect secondary data and references and information at relevant authorities ・ Construction method, component, period, and schedule ・ Specifications, operation frequency and period, and storage venues of construction equipment ・ Number of construction vehicles and transporting routes	N	Y	Y	Y	Y

(Note1) Project No. 1: Diagnosis Laboratory, No. 2: Construction of Park Underground Substation, No. 3: Expansion of Baruun and Umard Substations, No. 4: Conductor Replacement of Existing 110 kV Transmission Lines (No. 109 & No. 110), No. 5: Mobile substation
(Note2) "Y" stands for "Yes" (necessary) and "N" stands for "No" (not necessary).

(Source: developed by the JICA Survey Team)

9.2.3 Survey Results and Environmental Evaluation

The JICA Survey Team conducted an environmental evaluation on each item based on the survey results. There was no item as rated “A” (significant positive/negative impact is expected) in the scoping. Those rated as “B” (positive / negative impact is expected to some extent) and “C” (extent of impact is unknown) were accordingly examined. Although those items as rated “D” (no impact is expected) were excluded in the survey, some of them were selected again for re-examination when certain impacts were found possible.

Survey results and environmental evaluation are shown in the following tables for each project.

(1) Diagnosis Laboratory

There is no major negative impact anticipated. The project will contribute to the improvement of their maintenance and management skills of relevant facilities, and to better reliability of electricity supply (e.g. reduction of numbers in power failure). However, nitrogen (N), argon (Ar), helium (He) and hydrogen (H) will be created by the operation although the amount of gas as a whole created in the laboratory will stay small-scale. The implementing agency is strongly recommended to strictly manage air temperature and humidity of the stored rooms by using air-conditioners, and by regular ventilation. Wastes will also be created while conducting analyses at the laboratory. Insulating oils without PCB should be treated as industrial wastes, whereas those with PCB should be detoxicated or stored in an appropriate manner. The same will be applied to the case of organic solvent use (such as toluene and ethanol) required for cleaning the oil analysis equipment.

Table 9-7 Environmental Evaluation (Diagnosis Laboratory)

Item	Scoping Evaluation		Environmental Evaluation based on the Survey Results			
	Construction period	Operation Period	Construction Period		Operation Period	
Air Quality	D	B-	D	Not occur.	B-	Nitrogen (N), argon (Ar), helium (He) and hydrogen (H) will be created by the operation though the amount of gas created in the laboratory stays as small-scale as a few liters.
Wastes	D	D	D	Not occur.	B-	Wastes will be created while conducting analyses at the laboratory. Insulating oils without PCB should be treated as industrial wastes. Insulating oils with PCB should be detoxicated or stored in an appropriate manner. The same will be applied to the case of organic solvent use (such as toluene and ethanol) required for cleaning the oil analysis equipment.

Item	Scoping Evaluation		Environmental Evaluation based on the Survey Results			
	Construction period	Operation Period	Construction Period		Operation Period	
Noise, Vibration and Low Frequency Sound	B-	D	B-	Noise and vibration will be produced when carrying in the equipment to NPTGC.	B-	Mobile laboratory will produce noise and vibration while running in the street.
Existing Social Infrastructure and Services	D	D	D	No specific impact is anticipated.	B+	Enforcement of monitoring function will contribute to the improvement of reliability of electricity supply.
Accidents	B-	D	B-	Accidents may occur when carrying in the equipment to NPTGC.	B-	Accidents may occur while carrying mobile laboratory in the street.

(Source: developed by the JICA Survey Team)

(2) Construction of Park Underground Substation

In accordance with the EIA Law of Mongolia, a situation analysis survey is required prior to the construction work, and the survey results should be reflected into the project design. The MEGD conducts a general EIA to assess if a detailed EIA is required for further assessing the degree of environmental impact.

Groundwater level in Ulaanbaatar City is high, and significant impact is likely to be caused by the construction work if there are no measures taken against underground water outflow and land subsidence. Ulaanbaatar is located in the basin of the Tuul River, from which underground water originates to provide the city service water. The water use by the city population therefore may be affected by the potential water flow inhibition. Methods of excavation and earth retaining, measures such as cutoff, drainage, and chemical grouting to prevent underground water outflow should be carefully examined based on the actual situation of topographic and geological condition of the project site and surrounding area. Consultation with local residents should be conducted if the project requires a detailed EIA.

Transmission lines connected to the Park Substation will be laid underground along the existing roads and streets, which will not cause acquisition of private lands and involuntary resettlement. However, the existence of underground facilities should be carefully checked prior to the route selection. Information on the construction schedule and venues should be well disseminated to the public in order to increase local residents' awareness and to minimize adverse impacts on local traffic and others.

Table 9-8 Environmental Evaluation (Construction of Park Underground Substation)

Item	Scoping Evaluation		Environmental Evaluation based on the Survey Results	
	Construction period	Operation Period	Construction period	Operation Period

Item	Scoping Evaluation		Environmental Evaluation based on the Survey Results			
	Construction period	Operation Period	Construction period		Operation Period	
EIA and Environmental Permits	C	C	C	A situation analysis survey should be conducted, whose result is to be reflected into the project design. The MEGD will conduct a general EIA to assess if a detailed EIA is required for further assessing the degree of environmental impact.	D	Not relevant
Consultation with the Local Stakeholders	C	D	B-	The public park will not be available during construction period. Consultation with local residents should be conducted if the Project requires a detailed EIA by law.	B-	Not relevant
Air Quality	B-	D	B-	Discharge of exhaust fumes will occur from the operation of heavy machinery and trucks, production and diffusion of dust from treatment of the excavated soils and development of disposal yards.	D	Not occur.
Water Quality	B-	D	B-	Water turbidity will be caused by sludge treatment, from the temporary site of earth dig out, and by waste water from the construction work.	D	Discharge of rain water, waste water and cooling water may cause water turbidity during operation.
Wastes	B-	B-	B-	Excavated soil and sludge by the construction work will be produced during construction.	D	Wastes will be produced as the substation functions.
Soil	B-	D	B-	Soil pollution from sludge will occur by the excavation work and waste water.	D	Not occur.
Noise, Vibration and Low Frequency Sound	B-	D	B-	Noise and vibration is predicted by the operation of heavy machinery and trucks, and the transportation of materials and equipment.	D	Not occur.
Subsidence	B-	D	B-	Outflow of underground water and land subsidence may occur.	D	No specific impact is anticipated.
Hydrometeor	B-	B-	B-	Change of groundwater level and water veins, and water flow inhibition can be caused by the construction work.	B-	Change of water veins may continue.
Topography and Geology	B-	B-	B-	Soil runoff may occur from the exposed soil of the embankments and earth cuts. There may be certain impact from excavation work and construction of disposal yard. And foundation strength may become deteriorated.	B-	Impacts may stay after back-filling work.
Local Economy such as Employment and Livelihood Means	B+	D	B+	Job opportunities will be created during construction period.	D	No specific impact is anticipated.
Land Use and Utilization of Local Resources	B-	B-	B-	The park will not be available during construction, so Ulaanbaatar citizens lose a public space for entertainment.	B-	The land value may decline.
Water Usage	B-	B-	B-	Change of groundwater level and water veins, and water flow	B-	Change of water quality may continue.

Item	Scoping Evaluation		Environmental Evaluation based on the Survey Results			
	Construction period	Operation Period	Construction period		Operation Period	
				inhibition can be caused by the construction work.		
Existing Social Infrastructure and Services	B-	B+	B-	Traffic volume will increase.	B+	Stabler power supply with an increased capacity of substation facilities.
Social Institutions such as Social Infrastructure and Local Decision-Making Institutions	D	D	B-	Close contacts with Ulaanbaatar City will be required for obtaining the land use permit and future land use plan, and allocating the domestic budget.	D	No specific impact is anticipated.
Landscape	B-	B-	B-	View inhibition can be caused by the ventilating station.	B-	View inhibition will be minimized by limiting number and space for outside facilities.
Infectious Diseases such as HIV/AIDS	B-	D	B-	A temporary influx of migrant labor during construction period may increase infectious diseases.	D	Not occur.
Work Environment (including Work Safety and Public Health)	B-	B-	B-	Accidents involving laborers can occur at any time during construction period.	B-	Accidents involving substation employees may occur.
Right of Way	B-	D	D	Transmission lines connected to the Substation will be laid underground along the existing roads and streets, which will not cause acquisition of private lands and involuntary resettlement.	D	No specific impact is anticipated.
Accidents	B-	D	B-	Accidents of workers at construction site, traffic accidents nearby due to the increase of traffic volume may occur, and passers-by can be involved in the accidents at any time.	D	Accidents involving substation employees may occur.
Global Warming / Climate Change	D	B+	D	No specific impact is anticipated.	B+	Decrease in number and hours of power outage supply.

(Source: developed by the JICA Survey Team)

(3) Expansion of Baruun and Umard Substations

There is no major adverse impact anticipated. However, two substations are adjacent to the dense residential area where most people live in the *ger* houses, to which fires can spread from the site at any time so that prevention measures against fire should be considered. No specific impact by the electromagnetic field, on the other hand, is anticipated as new transformers will be kept within the yard.

It is anticipated that the Project will bring positive social impacts such as reduction of number and hours of power outages, and stable power supply by reinforcing the capacity of substation facilities.

Table 9-9 Environmental Evaluation (Expansion of Baruun and Umard Substations)

Item	Scoping Evaluation		Environmental Evaluation based on the Survey Results			
	Construction period	Operation Period	Construction period		Operation Period	
Air Quality	B-	D	B-	Discharge of exhaust fumes will occur from the operation of heavy machinery and trucks, production and diffusion of dust from treatment of the excavated soils and development of disposal yards.	D	Not occur.
Water Quality	B-	B-	B-	Water turbidity will be caused by sludge treatment, from the temporary site of earth dig out, and by waste water from the construction work.	D	Discharge of rain water, waste water and cooling water may cause water turbidity during operation.
Wastes	B-	B-	B-	Excavated soil and sludge by the construction work will be produced during construction.	D	Wastes will be produced as the substation functions.
Soil	B-	B-	B-	Soil pollution from sludge by the excavation work and waste water will occur.	D	Soil contamination can be caused by discharged water and waste water.
Noise, Vibration and Low Frequency Sound	B-	C	B-	Noise and vibration will occur by the operation of heavy machinery and trucks, and the transportation of materials and equipment.	D	Low frequency sound will occur but, the impact is limited as the facilities will be kept inside the site.
Local Economy such as Employment and Livelihood Means	B+	D	B+	Job opportunities will be created during construction period.	D	No specific impact is anticipated.
Existing Social Infrastructure and Services	B-	B+	B-	Traffic volume will increase.	B+	Stable power supply with an increased capacity of substation facilities.
Infectious Diseases such as HIV/AIDS	B-	D	B-	A temporary influx of migrant labor during construction period may increase infectious diseases.	D	Not occur.
Work Environment (including Work Safety and Public Health)	B-	B-	B-	Accidents involving laborers can occur at any time during construction period.	B-	Accidents involving substation employees may occur.
Accidents	B-	D	B-	Accidents of workers at construction site, and employees currently working at the existing substation.	D	Two substations are adjacent to the dense residential area where most people live in the *ger* houses, to which fires can spread from the site at any time.
Global Warming / Climate Change	D	B+	D	No specific impact is anticipated.	B+	Decrease in number and hours of power outage supply.

(Source: developed by the JICA Survey Team)

(4) Conductor Replacement of Existing 110 kV Transmission Lines (No. 109 & No. 110)

In accordance with the EIA Law of Mongolia, a situation analysis survey is required prior to the construction work, and the MEGD and Ulaanbaatar City will confirm if a detailed EIA is required for further assessing the degree of environmental impact. According to the JICA Survey Team's technical examination up to January 2014, the Project will require no new towers to be erected or

reinforcement of the existing towers either as the replaced conductors will weigh approximately the same by adopting the advanced light conductors. No land acquisition will then occur as it is not necessary to reroute the lines.

The existing lines were extended 30 years ago, and people have gradually moved to live in the ROW for 10km-long. Most of them live in the *ger* houses, where approximately over 200 households are found. In Mongolia it is not allowed to live in 10m-wide area of the ROW of 110kV electric lines, and NPTGC has been sending official notices for land clearance to those people who have been occupying the land without legal tenure in accordance with the Land Law. The Land Law allows the implementing agencies to evict the land occupants after a certain period of sending official notices[13], while NPTGC would like not to take such actions. Ulaanbaatar City is supposed to take necessary actions to resettle them as those areas are to be redeveloped under the Ulaanbaatar City's Development Master Plan 2020. However, no progress has been made as of December 2013. Consultation with local residents and close contact with Ulaanbaatar City will be the key for the future area development, and the Mongolian side is required to allocate sufficient budget to take such action.

Table 9-10 Environmental Evaluation (Conductor Replacement of Existing 110 kV Transmission Lines (No. 109 & No. 110))

Item	Scoping Evaluation		Environmental Evaluation based on the Survey Results			
	Construction period	Operation Period	Construction period		Operation Period	
EIA and Environmental Permits	C	C	D	A detailed EIA will not be required as no new tower will be erected. The new transmission wires will weigh the same level as the existing ones.	D	Not required.
Consultation with the Local Stakeholders	C	D	B-	Consultation with local stakeholders will not be required by law if a detailed EIA is not applicable. However, over 200 households are currently existing in the right of way and surrounding area after 30 years of wire extension.	D	Not required.
Air Quality	B-	D	B-	Discharge of exhaust fumes will occur from the operation of heavy machinery and trucks, production and diffusion of dust from the treatment of the excavated soils.	D	Not occur.
Water Quality	B-	B-	D	Not occur.	D	Not occur.
Wastes	B-	D	B-	Construction wastes will be created.	D	Not occur.
Soil	B-	D	D	Not occur.	D	Not occur.
Noise, Vibration and Low Frequency Sound	B-	D	B-	Noise and vibration is predicted by the operation of heavy machinery and trucks, and the transportation	D	Not occur.

[13] Article 58.5 and 58.6, Law on Land (7 June, 2002).

Item	Scoping Evaluation		Environmental Evaluation based on the Survey Results			
	Construction period	Operation Period	Construction period		Operation Period	
				of materials and equipment.		
Topography and Geology	C	C	D	No excavation work will be conducted as no new tower will be erected.	D	No specific impact is anticipated.
Involuntary Resettlement	D	D	B-	No land acquisition is anticipated as no new tower will be erected and route will remain same. NPTGC and Ulaanbaatar City will conduct consultation with those households residing in the ROW who have been occupying the venues for years without legal tenures.	D	No specific impact is anticipated.
Poor People	D	D	B-	10km out of the total length of extension (15km) will pass the *ger* areas where poor people live.	D	No specific impact is anticipated.
Local Economy such as Employment and Livelihood Means	B+	D	B+	Job opportunities will be created during construction period.	D	No specific impact is anticipated.
Land Use and Utilization of Local Resources	B-	B-	B-	Temporary impact on land use during construction period.	D	No specific impact is anticipated.
Water Usage	B-	B-	D	No excavation work will be conducted as no new tower is erected. No specific impact on water usage is thus anticipated.	D	No specific impact is anticipated.
Existing Social Infrastructure and Services	B-	B+	B-	Temporary impact may occur due to the increase of traffic volume and the planned power outage for construction work.	B+	Stable power supply with an increased capacity of transmission facilities.
Social Institutions such as Social Infrastructure and Local Decision-Making Institutions	D	D	B-	Close contact with Ulaanbaatar city will be necessary in order to conduct consultation meetings with local residents and implementation of area redevelopment. Budget allocation is also essential.	D	No specific impact is anticipated.
Landscape	B-	B-	D	No new tower will be erected and the route will remain same.	D	No specific impact is anticipated.
Infectious Diseases such as HIV/AIDS	B-	D	B-	A temporary influx of migrant labor during construction period may increase infectious diseases.	D	Not occur.
Work Environment (including Work Safety and Public Health)	B-	D	B-	Accidents involving laborers can occur at any time during construction period.	D	Not occur.
Electromagnetic Field	D	B-	D	No specific impact is anticipated.	D	No exceeding impact bigger than the present condition.
Right of Way (ROW)	B-	D	B-	Temporary impact during construction period.	D	No specific impact is anticipated.
Accidents	B-	B-	B-	Accidents of workers at construction site, traffic accidents nearby due to the increase of traffic volume may occur, and passers-by can be involved in the	B-	Electric shocks and accidental falls may occur during maintenance work

Item	Scoping Evaluation		Environmental Evaluation based on the Survey Results			
	Construction period	Operation Period	Construction period		Operation Period	
				accidents at any time.		
Global Warming / Climate Change	D	B+	D	No specific impact is anticipated.	B+	Decrease in number and hours of power outage supply.

(Source: developed by JICA Survey Team)

(5) Mobile Substation

The Project will help cope with emergency needs of substations when the transformers of the existing substations are broken down, and power demand surpluses the supply volume. There is no major negative impact anticipated by the project implementation. And it is anticipated that the Project will bring positive social impacts such as reduction of number and hours of power outages, and stable power supply. However, accidents may occur at any time while running in the deteriorated roads.

Table 9-11 Environmental Evaluation (Mobile Substation)

Item	Scoping Evaluation		Environmental Evaluation based on the Survey Results			
	Construction period	Operation Period	Construction period		Operation Period	
Air Quality	D	B-	D	Not occur.	B-	Exhaust fumes will be produced while operating the mobile substations.
Noise, Vibration and Low Frequency Sound	B-	B-	B-	Noise and vibration will be produced when carrying in the mobile substation into NPTGC.	B-	It will make noise and vibration while in operation.
Existing Social Infrastructure and Services	D	B+	D	No specific impact is anticipated.	B+	Stable power supply by coping with emergency cases.
Electromagnetic Field	D	B-	D	No specific impact is anticipated.	B-	Negative impact of electromagnetic fields on human health is anticipated.
Accidents	B-	B-	B-	Accidents may occur when equipment is transported.	B-	Accidents may occur when equipment is transported.
Global Warming / Climate Change	D	B+	D	No specific impact is anticipated.	B+	Decrease in number and hours of power outage

(Source: developed by JICA Survey Team)

9.2.4 Mitigation Measures and Required Budget

(1) Mitigation Measures during Construction Period

The following table shows mitigation measures during construction period for the items rated as

B-. Most of the negative impacts will be avoided by developing an appropriate construction schedule, proper budget allocation and supervision, proper installation and operation of equipment. Budgets for such measures are included in the construction cost or supervision.

It is Ulaanbaatar City who will allocate budget for consultation with local residents and if required, land acquisition. Most of the environmental monitoring will take place as part of construction work and supervision so that the required budget will stay small-scale.

