CHAPTER 4

DETAILED SURVEY
IN THE HIGHEST PRIORITY PROJECT AREA

CHAPTER 4 DETAILED SURVEY IN THE HIGHEST PRIORITY PROJECT AREA

4.1 General

Following the second site study, the Study Team carried out detailed survey during the third site study period to identify the facilities, which should be rehabilitated in the highest priority project area. The outline of the survey is shown in this chapter.

The Study Team applies the distribution system as of January 2000 to the basic design level study. This is because as a result of the occurrence of the landslide which was mentioned later on March 2000 in the highest priority project area, the system configuration was slightly changed in the area, however, BEN intends to revert to the original system in the future.

4.2 Transformer Stations

As shown in Appendix III.4.2-1, there are 91 numbers of transformer stations in the highest priority project area as of January 2000.

The Study Team carried out the detailed survey for the basic design level study on the transformer stations, which were selected through the discussions with BEN considering the deterioration level of the facilities and its importance in the distribution system. The main purpose of the survey is as follows.

(a) Confirmation of the current situation of the transformers and switchgears and also the comparison with the system diagram which was obtained from BEN

(b) Confirmation of the layout of the station buildings including arrangement and dimensions of the facilities

(c) Confirmation of the surrounding situation of the station buildings, especially width of carrying in road, establishment space for the temporary facilities, work space for the construction

(d) Possibility of the land acquisition for expansion of the station buildings

Figures III.4.2-1 (1) to (5) show the layout and single line diagram of the 5 high priority transformer stations from among the surveyed stations.

4.3 10 kV and 6 kV Lines

The Study Team also carried out the supplementary survey of the 10 kV and 6 kV distribution lines in parallel with the survey of the transformer stations as mentioned above. The purpose of this survey was to prepare the single line diagram and route map of distribution network in the highest priority project area. These drawings will contribute to establish the replacement and new laying plans of the MV cables in the area.

Although BEN has the single line diagrams and route maps of the MV distribution line, they are not updated according to the current condition. Therefore, the Study Team confirmed the connection between the transformer stations by investigating the switchgears at the time of the site survey, and identified the route of the underground cables by interview with the engineers of the network area who were accompanied to the survey.

Figures III.4.3-1 and III.4.3-2 show the single line diagram and route map of the MV lines respectively in the highest priority project area as of January 2000.

4.4 Low Voltage Lines

Since BEN does not have any kind of drawings that indicate the existing low-voltage distribution line, the Study Team has carried out the detailed survey for the actual situation of the LV lines together with the person who was in charge of the facilities O&M in the network area. The result of this survey will be a basic data/information to formulate the rehabilitation plan of LV cables in the highest priority project area.

The typical layout drawing of existing low-voltage lines in the higher priority project area are shown in Figure III.4.4-1.

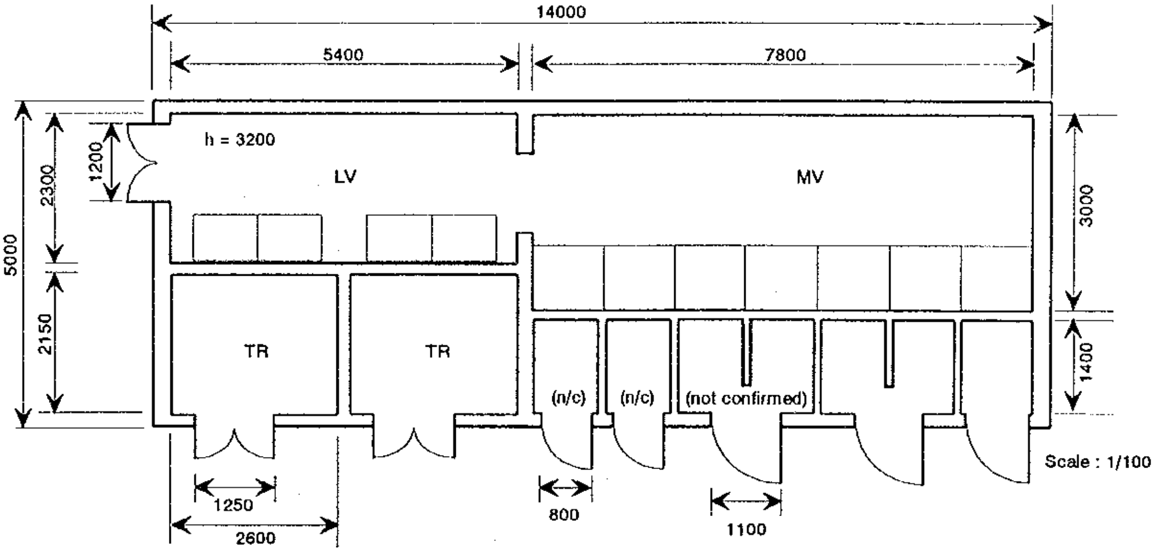
4.5 Influence of the Landslide on the Distribution System

A landslide disaster occurred in Baku on March 7, 2000. The place of the disaster was a hillock along the Bail Road and located in the south-west of the highest priority project area.

By the disaster, BEN's No.122 transformer station has been destroyed and seven circuits of 6 kV cables laid near the station from Azenerji's No.119 substation have been cut off by the slid of ground and covered thickly by the fallen soil. Since those cables were the important lines, the shortage of power supply to 6 kV system in the central part of Baku has become critical. To accommodate the effects of the disaster, BEN has isolated the 6 kV system facilities around the castle walls and connected them to 10 kV system by replacing the transformers. Figure III.4.5-1 shows the situation of change in system configuration as of July 2000.

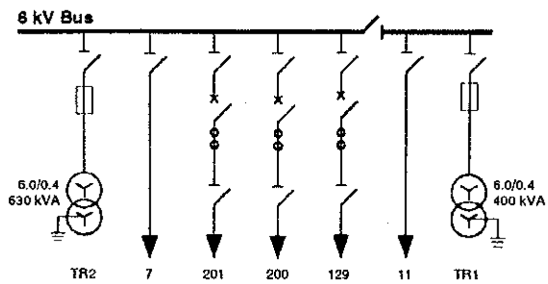
Since this system switching is only a makeshift and the capacity of the system is not sufficient, the electric power supply to the 10 kV system after switching is considered insufficient in the future. Therefore, the partial replacement work of the snapped cables has been undertaken by the governmental fund. However, the sections around the castle walls, which had been changed to 10 kV system, have been still operating as 10 kV.

No. 5



Layout Drawing

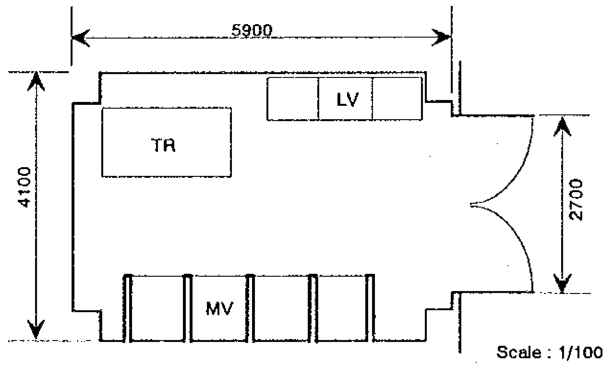
Station No.	5
District	Sabail
Voltage	6.0 kV
Network Area	2
Type of Building	КП
Year of Construction	1940
No.1 Transformer Capacity	400 kVA
No.2 Transformer Capacity	630 kVA
In or Out Cubicles	5
Transformer Cubicles	2
Nos of Feeder of No.1 LVDB	4
Nos of Feeder of No.2 LVDB	4



Single Line Diagram

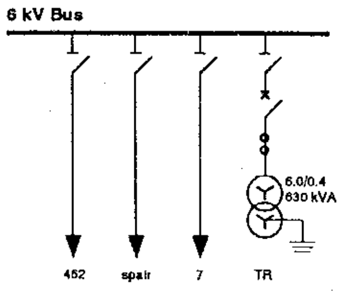
Master Plan Study on Rehabilitation and Reconstruction of Electric Supply in Baku Изучение Генерального Плана Восстановления И Реконструкции Электроснабжения Города Баку	Figure / Рисунок No. III.4.2-1 (1) Title / Название Рисунка Layout and Single Line Diagram of Transformer Station No. 5
Baku Electric Network ПО "БАКЭЛЕКТРОСЕТЬ" / Japan International Cooperation Agency Японское Агентство Международного Сотрудничества	
Joint Venture Nippon Koei Co., Ltd. & KRI International Corp. Совместное предприятие НИППОН КОЕИ и KRI Интернешнл Корп.	

No. 6



Layout Drawing

Station No.	6
District	Sabail
Voltage	6.0 kV
Network Area	2
Type of Building	KB
Year of Construction	1938
Transformer Capacity	630 kVA
In or Out Cubicles	3
Transformer Cubicles	1
Nos of Feeder of LVDB	16



Single Line Diagram

Master Plan Study on Rehabilitation and Reconstruction of Electric Supply in Baku Изучение Генерального Плана Восстановления И Реконструкции Электроснабжения Города Баку	Figure / Рисунок No. III.4.2-1(2) Title / Название Рисунка Layout and Single Line Diagram of Transformer Station No. 6
Baku Electric Network / ПО "БАКЭЛЕКТРОСЕТЬ" — Japan International Cooperation Agency / Японское Агентство Международного Сотрудничества	
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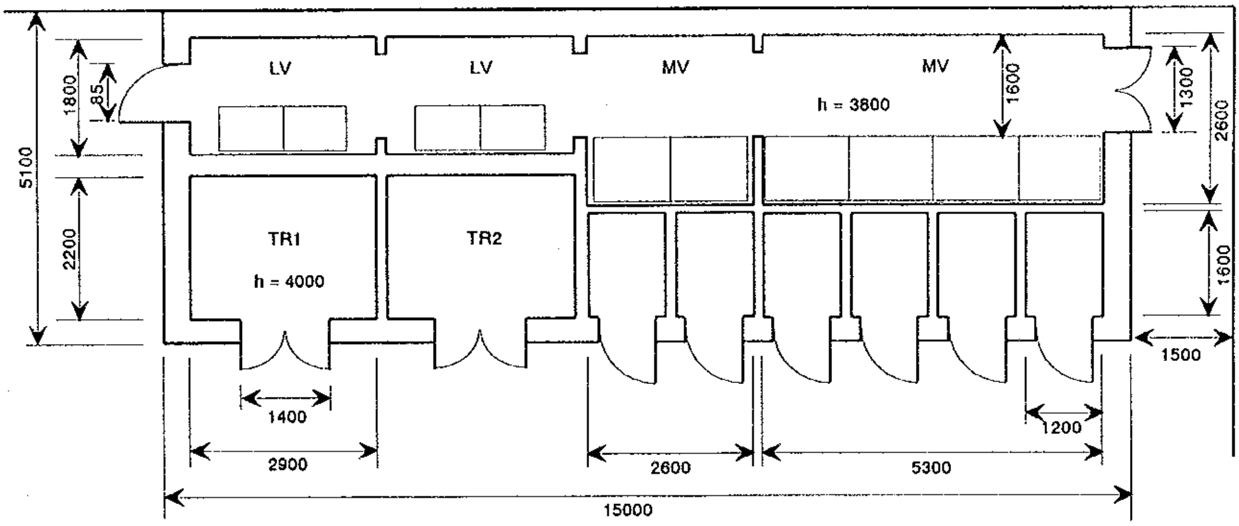
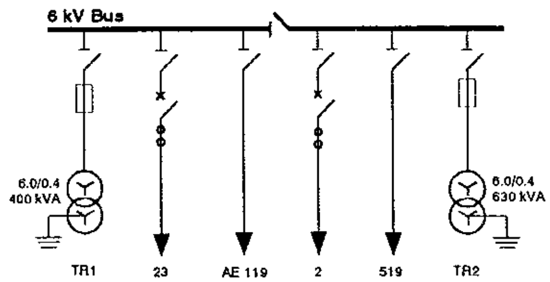
Scale : 1/100

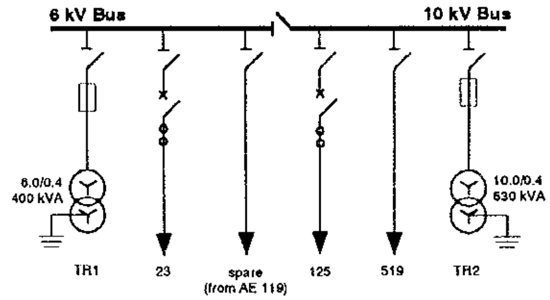


Layout Drawing

Station No.	17
District	Sabail
Voltage	6.0 kV and 10 kV
Network Area	2
Type of Building	KP
Year of Construction	1953
No.1 Transformer Capacity	400 kVA
No.2 Transformer Capacity	630 kVA
In or Out Cubicles	4
Transformer Cubicles	2
Nos of Feeder of No.1 LVDB	14
Nos of Feeder of No.2 LVDB	14



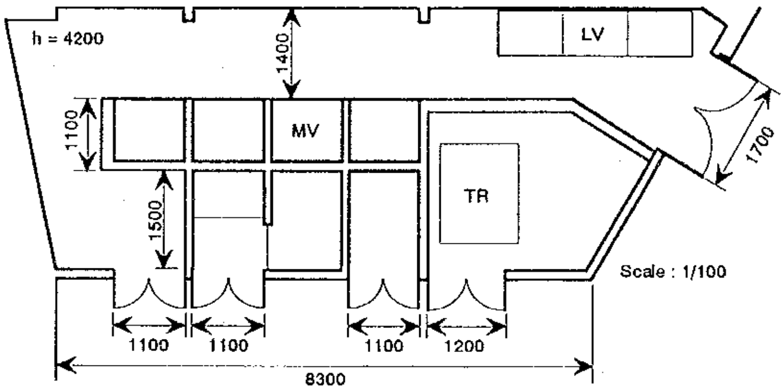
Single Line Diagram
(before landslide)



Single Line Diagram
(after landslide)

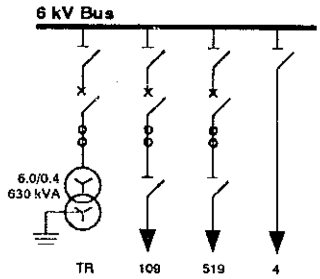
Master Plan Study on Rehabilitation and Reconstruction of Electric Supply in Baku Изучение Генерального Плана Восстановления И Реконструкции Электроснабжения Города Баку	Figure / Рисунок No. III.4.2-1 (3) Title / Название Рисунка Layout and Single Line Diagram of Transformer Station No. 17
Baku Electric Network ПО "БАКЭЛЕКТРОСЕТЬ" / Japan International Cooperation Agency Японское Агентство Международного Сотрудничества	
Joint Venture Nippon Koei Co., Ltd. & KRI International Corp. Совместное предприятие НИППОН КОЕИ и KRI Интернешнл Корп.	

