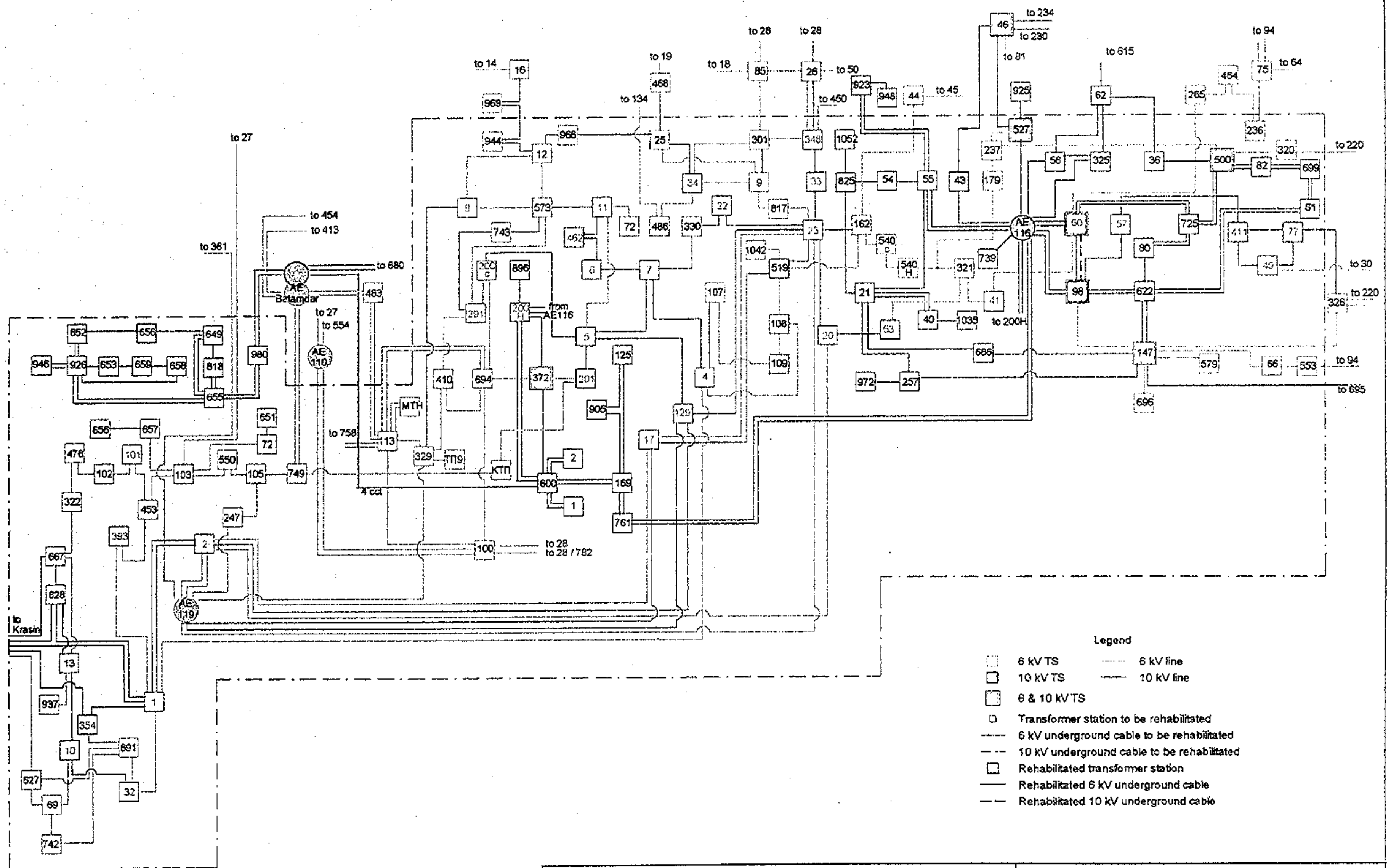
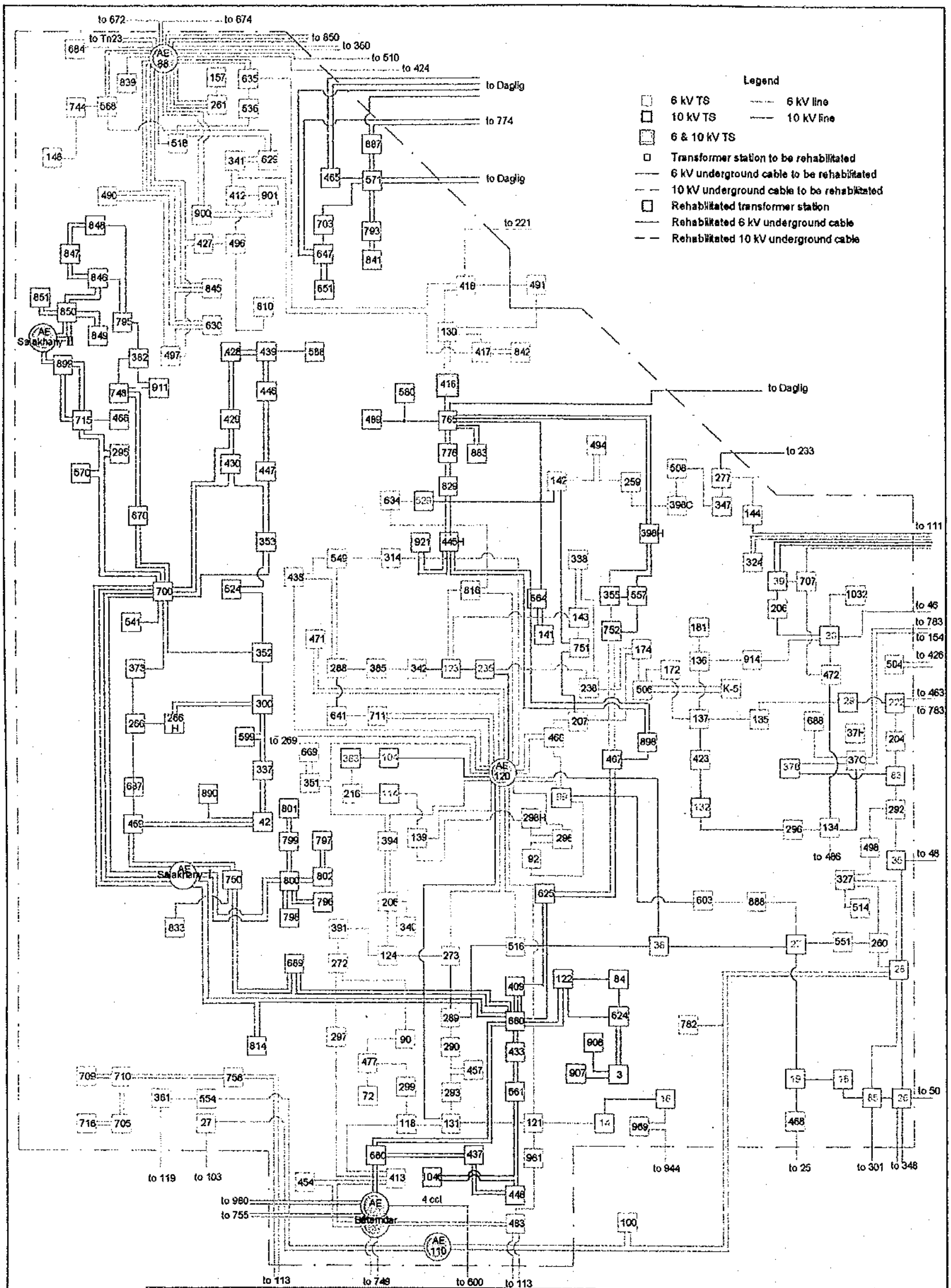


Legend

- 6 kV TS
- 10 kV TS
- 6 & 10 kV TS
- Transformer station to be rehabilitated
- 6 kV underground cable to be rehabilitated
- 10 kV underground cable to be rehabilitated
- Rehabilitated transformer station
- Rehabilitated 6 kV underground cable
- Rehabilitated 10 kV underground cable
- 6 kV line
- 10 kV line

Master Plan Study on Rehabilitation and Reconstruction of Electric Supply in Baku Изучение Генерального Плана Восстановления И Реконструкции Электроснабжения Города Баку	Figure / Рисунок No. II.8.1-1 (1)
Baku Electric Network ПО "БАКЭЛЕКТРОСЕТЬ" / Japan International Cooperation Agency Японское Агентство Международного Сотрудничества	Title / Название Рисунка Rehabilitation and reconstruction plan up to 2004 in Sabail (Phase I)
Joint Venture Nippon Koei Co., Ltd. & KRI International Corp. Совместное предприятие НИППОН КОЕИ и KRI Интернешнл Корп.	



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Baku Electric Network ПО "БАКЭЛЕКТРОСЕТЬ"	Japan International Cooperation Agency Японское Агентство Международного Сотрудничества	Title / Название Рисунка Rehabilitation and reconstruction plan up to 2004 in Yasamal (Phase I)
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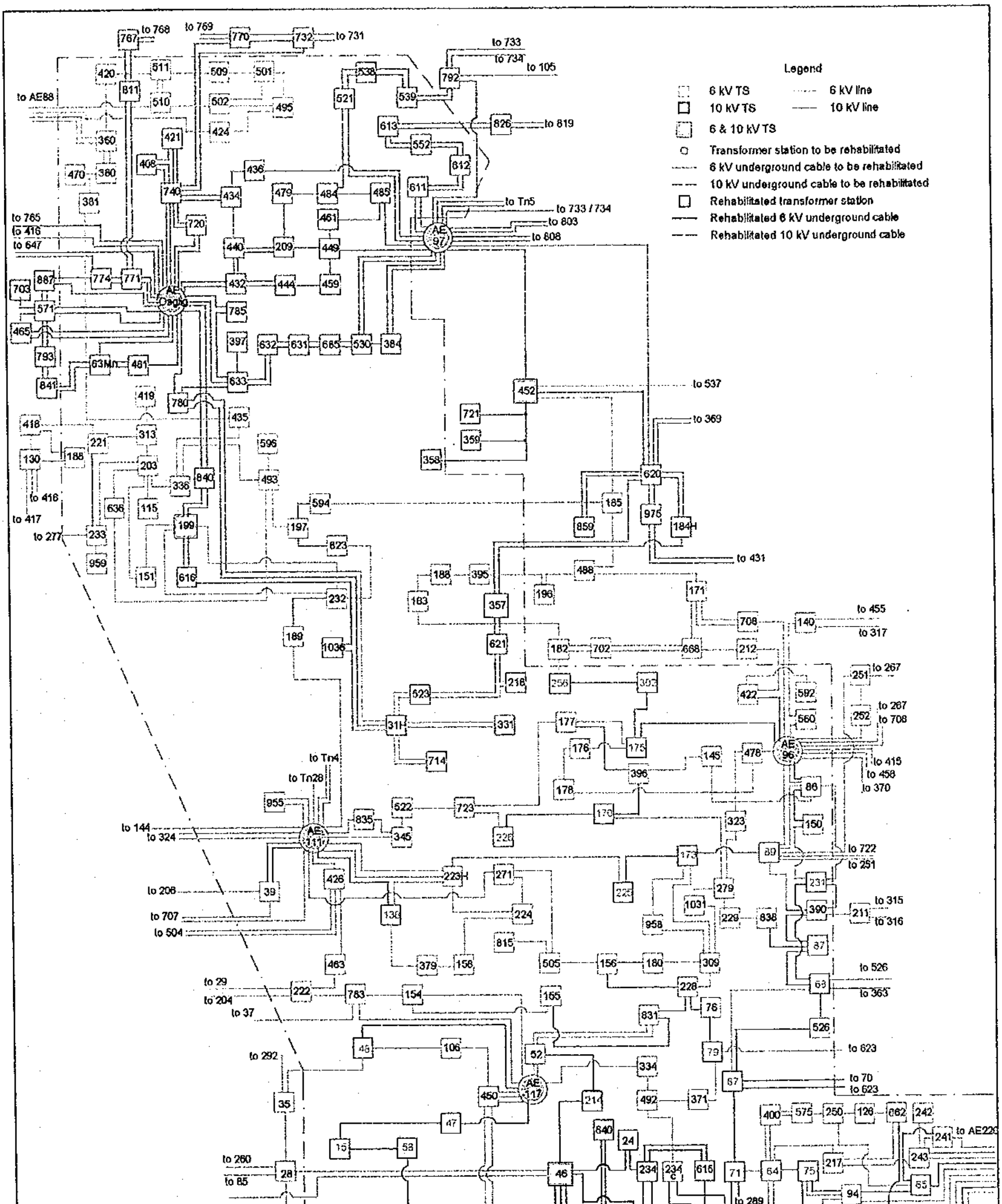

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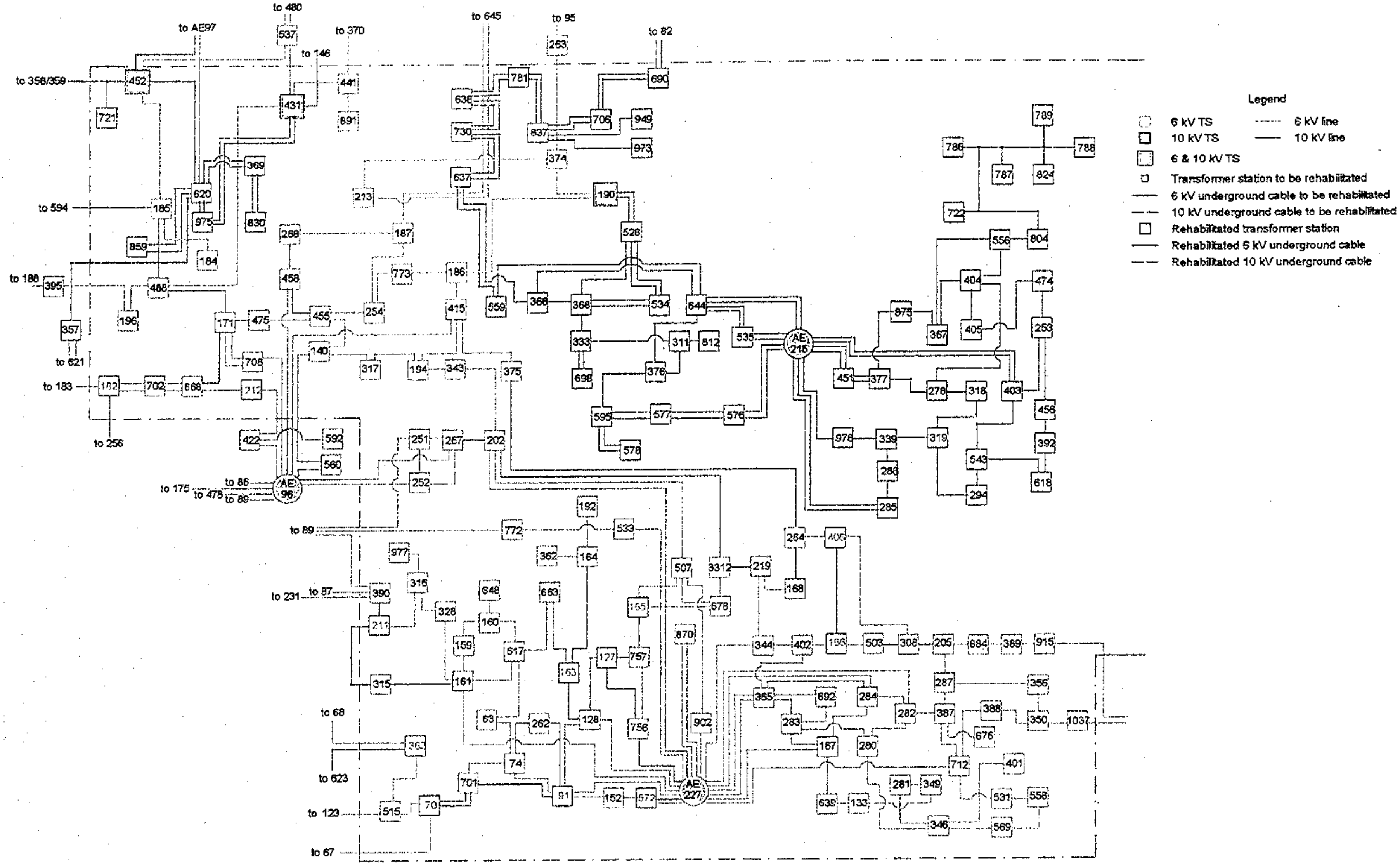

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Joint Venture Nippon Koei Co., Ltd. & KRI International Corp. Совместное предприятие НИППОН КОЕЙ и KRI Интернешнл Корп.	Rehabilitation and reconstruction plan up to 2004 in Narimanov (Phase I)

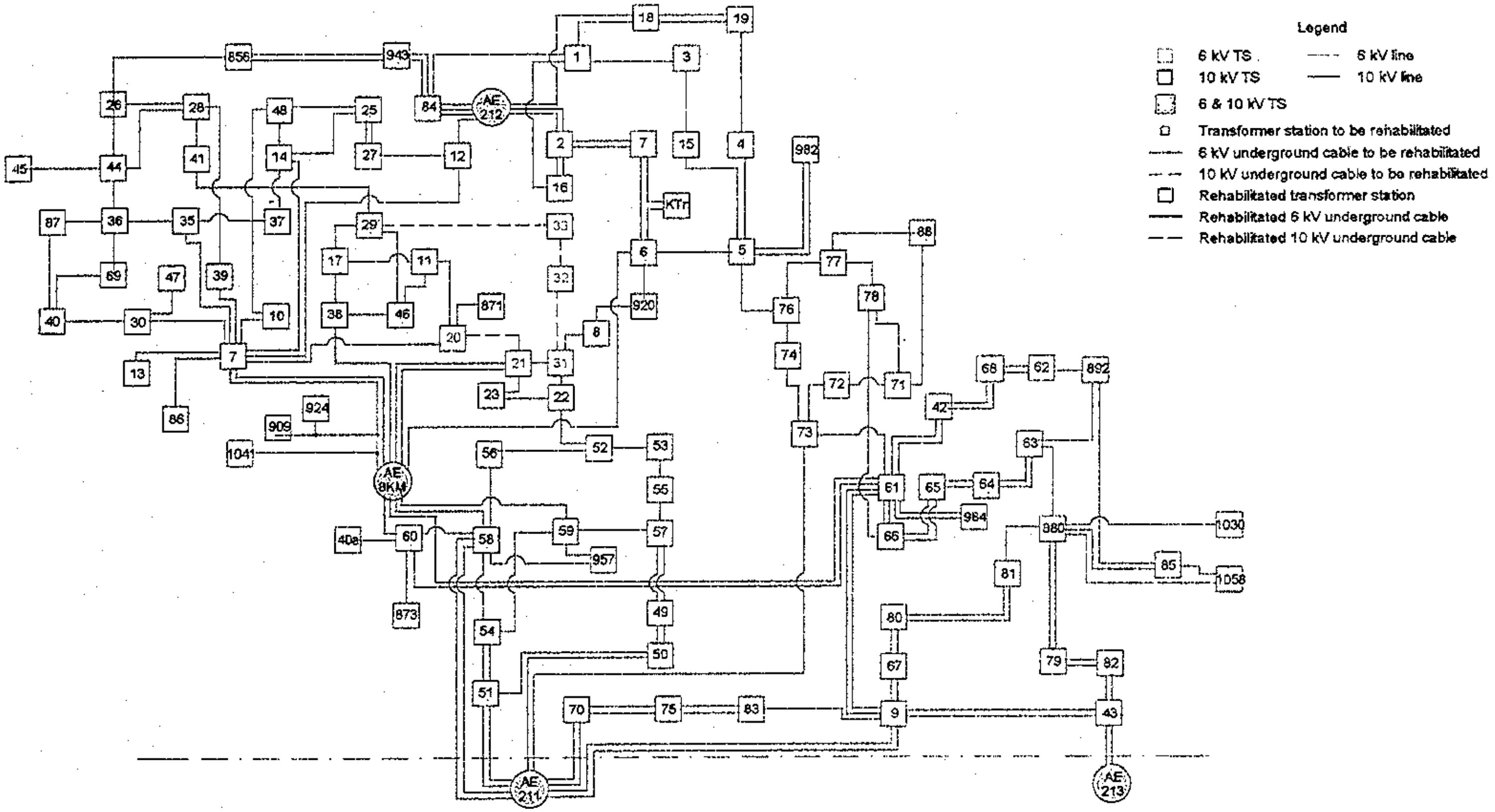

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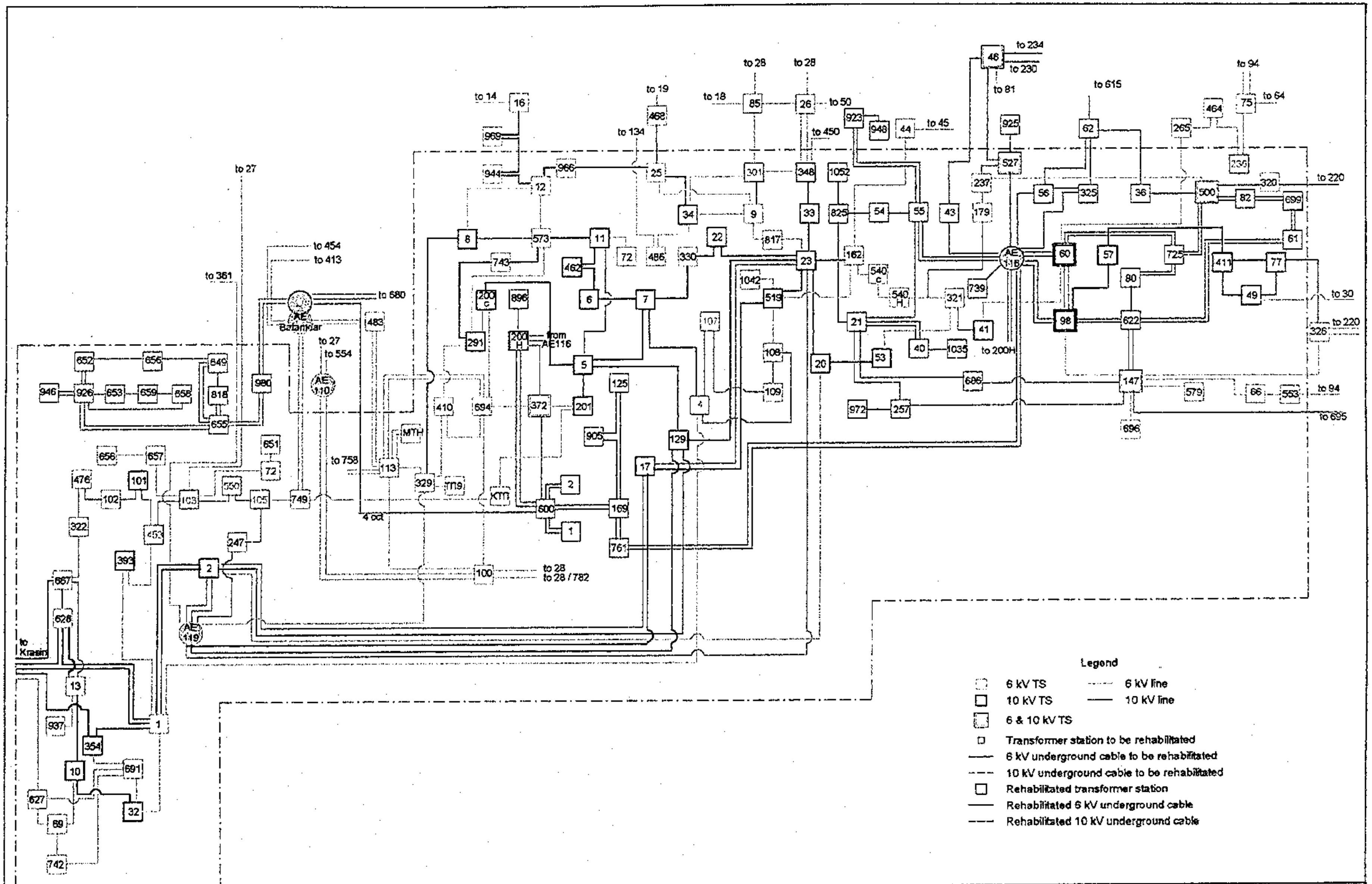
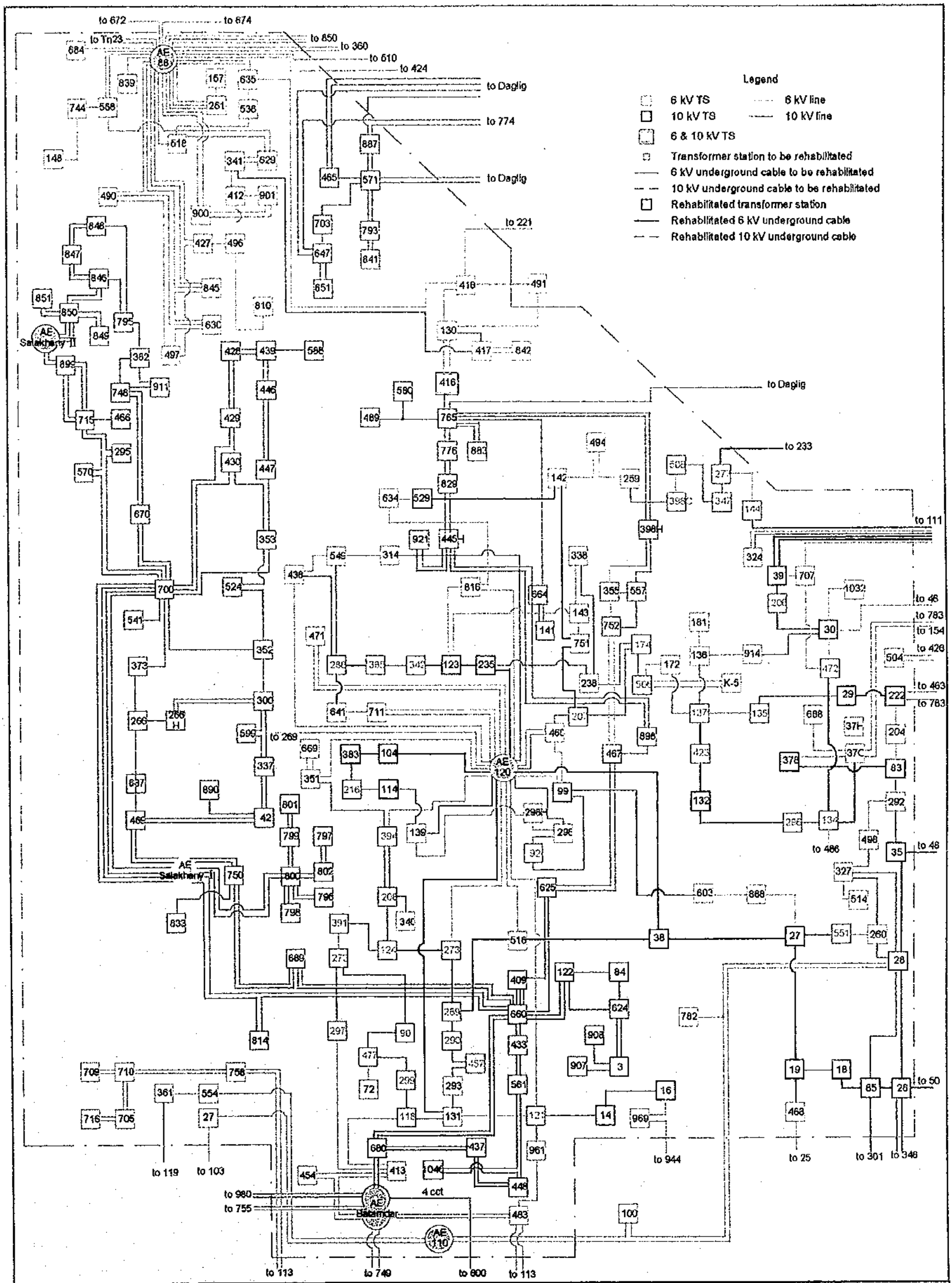
Figure / Рисунок No. II.8.1-1 (5)

Title / Название Рисунка

Rehabilitation and reconstruction plan up to 2004 in Nizami
(Phase I)



Master Plan Study on Rehabilitation and Reconstruction of Electric Supply in Baku **Изучение Генерального Плана Восстановления И Реконструкции Электроснабжения Города Баку**	**Figure / Рисунок No.** II.8.1-2 (1)
Baku Electric Network ПО "БАКЭЛЕКТРОСЕТЬ" / **Japan International Cooperation Agency** Японское Агентство Международного Сотрудничества	**Title / Название Рисунка**
Joint Venture Nippon Koei Co., Ltd. & KRI International Corp. Совместное предприятие НИППОН КОЕИ и KRI Интернешнл Корп.	Rehabilitation and reconstruction plan up to 2007 in Sabail (Phase II)



Master Plan Study on Rehabilitation and Reconstruction of Electric Supply in Baku Изучение Генерального Плана Восстановления И Реконструкции Электроснабжения Города Баку		Figure / Рисунок No. II.8.1-2 (2)
Baku Electric Network ПО "БАКЭЛЕКТРОСЕТЬ"	Japan International Cooperation Agency Японское Агентство Международного Сотрудничества	Title / Название Рисунка Rehabilitation and reconstruction plan up to 2007 in Yasamal (Phase II)
Joint Venture Nippon Koei Co., Ltd. & KRI International Corp. Совместное предприятие НИППОН КОЕИ и KRI Интернешнл Корп.		