Table 9-12 Mitigation Measures during Construction period (Transmission projects)

Item	Project No.*					Mitigation Measures	Implementing Agency	Supervising Agency	Cost
	1	2	3	4	5				
Consultation with the Local Stakeholders	N	Y	N	Y	N	**2: Construction of Park Underground Substation** The park should be blocked for nobody to enter during construction period. Consultation with citizens should be organized for information disclosure on construction schedule, project details etc. to increase their awareness and understanding. **4: Conductor Replacement of Existing 110 kV Transmission Lines (No. 109 & No. 110)** NPTGC should keep sending official notices to the occupants to inform them of the construction schedule and to vacate the land. NPTGC also should keep in close touch with Ulaanbaatar City to promote the implementation of the City Development Master Plan in which people living in the *ger* houses in the site are supposed to get resettled. Consultation with local residents will help increase their awareness and understanding toward the construction work.	contractors NPTGC Ulaanbaatar City	NPTGC Ulaanbaatar City MOE	Included in Ulaanbaatar City's budget as per expenses required for the City's redevelopment
Air Quality	N	Y	Y	Y	N	**<Common in all projects>** NPTGC should comply with the air quality standard as stipulated by the Law on Air of Mongolia. Construction work management including time management, employees' shifting system should be done in an appropriate manner to minimize negative impacts on environment.	contractors	NPTGC	Included in the construction supervision cost
Water Quality	N	Y	Y	N	N	**<Common in all projects>** NPTGC should comply with the water quality standard. Discharged water should be strictly monitored and prevent oil leakage.	contractors	NPTGC	Included in the construction supervision cost
Wastes	N	Y	Y	Y	N	**<Common in all projects>** NPTGC is recommended to contact and coordinate with Ulaanbaatar City for collection, transportation and disposal of wastes and debris as stipulated by the Law on Household and Industrial Waste of Mongolia.	contractors NPTGC Ulaanbaatar City	NPTGC	Included in the construction supervision cost

Item	Project No.*					Mitigation Measures	Implementing Agency	Supervising Agency	Cost
	1	2	3	4	5				
Soil	N	Y	Y	N	N	**<Common in all projects>** Wastewater should be strictly managed and treated to avoid or minimize soil contamination.	contractors	NPTGC	Included in the construction supervision cost
Noise, Vibration and Low Frequency Sound	Y	Y	Y	Y	Y	**<Common in all projects>** NPTGC will comply with the noise standard and reduce such noise and vibration with proper time management and work operation.	contractors	NPTGC	Included in the construction supervision cost
Subsidence	N	Y	N	N	N	**2: Construction of Park Underground Substation** Groundwater situation and geological situation should be thoroughly assessed in the situation analysis survey to examine the suitable construction method.	NPTGC	MOE MEGD Ulaanbaatar City	Included in the construction cost
Hydrometeor	N	Y	N	N	N	**2: Construction of Park Underground Substation** Groundwater situation and geological situation should be thoroughly assessed in the situation analysis survey to examine the suitable construction method.	NPTGC	MOE MEGD Ulaanbaatar City	Included in the construction cost
Topography and Geology	N	Y	N	N	N	**2: Construction of Park Underground Substation** Groundwater situation and geological situation should be thoroughly assessed in the situation analysis survey to examine the suitable construction method.	NPTGC	MOE MEGD Ulaanbaatar City	Included in the construction cost
Involuntary Resettlement	N	N	N	Y	N	**4: Conductor Replacement of Existing 110 kV Transmission Lines (No. 109 & No. 110)** NPTGC has kept sending official notices to the occupants to vacate the land. NPTGC also should keep in close touch with Ulaanbaatar City to conduct consultation with local residents to raise their awareness and understanding toward the construction work.	contractors NPTGC Ulaanbaatar City	NPTGC Ulaanbaatar City MOE	Included in the Ulaanbaatar City's budget
Poor People	N	N	N	Y	N	**4: Conductor Replacement of Existing 110 kV Transmission Lines (No. 109 & No. 110)** Power outage during construction period should be well planned in order not to harm the livelihood means or living condition of the poor.	contractors	NPTGC	Included in the construction supervision cost
Land Use and Utilization of Local Resources	N	Y	N	Y	N	**2: Construction of Park Underground Substation** The park should be blocked during construction period. Notice on construction period and schedule should be kept to raise awareness of people in the City. **4: Conductor Replacement of Existing 110 kV Transmission Lines (No. 109 & No. 110)**	contractors NPTGC Ulaanbaatar City	NPTGC Ulaanbaatar City MOE	Included in the construction supervision cost

Item	Project No.*					Mitigation Measures	Implementing Agency	Supervising Agency	Cost
	1	2	3	4	5				
						NPTGC should keep in close touch with Ulaanbaatar City to inform those people living in the ROW and surrounding areas of construction period and venues.			
Water Usage	N	Y	N	N	N	**2: Construction of Park Underground Substation** Groundwater situation and geological situation should be thoroughly assessed in the situation analysis survey to examine the suitable construction method.	NPTGC	MOE MEGD Ulaanbaatar City	Included in the construction cost
Existing Social Infrastructure and Services	N	Y	Y	Y	N	**<Common in all projects>** Construction work management including time management, employees' shifting system should be done in an appropriate manner to minimize the total length of construction period. Prior notice on the construction schedule and venues should be given to raise awareness of the city people.	contractors	NPTGC	Included in the construction supervision cost
Social Institutions such as Social Infrastructure and Local Decision-Making Institutions	N	Y	N	Y	N	**<Common in all projects>** Obtaining the land use permit, and local budget allocation should be well planned and approved for local consultations, area development. NPTGC should keep in close contact with Ulaanbaatar City to exchange information, estimate budget well in advance to ensure budget is allocated. Consultation with local residents in the site and surrounding areas should be conducted.	contractors NPTGC Ulaanbaatar City	NPTGC Ulaanbaatar City MOE	Included in the construction supervision cost
Landscape	N	Y	N	N	N	**2: Construction of Park Underground Substation** Blocked area for construction work should not be enlarged unnecessarily.	contractors	NPTGC	Included in the construction supervision cost
Infectious Diseases such as HIV/AIDS	N	Y	Y	N	N	**<Common in all projects>** Workers should be educated on hygiene management and given proper knowledge on infectious diseases for outbreak prevention.	contractors	NPTGC	Included in the construction supervision cost
Work Environment (including Work Safety and Public Health)	N	Y	Y	Y	N	**<Common in all projects>** NPTGC complies with the labor legislations and conditions in Mongolia. A tangible safety consideration should be given for laborers, such as wearing helmets, gloves, shoes and working clothes to mitigate risks of accidents. Appropriate working hours such as three-shift a day, two days off a week etc. can keep laborers' health condition well.	contractors	NPTGC	Included in the construction supervision cost
Right of Way	N	N	N	Y	N	**4: Conductor Replacement of Existing 110 kV Transmission Lines**	contractors NPTGC	NPTGC Ulaanbaatar	Included in the

Item	Project No.*					Mitigation Measures	Implementing Agency	Supervising Agency	Cost
	1	2	3	4	5				
(ROW)						**(No. 109 & No. 110)** NPTGC should keep in close touch with Ulaanbaatar City to inform those people living in the ROW and surrounding areas of construction period and venues.	Ulaanbaatar City	City MOE	construction supervision cost
Accidents	Y	Y	Y	Y	Y	**<Common in all projects>** Construction at night and weekend shift can be considered not to disturb the city traffic. Information on construction schedule should be disclosed for local community to be well aware and ready, and mitigate risks of traffic accidents. Installation of 'keep out' boards where construction work is done will help passers-by to avoid possibility of site accidents. A tangible safety consideration should be given for laborers, such as wearing helmets, gloves, shoes and working clothes to mitigate risks of accidents.	contractors	NPTGC	Included in the construction supervision cost

(Note1) Project No. 1: Diagnosis Laboratory, No. 2: Construction of Park Underground Substation, No. 3: Expansion of Baruun and Umard Substations, No. 4: Conductor Replacement of Existing 110 kV Transmission Lines (No. 109 & No. 110), No. 5: Mobile substation
(Note2) "Y" stands for "Yes" (necessary) and "N" stands for "No" (not necessary).

(Source: developed by JICA Survey Team)

(2) Mitigation Measures during Operation Period

The following table shows mitigation measures during operation period for the items rated as B-. Budgets for such measures are included in the construction cost or supervision.

Table 9-13 Mitigation Measures during Operation period (Transmission projects)

Item	Project No.					Mitigation Measures	Implementing Agency	Supervising Agency	Cost
	1	2	3	4	5				
Consultation with the Local Stakeholders	N	Y	N	N	N	**2: Construction of Park Underground Substation** As the park will be kept open to the public, actions such as strict entry and exit management, posting a notice board are recommended.	NPTGC	Ulaanbaatar City MOE	Included in the maintenance cost
Air Quality	Y	N	N	N	Y	**1: Diagnosis Laboratory** Air temperature and humidity should be strictly controlled by using air-conditioner. Ventilation should be regularly conducted for the benefit of human health. **5: Mobile Substation** Time management, schedule management and proper shifting system should be developed.	NPTGC	MOE	Included in the operation cost
Water Quality	N	N	Y	N	N	**3: Expansion of Baruun and Umard Substations** NPTGC will comply with the water quality standard. Discharged water should be strictly monitored.	NPTGC	MOE	Included in the operation cost
Wastes	Y	Y	Y	N	N	**<Common in all projects>**	NPTGC	MOE	Included in

Item	Project No.					Mitigation Measures	Implementing Agency	Supervising Agency	Cost
	1	2	3	4	5				
						NPTGC is recommended to contact and coordinate with Ulaanbaatar City for collection, transportation and disposal of such industrial wastes as stipulated by the Law on Household and Industrial Waste of Mongolia.			the maintenance cost
Soil	N	N	Y	N	N	**3: Expansion of Baruun and Umard Substations** Discharged water should be strictly monitored.	NPTGC	MOE	Included in the operation cost
Noise, Vibration and Low Frequency Sound	Y	N	N	N	Y	**<Common in all projects>** NPTGC will comply with the noise standard and reduce such noise and vibration with proper time management and work operation.	NPTGC	MOE	Included in the operation cost
Hydrometeor	N	Y	N	N	N	**2: Construction of Park Underground Substation** Proper selection of excavation method will leave no impact on environment during operation period.	NPTGC	MOE	Included in the construction cost
Topography and Geology	N	Y	N	N	N	**2: Construction of Park Underground Substation** Proper selection of excavation method will leave no impact on environment during operation period.	NPTGC	MOE	Included in the construction cost
Land Use and Utilization of Local Resources	N	Y	N	N	N	**2: Construction of Park Underground Substation** The surface land use should be properly planned and implemented.	NPTGC	MOE Ulaanbaatar City	Included in the Ulaanbaatar City's budget
Water Usage	N	Y	N	N	N	**2: Construction of Park Underground Substation** Proper selection of excavation method will leave no impact on environment during operation period.	NPTGC	MOE	Included in the construction cost
Work Environment (including Work Safety and Public Health)	N	Y	Y	N	N	**<Common in all projects>** Measures for safety management should be properly implemented.	NPTGC	MOE	Included in the maintenance cost
Electromagnetic Field	N	N	N	N	Y	**5: Mobile Substation** Impacts on local residents should be reduced by strict time management and proper planning of operational schedule.	NPTGC	MOE	Included in the operation cost
Accidents	Y	Y	Y	Y	Y	**<Common in all projects>** NPTGC complies with the labor legislations and conditions in Mongolia. A tangible safety consideration should be given for laborers, such as wearing helmets, gloves, shoes and working clothes to mitigate risks of accidents. Traffic condition and road condition should be well taken into consideration. As per substations, actions such as strict entry and exit management, posting a notice board are recommended. Fire extension should be prevented by introducing automatic fire extinguishing system	NPTGC	MOE	Included in the maintenance cost

Item	Project No.					Mitigation Measures	Implementing Agency	Supervising Agency	Cost
	1	2	3	4	5				
						and installing control protective wall.			

(Note1) Project No. 1: Diagnosis Laboratory, No. 2: Construction of Park Underground Substation, No. 3: Expansion of Baruun and Umard Substations, No. 4: Conductor Replacement of Existing 110 kV Transmission Lines (No. 109 & No. 110), No. 5: Mobile substation
(Note2) “Y” stands for “Yes” (necessary) and “N” stands for “No” (not necessary).

(Source: developed by JICA Survey Team

9.2.5 Environmental Monitoring Plan

Environmental monitoring plan will be the policy for the construction work and environmental management plan during operation period. No specific duty is required for the prevention of labor accidents except those projects obliged to conduct detailed EIAs. However, development of safety and security measures and record keeping of accidents should be clearly mentioned in the contractors' contract as part of their duties.

9.2.6 Others

The environmental checklist of *the JICA Guidelines* are comprised of i) category ii) environmental items, iii) main check items and their evaluation (Yes or No), and iv) confirmation of environmental considerations (reasons, mitigation measures). They are attached to this report as annexes.

9.3 Distribution Projects

9.3.1 Scoping

Like transmission projects, the JICA Survey Team evaluated environmental items, assuming no avoidance or mitigation measures for adverse impacts are taken, to classify A, B, C or D to screen particular items for further survey.

In addition to the direct or immediate impacts, the indirect, secondary, accumulative ones were also examined in the survey. Those caused by inseparable projects were also among them.

There was no item evaluated as A (Significant positive/negative impact is expected) in two distribution projects. The scoping results for each project are given below.

(1) Distribution Network Information Management System (DNIMS)

The Project will help enforce the data accumulation function of UBEDN, and simultaneously figure out the power supply condition. There is no major negative impact anticipated.

Table 9-14 Scoping Results (Distribution Network Information Management System)

category	No	Item	Construction stage		Operation stage	
			Rate	Evaluation	Rate	Evaluation
Permits & Consultation	1	EIA and Environmental Permits	D	Not required.	D	Not required.
	2	Consultation with the Local Stakeholders	D	Not required.	D	Not required.
Pollution Management	3	Air Quality	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	4	Water Quality	D	No specific impact is anticipated.	D	No specific impact is anticipated.

category	No	Item	Construction stage		Operation stage	
			Rate	Evaluation	Rate	Evaluation
	5	Wastes	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	6	Soil	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	7	Noise, Vibration and Low Frequency Sound	B-	Noise and vibration will occur when the equipment is transported.	D	No specific impact is anticipated.
	8	Subsidence	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	9	Offensive Odor	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	10	Bottom Sediment	D	No specific impact is anticipated.	D	No specific impact is anticipated.
Natural Environment	11	Nature Reserves (Protected Area)	D	Not applicable.	D	Not applicable.
	12	Biota and Ecosystem	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	13	Hydrometeor	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	14	Topography and Geology	D	No specific impact is anticipated.	D	No specific impact is anticipated.
Social Environment	15	Involuntary Resettlement	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	16	Poor People	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	17	Ethnic Minorities and Indigenous Peoples	D	Not applicable.	D	Not applicable.
	18	Local Economy such as Employment and Livelihood Means	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	19	Land Use and Utilization of Local Resources	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	20	Water Usage	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	21	Existing Social Infrastructure and Services	D	No specific impact is anticipated.	B+	Stabler power supply by improving management of outdoor distribution equipment and by reducing number and hours of power outages.
	22	Social Institutions such as Social Infrastructure and Local Decision-Making Institutions	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	23	Misdistribution of Benefits and Damages	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	24	Local Conflicts of Interest	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	25	Cultural Heritages	D	Not applicable.	D	Not applicable.
	26	Landscape	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	27	Gender	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	28	Children's Rights	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	29	Infectious Diseases such as HIV/AIDS	D	No specific impact is anticipated.	D	No specific impact is anticipated.

category	No	Item	Construction stage		Operation stage	
			Rate	Evaluation	Rate	Evaluation
	30	Work Environment (including Work Safety and Public Health)	D	No specific impact is anticipated.	D	No specific impact is anticipated.
Others	31	Electromagnetic Field	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	32	Right of Way (ROW)	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	33	Accidents	B-	Accidents may occur when equipment is transported.	B+	Accidents will be prevented by improving management of outdoor distribution equipment. Public disaster will be reduced. Failures and accidents of electric facilities at end-users' side will be prevented.
	34	Global Warming / Climate Change	D	No specific impact is anticipated.	B+	Decrease in number and hours of power outages.

(Note) A+/-: Significant positive/negative impact is expected. B+/-: Positive / negative impact is expected to some extent. C: Extent of impact is unknown (Further examination is needed, and the impact could be clarified later at the time of detailed design stage). D: No impact is expected.

(Source: developed by the JICA Survey Team)

(2) Introduction of Distribution Automation System

The project targets the District No.4 and Gandan District in Ulaanbaatar City, which is officially covering Khoroo 2, 16, 17, 18 and 19 of Bayangol Area. There are four circuits extended from the switching station RL13 to the District No.4, and another circuit from Umard Substation to the Gandan District. The *Ger* houses are congested in the Gandan District except the temple area.

It is anticipated that the Project will bring positive social impacts such as reduction of number and hours of power outages, and stabler power supply to meet the demand. The *ger* housing area of the Gandan District is subject to area development under the City Development Master Plan. Further information collection on the progress of the M/P is necessary.

Table 9-15 Scoping Results (Introduction of Distribution Automation System)

category	No	Item	Construction stage		Operation stage	
			Rate	Evaluation	Rate	Evaluation
Permits & Consultation	1	EIA and Environmental Permits	D	Not required.	D	Not required.
	2	Consultation with the Local Stakeholders	C	Potential impact on the surrounding areas when installing the underground cables.	D	Not required.
Pollution Management	3	Air Quality	B-	Discharge of exhaust fumes will occur from the operation of heavy machinery and trucks, production and diffusion of dust from the treatment of the excavated soils.	D	No specific impact is anticipated.
	4	Water Quality	B-	Water turbidity will be caused by sludge treatment, from the temporary site of earth dig out, and by waste water from the construction work	D	No specific impact is anticipated.

category	No	Item	Construction stage		Operation stage	
			Rate	Evaluation	Rate	Evaluation
	5	Wastes	B-	Excavated soil and sludge by the construction work will be produced.	D	No specific impact is anticipated.
	6	Soil	B-	Soil pollution from sludge by the excavation work and waste water	D	No specific impact is anticipated.
	7	Noise, Vibration and Low Frequency Sound	B-	Noise and vibration will occur by the operation of heavy machinery and trucks, and the transportation of materials and equipment.	D	No specific impact is anticipated.
	8	Subsidence	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	9	Offensive Odor	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	10	Bottom Sediment	D	No specific impact is anticipated.	D	No specific impact is anticipated.
Natural Environment	11	Nature Reserves (Protected Area)	D	Not applicable.	D	Not applicable.
	12	Biota and Ecosystem	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	13	Hydrometeor	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	14	Topography and Geology	D	No specific impact is anticipated.	D	No specific impact is anticipated.
Social Environment	15	Involuntary Resettlement	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	16	Poor People	D	No specific impact is anticipated.	B+	Living standard will be improved through stabler power supply.
	17	Ethnic Minorities and Indigenous Peoples	C	Need to identify if households with traditional housing style (*ger*) are included.	C	Need to identify if households with traditional housing style (*ger*) are included.
	18	Local Economy such as Employment and Livelihood Means	B+	Job opportunities will be created during construction period.	D	No specific impact is anticipated.
	19	Land Use and Utilization of Local Resources	B-	Temporary adverse impact on the land use will occur.	D	No specific impact is anticipated.
	20	Water Usage	B-	Water turbidity caused by waste water from the construction work may deteriorate water quality in the surrounding area.	D	No specific impact is anticipated.
	21	Existing Social Infrastructure and Services	B-	Traffic volume will increase during construction period	B+	Stabler power supply by improving management of outdoor distribution equipment and by reducing number and hours of power outages.
	22	Social Institutions such as Social Infrastructure and Local Decision-Making Institutions	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	23	Misdistribution of Benefits and Damages	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	24	Local Conflicts of Interest	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	25	Cultural Heritages	D	Not applicable.	D	Not applicable.

category	No	Item	Construction stage		Operation stage	
			Rate	Evaluation	Rate	Evaluation
	26	Landscape	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	27	Gender	D	No specific impact is anticipated.	B+	Living standard will be improved through stabler power supply.
	28	Children's Rights	D	No specific impact is anticipated.	B+	Stabler power supply can help children better develop.
	29	Infectious Diseases such as HIV/AIDS	B-	A temporary influx of migrant labor during construction period may increase infectious diseases.	D	No specific impact is anticipated.
	30	Work Environment (including Work Safety and Public Health)	B-	High risk rate of accidents is predicted in the construction work.	D	No specific impact is anticipated.
Others	31	Electromagnetic Field	D	No specific impact is anticipated.	D	No specific impact is anticipated.
	32	Right of Way (ROW)	B-	Impact on the surrounding area is anticipated.	D	No specific impact is anticipated.
	33	Accidents	B-	Accidents of workers, traffic accidents due to traffic volume increase, and involvement of passers-by and local residents near the construction site can occur during construction period.	B+	Accidents will be prevented by improving management of outdoor distribution equipment. Public disaster will be reduced. Failures and accidents of electric facilities at end-users' side will be prevented.
	34	Global Warming / Climate Change	D	No specific impact is anticipated.	B+	Decrease in number and hours of power outages, decrease of coal use and CO2 emission in the catchment area through stabler power supply.

(Note) A+/-: Significant positive/negative impact is expected. B+/-: Positive / negative impact is expected to some extent. C: Extent of impact is unknown (Further examination is needed, and the impact could be clarified later at the time of detailed design stage). D: No impact is expected.

(Source: developed by the JICA Survey Team)

9.3.2 Survey Terms of Reference (TOR)

Based on the above scoping results of each distribution project, the JICA Survey Team developed the terms of reference by short-listing the items to be surveyed. The items for which both projects are not likely relevant (rated as “D”) were excluded from the survey target.

Table 9-16 Survey Terms of Reference of Distribution Projects

Item	Survey Item	Survey Method	Project No. & Survey*	
			1	2
Examination of Alternatives	Examination of construction plan and schedule.	Examination of construction plan and schedule in order to reduce environmental impact and traffic congestions during construction period.	N	Y
Consultation with the Local Stakeholders	· Identify relevant laws and standards · Consultation with relevant authorities	· Collect secondary data and references, and information at relevant authorities · Site visit · Interview with relevant authorities	N	Y
Air Quality	· Identify relevant laws and standards · Identify traffic volumes and socio-economic conditions of surrounding area · Consultation with relevant authorities · The degree of impact during construction period	· Collect secondary data and references, and information at relevant authorities · Site visit and interview with relevant authorities · Construction method, component, period, and schedule · Specifications, operation frequency and period, and storage venues of construction equipment · Number of construction vehicles and transporting routes	N	Y
Water Quality	· Identify relevant laws and standards · Identify current use of underground water among citizens of Ulaanbaatar City	· Collect secondary data and references, and information at relevant authorities · Site visit and interview with relevant authorities	N	Y
Wastes	· Identify relevant laws and standards · Treatment method of construction wastes	· Collect secondary data and references, and information at relevant authorities · Site visit and interview with relevant authorities · Study on similar cases	N	Y
Soil	· Identify relevant laws and standards · Prevention measures of oil leakage during construction period	· Collect secondary data and references, and information at relevant authorities · Site visit · Construction method, component, period, and schedule · Specifications, operation frequency and period, and storage venues of construction equipment · Number of construction vehicles and transporting routes	N	Y
Noise, Vibration and Low Frequency Sound	· Identify relevant laws and standards · Distance from the origin to residential areas and public facilities · The degree of impact during construction period	· Collect secondary data and references, and information at relevant authorities · Site visit and interview with relevant authorities · Construction method, component, period, and schedule · Specifications, operation frequency and period, and storage venues of construction equipment · Number of construction vehicles and transporting routes	Y	Y
Poor People	Socio-economic conditions of people living at and around the project sites	· Collect secondary data and references (demographic data), Site visit	N	Y

Item	Survey Item	Survey Method	Project No. & Survey*	
			1	2
		・ Interview with relevant authorities		
Ethnic Minorities and Indigenous Peoples	Socio-economic conditions of the local society and current land use	・ Collect secondary data and references (demographic data and current land use), and information at relevant authorities ・ Site visit and interview with relevant authorities ・ Collect satellite photos ・ Collect information on the progress of area redevelopment	N	Y
Local Economy such as Employment and Livelihood Means	Socio-economic conditions of people living at and around the project sites	・ Collect secondary data and references (socioeconomic indicators) ・ Site visit and interview with relevant authorities	N	Y
Land Use and Utilization of Local Resources	Land use and local resources utilization in the local society	・ Collect secondary data and references (land use plan, city development plan and current progress), and information at relevant authorities ・ Site visit and interview with relevant authorities ・ Collect satellite photos	N	Y
Water Usage	Current water use in the local society (surface water and underground water)	・ Collect secondary data and references (surface water and underground water use), and information at relevant authorities ・ Site visit and interview with relevant authorities	N	Y
Existing Social Infrastructure and Services	Public facilities (school and medical institutions) and residences	・ Collect secondary data and references, and information at relevant authorities ・ Site visit and interview with relevant authorities	Y	Y
Gender	Socio-economic conditions of people living at and around the project sites	・ Collect secondary data and references (demographic data) ・ Site visit and interview with relevant authorities	N	Y
Children's Rights	Socio-economic conditions of people living at and around the project sites	・ Collect secondary data and references (demographic data) ・ Site visit and interview with relevant authorities	N	Y
Infectious Diseases such as HIV/AIDS	・ HIV/AIDS infection rate at project sites ・ Relevant authorities	・ Collect secondary data and references, information collection at relevant authorities ・ Interview with relevant authorities	N	Y
Work Environment (including Work Safety and Public Health)	・ Identify relevant laws and standards ・ Measures for labor safety and security	・ Collect secondary data and references, and information at relevant authorities ・ Study on similar cases	N	Y
Right of Way	Identify relevant laws and standards, current land use and living environment of the local society	・ Collect secondary data and references (demographic data and current land use), and information at relevant authorities	N	Y

Item	Survey Item	Survey Method	Project No. & Survey*	
			1	2
		・Site visit and interview with relevant authorities ・Collect satellite photos		
Accidents	・Increase in number of traffic accidents during construction period ・Accidents at construction sites	・Collect secondary data and references, and information at relevant authorities, site visit ・Construction method, component, period, and schedule ・Specifications, operation frequency and period, and storage venues of construction equipment ・Number of construction vehicles and transporting routes	Y	Y
Global Warming / Climate Change	・Identify relevant laws and standards ・The degree of impact during construction period	・Collect secondary data and references, and information at relevant authorities ・Construction method, component, period, and schedule ・Specifications, operation frequency and period, and storage venues of construction equipment ・Number of construction vehicles and transporting routes	Y	Y

(Note1) Project No. 1: Distribution Network Information Management System (DNIMS), No. 2: Introduction of Distribution Automation System
(Note2) "Y" stands for "Yes" (necessary) and "N" stands for "No" (not necessary).