No. 108

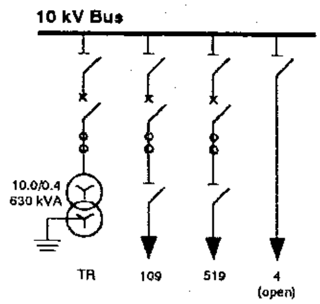


Layout Drawing

Station No.	108
District	Sabail
Voltage	10.0 kV
Network Area	2
Type of Building	КП
Year of Construction	1988
No.1 Transformer Capacity	400 kVA
In or Out Cubicles	3
Transformer Cubicles	1
Nos of Feeder of No.1 LVDB	22



Single Line Diagram
(before landslide)



Single Line Diagram
(after landslide)

Master Plan Study on Rehabilitation and Reconstruction of Electric Supply in Baku
Изучение Генерального Плана Восстановления И Реконструкции Электроснабжения Города Баку

Baku Electric Network
ПО "БАКЭЛЕКТРОСЕТЬ"

Japan International Cooperation Agency
Японское Агентство Международного Сотрудничества

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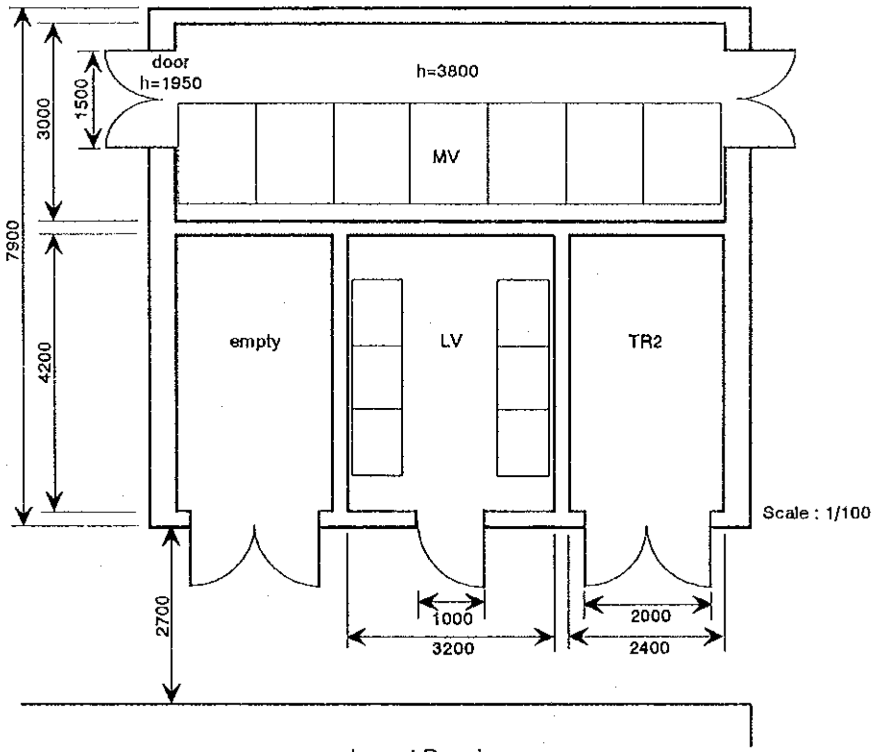
Figure / Рисунок No. III.4.2-1 (4)
Title / Название Рисунка

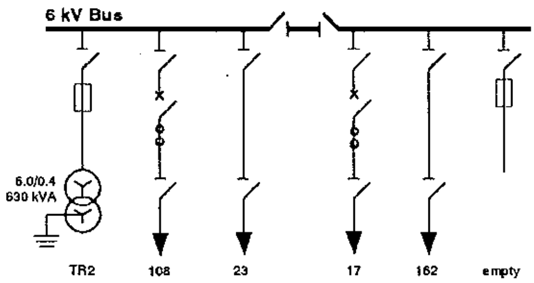
Layout and Single Line Diagram
of Transformer Station No. 108

No. 519

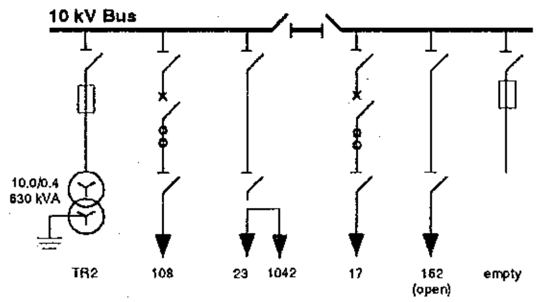


Layout Drawing

Station No.	519
District	Sabail
Voltage	10.0 kV
Network Area	2
Type of Building	KO
Year of Construction	
No.1 Transformer Capacity	empty
No.2 Transformer Capacity	630 kVA
In or Out Cubicles	5
Transformer Cubicles	2
Nos of Feeder of No.1 LVDB	10
Nos of Feeder of No.1 LVDB	10

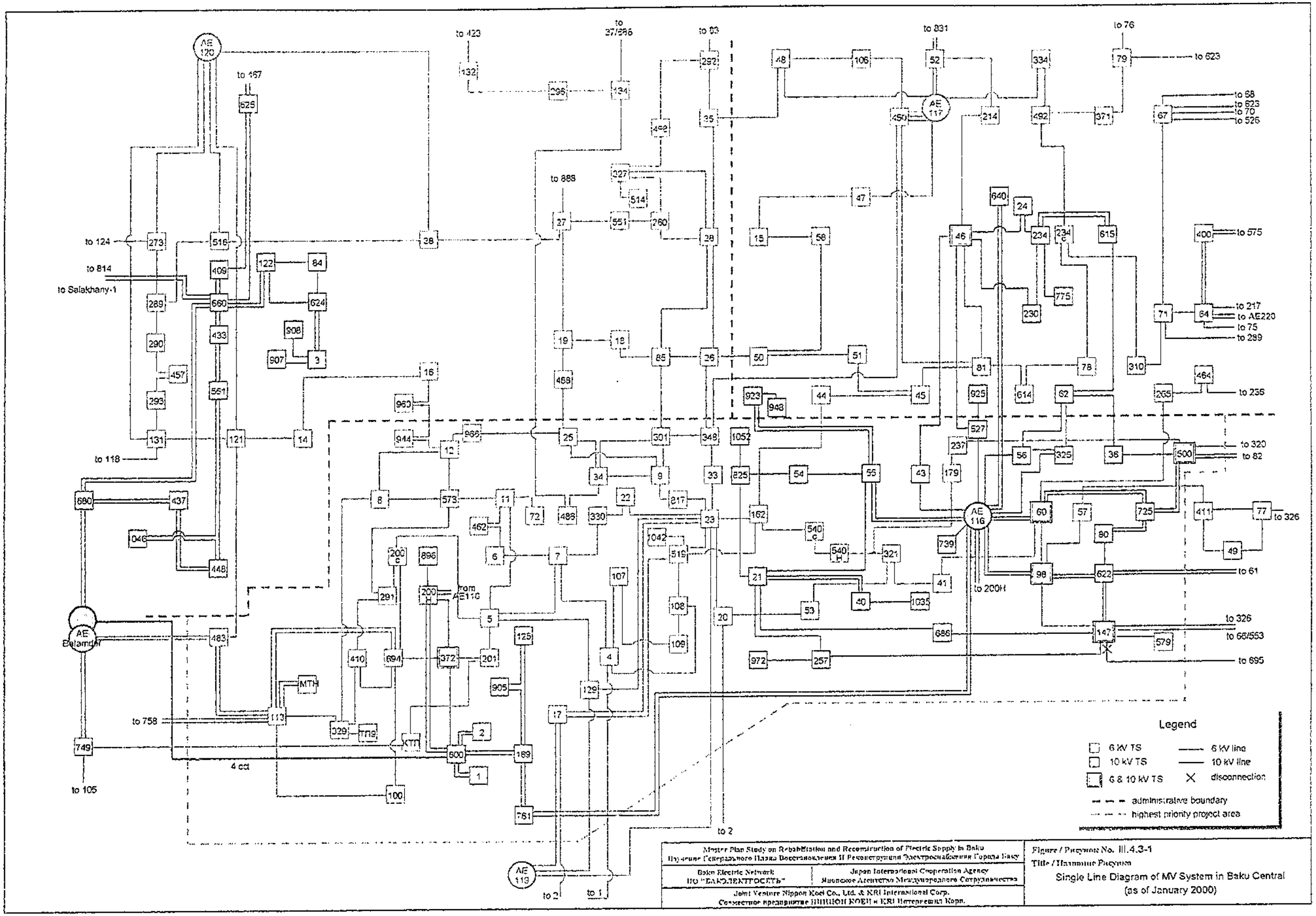


Single Line Diagram
(before landslide)



Single Line Diagram
(after landslide)

Master Plan Study on Rehabilitation and Reconstruction of Electric Supply in Baku Изучение Генерального Плана Восстановления И Реконструкции Электроснабжения Города Баку	Figure / Рисунок No. III.4.2-1 (5)
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.	Layout and Single Line Diagram of Transformer Station No. 519



Master Plan Study on Rehabilitation and Reconstruction of Electric Supply in Baku
Изучение Генерального Плана Восстановления И Реконструкции Электроснабжения Города Баку

Baku Electric Network
ПО "БАКЭЛЕКТРОСЕТЬ"

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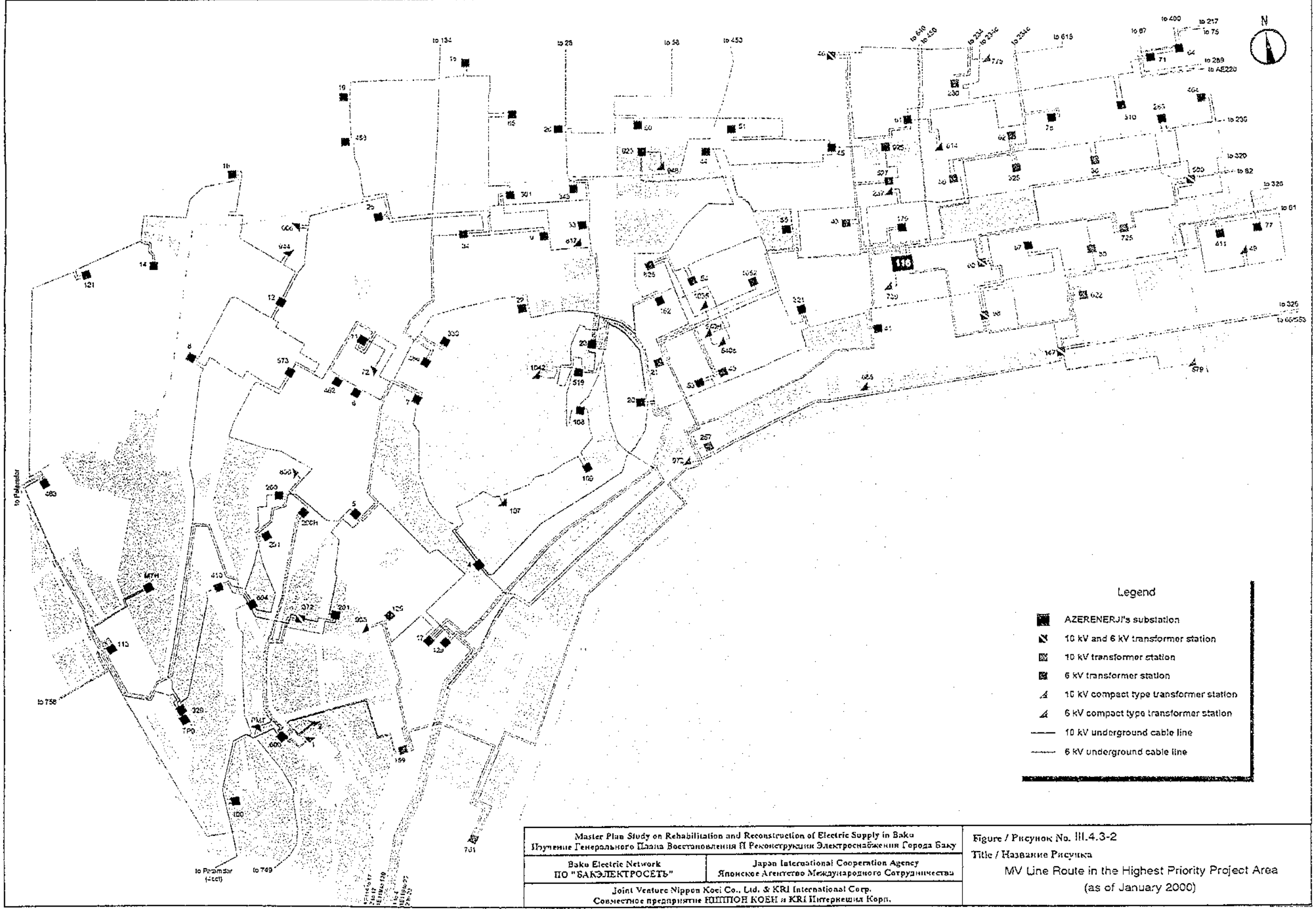
Figure / Рисунок No. III.4.3-1

Title / Название Рисунка

Single Line Diagram of MV System in Baku Central
(as of January 2000)



Master Plan Study on Rehabilitation and Reconstruction of Electric Supply in Baku
Изучение Генерального Плана Восстановления И Реконструкции Электроснабжения Города Баку

Baku Electric Network
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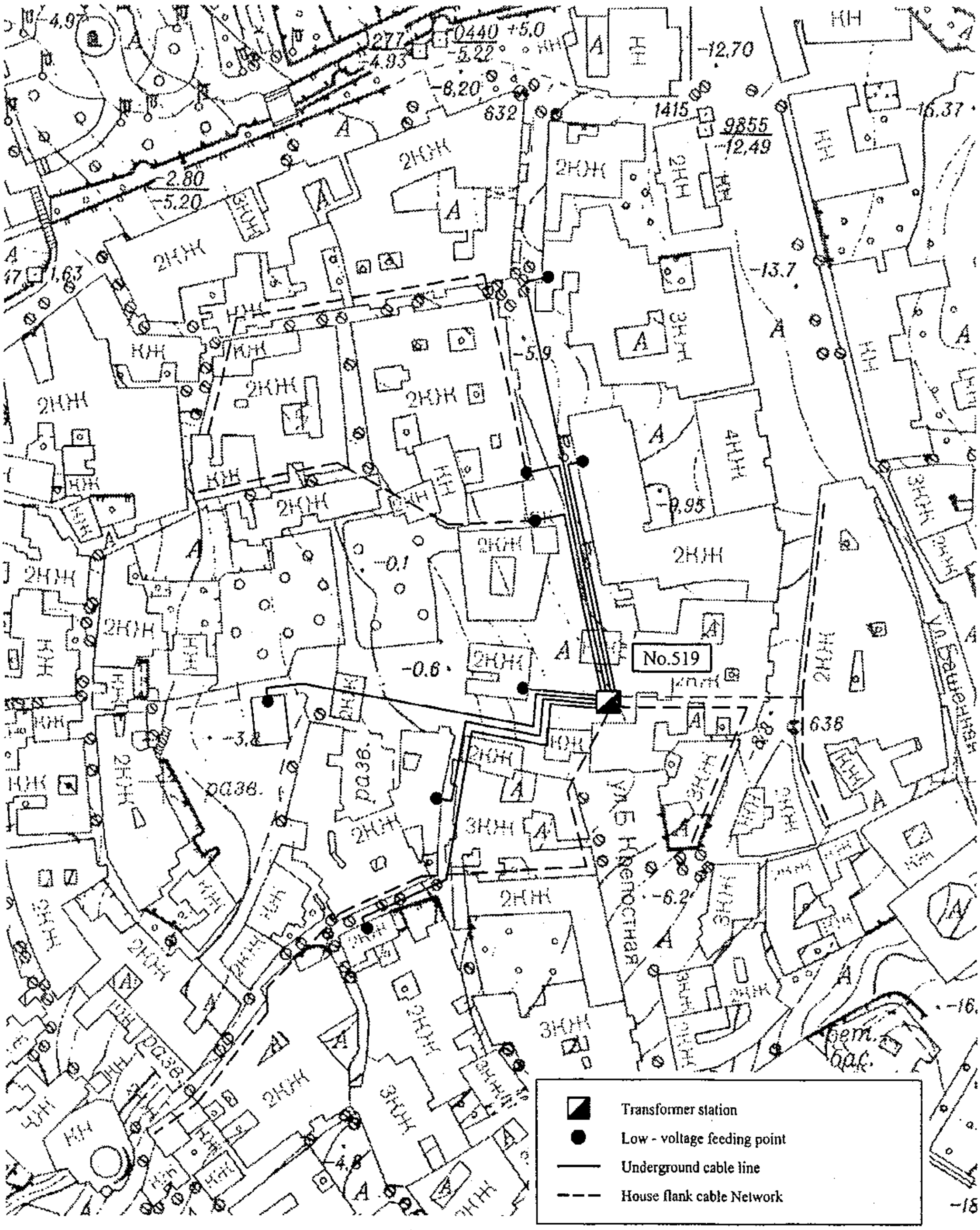
Figure / Рисунок No. III.4.3-2
Title / Название Рисунка
MV Line Route in the Highest Priority Project Area
(as of January 2000)