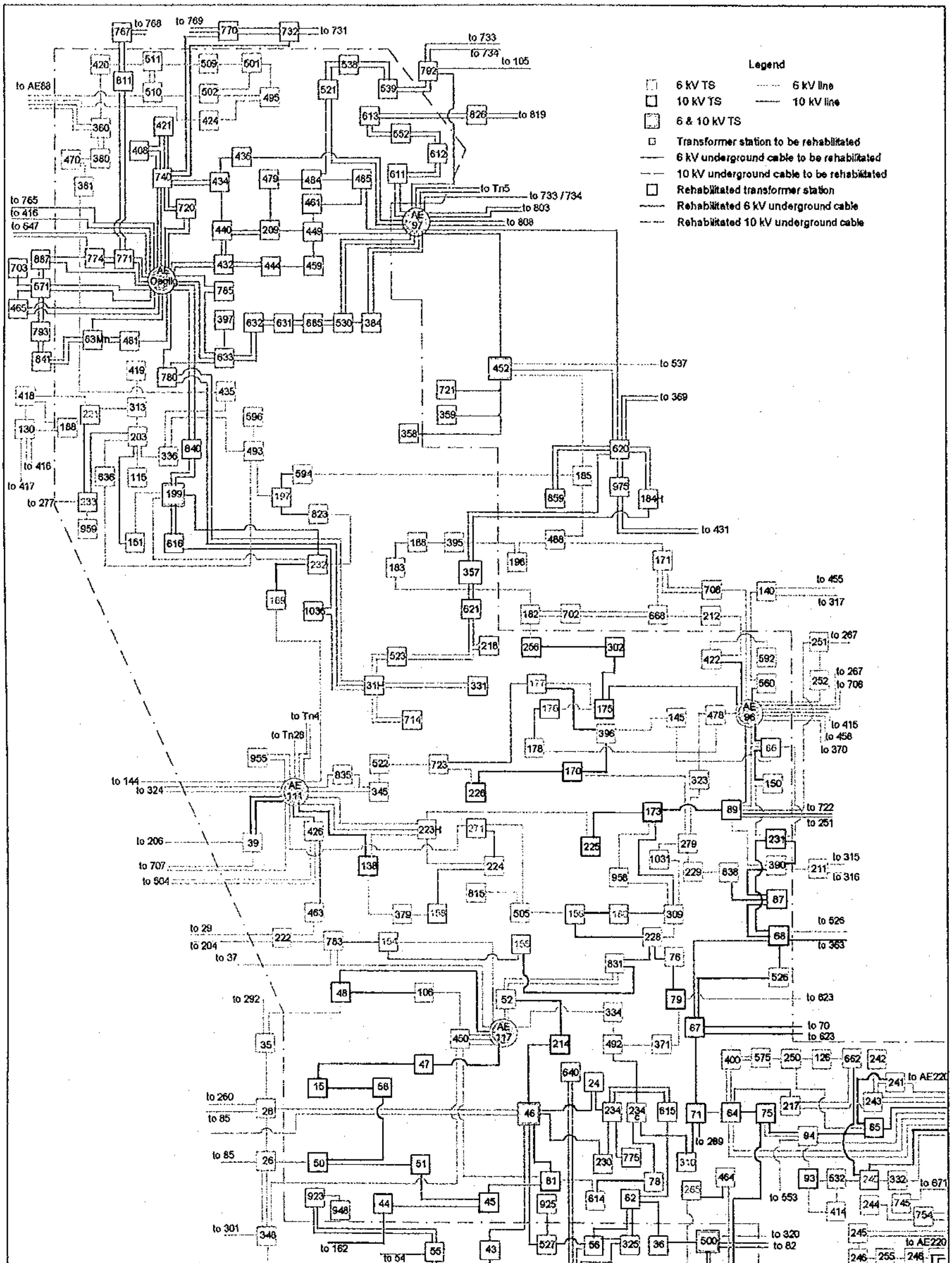


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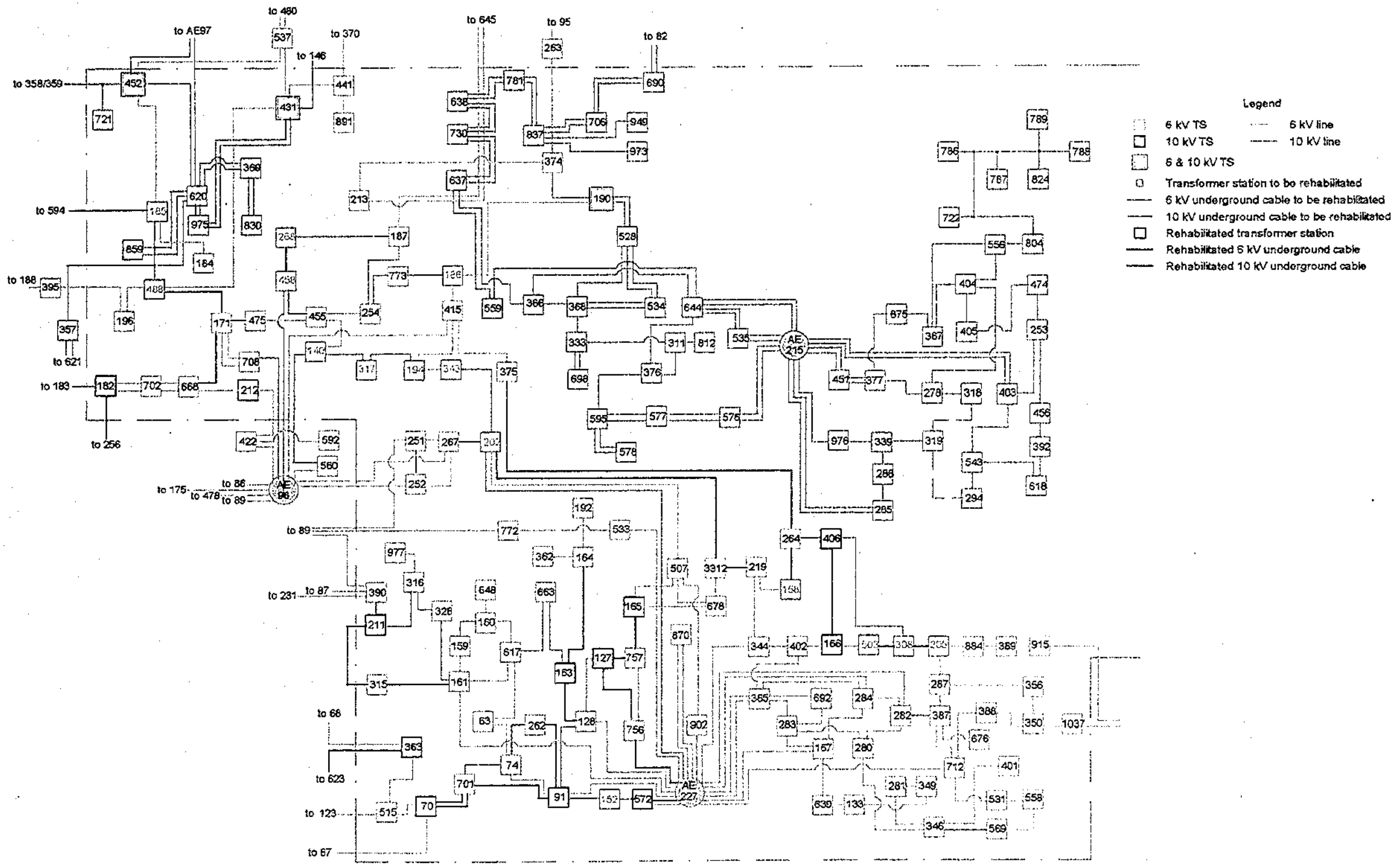
Figure / Рисунок No. II.8.1-2 (3)

Title / Название Рисунка

Rehabilitation and reconstruction plan up to 2007 in Nasimi (Phase II)



Master Plan Study on Rehabilitation and Reconstruction of Electric Supply in Baku Изучение Генерального Плана Восстановления И Реконструкции Электроснабжения Города Баку	Figure / Рисунок No. II.8.1-2 (4)
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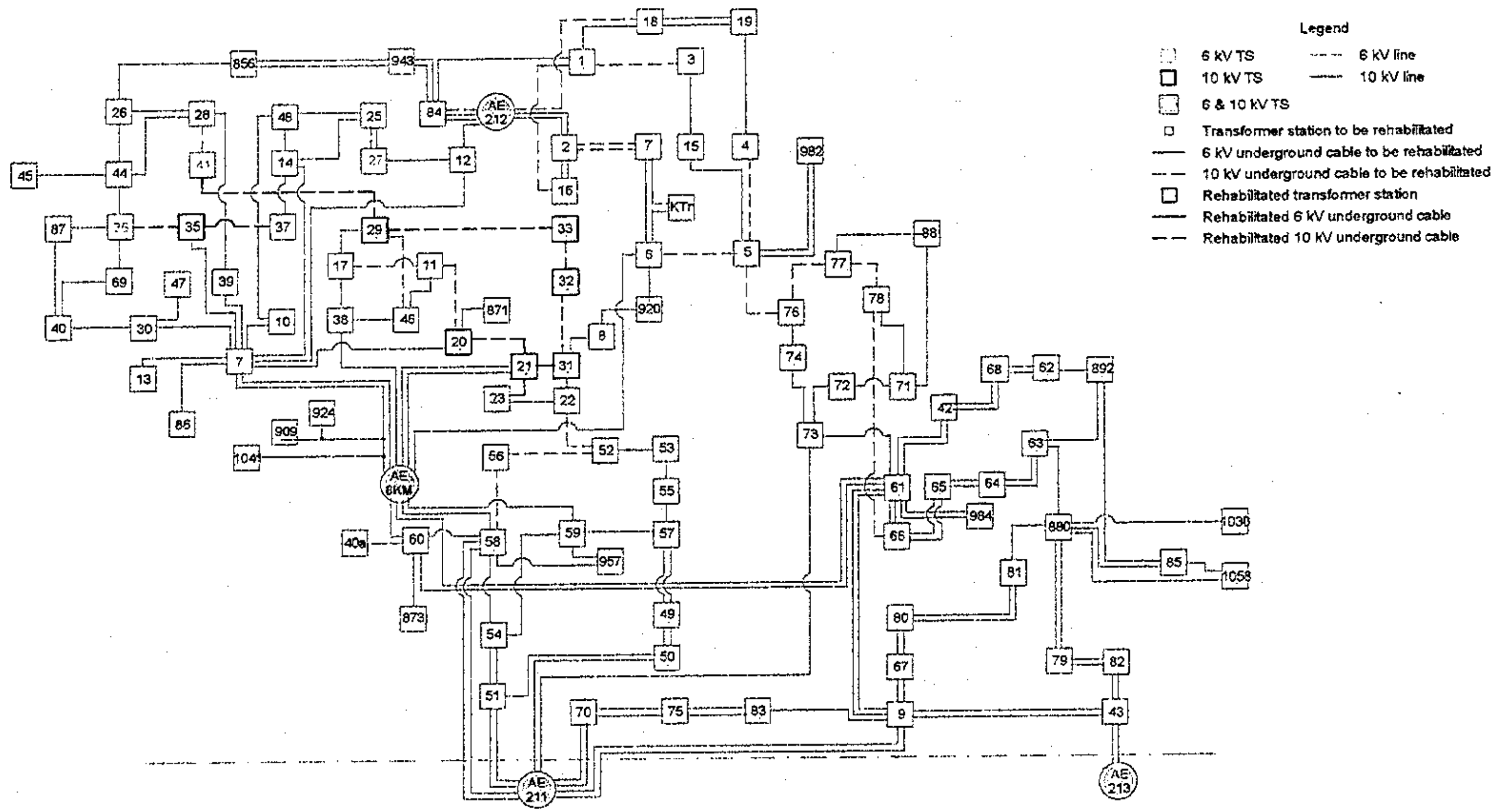

Master Plan Study on Rehabilitation and Reconstruction of Electric Supply in Baku Изучение Генерального Плана Восстановления И Реконструкции Электроснабжения Города Баку	Figure / Рисунок No. II.8.1-2 (5) Title / Название Рисунка Rehabilitation and reconstruction plan up to 2007 in Nizami (Phase II)
Baku Electric Network ПО "БАКЭЛЕКТРОСЕТЬ" / Japan International Cooperation Agency Японское Агентство Международного Сотрудничества	
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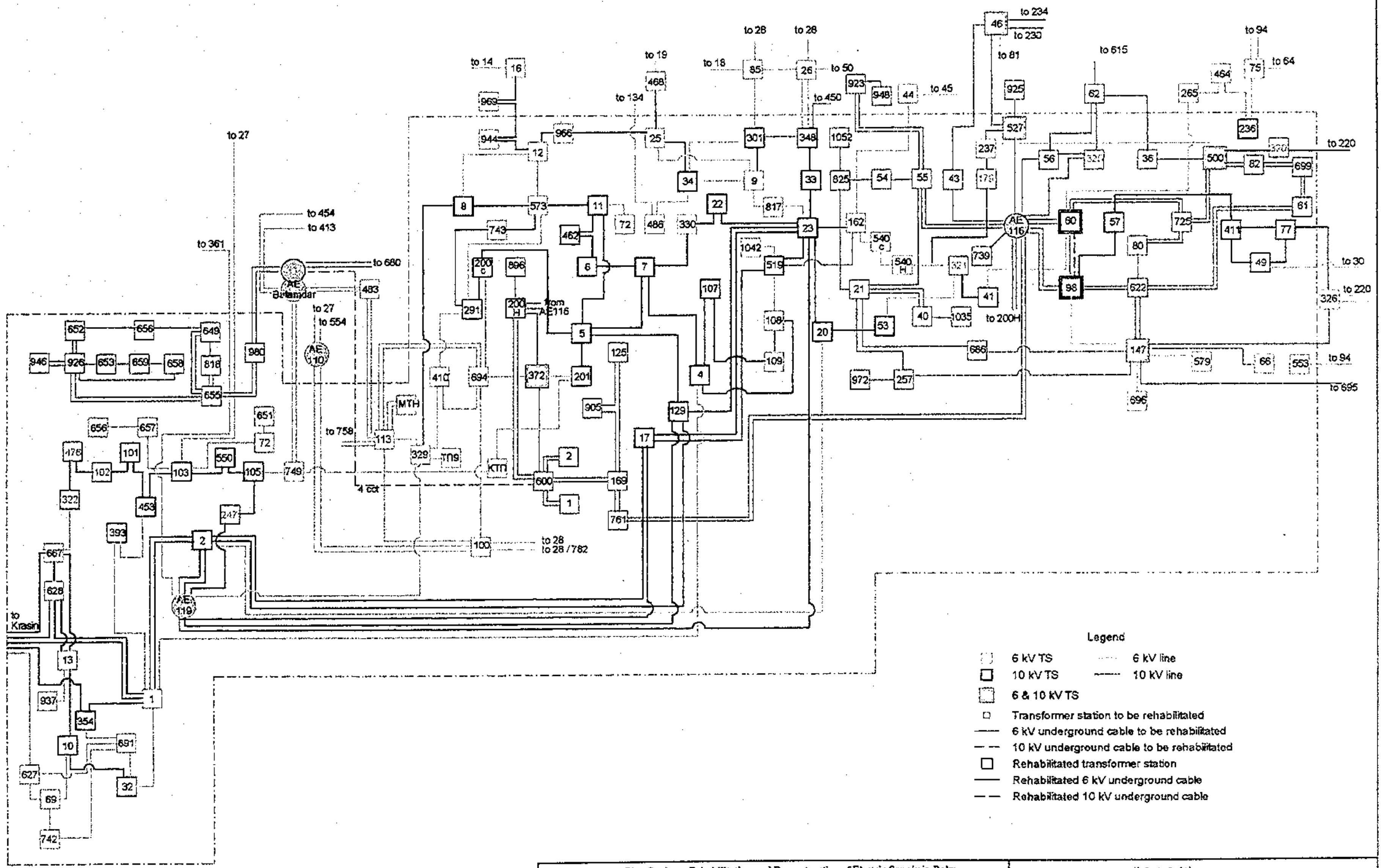

Legend

	6 kV TS		6 kV line
	10 kV TS		10 kV line
	6 & 10 kV TS		
	Transformer station to be rehabilitated		
	6 kV underground cable to be rehabilitated		
	10 kV underground cable to be rehabilitated		
	Rehabilitated transformer station		
	Rehabilitated 6 kV underground cable		
	Rehabilitated 10 kV underground cable		

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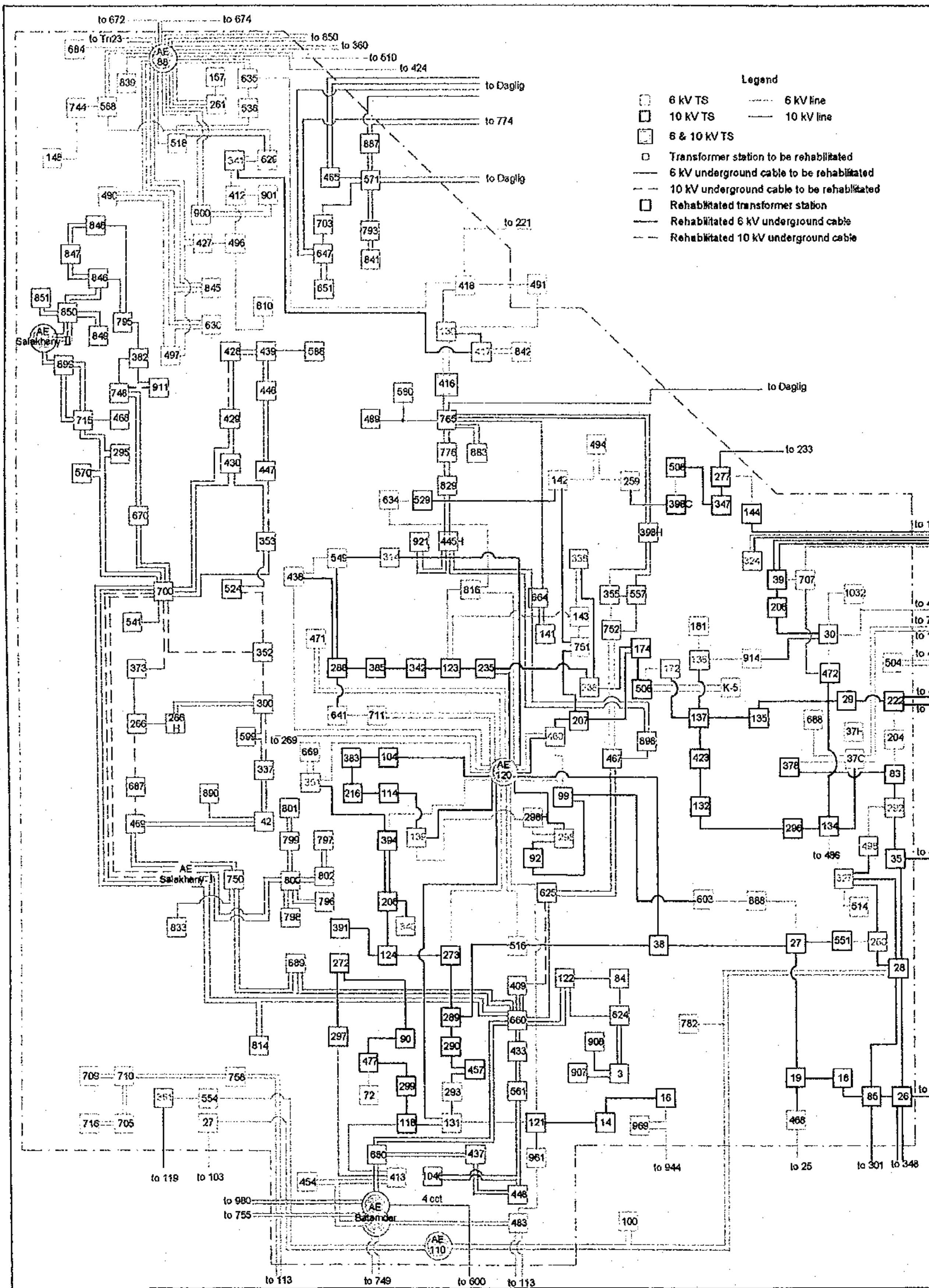
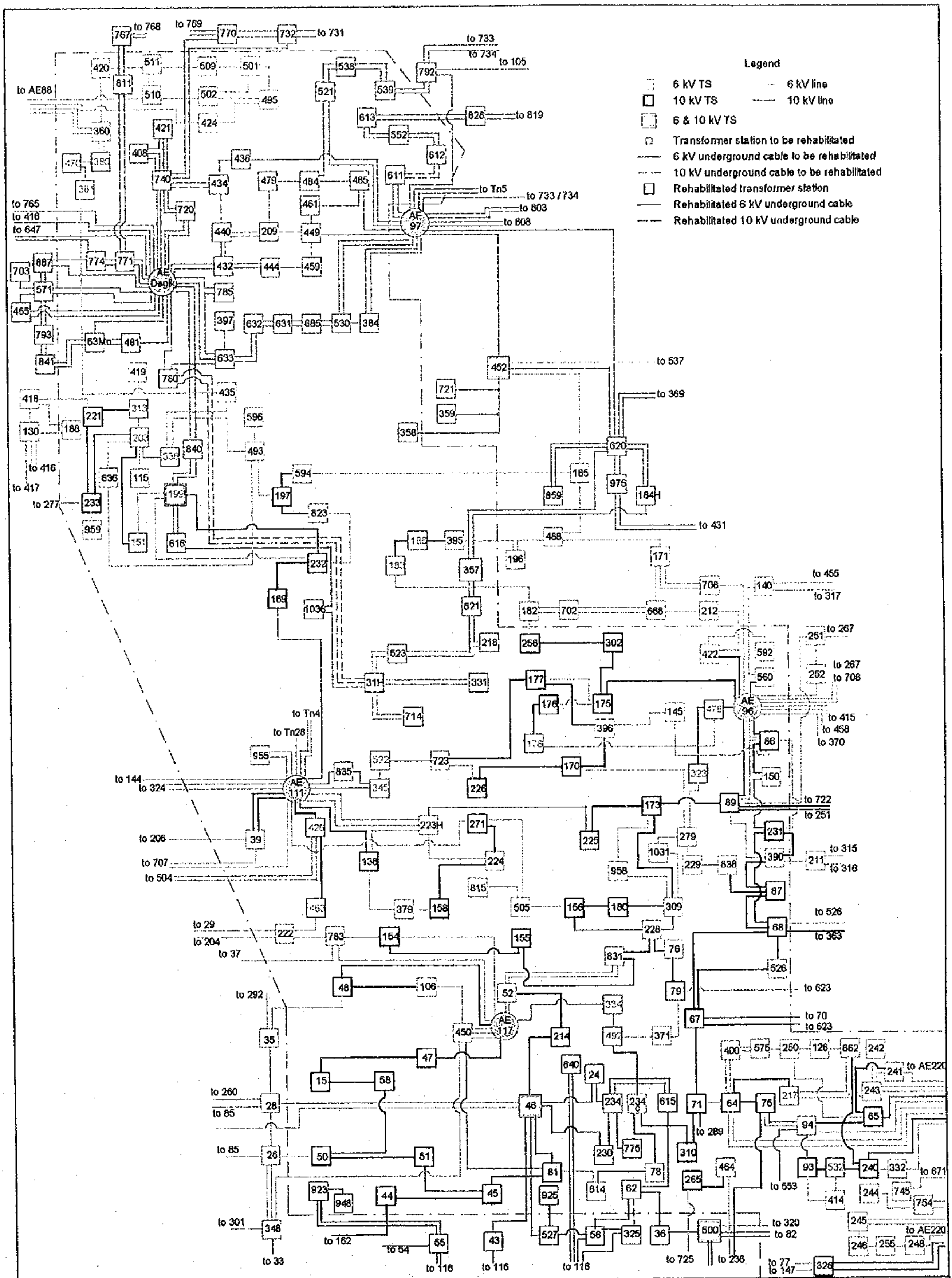
Figure / Рисунок No. II.8.1-3 (1)