(Source: developed by the JICA Survey Team)

9.3.3 Survey Results and Environmental Evaluation

Like the transmission projects, the JICA Survey Team conducted an environmental evaluation on each item of the distribution projects based on the survey results. Survey results and environmental evaluation are shown in the following tables for two distribution projects. Although the "D" items were excluded in the survey, some of them were selected again for re-examination when certain impacts were found possible.

(1) Distribution Network Information Management System (DNIMS)

There is no major negative impact anticipated. The Project will help enforce the data processing and analysis capacity of UBEDN, improve the management of the outside distribution facilities, improve power supply services by reducing power outage numbers and hours, reduce public accidents, prevent failures and accidents of the related facilities at consumers' side.

Table 9-17 Environmental Evaluation(Distribution Network Information Management System)

Item	Scoping Evaluation		Environmental Evaluation based on the Survey Results			
	Construction period	Operation Period	Construction period		Operation Period	
Noise, Vibration and Low Frequency Sound	B-	D	B-	Noise and vibration will occur when the equipment is transported.	D	Not occur.
Existing Social Infrastructure and Services	D	B+	D	No specific impact is anticipated.	B+	Stable power supply by improving management of outdoor distribution equipment and by reducing number and hours of power outage.
Accidents	B-	B+	B-	Accidents may occur when equipment is transported.	B+	Accidents will be prevented by improving management of outdoor distribution equipment. Public disaster will be reduced. Failures and accidents of electric facilities at end-users' side will be prevented.
Global Warming / Climate Change	D	B+	D	No specific impact is anticipated.	B+	Decrease in number and hours of power outages.

(Source: developed by the JICA Survey Team)

(2) Introduction of Distribution Automation System

Development plan of the *ger* housing area will leave the housing sections as they are, and improve such basic infrastructure as service water and electricity. There is no official plan of consumers' resettlement, and the *Ger* houses will be converted into one-/two-storied modern houses.

It is anticipated that power supply will become stabler by improving management of outdoor distribution equipment and by reducing number and hours of power outages, public accidents and fires, and prevent failures and accidents at end-users' side.

New distribution lines will be laid underground along the existing roads and streets, which will not cause acquisition of private lands and involuntary resettlement. However, the existence of underground facilities should be carefully checked prior to the route selection. Information on the construction schedule and venues should be well disseminated to the public in order to increase local residents' awareness and to minimize adverse impacts on local traffic and others.

Table 9-18 Environmental Evaluation (Introduction of Distribution Automation System)

Item	Scoping Evaluation		Environmental Evaluation based on the Survey Results			
	Construction period	Operation Period	Construction period		Operation Period	
Consultation with the Local Stakeholders	B-	D	B-	Although it is not mandatory to conduct consultation by law, it will help increase the awareness and understanding of the local residents toward the construction work.	D	Not occur.

Item	Scoping Evaluation		Environmental Evaluation based on the Survey Results			
	Construction period	Operation Period	Construction period		Operation Period	
Air Quality	B-	D	B-	Discharge of exhaust fumes will occur from the operation of heavy machinery and trucks, production and diffusion of dust from the treatment of the excavated soils.	D	Not occur.
Water Quality	B-	D	B-	Water turbidity will be caused by sludge treatment, from the temporary site of earth dig out, and by waste water from the construction work.	D	Not occur.
Wastes	B-	D	B-	Excavated soil and sludge by the construction work will be produced.	D	Not occur.
Soil	B-	D	B-	Soil pollution from sludge by the excavation work and waste water while installing the underground cables.	D	Not occur.
Noise, Vibration and Low Frequency Sound	B-	D	B-	Noise and vibration will occur by the operation of heavy machinery and trucks, and the transportation of materials and equipment while installing the underground cables.	D	Not occur.
Poor People	D	B+	D	No specific impact is anticipated.	B+	Living standard will be improved through stable power supply.
Ethnic Minorities and Indigenous Peoples	C	C	D	No specific impact is anticipated although the *ger* housing area is included in the site.	B+	Restoration time from power outages will be shortened by automation system.
Local Economy such as Employment and Livelihood Means	B+	D	B+	Job opportunities will be created during construction period.	D	No specific impact is anticipated.
Land Use and Utilization of Local Resources	B-	D	B-	Temporary adverse impact on the land use will occur.	D	No specific impact is anticipated.
Water Usage	B-	D	B-	Water turbidity caused by waste water from the construction work may deteriorate water quality in the surrounding area.	D	No specific impact is anticipated.
Existing Social Infrastructure and Services	B-	B+	B-	Traffic volume will increase and planned power outage may occur.	B+	Stable power supply by improving management of outdoor distribution equipment and by reducing number and hours of power outages.
Gender	D	B+	D	No specific impact is anticipated.	B+	Living standard will be improved through stable power supply.
Children's Rights	D	B+	D	No specific impact is anticipated.	B+	Stable power supply can help children better develop.
Infectious Diseases such as HIV/AIDS	B-	D	B-	A temporary influx of migrant labor during construction period may increase infectious diseases.	D	Not occur.
Work Environment (including Work Safety and Public Health)	B-	D	B-	High risk rate of laborers' accidents is predicted in the construction work.	D	No specific impact is anticipated.

Item	Scoping Evaluation		Environmental Evaluation based on the Survey Results			
	Construction period	Operation Period	Construction period		Operation Period	
Electromagnetic Field	D	B-	D	No specific impact is anticipated.	D	No specific impact is anticipated.
Right of Way (ROW)	B-	D	B-	Temporary impact given to the surrounding area while replacing and installing the underground cables.	D	No specific impact is anticipated.
Accidents	B-	B+	B-	Accidents of workers, traffic accidents due to traffic volume increase, and involvement of passers-by and local residents near the construction site can occur during construction period. Electric shocks and other accidents may occur while switching the existing and new distribution facilities.	B+	Accidents will be prevented by improving management of outdoor distribution equipment. Public disaster will be reduced. Failures and accidents of electric facilities at end-users' side will be prevented.
Global Warming / Climate Change	D	B+	D	No specific impact is anticipated.	B+	Decrease in number and hours of power outage supply.

(Source: developed by the JICA Survey Team)

9.3.4 Mitigation Measures and Required Budget

(1) Mitigation Measures during Construction Period

The following table shows mitigation measures during the construction period for the "B-" items. Developing an appropriate construction schedule, proper budget allocation and supervision, and proper installation and operation of equipment will leave no major negative impacts on the environment. Budgets for such measures are included in the construction cost or supervision.

It is Ulaanbaatar City who will allocate budget for consultation with local residents and land related issues. It is anticipated there will be minimum budget required as most of the environmental monitoring will take place as part of construction work and supervision.

Table 9-19 Mitigation Measures during Construction Period (Distribution projects)

Item	Project No.*		Mitigation Measures	Implementing Agency	Supervising Agency	Cost
	1	2				
Consultation with the Local Stakeholders	N	Y	**2: Distribution Automation System** Construction work management including construction schedule and supervision should be done in an appropriate manner to minimize impacts on environment. Prior notice and through dissemination on construction schedule and venues should be given to the local residents.	contractors UBEDN Ulaanbaatar City	UBEDN Ulaanbaatar City MOE	Included in the construction supervision cost
Air Quality	N	Y	**2: Distribution Automation System** UBEDN will comply with the	contractors	UBEDN	Included in the construction supervision cost

Item	Project No.*		Mitigation Measures	Implementing Agency	Supervising Agency	Cost
	1	2				
			air quality standard as stipulated by the Law on Air of Mongolia. Construction work management including time management, employees' shifting system should be done in an appropriate manner.			
Water Quality	N	Y	**2: Distribution Automation System** UBEDN will comply with the water quality standard. Discharged water should be strictly monitored and prevent oil leakage.	contractors	UBEDN	Included in the construction supervision cost
Wastes	N	Y	**2: Distribution Automation System** UBEDN is recommended to contact and coordinate with Ulaanbaatar City for collection, transportation and disposal of such industrial wastes as stipulated by the Law on Household and Industrial Waste of Mongolia.	contractors UBEDN Ulaanbaatar City	UBEDN	Included in the construction supervision cost
Soil	N	Y	**2: Distribution Automation System** Discharged water should be strictly monitored to minimize soil contamination.	contractors	UBEDN	Included in the construction supervision cost
Noise, Vibration and Low Frequency Sound	Y	Y	**<Common in all projects>** UBEDN will comply with the noise standard and reduce such noise and vibration with proper time management and work operation.	contractors	UBEDN	Included in the construction supervision cost
Land Use and Utilization of Local Resources	N	Y	**2: Distribution Automation System** Prior notice and through dissemination on construction schedule and venues should be given to the people living in the surrounding area.	contractors UBEDN Ulaanbaatar City	UBEDN Ulaanbaatar City MOE	Included in the construction supervision cost
Water Usage	N	Y	**2: Distribution Automation System** Discharged water should be strictly monitored.	contractors	UBEDN	Included in the construction cost
Existing Social Infrastructure and Services	N	Y	**1: Distribution Network Information Management System** Flexible schedule for installation will not disturb the city traffic, and traffic conditions and road conditions should be taken into consideration while carrying them into UBEDN. **2: Distribution Automation System** The construction work can be shifted during weekends while city traffic is less. Consultation with local residents within the	contractors	UBEDN	Included in the construction supervision cost

Item	Project No.*		Mitigation Measures	Implementing Agency	Supervising Agency	Cost
	1	2				
			catchment area and along the underground cable route can be organized for information disclosure on construction schedule, project details etc. to increase their understanding and preparedness for possible traffic disturbance.			
Infectious Diseases such as HIV/AIDS	N	Y	**2: Distribution Automation System** Workers should be educated on hygiene management and given proper knowledge on infectious diseases for outbreak prevention.	contractors	UBEDN	Included in the construction supervision cost
Work Environment (including Work Safety and Public Health)	N	Y	**2: Distribution Automation System** UBEDN complies with the labor legislations and conditions in Mongolia. A tangible safety consideration should be given for laborers, such as wearing helmets, gloves, shoes and working clothes to mitigate risks of accidents. Appropriate working hours such as three-shift a day, two days off a week etc. can keep laborers' health condition well.	contractors	UBEDN	Included in the construction supervision cost
Right of Way (ROW)	N	Y	**2: Distribution Automation System** UBEDN should keep in close touch with Ulaanbaatar City to inform those people living in the surrounding areas of construction period and venues.	contractors UBEDN Ulaanbaatar City	UBEDN Ulaanbaatar City MOE	Included in the construction supervision cost
Accidents	Y	Y	**2: Distribution Automation System** Construction at night and weekend shift can be considered not to disturb the city traffic. Information on construction schedule should be disclosed for local community to be well aware and ready, and mitigate risks of traffic accidents. Installation of 'keep out' boards where construction work is done will help passers-by to avoid possibility of site accidents. A tangible safety consideration should be given for laborers, such as wearing helmets, gloves, shoes and working clothes to mitigate risks of accidents. Appropriate working hours such as three-shift a day, two days off a week etc. can keep laborers' health condition well.	contractors	UBEDN	Included in the construction supervision cost

(Note1) Project No. 1: Distribution Network Information Management System (DNIMS), No. 2: Introduction of Distribution Automation System

(Note2) "Y" stands for "Yes" (necessary) and "N" stands for "No" (not necessary).

(Source: developed by the JICA Survey Team)

(2) Mitigation Measures during Operation Period

Mitigation measures will not be required as there is no B- in the environmental evaluation of the two projects.

9.3.5 Environmental Monitoring Plan

Environmental monitoring plan will be the policy for the construction work and environmental management plan during operation period. No specific duty is required for the prevention of labor accidents except those projects obliged to conduct detailed EIAs in Mongolia. However, development of safety and security measures and record keeping of accidents should be clearly mentioned in the contractors' contract as part of their duties.

9.3.6 Others

The environmental checklists of *the JICA Guidelines* are comprised of i) category ii) environmental items, iii) main check items and their evaluation (Yes or No), and iv) confirmation of environmental considerations (reasons, mitigation measures). They are attached to this report as annexes.

Chapter 10 Proposal of Packaging Japanese ODA Loan Projects

10.1 Proposal of Packaging Japanese ODA Loan Projects

Through the discussions with MOE, NPTGC and UBEDN, the following 6 projects (except for Mobile Substation) were proposed as a Japanese ODA Loan Project. Mobile Substation was deleted from the packaging list, because the cost was estimated to be very high due to only 1 unit purchase and the other agency has already decided to purchase some units.

The procurement lots for each project are proposed as follows.

Table 10-1 Expected Procurement Lots

Executing Agencies	Project Name	Procurement	Lot
MOE-NPTGC	Diagnosis Laboratory	Shopping	Lot 1
	Construction of Park Underground Substation	Construction	Lot 2
	Expansion of Baruun and Umard Substations and Conductor Replacement of Existing 110 kV Transmission Lines (No. 109 & No. 110)	Construction	Lot 3
MOE-UBEDN	DNIMS	Shopping	Lot 4
	Introduction of Distribution Automation System	Construction	Lot 5
MOE-NPTGC-UBEDN	Consulting Services for Construction Projects	Consultant	Lot 6

The above proposal considered the following points.

- Assuming shopping projects can start from 2015, the lots of shopping are separated from lots of construction projects which require more time for detailed design.
- Park Underground Substation is supposed to require more time in the detailed design than Baruun and Umard Substations. Considering the emergency situation of these substations, the lots are individually set up (lot 2 and lot 3).
- Lot 3 and lot 5 have a common construction area in connection of substation and distribution facilities (such as removal of existing distribution cables, newly connection of distribution cables, and construction schedule arrangement). It can be expected that these lots are merged into one lot. However, if they are merged into one, different agencies (NPTGC and UBEDN) will jointly procure and supervise one project. The implementation formation should be elaborated to realize such situation.

10.2 Project Implementation

10.2.1 Implementation Formation

(1) Loan Scheme

The loan scheme for the projects is assumed as follows, based on the similar past project.

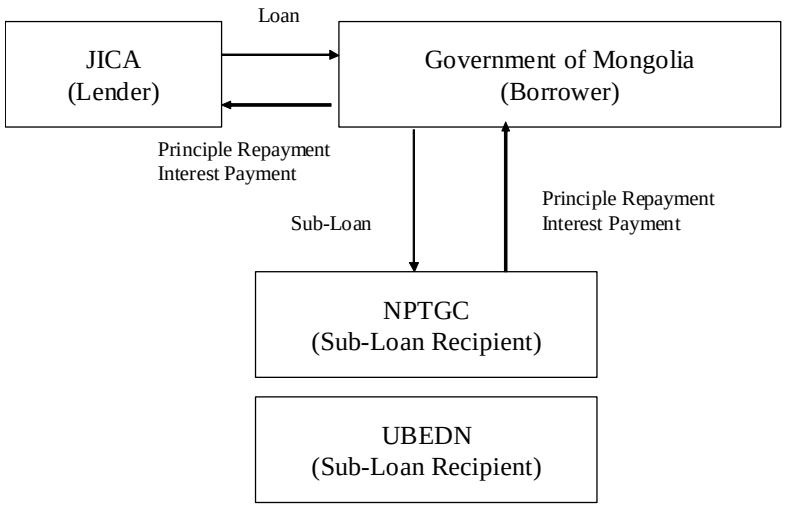


Figure 10-1 Loan Scheme

(2) Implementation Formation

In the past samples in the power sector of Mongolia, a project which is implemented by the government budget is mainly implemented by MOE as a main agency in cooperation with NPTGC or UBEDN from technical aspects for evaluation and supervision.

This Japanese ODA loan project is also supposed to adopt a similar manner in the project implementation.

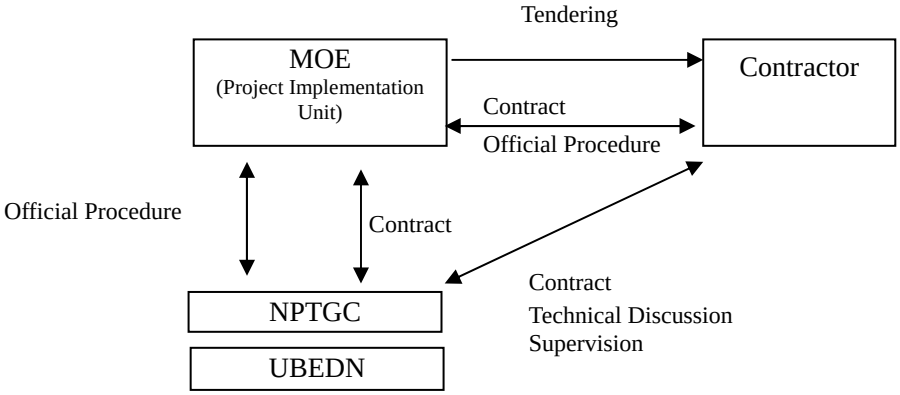


Figure 10-2 Implementation Formation (in case of Government Budget Project)

Within the above implementation formation, project teams are recommended to be formulated for operation and supervision of each project

Table 10-2 Project Team Formation

Executing Agencies	Project Name	Project Team
MOE-NPTGC	Diagnosis Laboratory	Facility Maintenance Engineers from MOE and NPTGC
	Construction of Park Underground Substation	Substation Construction Engineers from MOE and NPTGC
	Expansion of Baruun and Umard Substations and Conductor Replacement of Existing 110 kV Transmission Lines (No. 109 & No. 110)	Substation and Transmission Line Construction Engineers from MOE and NPTGC
MOE-UBEDN	DNIMS	General Affairs and IT Engineers from MOE and UBEDN
	Introduction of Distribution Automation System	Distribution Facility Construction Engineers from MOE and UBEDN
MOE-NPTGC-UBEDN	Consulting Services for Construction Projects	Chief Engineers from MOE, NPTGC and UBEDN

Roles of Executing Agencies in Construction Projects

Construction projects have more complicated procedures. In this context, project teams for construction projects including the consulting services are highly recommended for operation and supervision. The following roles are expected to be implemented by the project teams for construction projects.

（Before and Under Construction Stage）

- ✧ Formation of project teams for construction projects including the consulting services
- ✧ Coordination with related agencies and the local government
- ✧ Procedure for EIA and required permission (land use permission, construction permission, etc.) and compensation if necessary
- ✧ Selection of a consultant and supervision of the consultant
- ✧ Selection of contractors and supervision of the contractors
- ✧ Coordination with a donor in bidding, contracting, procuring and progress reporting, etc.
- ✧ Proper procedure for import of materials and equipment
- ✧ Issue of payment certificates to the consultant and contractors
- ✧ Claim treatment from the contractors and local residents
- ✧ Implementation of test run and final inspection

（Operation Stage）

- ✧ Education and training for operators and maintenance staff
- ✧ Proper operation and maintenance

10.3 Overall Schedule

Assuming the loan contract is concluded in September 2014, the following schedule is expected.