Master Plan Study on Rehabilitation and Reconstruction of Electric Supply in Baku
Изучение Генерального Плана Восстановления И Реконструкции Электроснабжения Города Баку

Baku Electric Network ПО "БАКЭЛЕКТРОСЕТЬ"	Japan International Cooperation Agency Японское Агентство Международного Сотрудничества

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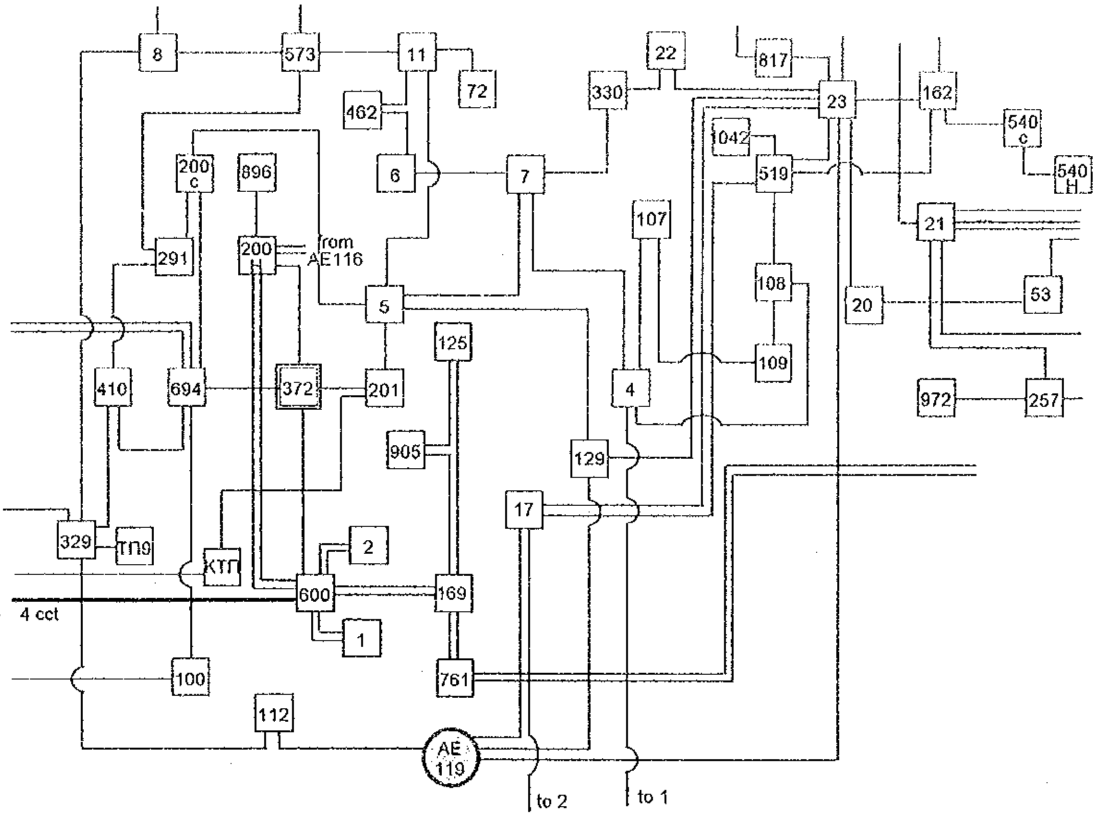
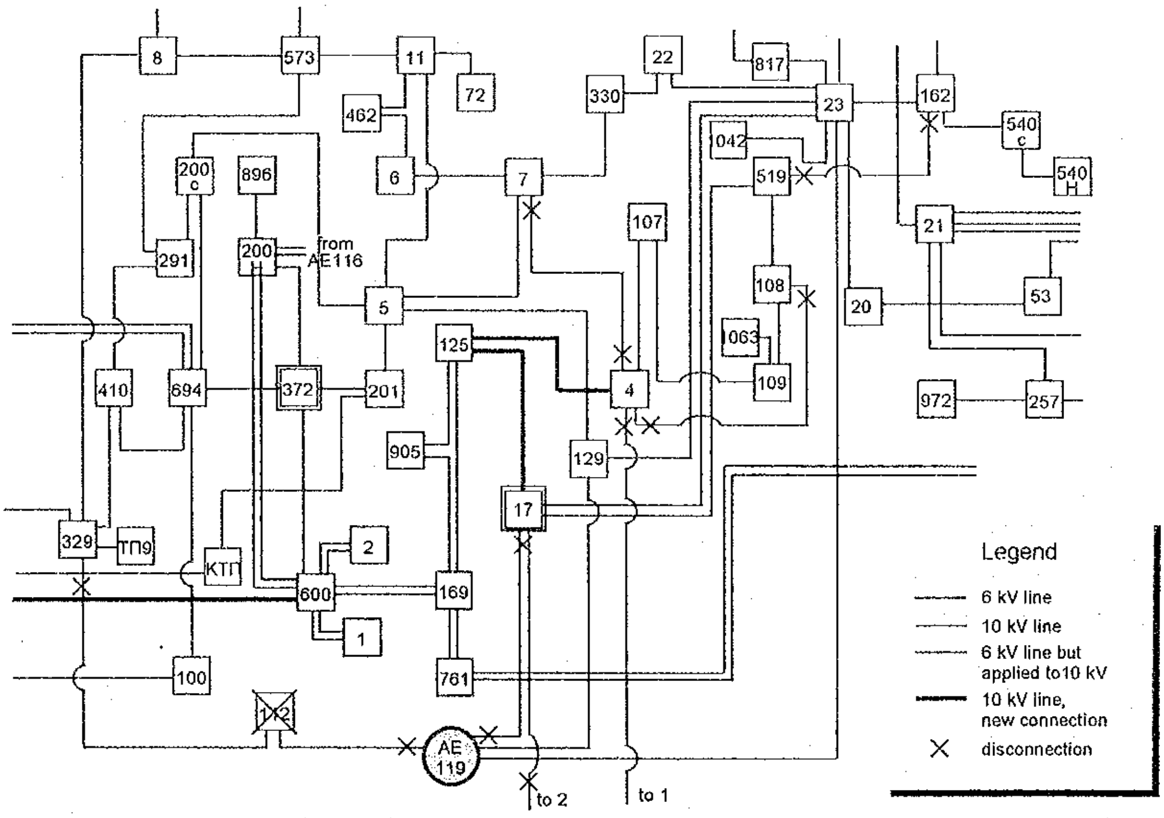
Figure / Рисунок No. III 4.4 - 1
Title / Название Рисунка

Existing Low-voltage Network



System configuration before landslide



System configuration after landslide

Master Plan Study on Rehabilitation and Reconstruction of Electric Supply in Baku Изучение Генерального Плана Восстановления И Реконструкции Электроснабжения Города Баку	Figure / Рисунок No. III.4.5-1
Baku Electric Network ПО "БАКЭЛЕКТРОСЕТЬ" / Japan International Cooperation Agency Японское Агентство Международного Сотрудничества	Title / Название Рисунка System configuration before and after the landslide
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Appendix III.4.2-1 Transformer stations in the highest priority project area

No.	Station No.	Qt's (nos)	Unit Capacity (kVA)	Catacity (kVA)	Volatage (kV)	Type	Chambers (nos)	CB (nos)	Year of Installation	Network Area	Investigation Date & Note
1	4	1	400	400	6.0	KP	4	0	1960	2	
2	5	2	400+630	1,030	6.0	KP	7	3	1940	2	2000/6/9
3	6	1	630	630	6.0	KB	4	1	1938	2	2000/6/9
4	7	2	250+400	650	6.0	KP	8	3	1937	2	1999/9/2, 2000/2/25
5	8	2	400+630	1,430	6.0	KO	6	3	1948	2	
6	9	2	320+400	720	6.0	KP	6	3	1974	2	2000/3/9
7	11	2	400+630	1,030	6.0	KB	5	2	1955	2	2000/6/9
8	12	2	630	1,260	6.0	KO	7	2	1988	2	
9	17	2	400+630	1,030	6.0	KP	6	2	1953	2	
10	20	1	400	400	6.0	KB	5	1	1939	2	1999/9/2, 2000/2/25
11	21 H	2	1,000	2,000	10.0	KB	9	6	1989	2	2000/5/25
12	22	1	400	400	6.0	KB	4	0	1966	2	2000/2/25
13	23	2	400	800	6.0	KB	8	4	1934	2	2000/3/9
14	25	3	2x630+400	1,660	6.0	KO	7+2	2	1983	3	2000/5/24、+PMT
15	33	2	320+630	950	6.0	KP	5	1	1930	2	2000/3/9
16	34	2	630	1,260	6.0	KO	6	5	1955	3	2000/5/24
17	36	2	400+630	1,030	10.0	KO	7	2	1988	5	2000/2/25
18	40	2	1,000	2,000	10.0	KP	6	2	1997	2	2000/2/24
19	41	1	400	400	6.0	KB	5	2	1928	2	2000/2/24
20	43	1	630	630	10.0	PMT	3	0	1998	5	2000/2/23
21	53	1	315	315	6.0	KB	3	1	1938	2	2000/5/24
22	54	1	630	630	10.0	KB	3	3	1954	2	2000/3/9
23	55	2	630	1,260	10.0	KO	9	4	1930	5	2000/2/23
24	56	1	630	630	10.0	KP	4	1	1972	5	2000/2/25
25	57	2	630	1,260	6.0	KO	4	4	1948	5	2000/2/24
26	60 10kV	2	400+630	1,030	10.0	KO	7	4	1937	5	2000/2/24
27	60 6kV	1	400	400	6.0	KO	2	0	1937	5	2000/2/24
28	80	2	630	1,260	10.0	KP	8	2	1984	5	2000/2/24
29	98 10 kV	2	400	800	10.0	KB	6	2	1934	5	2000/2/24
30	98 6 kV	0	-	-	6.0	KB	1	0	1934	5	2000/2/24
31	100	2	320	640	6.0	KB	4	0	1940	2	
32	107	1	400	400	6.0	PMT	3	0	1960	2	
33	108	1	630	630	6.0	KP	4	3	1988	2	2000/6/9
34	109	2	400	800	6.0	KO	6	2	1997	2	1999/9/2, 2000/2/25
35	113	1	250	250	6.0	KO	14	9	1977	2	2000/5/25
36	125	1	250+630	880	10.0	KO	7	2	1995	2	2000/2/25
37	129	0	-	-	6.0	KB	4	2	1932	2	2000/5/24、tolley office
38	147 10 kV	2	250+630	880	10.0	KO	7	4	1952	5	
39	147 6 kV	0	-	-	6.0	KO	5	2	1952	5	
40	162	2	315+400	715	6.0	KB	6	0	1980	2	
41	169	2	1,000	2,000	10.0	KP	9	6	1988	2	
42	179	1	400	400	6.0	KB	4	1	1960	5	2000/5/24
43	200 c	2	630	1,260	6.0	KO	6	3	1939	2	
44	200 H	4	‹630+2x1,000	3,260	10.0	KO	22	14	1983	2	
45	201	1	320	320	6.0	KO	2 (+1)	0	1937	2	
46	237	1	400	400	6.0	PMT	3	0		5	2000/5/24
47	257	2	630	1,260	10.0	KO	4	2	1910	2	2000/2/25
48	291	1	630	630	6.0	KB	4	3	1961	2	
49	301	2	630	1,260	6.0	KO	7	2	1964	2	
50	321	2	400+630	1,030	6.0	KO	6	2	1958	2	

Appendix III.4.2-1 Transformer stations in the highest priority project area

No.	Station No.	Qt's (nos)	Unit Capacity (kVA)	Catacity (kVA)	Volatage (kV)	Type	Chambers (nos)	CB (nos)	Year of Installation	Network Area	Investigation Date & Note
51	325	1	630	630	10.0	KB	4	2	1962	5	
52	329	2	320+560	880	6.0	KO	5 (+2)	2	1972	2	Trum Line (560 kVA)
53	330	1	630+400	1,030	6.0	KO	4	2	1991	2	2000/6/9
54	348	2	320	640	6.0	KB	5	1	1962	2	2000/2/24
55	372 10 kV	1	1,000	1,000	10.0	KO	3	2	1961	2	
56	372 6 kV	1	630	630	6.0	KO	4 (+1)	3	1961	2	
57	410	2	400	800	6.0	KO	6	2	1965	2	
58	462	1	400	400	6.0	PMT	2	0	1964	2	2000/6/9
59	483	2	320	640	6.0	KO	8	4	1965	2	
60	486	4	2x50+2x320	740	6.0		8	2	1965	2	
61	500 10 kV	2	630	1,260	10.0	KO	7	3	1972	5	2000/2/23
62	500 6 kV	0	-	-	6.0	KO	1	1	1972	5	2000/2/23
63	519	1	630	630	6.0	KO	7	2	1966	2	2000/6/9
64	527	1	400	400	10.0	KO	4	1	1972	5	2000/5/24
65	540 c	1	315	315	6.0	PMT	3	0	1960	2	
66	540 H	1	400	400	6.0	PMT	3	0	1968	2	
67	573	2	250+630	880	6.0	KO	6	3	1973	2	
68	579	1	400	400	6.0	PMT	3	0	1970	5	
69	600	0	-	-	10.0	KO	24	16	1971	2	Sw/S, 2000/5/25
70	622	4	630	2,520	10.0	KB	14	8	1972	5	
71	686	1	630	630	10.0	PMT	3	0	1976	2	
72	694	2	400	800	6.0	KB	9	4	1976	2	
73	725	4	630	2,520	10.0	KO	15 (+1)	7	1980	5	
74	739	1	250	250	10.0	PMT	3	1	1980	2	
75	761	4	1,000	4,000	10.0	KO	16	9	1998	2	
76	817	1	320	320	6.0	PMT	3	0	1986	2	
77	825	2	630	1,260	10.0	KO	7	2	1986	2	2000/3/9
78	896	1	250	250	10.0	PMT	1	-	1994	2	
79	905	1	400	400	10.0	PMT	3	0	1995	2	
80	944	1	400	400	6.0	PMT	3	-	1997	2	
81	966	1	400	400	6.0	PMT	3	0		2	
82	972	1	100	100	10.0	PMT	3	0	1998	2	
83	1035	1	400	400	10.0	PMT	3	0	1999	2	Oil Company (p)
84	1042	1	160	160	6.0	PMT	3	0	1999	2	
85	1052	1	400	400	10.0	KO	2	0	1999	2	Embassy of France,(p)
86	1063	1	630	630	10.0	PMT	2	0	2000	2	Embassy of Norway, (p)
87	2022 TП-9	2	630+320	950	6.0					2	Metro, private
88	2026 KTП-1	2	400	800	10.0	PMT	3	0		2	private
89	2027 KTП-2	1	400	400	10.0	PMT	3	0		2	private
90	MTH	2	400	800	6.0	PMT	3	0		2	private
91	KTП	1	400	400	6.0	PMT	3	0		2	private
total		141		74,775							

Note) KO ground mounted type (standing independently)
KP ground mounted type (close to building)
KB in-building type
PMT compact type

CHAPTER 5

IDENTIFICATION OF FACILITIES FOR THE BASIC DESIGN LEVEL STUDY

CHAPTER 5 IDENTIFICATION OF FACILITIES FOR THE BASIC DESIGN LEVEL STUDY

5.1 General

The method adopted for identifying the facilities to be rehabilitated for the Pre-feasibility study and the result are explained in Chapter 3 of this Volume. Though the method for identifying the facilities for basic design level study is basically in accordance with that for the Pre-feasibility study, more concrete identification of the facilities is undertaken with reference to more detailed supplementary study outputs in Chapter 4, as discussed with the counterpart and his request.