Title / Название Рисунка

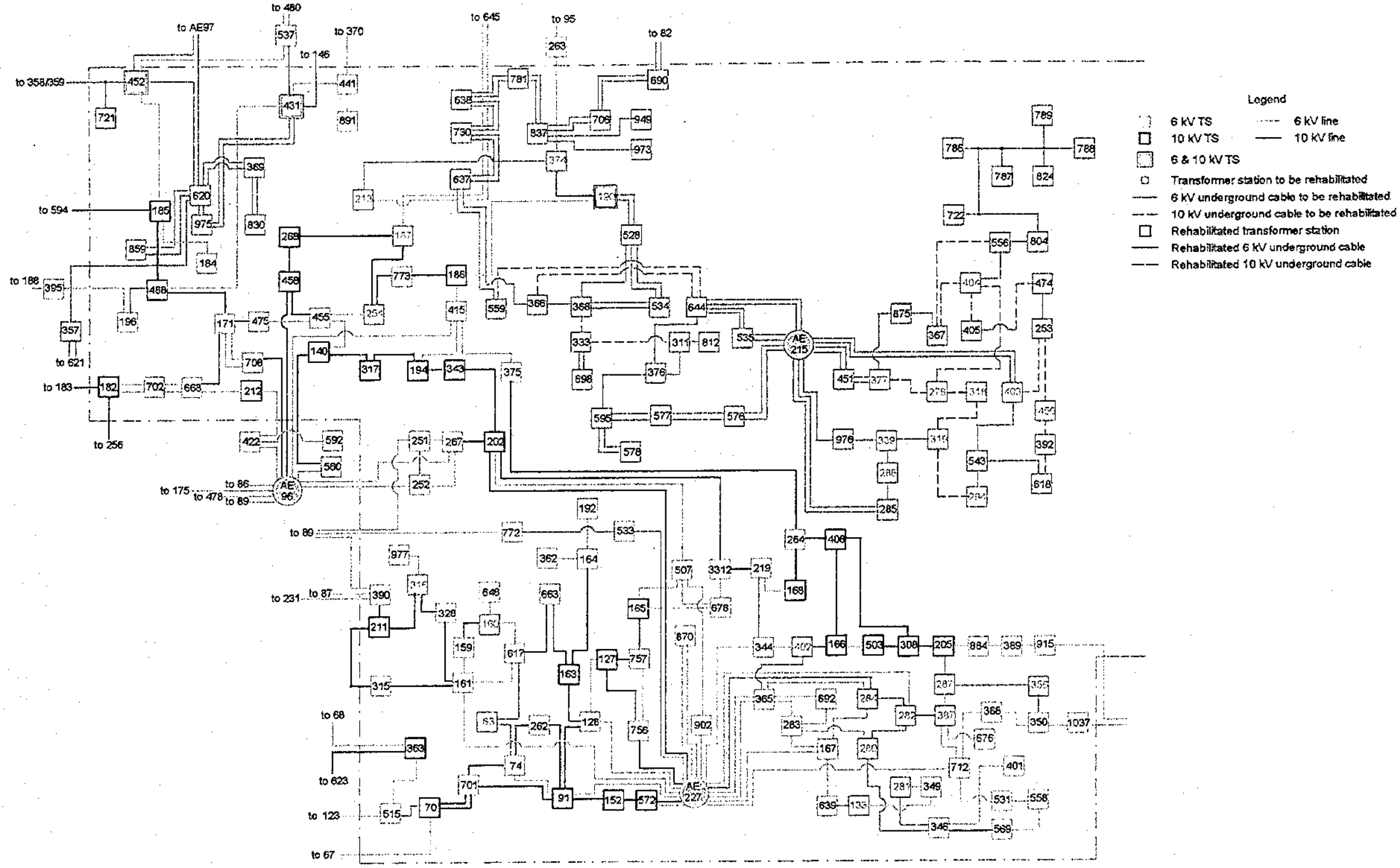
Rehabilitation and reconstruction plan up to 2010 in Sabail
(Phase III)



Master Plan Study on Rehabilitation and Reconstruction of Electric Supply in Baku Изучение Генерального Плана Восстановления И Реконструкции Электроснабжения Города Баку	Figure / Рисунок No. II.8.1-3 (2)
Baku Electric Network ПО "БАКЭЛЕКТРОСЕТЬ" / Japan International Cooperation Agency Японское Агентство Международного Сотрудничества	Title / Название Рисунка
Joint Venture Nippon Koei Co., Ltd. & KRI International Corp. Совместное предприятие НИППОН КОЕИ и KRI Интернешнл Корп.	Rehabilitation and reconstruction plan up to 2010 in Yasamal (Phase III)



Master Plan Study on Rehabilitation and Reconstruction of Electric Supply in Baku Изучение Генерального Плана Восстановления И Реконструкции Электроснабжения Города Баку	Figure / Рисунок No. II.8.1-3 (3)
Baku Electric Network ПО "БАКЭЛЕКТРОСЕТЬ" / Japan International Cooperation Agency Японское Агентство Международного Сотрудничества	Title / Название Рисунка
Joint Venture Nippon Koei Co., Ltd. & KRI International Corp. Совместное предприятие НИППОН КОЕИ и КРИ Интернешнл Корп.	Rehabilitation and reconstruction plan up to 2010 in Nasimi (Phase III)



Master Plan Study on Rehabilitation and Reconstruction of Electric Supply in Baku Изучение Генерального Плана Восстановления И Реконструкции Электроснабжения Города Баку		Figure / Рисунок No. II.8.1-3 (4)
Baku Electric Network ПО "БАКЭЛЕКТРОСЕТЬ"	Japan International Cooperation Agency Японское Агентство Международного Сотрудничества	Title / Название Рисунка Rehabilitation and reconstruction plan up to 2010 in Narimanov (Phase III)
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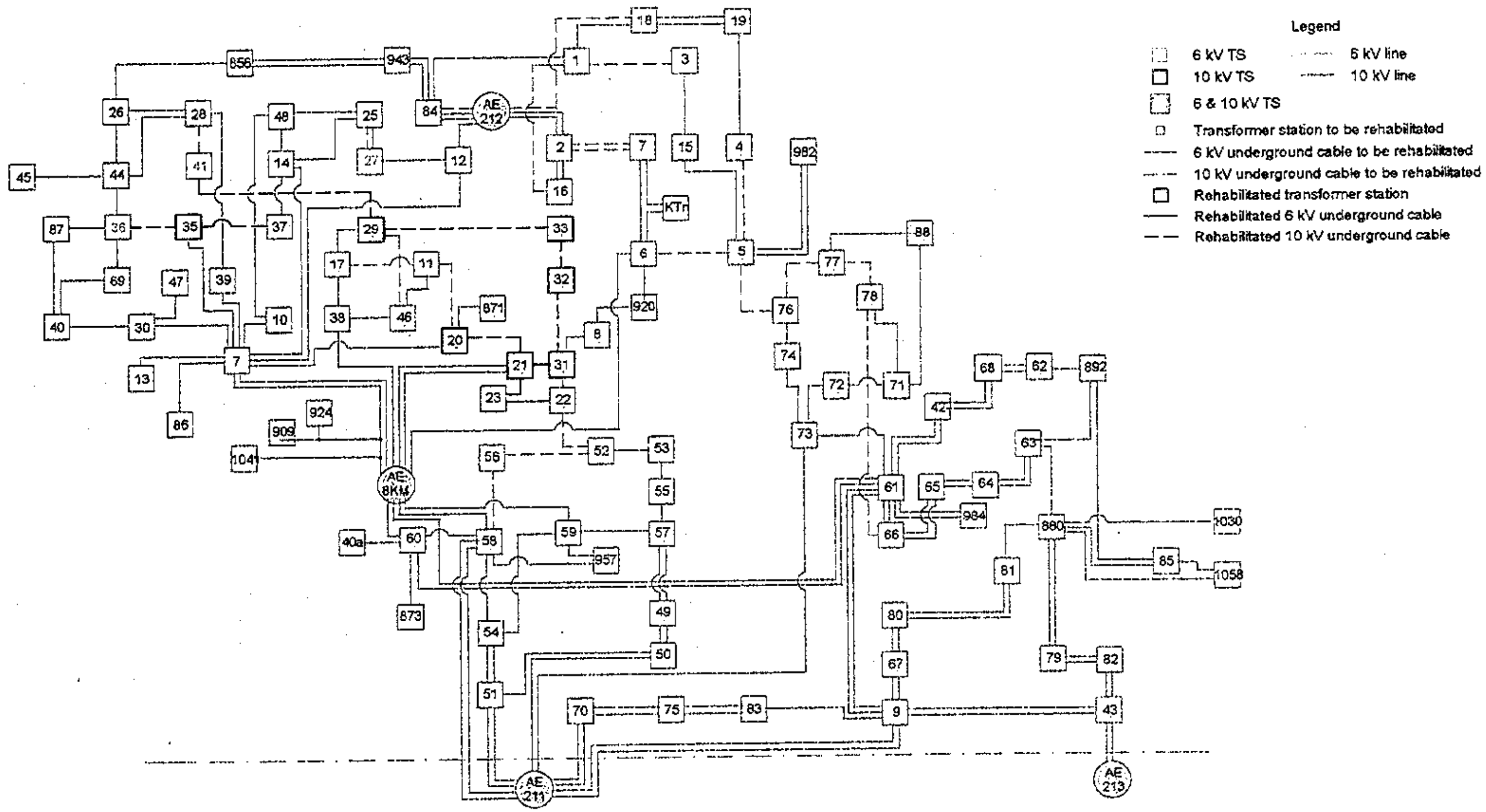

Master Plan Study on Rehabilitation and Reconstruction of Electric Supply in Baku Изучение Генерального Плана Восстановления И Реконструкции Электроснабжения Города Баку	Figure / Рисунок No. II.8.1-3 (5)
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Joint Venture Nippon Koei Co., Ltd. & KRI International Corp. Совместное предприятие НИППОН КОЕЙ и KRI Интернешнл Корп.	Rehabilitation and reconstruction plan up to 2010 in Nizami (Phase III)

Appendix II.8.1-1 Equipment and Materials to be Procured

Description	Unit	First Phase	Second Phase	Third Phase	Total
Facilities to be Rehabilitated					
1 MV underground cable lines					
(a) Number of line sections	nos.	199	147	123	469
(b) Line length	km	93.1	70.1	69.7	232.9
2 Distribution transformer stations					
(a) Number of transformer stations	nos.	106	78	78	262
(b) Number of transformers	nos.	156	102	116	374
Quantities of Facilities to be Procured					
A. Transformer Stations					
A.1 MV Cubicles					
a.1.1 Outgoing feeder (SF6 CB, 630 A, motor driven)	set	370	276	231	877
a.1.2 Incoming feeder (SF6 LBS, 630 A, motor driven)	set	370	276	231	877
a.1.3 Bus coupler (SF6 LBS, 2000 A, motor driven)	set	78	60	63	201
a.1.4 PT cubicles	set	156	120	126	402
a.1.5 Transformer circuit cubicle					
(a) SF6 LBS 200A w/fuse for 400 kVA trans.	set	57	34	47	138
(b) SF6 LBS 200 A w/fuse for 630 kVA trans.	set	83	49	55	187
(c) SF6 LBS 200 A w/fuse for 1,000 kVA trans.	set	15	10	11	36
A.2 Supply and Installation of Distribution Transformers (10/0.4-0.23 kV)					
a.2.1 Oil filled type					
(a) 400 kVA	set	31	24	34	89
(b) 630 kVA	set	48	38	44	130
(c) 1,000 kVA	set	10	8	8	26
a.2.2 Molded dry type					
(a) 400 kVA	set	26	10	13	49
(b) 630 kVA	set	35	11	11	57
(c) 1,000 kVA	set	5	2	3	10
A.3 Supply and Installation of Low Voltage Distribution Board (LVDB)					
a.3.1 1,600 A capacity with 4 feeders of 400 A and 4 feeders of 250 A	set	50	24	38	112
with bus-tie circuit breaker					
a.3.2 1,600 A capacity with 4 feeders of 400 A and 4 feeders of 250 A	set	105	69	75	249
A.4 Supply and Installation of wall mounted fuse switch					
a.4.1 Main fuse of 400 A with 4x250 fuse switches	set	622	384	456	1,462
A.5 Supply and Installation of Package Type Transformer Station					
(a) Station with 400 kVA transformer	set	0	3	1	4
(b) Station with 630 kVA transformer	set	1	6	2	9
B. Power Cable					
B.1 Supply and Erection of MV XLPE Underground Cables					
(a) 3 x 240 mm^2	km	138.1	104.1	103.5	345.7
(b) 3 x 150 mm^2	km	59.2	44.6	44.4	148.2
B.2 LV XLPE Cables					
b.2.1 Supply and Erection of LV Underground Cables					
(a) 3 x 240 + 1 x 95 mm^2	km	62.2	38.4	45.6	146.2
(b) 3 x 150 + 1 x 70 mm^2	km	55.9	34.4	41.0	131.3
b.2.2 Supply and Erection of ABC House Frank Cable					
(a) 3 x 150 + 1 x 70 mm^2	km	65.2	40.2	47.8	153.2
(b) 3 x 70 + 1 x 70 mm^2	km	65.2	40.2	47.8	153.2
C. Watt-hour Meters					
(a) Single phase 230 V 5/20 A	set	13,476	10,107	10,107	33,690
(b) Single phase 230 V 10/20 A	set	17,968	13,476	13,476	44,920
(c) Single phase 230 V 20/60 A	set	13,476	10,107	10,107	33,690
(d) Three phase 400 V 10/30 A	set	144	108	108	360
(e) Three phase 400 V 20/60 A	set	288	216	216	720
(f) Three phase 400 V 30/90 A	set	288	216	216	720

Appendix II.8.2-1 Unit pricees for power distribution facilities

Description	Unit	Unit Rate (FOB) Price (US$)
A. Transformer Stations		
A.1 Supply and Installation of MV Cubicles		
a.1.1 Outgoing feeder (SF6 CB, 630 A, motor driven)	set	13,863.1
a.1.2 Incoming feeder (SF6 LBS, 630 A, motor driven)	set	3,887.0
a.1.3 Bus coupler (SF6 LBS, 2000 A, motor driven)	set	4,556.4
a.1.4 PT cubicles	set	3,887.0
a.1.5 Transformer circuit cubicles		
(a) SF6 LBS 200A w/fuse for 400 kVA trans.	set	3,076.9
(b) SF6 LBS 200 A w/fuse for 630 kVA trans.	set	3,230.7
(c) SF6 LBS 200 A w/fuse for 1,000 kVA trans.	set	3,384.6
A.2 Supply and Installation of Distribution Transformers (10/0.4-0.23 kV)		
a.2.1 Oil filled type		
(a) 400 kVA	set	6,970.1
(b) 630 kVA	set	9,076.3
(c) 1,000 kVA	set	12,650.5
a.2.2 Molded dry type		
(a) 400 kVA	set	12,546.3
(b) 630 kVA	set	16,337.3
(c) 1,000 kVA	set	22,770.9
A.3 Supply and Installation of Low Voltage Distribution Board (LVDB)		
a.3.1 1,600 A capacity with 4 feeders of 400 A and 4 feeders of 250 A	set	25,568.0
with bus-tie circuit breaker		
a.3.2 1,600 A capacity with 4 feeders of 400 A and 4 feeders of 250 A	set	17,891.6
A.4 Supply and Installation of Package Type Transformer Station		
(a) Station with 400 kVA transformer	set	46,023.4
(b) Station with 630 kVA transformer	set	49,593.8
B. Power Cable		
B.1 Supply and Erection of MV XLPE Underground Cable		
(a) 3 x 240 mm^2	km	21,086.7
(b) 3 x 150 mm^2	km	16,474.7
B.2 LV XLPE Cables		
b.2.1 Supply and Erection of LV Underground Cables		
(a) 3 x 240 + 1 x 95 mm^2	km	13,619.6
(b) 3 x 150 + 1 x 70 mm^2	km	9,713.2
b.2.2 Supply and Erection of ABC House Frank Cable		
(a) 3 x 150 + 1 x 70 mm^2	km	7,284.2
(b) 3 x 70 + 1 x 70 mm^2	km	4,035.2

Building Works

1	New construction (10% of KO type)	nos.	27,966.0
2	Rearrangement of inside wall(KO*60%, KP:30%)	nos.	9,084.0
3	Cable duct and others(KO:30%,KP:70%)	nos.	5,285.0
4	Cable duct and others(KB:100%)	nos.	2,043.0

Note: KO: Ground-mounted type building standing independently
KP: Ground-mounted type building close to other buildings
KB: Rented room type

Appendix II.8.2-2 Unit prices for load dispatching facilities

Description	Unit	Unit Rate (FOB) Price (US$)
A. Load Dispatching Center		
a.1 Distribution network supervisory control unit	set	160,000
a.2 Substation supervisory control unit & communication equipment	set	254,000
a.3 Dispatcher terminal & accessory	set	44,000
a.4 Large size screen type display & control equipment	set	564,000
a.5 Distribution network display panel & control equipment	set	376,000
a.6 Substation network display panel & control unit	set	376,000
a.7 Radio communication equipment & control equipment	set	235,000
a.8 Training terminal	set	28,000
a.9 Office terminal, Office LAN, accessory	set	94,000
a.10 Power supply equipment	set	125,000
B. Transformer Station		
b.1 Remote terminal unit	set	18,797

CHAPTER 9

ECONOMIC AND FINANCIAL EVALUATION

Chapter 9 ECONOMIC AND FINANCIAL EVALUATION

9.1 General

9.1.1 Objective

Project evaluation is devoted to ascertain the viability of the Master Plan project (the Project) targeted for the entire study area in both economic and financial aspects through computation of economic and financial internal rate of return (EIRR and FIRR). IRR is explained as the maximum rate of interest that a project could pay if all resources were borrowed, and thus explained as a measure of the return on the cost mobilized in the project.

In the evaluation, "with or without approach" is adopted. Therefore, each internal rate of return is to be derived by comparing the incremental benefit and cost.

Economic evaluation is conducted from the point of view of the entire society as a whole. The Project cost is converted to economic cost to reflect real resources mobilized in the society as a whole either through eliminating transfer payment or through shadow pricing. EIRR thus obtained is compared with a cut-off rate, the economic opportunity cost of capital.

The financial analysis is conducted from the point of view of the Project itself (projected cash flow incurred by the Project). The Project cost based on the market price is compared with the Project benefit measured by the revenue accrued from distributing energy by the Project to each customer.

9.1.2 Summary of Cost Estimate and Disbursement Plan of the Project

Cost estimate of the Project is summarized in the preceding Chapter 8. Disbursement schedule in each Project stage is assumed that both procurement of materials and construction works start from the second year (the third year in the first phase) and take one and half years to complete. Ninety percent of the equipment/material procurement cost and 40 % of the construction cost are to be disbursed in the second year (the third year in the first phase) in each phase.

Annual fixed O&M cost for the distribution facilities, which are to be newly installed and constructed by the Project (i.e. incremental O&M cost incurred by the Project), is estimated at 2.0 % of direct project cost and would be realized from the next year of the project implementation.

9.1.3 Major Prepositions and Assumptions for the Project Evaluation

The following prepositions and assumptions are adopted in this study:

(a) Monetary value is in principle indicated in US Dollar (USD) and Azerbaijan Manats (AZM). An official exchange rate of AZM 4,456.0 as of 31 May 2000 is applied as needed. No shadow pricing was made for exchange rate, because the world (boarder) price numeraire approach was adopted.

(b) Economic evaluation is conducted with USD price level as base. On the other hand, financial evaluation was made with local currency price level as base.

(c) Cost estimate and disbursement schedule is made based on a real basis at year 2000 constant prices. As such there is no price inflation factored in the evaluation.

(d) Shadow pricing factor of the wage rate for unskilled labor was considered as 0.8, based on the practice by World Bank in Azerbaijan. Unskilled labor wage was assumed to account for certain 40% on the average for local currency portion in total project cost. Shadow pricing factor for the works by local currency and O&M costs was based on the standard conversion factor and assumed as 0.9, also based on the practice by other international development assistance institutions.

(e) From the above prepositions, "composite conversion factor" 0.86 was computed to work out the economic cost for local currency portion of the Project cost.

(f) For economic opportunity cost of capital as cut-off rate (discount rate), it was assumed as 10% in this project evaluation following recent practices in Azerbaijan. To assume average financial cost of capital in Azerbaijan, the refinancing rate by National Bank of Azerbaijan (NBA) was consulted. The rate as of end of 1999 was 10.0 % in nominal terms. To derive in real terms, the average inflation rate based on CPI during 1995-1999 (4.7 %) was taken into account. The resultant rate on a real basis was, therefore, computed to be 5.0 %[1].

(g) Economic facilities and equipment life was assumed as 25 years after the completion of each project phase, and the effect of facilities rehabilitation would generate over that period.

9.2 Benefit of the Project

9.2.1 Benefit

Project evaluation is carried out by comparing the likely events between "with project" and "without project"

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[1] Average cost of capital in financial price on a real basis = $[(1 + 10.0\%) \div (1 + 4.7\%)] - 1 = 5.06\%$

situations, and judged by incremental benefits (revenue) and costs as differences. The positive effect resulted from the Master Plan project is considered as "avoidance of unserved energy supply".

Major objective of the Project implementation is to enhance the energy supply capability through rehabilitating and reconstructing distribution facilities. Unserved energy supply (decline of supply capability) due to frequent accidents of distribution facilities and resultant shortage in capacity (without the Project case) will be avoided, and properly supplied/sold to those who demand. Avoidance of unserved energy supply by the Project implementation, in this context, shall bring about an increase in consumable and salable energy compared to "without the Project" situation.

The existing distribution facilities of BEN are extensively obsolete and superannuated, causing frequent accidents against a stable energy supply. Particularly in recent years, the occurrence of accident has been abruptly augmented. In case of "without the Project implementation", the supply interruption, which has been already apparent, is considered to increase geometrically. It is presumed for the project evaluation that unserved supply rate against total energy demand projection will annually increase by 3.0 % each from 2001 without the Project (then, expanding to 30.0% in 2010). Additional unserved supply, which shall occur over the level in 2010 without the Project case, will have to be dealt with by additional investment.

As for the energy demand which this evaluation covers, total energy demand excluding Khatai and Nizami district is referred. This is because the distribution facilities in the said districts are relatively newly-built, and only a little has been identified for rehabilitation as explained in Chapter 8 of this Volume. Unless the facilities are to be rehabilitated and replaced, serious unserved energy would not take place. Accordingly, the energy demand in those districts was subtracted from the total demand in the entire study area to estimate proper unserved energy amount.

In the rehabilitation project for energy distribution facilities, some other kinds of benefit will be usually realized. Those include a) reduction of technical loss during distribution process, b) reduction of non-technical loss (only as financial benefit) brought about by under-registration of meter, energy pilferage, and inappropriate billing activity. The scope of the Project is concerned with rehabilitation of the distribution facilities, not with contemplating measures to reduce non-technical loss. It is considered unreasonable, therefore, to incorporate the increasing revenue inflow by non-technical loss reduction in the financial evaluation.

As for technical loss, the accurate composition ratio of losses and the extent of those improvement have been hardly examined due to a lack of necessary data. This project evaluation adopted the same loss performance condition supposed in demand forecast for its calculation. However the loss improvement effect has not been reflected as a benefit by adopting the said condition into both cases of with and without project. As a result, total benefit by the Project implementation has been moderately estimated. The flow of incremental effects by the Project implementation until its target year is shown in Appendix II.9.2-1.