○ Shopping Projects (Diagnosis Laboratory, DNIMS)

Table 10-3 Implementation Schedule of Shopping Projects

Implementation Schedule

	Month	2013	2014	2015	2016	2017
Preparatory Survey	10					
F/F(February) & Appraisal(April)	2					
LOAN AGREEMENT PROCEDURE						
Pledge	1					
Exchange of Notes & Signing of Loan Agreement	1					
Effectuation of Loan Agreement	1					
INTERNATIONAL SHOPPING	6					
Prepreration of Bid Document	3					
JICA Concurrence	1					
Bidding for Shopping	3					
PROCUREMENT AND INSTALLATION PERIOD						
Diagnosis Laboratory	15					
Procurement and Installation	12					
Taking Over with Training	3					
DNIMS	33					
Design and Programming	18					
Installation	3					
Test Run	6					
Data Input	6					
Taking Over with Training	3					

○ Construction Projects 1 (Expansion of Baruun and Umard Substations and Conductor Replacement of Existing 110 kV Transmission Lines (No. 109 & No. 110), Introduction of Distribution Automation System)

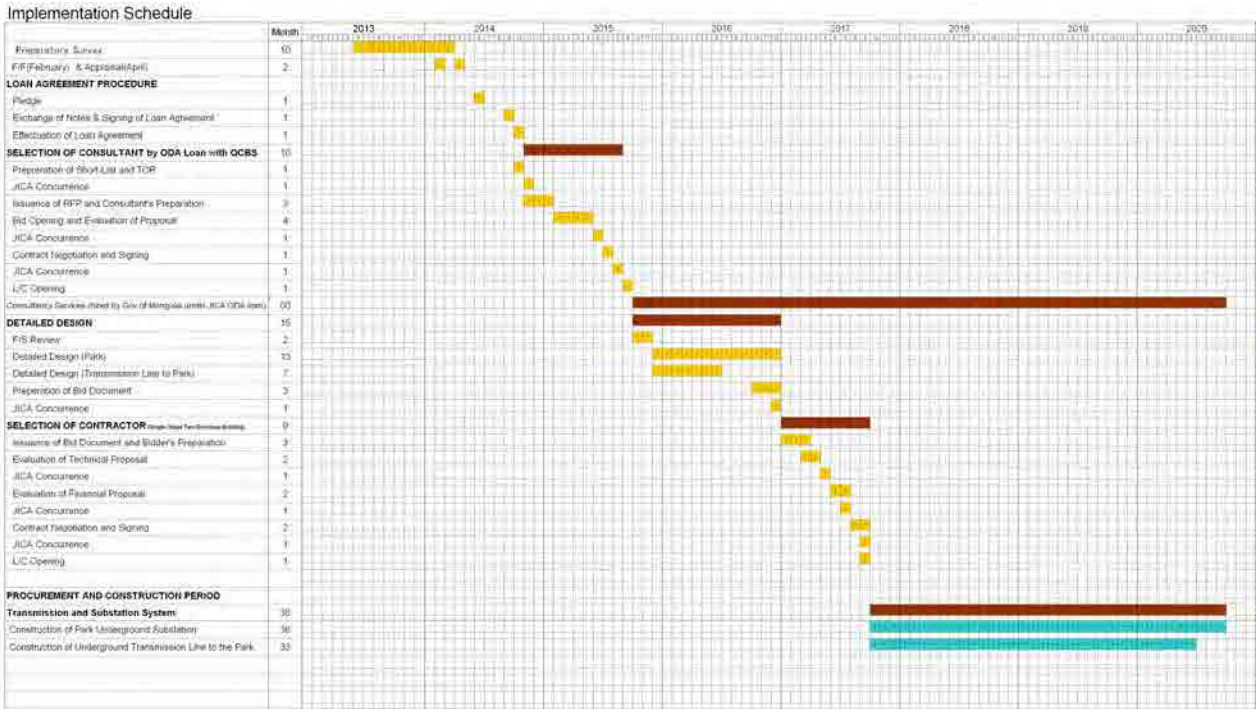
Table 10-4 Implementation Schedule of Construction Projects 1

Implementation Schedule

	Month	2013	2014	2015	2016	2017	2018	2019	2020
Preparatory Survey	10								
F/F(February) & Appraisal(April)	2								
LOAN AGREEMENT PROCEDURE									
Pledge	1								
Exchange of Notes & Signing of Loan Agreement	1								
Effectuation of Loan Agreement	1								
SELECTION OF CONSULTANT by ODA Loan with QCBS	10								
Preparation of Short-List and TOR	1								
JICA Concurrence	1								
Issuance of RFP and Consultant's Preparation	3								
Bid Opening and Evaluation of Proposal	4								
JICA Concurrence	1								
Contract Negotiation and Signing	1								
JICA Concurrence	1								
L/C Opening	1								
Consultancy Services (hired by GoM of Mongolia under JICA ODA loan)	54								
DETAILED DESIGN	9								
F/S Review	2								
Detailed Design (Baruun & Umard)	7								
Detailed Design (DAS)	7								
Preparation of Bid Document	3								
JICA Concurrence	1								
SELECTION OF CONTRACTOR (Single-stage Two-Envelope Bidding)	9								
Issuance of Bid Document and Bidder's Preparation	3								
Evaluation of Technical Proposal	2								
JICA Concurrence	1								
Evaluation of Financial Proposal	2								
JICA Concurrence	1								
Contract Negotiation and Signing	2								
JICA Concurrence	1								
L/C Opening	1								
PROCUREMENT AND CONSTRUCTION PERIOD									
Transmission and Substation System	24								
Baruun & Umard Substation Expansion	24								
Replacement of Conductors of No. 109 & No. 110 T/L	18								
Distribution System	36								
Distribution Automation System	36								

○ Construction Projects 2 (Construction of Park Underground Substation)

Table 10-5 Implementation Schedule of Construction Projects 2



10.4 Bidding Method and Evaluation Method

Procurement of Construction

Procurement of construction is expected to be made by an international competitive bidding in accordance with “Guidelines for Procurement under Japanese ODA Loans”

The guideline recommends a 1 step and 2 envelope bidding method where:

- At first, several bidders are selected by Pre-qualification (PQ).
- Selected bidders submit two proposals (technical proposal and financial proposal) at the same time.
- Bidders who satisfy the required specifications are selected.
- Financial proposals of only the satisfied bidders are opened and evaluated by the prices.

Shopping Procurement

An international shopping method is adopted. Price estimates are requested to be submitted from more than 3 contractors and the lowest price estimate is awarded. Contractors who are requested can be appointed by the owner from local companies as well as foreign companies.

Consulting Service

The consulting services are also selected by an international competitive bidding in accordance with "Guidelines for the Employment of Consultants under Japanese ODA Loans".

In general, the selection considers both quality and cost. In many cases, both technical proposal and financial proposal are totally evaluated by an international competitive bidding.

10.5 Eligible Portion of Japanese ODA Loan

The higher amount of 85 % of the total project costs, or all foreign portions, is adopted for the eligible portion of Japanese ODA Loan for Mongolia. In this project packaging, 85 % of the total project costs is estimated to be the higher amount. Therefore 85 % of the total project costs are adopted for the eligible portion.

As the non-eligible portion (exempted portion from the total project costs), the following items are proposed tentatively. Such exempted portion is selected from the viewpoints of high rate of local currency portion).

Table 10-6 Exempted Portion from Japanese ODA Loan (Tentative)

Exempted Item	Target Project	Amount (million JY)
VAT	All Projects	468
Import Tax	All Projects	473
Administration Cost	All Projects	212
Underground Transmission Line (Construction Cost and Transportation Cost)	Park	256
Indoor Substation Building	Baruun and Umard	423
Cable Replacement (Construction Costs of Cable Installation, Cable Pipe and Manhole & Handhole)	DAS	230
	Total	2,363（15.4 %）
	Total Project Costs	15,287

10.6 Total Project Costs and Annual Fund Requirement

Transmission Project

(1) Total Project Costs

Total project costs for the transmission projects which NPTGC requested are estimated below.

- Diagnosis Laboratory
- Construction of Park Underground Substation
- Expansion of Baruun and Umard Substations and Conductor Replacement of Existing 110 kV Transmission Lines (No. 109 & No. 110)

Table 10-7 Total Project Costs for the Transmission Projects

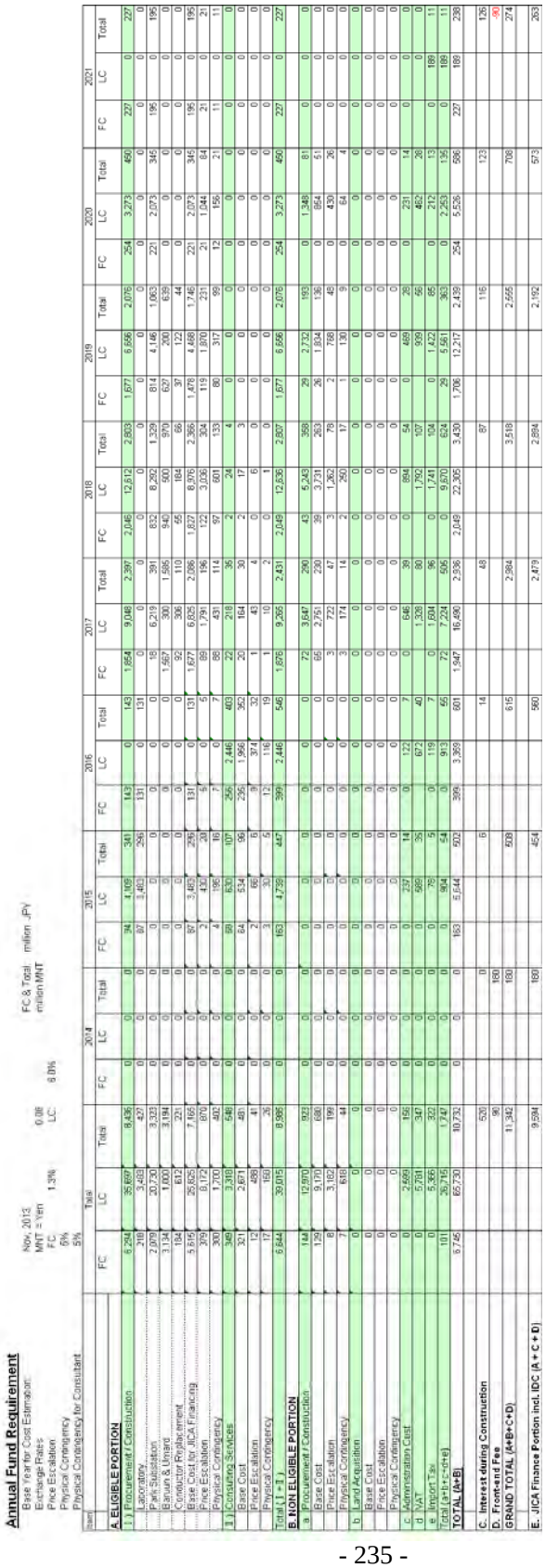
Item	Cost		Total
	Foreign	Local	
	JPY	MNT	JPY
(Base Cost)			
Laboratory	218,219,100	3,482,792,500	427,186,650
Park Substation	2,078,882,000	25,000,314,535	3,578,900,872
Baruun & Umard	3,263,360,000	5,900,002,000	3,617,360,120
Conductor Replacement	184,121,520	612,476,865	220,870,132
Sub-Total	**5,744,582,620**	**34,995,585,900**	**7,844,317,774**
Consulting Costs	320,544,584	2,671,204,868	480,816,876
Escalation	399,653,626	11,842,157,868	1,110,183,099
Physical Contingency	323,239,042	2,475,447,432	471,765,887
VAT	0	5,780,621,052	346,837,263
Import Tax	0	5,365,592,504	321,935,550
Administration Costs	0	2,599,219,803	155,953,188
Sub-Total	**1,043,437,252**	**30,734,243,527**	**2,887,491,864**
TOTAL	**6,788,019,872**	**65,729,829,427**	**10,731,809,638**

(Note) The following conditions are used for the above estimation.
Exchange Rate: 1 MNT = 0.06 JPY, 1 USD = 1,474.1 MNT
Escalation: Foreign currency: 1.3 %/year, Local currency: 6.0 %/year
Physical Contingency: 5 % of the Base Cost and Escalation
VAT: 10 % of all the local currency portion
Import Tax: 5 % of all the foreign currency portion
Administration Costs: 5 % of the base cost and consulting cost

(2) Annual Fund Requirement

Annual fund requirement of the transmission projects is shown below.

Table 10-8 Annual Fund Requirement of Transmission Projects



Annual Fund Requirement

Base Year for Cost Estimation: Nov. 2013
Exchange Rate: MMT 1 = Yen
FC 1.3%
LC 0.08
Price Escalation FC 6.0%
Physical Contingency 5%
Physical Contingency for Consultant 5%

FC & Total million JPY
million MMT

Item	FC	LC	Total	FC	2014 LC	Total	FC	2015 LC	Total	FC	2016 LC	Total	FC	2017 LC	Total	FC	2018 LC	Total	FC	2019 LC	Total	FC	2020 LC	Total	FC	2021 LC	Total
A. ELIGIBLE PORTION	8,294	35,697	8,436	0	0	0	394	4,909	341	143	0	143	1,854	9,046	2,397	2,046	12,612	2,803	1,677	6,666	2,076	254	3,273	450	227	0	227
1 i) Procurement / Construction	218	3,483	427	0	0	0	87	3,483	296	131	0	131	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Laboratory	2,979	20,730	3,323	0	0	0	0	0	0	18	0	18	6,219	391	833	8,292	1,329	814	4,146	1,063	221	2,073	345	195	0	195
Park Substation	3,134	1,000	3,194	0	0	0	0	0	0	1,567	300	1,586	940	500	970	627	200	639	0	0	0	0	0	0	0	0
Banyan & Umard	194	612	221	0	0	0	0	0	0	92	306	110	55	184	66	37	122	44	0	0	0	0	0	0	0	0	0
Conductor Replacement	5,816	25,825	7,165	0	0	0	87	3,483	296	131	0	131	1,677	6,825	2,096	1,672	8,976	2,366	1,476	4,466	1,746	221	2,073	345	195	0	195
Base Cost for JICA Financing	379	8,172	870	0	0	0	2	430	20	5	0	5	89	1,791	196	122	3,036	304	119	1,870	231	21	1,044	84	21	0	21
Price Escalation	300	1,700	402	0	0	0	4	195	16	7	0	7	88	431	114	97	601	133	80	317	99	12	156	21	11	0	11
Physical Contingency	349	3,318	548	0	0	0	89	630	107	256	2,446	403	22	218	35	2	24	4	0	0	0	0	0	0	0	0	0
1 j) Consulting Services	321	2,671	481	0	0	0	64	534	96	236	1,966	362	20	164	30	2	17	3	0	0	0	0	0	0	0	0	0
Base Cost	12	488	41	0	0	0	2	66	6	9	374	32	1	43	4	0	6	0	0	0	0	0	0	0	0	0	0
Price Escalation	17	160	26	0	0	0	3	33	5	12	116	19	1	10	2	0	1	0	0	0	0	0	0	0	0	0	0
Physical Contingency	6,844	39,015	8,986	0	0	0	163	4,739	447	399	2,446	546	1,876	9,265	2,431	2,049	12,636	2,807	1,677	6,666	2,076	254	3,273	450	227	0	227
Total (1 + 1 j)	144	12,970	923	0	0	0	0	0	0	72	3,647	290	43	5,243	356	29	2,732	193	0	1,348	81	0	0	0	0	0	0
B. NON ELIGIBLE PORTION	129	9,170	680	0	0	0	0	0	0	66	2,751	230	39	3,731	263	26	1,894	136	0	964	51	0	0	0	0	0	0
a iProcurement / Construction	8	3,162	199	0	0	0	0	0	0	3	722	47	3	1,362	75	2	766	45	0	439	26	0	0	0	0	0	0
Base Cost	7	616	44	0	0	0	0	0	0	3	174	14	2	250	17	1	130	9	0	64	4	0	0	0	0	0	0
Price Escalation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physical Contingency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
b. Land Acquisition	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Base Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Price Escalation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physical Contingency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
c. Administration Cost	0	2,669	156	0	0	0	0	237	14	0	122	7	0	646	39	0	884	54	0	469	28	0	231	14	0	0	0
d VAT	0	5,781	347	0	0	0	0	586	35	0	672	40	0	1,326	80	0	1,752	107	0	909	56	0	462	28	0	0	0
e Import Tax	0	5,366	322	0	0	0	0	79	5	0	119	7	0	1,004	96	0	1,741	104	0	1,422	85	0	212	13	0	189	11
Total (a+b+c+d+e)	101	26,716	1,747	0	0	0	0	904	54	0	913	55	72	7,224	506	0	9,670	624	29	5,561	363	0	2,453	155	0	189	11
TOTAL (A+B)	8,745	65,730	10,732	0	0	0	163	5,644	502	396	3,369	601	1,947	16,486	2,936	2,049	22,305	3,430	1,706	12,217	2,439	254	5,526	606	227	189	236
C. Interest during Construction			526			0			6			14			48			87			116			123			126
D. Front-end Fee			96			160																					-90
GRAND TOTAL (A+B+C+D)			11,342			160			509			615			2,984			3,516			2,555			706			274
E. JICA Finance Portion incl. IDC (A + C + D)			9,594			160			454			560			2,479			2,894			2,192			573			263

(3) Cash Flow Simulation

A cash flow simulation for the transmission projects is made below, assuming the following conditions are provided. Four scenarios are prepared for the payment allocation between NPTGC and the Government.

(Loan Eligible Portion)

Interest Rate: 1.4 %

Payment Period: 25 years

Grace Period: 7 years

Borrower: Government of Mongolia

Payer for the Loan: NPTGC (Assuming the spread to sub-finance (from the Government to NPTGC) is zero)

Simulation Scenarios

① Burden 100 % of principle repayment and interest payment by NPTGC

② Burden 75 % of principle repayment and interest payment by NPTGC and 25 % by the Government

③ Burden 50 % of principle repayment and interest payment by NPTGC and 50 % by the Government

④ Burden 10 % of principle repayment and interest payment by NPTGC and 90 % by the Government

(Loan Non-Eligible Portion)

Self-Finance (no loan)

Table 10-9 Results of Cash Simulation of the Transmission Projects

(Unit: million JY)

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
	1	2	3	4	5	6	7	8	9	10	11	12
Disbursement	447.48	545.84	2,431.49	2,806.71	2,075.89	450.42	226.74	0.00	0.00	0.00	0.00	0.00
Outstanding Loan (End of the Year)	447.48	993.31	3,424.81	6,231.52	8,307.41	8,757.83	8,984.57	8,485.42	7,986.28	7,487.14	6,988.00	6,488.85
Principle Payment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	499.14	499.14	499.14	499.14	499.14
Interest Payment	6.26	13.91	47.95	87.24	116.30	122.61	125.78	118.80	111.81	104.82	97.83	90.84
Front End Fee	179.69	0.00	0.00	0.00	0.00	0.00	-89.85	0.00	0.00	0.00	0.00	0.00
Total Repayment & Payment	**185.96**	**13.91**	**47.95**	**87.24**	**116.30**	**122.61**	**35.94**	**617.94**	**610.95**	**603.96**	**596.97**	**589.99**
Project Income (Project Income - O&M Costs)	**0.00**	**-0.06**	**-0.21**	**57.75**	**57.75**	**375.91**	**452.67**	**375.91**	**452.67**	**452.67**	**337.52**	**452.67**
Balance (100 % Payment by NPTGC)	-185.96	-13.97	-48.16	-29.49	-58.55	253.30	416.73	-242.03	-158.28	-151.29	-259.45	-137.32
Balance (75 % Payment by NPTGC)	-139.47	-10.49	-36.17	-7.68	-29.48	283.95	425.72	-87.55	-5.54	-0.30	-110.21	10.18
Balance (50 % Payment by NPTGC)	-92.98	-7.02	-24.19	14.13	-0.40	314.60	434.70	66.94	147.20	150.69	39.04	157.68
Balance (10 % Payment by NPTGC)	-18.60	-1.45	-5.01	49.03	46.12	363.65	449.08	314.11	391.58	392.27	277.83	393.67

Year	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
	13	14	15	16	17	18	19	20	21	22	23	24	25
Disbursement	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Outstanding Loan (End of the Year)	5,989.71	5,490.57	4,991.43	4,492.28	3,993.14	3,494.00	2,994.86	2,495.71	1,996.57	1,497.43	998.29	499.14	0.00
Principle Payment	499.14	499.14	499.14	499.14	499.14	499.14	499.14	499.14	499.14	499.14	499.14	499.14	499.14
Interest Payment	83.86	76.87	69.88	62.89	55.90	48.92	41.93	34.94	27.95	20.96	13.98	6.99	0.00
Front End Fee	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Repayment & Payment	**583.00**	**576.01**	**569.02**	**562.03**	**555.05**	**548.06**	**541.07**	**534.08**	**527.09**	**520.11**	**513.12**	**506.13**	**499.14**
Project Income (Project Income - O&M Costs)	**452.67**	**375.91**	**452.67**	**452.67**	**260.76**	**452.67**	**452.67**	**375.91**	**452.67**	**452.67**	**337.52**	**452.67**	**394.92**
Balance (100 % Payment by NPTGC)	-130.33	-200.10	-116.35	-109.36	-294.29	-95.39	-88.40	-158.18	-74.42	-67.44	-175.59	-53.46	-104.22
Balance (75 % Payment by NPTGC)	15.42	-56.10	25.90	31.15	-155.53	41.63	46.87	-24.66	57.35	62.59	-47.31	73.07	20.56
Balance (50 % Payment by NPTGC)	161.17	87.90	168.16	171.65	-16.76	178.64	182.14	108.87	189.12	192.62	80.96	199.61	145.35
Balance (10 % Payment by NPTGC)	394.37	318.31	395.77	396.47	205.25	397.87	398.56	322.50	399.96	400.66	286.21	402.06	345.01

From the above results, if the Government burdens the interest during construction, NPTGC can burden 75 % of the repayment of principle and payment of interest from the income of the projects.

Distribution Project

(1) Total Project Costs

Total project costs for the transmission projects which UBEDN requested are estimated below.