5.2 Approach for the Facilities Identification for Rehabilitation

The approach and criteria for identifying the distribution facilities to be rehabilitated are explained as follows:

(1) Medium voltage distribution lines

The approach and criteria to identify the MV distribution lines to be rehabilitated are same as those for the Pre-feasibility study. The candidate distribution lines for rehabilitation are shown in Appendix III.3.2-1. However, if the rehabilitation of distribution lines connected with the transformer stations (not indicated in the said Appendix) is required, then, these lines are also included. "Rehabilitation" here means the "replacement" of the underground cable.

(2) Medium voltage switchgears

The existing circuit breakers are partly bulk-oil type manufactured in 1930's, and minimum-oil contents type for the rest. The replacement from bulk-oil type to minimum-oil contents type has been occasionally conducted as necessary when the circuit breaker goes out of order. Therefore, the record on the circuit breaker replacement including the year has been hardly available. Therefore, the same criteria for the Master Plan study as follows are adopted to identify the facilities for rehabilitation. As it is difficult to install the new vacuum type and SF6 gas switchgear panels together with the existing switchgear, the facilities are totally replaced.

(a) The switchgears in the transformer station using bulk-oil type circuit breaker and in the transformer station connecting with the underground cables to be rehabilitated in this plan

(b) The switchgears requested for urgent replacement by the counterpart owing to their deterioration and frequent accidents

(c) The switchgears in other transformer stations, which are considered as necessary to be rehabilitated in terms of the relation with the underground cable connected and neighboring transformer stations

(3) Transformer stations

The transformer stations to be rehabilitated include those of which MV switchgears are to be replaced as explained in the last clause, and those of which transformer capacity is to be upgraded and type is to be changed from oil immersed type to dry type.

The scope of rehabilitation include a partitioning layout change in the facility rooms to accommodate the vacuum and SF6 gas type switchgears, and resultant alternation of transporting entrance and repairing the house itself including its roof. There are transformer stations, which play an important role in the system configuration, but which can not accommodate necessary number of switchgears due to a lack of space within its house. Such stations deserve to be newly constructed, as long as the neighboring space is easily available. For the station without the neighboring space, the system configuration shall be altered to transfer its role and the extent of contribution in the system to other transformer station.

Regarding the transformer station of where transformer only is replaced, as the existing transformer room is available as it is, it is excluded from the target of rehabilitation as long as its house has been severely deteriorated.

(4) Transformers

All the transformers installed in the transformer stations, where the MV switchgears are replaced, are replaced. The transformers dismantled are to be diverted to other transformer stations after the inspection and repairing at the transformer repair shop. To protect neighboring residents, which live near the "close to other building type", "rented room type" and "compact type" transformer stations, from a fire and its poisonous gas, the transformer in the stations is replaced with molded dry type transformer (as requested by the counterpart).

(5) Low voltage switchgears and distribution lines

All the low voltage switchgears installed in the transformer station, which required MV switchgears replacement, are totally replaced. The LV lines pulled out from the LV switchgears are also rehabilitated, however, the scope in this plan is limited to procurement of related facilities and materials, and BEN will follow the replacing work for LV lines on its own terms.

(6) Watt-hour meter

BEN's electricity tariff regime is a simple one, applying single tariff for several customer groups. Since the characteristics of BEN's energy demand structure is such that the peak load in winter is around twice of that in summer, and that its peak appears at night, it is recommended that more reflective electricity tariff regime be adopted to facilitate more efficient power supply. However, the change in the near future tariff regime is hardly predicted in Azerbaijan.

On the other hand, although the functions attached to watt-hour meter should be determined based on the electricity tariff regime adopted, the existing watt-hour meters measure only the energy amounts during a certain period. Under the present situation, it is difficult to determine the specification of the meter, and it is decided that the meters are not included in the procurement material in this plan.

5.3 Rehabilitation Facilities Identified

5.3.1 Voltage Augmentation from 6 kV to 10 kV in Baku Central

As explained in Section 4.5 of this Volume, as a consequent to the landslide disaster in March 2000, BEN has separated the transformer station in the central area from 6 kV system and converted to 10 kV system to continue the energy supply. No.119 substation of Azenerji has been playing the important role in power supply to the central area of city, but this location is far from the central area. It is also indicated by the study that the cable has been severely deteriorated (laid in early 1930's), and has been frequently replaced due to faults. On the other hand, 10 kV system has been supplied from relatively new No.116 substation of Azenerji near the old castle walls and Patamdar 110 kV substation, and has sufficient capacity in transformers and cables.

Under such a situation, BEN has strongly desired the permanent conversion into 10 kV system for the part, which was temporarily changed to 10 kV system. The area surrounded by the old castle walls and its surrounding area is characterized with higher demand density among the priority area in Sabail district (average demand density is 20.5 MW/ km^2 for the highest priority area). The request is accepted, because the permanent conversion into 10 kV system at this time is considered to provide an economic sense in terms of demand density and avoiding extra investment to correspond to the future increase of demand.

The existing 6 kV cable routes have been extended on an ad hoc basis according to demand increase, resulting in complication. By establishing the system configuration, which accommodates the relative relation on the locations of each transformer station and the space of station house, the cost is smaller by largely shortening of the cable length, compared with the case where 6 kV system is established.

The rehabilitation and reconstruction plan related to voltage augmentation from 6 kV to 10 kV is most prioritized in this area, having the highest demand density and cost advantage. The cable route layout for the concerned part as of January 2000 and that after permanent configuration to 10 kV system are shown in Figure III.5.3-1. Single line diagram of 10 kV system after voltage augmentation is also shown in Figure III.5.3-2

The above distribution facilities except those identified in Chapter 3 of this Volume are rehabilitation facilities related to the voltage augmentation to 10 kV. Appendixes III.5.3-1 and 5.3-2 show those transformer stations and those underground lines respectively. The number of MV switchgears is derived based on the basic design level study for each facility. The number of major rehabilitation facilities is indicated in Table III.5.3-1.

Table III.5.3-1 Rehabilitation facilities related to voltage augmentation (phase I)

Item	Existing	Rehabilitation
Distribution line		
1. Number of line	24	23
2. Line length	9.8 km	7.0 km
3. Cable length	9.8 km	10.4 km
Transformer station		
1. Number of transformer station	17	17
2. Number of transformer	25	27
3. Capacity of transformer	12.9 MVA	15.9 MVA

The following aspects are noticed in the above rehabilitation plan:

(a) Transformer station No.600 has extra two circuit breakers, and needs no additional circuit breaker to accommodate the addition of double circuit underground cable connecting to No.5.

(b) Transformer station No.21 has no extra circuit breaker, and needs an additional circuit breaker to accommodate the addition of a double circuit underground cable connecting to No.519. All the switchgears are to be replaced since the parallel use with the existing oil type circuit breaker is not possible.

(c) Transformer stations No.1042 and No.1063 are compact type ones with underground cable of 10 kV and newly constructed. Accordingly, they are replaced with the compact type, and the existing underground cables are left.

(d) As transformer station No.4 is narrow, it is difficult to allocate space to accommodate necessary facilities. In this regard, the change of system configuration is suggested, while decreasing the supply reliability. However, BEN has strongly requested a new construction in view of that the area around the station has a large potential for development in the near future, and that future availability for expansion is preferred. Therefore, the Study Team accepted BEN's request.

(e) No.6 and No.22 transformer stations are so narrow that transformers, MV switchgears, and LV panels should not be installed in orderly sequence. Although we tried to arrange the facilities with changing the system configuration, it is difficult to keep a space for protective fences of molded dry type transformer. Accordingly, such transformer should be installed in a cubicle with an air outlet.

5.3.2 6 kV System Rehabilitation and Reconstruction Plan

Base on the detail study output in Chapter 4 of this Volume, and the approach and criteria in Section 5.2, the distribution facilities not related to the above voltage augmentation are identified. The underground lines for rehabilitation shown in Appendix III.3.2-1 are scattered through the whole study area, but differ in the system configuration. Based on this difference, three sets of rehabilitation plans are prepared and presented to BEN. The examination made is outlined as follows:

(a) Overage 6 kV and 10 kV system are mixed in the eastern area around substation No.116 (35/10 kV) as in other area. In this area, 10 kV system has covered a larger area in power supply and 6 kV system is rather scattered. Accordingly, the voltage augmentation from a smaller number of 6 kV transformers to a 10 kV system is suggested. This suggestion will ensure that the underground line length is decreased to around 20 %, with minimizing the investment costs in accordance by future increase of energy demand (avoiding double investment).

(b) Power supply is made through only 6 kV system in the northern and surrounding area of the old castle wall. Accordingly, the facilities identified except those related to the voltage augmentation (Section 5.3.1) are to be rehabilitated in accordance with the existing system voltage.

(c) Except a part of the north-western area, 6 kV and 10 kV system are mixed and relatively new facilities are equipped in the western area. Only 6 kV system is utilized in the north-western area, and the same consideration is taken as in (b) above.

Based on the above examination results, the discussion with BEN was held. BEN agreed with the Study Team's suggestion (b) and (c). Regarding (a), however, BEN requested the rehabilitation for the area as 6 kV, and also requested to exclude the area from the scope of rehabilitation, if this request is judged as difficult. This request is derived based on the condition that a part of the area around the old castle wall has been already augmented to 10 kV, thus posing a lack of transformer capacity in No.116. The Study Team accepted to exclude the said area from the scope due to the following reasons with BEN's agreement:

- The rehabilitation as 6 kV system needs much higher project costs than the plan suggested by the Study Team.
- As the cables to be rehabilitated in this plan are overlapped with the existing 10 kV system, the role of these cables will not be sufficiently fulfilled if a voltage augmentation is made in the

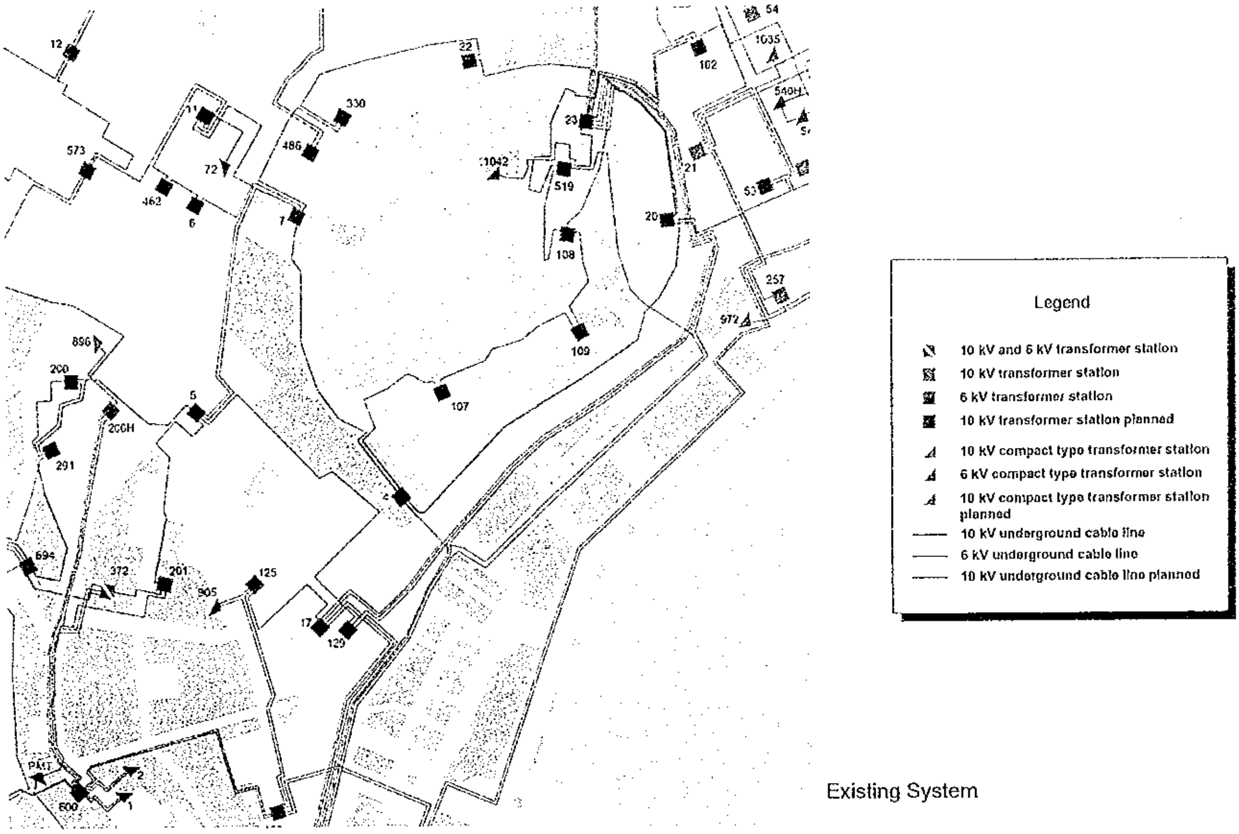
future.

The location of underground lines and transformer stations for rehabilitation is indicated in Figure III.5.3-3. Single line diagrams of 6 kV system after rehabilitation are also shown in Figures III.5.3-4 (1) and (2). Major rehabilitation facilities are also indicated in Table II.5.3-2, with the details of transformer stations depicted in Appendix III.5.3-3 and that of underground cable in Appendix III.5.3-4. As in the rehabilitation plan explained in the section 5.3.1, the transformer stations in the middle of identified underground cables have been also identified for rehabilitation to augment rehabilitation effects, unless identified in Chapter 3 in Volume 2 (the transformer stations with "blank" in "Priority Column" in Appendix III.5.3-3). In the transformer station of No.20, 53 and 162, the transformer will be stored in a cubicle to securing the safety of maintenance staff, because the each equipment is intermingled in one room of rented room type station.

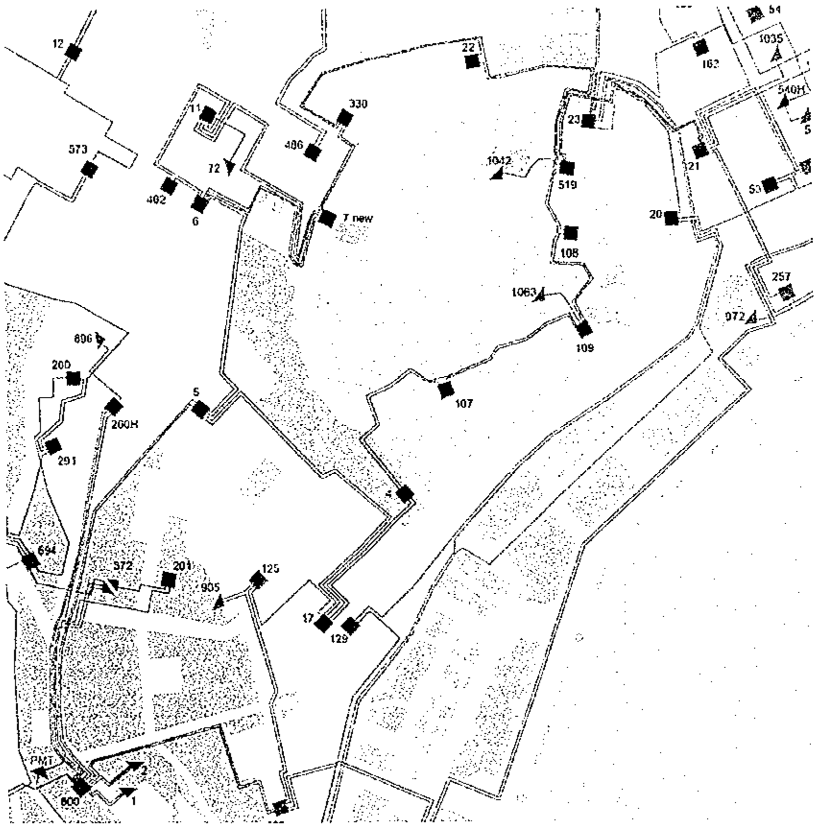
Though there is one transformer station owned and managed by the Cabinet of Minister's Office between No.291 and 573 stations, this is not identified for rehabilitation in along with BEN's suggestion. However, the circuit breakers will be installed in No.291 and 573 transformer stations by considering the possibility where newly replaced cables are to be connected to the said station.