9.2.2 Unit Rate of Benefit/Revenue

(1) Unit rate of economic benefit

Unserved energy has been valued based on the cost of non-network energy supply. It is assumed that unserved energy supply needs to be met by means of alternative source of power generation. This has been, in the study area, represented by the cost of energy generation by benzine-fueled generators, which has been operated by households and commercial sectors. By basic market survey, the unit cost of energy generation by benzine generator is derived as the range between around US cent 17-18/kWh depending on the type. Derivation of the unit cost of generator is presented in Appendix II.9.2-2 (1).

The generator referred is served for the use of household and small-scale commercial sector. This reference is considered appropriate since the dominant customer in BEN has been a residential sector and small-scale customer.

On the other hand, economic cost of energy supply through usual network system is normally represented by "Long-Run Marginal Cost (LRMC)" for the entire energy supply system concerned. In Azerbaijan so far, no estimation for LRMC is available. Therefore, the study takes a basic methodology refereed as "Long-Run Average Incremental Cost (LRAIC)" to derive the approximate value of LRMC.

LRAIC is based on solely future expansion plan of the entire electricity power supply system. The derivation of LRAIC is gained by referring to TACIS reports on electricity/energy sector, international fuel prices, and capital recovery factor at 10 %. Economic cost of supply at distribution end (to BEN's customer) is estimated as US cent 8.18/kWh. The derivation process for LRAIC is shown in Appendix II.9.2-2 (2).

In case of the Project implementation where unserved energy supply is avoided, the cost of corresponding energy supply through network shall be borne in the entire economy. Without the Project, however, the consumer will be imposed to bear the cost of alternative energy generation. Accordingly, it is considered that resources valued at US cent 9.24 (US cent 17.42/kWh minus US cent 8.18/kWh) shall be saved by an avoidance of unserved supply per kWh. This value represents the worth of resources saved by the Project implementation in the national economy as a whole, and is applied for an incremental consumable energy (incremental avoidable unserved energy).

(2) Unit rate of revenue

Owing to the Project implementation, the unserved energy without the Project case will be avoided and sold properly to customers, and the incremental financial benefit (revenue) will be realized by the Project. The weighted average retail price by BEN is calculated as AZM 90.7/kWh (equivalent to USD 0.02/kWh) based on total 1999's sales record. This unit price is of exclusive of VAT payment.

The following two changes, however, need to be addressed when discussing the weighted average retail price by BEN. Firstly, BEN's customer structure is largely changed since the Presidential Decree (on the establishment of JSC BEN, June 14, 2000) decided to make BEN also responsible for formerly Azenerji's customer in Baku City area.

Those customer groups had received energy supply with relatively higher voltage, and comprised of large-scale industry and commercial facilities. As a result, BEN's (JSC BEN in practice) customer structure is estimated to change, bringing about an increase in the weighted average retail tariff. This is because the ratio of residential customer for which the lowest tariff is applied becomes smaller.

Secondly, the energy tariff regime for all sectors except for residential/wholesale sectors was revised to be uniform and lowered on July 1, 2000, conversely bringing about a decline in the weighted average price.

As a result of combining these two changes, the weighted average retail price (based on 1999's actual sales record) by BEN is projected to increase to around AZM 92.3/kWh (equivalent to USD 0.021/kWh), assuming no effect of tariff change on energy consumption pattern. The derivation is shown in Appendix II.9.2-3.

On the other hand, current wholesale tariff excluding VAT portion from Azenerji is AZM 72.0/kWh (equivalent to USD 0.016/kWh). The margin to BEN between the retail and wholesale tariff is, therefore, AZM 20.3/kWh, which is incremental revenue by salable energy (avoided unserved energy) per kWh.

9.3 Economic Evaluation

9.3.1 Derivation of Economic Cost

For the local cost portion of the Project cost, the conversion factor is applied to represent the value in economic terms.

9.3.2 Computation of EIRR

EIRR of the Project was computed as 26.9 % as presented in Appendix II.9.3-1. Comparison of EIRR with the cut-off rate (10 %) presents that the Project is judged to be economically viable.

9.3.3 Sensitivity Test of EIRR

Sensitivity test of EIRR was carried out. Change of EIRR value was examined by varying the determinant of benefit and cost of the project and preparing the scenarios for each. One is to examine EIRR by varying the Project cost. Another is to examine EIRR by varying condition of unserved supply rate.

Table II.9.3-1 Results of sensitivity test for EIRR

Base case : Unserved supply rate (annual increase by 3% each)	26.9%
Unserved supply rate (minus 0.5% each annum)	22.0%
Unserved supply rate (plus 0.5% each annum)	31.7%
Construction cost : (minus 20%)	34.0%
Construction cost : (plus 20%)	22.0%

Even in the most conservative scenario where construction cost with 20 % up and unserved supply ratio with annual increase by 2.5 % each are realized, the Project still shows a strong viability, exceeding 10 % cut-off rate.

9.4 Financial Evaluation

9.4.1 Derivation of Financial Cost

The cost and benefit adopted in the financial evaluation are all the actual cost and benefit to be incurred and accrued by the Project implementation and operation. Therefore, a market based Project cost estimate (shown in Table II.8.4-1), and incremental O&M cost is compared with the revenue.

9.4.2 Computation of FIRR

Applying the present margin level to BEN explained in Section 9.2.2, FIRR dose not show the positive value, meaning that the present value of total incremental benefit is computed as less than that of total incremental cost with any positive discount rates.

The poor result of FIRR is mainly attributed to the following issues:

Firstly, present energy tariff is of heavily subsidized, and not representing the real cost of energy generation and supply to each customer (in accordance with LRMC or LRAIC concepts). The tariff applied for residential sector (AZM 80/kWh with VAT exclusive: USD 0.018/kWh), which should fundamentally bear the highest cost of energy supply, is most subsidized and far from the level of real energy supply cost.

Secondly, the customer structure in Baku City needs to be noted. Since the collapse of FSU, industrial/other sectors have been still in depression, not requiring a large energy use as before. Decline in the share of industrial/other sector's energy use (conversely an increase in the share of residential use), when higher (lower) tariff is applied, has suppressed total energy sales revenue and average retail price as a result. According to ESE, the share by residential sector in total energy use in Baku City during the last few years of

FSU period had been only around 25-27 % even in winter season (around 57 % in 1999 for the entire Baku City). The rest had been consumed by industrial/governmental sectors.

Thirdly, the tariff policy favorable for privileged group exists, bringing about further financial losses and suppressing the weighted average retail price. Along with the government policy, BEN has been responsible for charge-exempted supply to the privileged group in residential category including veterans and the handicapped. Against the refugee, the government is shouldering the energy bill of them up to a certain energy use. Though most of the refugee is consuming more than what government shoulders, BEN has a right to charge the refugee for exceeding use.

Under those conditions, the weighted average retail price realized by BEN/JSC BEN has been kept very low, suppressing the distribution margin as a result. Accordingly, due to such outside factors from BEN, the Project's financial soundness is hardly attained.

In this study, a projection of weighted average retail price is worked out assuming that those outside factors change as follows:

1) Customer structure during FSU period prevails again in Baku City, where energy use by industrial/other sectors accounts for the large share as did during FSU period (26 % by residential and 74 % by all other sectors).

   This is assumed in view of that recent tariff revision to activate industrial/public utility sector, rapid oil development, increase in oil export, active FDI in oil-related industry and others.

2) Tariff policy favorable for privileged group (including energy charge exemption) is abolished.

Taking into account above conditions, the weighted average retail price is projected as AZM 117.0/kWh (AZM 80/kWh x 26 % by residential + AZM 130 x 74 % by all other sectors). Even at this tariff level, however, FIRR is still calculated as negative. Accordingly, it is reasoned that the financial soundness of the Project to BEN will be hardly attained unless the retail tariffs are largely revised upward (suppressing wholesale tariff on the other hand), even if the economic improvement, customer structure and abolition of charge exemption are realized as assumed.

Appendix II.9.2-1 Flow of improved effects by the Master Plan Project

(for the Whole Study Area)

With Project Case	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Energy Sales Projection (GWh)	**993.3**	**1,013.9**	**1,035.0**	**1,056.5**	**1,078.5**	**1,100.9**	**1,123.7**	**1,147.1**	**1,170.9**	**1,195.2**	**1,220.1**	**1,261.5**
Growth (%)	--	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	3.40
Non-technical loss (GWh)	165.2	168.7	160.8	152.8	144.7	136.4	127.9	119.3	110.5	101.5	92.4	84.1
Non-technical loss (%)-assumed	13.4%	13.4%	12.7%	12.0%	11.2%	10.5%	9.7%	9.0%	8.2%	7.5%	6.7%	6.0%
Energy Consumption Projection (GWh)	**1,158.5**	**1,182.6**	**1,195.8**	**1,209.3**	**1,223.1**	**1,237.2**	**1,251.6**	**1,266.4**	**1,281.4**	**1,296.7**	**1,312.4**	**1,345.6**
Technical loss (GWh)	70.8	72.3	70.7	69.1	67.5	65.9	64.2	62.5	60.8	59.0	57.2	56.1
Technical loss (%)-assumed	5.8%	5.8%	5.6%	5.4%	5.2%	5.1%	4.9%	4.7%	4.5%	4.4%	4.2%	4.0%
Energy Requirement Projection (GWh)	**1,229.3**	**1,254.9**	**1,266.5**	**1,278.4**	**1,290.6**	**1,303.1**	**1,315.8**	**1,328.9**	**1,342.2**	**1,355.7**	**1,369.6**	**1,401.7**
Without Project Case	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Unserved energy for total requirement (%)			3.0%	6.0%	9.0%	12.0%	15.0%	18.0%	21.0%	24.0%	27.0%	30.0%
Unserved energy for requirement (GWh)	0.0	0.0	38.0	76.7	116.2	156.4	197.4	239.2	281.9	325.4	369.8	420.5
Available Energy for Supply / actual requirement (GWh)	**1,229.3**	**1,254.9**	**1,228.5**	**1,201.7**	**1,174.5**	**1,146.7**	**1,118.5**	**1,089.7**	**1,060.3**	**1,030.4**	**999.8**	**981.2**
Technical loss (GWh)	70.8	72.3	68.6	65.0	61.4	58.0	54.6	51.3	48.0	44.8	41.8	39.2
Technical loss (%)-assumed	5.8%	5.8%	5.6%	5.4%	5.2%	5.1%	4.9%	4.7%	4.5%	4.4%	4.2%	4.0%
Energy Consumption (GWh)	**1,158.5**	**1,182.6**	**1,159.9**	**1,136.7**	**1,113.0**	**1,088.7**	**1,063.9**	**1,038.4**	**1,012.3**	**985.5**	**958.1**	**941.9**
Non-technicallLoss (GWh)	165.2	168.7	156.0	143.6	131.6	120.0	108.7	97.8	87.3	77.2	67.4	58.9
Non-technical loss (%)-assumed	13.4%	13.4%	12.7%	12.0%	11.2%	10.5%	9.7%	9.0%	8.2%	7.5%	6.7%	6.0%
Energy Sales (GWh)	**993.3**	**1,013.9**	**1,004.0**	**993.1**	**981.4**	**968.8**	**955.2**	**940.6**	**925.0**	**908.4**	**890.6**	**883.1**
A) For Economic Evaluation of the Project												
Avoidable unserved energy for consumption (GWh)	**0.0**	**0.0**	**35.9**	**72.6**	**110.1**	**148.5**	**187.7**	**227.9**	**269.1**	**311.2**	**354.4**	**403.7**
Economic value of resource saving (USC/kWh)	9.24	9.24	9.24	9.24	9.24	9.24	9.24	9.24	9.24	9.24	9.24	9.24
Incremental benefit -resource saving ('000USD)	**0.0**	**0.0**	**3,314.8**	**6,704.4**	**10,171.3**	**13,718.2**	**17,347.5**	**21,061.9**	**24,864.1**	**28,756.6**	**32,742.4**	**37,300.0**
Add. energy requirement for the above consumption (GWh)	**0.0**	**0.0**	**2.1**	**4.1**	**6.1**	**7.9**	**9.6**	**11.3**	**12.8**	**14.2**	**15.4**	**16.8**
Economic cost of network energy supply (USC/kWh)	8.18	8.18	8.18	8.18	8.18	8.18	8.18	8.18	8.18	8.18	8.18	8.18
Incremental cost for energy supply ('000USD)	**0.0**	**0.0**	**173.6**	**339.3**	**497.1**	**646.7**	**787.9**	**920.4**	**1,044.0**	**1,158.3**	**1,263.2**	**1,375.9**
Net Incremental Benefit - net resource savings ('000USD)	**0.0**	**0.0**	**3,141.2**	**6,365.0**	**9,674.2**	**13,071.5**	**16,559.6**	**20,141.5**	**23,820.1**	**27,598.3**	**31,479.2**	**35,924.2**
Realizable Benefit by the Project Implementation ('000USD)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**6,535.7**	**16,559.6**	**16,559.6**	**20,189.9**	**27,598.3**	**27,598.3**	**31,761.2**
B) For Financial Evaluation of the Project												
Incremental energy sales (GWh)	**0.0**	**0.0**	**31.1**	**63.4**	**97.1**	**132.1**	**168.6**	**206.5**	**245.9**	**286.9**	**329.4**	**378.5**
Projection of weighted average retail price (AZM/kWh)	117.0	117.0	117.0	117.0	117.0	117.0	117.0	117.0	117.0	117.0	117.0	117.0
Incremental revenue (million AZM)	**0.0**	**0.0**	**3,632.9**	**7,416.6**	**11,356.1**	**15,456.0**	**19,721.4**	**24,157.3**	**28,769.1**	**33,562.0**	**38,541.7**	**44,278.7**
Incremental energy purchase (GWh)	**0.0**	**0.0**	**38.0**	**76.7**	**116.2**	**156.4**	**197.4**	**239.2**	**281.9**	**325.4**	**369.8**	**420.5**
Wholesale price (AZM/kWh)	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0
Incremental energy purchase cost (million AZM)	**0.0**	**0.0**	**2,735.7**	**5,522.9**	**8,363.3**	**11,258.8**	**14,211.1**	**17,222.0**	**20,293.5**	**23,427.3**	**26,625.4**	**30,276.0**
Net project's operational profit (million AZM)	**0.0**	**0.0**	**897.2**	**1,893.8**	**2,992.8**	**4,197.3**	**5,510.3**	**6,935.3**	**8,475.6**	**10,134.7**	**11,916.2**	**14,002.7**
Realizable Revenue by the Project Implementation ('000USD)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**2,098.6**	**5,510.3**	**5,510.3**	**6,993.0**	**10,134.7**	**10,134.7**	**12,068.7**

Appendix II.9.2-2 (1) Estimation of generation cost by alternative source (benzine generator for domestic use)

Based on the market price data as of June 2000

	Small type	Medium type
Generator price plus installment cost ($)	720.0	1,000.0
Power output (kW)	2.2	3.5
Capital cost ($/kW)	327.3	285.7
Capital recovery factor (CRF) at 10 % (6 years) *1	0.264	0.264
Annuitaized capital cost ($/kW-year)	**86.3**	**75.4**
Annual average household consumption per customer (kWh)	7,420	7,420
Utilization factor (%)	0.39	0.24
Capital cost (cent/kWh)	**2.56**	**3.56** ①
Benzine cost per litter (manat)		1,600
Fuel amount for 1 kWh (l/kWh)		0.40
Fuel cost (manat/kWh)		640.0
Fuel cost (cent/kWh)		**14.36** ②
Generation cost per kWh (cent/kWh) ①+②	**16.92**	**17.92**
Average generation cost per kWh (cent/kWh)		**17.42**

Note1 : Economic use life is assumed to be 6 years.

Note2 : The figure (for 2000) is estimated by applying the growth rate during 1998-99 for the average household consumption record in 1999.

Appendix II.9.2-2 (2) Estimation of Long-run Average Incremental Cost (LRAIC)

Proposed Generation Plants / Year (2000-05) *1

	1	2	3	4	5~	28	Present Value	
1) Severnaya TPP (No1) -Combined Cycle								
Cost disbursement (million USD)	67.2	93.6	79.2	-	-	-	198.0	76.4
Output capacity (MW)	0	0	0	380	380	380	2,591.5	
2) Sumgait TPP -Combined Cycle								
Cost disbursement (million USD)	65.4	91.0	77.0	-	-	-	192.5	70.6
3) Severnaya TPP (No2) -Combined Cycle								
Cost disbursement (million USD)	68.5	95.4	80.7	-	-	-	201.7	73.9
Output capacity (MW)	0	0	0	400	400	400	2,727.9	
				Weighted average for annuitaized capital cost				73.6
Capital Recovery Factor (CRF)	10.0%	0.110						

(A) Capacity/Capital Cost Estimation *2

		Generation end	Transmission end	Distribution end	
Average incremental capital cost	$/kW	667.9	912.8	1,484.2	
Weighted average for annuitaized capital cost	$/kW year	73.6	100.6	163.5	
Degrating/inhouse loss rate	3.0%	75.9	103.7	168.6	
Forced outage loss rate	6.0%	80.7	110.3	173.9	
Scheduled maintenance and inspection loss rate	7.7%	87.4	119.5	188.5	
Transmission and distribution loss rate	21.6%		125.8	221.9	
Load factor		60.0%	57.5%	55.0%	
LRAIC for capital cost	cent/kWh	1.66	2.19	4.61	
LRAIC for O&M cost (cent/kWh)	3.0%	0.38	0.54	0.92	
LARIC for total capacity Cost	cent/kWh	**2.04**	**2.73**	**5.53**	①

(B) Energy Cost Estimation *3

Heat rate (combined cycle)	kcal/kWh	1,720.0
Thermal efficiency rate	%	50.0%

	Heavy Fuel Oil	(fob ave. 2000)	Natural Gas	(cif Euro. 2000)	
Economic fuel cost	$/ton	125.0	$/1000m3	89.3	
Calorific value (heat content)	kcal/kg	9,600	kcal/m3	8,600	
Fuel cost per Gigacalorie	$/Gcal	13.0	$/Gcal	10.4	
Assumed contribution by fuel type for energy generation	%	50.0%	%	50.0%	
Fuel amount required for 1kWh generation	kg/kWh	0.18	m3/kWh	0.20	
Economic energy (fuel) cost per kWh	cent/kWh	2.24	cent/kWh	1.79	
Weighted average economic fuel cost per kWh	cent/kWh			2.01	
		Generation end	Transmission end	Distribution end	
LRAIC for Energy (Fuel) cost (USC/kWh)	cent/kWh	**2.01**	**2.18**	**2.65**	②
LRAIC (USC/kWh) ①+②	cent/kWh	**4.06**	**4.92**	**8.18**	

Note : Above estimation is made by referring to the following reports, and the data obtained by JICA study team for the purpose of updating some parameters.

1) Advice to Government : Azerbaijan, (Part VII Electricity Sector - Development of electricity facilities), January 1995, TACIS

2) Rehabilitation of the Energy Distribution Systems in the Region of Baku and Sumgait (Volume 2), February 1999, TACIS

Economic facility life is assumed to be 25 years.

Note1 : Cost estimate of the proposed plant is adjusted to 2000 price leve by average CPI (4.7%) recorded during 1995-99 for only local portion.

Cost estimate based on financial price is adjusted to economic price with Standard Conversion Factor (0.9) for local portion.

Local portion is assumed to account for 20 % of total cost, as been in TACIS report.

Note2 : LRAIC at transmission/distribution end is estimated based on the following component ratio of the asset value of electric facilities, available by hearing to Azenerji.

40.0~45.0% Asset value of power generation facilities

16.5~18.0% Asset value of transmission facilities

43.5~37.0% Asset value of distribution facilities

Note3 : Fuel price is referred to World Bank projection as of July 27, 1999 with no price escalation adjustment.

Appendix II.9.2-3 Projection for weighted average retail price after incorporating former Azenerji's customer in Baku City

Revenue by Tariff Category for the entire Baku City (VAT exclusive)	Energy Sales (GWh)	Ratio against Total	Eenrgy Tariff Applied (AZM/kWh)	Projected Revenue (million AZM)
1) Indusrial Sector	1,140.4	25.4%	130.0	148,252.0
2) Budget Sector	177.4	4.0%	130.0	23,062.0
3) Non-industrial Sector	162.5	3.6%	130.0	21,125.0
4) Commercial and Service Sector	106.1	2.4%	130.0	13,793.0
5) Electric Railway	54.6	1.2%	130.0	7,098.0
6) Urban Transportation / Water Company	278.8	6.2%	130.0	36,244.0
7) Agricultural Sector	12.3	0.3%	130.0	1,599.0
8) Residential Sector	2,555.3	56.9%	63.8	163,028.1
Weighted Average Sales Tariff exclusive VAT	4,487.4	100.0%	**92.3**	414,201.1

Source : Azenerji, AHPNE/CHPNE, BEN/ESE

Note : Energy sales amount is based on 1999's actual record, assuming no effect of tariff change on consumption pattern.

Note : Energy tariff applied for residential sector takes into account the financial loss portion by free-charge supply to privileged groups.

Appendix II.9.3-1 Computation of Economic Internal Rate of Return (EIRR) for Master Plan Project

(unit : '000USD)

Year	Incremental Project Cost F.C. Portion	Incremental Project Cost L.C. Portion	Incremental Project Cost Sub-total	Incremental O & M Cost	Incremental Project Cost	Incremental Project Benefit	Balance Benefit - Cost
2001	-	-	-	-	-	-	-
2002	941.5	-	941.5	-	941.5	-	(941.5)
2003	32,069.1	1,703.9	33,773.0	337.7	34,110.7	-	(34,110.7)
2004	7,837.7	2,555.9	10,393.6	779.4	11,173.0	6,535.7	(4,637.3)
2005	941.5	-	941.5	883.3	1,824.8	16,559.6	14,734.8
2006	31,946.0	1,247.6	33,193.6	1,215.3	34,408.9	16,559.6	(17,849.2)
2007	6,909.1	1,871.4	8,780.5	1,635.0	10,415.5	20,189.9	9,774.4
2008	941.5	-	941.5	1,722.8	2,664.3	27,598.3	24,934.0
2009	25,123.1	1,279.2	26,402.3	1,986.8	28,389.1	27,598.3	(790.8)
2010	6,094.8	1,907.1	8,001.9	2,330.9	10,332.8	31,761.2	21,428.4
2011				2,410.9	2,410.9	35,924.2	33,513.3
2012				2,410.9	2,410.9	35,924.2	33,513.3
2013				2,410.9	2,410.9	35,924.2	33,513.3
2014				2,410.9	2,410.9	35,924.2	33,513.3
2015				2,410.9	2,410.9	35,924.2	33,513.3
2016				2,410.9	2,410.9	35,924.2	33,513.3
2017				2,410.9	2,410.9	35,924.2	33,513.3
2018				2,410.9	2,410.9	35,924.2	33,513.3
2019				2,410.9	2,410.9	35,924.2	33,513.3
2020				2,410.9	2,410.9	35,924.2	33,513.3
2021				2,410.9	2,410.9	35,924.2	33,513.3
2022				2,410.9	2,410.9	35,924.2	33,513.3
2023				2,410.9	2,410.9	35,924.2	33,513.3
2024				2,410.9	2,410.9	35,924.2	33,513.3
2025				2,410.9	2,410.9	35,924.2	33,513.3
2026				2,410.9	2,410.9	35,924.2	33,513.3
2027				2,410.9	2,410.9	35,924.2	33,513.3
2028				2,392.5	2,392.5	35,650.0	33,257.5
2029				1,732.5	1,732.5	25,815.6	24,083.1
2030				1,529.4	1,529.4	22,789.0	21,259.6
2031				1,511.0	1,511.0	22,514.9	21,003.9
2032				862.3	862.3	12,849.2	11,986.9
2033				690.7	690.7	10,292.4	9,601.6
2034				672.3	672.3	10,018.2	9,345.9
2035				156.4	156.4	2,330.1	2,173.7
PV	65,831.8	5,968.2	71,800.0	13,404.6	85,204.5	190,485.2	105,280.6

EIRR	26.89%
B/C	2.24

(Project Cost +20%)

Year	Incremental Project Cost F.C. Portion	Incremental Project Cost L.C. Portion	Incremental Project Cost Sub-total	Incremental O & M Cost	Incremental Project Cost	Balance Benefit - Cost
2001	-	-	-	-	-	-
2002	1,129.8	-	1,129.8	-	1,129.8	(1,129.8)
2003	38,482.9	2,044.7	40,527.6	405.3	40,932.9	(40,932.9)
2004	9,405.2	3,067.1	12,472.3	935.3	13,407.6	(6,871.9)
2005	1,129.8	-	1,129.8	1,060.0	2,189.8	14,369.8
2006	38,335.2	1,497.1	39,832.3	1,458.3	41,290.6	(24,731.0)
2007	8,290.9	2,245.6	10,536.6	1,962.0	12,498.6	7,691.3
2008	1,129.8	-	1,129.8	2,067.4	3,197.2	24,401.1
2009	30,147.7	1,535.0	31,682.7	2,384.2	34,066.9	(6,468.6)
2010	7,313.8	2,288.6	9,602.3	2,797.1	12,399.4	19,361.9
2011				2,893.1	2,893.1	33,031.1
2012				2,893.1	2,893.1	33,031.1
2013				2,893.1	2,893.1	33,031.1
2014				2,893.1	2,893.1	33,031.1
2015				2,893.1	2,893.1	33,031.1
2016				2,893.1	2,893.1	33,031.1
2017				2,893.1	2,893.1	33,031.1
2018				2,893.1	2,893.1	33,031.1
2019				2,893.1	2,893.1	33,031.1
2020				2,893.1	2,893.1	33,031.1
2021				2,893.1	2,893.1	33,031.1
2022				2,893.1	2,893.1	33,031.1
2023				2,893.1	2,893.1	33,031.1
2024				2,893.1	2,893.1	33,031.1
2025				2,893.1	2,893.1	33,031.1
2026				2,893.1	2,893.1	33,031.1
2027				2,893.1	2,893.1	33,031.1
2028				2,871.0	2,871.0	32,779.0
2029				2,079.0	2,079.0	23,736.6
2030				1,835.3	1,835.3	20,953.8
2031				1,813.2	1,813.2	20,701.7
2032				1,034.8	1,034.8	11,814.4
2033				828.9	828.9	9,463.5
2034				806.8	806.8	9,211.4
2035				187.6	187.6	2,142.4
PV	78,998.1	7,161.9	86,160.0	16,085.5	102,245.5	88,239.7