- DNIMS
- Introduction of Distribution Automation System

Table 10-10 Total Project Costs for the Distribution Projects

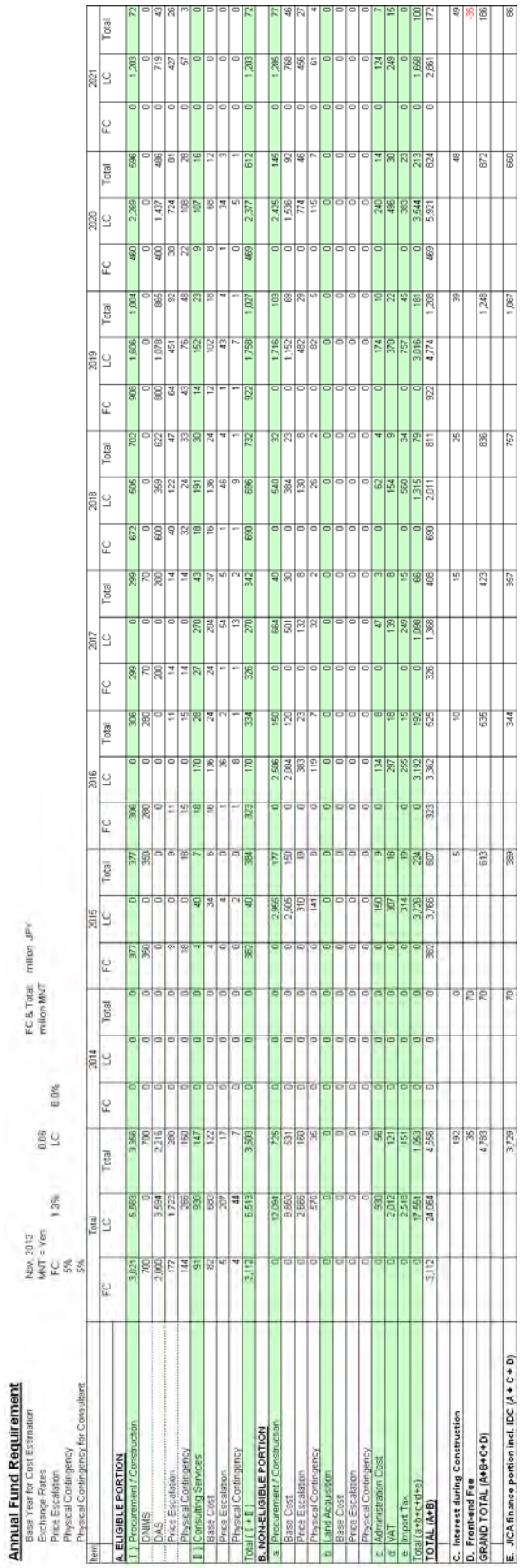
Item	Cost		Total
	Foreign	Local	
	JPY	MNT	JPY
(Base Cost)			
DNIMS	700,000,000	5,010,000,000	1,000,600,000
DAS	2,000,290,000	7,433,468,000	2,446,298,080
Sub-Total	**2,700,290,000**	**12,443,468,000**	**3,446,898,080**
Consulting Costs	81,543,269	679,527,244	122,314,904
Escalation	181,794,931	4,595,523,033	457,526,313
Physical Contingency	148,181,410	885,925,914	201,336,965
VAT	0	2,011,708,490	120,702,509
Import Tax	0	2,517,542,640	151,052,558
Administration Costs	0	930,222,210	55,813,333
Sub-Total	**411,519,610**	**11,620,449,530**	**1,108,746,582**
TOTAL	**3,111,809,610**	**24,063,917,530**	**4,555,644,662**

(Note) The following conditions are used for the above estimation.
Exchange Rate: 1 MNT = 0.06 JPY, 1 USD = 1,474.1 MNT
Escalation: Foreign currency: 1.3 %/year, Local currency: 6.0 %/year
Physical Contingency: 5 % of the Base Cost and Escalation
VAT: 10 % of all the local currency portion
Import Tax: 5 % of all the foreign currency portion
Administration Costs: 5 % of the base cost and consulting cost

(2) Annual Fund Requirement

Annual fund requirement of the distribution projects is shown below.

Table 10-11 Annual Fund Requirement of Distribution Projects



Annual Fund Requirement

Base Year for Cost Estimation: Nov. 2013
Exchange Rates: MNT = Yen
Price Escalation: FC: 1.3%
Physical Contingency: 5%
Physical Contingency for Consultant: 5%
LC: 0.0%
FC & Total: million MNT
million JPY

Item	Total			2014			2015			2016			2017			2018			2019			2020			2021		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
A. ELIGIBLE PORTION																											
I) Procurement / Construction	3,021	6,883	3,366	0	0	0	377	0	377	306	0	306	299	672	506	702	906	1,606	1,004	460	2,269	596	0	1,203	72		
CNMS	700	0	700	0	0	0	350	0	350	280	0	280	70	0	0	0	0	0	0	0	0	0	0	0	0		
DAS	2,000	3,594	2,216	0	0	0	0	0	0	0	0	0	200	600	359	622	800	1,078	865	460	1,437	486	0	719	43		
Price Escalation	172	1,723	280	0	0	0	9	0	9	11	0	11	14	40	122	47	64	451	92	36	724	81	0	427	26		
Physical Contingency	144	286	150	0	0	0	18	0	18	15	0	15	14	32	24	33	43	76	48	22	108	28	0	57	3		
II) Consulting Services	911	936	1,147	0	0	0	4	40	71	18	170	28	27	270	43	18	191	30	14	152	23	9	107	16	0	0	0
Base Cost	82	680	122	0	0	0	4	34	55	16	136	24	24	204	37	16	136	24	12	102	18	8	86	12	0	0	0
Price Escalation	5	207	17	0	0	0	0	4	0	1	26	2	1	54	5	1	46	4	1	43	4	1	34	3	0	0	0
Physical Contingency	4	44	7	0	0	0	0	2	0	1	6	1	1	13	2	1	9	1	1	7	1	0	5	1	0	0	0
Total (I + II)	3,112	6,819	3,503	0	0	0	382	40	384	323	170	334	326	270	342	690	696	732	922	1,758	1,027	469	2,377	612	0	1,203	72
B. NON-ELIGIBLE PORTION																											
a. Procurement / Construction	0	17,091	725	0	0	0	0	2,965	177	0	2,506	150	0	664	40	0	540	32	0	1,716	103	0	2,425	145	0	1,286	77
Base Cost	0	8,860	531	0	0	0	0	2,565	150	0	2,004	120	0	501	30	0	384	23	0	1,152	69	0	1,536	92	0	768	46
Price Escalation	0	2,866	160	0	0	0	0	310	18	0	383	23	0	132	8	0	130	8	0	482	29	0	774	46	0	456	27
Physical Contingency	0	576	35	0	0	0	0	141	9	0	119	7	0	32	2	0	26	2	0	82	5	0	115	7	0	61	4
b. Land Acquisition	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Base Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Price Escalation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physical Contingency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
c. Administration Cost	0	590	96	0	0	0	0	160	9	0	134	8	0	47	3	0	62	4	0	174	10	0	240	14	0	124	7
d. VAT	0	2,712	121	0	0	0	0	307	18	0	297	18	0	139	8	0	154	9	0	370	22	0	496	30	0	248	15
e. Import Tax	0	2,549	151	0	0	0	0	314	19	0	255	15	0	249	15	0	260	34	0	757	45	0	383	23	0	0	0
Total (a+b+c+d+e)	0	31,941	1,653	0	0	0	0	3,726	224	0	3,192	192	0	1,088	66	0	1,315	79	0	3,196	191	0	5,544	213	0	1,658	100
TOTAL (A+B)	3,112	24,964	4,556	0	0	0	382	3,766	607	323	3,362	525	326	1,366	466	690	2,011	811	922	4,774	1,368	469	5,921	824	0	2,861	172
C. Interest during Construction			192				5					10			15			25			39			46			69
D. Front-end Fee			35																								35
GRAND TOTAL [A+B+C+D]			4,783			70			613			535			423			836			1,248			872			186
E. JICA finance portion incl. IDC (A + C + D)			3,729			70			389			344			357			757			1,087			660			86

(3) Cash Flow Simulation

A cash flow simulation for the transmission projects is made below, assuming the following conditions are provided. 4 scenarios are prepared for the payment allocation between UBEDN and the Government.

(Loan Eligible Portion)

Interest Rate: 1.4 %

Payment Period: 25 years

Grace Period: 7 years

Borrower: Government of Mongolia

Payer for the Loan: UBEDN (Assuming the spread to sub-finance (from the Government to UBEDN) is zero)

Simulation Scenarios

① Burden 100 % of principle repayment and interest payment by UBEDN

② Burden 75 % of principle repayment and interest payment by UBEDN and 25 % by the Government

③ Burden 50 % of principle repayment and interest payment by UBEDN and 50 % by the Government

④ Burden 10 % of principle repayment and interest payment by UBEDN and 90 % by the Government

(Loan Non-Eligible Portion)

Self-Finance (no loan)

Table 10-12 Results of Cash Simulation of the Distribution Projects

(Unit: million JY)

Year	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
	1	2	3	4	5	6	7	8	9	10	11	12
Disbursement	383.92	333.61	341.83	732.15	1,027.15	611.79	72.17	0.00	0.00	0.00	0.00	0.00
Outstanding Loan (End of the Year)	383.92	717.53	1,059.36	1,791.50	2,818.65	3,430.44	3,502.61	3,308.02	3,113.43	2,918.84	2,724.25	2,529.66
Principle Repayment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	194.59	194.59	194.59	194.59	194.59
Interest Payment	5.37	10.05	14.83	25.08	39.46	48.03	49.04	46.31	43.59	40.86	38.14	35.42
Front End Fee	70.05	0.00	0.00	0.00	0.00	0.00	-35.03	0.00	0.00	0.00	0.00	0.00
Total Reayment & Payment	**75.43**	**10.05**	**14.83**	**25.08**	**39.46**	**48.03**	**14.01**	**240.90**	**238.18**	**235.45**	**232.73**	**230.00**
Project Income (Revenue - O&M Costs)	**0.00**	**0.00**	**0.00**	**40.90**	**40.90**	**40.90**	**39.68**	**39.68**	**39.68**	**39.68**	**39.68**	**39.68**
Balance (100 % Payment by UBEDN)	-75.43	-10.05	-14.83	15.82	1.44	-7.12	25.67	-201.22	-198.50	-195.77	-193.05	-190.33
Balance (75 % Payment by UBEDN)	-56.57	-7.53	-11.12	22.09	11.31	4.88	29.17	-141.00	-138.95	-136.91	-134.87	-132.82
Balance (50 % Payment by UBEDN)	-37.71	-5.02	-7.42	28.36	21.17	16.89	32.67	-80.77	-79.41	-78.05	-76.69	-75.32
Balance (10 % Payment by UBEDN)	-7.54	-1.00	-1.48	38.39	36.96	36.10	38.28	15.59	15.86	16.13	16.41	16.68

Year	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**
	13	14	15	16	17	18	19	20	21	22	23	24	25
Disbursement	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Outstanding Loan (End of the Year)	2,335.07	2,140.48	1,945.89	1,751.30	1,556.71	1,362.12	1,167.54	972.95	778.36	583.77	389.18	194.59	0.00
Principle Repayment	194.59	194.59	194.59	194.59	194.59	194.59	194.59	194.59	194.59	194.59	194.59	194.59	194.59
Interest Payment	32.69	29.97	27.24	24.52	21.79	19.07	16.35	13.62	10.90	8.17	5.45	2.72	0.00
Front End Fee	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Reayment & Payment	**227.28**	**224.56**	**221.83**	**219.11**	**216.38**	**213.66**	**210.93**	**208.21**	**205.49**	**202.76**	**200.04**	**197.31**	**194.59**
Project Income (Revenue - O&M Costs)	**39.68**	**39.68**	**39.68**	**39.68**	**39.68**	**39.68**	**-1.22**	**-1.22**	**-1.22**	**-1.22**	**-1.22**	**-1.22**	**-1.22**
Balance (100 % Payment by UBEDN)	-187.60	-184.88	-182.15	-179.43	-176.70	-173.98	-212.16	-209.43	-206.71	-203.98	-201.26	-198.54	-195.81
Balance (75 % Payment by UBEDN)	-130.78	-128.74	-126.69	-124.65	-122.61	-120.57	-159.42	-157.38	-155.34	-153.29	-151.25	-149.21	-147.16
Balance (50 % Payment by UBEDN)	-73.96	-72.60	-71.24	-69.87	-68.51	-67.15	-106.69	-105.33	-103.97	-102.60	-101.24	-99.88	-98.52
Balance (10 % Payment by UBEDN)	16.95	17.22	17.50	17.77	18.04	18.31	-22.32	-22.04	-21.77	-21.50	-21.23	-20.95	-20.68

The revenue from the implementation of the Distribution Automation System is marginal compared to the volume of initial investments. Therefore, the repayment of a loan only through the project revenue is deemed extremely challenging.

Based on the above, it is recommended that the Government of Mongolia carefully considers the extent to which it can shoulder the loan repayment, and analyze the options for improving the project economy through increasing the substations load and reducing blackouts durations.

10.7 Expected Contents of Consulting Services

Expected Contents

The consulting services are expected to cover the following transmission and distribution projects.

- Construction of Park Underground Substation
- Expansion of Baruun and Umard Substations and Conductor Replacement of Existing 110 kV Transmission Lines (No. 109 & No. 110)
- Introduction of Distribution Automation System

The following contents are expected to be covered by the consulting services. The draft Terms of Reference of Consulting Services are attached in Appendix.

- ✧ Review of the results of feasibility study and basic design
- ✧ Detailed design (field survey, detailed study for each facility, cost estimation, creation of technical specifications)
- ✧ Assistance for a Pre-Qualification procedure for selection of contractors
- ✧ Assistance for creation of Bid Documents and procedure
- ✧ Inspection of approval documents/drawings for manufacturing or construction
- ✧ Check of materials/equipment quality in factories
- ✧ Project management and supervision (schedule, quality, safety, etc)
- ✧ Creation of maintenance and operation manuals and progress/completion reports
- ✧ Inspection of completion (before guarantee period)
- ✧ Technology transfer for operators and maintenance staff

Expected Experts

Expected experts for the consulting services are shown below.

Table 10-13 Expected Experts

Item	Contents
Cost	603 million JY (Foreign Currency: 402 million JY, Local Currency: 3,350 million MNT)
Required MM	International Experts: 134 MM Local Experts: 137 MM
Required Experts	・ Project Manager ・ Substation Planning Expert ・ Substation Facility Expert (Electrical) ・ Substation Facility Expert (Civil) ・ Substation Facility Expert (Architectural) ・ Transmission Facility Expert (Overhead Line and Tower) ・ Transmission Facility Expert (Civil) ・ Transmission Facility Expert (Underground Cable) ・ Distribution Planning Expert ・ Distribution Facility Expert (Electrical) ・ Distribution Facility Expert (Civil and Architectural) ・ Geologist ・ Tele-communication Expert ・ Bidding Document Expert

Table 10-14 Expected Cost for the Consulting Services

0.06 JY = 1 MNT

				Foreign Portion		Local Portion		Total
				JPY		MNT		JPY
		Unit	Qty	Rate	Amount	Rate	Amount	
				('000)	('000)	('000)	('000)	('000)
A. Remuneration								
1	Professional (A)	MM	134	2,753	368,902			368,902
2	Professional (B)	MM	137			15,294	2,095,339	125,720
3	Supporting Staff	MM	120			2,294	275,300	16,518
	Sub-total (A)							511,140
B. Direct Cost								
1	International Airfare	time	76	200	15,200			15,200
2	Accomodation and Allowance	night	3,000	4	12,000	167	500,000	42,000
3	Vehicle	month	120			2,000	240,000	14,400
4	Office Rental	month	60			1,700	102,000	6,120
5	Office Equipment	month	60			500	30,000	1,800
6	International Communications	month	60	20	1,200			1,200
7	Printing Reports	set	1	500	500			500
	Sub-total (B)							81,220
C.	Training Costs							
1	International Airfare	time	10	200	2,000			2,000
2	Accomodation and Allowance	night	15	14	210			210
3	Fees for Trainers	set	1	1,000	1,000			1,000
	Sub-total (C)							3,210
D.	Miscellaneous	set	1		1,076		108,093	7,562
E	Total (A) + (B) + (C) + (D)				402,088		3,350,732	603,132

10.8 Operation and Effect Indicators

The operation and effect indicators of each project are proposed as follows.

Table 10-15 Expected Operation and Effect Indicators

Project Name	Operation Indicator			Effect Indicator		
	Indicator	Baseline	Target (2 years after completion)	Indicator	Baseline	Target (2 years after completion)
Diagnosis Laboratory	Implementation ratio in facility maintenance based on international standards (such as IEC)	N/A (IEC conformance 0%, lack of tools and machines)	Relay inspection: 100 % of new relays, IEC conformance: over 50%. Circuit breaker inspection 10 %/year of total facilities Transformer voltage test 10 %/year of total facilities	Number of accidents in Substations	Transformer 73 accidents/year Circuit Breaker 99 accidents/year (2009-2013)	Target: Reduction of 1 accident in a year
	Number of oil analyses of transformers	N/A	Target: 100 analyses/year from 2017-2019, 10 analyses/year after 2020			
Construction of Park Underground Substation	Maximum load factor of the substation	N/A	50 % *1	Electricity sales through the substation	N/A	498 GWh/year
Expansion of Baruun and Umard Substations and Conductor Replacement of Existing 110 kV Transmission Lines (No. 109 & No. 110)	Maximum load factor of the substation	Baruun: 78% Umard: 74% (2012)	50 % *1	Electricity sales through the substations	123 GWh/year (estimated by 2012 actual result)	457 GWh/year
	Maximum load factor of the transmission line	No. 109,110: 59% (From No4 TPP) (2013)	50 % *1			
DNIMS	Number of access to the system	N/A	70,000 times/ year	SAIDI in the whole UBEDN area	19.5 hours/year (2012)	12.9 hours/year
Introduction of Distribution Automation System	Proper Operation Rate of Remote Control Equipment	N/A	100%	SAIDI in the target area	14.1 hours/year (2011)	2.4 hours/year

*1 From the viewpoint of system reliability, the load factors should be low. Actual load factors of the facilities depend on operation of other facilities.

10.9 Estimation of CO2 Emission Reduction

Regarding the projects packaged in the Japanese ODA Loan, CO2 emission reduction effects are estimated by the following assumptions.

- If the projects are not implemented, outage time of the project area is not reduced or electricity sales do not increase. To avoid such cases, alternative diesel generators in all the consumers are operated and supply electricity.
- If the alternative diesel generators in all the customers in the project's area are made, electricity supply from the national grid is reduced. Thus CO2 emission reduction is calculated by the difference between the thermal efficiency of the national grid and that of the alternative diesel generators.

Table 10-16 Estimation of CO2 Emission Reduction by the Projects

	Increase of Sales Electricity	CO2 Emission Factor of the National Grid	CO2 Emission Factor of Alternative Deisel Generator	CO2 Emission Reduction
	GWh/year	ton/GWh	ton/GWh	ton/year
Diagnosis Laboratory	6	1,103	1,300	1,182
Construction of Park Underground Substation	498			98,106
Expansion of Baruun and Umard Substations	456			89,832
Conductor Replacement of Existing 110 kV Transmission Lines (No. 109 & No. 110)				
DNIMS	1.6			315
Introduction of Distribution Automation System	0.052			10
Total	962			189,445

Note: The CO2 emission factor of the national grid uses 1,103 ton/GWh which is referred to in a value indicated in a website of CDM National Bureau of Mongolia. As for the CO2 emission factor of a diesel generator, 1,300 ton/GWh is referred to in a methodology, (<=15 kW <35 kW, 50 % load factor in Table I.F.1AMS, AMS-I.F.)

10.10 Consideration of Cost Reduction Methods

Regarding cost reduction methods, it is necessary to take local conditions in Mongolia into account. In particular, it is very cold in winter, and transportation costs for large materials/equipment are very high because they need to be imported from other countries. Those conditions should be considered. At the same time, the specifications need to be examined to guarantee the operation temperature of the main equipment under the cold temperature.

Table 10-17 Consideration of Cost Reduction Methods

No.	Item	Summary	Notes
1	Shortening of work period	Shortening of the work period is effective to reduce the overall costs. ① Since the civil engineering work (including foundation work) makes up a large portion of both the transmission and distribution, implement the civil engineering work process carefully. ② For the reason stated above, utilize secondary concrete products such as manholes and culverts to reduce cast-in-place concrete.	
2	Introduction of general-purpose items	Proper operation under the extreme cold temperature is required in the target area, therefore introduction of design and products which take those conditions into account is necessary. However, if only this aspect were paid attention to, cost would greatly increase resulting in dependency on a specific manufacturer. Therefore, implement optimal design and adopt general-purpose items as much as possible.	Closely examine for which part the cold start performance is to be guaranteed.
3	Module transportation	Transportation of heavy equipment from the third country is largely expected for both the transmission and distribution portions. To reduce the transportation cost, divide the heavy equipment into modules so that they are able to be transported by rail, which is safer with lower cost.	It is necessary to understand the limit dimensions of rail transport and divide the GIS units into modules.
4	Optimization of overhead cost	It is possible to reduce overhead cost by packaging similar work and consulting services as much as possible.	It is necessary to pay careful attention to possible delay in schedule caused by packaging projects with different schedules.

10.11 Proposal of Technical Assistance

Capacity improvement of executing agencies can expect to effectively utilize facilities procured by the projects. Technical assistance supported by JICA is expected in the following fields.