Table III.5.3-2 Facilities for 6 kV system rehabilitation (phase II)

Item	Existing	Rehabilitation
Distribution line		
1. Number of line	18	19
2. Line length	10.2 km	10.4 km
3. Cable length	10.5 km	18.2 km
Transformer station		
1. Number of transformer station	18	18
2. Number of transformer	27	27
3. Capacity of transformer	13.9 MVA	17.0 MVA

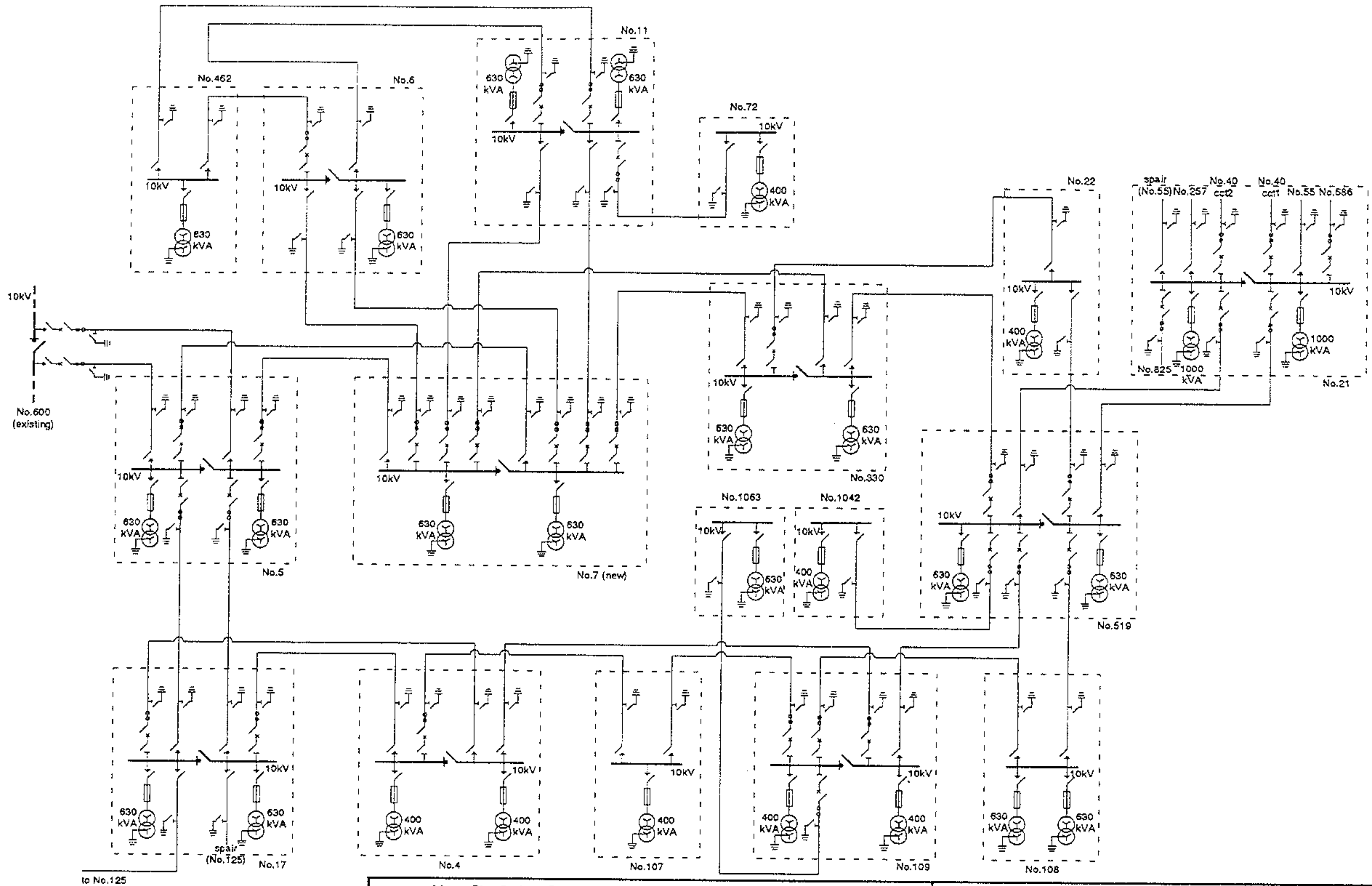


Existing System



Voltage augmentation plan
from 6 kV to 10 kV

Master Plan Study on Rehabilitation and Reconstruction of Electric Supply in Baku Изучение Генерального Плана Восстановления И Реконструкции Электроснабжения Города Баку		Figure / Рисунок No. III.5.3-1
Baku Electric Network ПО "БАКЭЛЕКТРОСЕТЬ"	Japan International Cooperation Agency Японское Агентство Международного Сотрудничества	Title / Название Рисунка Voltage Augmentation Plan in Baku Central
Joint Venture Nippon Koei Co., Ltd. & KRI International Corp. Совместное предприятие НИППОН КОЕИ и KRI Интернешнл Корп.		



Master Plan Study on Rehabilitation and Reconstruction of Electric Supply in Baku
Изучение Генерального Плана Восстановления И Реконструкции Электроснабжения Города Баку

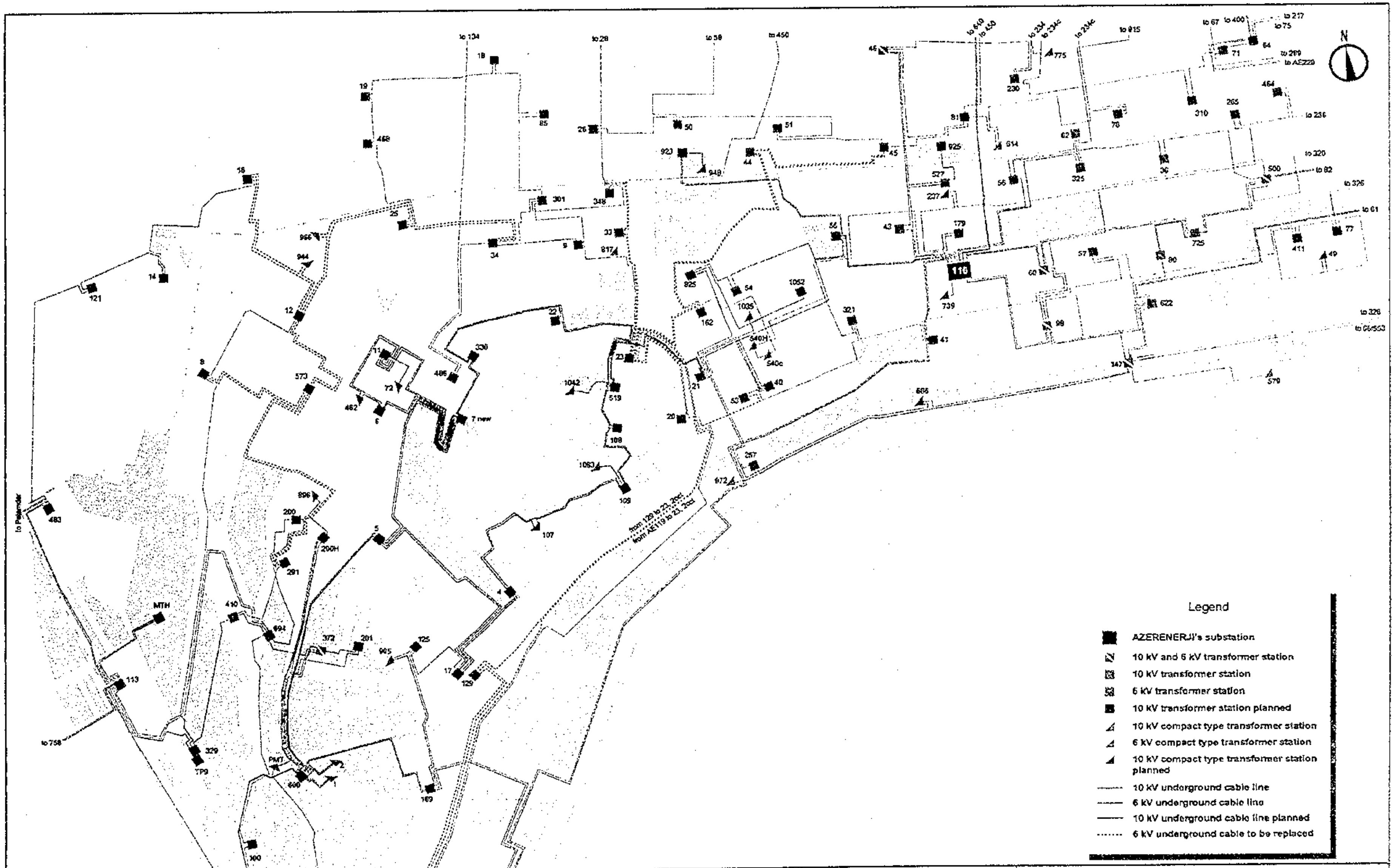
Baku Electric Network ПО "БАКЭЛЕКТРОСЕТЬ"	Japan International Cooperation Agency Японское Агентство Международного Сотрудничества

Joint Venture Nippon Koei Co., Ltd. & KRI International Corp.
Совместное предприятие НИППОН КОЕИ и KRI Интернешнл Корп.

Figure / Рисунок No. III.5.3-2

Title / Название Рисунка

10 kV system after voltage augmentation plan (phase I)



Master Plan Study on Rehabilitation and Reconstruction of Electric Supply in Baku
Изучение Генерального Плана Восстановления И Реконструкции Электроснабжения Города Баку

Baku Electric Network
ПО "БАКЭЛЕКТРОСЕТЬ"

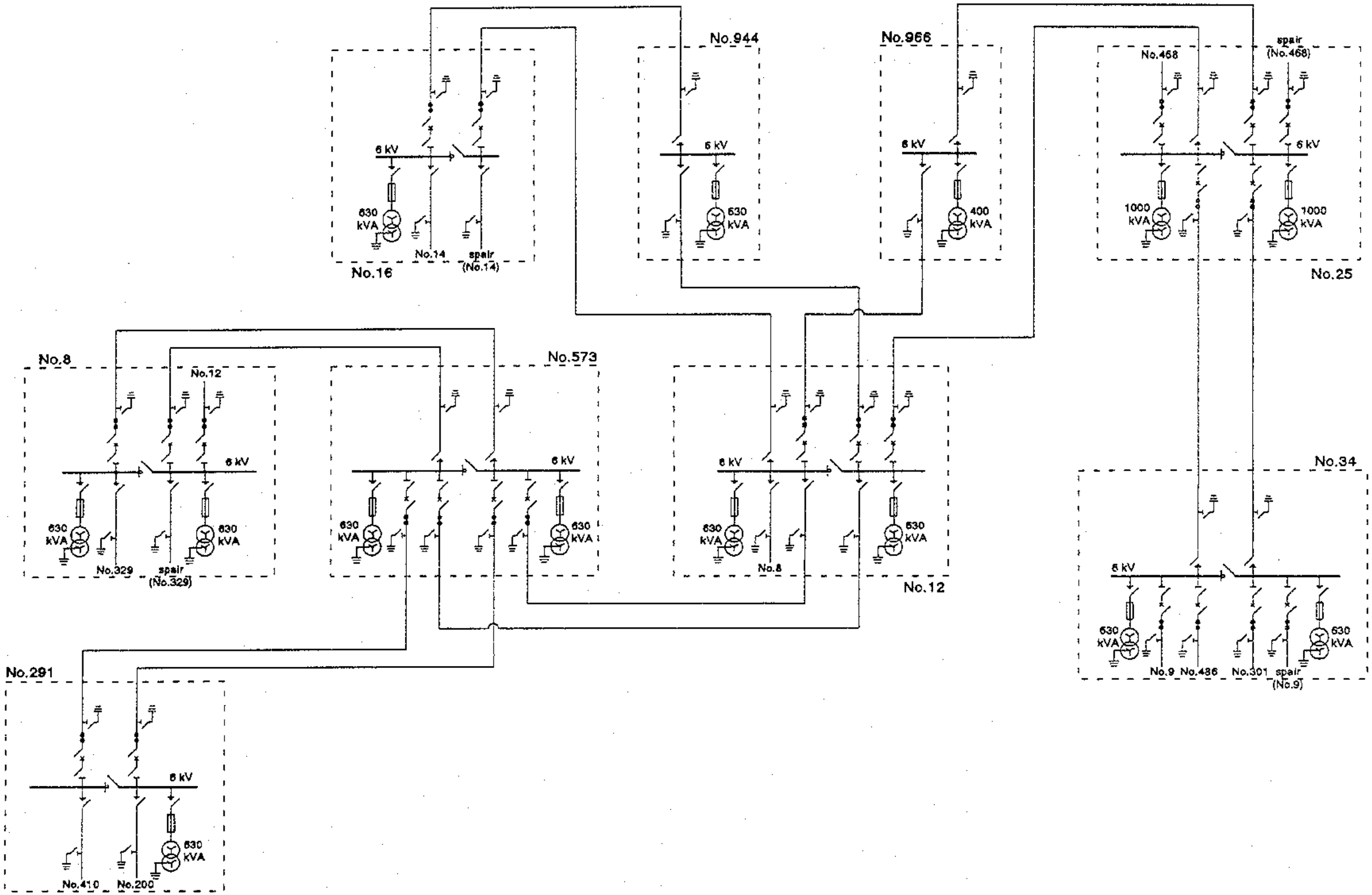
Japan International Cooperation Agency
Японское Агентство Международного Сотрудничества

Joint Venture Nippon Koei Co., Ltd. & KRI International Corp.
Совместное предприятие НИППОН КОЕЙ и KRI Интернешнл Корп.