EIRR	22.03%
B/C	1.86

(Project Cost -20%)

Year	Incremental Project Cost F.C. Portion	Incremental Project Cost L.C. Portion	Incremental Project Cost Sub-total	Incremental O & M Cost	Incremental Project Cost	Balance Benefit - Cost
2001	-	-	-	-	-	-
2002	753.2	-	753.2	-	753.2	(753.2)
2003	25,655.3	1,363.1	27,018.4	270.2	27,288.6	(27,288.6)
2004	6,270.2	2,044.7	8,314.9	623.5	8,938.4	(2,402.7)
2005	753.2	-	753.2	706.7	1,459.9	15,099.8
2006	25,556.8	998.1	26,554.9	972.2	27,527.1	(10,967.5)
2007	5,527.3	1,497.1	7,024.4	1,308.0	8,332.4	11,857.5
2008	753.2	-	753.2	1,378.3	2,131.5	25,466.9
2009	20,098.5	1,023.3	21,121.8	1,589.5	22,711.3	4,887.0
2010	4,875.8	1,525.7	6,401.5	1,864.7	8,266.3	23,495.0
2011				1,928.7	1,928.7	33,995.4
2012				1,928.7	1,928.7	33,995.4
2013				1,928.7	1,928.7	33,995.4
2014				1,928.7	1,928.7	33,995.4
2015				1,928.7	1,928.7	33,995.4
2016				1,928.7	1,928.7	33,995.4
2017				1,928.7	1,928.7	33,995.4
2018				1,928.7	1,928.7	33,995.4
2019				1,928.7	1,928.7	33,995.4
2020				1,928.7	1,928.7	33,995.4
2021				1,928.7	1,928.7	33,995.4
2022				1,928.7	1,928.7	33,995.4
2023				1,928.7	1,928.7	33,995.4
2024				1,928.7	1,928.7	33,995.4
2025				1,928.7	1,928.7	33,995.4
2026				1,928.7	1,928.7	33,995.4
2027				1,928.7	1,928.7	33,995.4
2028				1,914.0	1,914.0	33,736.0
2029				1,386.0	1,386.0	24,429.6
2030				1,223.5	1,223.5	21,565.5
2031				1,208.8	1,208.8	21,306.1
2032				689.9	689.9	12,159.3
2033				552.6	552.6	9,739.8
2034				537.9	537.9	9,480.4
2035				125.1	125.1	2,205.0
PV	52,665.4	4,774.6	57,440.0	10,723.7	68,163.6	122,321.5

EIRR	34.04%
B/C	2.79

Year	(UES 3.5%) Incremental Project Benefit	(UES 3.5%) Balance Benefit - Cost	(UES 2.5%) Incremental Project Benefit	(UES 2.5%) Balance Benefit - Cost
2001	-	-	-	-
2002	-	(941.5)	-	(941.5)
2003	-	(34,110.7)	-	(34,110.7)
2004	7,625.0	(3,548.0)	5,446.5	(5,726.6)
2005	19,319.6	17,494.8	13,799.7	11,974.9
2006	19,319.6	(15,089.3)	13,799.7	(20,609.2)
2007	23,554.9	13,139.4	16,824.9	6,409.4
2008	32,198.0	29,533.7	22,998.6	20,334.3
2009	32,198.0	3,808.9	22,998.6	(5,390.5)
2010	37,054.8	26,722.0	26,467.7	16,134.9
2011	41,911.5	39,500.6	29,936.8	27,525.9
2012	41,911.5	39,500.6	29,936.8	27,525.9
2013	41,911.5	39,500.6	29,936.8	27,525.9
2014	41,911.5	39,500.6	29,936.8	27,525.9
2015	41,911.5	39,500.6	29,936.8	27,525.9
2016	41,911.5	39,500.6	29,936.8	27,525.9
2017	41,911.5	39,500.6	29,936.8	27,525.9
2018	41,911.5	39,500.6	29,936.8	27,525.9
2019	41,911.5	39,500.6	29,936.8	27,525.9
2020	41,911.5	39,500.6	29,936.8	27,525.9
2021	41,911.5	39,500.6	29,936.8	27,525.9
2022	41,911.5	39,500.6	29,936.8	27,525.9
2023	41,911.5	39,500.6	29,936.8	27,525.9
2024	41,911.5	39,500.6	29,936.8	27,525.9
2025	41,911.5	39,500.6	29,936.8	27,525.9
2026	41,911.5	39,500.6	29,936.8	27,525.9
2027	41,911.5	39,500.6	29,936.8	27,525.9
2028	41,591.7	39,199.2	29,708.3	27,315.8
2029	30,118.2	28,385.7	21,513.0	19,780.5
2030	26,587.2	25,057.8	18,990.9	17,461.5
2031	26,267.4	24,756.4	18,762.4	17,251.4
2032	14,990.7	14,128.4	10,707.6	9,845.3
2033	12,007.8	11,317.0	8,577.0	7,886.3
2034	11,687.9	11,015.6	8,348.5	7,676.2
2035	2,718.4	2,562.1	1,941.7	1,785.4
PV	222,232.7	137,028.2	158,737.6	73,533.1

	(UES 3.5%)	(UES 2.5%)
EIRR	31.67%	22.03%
B/C	2.61	1.86

Unit rate for benefit
USC/kWh 9.24

Unserved energy supply
Increasing rate per each annum 3.0%

Economic opportunity cost of capital
also as a discount rate 10.0%

CHAPTER 10

DATABASE SYSTEM FOR OPERATION AND MAINTENANCE

Chapter 10 DATABASE SYSTEM FOR OPERATION AND MAINTENANCE

10.1 Necessity of Database System

10.1.1 General

For an electricity power distributor to properly operate and expand its system, it is essential to accumulate, renew and utilize the extensive range of information/data, comprising of energy sale, customer, equipment/material procurement, inventory control, construction works, faults and recovery as well as technical specification of facility. For the purpose of meeting this requirement, the power utility enterprise usually endeavors to compile those broad range of information/data, build a computer based information management system usually called as database system, and utilize this in the broad field encompassing the planning, designing, construction, operation, and maintenance.

Firstly, to properly maintain and efficiently operate the distribution network, it is important to grasp precisely the present status of each element constituting the network. Furthermore, as each element is changing from time to time, it is also necessary to regularly add and delete, or renew the information/data. The Study Team has found it difficult and inefficient for BEN to properly conduct operation and maintenance, and quickly respond to the faults under the current BEN's system using record books. Especially, at the time of recovery from the faults requiring urgent correspondence, the present system might result in prolonged recovery actions, while declining the reliability of energy supply.

Secondly, also in view of properly formulating the rehabilitation and expansion plan of distribution network, a series of information/data related to energy distribution operation has to be properly managed. When the rehabilitation and expansion plan is to be reviewed in correspondence to yearly change in energy/power demand trend, it is of basic principle of planning to maximize the utilization level of the existing facility, and resolve the obvious problems in the operation of the existing distribution network. In this context, the present status of the existing elements constituting the network, the past trend in energy/power consumption (demand), and customer needs to be well managed and referred periodically.

The present BEN's information management system has not worked out satisfactory enough in answering the above statements, with which the energy supply operator should tackle. The following issues has been observed, regarding its information management:

(a) Information/data on the elements (facilities, equipment and material) constituting the network has been dispersed into the each network area and unit which are responsible for. In other words, the information/data has not been commonly shared among BEN as a whole.

(b) Information/data kept and managed for operation has been mostly recorded in the record book (paper), bringing about the deterioration of record book itself.

(c) Renewal, addition and deletion of the record books have not been properly conducted.

(d) Computer based information/data management has been applied only in very limited area.

To follow the issues presently observed in BEN, and to properly tackle the above statement, the Study Team proposes the management method for information/data necessary for distribution system operation through the utilization of computer based database system.

10.1.2 Basic Database

The scope for the type and item of information/data on the distribution network operation varies depending upon the objective and form of information/data utilization. With the timeframe given to this Study, extensive collection of data and establishment of database, which covers the entire distribution facilities and operation data is difficult. Accordingly, the proposed basic database by the Study Team covers the information/data specified below:

"Information/data" required in case that the "Master Plan" for Rehabilitation and Reconstruction formulated in the Study will be periodically reviewed and modified in correspondence to:

i) Change in customer's consumption (demand) trend,
ii) Status of the upper stream distribution system development, for which Azenerji had been responsible (until the establishment of JSC BEN) and,
iii) Progress of the implementation of the Master Plan.

The general coverage and contents, which meet the above statement, are as follows:

(a) Target areas:
The six administrative areas (the Study area for the Master Plan), namely as Sabail, Yasamal, Nasimi, Narimanov, Nizami and Khatai districts

(b) Information/data on the distribution facilities required for formulating the Master Plan, comprising:

(i) Data on transformer stations including location, layout plan of station building, transformers, switchgear equipment, etc.

(ii) Data on distribution lines including location, conductor type, line length, commissioning year, etc.

(c) Information/data on the past energy/power consumption and major economic indicators required for reviewing future trend in energy/power demand, comprising of data on energy purchase and sale, the number of customer, etc (all by category and by area).

Basic database is thus prepared based on the information/data collected for the Master Plan formulation by the Study Team under the cooperation provided by BEN. However, the information/data presented by BEN considerably shows deficiency and contradiction. Accordingly, it is expected that BEN will modify or supplement for the basic database prepared by the Study Team. It is also recommended for BEN to add information/data on the distribution facilities in the outside Study area and those with less than 35 kV which had been formerly the property of Azenerji (transferred to JSC BEN) to this database.

As for item (c), the Study Team initially planned to prepare an additional database, which intends to manage the data on energy sale and purchase, and the number of customer, and is useful to monitoring and rough forecast for energy demand. ESE has been currently taking lengthy time in working out to process such information/data, since such work has been manually undertaken. It was found during the site Study, however, that ESE has been in the process of preparing for the customer management database system, which responds to what the Study Team initially intended.

According to ESE, the data management and accumulation currently based on the record-book files will be replaced by computer-based record keeping. All the information/data on each customer ranging from the name and address to monthly energy sales and invoiced amount will be input in the database and easily automatically processed to provide any type of essential data (such as energy sales by tariff category, season and area). Owing to this proposed database, further processed information such as the growth rate in energy consumption in particular area and the basic estimate for energy demand projection will be easily available to BEN/ESE for future facilities planning purpose.

To avoid the duplication, therefore, it was decided that the basic database prepared in the Study covers the distribution facilities (item (b)).

10.2 Information/Data Incorporated in the Basic Database

Based on the concept explained in preceding section, the Study Team prepared the basic database for both transformer station and underground cable. The information/data included in each basic database is shown in Table II.10.2-1 and II.10.2-2.

The data items, which the basic database shall manage, include those on transformers and switchgears, which have not been collected during the Study period due to poor data management by BEN. However, those data need to be managed for proper operation and maintenance of distribution facilities, therefore, the input box for those information/data is included in the proposed basic database. It is expected that those information/data be collected and input into the database by BEN.

Table II.10.2-1 Basic database for transformer stations

1) Transformer station	2) Transformer	3) Switchgear
Location	Type	Type
Station number	Voltage	Voltage
Network area number	Capacity	Capacity
Number of TR	Type of winding	Manufacturing number
Number of switchgears	Manufacturing no.	Manufacture
No. of out-going feeders	Manufacture	Year of installation
No. of in-coming feeders	Year of installation	
Construction year	Tap ratio	
No. of LV feeders		
Layout plan		

Table II.10.2-2 Basic database for underground cables

MV underground cable
Network area number
Cable number
Network area at a starting point
Transformer station number at a starting point
Network area at a endpoint
Transformer station number at a endpoint
Number of circuit
Voltage
Type and size of the cable
Cable length
Commissioning year
Manufacturer

10.3 Merits and Recommendation on the Basic Database

The format for information/data input is in mostly accordance with the existing practices of BEN in the record book keeping. Therefore, handiness for routine use to the existing BEN's staff is particularly secured. The following merits by utilizing the basic database is considered:

(a) Uniform format for information/data management will be maintained among BEN.

(b) Prompt derivation of processed information, essential for reviewing and monitoring the Master Plan (distribution facilities plan) implementation will be available.

(c) Centralization and common sharing of information/data and prevention of data from deteriorating and missing will be achieved.

Beyond this scope, however, it is ultimately expected that BEN will customize the basic database prepared by the Study Team for the purpose of enhancing its convenience in the medium and long-term period of course. For instance, the database on distribution facilities can be linked with the data on energy demand

and customer so that specific distribution facility can be promptly located to upgrade its capacity in correspondence to an increase in energy demand in particular area. It is also suggested that the database be expanded to incorporate all information/data for the distribution facilities located in Baku City to cover the whole marketing area of newly established JSC BEN.

CHAPTER 11

MEASURES AGAINST ENVIRONMENTAL ISSUES

CHAPTER 11 MEASURES AGAINST ENVIRONMENTAL ISSUES

11.1 Issues Concerned with Underground Line Construction Works

11.1.1 Anticipated Issues

The underground line construction works will be undertaken along with the streets and roads of the area where the office buildings or apartment complexes are heavily concentrated. Accordingly, noises and vibrations caused by construction machinery, and traffic congestion might exert negative influences to the surrounding local communities. In carrying out the construction work, it is necessary to consider the following items and to take security and environmental measures.

(1) Route selection

To minimize obstruction to traffic and the other underground facilities, selection of the underground line routes should be selected at places where

(a) Cable length can be shortened

(b) Wide road and low traffic, and construction and maintenance works can be easily done

(c) There are few crossing point with underground facilities such as water and gas pipe, and places where it is possible to lay the cables keeping good distance with them

(d) There are few road crossing points and place where is able to lay the cables to a right angle to the road

(e) Groundwater level is low and soil condition is firm and stable

(2) Electromagnetic induction problems

A certain amount of voltage is induced on the communication line running in parallel with a distribution line due to the electromagnetic induction phenomena when unbalanced current flows in the distribution line. High induction voltage under a ground fault on the distribution line endangers human bodies and connected communication facilities when the induced voltage exceeded a certain limit.

The grounding system of 6 kV and 10 kV distribution line is the isolated neutral system. In this system, since the one line-to-ground fault current is small, the electromagnetic inductive obstacle to communication line is not caused.

(3) Issues during construction works

Since the objective area of the Master Plan is a densely populated and heavy traffic area, the following issue may be caused during the underground line construction period. Sufficient precautionary measures are necessary to these issues.

(a) Obstruction to the traffic

(b) Damages to the other underground facilities by the excavation

(c) The noise and the vibration to the local residents by the excavation

11.1.2 Measures to be Taken

The measures to the issues caused by the underground line construction works are shown below.

(1) Traffic safety measures

(a) To secure traffic, public and worker's safety, the facilities for security and safety should be set up in the construction site. To avoid an inrush of a vehicle into the construction site, proper safety measures should be taken in front and behind of the site.

(b) The construction site should be arranged as clear as possible to identify. The traffic control personnel should be placed for safety and traffic if and where necessary.

(c) For all workers, safety measures for work on the road and condition of the road and traffic should be recognized.

(2) Safety measures for excavation work

(a) At the construction site where the underground facilities are congested, situation and location of those facilities should be investigate in advance.

(b) Since there is a possibility that existing underground facilities are not buried in the location same as the drawing, excavation work should be done by hand in principle. So as not to damage the underground facilities, a close attention should be paid on the use of pick and tools like that.

(c) So as not to interfere with traffic, the traffic control personnel should be placed during the excavation work and the construction materials such as surplus soil and the electric wires should be put in order.

(3) Environmental measures

To maintain living environment of the local residents, the pollution such as noise, vibration and land subsidence should be avoid, and the following items should be noted on all locations of the construction work.

(a) To minimize noise and vibration from the construction site to the local residents, construction work time should be considered.

(b) To carry out the construction work smoothly, the construction period and place should be noticed to the local residents with signboards in advance.

(c) For the construction work that occupies a road, a passage for pedestrians and car should be secured.

11.2 Issues Concerned with Construction and Operation of Transformer Stations

The environmental problems to the local communities concerned with the replacement of equipment, renovation/construction works of the station house, and operation of the transformer station are shown below.

11.2.1 Issues concerned with Construction Works

(1) Planned outage

Planned outage will be inevitable in forwarding the renovation and construction works of the transformer station building, and replacement works of the equipment. As the target area of the Master Plan in particular is a center of City, with office buildings and apartment complex heavily concentrated, there are a large number of resident living in this area and will be greatly affected by energy outage. Accordingly, the following measures, which minimize the number and time of stoppage, should be taken as in this plan.

(a) Utilization of temporary transformer station facilities

(b) Formulation of the plan, which minimizes new construction and expansion of the station building

(c) Examination of the system configuration and selection of the equipment, which minimize the renovation of the station building

Furthermore, regarding the implementation of construction works, a preparation of the implementation schedule based on the sufficient study of the surrounding situation, a close discussion between the client and the contractor, and appropriate reporting to the surrounding residents are required to minimize the negative impacts on the local communities.

(2) Land issues

Since the objective area is in an urban area, the acquisition of land for expansion or new construction of a transformer station building, except a transformer station, which is erected in a park or green belt, is a difficult situation. As described in Section 4.6 of Volume II, a transformer station, which is in a existing apartment or commercial building, doesn't have any space for expansion. To solve these problems, it's necessary to rearrange the partition wall of each facility room in transformer station and size selection of MV switchgears has to be paid particular attention.

(3) Protection against residents

Most of the rented room type transformer stations face the public roads, and some ground-mounted transformer stations do adhered to the other buildings. For the replacement works of the facilities in the transformer stations, sufficient protection measures to prevent neighboring residents from accidents caused by transformer stations including temporary facilities as well as to minimize the traffic disturbance will be essential.

As conceivable measures, the adoption of shut-up type temporary facilities to minimize the portion of exposure, establishment of protection fence around temporary facilities and construction site, adjustment of working schedule, preparation of security staff and so on will be required and taken in accordance with surrounding environment of each project site.

11.2.2 Issues concerned with Operation of the Facilities after the Project Completion

(1) Noise and vibration

Although a noise of distribution transformer increases with its deterioration, the transformer is isolated with concrete walls and the noise, which leaks to the exterior, is small. Actually, the complaint to BEN from the residents who are adjacent to the transformer station is few.

Since the vibration of a distribution transformer is originally faint and also the transformer is installed on the thick concrete foundation, it is conceivable that there are few instances of vibration to the neighboring resident.

(2) Soil pollution with oil leakage

A transformer and switchgear that are containing oil inside are installed in the transformer station building made of concrete, except for the compact type station. Even if the oil leakage occurs in the station building, the oil flows into cable duct and does not leak out structurally. Therefore, it is conceivable that there is little possibility of the soil pollution by oil leakage.

(3) Fire on transformer

The fire accidents have occurred to some existing distribution transformers. It is conceivable that this cause depends on the deterioration and overload operation of the transformers. Since capacity of transformer, which is planned to introduce by the Master Plan, is selected with consideration of the demand increase and installation of a power fuse is also planned to protect the transformer, it is possible to minimize the fire accident of the transformer by the overload.

Although each facility room is divided with the concrete partition walls, spreading of the fire can be prevented in the event of fire. However, since the load of each transformer is changing from moment to moment, it's important to establish O&M system such as periodic measurement of maximum load of the transformer.

To prevent a fire, a dry type transformer, in which insulation oil is not contained, is applied to the in-building type transformer station.

VOLUME III

BASIC DESIGN LEVEL STUDY

CHAPTER 1

SELECTION OF PRIORITY ADMINISTRATIVE AREA

CHAPTER 1 SELECTION OF PRIORITY ADMINISTRATIVE AREA

1.1 General

The objectives of the present Study are to prepare the Master Plan for rehabilitating and reconstructing the power distribution network in the six administrative districts in Baku, and to carry out a basic design level study for the project/area with the highest urgency attached as a result of selection. The basic design level study followed by the Master Plan is to prepare the design output to be utilized for the implementation of a more concrete rehabilitation and reconstruction plan. Therefore, a clarification, basic design, cost estimate of targeted facility and formulating its implementation plan shall be covered.

Initially, the prioritization among the Study area (six administrative districts) is conducted, before a selection of the highest priority project/area.

1.2 Basic Data for Prioritization

Prioritization is examined from the viewpoints of (a) urgency for implementation of rehabilitation and reconstruction plan, and (b) impacts of the plan, with the following aspects analyzed:

(a) Urgency for implementation of rehabilitation and reconstruction plan
   i) Supply capacity of the distribution facilities in response to electricity demand, in other words, the number of transformer station and feeder lines, and capacity of transformers
   ii) Operational condition of the distribution facilities, in other words, demand density, energy loss, frequency of accident, and such as those which indicate technical improvement effects by implementing the rehabilitation and reconstruction plan
   iii) The extent to which the distribution facility has aged

(b) Impacts of implementation of rehabilitation and reconstruction plan
   i) Condition in major public facility's distribution in the Study area
   ii) Beneficiary size including population served by implementing the plan

Appendix III.1.2-1 presents the data to examine along with the above items. Each data is given supporting explanation as follows:

(1) Size of Sabail district

The three quarters of Sabail district is the old oil extraction area, where only a few oil extraction works are still going on. There are almost no residential area or public facility in the oil extraction area. Mainly overhead distribution lines are installed in this area for supplying power for pump facilities. The remaining one fourth of the Sabail district forms part of the old city area, with a large size population and a concentration of many public facilities. Considering these conditions, only one-third of the district area is included in the calculation of densities of population, public facility and such.

(2) Population

Although the population estimates in Baku are varying among the material and expert personnel who the Study Team met, there was no decisive means to confirm the actual population size, therefore, the data provided by the statistical office of Baku City were applied. It should be noted, however, that even this data from the statistical office is also not reliable, as mentioned in the section of "electrification ratio" in Chapter 5 of Volume II.

(3) Educational, medical and other public facilities

The Study Team found that the statistical office of Baku City has no data on the number of various public facilities distributed in each district. The Study Team, therefore, collected the information from "Directory of Baku City" (Telephone Directory). Among the information found in the directory, those relating to religious facilities are judged not reliable enough for use as an evaluation item, and therefore excluded.

(4) Energy Supply

According to BEN's data, although each administrative district records energy sale, energy purchase from Azenerji is recorded only by lumping the total of Sabail, Yasamal, Nasimi, Narimanov and Binagady districts. Therefore, energy supply and loss amounts are not available by each district. Accordingly, energy supply volume is estimated by applying the average energy loss rate in the Study area (see in Chapter 7 in Volume II). Also the peak load by district is estimated based on those energy supply amounts and an annual load factor of 55 % for BEN's customer.

(5) Accident records of facilities

Each BEN's Network Area has compiled the accident record of distribution facilities, and furthermore the boundary of Network Area is determined without reflecting that of administrative area. Therefore, the number of accident by administrative district is not available, so the total number of facility accident is proportioned in accordance to the ratio of area size.

1.3 Indicator for Prioritization

The figures in Appendix III.1.2-1 were not directly used for prioritization purpose. To make a reasonable comparison of the effects realized by investment for rehabilitating distribution facilities, those figures were converted to those per a unit of area size (density indicator).

Table III.1.3-1 shows those density indicators by each item and district.

Table III.1.3-1 Comparative indicators (density indicators)

	($/km^2$)	Sabail	Yasamal	Nasimi	Narimanov	Nizami	Khatai
1. General							
Population	1,000	7.9	13.5	20.0	6.0	5.0	6.8
Medical facility	Nos.	2.45	1.52	2.45	0.86	0.31	0.32
Educational facility	Nos.	6.91	5.30	9.08	3.16	2.30	2.63
Other public facility	Nos.	6.91	2.20	3.78	1.23	0.36	0.44
2. Power Demand							
Demand density	MW	6.19	4.09	6.82	2.59	2.37	2.44
Residential customers	1,000	2.86	2.32	3.87	1.27	1.82	1.66
Losses	GWh	5.72	3.78	6.31	2.40	0.96	1.59
3. D/L facility							
Transformers	Nos.	24.36	24.45	35.71	11.43	9.03	9.94
Tr. Capacity	MVA	11.93	12.63	17.22	5.51	4.44	5.42
Feeders	Nos.	4.15	5.00	7.55	1.56	1.12	1.42
4. Faults/Accidents							
Transformers	Nos.	2.77	2.56	4.39	1.48	1.07	1.01
Underground cables	Nos.	36.06	38.11	46.84	17.13	18.42	9.87
5. Facility over 40 years use							
Transformers	Nos.	4.36	3.17	6.53	1.80	0.56	0.22
Underground cables	km	4.17	2.76	4.50	1.78	0.35	0.08

1.4 Prioritization

A scoring method was applied for prioritization through those density indicators. The district with the highest value for an item is given six points, and the district with next lower value is given one point lower score with continuous prioritization in a descending order. A district with the higher score, therefore, has the higher priority. The scoring result thus computed is shown in Table III.1.4-1.