Table 10-18 Technical Assistance Idea (Option 1)

1. Project Name	Capacity Improvement in Maintenance of Transmission and Distribution Facilities
2. Duration	2014/8-2015/8
3. Objective	By capacity development of NPTGC and UBEDN maintenance staff, facility life can be extended and reliability can be kept through proper maintenance manners.
4. Contents	(1) Assistance for Capacity Development of Maintenance Ability of Substation Facilities (Preventive Maintenance and its Programs) Proper maintenance programs to prevent accidents are studied. The following contents are expected. ● Effective patrol and inspection using laboratory tools ● Trial diagnosis for existing facilities using laboratory tools (oil analysis, electric tests, etc.) and review of the high quality maintenance methods ● Confirmation of conditions of existing facilities by a trend grasping method from patrol records ● Capacity development of judgment of necessity for repair ● Proposal of technical specification for laboratory tools ● Proposal of effective preventive maintenance programs ● Capacity development for improvement of analysis ability (Data management, identification of maintenance points, judgment of facility life, etc.) (2) Capacity Development of Maintenance Ability in Distribution Facilities ● Technology transfer of maintenance points through a joint patrol for several distribution towers ● Capacity development of judgment of necessity for repair ● Identification of detailed maintenance points by borrowing laboratory tools of NPTGC (3) Capacity Development of Transmission and Distribution Staff ● Training program in Japan (Introduction of maintenance methods and operation methods) (4) Assistance for Effective O&M of Substation Facilities ● Training program in O&M for indoor and underground substations

Table 10-19 Technical Assistance Idea (Option 2)

1. Project Name	Study for Capacity Improvement of Transmission and Distribution Facilities in Ulaanbaatar City
2. Duration	2015/3-2016/9
3. Objective	By capacity development of NPTGC and UBEDN planning staff, effective planning and reliability improvement are realized.
4. Contents	(1) Demand forecast for Ulaanbaatar City (2) Review of load factors of existing facilities and grasping facility conditions (3) Strengthening capacity in system planning and analysis (4) Review of planning methods of substation facilities (including circuit breaker and capacitor) and operation of substation (5) Recommendation of appropriate design criteria (standard capacity, relay of transmission and distribution network, bank configuration standard, capacity of short circuit current, measure for earth fault current, check of system reliability) (6) Recommendation on distribution planning

Table 10-20 Technical Assistance Idea (Option 3)

1. Project Name	Study for Capacity Improvement of Transmission System Planning
2. Duration	2015/3-2016/9
3. Objective	By capacity development of NPTGC's planning staff, effective planning and reliability improvement are realized.
4. Contents	(1) Demand forecasts for the national grid and Ulaanbaatar City (including interconnection with Russia) (2) Review of load factors of existing facilities (3) Study on the possibility of a model transmission line (Case study, proposal of specification and cost/benefit analysis) (4) Strengthening staff's capacity through the above system planning and case study of model transmission line (5) Identification of priority transmission line and substation projects

Chapter 11 Project Risks and Expected Countermeasure

Project risks and expected countermeasures for the projects of the JICA ODA Loan are described below.

11.1 Transmission Projects

11.1.1 Risks of Project Cost Increase

Risks of project cost increase for each project and countermeasures are described below.

Table 11-1 Risks of Project Cost Increase and Countermeasures

No.	Project Name	Assumed Risks	Countermeasure
1	Diagnosis Laboratory	-	-
2	Construction of Park Underground Substation	① Detour of lead-in route of 110kV transmission line Since the route to the Park Substation site passes through the urban development area as well as a bridge and a railway, detour might be required.	● Set up a working committee consisting of stakeholders to achieve effective route selection through close information exchange and coordination.
		② Inflow of underground water during the construction period If the underground status is not fully understood, unexpected inflow of underground water might occur.	● Implement geological survey to acquire accurate geological information and take waterproofing measures in advance.
3	Expansion of Baruun and Umard Substations	① Traffic obstacles for construction vehicles Both substations are located in the Gel area, and the road conditions from trunk roads to the substation site are substantially deteriorated. Therefore, carry-in of materials/equipment and passage of construction vehicles might be hindered.	● Surface leveling of the passage way. ● Weight saving of heavy machinery and equipment. (Carry-in by installment as much as possible.)
4	Replacement of Conductors of Existing 110 kV Transmission Line (No. 109 & No. 110)	① Insufficient strength of the existing steel tower (including foundation). While replacement for each line is required, deformation or collapse due to strength poverty is anticipated.	● Examine the strength of the existing steel tower, and take necessary measures such as reinforcement.
5	Mobile Substation	-	-

11.1.2 Risks of Schedule Delay

Risks of schedule delay for each project and countermeasures are described below.

Table 11-2 Risks of Schedule Delay and Countermeasures

No.	Project Name	Assumed Risks	Countermeasure
1	Diagnosis Laboratory	-	-
2	Construction of Park Underground Substation	① Delay of permitting processes This project is the first case of an underground substation in Mongolia; therefore, deliberation and approval/permit by EIA are required prior to commencement of construction work.	● Confirm necessary procedures before tendering to smoothly proceed with approval/permit processes. To this end, adequate cooperation with stakeholders is required.
		② Inflow of underground water during the construction period If the underground status is not fully understood, unexpected inflow of underground water might occur.	● Implement geological survey to acquire accurate geological information and take waterproofing measures in advance.
3	Expansion of Baruun and Umard Substations	-	-
4	Replacement of Conductors of Existing 110 kV Transmission Line (No. 109 & No. 110)	① Inexperience in construction work due to introduction of new wire type Delayed work due to particular kind of construction method.	● Dispatch a trainer in advance from a wire manufacturer or a construction company.
5	Mobile Substation	-	-

11.1.3 Safety Risks

Safety risks for each project and countermeasures are described below.

Table 11-3 Safety Risks and Countermeasures

No.	Project Name	Assumed Risks	Countermeasure
1	Diagnosis Laboratory	-	-
2	Construction of Park Underground Substation	① Vehicle accident Since the construction site is located in the central part of the city, traffic accidents between the construction vehicles and other vehicles or pedestrians might occur.	● Arrange traffic control persons at the site and the passageway.
		② Impact on public facilities If the lead-in 110kV transmission line is installed underground, collapse due to strength poverty or uneven settlement might be caused when installing on the bridge or crossing the railways.	● When installing the lead-in lines on the bridge, examine the bridge strength and take necessary measures such as reinforcement. ● When crossing the railways, secure the necessary depth of burial and perform adequate curing.
3	Expansion of Baruun and Umard Substations	① Vehicle accident The construction site is located within the Gel area, therefore traffic accidents between the construction vehicles and other vehicles or pedestrians might occur.	● Arrange traffic control persons at the passageway. ● Provide community residents with sufficient prior explanation to improve their safety awareness.
4	Replacement of Conductors of Existing 110 kV Transmission Line (No. 109 & No. 110)	① Vehicle accident The construction site is located within the Gel area, therefore traffic accidents between the construction vehicles and other vehicles or pedestrians might occur.	● Arrange traffic control persons at the passageway. ● Provide community residents with sufficient prior explanation to improve their safety awareness.
		② Electrification accident at a live part When conducting wire replacement for each line, the other line is active making the worker proximate to the live part. Therefore, there is a safety risk.	● Need to take sufficient safety measures. ● Taking load switching condition and construction schedule into account, consider the possibility of simultaneous wire replacement for 2 lines. If this is possible, the risk of electrification accident at the live part is eliminated.
5	Mobile Substation	-	-

11.1.4 Environmental and Social Risks

Environmental and social risks for each project and countermeasures are described below.

Table 11-4 Environmental / Social Risks and Countermeasures

No.	Project Name	Assumed Risks	Countermeasure
1	Diagnosis Laboratory	① Treatment of wastes (Environment) Wastes are generated by analysis. The dielectric oil containing PCB requires industrial waste disposal, while the dielectric oil which does not contain PCB requires detoxification and storage. When washing the oil analysis equipment, organic solvent (toluene and ethanol, etc.) is necessary. As is the case for the dielectric oil, the solvent containing PCB is industrial waste, and the solvent not containing PCB requires storage.	● Consult closely with UB authorities, and arrange/coordinate proper disposal of industrial wastes.
2	Construction of Park Underground Substation	① Subsidence of surrounding area due to lowered groundwater level (environmental aspect) Subsidence might occur due to change in groundwater level in the surrounding area caused by groundwater outflow during the construction and inflow after the construction.	● Implement geological survey to acquire accurate geological information and take waterproofing measures in advance. ● Install a water bar on the outer wall of underground structure to prevent the water inflow to the structure as much as possible.
		② Impact on residents (social aspect) The site is used as a park, but is not to be available during the construction period. Moreover, installation of underground cables might affect the daily life of the community residents including traffic influence.	● Take necessary measures to obtain understanding for construction among the community residents, including getting residents informed about the construction plan through giving them advance notice and holding briefings.
3	Expansion of Baruun and Umard Substations	-	-
4	Replacement of Conductors of Existing 110 kV Transmission Line (No. 109 & No. 110)	-	-
5	Mobile Substation	-	-

11.2 Distribution Projects

11.2.1 Risks of Project Cost Increase

Risks of project cost increase for each project and countermeasures are described below.

Table 11-5 Risks of Project Cost Increase and Countermeasures

No.	Project Name	Assumed Risks	Countermeasure
1	Distribution Network Information Management System (DNIMS)	① Insufficient space for data center There might not be sufficient space to install the hardware equipment of the data system in the existing server room due to an expansion plan of other equipment.	● If it is not possible to install the system in the main office, arrangement of new server room is required. ● If communication lines are available between the main office and the branch offices, consider installing the equipment in the branch office, not in the main office.
2	Introduction of Distribution Automation System	① Power outage during construction period To shorten power outage time during construction period, it might be necessary to install the power switching bypass between the existing distribution facility and a new distribution facility depending on the site.	● It is necessary to consider a method in which temporal bypass work is not required by shortening the power outage at the time of switching work as much as possible.
		② Insufficient reliability of backup communication line Radio wave is assumed for backup communication, but reliability is not secured regarding the wave reception.	● To avoid installation of a dedicated line, implement radio wave survey in advance, and identify the areas where the radio wave is difficult to penetrate and take necessary measures. (Discussion with the communication company is required regarding cost sharing for such measure.)

11.2.2 Risks of Schedule Delay

Risks of schedule delay for each project and countermeasures are described below.

Table 11-6 Risks of Schedule Delay and Countermeasures

No.	Project Name	Assumed Risks	Countermeasure
1	Distribution Network Information Management System (DNIMS)	-	-
2	Introduction of Distribution Automation System	① Interference by underground objects of other operators Due to interference of underground objects buried by other operators such as waterworks and sewage, heating pipes, telephone lines/communication lines, it might take time to bypass or relocate them.	● Consult closely with each operator based on the map of buried objects in advance as much as possible to secure smooth process of the construction work.
		② Inconsistency between construction schedule of upper substation Installation schedule of distribution board/relay control board in the upper substation and construction schedule of the distribution project might not be consistent.	● Consult closely with subcontractors of substation construction regarding the schedule.

11.2.3 Safety Risks

Safety risks for each project and countermeasures are described below.

Table 11-7 Safety Risks and Countermeasures

No.	Project Name	Assumed Risks	Countermeasure
1	Distribution Network Information Management System (DNIMS)	-	-
2	Introduction of Distribution Automation System	① Vehicle accident The construction site is located within the Gel area, therefore traffic accidents between the construction vehicles and other vehicles or pedestrians might occur.	● Arrange traffic control persons at the passageway. ● Provide community residents with sufficient prior explanation to improve their safety awareness.
		② Risks of electrification accident Power switching work from the existing distribution facility to the new distribution facility might cause electrification accidents, etc.	● Carry out necessary preparation such as preparation of switching work process chart, etc.

11.2.4 Environmental and Social Risks

Environmental and social risks for each project and countermeasures are described below

Table 11-8 Environmental / Social Risks and Countermeasures

No.	Project Name	Assumed Risks	Countermeasure
1	Distribution Network Information Management System (DNIMS)	-	-
2	Introduction of Distribution Automation System	① Impact of construction work on traffic and surrounding area (social aspect) Traffic influence and temporal power outage due to underground cable installation work are expected.	● Take necessary measures to obtain understanding for construction among the community residents, including getting residents informed about the construction plan through giving them advance notice and holding briefings.

Appendix

Specification and Example Photos of Laboratory Tools and Machines

Laboratory List — Oil Laboratory

Categories	Oil Laboratory
Device name	Gas concentration monitoring equipment
Manufacturer	RIKEN KEIKI
Type	RM590
Quantity	1

Standard specification
Including gas sensor
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〃

Categories	Oil Laboratory
Device name	Laboratory installation
Manufacturer	〃
Type	〃
Quantity	1

Standard specification
Including gas sensor
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〃
〃

Categories	Oil Laboratory
Device name	Laboratory installation
Manufacturer	〃
Type	〃
Quantity	1

Standard specification
Gas sensor
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〃
〃

Categories	Oil Laboratory
Device name	Laboratory installation
Manufacturer	〃
Type	〃
Quantity	1

Standard specification
Oil gas extraction equipment
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Categories	Oil Laboratory
Device name	Acid value measurement device
Manufacturer	Mitsubishi Chemical Corporation
Type	GT－１００
Quantity	1

Standard specification
IEC62021
IEC61125
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〃

-1-

Categories	Oil Laboratory
Device name	isture measuring instrument
Manufacturer	Mitsubishi Chemical Corporation
Type	CA-200
Quantity	1

Standard specification

IEC60814
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Categories	Oil Laboratory
Device name	Electrostatic tangent measuring device
Manufacturer	Soken-Denki
Type	〃
Quantity	1

Standard specification

IEC60247
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〃

Categories	Oil Laboratory
Device name	Automatic flash point instrument
Manufacturer	Tanaka
Type	APM-7
Quantity	1

Standard specification

ISO2719
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Categories	Oil Laboratory
Device name	Density hydrometer
Manufacturer	Kyoto Kogyo
Type	DA-500
Quantity	1

Standard specification

ISO3675
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Categories	Oil Laboratory
Device name	Volume resistivity meter
Manufacturer	ADCMT
Type	R8340A
Quantity	1

Standard specification

IEC60666
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-2-

Categories	Oil Laboratory
Device name	Kinematic viscosity measuring instrument
Manufacturer	Tomus Kagaku
Type	TV-7NS
Quantity	1

Standard specification

ISO3104
ISO3016
〃
〃

Categories	Oil Laboratory
Device name	Dissolved gas analyzer
Manufacturer	simazu
Type	GCMS-TQ8030
Quantity	1

Standard specification

IEC60422
IEC60296
IEC60970
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Categories	Oil Laboratory
Device name	Accessory equipment
Manufacturer	〃
Type	〃
Quantity	1

Standard specification

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〃
〃

Categories	Oil Laboratory
Device name	Consumables
Manufacturer	〃
Type	〃
Quantity	1

Standard specification

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Categories	Oil Laboratory
Device name	Office supplies and furniture
Manufacturer	〃
Type	〃
Quantity	1

Standard specification

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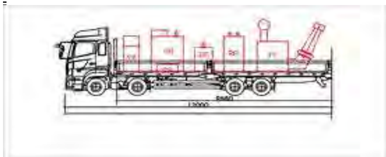
Laboratory List — High Voltage Laboratory



Categories	High Voltage Laboratory
Device name	High voltage test equipment
Manufacturer	Tokyo transformer
Type	220kV,100kVA
Quantity	1

Standard specification
IEC60076
IEC6227
IEC60060
with Compensation-Reactor,Std HV Tr.

Categories	High Voltage Laboratory
Device name	Test equipment installed on a vehicle
Manufacturer	Mitsubishi Fuso
Type	〃
Quantity	1

Standard specification
Load capacity 1500kg or more
Split mounted on One high-voltage test equipment
0
0

写真

Categories	〃
Device name	〃
Manufacturer	〃
Type	〃
Quantity	〃

Standard specification
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写真

Categories	〃
Device name	〃
Manufacturer	〃
Type	〃
Quantity	〃

Standard specification
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写真

Categories	〃
Device name	〃
Manufacturer	〃
Type	〃
Quantity	〃

Standard specification
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Laboratory List

Relay Laboratory

Categories	Relay Laboratory
Device name	Tester environment (temperature and humidity tester)
Manufacturer	thermotron
Type	SR4
Quantity	1

Standard specification

IEC60068
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〃

Categories	Relay Laboratory
Device name	Phylogenetic analysis simulator
Manufacturer	RTDS
Type	〃
Quantity	1

Standard specification

IEC60255
〃
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〃

写真

Categories	Relay Laboratory
Device name	Voltage and current analog amplifier
Manufacturer	Megger
Type	SMRT 1
Quantity	8

Standard specification

IEC60255
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Categories	Relay Laboratory
Device name	Electronic components insulation diagnosis device (tan δ)
Manufacturer	Associated Research
Type	HYPOT Ⅲ
Quantity	1

Standard specification

IEC60255
IEC62321
〃
〃

Categories	Relay Laboratory
Device name	Radio test equipment
Manufacturer	EM TEST
Type	OCS 500N6
Quantity	1

Standard specification

IEC60255
IEC61010
Including electromagnetic wave shielding sheet
〃

-5-

Categories	Relay Laboratory
Device name	Current applied tester
Manufacturer	Megger
Type	CSU600A-AT
Quantity	1

Standard specification
IEC60255
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〃
〃

Categories	Relay Laboratory
Device name	Primary current injection test set
Manufacturer	Megger
Type	PCIT2000/2
Quantity	1

Standard specification
IEC60255
〃
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〃

Categories	Mobile Diagnostics Laboratory
Device name	Protection relay test equipment
Manufacturer	Megger
Type	SMRT 410
Quantity	6

Standard specification
IEC60255
Professional Application CD×2
〃
〃

Categories	Mobile Diagnostics Laboratory
Device name	Battery impedance test equipment
Manufacturer	Megger
Type	BITE3
Quantity	6

Standard specification
IEC60095
〃
〃
〃

Categories	Mobile Diagnostics Laboratory
Device name	Battery capacity tester
Manufacturer	Megger
Type	TORKEL820
Quantity	6

Standard specification
IEC60095
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Laboratory List

Mobile Diagnostics Laboratory

Categories	Mobile Diagnostics Laboratory
Device name	Transformer diagnostic instrument
Manufacturer	Megger
Type	Delta-4310
Quantity	5

Standard specification
IEC60076
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〃

Categories	Mobile Diagnostics Laboratory
Device name	Low resistance meter
Manufacturer	Megger
Type	MOM-200A
Quantity	5

Standard specification
IEC60076
〃
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Categories	Mobile Diagnostics Laboratory
Device name	Winding resistance measuring instrument
Manufacturer	Megger
Type	MTO-330
Quantity	3

Standard specification
IEC60076
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Categories	Mobile Diagnostics Laboratory
Device name	Digital low resistance meter
Manufacturer	Megger
Type	DLRO10HD
Quantity	2

Standard specification
IEC60076
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〃

Categories	Mobile Diagnostics Laboratory
Device name	Insulation resistance tester
Manufacturer	Megger
Type	DET3TD
Quantity	3

Standard specification
IEC60076
〃
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-7-

Categories	Mobile　Diagnostics Laboratory
Device name	Protection relay test equipment
Manufacturer	Megger
Type	SMRT 410
Quantity	6

Standard specification
IEC60255
Professional Application CD×2
〃
〃

Categories	Mobile　Diagnostics Laboratory
Device name	Gas leak tester
Manufacturer	Eimesu
Type	Aimex WPAI-007M
Quantity	6

Standard specification
IEC62271
〃
〃
〃

Categories	Mobile　Diagnostics Laboratory
Device name	10kV insulation resistance tester
Manufacturer	Megger
Type	MIT-1025
Quantity	5

Standard specification
IEC60076
IEC60060
〃
〃

Categories	Mobile　Diagnostics Laboratory
Device name	Earth resistance meter
Manufacturer	Megger
Type	DET-14C
Quantity	1

Standard specification
IEC60076
〃
〃
〃

Categories	Mobile　Diagnostics Laboratory
Device name	eep frequency response analyzer
Manufacturer	Megger
Type	FRAX-150
Quantity	1

Standard specification
IEC60076
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〃

写真

Categories	Mobile Diagnostics Laboratory
Device name	Insulation diagnostic analyzer
Manufacturer	Megger
Type	IDAX 300
Quantity	1

Standard specification

IEC60076
IEC60071
〃
〃

Categories	Mobile Diagnostics Laboratory
Device name	Gas circuit breaker diagnostic equipment
Manufacturer	Megger
Type	TM1800+SDRM202(3)
Quantity	1

Standard specification

IEC62271
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〃

Categories	Mobile Diagnostics Laboratory
Device name	Vacuum circuit breaker diagnostic instrument
Manufacturer	Megger
Type	VIDAR /vacuum
Quantity	1

Standard specification

IEC62271
〃
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〃

Categories	Mobile Diagnostics Laboratory
Device name	eflective cable fault point diagnostic equipment
Manufacturer	Megger
Type	Teleflex VX+Pulse generator
Quantity	1

Standard specification

IEC60055
〃
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〃

Categories	Mobile Diagnostics Laboratory
Device name	Mobile testing transformer
Manufacturer	〃
Type	АИДе-70/50
Quantity	4

Standard specification

IEC60076
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-9-

Categories	Mobile　Diagnostics Laboratory
Device name	Infrared temperature measuring instrument
Manufacturer	InfraTec
Type	VarioCAM hr basic
Quantity	1

Standard specification

IEC60076
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〃
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Categories	Mobile　Diagnostics Laboratory
Device name	Moving vehicle
Manufacturer	Toyota
Type	HI-ACE
Quantity	1

Standard specification

Load capacity 1000kg or more
4WD
〃
〃

Categories	Mobile　Diagnostics Laboratory
Device name	Breakdown voltage test of oil
Manufacturer	Megger
Type	OTS80PB
Quantity	1

Standard specification

IEC60156
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Categories	Mobile　Diagnostics Laboratory
Device name	Vibration measuring instrument
Manufacturer	SINUS
Type	soundbook MK2
Quantity	1

Standard specification

IEC60095
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Categories	Mobile　Diagnostics Laboratory
Device name	Surveying instrument
Manufacturer	LEICA
Type	3D_Disto Leica
Quantity	1