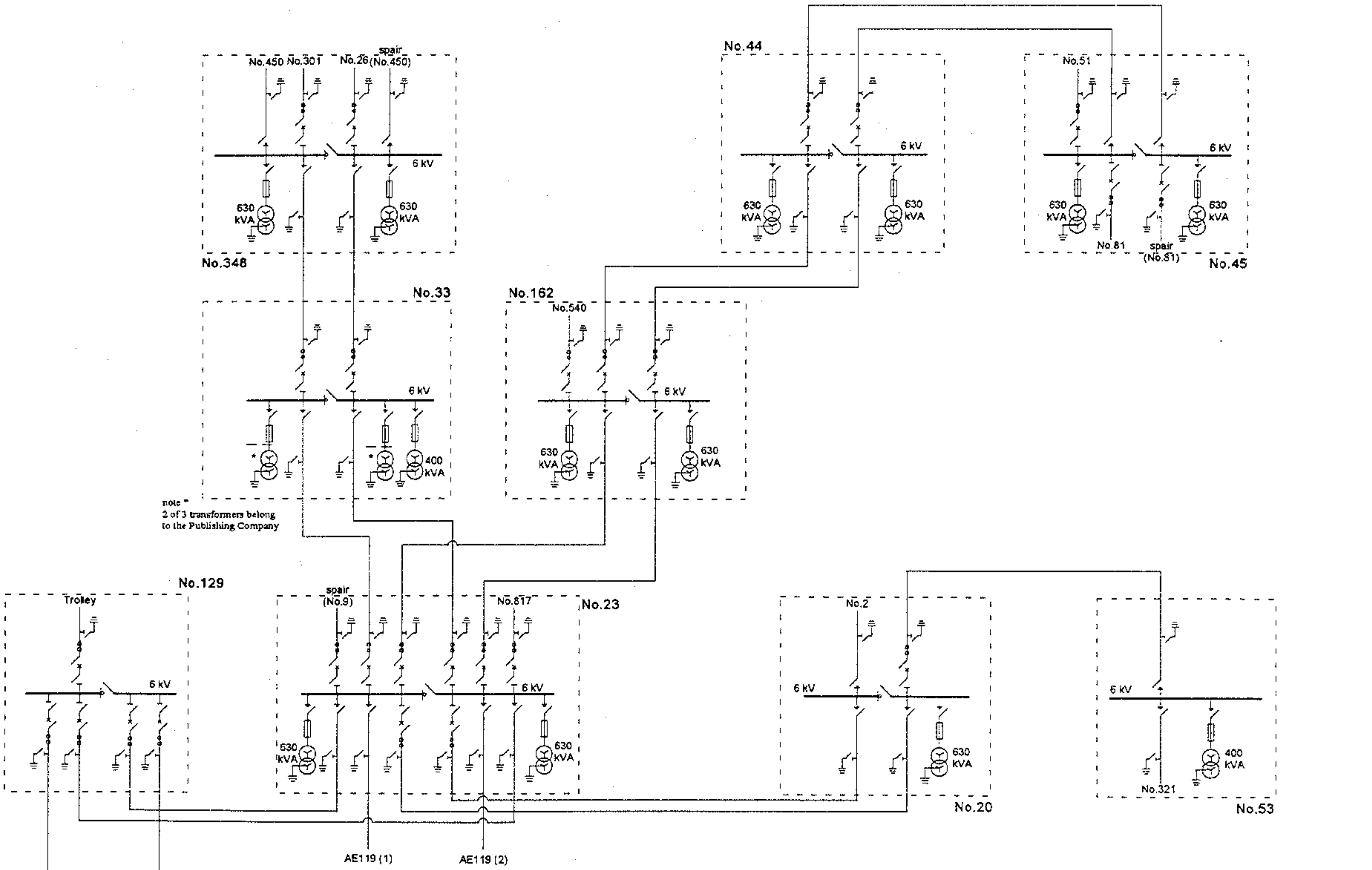
Figure / Рисунок No. III.5.3-3

Title / Название Рисунка

Rehabilitaion and Reconstruction Plan in the Highest Priority Project Area



Master Plan Study on Rehabilitation and Reconstruction of Electric Supply in Baku Изучение Генерального Плана Восстановления И Реконструкции Электроснабжения Города Баку	Figure / Рисунок No. III.5.3-4 (1)
Baku Electric Network ПО "БАКЭЛЕКТРОСЕТЬ" / Japan International Cooperation Agency Японское Агентство Международного Сотрудничества	Title / Название Рисунка 6 kV system after rehabilitation and reconstruction (1) (phase II)
Joint Venture Nippon Koei Co., Ltd. & KRI International Corp. Совместное предприятие НИППОН КОЕИ и KRI Интернешнл Корп.	



note:
The cables between No.23 and AE119, and between No.129 and AE119 will be replaced.

Master Plan Study on Rehabilitation and Reconstruction of Electric Supply in Baku Изучение Генерального Плана Восстановления И Реконструкции Электроснабжения Города Баку		Figure / Рисунок No. III.5.3-4 (2) Title / Название Рисунка 6 kV system after rehabilitation and reconstruction (2) (phase II)
Baku Electric Network ПО "БАКЭЛЕКТРОСЕТЬ"	Japan International Cooperation Agency Японское Агентство Международного Сотрудничества	
Joint Venture Nippon Koei Co., Ltd. & KRI International Corp. Совместное предприятие НИППОН КОЕЙ и KRI Интернешнл Корп.		

Appendix III.5.3-1 Transformer stations related to voltage augmentation (phase I)

Exsiting Facilities

No.	Tr. Station No.	Transformers Unit (nos)	No.1 (kVA)	No.2 (kVA)	Total (kVA)	Prim. Volt (kV)	Type of Station	Commis. Year	Priority (a)
1	4 (b)	1	400		400	6.0	KP	1960	36
2	5	2	400	630	1,030	6.0	KP	1940	1
3	6	1	630		630	6.0	KB	1938	2
4	7 (c)	2	250	400	650	6.0	KP	1937	3
5	11	2	400	630	1,030	6.0	KB	1955	34
6	17	2	400	630	1,030	6.0	KP	1953	5
7	21	2	1,000	1,000	2,000	10.0	KB	1989	
8	22	1	400		400	6.0	KB	1966	26
9	72	1	400		400	6.0	PMT (e)	1976	
10	107	1	400		400	6.0	PMT	1960	37
11	108 (d)	1	630		630	6.0	KP	1988	
12	109	2	400	400	800	6.0	KO	1997	
13	330	2	400	630	1,030	6.0	KO	1991	
14	462	1	400		400	6.0	PMT	1964	
15	519	2	630	630	1,260	6.0	KO	1966	25
16	1042	1	160		160	6.0	PMT	1999	
17	1063	1	630		630	6.0	PMT	2000	
Total		**25**			**12,880**				

Equipment to be installed in the Plan

Transformers Unit (nos)	Transformers No.1 (kVA)	Transformers No.2 (kVA)	Transformers Total (kVA)	Number of MV Switchgear Panels: CB Feeder	LBS Feeder	Bus Tie	PT	Tr.	LV Panels: with 2-CB	with 1-CB	Type of Trans.
2	400	400	800	1	3	1	1	2	1	1	Dry
2	630	630	1,260	4	2	1	2	2	1	1	Dry
1	630		630	1	3	1	1	1		1	Dry
2	630	630	1,260	6	2	1	2	2	1	1	Dry
2	630	630	1,260	3	2	1	2	2	1	1	Dry
2	630	630	1,260	2	4	1	2	2	1	1	Dry
2	1,000	1,000	2,000	6	3	1	2	2	1	1	Dry
1	400		400		2			1		1	Dry
1	400		400								Dry
1	400		400								Dry
2	630	630	1,260		2			2	1	1	Dry
2	400	400	800	4	1	1	2	2	1	1	Oil
2	630	630	1,260	1	3	1	1	2	1	1	Oil
1	630		630								Dry
2	630	630	1,260	5	2	1	2	2	1	1	Oil
1	400		400								Dry
1	630		630								Dry
27			**15,910**	**33**	**29**	**10**	**17**	**22**	**10**	**12**	

Remarks :

(a) Figure in coloum of "Priority" is a number (priority) indicated in Appendix II.3.3-2(1) for the Master Plan.

(b) No. 4 station building will be newly constructed.

(c) Old No. 7 station building will be abandoned and existing new building will be used.

(d) Number of transformer will be increased to 2 units due to modification of inside wall.

(e) MV switchgear(LBSs) and LVDB of PMT type transformer stations is not counted here, because those are mounted in transformer cubicle.

(f) Molded dry type transformers for No.6 & No.22 transformer stations will be enclosed in the cubicle with proper ventilation sysytem.

Appendix III.5.3-2 Underground cables lines related to voltage augmentation (phase I)

No.	Existing MV Distribution Lines related to Upgrading: From S/S No.	To S/S No.	Circuit (CCT)	Rated Voltage of Cable	Cable Size	Route Length (m) (b)	Cable Length (cct·m)	Commiss. Year	Pri-ority (a)	Rehabilitation
1	1	4	1	6 kV	3 x 95	1,380	1,380	1973		Reconnected to other T.S
2	4	7	1	6 kV	3 x 95	483	483	1957	50	Replaced with 10 kV cables
3	4	107	1	6 kV	3 x 95	220	220	1957	51	Replaced with 10 kV cables
4	4	108	1	6 kV	3 x 70	1,269	1,269	1960	73	Replaced with 10 kV cables
5	5	7	1	6 kV	3 x 70	427	427	1933	26	Replaced with 10 kV cables
6	5	129	1	6 kV	3 x 70	614	614	1933	27	Abandonment
7	5	200	1	6 kV	3 x 70	367	367	1940	34	Abandonment
8	5	201	1	6 kV	3 x 70	230	230	1940	35	Abandonment
9	5	11	1	6 kV	3 x 120	550	550	1959	60	Replaced with 10 kV cables
10	6	7	1	6 kV	3 x 70	272	272	1933	28	Replaced with 10 kV cables
11	6	462	1	6 kV	3 x 70	65	65	1954	47	Replaced with 10 kV cables
12	7	330	1	6 kV	3 x 70	250	250	1933	29	Replaced with 10 kV cables
13	11	462	1	6 kV	3 x 95	558	558	1954	48	Replaced with 10 kV cables
14	11	573	1	6 kV	3 x 95	329	329	1954	49	Abandonment
15	11	72	1	6 kV	3 x 185	70	70	1984		Replaced with 10 kV cables
16	22	330	1	6 kV	3 x 70	387	387	1933	30	Replaced with 10 kV cables
17	22	23	1	6 kV	3 x 150	282	282	1933	31	Abandonment(partially)
18	23	519	1	6 kV	3 x 95	200	200	1932	25	Abandonment
19	107	109	1	6 kV	3 x 95	300	300	1959	63	Replaced with 10 kV cables
20	108	109	1	6 kV	3 x 95	245	245	1958	57	Replaced with 10 kV cables
21	108	519	1	6 kV	3 x 185	110	110	1964		Replaced with 10 kV cables
22	109	1063	1	10 kV	3 x 150	300	300	2000		Remained unchange
23	162	519	1	10 kV	3 x 150	780	780	1973	81	Abandonment
24	519	1042	1	10 kV	3 x 95	160	160	2000		Remained unchange
	Total		**24**			**9,848**	**9,848**			

No.	Distribution Lines to be rehabilitated in the Plan: From S/S No.	To S/S No.	Circuit (CCT)	Rated Voltage of Cable	Route Length (m)	Length for Erection	Cable Length (cct·m)
1	4	17	2	10 kV	278	278	556
2	4	107	1	10 kV	235	235	235
3	4	109	1	10 kV	556		556
4	5	7	2	10 kV	342	342	684
5	5	17	2	10 kV	605	605	1,210
6	5	600	2	10 kV	610	610	1,220
7	6	7	2	10 kV	396	396	792
8	6	11	1	10 kV	396		396
9	6	462	1	10 kV	70	70	70
10	7	11	2	10 kV	487	487	974
11	7	330	2	10 kV	150	150	300
12	11	72	1	10 kV	75	75	75
13	11	462	1	10 kV	326	326	326
14	21	519	2	10 kV	599	599	1,198
15	22	330	1	10 kV	414	414	414
16	22	519	1	10 kV	433	433	433
17	107	109	1	10 kV	321	321	321
18	108	109	1	10 kV	262	262	262
19	108	519	1	10 kV	118	118	118
20	109	519	1	10 kV	380		380
21	330	519	1	10 kV	847		847
Subtotal			**27**		**6,673**	**5,721**	**10,140**
22	109	1063	1	10 kV	139	0 (c)	139
23	519	1042	1	10 kV	139	0 (c)	139
Subtotal			**2**		**278**		**278**
Total			**29**		**6,951**	**5,721**	**10,418**

Remarks :

(a) Figure in coloum of "Priority" is a number (priority) indicated in Appendix II.3.3-1(1) for the Master Plan.

(b) Route length of line to be rehabilitated indicated in the above table is measured on the map of scale 1/5000 with allowance.

(c) Existing power cable for "No.109 - No.1063" and "No.519 - No.1042" will be used.

Appendix III.5.3-3 Transformer stations to be rehabilitated (phase II)

Existing Facilities

No.	Tr. Station No.	Transformers Unit (nos)	No.1 (kVA)	No.2 (kVA)	Total (kVA)	Prim. Volt (kV)	Type of Station	Commis. Year	Pri-ority (a)
1	8	2	400	630	1,030	6.0	KO	1948	4
2	12	2	630	630	1,260	6.0	KO	1988	
3	16	1	630		630	6.0	KP	1942	16 (c)
4	20	1	400		400	6.0	KB	1939	6
5	23	2	400	400	800	6.0	KB	1934	7
6	25	3	630	2x630	1,890	6.0	KO	1983	5
7	33 (b)	1	400		400	6.0	KP	1930	8
8	34	2	630	630	1,260	6.0	KO	1955	9
9	44	2	320	630	950	6.0	KP	1938	2 (d)
10	45	1	630		630	6.0	KP	1953	11 (d)
11	53	1	315		315	6.0	KB	1938	21
12	129	0			0	6.0	KB	1932	13
13	162	2	315	400	715	6.0	KB	1980	
14	291	1	630		630	6.0	KB	1961	14
15	348	2	630	630	1,260	6.0	KB	1962	32
16	573	2	250	630	880	6.0	KO	1973	20
17	944	1	400		400	6.0	PMT (e)	1997	
18	966	1	400		400	6.0	PMT		
Total		**27**			**13,850**				

Equipment to be installed in the Plan

Transformers Unit (nos)	No.1 (kVA)	No.2 (kVA)	Total (kVA)	Number of MV Switchgear Panels: CB Feeder	LBS Feeder	Bus Tie	PT	Tr.	LV Panels: with 2-CB	with 1-CB	Type of Trans.
2	630	630	1,260	3	2	1	2	2	1	1	Oil
2	630	630	1,260	3	4	1	2	2	1	1	Oil
1	630		630	2	2	1	2	1		1	Dry
1	630		630	1	3	1	1	1		1	Dry
2	630	630	1,260	10	2	1	2	2	1	1	Dry
2	1,000	1,000	1,890	5	2	1	2	2	1	1	Oil
1	400		400	2	2	1	2	3		1	Dry
2	630	630	1,260	4	2	1	2	2	1	1	Oil
2	630	630	1,260	2	2	1	2	2	1	1	Dry
2	630	630	1,260	3	2	1	2	2	1	1	Dry
1	400		400		2			1		1	Dry
0			0	3	2	1	1				
2	630	630	1,260	3	2	1	2	2	1	1	Dry
1	630		630	2	2	1	2	1		1	Dry
2	630	630	1,260	2	4	1	1	2	1	1	Dry
2	630	630	1,260	4	2	1	2	2	1	1	Oil
1	630		630								Dry
1	400		400								Dry
27			**16,950**	**49**	**37**	**15**	**27**	**27**	**10**	**15**	

Remarks :

(a) Figure in coloum of "Priority" is a number (priority) indicated in Appendix II.3.3-2(1) for the Master Plan.

(b) No. 33 has 1 transformer owned by BEN and another 2 by customer.

(c) Priority of Yasamal district in the master Plan.

(d) Priority of Nasimi district in the Master Plan.

(e) MV switchgear(LBSs) and LVDB is not counted here, because they are mounted in transformer cubicle.

(f) Molded dry type transformers for No.20, No.53 & No.162 transformer stations will be enclosed in the cubicle with proper ventilation sysytem.