As shown in Table III.1.4-1, it is found that Nasimi district shows a distinctive result, followed by Sabail and Yasamal districts in all evaluation items. Therefore, the highest priority project/area is to be selected from among those three districts.

Table III.1.4-1 Scoring for each district

	Sabail	Yasamal	Nasimi	Narimanov	Nizami	Khatai
1. General	(20)	(18)	(22)	(8)	(8)	(8)
Population	4	5	6	2	1	3
Medical facility	5	4	6	2	3	1
Educational facility	5	4	6	1	3	2
Other public facility	6	5	4	3	1	2
2. Energy Demand	(15)	(12)	(18)	(5)	(7)	(6)
Demand density	5	4	6	1	3	2
No. of residential customer	5	4	6	1	3	2
Losses	5	4	6	3	1	2
3. D/L facility	(12)	(15)	(18)	(9)	(3)	(6)
No. of transformers	4	5	6	3	1	2
Tr. Capacity	4	5	6	3	1	2
No. of feeders	4	5	6	3	1	2
4. Faults/Accidents	(9)	(9)	(12)	(5)	(5)	(2)
Transformers	5	4	6	3	2	1
Underground cables	4	5	6	2	3	1
5. Facility over 40 years use	(10)	(8)	(12)	(6)	(4)	(2)
Transformers	5	4	6	3	2	1
Underground cables	5	4	6	3	2	1
Total	66	61	82	35	26	24

Appendix III.1.2-1 Materials for selection of priority area

	Unit	Study Area						Total	Baku
		Sabail	Yasamal	Nasimi	Narimanov	Nizami	Khatai		Total
1. General Information									
1.1 Area	km²	9.4 (28.1)	16.4	9.8	24.4	19.6	31.6	111.2	
1.2 Population	1,000	74.3	221.5	195.8	147.9	159.1	215.5	1,014.1	1,788.6
1.3 Estimated Nos. of Household	1,000	18.6	55.4	49.0	37.0	39.8	53.9	253.7	447.2
1.4 Medical Services	Nos.	23	25	24	21	6	10	109	
Number of Hospital	Nos.	12	12	12	9	3	5	53	
Number of Clinic	Nos.	11	13	12	12	3	5	56	
1.5 Schools	Nos.	65	87	89	77	45	83	446	
High Education	Nos.	16	22	13	17	0	6	74	
Secondary Schools	Nos.	23	22	33	24	24	27	153	
Kindergartens	Nos.	26	43	43	36	21	50	219	
1.6 Public Utilities	Nos.	65	36	37	30	7	14	189	
Theaters incl. Cinema	Nos.	12	3	9	2	1	2	29	
Museum incl. Art Galleries	Nos.	24	4	0	0	0	1	29	
Libraries	Nos.	11	12	12	11	4	4	54	
Community Centers	Nos.	9	7	7	7	1	4	35	
Sports Facilities incl. Stadium	Nos.	9	10	9	10	1	3	42	
1.7 Others (Hotels,Resorts, Places for Rest, Dormitories etc)	Nos.	40	20	15	26	4	18	123	
2. Power Supply and Demand									
2.1 Power Supply (1999)									
Supplied Energy	GWh	280.2	322.8	321.7	304.8	223.6	371.3	1,824.4	3,616.9
Peak Demand	MW	58.2	67.0	66.8	63.3	46.4	77.1	378.7	750.7
2.2 Demand									
Consumed Energy	GWh	226.4	260.8	259.9	246.3	204.8	321.2	1,519.4	3,001.8
Residential Customers	1,000	26.9	38.0	37.9	30.9	35.6	52.6	221.9	357.6
2.3 Losses	GWh	53.8	62.0	61.8	58.5	18.8	50.1	305.0	615.1
	(%)	19.2	19.2	19.2	19.2	8.4	13.5	16.7	17.0
3. Distribution Facilities									
3.1 Transformer station									
Numbers (BEN)	Nos.	149	247	215	182	111	197	1,101	2,278
Transformers	Nos.	229	401	350	279	177	314	1,750	3,166
Total Capacity	MVA	112.1	207.2	168.8	134.4	87.0	171.4	880.9	1,358.8
3.2 Number of Feeders	Nos.	39	82	74	38	22	45	300	798
6 kV	Nos.	17	55	51	21	0	9	153	542
10 kV	Nos.	22	27	23	17	22	36	147	256
4. Faults/Accidents (1998)									
4.1 Underground Cables	Times	339	625	459	418	361	312	2514	2,880
4.2 Transformers	Nos.	26	42	43	36	21	32	200	366
5. Dertioration of Facilities (more than 40 years)									
5.1 Substation (Building)	Nos.	41	52	64	44	11	7	219	
5.2 Underground Cables	km	39.2	45.3	44.1	43.5	6.9	2.4	181.4	
6 kV	km	38.9	44.3	44.0	40.1	2.4	0.0	169.7	
10 kV	km	0.3	1.1	0.1	3.4	4.5	2.4	11.8	

CHAPTER 2

CANDIDATE AREA FOR PRIORITY PROJECT

CHAPTER 2 CANDIDATE AREA FOR PRIORITY PROJECT

2.1 Candidate Area

Baku City has its own conceptual plan to rehabilitate the distribution network in the central part of the city, extending over the three administrative districts. These districts are same as those selected as candidate area in the last Chapter. Figure III.2.1-1 (1) shows the location delineated for this plan. JICA's preliminary study team also points out the necessity for urgent rehabilitation of this area. Actually, around 43 % of medical facilities and 32 % of the total in the Study area (six administrative area) are concentrated in this area (shown in Table III.2.1-1), although the area size (12.9 km^2) accounts for only 10 % of the total.

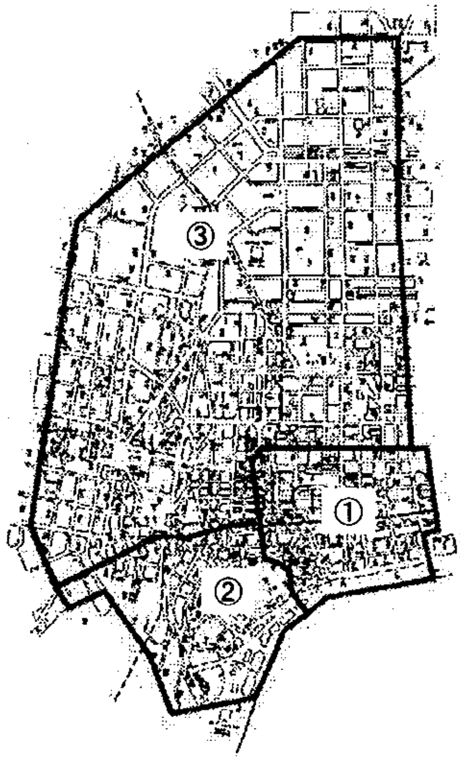

Figure III.2.1-1(1) Project area based on BEN's plan

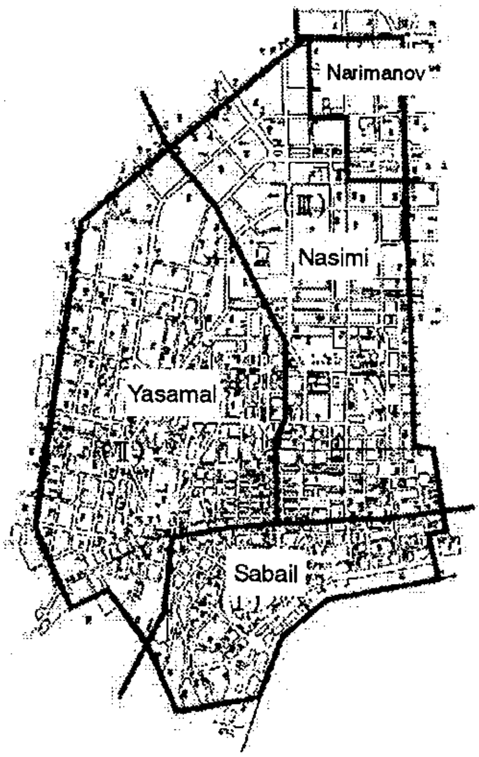

Figure III.2.1-1(2) Project area based on district

Furthermore, a large number of offices of major public organization, business enterprises, and foreign public organization and capitals are located in this central area, being the economic and commercial center of Azerbaijan. Also energy demand density in this area is extensively higher compared to other areas. In addition, the distribution facilities in this area has used a considerable number of old cables installed at the time when the first 6 kV system were introduced in Baku City, and been relatively obsolete. Taking into account those situations, this central area of Baku City is selected as priority project/area with confirmation by the counterpart.

Table III.2.1-1 The characteristics of priority project area (the central area of Baku)

Item		Priority project area				Ratio against the entire Study area
		I	II	III	Total	
1. General						
Medical facility	(Nos.)	15	12	20	47	43.1 %
Educational facility	(Nos.)	23	50	69	142	31.8 %
Other public facility	(Nos.)	25	26	23	74	39.2 %
2. Power demands	(MW)	38.5	36.9	33.8	107.8	28.5 %
3. Distribution facility						
Transformer capacity	(MVA)	74.2	114.3	85.6	274.1	31.6 %
Underground cable length	(cct•km)	85.1	118.8	64.8	268.7	31.7 %

2.2 Dividing the Area

To select the project/area for the basic design level study for the rehabilitation plan in the central area of Baku, which BEN strongly desires to promptly implement, can be judged as valid, considering the examination results in the preceding Chapter. However, it is difficult to identify the whole plan for this central area as an object for basic design level study since the study period is rather limited. Accordingly, it is recommended to further divide the plan and narrow the size of project for basic design level study.

The following two methods to divide the central area of the plan are suggested, and also shown in Figure III.2.1-1:

(i) Dividing along with Baku City's plan (shown in Figure III.2.1-1 (1))

(ii) Dividing along the boundary of administrative district (shown in Figure III.2.1-1 (2))

In this study, the Master Plan for rehabilitation and reconstruction of energy distribution network, which targets for each 6 administrative districts is to be formulated along with basic design level study for the highest priority project/area. The said highest priority project/area is to be integrated as a part of the Master Plan. This means that the consistency between the Master Plan and the priority project is to be ensured. Therefore, the highest priority project/area shall be selected in accordance with the above method (ii), by which the consistency with the Master Plan is easily examined. Each divided priority project area as selection target is called as Sabail, Yasamal, and Nasimi priority area respectively.

CHAPTER 3

SELECTION OF THE HIGHEST PRIORITY PROJECT

CHAPTER 3 SELECTION OF THE HIGHEST PRIORITY PROJECT

3.1 General

The highest priority project as a target of basic design level study is selected from among the three higher priority project/area mentioned before. A series of works in Pre-Feasibility study including identification of facilities to be rehabilitated, cost estimation, and prioritization by economic evaluation has confirmed the viability and priority of the project. Based on the outcome, then, a discussion with counterparts has been made, and confirmed the highest priority of the selected project. This Chapter presents and discusses the outcome of the said examination.

3.2 Identification of Rehabilitation Facilities for Pre-Feasibility Study

3.2.1 Distribution Facilities in the Priority Project Area

Based on the database for the existing transformer stations and underground cables explained in Chapter 2 in Volume 2, the MV distribution facilities in the priority project area are picked out, and shown in Table III.3.2-1. The ratio of which those facilities in the priority project area account for the total in each administrative district is presented in Table III.3.2-2. From the table, it is known that more than 60% of MV distribution facilities have been concentrated in the entire Sabail district, though the area size of the priority project area in Sabail only accounts for 7.3 % of the entire Sabail administrative district. Also, in the priority area extended over other districts, the concentration of distribution facility into the priority area has been clearly large.

Table III.3.2-1 Distribution facilities by district in the priority project area

Facilities		Sabail priority area	Yasamal priority area	Nasimi priority area	Total
Transformer station (number)	6 kV	57	106	83	246
	10 kV	34	38	23	95
	total	91	144	106	341
Transformer (number)	6 kV	82	160	124	366
	10 kV	58	67	32	157
	total	130	227	156	513
Transformer capacity (MVA)	6 kV	36.8	79.0	59.4	175.2
	10 kV	37.4	35.3	26.1	98.8
	total	74.2	114.3	85.5	274.1
Underground cable length (km)	6 kV	46.0	76.2	49.7	171.9
	10 kV	39.1	42.6	15.1	96.4
	total	85.1	118.8	64.8	268.3

Table III.3.2-2 Ratio of distribution facility in the priority area against the entire administrative area

Facilities	unit	Sabail priority area		Yasamal priority area		Nasimi priority area		Total	
Area	km^2	28.1	7.3%	16.4	36.0%	24.4	20.4%	68.9	18.8%
Transformer station (6/10 kV)	Nos.	149	61.1%	247	58.3%	215	49.3%	611	55.8%
Transformer (6/10 kV)	Nos.	229	56.8%	401	56.6	349	44.7%	979	52.4%
Transformer capacity (6/10 kV)	MVA	112.1	66.2%	207.2	55.2%	168.8	50.7%	488.1	56.2%
Cable length (6/10 kV)	km	120.5	70.6%	206.9	57.4%	146.2	44.3%	473.6	56.6%

3.2.2 Identification of Objective Facilities

The highest priority project area is determined by the Pre-feasibility study for the facility rehabilitation and reconstruction plan for the above mentioned priority areas. The scope of facility identification for Pre-Feasibility study is considered as MV distribution cables, buildings of transformer station, MV switchgears, transformers, LV switchboards and LV cables. The criteria for facility identification for rehabilitation have been in accordance with the one for Master Plan Study. It is noted, however, that some facilities in this section are selected by different criteria from the one for the highest priority project in basic design level study examined later. It is because that the facility identification in this section is for Pre-feasibility study level, therefore, undertaken conveniently.

(1) Medium voltage underground cables

All MV distribution lines in the priority project area are underground cables. MV distribution lines for the Pre-feasibility study have been selected from the following criteria.

(a) All the distribution lines constituted by the cables laid before 1960 are replaced. Also the lines constituted as one section by connecting plural cables are replaced, as far as a part of the cables was laid before 1960.

(b) In case that more than 2 points of cable joint are observed, and that the year of cable laying is varied among each cable, it is considered that the certain section of cables has been replaced due to fire accident or ground fault. The cable, which has such records, is rehabilitated regardless the year of laying.

Table III.3.2-3 shows the length of the cables identified according to the above criteria, and the detailed information is provided in Appendixes III.3.2-1 (1) - (3). As known from the table below, the underground cables laid before 1960 are only 6 kV cables. The cables laid before 1960, which constitutes 10 kV distribution system, were initially installed as the element of 6 kV system and used later as the part of 10 kV system.

Table III.3.2-3 Underground lines to be rehabilitated

Item	Sabail Priority area	Yasamal priority area	Nasimi priority area	Total
6 kV underground line				
laid before 1960	25.2 km	40.5 km	30.2 km	95.9 km
more than 2 connection points	3.5 km	2.1 km	3.8 km	9.4 km
total	28.7 km	42.6 km	34.0 km	105.3 km
the number of section	54	100	75	229
10 kV underground line				
laid before 1960	0.3 km	-	0.1 km	0.4 km
more than 2 connection points	-	0.7 km	4.5 km	5.2 km
total	0.3 km	0.7km	4.6 km	5.6 km
the number of section	1	1	3	5

(2) Transformer stations

The identification of transformer stations to replace urgently the switchgears and transformers should be undertaken with more detailed site survey. For the purpose of Pre-feasibility study to select the project for basic design level study, however, one third of total transformer stations in the priority project area is considered as the target facility.

Not directly related to the extent of overage of facilities in the transformer station building, the number of buildings constructed before 1960 accounts for 38 % of total as shown in Table III.3.2-4. Hence, the assumption of "one third" is considered as valid as the facility scale for urgent rehabilitation project.

Table III.3.2-4 Number of transformer stations constructed before 1960

Item	Sabail priority area	Yasamal priority area	Nasimi priority area	Total
6 kV transformer station	25	51	41	117
10 kV transformer station	6	5	3	14
Total	31	56	44	131
Ratio against the total in the priority area	34.1 %	38.9 %	41.1 %	38.4 %

Adoption of 10 kV system into Baku is supposed to be initiated since 1965, considering the laying year of underground cable. It is true for the priority project area, the initial laying year of 10 kV cable was in 1967. Accordingly, the switchgears and underground cables as well as buildings of the 10 kV transformer station constructed before 1960 (shown in Table III.3.2-4) were diverted as they were to augment existing 6 kV to 10 kV system. This is confirmed by referring to Appendix III.3.2-1 (1) - (3).

(3) Transformers

It has been difficult to identify the target transformer from its past record. It is because the record on the year of manufacturing, purchase, and installment of each transformer has not been sufficiently maintained. Accordingly, considering the above situation, the number of transformers and the capacity to be replaced is set as one third of the total in the priority project area as was done in the transformer stations, and shown in Table III.3.2-5.

Table III.3.2-5 Transformers to be replaced

Item	Sabail Priority area	Yasamal Priority area	Nasimi Priority area	Total
Existing number of unit	130	227	156	513
Number of unit to be replaced	43	76	52	171
Existing capacity	74.2 MVA	114.3 MVA	85.5 MVA	274.0 MVA
Capacity to replaced	24.7 MVA	38.1 MVA	28.5 MVA	91.3 MVA

(4) Medium and low voltage switchgears

The amount of target MV and LV switchgears have been estimated from the necessary quantity to build double circuit system based on the number of lines identified in item (1) above, and the number of transformers.

(5) Other facilities

As other facilities considered, the facilities for distribution system monitoring and dispatching, and the facilities in the 110 kV and 35 kV substations, which supply power to the Study area can be included. However, they have not been considered as the scope of examination is to confirm the highest priority project area only.

3.3 Pre-feasibility Study for Selecting the Highest Priority Project

The highest priority project/area is identified from among the three candidate project areas based on the prioritization through economic evaluation.

3.3.1 Cost Estimate

For the purpose of priority project cost estimation, the extents of rehabilitation and replacement have been supposed as follows:

(a) Transformer station buildings
As explained in Volume 2, it is considered as difficult to expand the transformer station buildings except for a part of them. Therefore, in the Pre-feasibility study, the replacement of facilities in the transformer stations are emphasized while not taking into account the new construction of the building. However, since the existing MV switchgear rooms are generally too narrow to install a vacuum type or FS6 gas type switchgear panels, the change in partition layout inside the transformer station building has been considered.

(b) Transformers and switchgears

It is supposed that though all the transformers and switchgears in the identified transformer station for rehabilitation are to be replaced, the number of units and the total capacity is not changed. Voltage augmentation from 6 kV to 10 kV is not considered. Under the existing system, a number of circuit breaker with plural cable connections have been seen, but, the number of switchgear is adjusted to fit the number of lines when estimating cost.

(c) Medium and low voltage distribution line

It is supposed that the MV underground cables to be rehabilitated are replaced without altering the existing number of circuits, and the route. In other words, the cables are procured and laid in accordance with the length of underground line to be rehabilitated.

The unit CIF prices for equipment and cable materials are derived with reference to the record of other distribution network rehabilitation projects. Remodeling work for transformer station building, removal and laying work for underground cable are supposed to be undertaken by the local contractors. Though the installation, adjustment and testing of equipment are usually followed by the foreign supplier, it is also presumed that the work arising here are mostly conducted by the local contractors. Regarding the LV distribution lines, it is supposed that the procurement of cables and connecting materials are within the scope, and the replaced against the existing LV lines is followed on BEN's own terms. The cost for the said BEN's work is not included.

The priority project cost estimate, based on the above supposition and conditions, is derived as shown in Table III.3.3-1. Around 32 % of the construction cost is for renovation and repairing works of transformer stations and laying works of underground cable lines. The unit prices for these works are set with small allowance against the actual cost figures of BEN's works in 1999. For renovation works of transformer stations, actual construction cost data of the transformer station No.224 is referred, and that of cable laying works of 10 kV (four circuit line:1,160 km) between Patamdar 110 kV substation and transformer station No.600 is referred for cable laying works. The renovation works of transformer stations and laying works of underground cable account for small portion in the total construction cost, since the implementation of these works by local contractor is presumed.

Table III.3.3-1 Breakdown of the priority project cost (thousand US$)

Item	Sabail priority area	Yasamal priority area	Nasimi priority area
Equipment and material cost (CIF)	7,921	12,377	9,460
Construction cost: foreign portion	2,272	3,537	2,730
Construction cost: local portion	1,175	1,807	1,442
Sub-total	11,368	17,721	13,632
Detail design and construction supervision	1,137	1,772	1,363
Total	12,505	19,493	14,995

3.3.2 Project Cost for Evaluation

As the costs for project evaluation, the project cost estimate derived in the last clause (disbursement schedule as 20%-first year/ 50%-second year/ 30%-third year) and the incremental operation and maintenance (O&M) cost (2.0 % of the project cost) purely incurred by newly established facilities by the project are used. Composite conversion factor applied in Master Plan evaluation is used to derive economic cost.

3.3.3 Benefit for Evaluation

(1) Effects of the priority project

As in the case of Master Plan project evaluation, "avoidable unserved energy supply by the project implementation" is considered. Unserved energy, brought about by accidents of facilities and resultant capacity shortage without the project implementation in the three priority projects/areas, will be adequately supplied after the project implementation. Accordingly, the incremental energy supply is considered as a benefit. Since the overage distribution facilities are more highly concentrated in the priority project areas, it is reasoned that the rate of increase in unserved energy supply without the project will be much higher than that assumed for the whole Study area. However, the examination is conducted by adopting the same rate as in the Master Plan evaluation.

(2) Demand projection for the priority project/area

As BEN/ESE has undertaken the customer management, inspection, charge billing and collection only for each administrative district, it is difficult to apply the practice for the purpose of grasping the demand (consumption) level for such optional area as the priority project area. In this study, therefore, the demand for the optional area has been estimated by deriving the peak demand based on total capacity and average capacity factor of transformers in each priority project area. Annual load factor 55 % and power factor 90 % is adopted for estimating the peak demand and capacity factor of transformers respectively.

Table III.3.3-2 Demand estimate for the priority project area

Year 1999	unit	Sabail priority area	Yasamal priority area	Nasimi priority area
Energy demand	GWh	280.2	322.8	321.7
Peak demand	MW	58.1	67.0	66.8
Total capacity of transformer	MVA	112.5	207.2	168.8
Capacity factor of transformer	%	57.6	35.9	43.9
For the priority project area				
Total capacity of transformer	MVA	74.2	114.3	85.6
Peak demand	MW	38.3	36.9	33.8
Energy demand	GWh	185.4	177.9	162.8
Ratio the priority area accounts for	%	66.2	55.1	50.6

Based on the demand data for year 1999 (in the above table), demand projection for the priority project/area is derived by applying the same growth rate adopted in Chapter 7 in Volume II.

(3) Unit rate of benefit

As explained in Master Plan project evaluation, the unit rate for benefit computation is derived in terms of the saving from resource mobilization (avoidable cost) realized by the improvement of supply capability. From the kWh cost for obtaining the energy from non-network sources (assuming domestic type generator use) in case of supply interruption, economic supply cost per kWh by the network (LRAIC) to LV customer (at LV distribution network outlet) is deducted. As a result, unit rate of benefit for the project evaluation is computed to be US cent 9.24/kWh.

3.3.4 Sensitivity Test

Sensitivity test is undertaken to ascertain the extent of influence of major variants to the priority projects' EIRR, and examined by varying the project cost (plus and minus 20 %) and the assumed rate of increase in unserved energy supply (plus and minus 1 %/year against base case).

3.3.5 Evaluation Result

The evaluation result in terms of IRR is shown in Table III.3.3-3, and detailed in Appendix III.3.3-1. In selecting the highest priority project/area, a priority project in Sabail area shows the highest IRR both in base case and each sensitivity scenario. Therefore, following the consultation with the counterpart, the project in Sabail district is selected as the highest priority project/area. The urgency of the rehabilitation for this area has been strongly indicated by the counterpart before this Pre-feasibility study.