Standard specification

IEC60095
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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? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (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?	(a)N (b)N (c)N (d)N	(a) Not required. (b) N/A (c) N/A (d) N/A
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a) N/A (b) N/A	(a) Not applicable as the facilities and equipment will be installed at NPTGC. (b) N/A
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) Multiple alternatives were examined while project processing in order to avoid or minimize adverse impacts.
2 Pollution Control	(1) Air Quality	(a) Do air pollutants emitted from facilities comply with the country's emission standards?	(a) Y	Nitrogen (N), argon (Ar), helium (He) and hydrogen (H) will be created by the operation though the amount of gas created in the laboratory stays small-scale. **(mitigation measures)** Air temperature and humidity should be strictly controlled by using air-conditioner. Ventilation should be kept for the benefit of human health.
	(2) 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) There will be no excavation works required.
	(3) Wastes	(a) Are wastes generated by the operation properly treated and disposed of in accordance with the country's standards?	(a) Y	Wastes will be created while conducting analyses at the laboratory. Insulating oils without PCB should be treated as industrial wastes. Insulating oils with PCB should be detoxicated or stored in an appropriate manner. The same will be applied to the case of organic solvent use (such as toluol and ethanol) required for cleaning the oil analysis equipment. **(mitigation measures)** NPTGC is recommended to contact and coordinate with UB City for collection, transportation and disposal of such industrial wastes as stipulated by the Law on Household and Industrial Waste of Mongolia.
	(5) Noise and Vibration	(1) Do noise and vibrations comply with the country's standards?	(a) Y	Noise and vibration will be produced when carrying in the equipment to NPTGC. Mobile laboratory will produce noise and vibration while running in the street. **(mitigation measures)** NPTGC will comply with the noise standard and reduce such noise and vibration with proper time management and work operation.
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) There is no protected areas in the project site.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Are adequate measures taken to prevent disruption of migration routes and habitat fragmentation of wildlife and livestock? (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? (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?	(a) N/A (b) N/A (c) N/A (d) N/A (e) N/A (f) N/A	(a) There is no forest or other ecologically vulnerable area in and around the project site. (b) do (c) do (d) do (e) do (f) The project site is located in developed area in the heart of UB city.
	(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? (b) Is there any possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides? (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?	(a) N (b) N (c) N	(a) There will be no excavation works required. (b) do (c) do
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? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Are the compensations going to be paid prior to the resettlement? (e) Are the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(a) N/A (b) N/A (c) N/A (d) N/A (e) N/A (f) N/A (g) N/A (h) N/A (i) N/A (j) N/A	(a) No involuntary resettlement caused by the project. (b) do (c) do (d) do (e) do (f) do (g) do (h) do (i) do (j) do
	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (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? (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? (d) Are the compensations for transmission wires given in accordance with the domestic law?	(a) N/A (b) N/A (c) N/A (d) N/A	(a) No such impact is anticipated to the local residents living around the site. (b) do (c) do (d) do
4 Social Environment	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	(a) No such impact is anticipated as the facilities and equipment will be installed at NPTGC.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) No such impact is anticipated as the facilities and equipment will be installed at NPTGC.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a) N/A (b) N/A	(a) No such social impact is anticipated. (b) There is no ethnic minorities or indigenous people.
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (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? (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.? (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?	(a) N (b) Y (c) Y (d) Y	(a) NPTGC is obedient to the Law on Labor and the relevant safety standards of Mongolia. (b) do (c) do (d) do
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	(a) Y (b) N/A (c) Y	(a) It is anticipated that there will be noise and vibration while carrying the equipment into the site. NPTGC will instruct suppliers to minimize them. (b) Impact to natural ecosystems negligible. (c) Accidents may occur while carrying the equipment into the site as heavy traffic is constantly expected in UB city during day time. **(mitigation measures)** Flexible schedule for installation will not to disturb the city traffic. The same case is said to the operation of mobile laboratory. Action to protect employees (such as wearing helmets, gloves and work clothes) should be taken to minimize such accident risk. Traffic conditions and road conditions should be taken into consideration while operating the mobile laboratory.
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (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?	(a) Y (b) Y (c) Y (d) N	(a) NPTGC will keep monitoring the specific items throughout the operation period, such as waste treatment, safety & health and excessive noise at the laboratory. (b) Wastes and safety & health. Methods and frequencies are based on the requirements from the relevant laws and standards. (c) It is the laboratory manager responsible for monitoring. (d) Methods and frequencies are based on the requirements from the relevant laws and standards. There is no requirement from the MOE to 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) Not applicable
	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	(a) Not applicable

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? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (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?	(a)No (b)No (c)No (d)No	(a) A situation analysis survey should be conducted, whose result is to be reflected into the project design. The Ministry of Environment and Green Development (MEGD) will conduct a general EIA to assess if a detailed EIA is required for further assessing the degree of environmental impact. Environmental Protection Plan and Environmental Monitoring Plan should be conducted if the Project requires a detailed EIA. (b) do (c) do (d) do
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a) N (b) N	(a) Consultation with local residents should be conducted if the Project requires a detailed EIA according to the relevant Mongolian laws. (b) No.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) N	(a) Multiple alternatives were examined while project processing in order to avoid or minimize adverse impacts.
2 Pollution Control	(1) Air Quality	(a) Do air pollutants emitted from facilities comply with the country's emission standards?	(a) Y	(a) Discharge of exhaust fumes from the operation of heavy machinery and trucks, production and diffusion of dust from treatment of the excavated soils and development of disposal yards will occur. **(mitigation measures)** NPTGC will comply with the air quality standard as stipulated by the Law on Air of Mongolia. Construction work management including time management, employees' shifting system should be done in an appropriate manner.
	(2) 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) Water turbidity will be caused by sludge treatment, from the temporary site of earth dig out, and by waste water from the construction work. Discharge of rain water, waste water and cooling water may cause water turbidity during operation. **(mitigation measures)** NPTGC will comply with the water quality standard. Discharged water should be strictly monitored and prevent oil leakage.
	(3) Wastes	(a) Are wastes generated by the operation properly treated and disposed of in accordance with the country's standards?	(a) Y	(a) Excavated soil and sludge by the construction work will be produced during construction. Wastes will be produced as the substation functions. **(mitigation measures)** NPTGC is recommended to contact and coordinate with UB City for collection, transportation and disposal of such industrial wastes as stipulated by the Law on Household and Industrial Waste of Mongolia.
	(5) Noise and Vibration	(1) Do noise and vibrations comply with the country's standards?	(a) Y	Noise and vibration is predicted by the operation of heavy machinery and trucks, and the transportation of materials and equipment. **(mitigation measures)** NPTGC will comply with the noise standard and reduce such noise and vibration with proper time management and work operation.
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) There is no protected areas in the project site.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Are adequate measures taken to prevent disruption of migration routes and habitat fragmentation of wildlife and livestock? (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? (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?	(a) N/A (b) N/A (c) N/A (d) N/A (e) N/A (f) N/A	(a) There is no forest or other ecologically vulnerable area in and around the project site. (b) do (c) do (d) do (e) do (f) No
	(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? (b) Is there any possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides? (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?	(a) N/A (b) N (c) Y	(a) Not applicable (b) do (c) Change of groundwater level and water veins, and water flow inhibition can be caused by the construction work. Soil runoff may occur from the exposed soil of the embankments and earth cuts. There may be certain impact from excavation work and construction of disposal yard. And foundation strength may become deteriorated. **(mitigation measures)** Groundwater situation and geological situation should be thoroughly assessed in the situation analysis survey to examine the suitable construction method.
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? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Are the compensations going to be paid prior to the resettlement? (e) Are the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(a) N/A (b) N/A (c) N/A (d) N/A (e) N/A (f) N/A (g) N/A (h) N/A (i) N/A (j) N/A	(a) No involuntary resettlement caused by the project as the site is located within a public park. (b) do (c) do (d) do (e) do (f) do (g) do (h) do (i) do (j) do
	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (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? (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? (d) Are the compensations for transmission wires given in accordance with the domestic law?	(a) N/A (b) Y (c) N/A (d) N/A	(a) The proposed site belongs to the UB City and no resettlement is thus required. (b) A temporary influx of migrant labor during construction period may increase infectious diseases. (c) No specific impact is anticipated as the substation will be constructed in the public park and the underground wires will be installed along with public roads. (d) Not applicable.
4 Social Environment	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N/A	(a) There is no local archeological, historical, cultural, and religious heritage admitted in the project area.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N/A	(a) View inhibition can be caused by the ventilating station.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a) N/A (b) N/A	(a) No such social impacts are anticipated. (b) do
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (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? (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.? (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?	(a) N (b) Y (c) Y (d) Y	(a) NPTGC is obedient to the labor legislations and conditions in Mongolia. (b) do (c) do (d) do
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	(a) Y (b) N/A (c) N/A	(a) It is anticipated that there will be air pollution such as exhaust, waste water discharge, dust emission, noise and vibration during construction period. However, the impact is temporary and anticipated to be minor. NPTGC will examine measures to minimize them and strictly monitor them. (b) Impact to natural ecosystems is negligible (c) The public park will not be available during construction, which UB citizens lose a space for entertainment. Accidents of workers, traffic accidents due to traffic volume increase, and involvement of passers-by nearby the construction site can occur during construction period. **(mitigation measures)** Consultation with UB citizens should be organized for information disclosure on construction schedule, project details etc. to increase their understandings and preparedness for possible traffic disturbance.
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (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?	(a) Y (b) Y (c) Y (d) N	(a) NPTGC will keep monitoring the specific items throughout the operation period, such as waste treatment, safety & health and excessive noise at the laboratory. (b) Noise, vibrations, wastes and safety & health. Methods and frequencies are based on the requirements from the relevant laws and standards. (c) It is the substation manager responsible for monitoring. (d) Methods and frequencies are based on the requirements from the relevant laws and standards.
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) Y	(a) Not applicable
	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	(a) Not applicable

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? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (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?	(a)N/A (b)N/A (c)N/A (d)N/A	(a) Not required. (b) do (c) do (d) do
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a) N (b) N	(a) Not required. (b) do (c) do (d) do
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) N	(a) Multiple alternatives were examined while project processing in order to avoid or minimize adverse impacts.
2 Pollution Control	(1) Air Quality	(a) Do air pollutants emitted from facilities comply with the country's emission standards?	(a) Y	(a) Discharge of exhaust fumes from the operation of heavy machinery and trucks, production and diffusion of dust from treatment of the excavated soils and development of disposal yards will occur. **(mitigation measures)** NPTGC will comply with the air quality standard as stipulated by the Law on Air of Mongolia. Construction work management including time management, employees' shifting system should be done in an appropriate manner.
	(2) 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) Water turbidity will be caused by sludge treatment, from the temporary site of earth dig out, and by waste water from the construction work. Discharge of rain water, waste water and cooling water may cause water turbidity during operation. **(mitigation measures)** NPTGC will comply with the water quality standard. Discharged water should be strictly monitored and prevent oil leakage.
	(3) Wastes	(a) Are wastes generated by the operation properly treated and disposed of in accordance with the country's standards?	(a) Y	(a) Excavated soil and sludge by the construction work will be produced during construction. Wastes will be produced as the substation functions. **(mitigation measures)** NPTGC is recommended to contact and coordinate with UB City for collection, transportation and disposal of such industrial wastes as stipulated by the Law on Household and Industrial Waste of Mongolia.
	(5) Noise and Vibration	(1) Do noise and vibrations comply with the country's standards?	(a) Y	Noise and vibration is predicted by the operation of heavy machinery and trucks, and the transportation of materials and equipment. **(mitigation measures)** NPTGC will comply with the noise standard and reduce such noise and vibration with proper time management and work operation.
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) There is no protected areas in the project site.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Are adequate measures taken to prevent disruption of migration routes and habitat fragmentation of wildlife and livestock? (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? (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?	(a) N/A (b) N/A (c) N/A (d) N/A (e) N/A (f) N/A	(a) There is no forest or other ecologically vulnerable area in and around the project site. (b) do (c) do (d) do (e) do (f) No
3 Natural Environment	(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? (b) Is there any possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides? (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?	(a) N/A (b) N (c) N	(a) No specific impact is anticipated. (b) do (c) do
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? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Are the compensations going to be paid prior to the resettlement? (e) Are the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(a) N/A (b) N/A (c) N/A (d) N/A (e) N/A (f) N/A (g) N/A (h) N/A (i) N/A (j) N/A	(a) No involuntary resettlement caused by the project. (b) do (c) do (d) do (e) do (f) do (g) do (h) do (i) do (j) do
	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (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? (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? (d) Are the compensations for transmission wires given in accordance with the domestic law?	(a) N/A (b) N/A (c) N/A (d) N/A	(a) The proposed site within the existing substation compounds and no resettlement is thus required. (b) A temporary influx of migrant labor during construction period may increase infectious diseases. (c) No specific impact is anticipated as it is within the existing substation compounds. (d) Not applicable.
4 Social Environment	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N/A	(a) There is no local archeological, historical, cultural, and religious heritage admitted in the project area.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N/A	(a) No such impact is anticipated as it is within the substation compounds.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a) N/A (b) N/A	(a) No such social impacts are anticipated. (b) do
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (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? (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.? (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?	(a) N (b) Y (c) Y (d) Y	(a) NPTGC is obedient to the labor legislations and conditions in Sri Lanka. (b) do (c) do (d) do
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	(a) Y (b) N/A (c) N/A	(a) It is anticipated that there will be air pollution such as exhaust, waste water discharge, dust emission, noise and vibration during construction period. However, the impact is temporary and anticipated to be minor. NPTGC will examine measures to minimize them and strictly monitor them. (b) Impact to natural ecosystems is negligible (c) The substations are surrounded by residential areas including ger houses. **(mitigation measures)** Consultation with local residents around the substations should be organized for information disclosure on construction schedule, project details etc. to increase their understandings and preparedness for possible traffic disturbance.
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (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?	(a) Y (b) Y (c) Y (d) N	(a) NPTGC will keep monitoring the specific items throughout the operation period, such as waste treatment, safety & health and excessive noise at the laboratory. (b) Noise, vibrations, wastes and safety & health. Methods and frequencies are based on the requirements from the relevant laws and standards. (c) It is the substation manager responsible for monitoring. (d) Methods and frequencies are based on the requirements from the relevant laws and standards.
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) Y	(a) Not applicable
	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	(a) Not applicable

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? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (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?	(a) N/A (b) N/A (c) N/A (d) N/A	(a) A detailed EIA will not be required as no new tower will be erected. The number and volume of transmission wires will also remain same level. (b) do (c) do (d) do
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a) Y (b) N	(a) It is not required by law if a detailed EIA is not applicable. However, over 200 households are currently existing in the right of way and surrounding area after 30 years of wire extension. **(mitigation measures)** Consultation with local residents will help increase their awareness and understanding toward the construction works. (b) No.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) Multiple alternatives were examined in order to avoid or minimize adverse impacts, and CEB has already identified a vacant land suitable for substation construction.
2 Pollution Control	(1) Air Quality	(a) Do air pollutants emitted from facilities comply with the country's emission standards?	(a) Y	(a) Discharge of exhaust fumes from the operation of heavy machinery and trucks, production and diffusion of dust from the treatment of the excavated soils will occur. **(mitigation measures)** NPTGC will comply with the air quality standard as stipulated by the Law on Air of Mongolia. Construction work management including time management, employees' shifting system should be done in an appropriate manner.
	(2) 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) Water turbidity will be caused by sludge treatment, by soil runoff from the exposed soil of the embankments and earth cuts, and by waste water from the construction work **(mitigation measures)** NPTGC will comply with the water quality standard. Discharged water should be strictly monitored and prevent oil leakage.
	(3) Wastes	(a) Are wastes generated by the operation properly treated and disposed of in accordance with the country's standards?	(a) Y	(a) Construction wastes will be created. **(mitigation measures)** NPTGC is recommended to contact and coordinate with UB City for collection, transportation and disposal of such industrial wastes as stipulated by the Law on Household and Industrial Waste of Mongolia.
	(5) Noise and Vibration	(1) Do noise and vibrations comply with the country's standards?	(a) Y	Noise and vibration is predicted by the operation of heavy machinery and trucks, and the transportation of materials and equipment. **(mitigation measures)** NPTGC will comply with the noise standard and reduce such noise and vibration with proper time management and work operation.
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) Y	(a) There is no protected areas in the project site.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Are adequate measures taken to prevent disruption of migration routes and habitat fragmentation of wildlife and livestock? (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? (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?	(a) N/A (b) Y (c) N/A (d) Y (e) N/A (f) N/A	(a) There is no forest or other ecologically vulnerable area in and around the project site. (b) do (c) do (d) do (e) do (f) No
	(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? (b) Is there any possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides? (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?	(a) N (b) N (c) N	(a) No specific impact is anticipated. (b) do (c) do
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? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Are the compensations going to be paid prior to the resettlement? (e) Are the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(a) N/A (b) N/A (c) N/A (d) N/A (e) N/A (f) N/A (g) N/A (h) N/A (i) N/A (j) N/A	(a) No involuntary resettlement caused by the project. (b) do (c) do (d) do (e) do (f) do (g) do (h) do (i) do (j) do
	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (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? (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? (d) Are the compensations for transmission wires given in accordance with the domestic law?	(a) Y (b) Y (c) N (d) N	(a) Increased risk of accidents is anticipated en route where population density is high. **(mitigation measures)** The extension work can be shifted during weekends while city traffic is less. Consultation with local residents along the route can be organized for information disclosure on construction schedule, project details etc. to increase their understandings and preparedness for possible traffic disturbance. (b) A temporary influx of migrant labor during construction period may increase infectious diseases. (c) No specific impact is anticipated as the height is sufficiently away from local settlements so that serious radio interference is not likely anticipated. (d) Not applicable
4 Social Environment	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N/A	(a) There is no local archeological, historical, cultural, and religious heritage admitted in the project area.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N/A	(a) The landscape will remain same as no new tower will be erected. The number and volume of transmission wires will also remain same level.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a) N/A (b) N/A	(a) No such social impacts are anticipated. (b) do
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (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? (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.? (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?	(a) N (b) Y (c) Y (d) Y	(a) NPTGC is obedient to the labor legislations and conditions in Mongolia. (b) do (c) do (d) do
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	(a) Y (b) N/A (c) N/A	(a) It is anticipated that there will be air pollution such as exhaust, waste water discharge, dust emission, noise and vibration during construction period. However, the impact is temporary and anticipated to be minor. NPTGC will examine measures to minimize them and strictly monitor them. (b) Impact to natural ecosystems is negligible (c) Accidents of workers, traffic accidents due to traffic volume increase, and involvement of passers-by and local residents nearby the construction site can occur during construction period. **(mitigation measures)** Consultation with local residents will help increase their awareness and understanding toward the construction works.
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (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?	(a) Y (b) Y (c) Y (d) N	(a) NPTGC will keep monitoring the specific items throughout the operation period, such as waste treatment, safety & health and excessive noise at the laboratory. (b) Noise, vibrations, wastes and safety & health. Methods and frequencies are based on the requirements from the relevant laws and standards. (c) It is the laboratory manager responsible for monitoring. (d) Methods and frequencies are based on the requirements from the relevant laws and standards.
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) Y	(a) Not applicable
	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) Not applicable

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? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (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?	(a) N/A (b) N/A (c) N/A (d) N/A	(a) A detailed EIA will not be required as no new tower will be erected. The number and volume of transmission wires will also remain same level. (b) do (c) do (d) do
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a) Y (b) N	(a) It is not required by law if a detailed EIA is not applicable. However, over 200 households are currently existing in the right of way and surrounding area after 30 years of wire extension. **(mitigation measures)** Consultation with local residents will help increase their awareness and understanding toward the construction works. (b) No.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) Multiple alternatives were examined in order to avoid or minimize adverse impacts, and CEB has already identified a vacant land suitable for substation construction.
2 Pollution Control	(1) Air Quality	(a) Do air pollutants emitted from facilities comply with the country's emission standards?	(a) Y	(a) Discharge of exhaust fumes from the operation of heavy machinery and trucks, production and diffusion of dust from the treatment of the excavated soils will occur. **(mitigation measures)** NPTGC will comply with the air quality standard as stipulated by the Law on Air of Mongolia. Construction work management including time management, employees' shifting system should be done in an appropriate manner.
	(2) 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) Water turbidity will be caused by sludge treatment, by soil runoff from the exposed soil of the embankments and earth cuts, and by waste water from the construction work **(mitigation measures)** NPTGC will comply with the water quality standard. Discharged water should be strictly monitored and prevent oil leakage.
	(3) Wastes	(a) Are wastes generated by the operation properly treated and disposed of in accordance with the country's standards?	(a) Y	(a) Construction wastes will be created. **(mitigation measures)** NPTGC is recommended to contact and coordinate with UB City for collection, transportation and disposal of such industrial wastes as stipulated by the Law on Household and Industrial Waste of Mongolia.
	(5) Noise and Vibration	(1) Do noise and vibrations comply with the country's standards?	(a) Y	Noise and vibration is predicted by the operation of heavy machinery and trucks, and the transportation of materials and equipment. **(mitigation measures)** NPTGC will comply with the noise standard and reduce such noise and vibration with proper time management and work operation.
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) Y	(a) There is no protected areas in the project site.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Are adequate measures taken to prevent disruption of migration routes and habitat fragmentation of wildlife and livestock? (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? (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?	(a) N/A (b) Y (c) N/A (d) Y (e) N/A (f) N/A	(a) There is no forest or other ecologically vulnerable area in and around the project site. (b) do (c) do (d) do (e) do (f) No
	(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? (b) Is there any possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides? (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?	(a) N (b) N (c) N	(a) No specific impact is anticipated. (b) do (c) do
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? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Are the compensations going to be paid prior to the resettlement? (e) Are the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(a) N/A (b) N/A (c) N/A (d) N/A (e) N/A (f) N/A (g) N/A (h) N/A (i) N/A (j) N/A	(a) No involuntary resettlement caused by the project. (b) do (c) do (d) do (e) do (f) do (g) do (h) do (i) do (j) do
	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (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? (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? (d) Are the compensations for transmission wires given in accordance with the domestic law?	(a) Y (b) Y (c) N (d) N	(a) Increased risk of accidents is anticipated en route where population density is high. **(mitigation measures)** The extension work can be shifted during weekends while city traffic is less. Consultation with local residents along the route can be organized for information disclosure on construction schedule, project details etc. to increase their understandings and preparedness for possible traffic disturbance. (b) A temporary influx of migrant labor during construction period may increase infectious diseases. (c) No specific impact is anticipated as the height is sufficiently away from local settlements so that serious radio interference is not likely anticipated. (d) Not applicable
4 Social Environment	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N/A	(a) There is no local archeological, historical, cultural, and religious heritage admitted in the project area.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N/A	(a) The landscape will remain same as no new tower will be erected. The number and volume of transmission wires will also remain same level.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a) N/A (b) N/A	(a) No such social impacts are anticipated. (b) do
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (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? (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.? (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?	(a) N (b) Y (c) Y (d) Y	(a) NPTGC is obedient to the labor legislations and conditions in Mongolia. (b) do (c) do (d) do
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	(a) Y (b) N/A (c) N/A	(a) It is anticipated that there will be air pollution such as exhaust, waste water discharge, dust emission, noise and vibration during construction period. However, the impact is temporary and anticipated to be minor. NPTGC will examine measures to minimize them and strictly monitor them. (b) Impact to natural ecosystems is negligible (c) Accidents of workers, traffic accidents due to traffic volume increase, and involvement of passers-by and local residents nearby the construction site can occur during construction period. **(mitigation measures)** Consultation with local residents will help increase their awareness and understanding toward the construction works.
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (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?	(a) Y (b) Y (c) Y (d) N	(a) NPTGC will keep monitoring the specific items throughout the operation period, such as waste treatment, safety & health and excessive noise at the laboratory. (b) Noise, vibrations, wastes and safety & health. Methods and frequencies are based on the requirements from the relevant laws and standards. (c) It is the laboratory manager responsible for monitoring. (d) Methods and frequencies are based on the requirements from the relevant laws and standards.
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) Y	(a) Not applicable
	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) Not applicable