Appendix III.5.3-4 6 kV underground cables lines to be rehabilitated (phase II)

Existing MV Distribution Lines subject to Rehabilitation

No.	From S/S No.	To S/S No.	Circuit (CCT)	Rated Volt of Cable	Cable Size	Route Length (m) (b)	Cable Length (cct·m)	Commiss. Year	Priority (a)
1	8	573	1	6 kV	3 x 185	340	340	1958	54
2	12	16	1	6 kV	3 x 50	370	370	1929	15
3	12	573	1	6 kV	3 x 70	432	432		80
4	12	966	1	6 kV	3 x 50	441	441		16
5	20	23	1	6 kV	3 x 95	377	377	1910	6
6	20	53	1	6 kV	3 x 70	252	252	1930	20
7	23	119	1	6 kV	3 x 185	2,466	2,466		71
8	23	129	1	6 kV	3 x 95	1,203	1,203		11
9	23	162	1	6 kV	3 x 95	285	285	1936	33
10	23	33	1	6 kV	3 x 95	345	345		17
11	25	34	1	6 kV	3 x 50	330	330	1913	10
12	25	966	1	6 kV	3 x 70	128	441	1929	18
13	33	348	1	6 kV	3 x 95	120	120	1929	19
14	44	45	1	6 kV	3 x 95	365	365	1911	1 (c)
15	44	162	1	6 kV	3 x 95	645	645	1936	28 (c)
16	129	119	1	6 kV	3 x 95	1,365	1,365	1910	7
17	291	743	1	6 kV	3 x 185	173	173	1952	45
18	573	743	1	6 kV	3 x 185	567	567	1952	46
	Total		18			10,204	10,517		

Distribution Lines to be rehabilitated

No.	From S/S No.	To S/S No.	Circuit (CCT)	Rated Volt of Cable	Route Length (m)	Length for Erection	Cable Length (cct·m)
1	8	573	2	10 kV	300	300	600
2	12	16	1	10 kV	503		503
3	12	25	1	10 kV	589		589
4	12	573	2	10 kV	353	353	706
5	12	944	1	10 kV	235	235	235
6	12	966	1	10 kV	300	300	300
7	16	944	1	10 kV	300	300	300
8	20	23	1	10 kV	460	460	460
9	20	53	2	10 kV	321	321	642
10	23	33	2	10 kV	417	417	834
11	23	162	2	10 kV	407	407	814
12	23	119	2	10 kV	2,211	2,211	4,422
13	25	34	2	10 kV	428	428	856
14	25	966	1	10 kV	289	289	289
15	33	348	2	10 kV	235	235	470
16	44	45	2	10 kV	407	407	814
17	44	162	2	10 kV	674	674	1,348
18	129	119	2	10 kV	1,033	1,033	2,066
19	291	573	2	10 kV	973	973	1,946
Total			31		10,435	9,341	18,194

Remarks :

(a) Figure in coloum of "Priority" is a number (priority) indicated in Appendix II.3.3-1(1) for the Master Plan.

(b) Route length of line to be rehabilitated indicated in the above table is measured on the map of scale 1/5000 with allowance.

(c) Priority of Nasimi district in the Master Plan.

CHAPTER 6

BASIC DESIGN

CHAPTER 6 BASIC DESIGN

6.1 Design Criteria

The design criteria of this plan are as follows:

(a) Applying the technical level of BEN
(b) Considering the easiness of operation and maintenance
(c) Applying the design and facilities that are adjusted to the existing facilities
(d) Ensuring high safety and reliability level
(e) Securing of economy (Effective use of existing building)
(f) Establishment of flexible distribution system corresponding to expansion in the future

6.2 Basic Plans

6.2.1 Outline of Facilities

(1) Objective area and facilities

(a) Objective area
The objective area for this plan is the priority area in Sabail district, which have been selected by the Pre-feasibility study.

(b) Objective facilities
The outline of the objective facilities of this plan is shown in the following table and details are shown in Chapter 5.

Table III.6.2-1 Outline of the objective facilities

	Items	Unit	Existing	After improvement
Phase I	U/G line	nos.	24	23
	Transformer station	nos.	17	17
Phase II	U/G line	nos.	18	19
	Transformer station	nos.	18	18

(2) Standard to be applied

International Electro-technical Committee (IEC) standard is applied to technical specifications of each facility such as design, manufacturing, factory inspection.

The common items for the planning and designing of the distribution facilities are as follows.

(a) Standard voltage and frequency

The standard voltage and frequency applied to the distribution network are as shown in Table III.6.2-2.

Table III.6.2-2 Standard voltage and frequency

System	Standard Voltage	Frequency
Medium Voltage	6.0 or 10.0 kV	50 Hz
Low Voltage	0.4 kV	50 Hz

(b) Electricity system

The electricity system applied to the distribution network is as shown in Table III.6.2-3.

Table III.6.2-3 Electricity system

System	Electricity System
Medium Voltage	3 Phases 3 wires, isolated neutral system
Low Voltage	3 phases 4 wires, earthed neutral system

(c) Insulation level

The insulation level for distribution facilities is as shown in Table III.6.2-4.

Table III.6.2-4 Insulation level

Item	Medium Voltage		Low voltage
Nominal voltage	6 kV	10.0 kV	0.23 – 0.4 kV
Rated voltage	7.2 kV	12 kV	0.254 – 0.44 kV
AC withstand voltage	20 kV	28 kV	2,000 V
Impulse withstand voltage	60 kV	75 kV	6,000 V

(d) Fault short circuit current level

The fault short circuit current in the distribution network should be kept within the value as shown in Table III.6.2-5

Table III.6.2-5 Fault short circuit current

Voltage Class	Fault short circuit current level
6.0 kV	20 kA
10.0 kV	20 kA

6.2.2 Transformer Station and Switchgears

(1) Transformer station buildings

The transformer station buildings to be improved in the plan are classified into three installation types. Items to be rehabilitated and improved and facilities to be installed in each type of transformer station are as follows.

(a) Ground-mounted type transformer station

This type of buildings is of stone and mortar and self-supporting structure. These buildings are classified into two types further, the one is to be installed on green belt, parks or courtyard where there is comparatively enough space and the other is to be built adjacent to other existing buildings. As for the former, there is a lot of space in each equipment room of the building. Then it is possible to properly install the new equipment by rearranging the existing partition of the rooms according to the number of equipment to be installed. On the other hand, the latter has not enough space inside to install the new equipment. Beside it is difficult to extend the building because the building are mostly facing resident's passages. Therefore, for the effective use of the existing building, the improvement of the transformer station is designed based on the following policies.

i) To adopt the SF6 gas insulation type for the switchgear to save the space inside the building

ii) To use the existing building by the rearrangement of partitions for the equipment rooms

iii) In case that it is not possible to install the new equipment in the building with the rearrangement of the partition, only the extension of the existing building is considered. If it is still not possible to secure enough space, the number of switchgear board is to be reduced with rearrangement of system configuration.

The major facilities to be installed in this type of transformer stations are as follows:

- Incoming and outgoing feeder cubicles
- Bus-tie cubicles
- Transformer primary circuit cubicles
- Measuring transformer cubicles
- Distribution transformers
- Low-voltage distribution boards, Low-voltage current transformers, watt-hour meters

(b) In-building type transformer substation

In this type of transformer stations, distribution facilities are installed in the rental rooms of an existing building such as apartment and commercial building. In the target transformer stations, the rooms will be improved and the partitions of the room will be changed, the extension of the room, however, is impossible. If it is still not possible to secure the enough space, the number of switchgear board is to be reduced with rearrangement of system configuration.

The major facilities to be installed in this type of transformer stations are the same as in ground-mounted type.

(c) Ground-mounted compact type transformer station

Since this type of transformer station is compact and results in space savings, it shall be set to the place where construction of above 2 types of transformer stations is difficult. For the purpose of outdoor setting, this type of transformer station shall be of metal housing with thermal insulation and waterproof and set on the concrete foundation. All the facilities such as feeder circuits, transformer primary circuit, transformer and LV distribution board shall be installed in the housing.

This type of transformer station will also be used as temporary ones during the rehabilitation of existing transformer station.

(d) Repair items of the existing buildings

Most of the buildings of target transformer stations have deteriorated. The walls and doors of some buildings have been badly damaged and it was observed that there was a bad leak in the roof. Therefore, leaks in the roof, damaged door and ventilation, crumbled mortar wall, and peeled paint in the target transformer stations shall be repaired under the project.

The connection among the existing facilities in the transformer station is made with bare aluminum bars. Furthermore, cable ducts are equipped to lay the cables connected from distribution line to switchgears. However, only a few of cable ducts are available. Therefore, the layout change and new construction of cable duct will be required in almost all transformer stations.

In the case that the switchgear board will be installed in the target transformer stations, the partition of some buildings will be changed to secure space for installation of the switchgear board. Moreover, the building is newly constructed when there is a strong request from the client and it is judged it is appropriate.

(2) Transformers

The transformer capacities such as 400 kVA, 630 kVA and 1,000 kVA shall be applied based on IEC standard. The dry type transformer will be adopted to "close to other building type", "rented room type", and "compact type" transformer stations.

The major specification of transformers is as shown in Table III.6.2-6.

Table III.6.2-6 Specification of transformers

Items		Specification
Type		Three phases, oil immersed or dry type
Rated Voltage	: primary side	6 kV or 10.0 kV
	: secondary side	230 – 400 V
Vector group		Yyn0
Capacity		400, 630 and 1,000 kVA
Tap ratio		+5.0, +2.5, ±0, -2.5, -5.0% off-load tap changer
Cooling system		Natural cooling

(3) MV switchgear cubicles

MV switchgear cubicles will consist of the following panels:

- SF6 gas type circuit breaker (for out-going feeders)
- SF6 gas type load break switch (for in-coming feeder)
- SF6 gas type load break switch (for bus-tie)
- SF6 gas type load break switch with power fuse (for primary side of transformer circuit)
- Instrument transformer (for earthling fault detection device)

The specification of all the switchgears, which will be installed in the project, shall meet the application of remote control from the load dispatching center in future.

The specifications of the facilities, which shall be installed in the cubicles, are as follows.

(a) MV switchgear

The specification of MV switchgear is as shown in Table III.6.2-7.

Table III.6.2-7 Specification of MV switchgear

Items	Specification	
Switchgears	Circuit breaker (SF6 gas type)	Load break switch (SF6 gas type)
Rated voltage	7.2 kV or 12 kV	
Rated current	630 A for main feeder	630 A for main feeder 200 A for transformer circuit
Breaking capacity	20 kA	20 kA

(b) Power Fuse

The power fuse shall be installed in the primary side of transformer circuit. The major specification of power fuse is as shown in Table III.6.2-8.

Table III.6.2-8 Rated current of power fuse

Transformer Capacity	Power fuse 6.0 kV	10.0 kV
400 kVA	80 A	50 A
630 kVA	100 A	80 A
1,000 kVA	125 A	100 A

(c) Earthed Voltage Transformers (EVT)

The earthed voltage transformer shall be installed on the bus bar, which connects circuit breaker circuit. The specification of earthed voltage transformer is as shown in Table III.6.2-9.

Table III.6.2-9 Specification of earthed voltage transformer

Items	Specification
Rated voltage	7.2 kV or 12 kV
Voltage ratio	6.0 kV/100/$\sqrt{3}$ V or 10 kV / 100/$\sqrt{3}$ V

(d) Current Transformers (CT)

The current transformer shall be installed in the feeder and transformer circuit cubicle to detect a short-circuit fault for out-going feeder and to measure current value. The specification of the current transformer is as shown in Table III.6.2-10.

Table III.6.2-10 Specification of current transformer

Items	Specification
Rated voltage:	7.2 kV or 12 kV
Current ratio:	
Out-going feeder	400/5 A
Transformer circuit	200/5 A

Since there are a lot of feeders connected to No.7 transformer station, it is difficult to install all the transformer circuit panels with CT. Accordingly, current values will be measured at the LV side.

(e) Zero-phase Current Transformers (ZCT)

The zero-phase current transformer shall be installed in the feeder cubicle, which equips circuit breaker. The specification of zero-phase current transformer is as shown in Table III.6.2-11.

Table III.6.2-11 Specification of zero-phase current transformer

Items	Specification
Rated voltage	7.2 kV or 12 kV
Current ratio	400A, 200mA/1.5mA

(4) Low-voltage distribution boards

The wall mounted and metal-clad indoor type LV distribution boards will be installed at the secondary side of transformer. The LV disconnecting switches and the cartridge type fuses will be installed in the main circuits and LV feeders of the boards respectively. The measurement of watt-hour is measured only with the transformer circuit, and low-voltage feeders are not measured. The specification of LV distribution boards is shown as shown in Table III.6.2-12.

Table III.6.2-12 Specification of LV distribution boards

Items		Specification
Rated voltage		400 V
Type		Wall mounted
Rated current	: main circuit	800A, 1,200 A and 1,800 A
	: feeder	400 A
Low-voltage fuse		400 A or 200 A
Number of circuit		8

6.2.3 Medium Voltage Distribution Line Facilities

In this project, considering the upgrading of the system voltage form 6 kV to 10 kV in future, the cables for 10 kV shall be applied to the 6 kV system.

The "6/10 (12) kV cross-linked polyethylene (XLPE) insulated PVC sheathed cable with aluminum conductor" shall be applied to underground MV distribution line. To reduce the accessories, two sizes of the cables such as 3 x 240 mm^2 for the main feeders and 3 x 150 mm^2 for the branch lines shall be applied The specification of MV underground cables is as shown in Table III.6.2-13.

Table III.6.2-13 Specification of MV underground cables

Items	Specification
Rated voltage	6/10 (12) kV
Number of cores	3
Material of conductor	Aluminum
Nominal section area	240 mm^2 (for main feeder)
	150 mm^2 (for branch line)
Insulation material	XLPE
Insulation thickness	3.4 mm
Outer diameter	App. 56 mm (150 mm^2), 65 mm (240 mm^2)
Weight	App. 3.2kg/m (150 mm^2), 4.5kg/m (240 mm^2)

6.2.4 Low Voltage Distribution Line Facilities

(1) LV underground cables

The "0.6/1 kV cross-linked polyethylene (XLPE) insulated PVC sheathed steel tape armored cable with aluminum conductor" shall be applied to underground LV distribution line. To reduce the accessories, two sizes of the cables such as 3 x 240 + 95 mm² for the main feeders and 3 x 150 + 70 mm² for the branch lines shall be applied. The specification of LV underground cables is as shown in Table III.6.2-14.

Table III.6.2-14 Specification of LV underground cables

Items	Specification
Rated voltage	0.6/1 kV
Number of cores	3
Material of conductor	Aluminum
Nominal section area	3x240+1x95 mm² (for main feeder)
	3x150+1x70 mm² (for branch line)
Insulation material	XLPE
Insulation thickness	1.7 mm (240 mm²), 1.4mm (150), 1.1mm(95 and 70)
Outer diameter	App. 58.7 mm (3x240+95), 48.5 mm (3x150+70)
Weight	App. 4.27 kg/m (3x240+95), 2.88 kg/m (3x150+70)

(2) House flank cable lines

The Aerial Bundled Conductors (ABC) of 0.6/1 kV cross-linked polyethylene (XLPE) insulated PVC sheathed cable with aluminum conductor shall be applied to low voltage house flank lines. To reduce the accessories, two sizes of the cables such as 3 x 150 + 70 mm² for the main feeders and 3 x 70 + 1 x 70 mm² for the branch lines shall be applied. The specification of LV ABC is as shown in Table III.6.2-15.

Table III.6.2-15 Specification of LV ABC cable

Items	Specification
Rated voltage	0.6/1 kV
Number of cores	3
Material of conductor	Aluminum
Nominal section area	3x150+1x70 mm² (for main feeder)
	3x70+1x70 mm² (for branch line)
Insulation material	XLPE
Insulation thickness	1.4mm (150), 1.1mm(70)
Outer diameter	App.39mm (3x150+70), 33 mm (3x70+70)
Weight	App. 1.7 kg/m (3x150+70), 1.0 kg/m (3x70+70)

6.3 Design for Transformer Stations

Based on the result of the detailed survey as described in Chapter 4 of this Volume and the result of examination for objective facilities as indicated in Figures III.5.3-2, 5.3-4(1) and 5.3-4(2), improvement plans and facilities layout plans for each transformer station are designed. Figures III.6.3-1 (1)-(13) shows the result of design for transformer stations relating to the voltage augmentation plan (phase I) as described in Section 5.3.1. Figures III.6.3-2 (1)-(17) also shows the result of design for transformer stations relating to the 6 kV system rehabilitation plan (phase II).