Table III.3.3-3 Project evaluation result by EIRR

		Sabail Priority area	Yasamal priority area	Nasimi priority area
Base case		24.6 %	17.4 %	19.0 %
Sensitivity test				
1) Project cost	(- 20%)	29.8 %	21.3 %	23.1 %
	(+ 20%)	21.0 %	14.6 %	16.0 %
2) Supply interruption growth rate	(-0.5%/year)	21.0 %	14.6 %	16.0 %
	(+0.5%/year)	28.1 %	20.0 %	21.8 %

Appendix III.3.2-1(1) Underground cables to be rehabilitated in Sabail (Sabail priority project area)

No.	From		To		Circuit	Voltage	Joint	Cable	Cable	Route	Cable	Commiss.	Remarks
	N. No	S/S No.	N. No	S/S No.	(CCT)	(kV)		Type	Size	Length (m)	Length (cct·m)	Year	
(6 kV Underground Cable Lines Constructed before 1960)													
1	2	20	2	23	1	6.0		СБ-6	3 x 95	377	377	1910	
2	2	129	88	119	1	6.0	1	СБ-6	3 x 95	1,365	1,365	1910	АСБ-6 3x185:520(59)
3	3	25	2	34	1	6.0	1	СБ-6	3 x 50	330	330	1913	АСВ10,3x150:170(83)
4	5	64	5	75	1	6.0	1	СБ-10	3 x 95	599	599	1923	СБ-10 3x95:250(70)
5	2	23	2	129	1	6.0		СБ-6	3 x 95	1,203	1,203	1926	
6	2	12	3	16	1	6.0	1	СБ-6	3 x 50	370	370	1929	ААВ10,3x185:0(88)
7	2	12	2	966	1	6.0	2	СВ-6	3x50	421	421	1929	
8	2	23	2	33	1	6.0		СБ-6	3 x 95	345	345	1929	
9	3	25	3	966	1	6.0	3	СБ-6	3 x 70	20	20	1929	АСБ-10 3x150:50(83),СБ-6 3x50:263(29),ААБ-10 3x185:0(89)
10	2	33	2	348	1	6.0		СБ-6	3 x 95	120	120	1929	
11	2	20	2	53	1	6.0		СБ-6	3 x 70	252	252	1930	
12	5	60	5	98	1	6.0		СБ-6	3 x 95	260	260	1931	
13	2	17	2	519	1	6.0	1	СБ-6	3 x 95	1,322	1,322	1932	АСБ-10 3 x 185:100(80)
14	2	17	88	119	1	6.0	3	СБ-6	3 x 95	1,455	1,455	1932	СБ-6 3x95:100(32),АСБ-6 3x150:625(59),АСБ-10 3x150:500(73)
15	2	23	2	519	1	6.0	1	СБ-6	3 x 95	200	200	1932	СБ-10 3x150:100(80)
16	2	5	2	7	1	6.0	1	СБ-6	3 x 70	427	427	1933	
17	2	5	2	129	1	6.0	1	СБ-6	3 x 70	614	614	1933	СБ-6 3 x 70:220(60),АСБ-63 x 185:325(60)
18	2	6	2	7	1	6.0		СБ-6	3 x 70	272	272	1933	
19	2	7	2	330	1	6.0	1	СБ-6	3 x 70	250	250	1933	СБ-6 3x185:70(60)
20	2	22	2	330	1	6.0	1	СБ-6	3 x 70	387	387	1933	СБ-6 3x185:70(33)
21	2	22	2	23	1	6.0		СБ-6	3 x 150	282	282	1933	
22	3	25	3	468	1	6.0	2	АСБ-10	3 x 95	298	298	1933	АСВ10,3x1855:35(75);3x150:50(83)
23	2	23	2	162	1	6.0	1	СБ-6	3 x 95	285	285	1936	АСБ-10 3x185:25(80)
24	2	5	2	200	1	6.0		СБ-6	3 x 70	367	367	1940	
25	2	5	2	201	1	6.0		СБ-6	3 x 70	230	230	1940	
26	5	57	5	411	1	6.0		СБ-6	3 x 95	795	795	1948	СБ-6 3 x 185:350(49)
27	5	57	5	98	1	6.0		СБ-6	3 x 95	394	394	1948	
28	2	8	2	329	1	6.0	2	СБ-6	3 x 70	855	855	1952	АСБ-6 3x185:115(61),ААБЛ-10 3x95:350(80)
29	2	291	2	743	1	6.0	3	СБ-6	3 x 185	173	173	1952	АСБ-6 3x185:21(61),АСБ-10 3x185:7(78),АСБ-10 3x70:145(58)
30	2	573	2	743	1	6.0	2	СБ-6	3 x 185	567	567	1952	СБ-10 3 x 150:180(73),АСБ-10 3 x 185:7(78)
31	2	6	2	462	1	6.0	1	СБ-6	3 x 70	65	65	1954	АСБ-6 3x185:30(64)
32	2	11	2	462	1	6.0	1	СБ-6	3 x 95	558	558	1954	АСБ-6 3x185:30(64),СБ-6 3x70:45(54)
33	2	11	2	573	1	6.0	2	СБ-6	3 x 95	329	329	1954	СБ-10 3x150:125(73),СБ-6 3x70:21(54)
34	2	4	2	7	1	6.0	1	АСБ-6	3 x 95	483	483	1957	АСБ-6 3x185:113(60)
35	2	4	2	107	1	6.0	1	АСБ-6	3 x 95	220	220	1957	АСБ-6 3x185:110(60)
36	2	9	2	301	1	6.0		АСБ-6	3 x 120	210	210	1957	
37	2	8	2	573	1	6.0	1	СБ-6	3 x 185	340	340	1958	СБ-6 3x150:180(74)
38	2	108	2	109	1	6.0		АСБ-6	3 x 95	245	245	1958	
39	2	200	2	291	1	6.0	1	АСБ-6	3 x 70	145	145	1958	АСБ-6 3x185:21(61)
40	2	5	2	11	1	6.0	1	АСБ-6	3 x 120	550	550	1959	
41	2	23	88	119	1	6.0	3	СБ-6	3 x 185	2,466	2,466	1959	АСБ-10 3x185:470(71),СБ-6 0:386(0),АСБ-10 3x150:270(71)
42	2	41	2	321	1	6.0	2	СБ-6	3 x 50	230	230	1959	СБ-6 3 x 185:435(59),СБ-6 3x50:70(59)
43	5	64	5	217	1	6.0	1	АСБ-6	3 x 185	632	632	1959	СБ-6 3x95:250(70)
44	2	107	2	109	1	6.0		АСБ-6	3 x 95	300	300	1959	
45	5	179	2	321	1	6.0	1	СБ-6	3 x 185	645	645	1959	СБ-6 3x95:210(60)
46	2	4	2	108	1	6.0	1	СБ-6	3 x 70	1,269	1,269	1960	СБ-6 3x50:219(60)
47	2	17	2	23	1	6.0		АСБ-6	3 x 120	1,275	1,275	1960	
48	5	179	4	527	1	6.0	1	СБ-6	3 x 50	422	422	1960	СБ-6 3x95:342(60)
49	5	179	2	237	1	6.0		СБ-6	3 x 185	0	0	1960	
50	5	237	5	500	1	6.0		0	0	0	0	1960	
					50					25,219	25,219		
(6 kV Underground Cable Lines with 2 and More Joints)													
51	2	12	2	573	1	6.0	3	АСБ-10	3 x 150	432	432	1973	СБ-6 3x70:307(0),ААБ-10 3x120:0(88)
52	2	162	2	519	1	6.0	3	АСБ-10	3 x 150	780	780	1973	ААБ-10 3x185:100(80),СБ-6 3x70:240(89),АСБ-6 3x185:410(89)
53	2	301	2	348	1	6.0	2	СБ-6	3 x 50	300	300	1976	АСБ-10 3x185:73(84),СБ-6 3x185:45(76)
54	2	348	5	450	1	6.0	2	АСБ-10	3 x 150	2,000	2,000	1980	СБ-6 3x185:1460(89),АСБ-10 3x185:120(89)
					4					3,512	3,512		
(10 kV Underground Cable Lines Constructed before 1960)													
55	5	60	5	98	1	10.0		СБ-6	3 x 95	260	260	1931	
(10 kV Underground Cable Lines with 2 and More Joints) : Nil													
Total		6 kV			54					28,731	28,731		
		10 kV			1					260	260		
		Total			55					28,991	28,991		

Appendix III.3.2-1(2) Underground cables to rehabilitated in Yasamal (Yasamal priority project areas)

No.	From		To		Circuit	Voltage	Joint	Cable	Cable	Route	Cable	Commiss.	Remarks
	N. No	S/S No.	N. No	S/S No.	(CCT)	(kV)		Type	Size	Length (m)	Length (cct·m)	Year	
(6 kV Underground Cable Lines Constructed before 1960)													
1	2	26	3	50	1	6.0	1	СБ-6	3 x 50	324	324	1928	СБ-6 3 x 95:60(28)
2	2	26	2	348	1	6.0		СБ-6	3 x 95	184	184	1928	
3	2	26	3	28	1	6.0	1	СБ-6	3 x 70	215	215	1929	АСБ-6 3 x 150:65(62)
4	3	28	3	35	1	6.0	3	СБ-6	3 x 70	235	235	1929	АСВ6,3x150:65(62);АСВ10,3x185:70(74)
5	3	19	3	27	1	6.0		АСБ-6	3 x 70	300	300	1933	
6	3	19	3	468	1	6.0	1	АСБ-6	3 x 70	165	165	1933	АСВ10,3x185:35(75)
7	3	18	3	19	1	6.0		СБ-6	3 x 50	304	304	1935	
8	4	29	4	222	1	6.0		СБ-6	3 x 70	375	375	1935	АС6,3x150:242(59)
9	3	35	3	48	1	6.0		СБ-6	3 x 50	395	395	1935	
10	3	18	3	85	1	6.0		СБ-6	3 x 70	292	292	1936	
11	2	26	3	85	1	6.0		СБ-6	3 x 70	150	150	1936	
12	4	83	4	378	1	6.0	0	СБ-6	3 x 70	120	120	1936	?? Change to No.37, AC10,3x185:30(65)
13	3	27	3	38	1	6.0		СБ-6	3 x 95	462	462	1951	No.103&110
14	3	38	3	516	1	6.0		СБ-6	3 x 95	600	600	1951	
15	3	38	88	120	1	6.0		СБ-6	3 x 95	1,313	1,313	1951	
16	4	99	3	603	1	6.0	2	СБ-6	3 x 95	516	516	1952	ААШЕ-10 3x240:80(71),СБ-10 3x95:12(71)
17	4	104	88	120	1	6.0	0	СБ-6	3 x 70	480	480	1952	
18	4	123	4	235	1	6.0	1	СБ-6	3 x 50	270	270	1952	C6,3x70:200(68)
19	4	235	88	120	1	6.0	1	СБ-6	3 x 50	470	470	1952	СБ-6 3x70:200(68)
20	4	39	88	111	1	6.0	1	СБ-6	3 x 95	590	590	1953	АСБ-10 3x240:370(98)
21	4	104	4	383	1	6.0	1	СБ-6	3 x 95	370	370	1953	C6,3x70:190(58)
22	4	142	4	529	1	6.0	0	СБ-6	3 x 95	770	770	1953	
23	3	14	3	16	1	6.0	3	СБ-6	3 x 95	544	544	1954	СВ6,3x95:85(54),254(58);АСВ10,3x150:102(73)
24	4	30	4	206	1	6.0	2	СБ-6	3 x 120	485	485	1954	C6,3x185:145(54);AC10,3x150:20(68)
25	4	39	4	206	1	6.0	0	СБ-6	3 x 185	300	300	1954	
26	3	131	88	120	1	6.0		СБ-6	3 x 50	1,700	1,700	1954	
27	4	132	4	296	1	6.0	0	СБ-6	3 x 95	440	440	1954	
28	4	132	4	423	1	6.0	0	СБ-6	3 x 95	140	140	1954	
29	4	134	4	472	1	6.0		СБ-6	3 x 95	546	546	1954	C6,3x150:75(64)
30	4	137	4	423	1	6.0	1	СБ-6	3 x 95	272	272	1954	AC6,3x185:12(63)
31	4	142	4	751	1	6.0	2	СБ-6	3 x 50	950	950	1954	C6,3x95:850(54);AC10,3x150:75(80)
32	3	27	3	551	1	6.0	1	СБ-6	3 x 95	445	445	1955	АСБ-10 3x150:135(69)
33	4	123	4	342	1	6.0	4	АСБ-6	3 x 185	806	806	1955	AC6,3x95:171(60);AC6,3x150:250(68);AA6,3x240:75(68)
34	3	124	3	273	1	6.0	2	СБ-6	3 x 70	558	558	1955	C6,3x95:241(58);3x185:141(62)
35	4	144	88	111	1	6.0	0	СБ-6	3 x 95	270	270	1955	C6,3x150:150(66)
36	3	273	5	289	1	6.0	1	СБ-6	3 x 70	134	134	1955	C6,3x95:361(58)
37	4	288	4	385	1	6.0	0	АСБ-6	3 x 185	320	320	1955	
38	4	288	4	641	1	6.0	2	АСБ-6	3 x 185	375	375	1955	AC10,3x185:120(65);AC10,3x150:60(73)
39	5	289	3	516	1	6.0	3	СБ-6	3 x 70	1,040	1,040	1955	C6,3x95:100(58);3x70:12(60);AC10,3x185:195(71)
40	4	207	4	751	1	6.0	1	СБ-6	3 x 95	385	385	1956	AC10,3x50:75(80)
41	6	37	4	134	1	6.0	1	АСБ-6	3 x 185	903	903	1957	AC10,3x150:470(74)
42	3	85	2	301	1	6.0		АСБ-6	3 x 185	360	360	1957	
43	3	90	3	272	1	6.0		СБ-6	3 x 95	525	525	1957	
44	4	114	4	216	1	6.0	0	СБ-6	3 x 95	150	150	1957	
45	3	118	3	131	1	6.0		СБ-6	3 x 70	370	370	1957	
46	3	121	3	961	1	6.0	1	АСБ-10	3 x 120	305	305	1957	АСБ-10 3 x 120:5(95)
47	3	124	3	391	1	6.0	1	СБ-6	3 x 95	670	670	1957	AC6,3x185:170(63)
48	4	174	4	207	1	6.0	0	СБ-6	3 x 70	420	420	1957	
49	4	174	4	506	1	6.0	2	АСБ-6	3 x 95	430	430	1957	AC6,3x185:163(62);AC10,3x150:150(69)
50	3	208	3	394	1	6.0		СБ-6	3 x 150	350	350	1957	
51	4	222	4	783	1	6.0	1	СБ-6	3 x 95	230	230	1957	AC10,3x95:150(83)
52	3	14	3	121	1	6.0	1	C-6	3x70	281	281	1958	СВ6,3x95:51(58)
53	4	29	4	135	1	6.0	0	СБ-6	3 x 50	315	315	1958	
54	4	30	4	914	1	6.0	2	АСБ-10	3 x 150	470	470	1958	ААБ-10,3x95:50(95),АСБ-10,3x150:20(68)
55	3	90	3	477	1	6.0	1	СБ-6	3 x 150	450	450	1958	ААВ10,3x150:0(65)
56	4	92	4	99	1	6.0	1	АСБ-6	3 x 185	400	400	1958	ААШ10,3x240:80(71)
57	3	118	3	299	1	6.0		СБ-6	3 x 150	230	230	1958	
58	3	124	3	208	1	6.0		АСБ-6	3 x 185	570	570	1958	
59	3	131	3	293	1	6.0		СБ-6	3 x 95	125	125	1958	AC6,3x185:35(62)
60	4	135	4	137	1	6.0	0	СБ-6	3 x 50	375	375	1958	
61	4	216	4	383	1	6.0	1	СБ-6	3 x 70	115	115	1958	AC6,3x185:75(62)
62	4	222	4	463	1	6.0	1	СБ-6	3 x 95	410	410	1958	AC10,3x150:100(68)
63	3	272	3	297	1	6.0	0	АСБ-6	3 x 150	296	296	1958	
64	4	277	4	347	1	6.0	1	АСБ-6	3 x 185	255	255	1958	AA10,3x185:75(70)
65	5	289	3	290	1	6.0	0	СБ-6	3 x 95	360	360	1958	
66	3	290	3	457	1	6.0	1	СБ-6	3 x 95	134	134	1958	AC6,3x150:46(64)

Appendix III.3.2-1(2) Underground cables to rehabilitated in Yasamal (Yasamal priority project areas)

No.	From		To		Circuit	Voltage	Joint	Cable	Cable	Route	Cable	Commiss.	Remarks
	N. No	S/S No.	N. No	S/S No.	(CCT)	(kV)		Type	Size	Length (m)	Length (cct·m)	Year	
67	3	293	3	457	1	6.0	1	СБ-6	3 x 95	217	217	1958	Ac6,3x150:46(61);3x185:35(62)
68	3	299	3	477	1	6.0	1	СБ-6	3 x 150	565	565	1958	AA10,3x150:290(65)
69	4	347	4	508	1	6.0	1	АСБ-6	3 x 185	95	95	1958	AA10,3x150:430(66)
70	3	35	4	292	1	6.0		АСВ-6	3x120	210	210	1959	
71	4	83	4	292	1	6.0	0	АСБ-6	3 x 185	285	285	1959	
72	4	92	4	298	1	6.0	1	АСБ-6	3 x 150	107	107	1959	AC6,3x185:70(58)
73	4	134	4	296	1	6.0	1	СБ-6	3 x 95	294	294	1959	C6,3x185:120(54)
74	4	136	4	137	1	6.0	1	СБ-6	3 x 95	323	323	1959	C6,3x185:45(52)
75	4	137	4	172	1	6.0	1	СБ-6	3 x 70	230	230	1959	C6,3x185:50(52)
76	4	174	4	238	1	6.0	0	АСБ-6	3 x 185	240	240	1959	
77	4	207	4	460	1	6.0	1	СБ-6	3 x 95	390	390	1959	AC6,3x150:90(64)
78	4	235	4	238	1	6.0	0	АСБ-6	3 x 150	480	480	1959	
79	4	460	88	120	1	6.0	1	СБ-6	3 x 95	214	214	1959	AC6,3x150:90(64)
80	3	28	3	85	1	6.0		АСБ-6	3 x 150	460	460	1960	
81	3	28	3	260	1	6.0	1	АСБ-6	3 x 150	170	170	1960	ACB6,3x185(60)
82	3	28	3	327	1	6.0		АСБ-6	3 x 185	392	392	1960	
83	4	114	4	139	1	6.0	0	АСБ-6	3 x 185	350	350	1960	
84	4	139	88	120	1	6.0	1	АСБ-6	3 x 185	575	575	1960	AA6,3x185:320(64)
85	3	208	3	340	1	6.0		АСБ-6	3 x 185	250	250	1960	
86	3	208	3	394	1	6.0		АСБ-6	3 x 185	370	370	1960	
87	4	238	4	338	1	6.0	0	АСБ-6	3 x 185	367	367	1960	
88	3	260	3	327	1	6.0		АСБ-6	3 x 185	263	263	1960	
89	4	288	4	438	1	6.0	2	СБ-6	3 x 95	470	470	1960	AC6,3x185:340(63);AC6,3x95:80(64)
90	4	288	4	549	1	6.0	2	СБ-6	3 x 95	610	610	1960	AC10,3x150:135(74)&85(76)
91	4	298	88	120	1	6.0	2	АСБ-6	3 x 185	720	720	1960	AC6,3x185:320(64);AA10,3x185:330(89)
92	4	314	4	549	1	6.0	1	СБ-6	3 x 95	285	285	1960	AC10,3x150:135(60)
93	4	314	88	120	1	6.0	1	СБ-6	3 x 95	1,302	1,302	1960	C6,3x95:385(60)
94	4	324	88	111	1	6.0	1	АСБ-6	3 x 185	566	566	1960	C6,3x185:286(60)
95	3	327	3	498	1	6.0	1	АСБ-6	3 x 185	240	240	1960	AA10,3x150:130(65)
96	4	342	4	385	1	6.0	1	АСБ-6	3 x 95	385	385	1960	AC6,3x185:214(60)
97	3	351	3	394	1	6.0	3	АСБ-6	3 x 185	935	935	1960	AC6,3x185:100(62);AA10,3x185:225(68)
					97					40,469	40,469		
(6 kV Underground Cable Lines with 2 and More Joints)													
98	3	118	2	413	1	6.0	3	АСБ-6	3 x 70	250	250	1962	AA10,3x185:100(83):AAШ6,3x150:140(83)
99	3	297	2	413	1	6.0	2	АСБ-6	3 x 70	1,450	1,450	1962	AAШ10,3x185:1100(75);AA10,3x185:100(83)
100	4	472	4	707	1	6.0	2	СБ-6	3 x 95	400	400	1964	C6,3x150:75(64);AC10,3x185:45(77)
					3					2,100	2,100		
(10 kV Underground Cable Lines Constructed before 1960) : Nil													
(10 kV Underground Cable Lines with 2 and More Joints)													
101	3	409	3	625	1	10.0	2	АСБ-10	3 x 150	670	670	1975	АСБ-10 3x150:50(75),АСБ-10 3x150:70(80)
Total		**6 kV**			**100**					**42,569**	**42,569**		
		10 kV			**1**					**670**	**670**		
		Total			**101**					**43,239**	**43,239**		

Appendix III.3.2-1(3) Underground cables to be rehabilitate in Nasimi (Nasimi priority project area)

No.	From		To		Circuit	Voltage	Joint	Cable Type	Cable Size	Route Length	Cable Length	Commiss. Year	Remarks
	N. No	S/S No.	N. No	S/S No.	(CCT)	(kV)				(m)	(cct·m)		
(6kV Underground Cable Lines Constructed before 1960)													
1	2	44	5	45	1	6.0		СБ-6	3 x 95	365	365	1911	
2	5	78	5	234	1	6.0	1	СБ-6	3 x 70	267	267	1911	СБ-6 3x70:360(31)
3	5	45	5	81	1	6.0	1	СБ-6	3 x 70	358	358	1912	СБ-6 3x95:125(58)
4	5	46	5	81	1	6.0	1	СБ-6	3 x 70	429	429	1912	СБ-6 3x95:125(58)
5	5	78	5	614	1	6.0		АСБ-10	3 x 150	170	170	1912	
6	5	46	5	214	1	6.0	2	СБ-6	3 x 95	587	587	1913	СБ-6 3x70:153(72),ААБ-10 3x150:15(72)
7	5	71	5	3289	1	6.0	2	СБ-6	3 x 70	961	961	1920	СБ-6 3x185:430(67),СБ-10 3x95:185(70)
8	3	47	88	117	1	6.0	1	СБ-6	3 x 50	662	662	1922	АСБ-6 3x150:340(22)
9	3	48	88	117	1	6.0	1	АСБ-10	3 x 150	450	450	1922	СБ-6 3x50:100(22)
10	6	67	7	70	1	6.0	2	СБ-6	3 x 95	540	540	1926	С6,3x70:160(56);АА10,3x150:140(82)
11	3	15	3	58	1	6.0	1	СБ-6	3 x 50	175	175	1927	СВ6,3x70:61(--)
12	3	50	3	58	1	6.0	1	СБ-6	3 x 50	519	519	1928	СН6,3x95:70(53)
13	5	45	3	51	1	6.0		СБ-6	3 x 70	293	293	1931	
14	3	50	3	51	1	6.0	1	СБ-6	3 x 50	340	340	1931	СВ6,3x95:115(53)
15	6	67	6	526	1	6.0	0	СБ-6	3 x 95	317	317	1931	
16	3	15	3	47	1	6.0	1	СБ-6	3 x 50	262	262	1935	СВ6,3x70:50(--)
17	3	48	5	106	1	6.0	1	СБ-6	3 x 70	410	410	1935	АСБ-10 3x185:200(77)
18	2	44	2	162	1	6.0		СБ-6	3 x 95	645	645	1936	ААБ-10 3x185:25(80),СБ-6 3x50:460(0)
19	6	67	6	623	1	6.0	1	СБ-6	3 x 50	230	230	1949	АС10,3x150:135(73)
20	6	170	6	226	1	6.0	1	СБ-6	3 x 95	387	387	1950	АС6,3x95:213(64)
21	6	170	6	396	1	6.0	1	СБ-6	3 x 50	470	470	1950	С6,3x95:220(55)
22	5	76	5	79	1	6.0		СБ-6	3 x 70	341	341	1951	
23	5	173	5	225	1	6.0	1	СБ-6	3 x 95	200	200	1951	АСБ-6 3x185:350(62)
24	5	138	88	111	1	6.0	1	СБ-6	3 x 70	603	603	1953	АСБ-6 3x95:382(61)
25	5	52	5	214	1	6.0	1	СБ-6	3 x 95	490	490	1954	АСБ-10150:80(80)
26	6	67	5	71	1	6.0		СБ-6	3 x 95	476	476	1954	
27	5	155	5	831	1	6.0		СБ-6	3 x 70	545	545	1954	
28	5	156	5	180	1	6.0		АСБ-6	3 x 120	495	495	1954	
29	5	156	1	228	1	6.0	1	СБ-6	3 x 70	335	335	1954	АСБ-10 3x185:50(74)
30	5	228	5	831	1	6.0	1	СБ-6	3 x 70	305	305	1954	АСБ-6 3x185:130(77)
31	5	234	5	310	1	6.0	2	СБ-6	3 x 70	300	300	1954	СБ-6 3x95:400(55),СБ-6 3x185:100(59)
32	5	71	5	310	1	6.0	1	СБ-6	3 x 95	230	230	1955	СБ-6 3x183:100(59)
33	5	76	1	228	1	6.0	1	СБ-6	3 x 70	270	270	1955	АСБ-10 3x185:120(77)
34	6	175	6	302	1	6.0	1	СБ-6	3 x 95	620	620	1955	АС6,3x150:210(59)
35	6	175	88	96	1	6.0	3	ОСБ-35	3 x 95	584	584	1955	С6,3x185:80(55);3x150:85(65)
36	6	177	6	396	1	6.0	1	СБ-6	3 x 95	530	530	1955	С6,3x50:250(62)
37	4	189	9	232	1	6.0	0	АСБ-6	3 x 70	510	510	1955	
38	9	197	9	594	1	6.0	1	СБ-6	3 x 95	414	414	1955	АС10,3x185:7(72)
39	9	197	9	823	1	6.0	1	СБ-6	3 x 95	230	230	1955	АА10,3x185:100(85)
40	6	256	6	302	1	6.0	1	СБ-6	3 x 95	275	275	1955	АС6,3x150:230(59)
41	4	277	9	233	1	6.0	5	СБ-6	3 x 95	1,327	1,327	1955	АС6,3x185:97(58);АС6,3x150:755(67);АС10,3x150:85(70);270(73)
42	5	265	5	464	1	6.0	2	СБ-6	3 x 95	195	195	1956	СБ-6 3x70:55(56),АСБ-10 3x150:50(80)
43	5	154	4	783	1	6.0	2	СБ-6	3 x 70	573	573	1957	С6,3x95:236(57);АС6,3x95:150(83)
44	5	154	5	155	1	6.0	1	АСБ-6	3 x 185	580	580	1957	СБ-6 3x70:180(57)
45	5	158	5	224	1	6.0	1	СБ-6	3 x 70	312	312	1957	АСБ-6 3x150:12(87)
46	6	175	6	176	1	6.0	0	АСБ-6	3 x 120	250	250	1957	
47	6	175	6	177	1	6.0	0	СБ-6	3 x 95	229	229	1957	
48	5	224	5	271	1	6.0	1	АСБ-6	3 x 150	433	433	1957	АСБ-6 3x150:55(87)
49	6	67	6	68	1	6.0	0	СБ-6	3 x 95	635	635	1958	
50	6	176	6	178	1	6.0	1	АСБ-6	3 x 95	280	280	1958	АС10,3x185:65(68)
51	9	183	9	188	1	6.0		АСБ-10	3 x 120	650	650	1958	ААБ-6, 3x95:270(58),3x120:195(58),3x95:30(58),ААБ-10,3x120:55(79)
52	9	188	9	395	1	6.0		АСБ-6	3 x 95	160	160	1958	
53	5	234	5	492	1	6.0	3	АСБ-6	3 x 185	439	439	1958	СБ-6 3x185:74(68),АСБ-10 3x150:160(72),СБ-6 3x70:175(58)
54	5	426	4	463	1	6.0	2	СБ-6	3 x 95	515	515	1958	АС6,3x150:90(58);АС10,3x150:515(68)
55	5	426	88	111	1	6.0	1	СБ-6	3 x 95	262	262	1958	АСБ-6 3x150:90(63)
56	5	173	5	309	1	6.0	1	АСБ-6	3 x 185	790	790	1959	ААШБ-10 3x185:110(79)
57	5	180	5	309	1	6.0	1	АСБ-6	3 x 120	290	290	1959	ААШБ-6 3x120:110(70)
58	9	151	9	203	1	6.0	0	СБ-6	3 x 95	550	550	1960	
59	6	177	6	723	1	6.0	3	СБ-6	3 x 95	626	626	1960	С6,3x185:350(60);АС10,3x240:110(60)
60	9	199	9	232	1	6.0	0	АСБ-6	3 x 120	800	800	1960	
61	9	203	9	233	1	6.0	0	АСБ-6	3 x 95	600	600	1960	
62	9	203	9	313	1	6.0	0	СБ-6	3 x 95	270	270	1960	
63	9	203	9	336	1	6.0	0	АСБ-6	3 x 95	110	110	1960	
64	5	223	5	225	1	6.0	1	АСБ-10	3 x 120	250	250	1960	АСБ-6 3x185:210(60)
65	6	323	6	478	1	6.0	1	АСБ-6	3 x 240	615	615	1960	АСБ-6 3x185:160(60),АСБ-6 3x185:90(60)
66	5	334	5	492	1	6.0	2	АСБ-6	3 x 185	112	112	1960	АСБ-10 3x185:70(69),АСБ-6 3x185:22(79)