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? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (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?	(a)N (b)N (c)N (d)N	(a) It will not likely require EIA (general / detailed) as the environmental impact is anticipated minimum. (b) N/A (c) N/A (d) N/A
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a) N (b) N	(a) As the facilities and equipment will be installed at UBEDN, consultation with local stakeholders will not be required. (b) N/A
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) Multiple alternatives were examined while project processing in order to avoid or minimize adverse impacts.
2 Pollution Control	(2) 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) There will be no excavation works required.
	(5) Noise and Vibration	(1) Do noise and vibrations comply with the country's standards?	(a) Y	Noise and vibration will be produced when carrying in the facilities and equipment into UBEDN. **(mitigation measures)** UBEDN will comply with the noise standard and reduce such noise and vibration with proper time management and installation work plan.
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) There is no protected areas in the project site.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Are adequate measures taken to prevent disruption of migration routes and habitat fragmentation of wildlife and livestock? (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? (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?	(a) N/A (b) N/A (c) N/A (d) N/A (e) N/A (f) N/A	(a) There is no forest or other ecologically vulnerable area in and around the project site. (b) do (c) do (d) do (e) do (f) The project site is located in developed area in the heart of UB city.
3 Natural Environment	(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? (b) Is there any possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides? (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?	(a) N (b) N (c) N	(a) There will be no excavation works required. (b) do (c) do
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? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Are the compensations going to be paid prior to the resettlement? (e) Are the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(a) N/A (b) N/A (c) N/A (d) N/A (e) N/A (f) N/A (g) N/A (h) N/A (i) N/A (j) N/A	(a) No involuntary resettlement caused by the project. (b) do (c) do (d) do (e) do (f) do (g) do (h) do (i) do (j) do
	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (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? (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? (d) Are the compensations for transmission wires given in accordance with the domestic law?	(a) N/A (b) N/A (c) N/A (d) N/A	(a) No such impact is anticipated to the local residents living around the site. (b) do (c) do (d) do
4 Social Environment	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	(a) No such impact is anticipated as the facility and equipment will be kept at UBEDN.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) No such impact is anticipated as the facility and equipment will be kept at UBEDN.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a) N/A (b) N/A	(a) No such social impact is anticipated. (b) There is no ethnic minorities or indigenous people.
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (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? (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.? (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?	(a) N (b) Y (c) Y (d) Y	(a) UBEDN is obedient to the Law on Labor and the relevant safety standards of Mongolia. (b) do (c) do (d) do
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	(a) Y (b) N/A (c) Y	(a) It is anticipated that there will be noise and vibration while carrying the facility and equipment into the UBEDN. UBEDN will instruct suppliers to minimize them. (b) Impact to natural ecosystems negligible. (c) Accidents may occur while carrying the mobile substation as a heavy traffic is constantly expected in UB city during day time. **(mitigation measures)** Flexible schedule for installation will not to disturb the city traffic, and traffic conditions and road conditions should be taken into consideration while carrying them into UBEDN.
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (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?	(a) N/A (b) N/A (c) N/A (d) N/A	(a) No specific monitoring is required. (b) do (c) do (d) do
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) Not applicable
	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	(a) Not applicable

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? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (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?	(a)N (b)N (c)N (d)N	(a) It will not likely require EIA (general / detailed) as the environmental impact is anticipated minimum. (b) N/A (c) N/A (d) N/A
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a) N (b) N	(a) Although it is not mandatory to conduct consultation by law, it will help increase the awareness and understanding of the local residents toward the construction works. (b) No.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) Multiple alternatives were examined while project processing in order to avoid or minimize adverse impacts.
2 Pollution Control	(1) Air Quality	(a) Do air pollutants emitted from facilities comply with the country's emission standards?	(a) Y	(a) Discharge of exhaust fumes from the operation of heavy machinery and trucks, production and diffusion of dust from the treatment of the excavated soils will occur. **(mitigation measures)** UBEDN will comply with the air quality standard as stipulated by the Law on Air of Mongolia. Construction work management including time management, employees' shifting system should be done in an appropriate manner.
	(2) 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) Water turbidity will be caused by sludge treatment, from the temporary site of earth dig out, and by waste water from the construction work. **(mitigation measures)** UBEDN will comply with the water quality standard. Discharged water should be strictly monitored and prevent oil leakage.
	(3) Wastes	(a) Are wastes generated by the operation properly treated and disposed of in accordance with the country's standards?	(a) Y	(a) Excavated soil and sludge by the construction work will be produced. **(mitigation measures)** UBEDN is recommended to contact and coordinate with UB City for collection, transportation and disposal of such industrial wastes as stipulated by the Law on Household and Industrial Waste of Mongolia.
	(5) Noise and Vibration	(1) Do noise and vibrations comply with the country's standards?	(a) Y	Noise and vibration is predicted by the operation of heavy machinery and trucks, and the transportation of materials and equipment. **(mitigation measures)** UBEDN will comply with the noise standard and reduce such noise and vibration with proper time management and work operation.
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) There is no protected areas in the project site.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Are adequate measures taken to prevent disruption of migration routes and habitat fragmentation of wildlife and livestock? (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? (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?	(a) N/A (b) N/A (c) N/A (d) N/A (e) N/A (f) N/A	(a) There is no forest or other ecologically vulnerable area in and around the project site. (b) do (c) do (d) do (e) do (f) The project site is located in developed area in the heart of UB city.
	(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? (b) Is there any possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides? (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?	(a) N (b) N (c) N	(a) There will be no excavation works required. (b) do (c) do
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? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Are the compensations going to be paid prior to the resettlement? (e) Are the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(a) N/A (b) N/A (c) N/A (d) N/A (e) N/A (f) N/A (g) N/A (h) N/A (i) N/A (j) N/A	(a) No involuntary resettlement caused by the project. (b) do (c) do (d) do (e) do (f) do (g) do (h) do (i) do (j) do
	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (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? (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? (d) Are the compensations for transmission wires given in accordance with the domestic law?	(a) Y (b) Y (c) N (d) N	(a) Increased risk of accidents is anticipated en route where population density is high. The extension work can be conducted during weekends while city traffic is less. (b) A temporary influx of migrant labor during construction period may increase infectious diseases. (c) No specific impact is anticipated as the height is sufficiently away from local settlements so that serious radio interference is not likely anticipated. (d) Not applicable
4 Social Environment	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N/A	(a) There is no local archeological, historical, cultural, and religious heritage admitted in the project area.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N/A	(a) The landscape will remain same as no new tower will be erected. The number and volume of transmission wires will also remain same level.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a) N/A (b) N/A	(a) No such social impacts are anticipated. (b) do
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (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? (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.? (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?	(a) N (b) Y (c) Y (d) Y	(a) NPTGC is obedient to the labor legislations and conditions in Mongolia. (b) do (c) do (d) do
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	(a) Y (b) N/A (c) N/A	(a) It is anticipated that there will be air pollution such as exhaust, waste water discharge, dust emission, noise and vibration during construction period. However, the impact is temporary and anticipated to be minor. NPTGC will examine measures to minimize them and strictly monitor them. (b) Impact to natural ecosystems is negligible (c) Accidents of workers, traffic accidents due to traffic volume increase, and involvement of passers-by and local residents nearby the construction site can occur during construction period. **(mitigation measures)** The construction work can be shifted during weekends while city traffic is less. Consultation with local residents within the catchment area and along the underground cable route can be organized for information disclosure on construction schedule, project details etc. to increase their understandings and preparedness for possible traffic disturbance.
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (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?	(a) Y (b) Y (c) Y (d) N	(a) UBEDN will keep monitoring the specific items throughout the operation period, such as waste treatment, safety & health and excessive noise at the laboratory. (b) Noise, vibrations, wastes and safety & health. Methods and frequencies are based on the requirements from the relevant laws and standards. (c) It is the laboratory manager responsible for monitoring. (d) Methods and frequencies are based on the requirements from the relevant laws and standards.
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) Y	(a) Not applicable
	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) Not applicable

Draft Terms of Reference of Consulting Services

1. Introduction

Power demand in Mongolia has recently increased, due to the country's high economic growth. It is forecasted that the power demand in Ulaanbaatar, which comprises more than 40 % of the country, will grow by 6-7 % per year. To respond to such a situation, the Government of Mongolia is aiming to install new power plants and other electric infrastructure. Based on this government policy, Ulaanbaatar No.5 Thermal Plant is planned to be one of the newly installed power resources, and rehabilitation of old power stations is planned in order to recover the rated capacity. Conversely, development and rehabilitation of transmission and distribution fields seems to lag behind the development of power stations.

Most of the transmission system in Ulaanbaatar has been in service for 30 years since its construction and deterioration and lack of capacity have become serious problems. However, in order to meet the high demand growth for power, transmission lines should be reinforced or renewed, and some substations also require replacement.

In Ulaanbaatar's distribution system, most of the underground cable system has reached its expected lifetime and frequent outages happen due to the aging facilities. Furthermore, because no distribution automation system has yet been installed, restoration time for outages is considerable, and the outage area is also difficult to minimize. In this context, a power supply of high quality and high reliability is crucial to maintaining the social and economic development of Ulaanbaatar. Thus, upgrade of the transmission and distribution system in Ulaanbaatar is a critical issue.

2. Project Brief

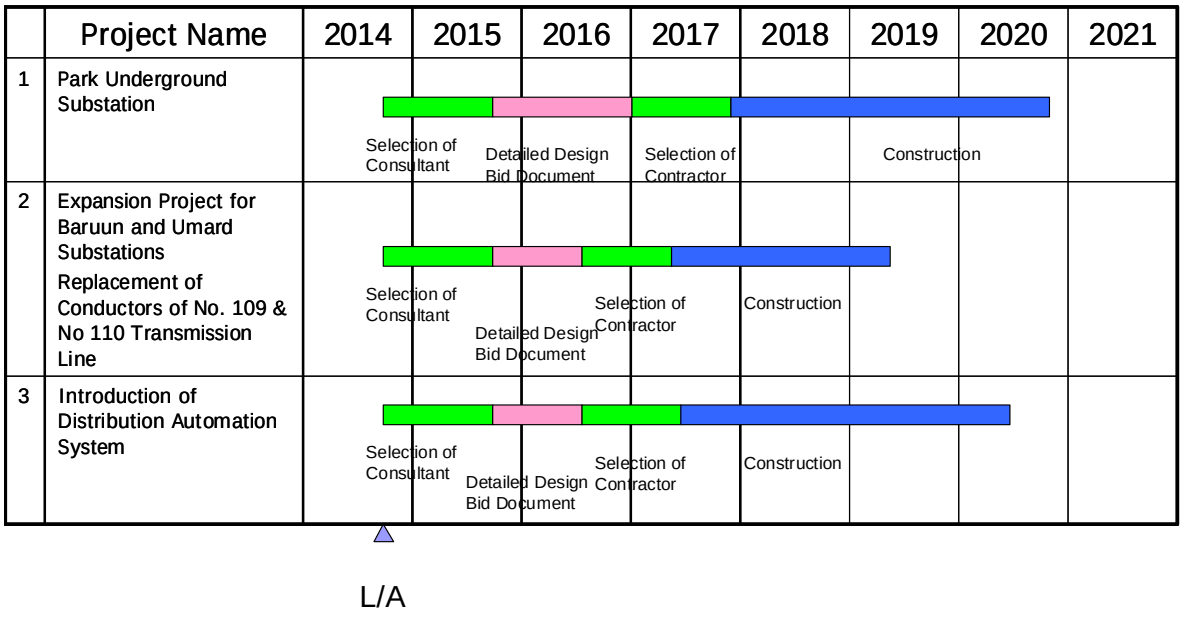
(1) Scope of the Projects

The consulting services are expected to cover the following transmission and distribution projects.

- ◆ Construction of Park Underground Substation
- ◆ Expansion of Baruun and Umard Substations and Conductor Replacement of Existing 110 kV Transmission Lines (No. 109 & No. 110)
- ◆ Introduction of Distribution Automation System

(2) Project Schedule

This TOR is assumed that the following schedule is proceeded.



3. Project Handling Unit

The projects are handled by a project handling unit consisting of representatives of MOE, NPTGC and UBEDN, (hereinafter, the Project Team: PT).

4. Scope of the Services

(1) Review of F/S and Basic Design

The Consultant shall undertake the following works:

- Review of the results of the feasibility study prepared by JICA in 2014
- Preparation of basic plans, layout, location, specifications of each facility
- Assistance to PT for arrangement of required permission (if necessary)

(2) Detailed Design

The Consultant shall undertake the following works:

- Field survey (geological survey, measurement survey, etc.)
- Detailed study for layout, location and each facility
- Creation of technical specifications
- Cost estimation for bidding

(3) Assistance to PT in Pre-Qualification (PQ)

The Consultant shall undertake the following works:

- Assistance to preparation and announcement of pre-qualification documents

- Assistance to evaluation of submitted documents from bidders
- Preparation of draft evaluation report and assistance to PT in preparing final evaluation report

(4) Assistance to PT in Bidding

The Consultant shall undertake the following works:

- Assistance to preparation of bid documents
- Assistance to PT in replying to Bidder's question and in issuing agenda to bid documents
- Assistance to PT in evaluation of bidders' proposal
- Assistance to PT in clarification meeting with bidders
- Preparation of draft evaluation report and assistance to PT in preparing final evaluation report
- Preparation of contract documents

(5) Assistance to PT in Pre-Construction Supervision

The Consultant shall undertake the following works:

- Inspection of approval documents/drawings for manufacturing or construction
- Check of materials/equipment quality in factories
- Assistance to PT in design coordination meeting with the Contractor in Mongolia

(6) Inspection, Testing and Delivery Control during Manufacturing

The Consultant shall undertake the following works:

- Review and approval of proposal on quality assurance, quality control plan and delivery schedule prepared by the Contractors
- Regular review of production and delivery schedule submitted by the Contractors
- Review and approval of shop test procedures and shop test reports submitted by the Contractors
- Shop test witness of major equipment

(7) Assistance to PT in Construction Supervision

The Consultant shall undertake the following works:

- Coordination, supervision and inspection of all construction and erection works
- Review and approval of the Contractor's quality assurance and control program at site
- Monitoring and control of work progress and initiation of corrective measures, if required
- Submission of monthly progress reports
- Assistance to PT at site coordination meeting with the Contractor in Mongolia
- Inspection and direction of preventive safety
- Assistance to PT during the various commissioning stages including performance guarantee test
- Commissioning and acceptance tests

(8) Others

The Consultant shall undertake the following works:

- Assistance in Reporting to JICA
- Technology transfer for operators and maintenance staff
- Support for creation of maintenance and operation manuals

5. Reports and Documents

The Consultant shall be prepare and submit to PT as follows:

1) Basic design report with drawings	5 copies
2) Pre-qualification documents	5 copies
3) Bid documents	5 copies
4) Draft evaluation report of pre-qualification	5 copies
5) Draft evaluation report of bidding	5 copies
6) Monthly progress report	10 copies
7) Quarterly progress report	10 copies
8) Project completion report	10 copies

6. Consulting Staff Expertise Requirement

The consulting services will be provided by a composite team of foreign and local consultant which will include but not be limited to the following engineers:

1) Foreign Engineer

- Project Manager
- Substation Planning Expert
- Substation Facility Expert (Electrical)
- Substation Facility Expert (Civil)
- Substation Facility Expert (Architectural)
- Transmission Facility Expert (Overhead Line and Tower)
- Transmission Facility Expert (Civil)
- Transmission Facility Expert (Underground Cable)
- Distribution Planning Expert
- Distribution Facility Expert (Electrical)
- Distribution Facility Expert (Civil and Architectural)
- Geologist
- Tele-communication Expert
- Bidding Document Expert

2) Local Engineer

- Substation Planning Expert
- Substation Facility Expert (Electrical)
- Substation Facility Expert (Civil)
- Substation Facility Expert (Architectural)

- Transmission Facility Expert (Overhead Line and Tower)
- Transmission Facility Expert (Civil)
- Transmission Facility Expert (Underground Cable)
- Distribution Planning Expert
- Distribution Facility Expert (Electrical)
- Distribution Facility Expert (Civil and Architectural)
- Geologist
- Tele-communication Expert
- Bidding Document Expert

7. Facilities to be Provided by PT

PT shall provide following facilities and services to the Consultant.

- Assistance in obtaining visa, working permit, etc. for foreign consultants, if necessary
- Access to all area of PT and other area, building and facilities relating to the projects in Mongolia
- Supply of necessary data, documents and information, including authorization for taking photographs, and arrangement of meeting with relating engineers, as required by the Consultant
- Tax exemption for foreign consultants

8. Responsibility of PT

PT shall comply with the Guidelines for the Employment of Consultants under Japanese ODA Loans, April, 2012. Special attention shall be paid to the followings:

1) In the case of difference of opinion between PT and the Consultant on any important matters involving professional judgment that might affect the proper evaluation or execution of the Project, PT shall allow the Consultant to submit promptly to PT a written report and simultaneously, to submit a copy to JICA. PT shall forward the report to JICA with its comments in time to allow JICA to study it and communicate with PT before any irreversible steps are taken in the matter. In case of urgency, the Consultant shall have the right to request PT and/or JICA that the matter be discussed immediately between PT and JICA.
2) PT is responsible for supervising the Consultant's performance and ensuring that the Consultant carries out the assignment in accordance with the Contract. Without assuming the responsibilities of PT or the Consultant, JICA may monitor the work as necessary in order to confirm that this is being carried out in accordance with appropriate standard and based on acceptable data. As appropriate, JICA may take part in the discussions between PT and the Consultant. However, JICA shall not be liable in any way for the implementation of the Project by reason of such monitoring or participation in the discussions. Neither PT nor the Consultant shall be released from any responsibility for the Project by the reason of JICA's monitoring or participation in discussion.

ATTCHEMENT: Manning Schedule

ATTACHMENT

Maning Schedule of the Consulting Services

	Month
LOAN AGREEMENT PROCEDURE	
SELECTION OF CONSULTANT by ODA Loan with QCBS	10
Consultancy Services	60
DETAILED DESIGN	9
F/S Review and Basic Design	2
Detailed Design (Park)	13
Detailed Design (Baruun & Umard)	7
Detailed Design (DAS)	7
Preperation of Bid Document (Baruun&Umardm DAS)	6
SELECTION OF CONTRACTOR (Single Stage Two Envelope Bidding)	9
CONSTRUCTION PERIOD	
Construction of Park Underground Substation	36
Baruun & Umard Substation Expansion	24
Replacement of Conductors of No. 109 & No. 110 T/L	18
Distribution Automation System	36
EXPERT ASSIGNMENT (FOREIGN)	
Project Manager	44
Substation Planning Expert	10
Substation Facility Expert (Electrical)	20
Substation Facility Expert (Civil)	7
Substation Facility Expert (Architectural)	6
Transmission Facility Expert (Overhead Line and Tower)	3
Transmission Facility Expert (Civil)	2
Transmission Facility Expert (Underground Cable)	4
Distribution Planning Expert	11
Distribution Facility Expert (Electrical)	11
Distribution Facility Expert (Civil and Architectural)	5
Geologist	3
Tele-communication Expert	4
Bidding Document Expert	4
Total	134
EXPERT ASSIGNMENT (LOCAL)	
Substation Planning Expert	12
Substation Facility Expert (Electrical)	28
Substation Facility Expert (Civil)	20
Substation Facility Expert (Architectural)	12
Transmission Facility Expert (Overhead Line and Tower)	3
Transmission Facility Expert (Civil)	3
Transmission Facility Expert (Underground Cable)	7
Distribution Planning Expert	14
Distribution Facility Expert (Electrical)	22
Distribution Facility Expert (Civil and Architectural)	3
Geologist	3
Tele-communication Expert	4
Bidding Document Expert	6
Total	137