Appendix III.3.2-1(3) Underground cables to be rehabilitate in Nasimi (Nasimi priority project area)

No.	From		To		Circuit	Voltage	Joint	Cable	Cable	Route	Cable	Commiss.	Remarks
	N. No	S/S No.	N. No	S/S No.	(CCT)	(kV)		Type	Size	Length (m)	Length (cct·m)	Year	
67	5	334	88	117	1	6.0	2	АСБ-6	3 x 185	476	476	1960	АСБ-10 3x185:21(79),АСБ-10 3x185:435(69)
68	6	345	6	522	1	6.0	2	АСБ-10	3 x 185	285	285	1960	СБ-6 3x185:145(60),СБ-6 3x150:15(67)
69	6	345	9	835	1	6.0		СБ-6	3 x 95	190	190	1960	
70	6	345	88	111	1	6.0		СБ-6	3 x 95	290	290	1960	
71	6	522	6	723	1	6.0	1	СБ-6	3 x 185	410	410	1960	АСБ-10 3x240:110(78)
					71					30,094	30,094		
(6kV Underground Cable Lines with 2 and More Joints)													
72	5	228	5	309	1	6.0	2	АСБ-6	3 x 185	500	500	1961	ААШБ-10 3x185:110(74),АСБ-10 3x185:110(76)
73	5	147	5	326	1	6.0	3	ААБ- 6	3 x 120	1,085	1,085	1962	СБ-6 3x95:60(70),ААБ-10 3x120:130(71),ААБ-10 3x120:245(71)
74	4	189	88	111	1	6.0	2	СБ-6	3 x 150	1,380	1,380	1965	ААБ-10 3x185:730(67),АСБ-6,3x150:150(65):220(67)
75	5	81	5	450	1	6.0	2	АСБ-10	3 x 150	840	840	1980	АСБ-10 3x185:270(89),АСБ-10 3x240:150(74)
					4					3,805	3,805		
(10kV Underground Cable Lines Constructed before 1960)													
76	5	62	5	325	1	10.0		СБ-6	3 x 185	130	130	1960	СБ-6 3x95:80(60)
(10kV Underground Cable Lines with 2 and More Joints)													
77	5	24	5	234	1	10.0	2	АСБ-10	3 x 185	475	475	1972	АСБ-10 3 x 185:10(85),АСБ-10 3 x 185:190(72)
78	6	31	6	780	2	10.0	2	АСБ-10	3 x 150	2,037	4,074	1977	АСБ-10 3x185:100(83),АСБ-10 3x240:737(84)
					3					2,512	4,549		
Total		**6 kV**			**75**					**33,899**	**33,899**		
		10 kV			**4**					**2,642**	**4,679**		
		Total			**79**					**36,541**	**38,578**		

Appendix III.3.3-1 (1) Evaluation for selecting the highest priority project/area

for Project area in Sabail

	Base Case						Project cost over		20.0%	Project cost down		20.0%	Annual rate of increase of unserved energy		3.5%	Annual rate of increase of unserved energy		2.5%
	Project Cost ('000 USD)	O/M Cost ('000 USD)	Energy Consumption (GWh)	Avoidable Unserved Energy (GWh)	Benefit ('000 USD)	Balance ('000 USD)	Project Cost ('000 USD)	O/M Cost ('000 USD)	Balance ('000 USD)	Project Cost ('000 USD)	O/M Cost ('000 USD)	Balance ('000 USD)	Avoidable Unserved Energy (GWh)	Benefit ('000 USD)	Balance ('000 USD)	Avoidable Unserved Energy (GWh)	Benefit ('000 USD)	Balance ('000 USD)
2000			176.3															
2001	2,692.1		177.9	0.0	0.0	-2,692.1	3,230.5		-3,230.5	2,153.7		-2,153.7	0.0	0.0	-2,692.1	0.0	0.0	-2,692.1
2002	6,730.3	53.8	179.5	10.8	995.1	-5,789.1	8,076.4	64.6	-7,145.9	5,384.2	43.1	-4,432.3	12.6	1,160.9	-5,623.2	9.0	829.2	-5,954.9
2003	3,634.4	188.4	181.1	16.3	1,506.1	-2,316.7	4,361.2	226.1	-3,081.3	2,907.5	150.8	-1,552.2	19.0	1,757.1	-2,065.7	13.6	1,255.1	-2,567.8
2004		261.1	182.8	21.9	2,026.4	1,765.3		313.4	1,713.1		208.9	1,817.5	25.6	2,364.2	2,103.0	18.3	1,688.7	1,427.6
2005		261.1	184.4	27.7	2,556.4	2,295.3		313.4	2,243.1		208.9	2,347.5	32.3	2,982.5	2,721.4	23.1	2,130.4	1,869.2
2006		261.1	186.2	33.5	3,096.3	2,835.2		313.4	2,783.0		208.9	2,887.4	39.1	3,612.4	3,351.2	27.9	2,580.3	2,319.1
2007		261.1	187.9	39.5	3,646.4	3,385.2		313.4	3,333.0		208.9	3,437.5	46.0	4,254.1	3,993.0	32.9	3,038.6	2,777.5
2008		261.1	189.7	45.5	4,206.9	3,945.8		313.4	3,893.5		208.9	3,998.0	53.1	4,908.0	4,646.9	37.9	3,505.7	3,244.6
2009		261.1	191.5	51.7	4,778.2	4,517.0		313.4	4,464.8		208.9	4,569.2	60.3	5,574.5	5,313.4	43.1	3,981.8	3,720.7
2010		261.1	193.4	58.0	5,361.3	5,100.2		313.4	5,048.0		208.9	5,152.4	67.7	6,254.9	5,993.7	48.4	4,467.8	4,206.6
2011		261.1		58.0	5,361.3	5,100.2		313.4	5,048.0		208.9	5,152.4	67.7	6,254.9	5,993.7	48.4	4,467.8	4,206.6
2012		261.1		58.0	5,361.3	5,100.2		313.4	5,048.0		208.9	5,152.4	67.7	6,254.9	5,993.7	48.4	4,467.8	4,206.6
2013		261.1		58.0	5,361.3	5,100.2		313.4	5,048.0		208.9	5,152.4	67.7	6,254.9	5,993.7	48.4	4,467.8	4,206.6
2014		261.1		58.0	5,361.3	5,100.2		313.4	5,048.0		208.9	5,152.4	67.7	6,254.9	5,993.7	48.4	4,467.8	4,206.6
2015		261.1		58.0	5,361.3	5,100.2		313.4	5,048.0		208.9	5,152.4	67.7	6,254.9	5,993.7	48.4	4,467.8	4,206.6
2016		261.1		58.0	5,361.3	5,100.2		313.4	5,048.0		208.9	5,152.4	67.7	6,254.9	5,993.7	48.4	4,467.8	4,206.6
2017		261.1		58.0	5,361.3	5,100.2		313.4	5,048.0		208.9	5,152.4	67.7	6,254.9	5,993.7	48.4	4,467.8	4,206.6
2018		261.1		58.0	5,361.3	5,100.2		313.4	5,048.0		208.9	5,152.4	67.7	6,254.9	5,993.7	48.4	4,467.8	4,206.6
2019		261.1		58.0	5,361.3	5,100.2		313.4	5,048.0		208.9	5,152.4	67.7	6,254.9	5,993.7	48.4	4,467.8	4,206.6
2020		261.1		58.0	5,361.3	5,100.2		313.4	5,048.0		208.9	5,152.4	67.7	6,254.9	5,993.7	48.4	4,467.8	4,206.6
2021		261.1		58.0	5,361.3	5,100.2		313.4	5,048.0		208.9	5,152.4	67.7	6,254.9	5,993.7	48.4	4,467.8	4,206.6
2022		261.1		58.0	5,361.3	5,100.2		313.4	5,048.0		208.9	5,152.4	67.7	6,254.9	5,993.7	48.4	4,467.8	4,206.6
2023		261.1		58.0	5,361.3	5,100.2		313.4	5,048.0		208.9	5,152.4	67.7	6,254.9	5,993.7	48.4	4,467.8	4,206.6
2024		261.1		58.0	5,361.3	5,100.2		313.4	5,048.0		208.9	5,152.4	67.7	6,254.9	5,993.7	48.4	4,467.8	4,206.6
2025		261.1		58.0	5,361.3	5,100.2		313.4	5,048.0		208.9	5,152.4	67.7	6,254.9	5,993.7	48.4	4,467.8	4,206.6
2026		261.1		58.0	5,361.3	5,100.2		313.4	5,048.0		208.9	5,152.4	67.7	6,254.9	5,993.7	48.4	4,467.8	4,206.6
2027		207.3		46.4	4,289.1	4,081.8		248.8	4,040.3		165.8	4,123.2	54.2	5,003.9	4,796.6	38.7	3,574.2	3,366.9
2028		72.7		17.4	1,608.4	1,535.7		87.2	1,521.2		58.1	1,550.2	20.3	1,876.5	1,803.8	14.5	1,340.3	1,267.6
PV	10,740.2	2,144.8	1,131.3	337.8	31,210.7	18,520.8	12,888.2	2,573.7	15,982.8	8,592.1	1,715.8	21,058.8	394.1	36,412.5	23,722.6	281.5	26,008.9	13,319.0

Case	EIRR	B/C
Base Case	24.62%	2.42
Project cost over	20.96%	2.02
Project cost down	29.83%	3.03
Annual rate of increase of unserved energy 3.5%	28.12%	2.83
Annual rate of increase of unserved energy 2.5%	20.96%	2.02

Unit rate for benefit
USC/kWh 9.24

Unserved energy supply
Increasing rate per each annu 3.0%

Economic opportunity cost of capital
10.0%

Appendix III.3.3-1 (2) Evaluation for selecting the highest priority project/area
for Project area in Yasamal

	Base Case						Project cost over 20.0%			Project cost down 20.0%			Annual rate of increase of unserved energy 3.5%			Annual rate of increase of unserved energy 2.5%		
	Project Cost ('000 USD)	O/M Cost ('000 USD)	Energy Consumption (GWh)	Avoidable Unserved Energy (GWh)	Benefit ('000 USD)	Balance ('000 USD)	Project Cost ('000 USD)	O/M Cost ('000 USD)	Balance ('000 USD)	Project Cost ('000 USD)	O/M Cost ('000 USD)	Balance ('000 USD)	Avoidable Unserved Energy (GWh)	Benefit ('000 USD)	Balance ('000 USD)	Avoidable Unserved Energy (GWh)	Benefit ('000 USD)	Balance ('000 USD)
2000			171.6															
2001	4,197.4		175.7	0.0	0.0	-4,197.4	5,036.9		-5,036.9	3,357.9		-3,357.9	0.0	0.0	-4,197.4	0.0	0.0	-4,197.4
2002	10,493.5	83.9	179.9	10.8	997.6	-9,579.8	12,592.1	100.7	-11,695.3	8,394.8	67.2	-7,464.4	12.6	1,163.8	-9,413.6	9.0	831.3	-9,746.1
2003	6,296.1	293.8	184.3	16.6	1,532.5	-5,057.4	7,555.3	352.6	-6,375.4	5,036.9	235.1	-3,739.4	19.3	1,787.9	-4,802.0	13.8	1,277.1	-5,312.8
2004		419.7	188.8	22.7	2,092.9	1,673.1		503.7	1,589.2		335.8	1,757.1	26.4	2,441.7	2,021.9	18.9	1,744.1	1,324.3
2005		419.7	193.3	29.0	2,679.8	2,260.0		503.7	2,176.1		335.8	2,344.0	33.8	3,126.4	2,706.7	24.2	2,233.2	1,813.4
2006		419.7	198.1	35.7	3,294.3	2,874.6		503.7	2,790.7		335.8	2,958.5	41.6	3,843.4	3,423.7	29.7	2,745.3	2,325.5
2007		419.7	202.9	42.6	3,937.7	3,518.0		503.7	3,434.0		335.8	3,601.9	49.7	4,594.0	4,174.2	35.5	3,281.4	2,861.7
2008		419.7	207.9	49.9	4,611.0	4,191.3		503.7	4,107.4		335.8	4,275.2	58.2	5,379.5	4,959.8	41.6	3,842.5	3,422.8
2009		419.7	213.1	57.5	5,315.6	4,895.9		503.7	4,811.9		335.8	4,979.8	67.1	6,201.6	5,781.8	47.9	4,429.7	4,009.9
2010		419.7	218.3	65.5	6,052.5	5,632.7		503.7	5,548.8		335.8	5,716.7	76.4	7,061.2	6,641.5	54.6	5,043.7	4,624.0
2011		419.7		65.5	6,052.5	5,632.7		503.7	5,548.8		335.8	5,716.7	76.4	7,061.2	6,641.5	54.6	5,043.7	4,624.0
2012		419.7		65.5	6,052.5	5,632.7		503.7	5,548.8		335.8	5,716.7	76.4	7,061.2	6,641.5	54.6	5,043.7	4,624.0
2013		419.7		65.5	6,052.5	5,632.7		503.7	5,548.8		335.8	5,716.7	76.4	7,061.2	6,641.5	54.6	5,043.7	4,624.0
2014		419.7		65.5	6,052.5	5,632.7		503.7	5,548.8		335.8	5,716.7	76.4	7,061.2	6,641.5	54.6	5,043.7	4,624.0
2015		419.7		65.5	6,052.5	5,632.7		503.7	5,548.8		335.8	5,716.7	76.4	7,061.2	6,641.5	54.6	5,043.7	4,624.0
2016		419.7		65.5	6,052.5	5,632.7		503.7	5,548.8		335.8	5,716.7	76.4	7,061.2	6,641.5	54.6	5,043.7	4,624.0
2017		419.7		65.5	6,052.5	5,632.7		503.7	5,548.8		335.8	5,716.7	76.4	7,061.2	6,641.5	54.6	5,043.7	4,624.0
2018		419.7		65.5	6,052.5	5,632.7		503.7	5,548.8		335.8	5,716.7	76.4	7,061.2	6,641.5	54.6	5,043.7	4,624.0
2019		419.7		65.5	6,052.5	5,632.7		503.7	5,548.8		335.8	5,716.7	76.4	7,061.2	6,641.5	54.6	5,043.7	4,624.0
2020		419.7		65.5	6,052.5	5,632.7		503.7	5,548.8		335.8	5,716.7	76.4	7,061.2	6,641.5	54.6	5,043.7	4,624.0
2021		419.7		65.5	6,052.5	5,632.7		503.7	5,548.8		335.8	5,716.7	76.4	7,061.2	6,641.5	54.6	5,043.7	4,624.0
2022		419.7		65.5	6,052.5	5,632.7		503.7	5,548.8		335.8	5,716.7	76.4	7,061.2	6,641.5	54.6	5,043.7	4,624.0
2023		419.7		65.5	6,052.5	5,632.7		503.7	5,548.8		335.8	5,716.7	76.4	7,061.2	6,641.5	54.6	5,043.7	4,624.0
2024		419.7		65.5	6,052.5	5,632.7		503.7	5,548.8		335.8	5,716.7	76.4	7,061.2	6,641.5	54.6	5,043.7	4,624.0
2025		419.7		65.5	6,052.5	5,632.7		503.7	5,548.8		335.8	5,716.7	76.4	7,061.2	6,641.5	54.6	5,043.7	4,624.0
2026		419.7		65.5	6,052.5	5,632.7		503.7	5,548.8		335.8	5,716.7	76.4	7,061.2	6,641.5	54.6	5,043.7	4,624.0
2027		335.8		52.4	4,842.0	4,506.2		402.9	4,439.0		268.6	4,573.3	61.1	5,649.0	5,313.2	43.7	4,035.0	3,699.2
2028		125.9		19.7	1,815.7	1,689.8		151.1	1,664.6		100.7	1,715.0	22.9	2,118.4	1,992.4	16.4	1,513.1	1,387.2
PV	17,218.4	3,438.4	1,183.4	372.7	34,440.1	14,095.9	20,662.1	4,126.1	10,027.0	13,774.7	2,750.7	18,164.7	434.9	40,180.1	19,835.9	310.6	28,700.1	8,355.9

	Base Case	Project cost over	Project cost down	Unserved energy 3.5%	Unserved energy 2.5%
EIRR	17.42%	14.62%	21.29%	20.03%	14.62%
B/C	1.67	1.39	2.08	1.95	1.39

Unit Benefit
USC/kWh 9.24

Decline of Supply capability
per each annum 3.0%

Economic opportunity cost of capital
10.0%

Appendix III.3.3-1 (3) Evaluation for selecting the highest priority project/area for Project area in Nasimi

	Base Case						Project cost over 20.0%			Project cost down 20.0%			Annual rate of increase of unserved energy 3.5%			Annual rate of increase of unserved energy 2.5%		
	Project Cost ('000 USD)	O/M Cost ('000 USD)	Energy Consumption (GWh)	Avoidable Unserved Energy (GWh)	Benefit ('000 USD)	Balance ('000 USD)	Project Cost ('000 USD)	O/M Cost ('000 USD)	Balance ('000 USD)	Project Cost ('000 USD)	O/M Cost ('000 USD)	Balance ('000 USD)	Avoidable Unserved Energy (GWh)	Benefit ('000 USD)	Balance ('000 USD)	Avoidable Unserved Energy (GWh)	Benefit ('000 USD)	Balance ('000 USD)
2000			155.5															
2001	3,227.3		157.7	0.0	0.0	-3,227.3	3,872.7		-3,872.7	2,581.8		-2,581.8	0.0	0.0	-3,227.3	0.0	0.0	-3,227.3
2002	8,068.2	64.5	160.0	9.6	887.0	-7,245.7	9,681.8	77.5	-8,872.3	6,454.5	51.6	-5,619.2	11.2	1,034.8	-7,097.9	8.0	739.1	-7,393.6
2003	4,840.9	225.9	162.3	14.6	1,349.5	-3,717.3	5,809.1	271.1	-4,730.6	3,872.7	180.7	-2,703.9	17.0	1,574.4	-3,492.4	12.2	1,124.6	-3,942.2
2004		322.7	164.6	19.8	1,825.3	1,502.6		387.3	1,438.1		258.2	1,567.2	23.0	2,129.6	1,806.8	16.5	1,521.1	1,198.4
2005		322.7	167.0	25.1	2,314.8	1,992.1		387.3	1,927.6		258.2	2,056.7	29.2	2,700.7	2,377.9	20.9	1,929.0	1,606.3
2006		322.7	169.5	30.5	2,818.5	2,495.7		387.3	2,431.2		258.2	2,560.3	35.6	3,288.2	2,965.5	25.4	2,348.7	2,026.0
2007		322.7	172.0	36.1	3,336.6	3,013.9		387.3	2,949.3		258.2	3,078.4	42.1	3,892.7	3,570.0	30.1	2,780.5	2,457.8
2008		322.7	174.5	41.9	3,869.7	3,547.0		387.3	3,482.5		258.2	3,611.6	48.9	4,514.7	4,192.0	34.9	3,224.8	2,902.1
2009		322.7	177.1	47.8	4,418.3	4,095.6		387.3	4,031.1		258.2	4,160.2	55.8	5,154.7	4,832.0	39.8	3,681.9	3,359.2
2010		322.7	179.7	53.9	4,982.1	4,659.4		387.3	4,594.9		258.2	4,724.0	62.9	5,812.5	5,489.8	44.9	4,151.8	3,829.1
2011		322.7		53.9	4,982.1	4,659.4		387.3	4,594.9		258.2	4,724.0	62.9	5,812.5	5,489.8	44.9	4,151.8	3,829.1
2012		322.7		53.9	4,982.1	4,659.4		387.3	4,594.9		258.2	4,724.0	62.9	5,812.5	5,489.8	44.9	4,151.8	3,829.1
2013		322.7		53.9	4,982.1	4,659.4		387.3	4,594.9		258.2	4,724.0	62.9	5,812.5	5,489.8	44.9	4,151.8	3,829.1
2014		322.7		53.9	4,982.1	4,659.4		387.3	4,594.9		258.2	4,724.0	62.9	5,812.5	5,489.8	44.9	4,151.8	3,829.1
2015		322.7		53.9	4,982.1	4,659.4		387.3	4,594.9		258.2	4,724.0	62.9	5,812.5	5,489.8	44.9	4,151.8	3,829.1
2016		322.7		53.9	4,982.1	4,659.4		387.3	4,594.9		258.2	4,724.0	62.9	5,812.5	5,489.8	44.9	4,151.8	3,829.1
2017		322.7		53.9	4,982.1	4,659.4		387.3	4,594.9		258.2	4,724.0	62.9	5,812.5	5,489.8	44.9	4,151.8	3,829.1
2018		322.7		53.9	4,982.1	4,659.4		387.3	4,594.9		258.2	4,724.0	62.9	5,812.5	5,489.8	44.9	4,151.8	3,829.1
2019		322.7		53.9	4,982.1	4,659.4		387.3	4,594.9		258.2	4,724.0	62.9	5,812.5	5,489.8	44.9	4,151.8	3,829.1
2020		322.7		53.9	4,982.1	4,659.4		387.3	4,594.9		258.2	4,724.0	62.9	5,812.5	5,489.8	44.9	4,151.8	3,829.1
2021		322.7		53.9	4,982.1	4,659.4		387.3	4,594.9		258.2	4,724.0	62.9	5,812.5	5,489.8	44.9	4,151.8	3,829.1
2022		322.7		53.9	4,982.1	4,659.4		387.3	4,594.9		258.2	4,724.0	62.9	5,812.5	5,489.8	44.9	4,151.8	3,829.1
2023		322.7		53.9	4,982.1	4,659.4		387.3	4,594.9		258.2	4,724.0	62.9	5,812.5	5,489.8	44.9	4,151.8	3,829.1
2024		322.7		53.9	4,982.1	4,659.4		387.3	4,594.9		258.2	4,724.0	62.9	5,812.5	5,489.8	44.9	4,151.8	3,829.1
2025		322.7		53.9	4,982.1	4,659.4		387.3	4,594.9		258.2	4,724.0	62.9	5,812.5	5,489.8	44.9	4,151.8	3,829.1
2026		322.7		53.9	4,982.1	4,659.4		387.3	4,594.9		258.2	4,724.0	62.9	5,812.5	5,489.8	44.9	4,151.8	3,829.1
2027		258.2		43.1	3,985.7	3,727.5		309.8	3,675.9		206.5	3,779.2	50.3	4,650.0	4,391.8	35.9	3,321.4	3,063.3
2028		96.8		16.2	1,494.6	1,397.8		116.2	1,378.5		77.5	1,417.2	18.9	1,743.8	1,646.9	13.5	1,245.5	1,148.7
PV	13,238.8	2,643.7	1,023.4	311.4	28,769.8	13,127.6	15,886.6	3,172.5	9,999.2	10,591.0	2,115.0	16,256.0	363.3	33,564.7	17,922.6	259.5	23,974.8	8,332.6

	Base Case	Project cost over	Project cost down	Annual rate of increase of unserved energy 3.5%	Annual rate of increase of unserved energy 2.5%
EIRR	18.95%	15.95%	23.13%	21.77%	15.95%
B/C	1.81	1.51	2.26	2.11	1.51

Unit Benefit
USC/kWh 9.24

Decline of Supply capability
per each annum 3.0%

Economic opportunity cost of capital
10.0%