In the transformer stations such as No.17 and No.21 as shown in Figure III.5.3-4 (2), not only switchgear panel for connection to existing one circuit of cable line (non-target line for rehabilitation) but also spare switchgear panel is planned for future extension to two circuits.

6.4 Project Implementation Setup

6.4.1 Organizational Setup

In May 1999, some departments in BEN, which had been originally playing important functions in electricity distribution sector, were separated from BEN. Those who were separated includes the Division for Special Construction (DSC), the Enterprise for Power Supervision and Sale (EPSS) and the Transformer Repair Shop (TRS). As a result, the role of BEN have been limited to the operation and maintenance of 10/6 kV and low voltage distribution facilities, replacement of transformers, repair works of underground cables, and laying work of service wires for customers. DSC that had been responsible for any rehabilitation and construction work including construction of transformer stations, renovation of large facility, laying and replacement of underground cables, has been absorbed into DEC.

However, the Presidential Decree on the restructuring of electricity distribution sector through establishing Joint Stock Company BEN (JSC BEN) was issued on 14 June 2000. The Decree decides to re-incorporate the functions, which are once separated and to establish the organization setup that is close to the former BEN (i.e. before re-organization dated in May 1999). Accordingly, the energy related section in MRCIAE (construction department) of DEC, which had been responsible for the project implementation works suggested, has been incorporated as one of the functions of JSC BEN.

As of now, those functions incorporated into JSC BEN have been identified from the Presidential Decree. However, there has been some points yet to be confirmed, including how the organizational setup inside JSC BEN will be established for the implementation of the facility rehabilitation/expansion plan and O&M, and how the responsibility allocation with distribution operator to be selected by tender will be established. Therefore, concrete organization setup for the priority project implementation has not been confirmed. At this time, on the condition that those functions related to the project implementation have been incorporated into JSC BEN, the organization setup for the project implementation based on the past structure (after re-organization in May 1999) is shown below:

Table III.6.4-1 Project implementation setup

Project Supervising, Monitoring, Reviewing	BEN – Head Quarter
Procurement of Material, Equipment	Technical Procurement Department (BEN)
D/D, Construction, Installment Works	Energy related division in MRCIAE (DEC)
Operation, Maintenance, Repairing Works	City and Suburb Electric Networks: BEN

Note: The above functions are incorporated into Joint Stock Company BEN.

6.4.2 Budgeting Allocation by BEN for the Project

As of now, the budgeting plan by BEN's own fund for the project has not been indicated nor will be available, due to the following reason:

(a) BEN has been currently operating in deficit, with no reliable source of accumulation into its investment funds.

(b) The decision on fund injection to investment rehabilitation plan has been made on the case by case basis as is stipulated by outside. Therefore, even though the investment plan was formulated, no financing plan to substantiate the investment has been contemplated so far, nor will be.

(c) Due to the transition process into full-operation as Joint Stock Company BEN, current BEN has had no definite basis or prospect for formulating any future plans.

It is noted that BEN has contemplated neither definite nor periodical financing/budgeting plan even for its own investment plan (Three years rehabilitation and replacement plan for 1996-1998). At this time, financing/budgeting plan by own fund for the priority project will be hardly available, as the privatization process has just started and the business plan, organization setup, and financing plan of the newly established corporation has not been finalized.

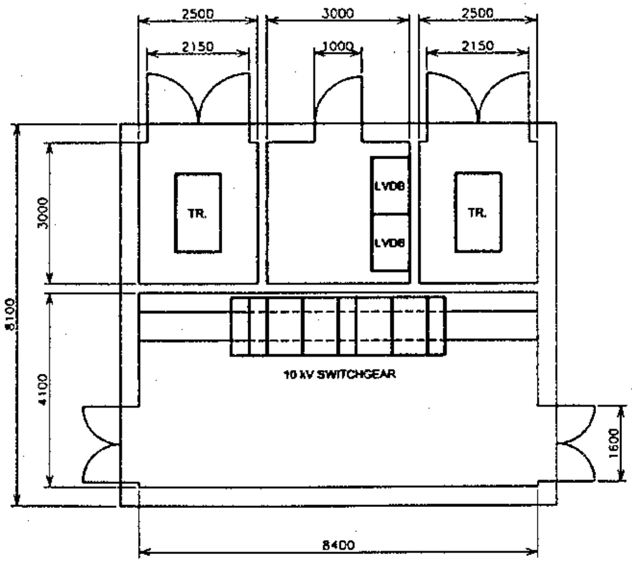
6.4.3 Personnel and Technological Level

Since new organizational structure of JSC BEN has not been settled yet, the personnel and technological level based on the organization setup before establishment of JSC BEN are described in this section.

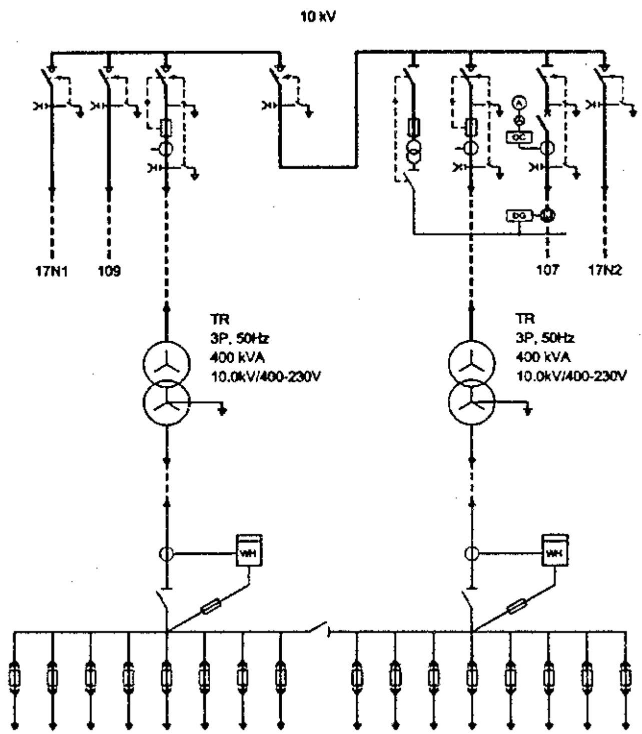
The section, which is directly and technically concerned with the project implementation, is DSC, which used to be a part of BEN before re-organization in May 1999 (i.e. energy related section in MRCIAE of DEC). The staff in this section will be mainly responsible for detail designing study and implementation (construction and installation works) for the project, and is staffed with around 125 persons. The working group will provide the cooperation for project management and operation assistance.

BEN has enough experiences in construction and installment works for distribution facilities. For example, BEN executed the replacement works for 53 km of MV (29 km) and LV (24 km) underground cables and 148 transformers within the year 1999. Therefore, the technological level of BEN is judged to be acceptable for the project implementation.

In the project, the cross-linked polyethylene (XLPE) insulated PVC sheathed cable will be applied to the underground cable lines. However, since BEN has no experience in the use of such kind of cables, support from cable technicians will be essential for cable joint and cable termination works.



LAYOUT (New Equipment)



LEGEND

	Load Break Switch		Voltage Detector
	Disconnecting Switch		Cable Termination
	Circuit Breaker		A.C Ammeter
	Distribution Transformer		Electronic Watt-hour Meter
	Power Fuse		Current Transformer
	Earthing Switch		LV Fuse
	Earthing Voltage Transformer		Over Current Relay
	Zero-phase Current Transformer		Directional Ground Relay

Scale 1:100

0 1m 2m 3m 4m 5m

Master Plan Study on Rehabilitation and Reconstruction of Electric Supply in Baku
Изучение Генерального Плана Восстановления И Реконструкции Электроснабжения Города Баку

Baku Electric Network
ПО "БАКЭЛЕКТРОСЕТЬ"

Japan International Cooperation Agency
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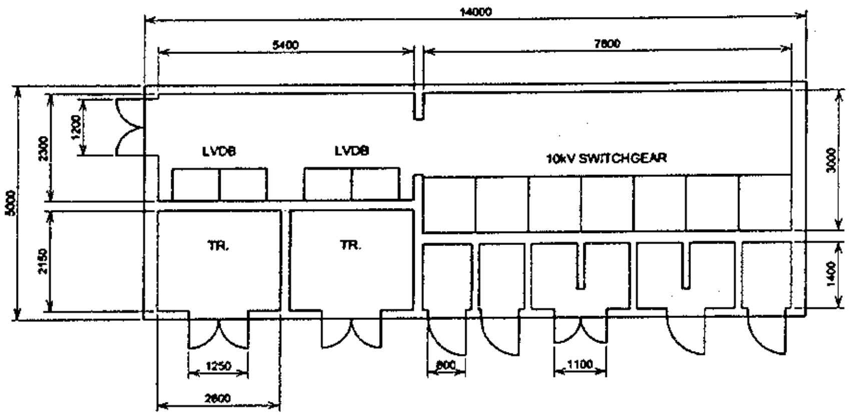
Joint Venture Nippon Koei Co., Ltd. & KRI International Corp.
Совместное предприятие НИППОН КОЕЙ и KRI Интернешнл Корп.

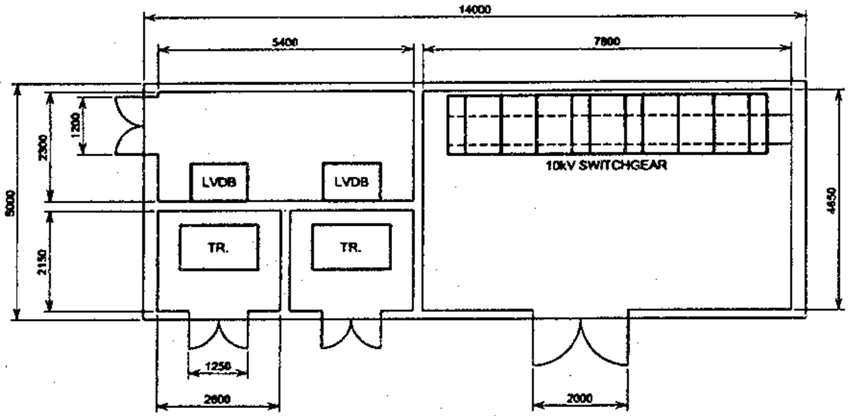
Figure / Рисунок No. III.6.3-1(1)

Title / Название Рисунка

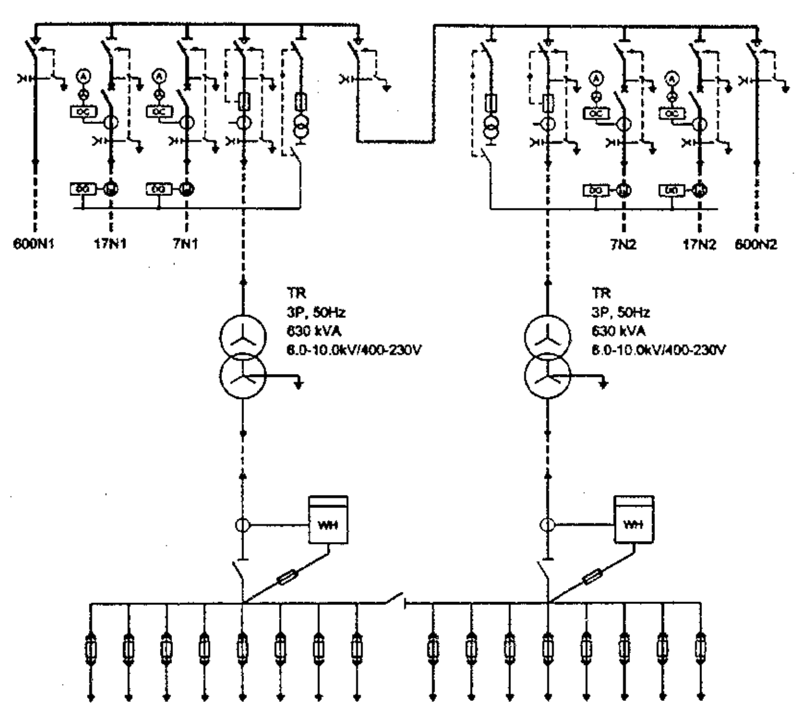
Layout and single line diagram of transformer station No. 4



LAYOUT (Existing Equipment)



LAYOUT (New Equipment)



LEGEND			
	Load Break Switch		Voltage Detector
	Disconnecting Switch		Cable Termination
	Circuit Breaker		A.C Ammeter
	Distribution Transformer		Electronic Watt-hour Meter
	Power Fuse		Current Transformer
	Earthing Switch		LV Fuse
	Earthing Voltage Transformer	OC	Over Current Relay
	Zero-phase Current Transformer	DG	Directional Ground Relay

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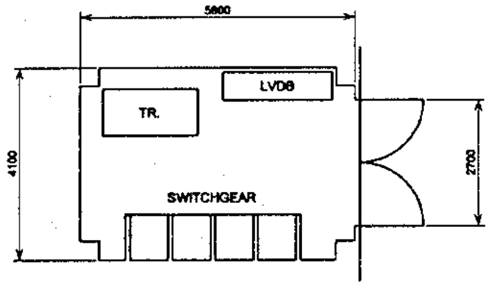
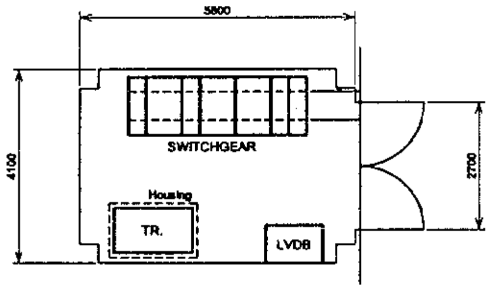
Figure / Рисунок No. III.6.3-1(2)

Title / Название Рисунка

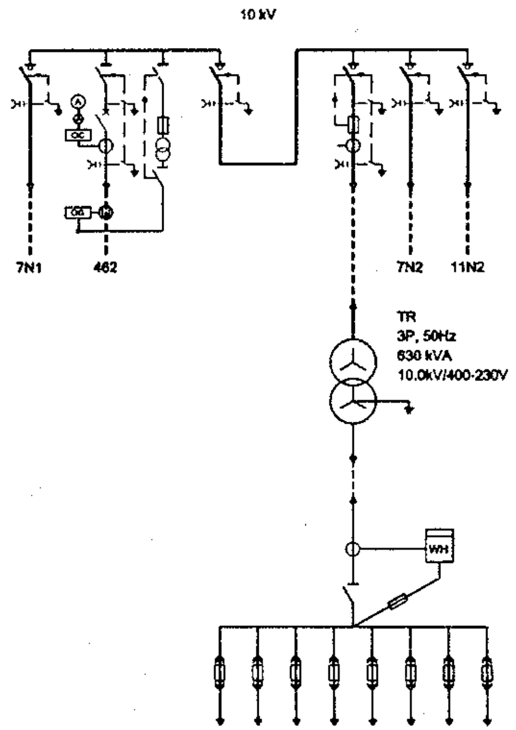
Layout and single line diagram of transformer station No. 5



LAYOUT (Existing Equipment)



LAYOUT (New Equipment)



LEGEND			
	Load Break Switch		Voltage Detector
	Disconnecting Switch		Cable Termination
	Circuit Breaker		A.C Ammeter
	Distribution Transformer		Electronic Watt-hour Meter
	Power Fuse		Current Transformer
	Earthing Switch		LV Fuse
	Earthing Voltage Transformer	OC	Over Current Relay
	Zero-phase Current Transformer	DG	Directional Ground Relay

Scale 1:100

0 1m 2m 3m 4m 5m

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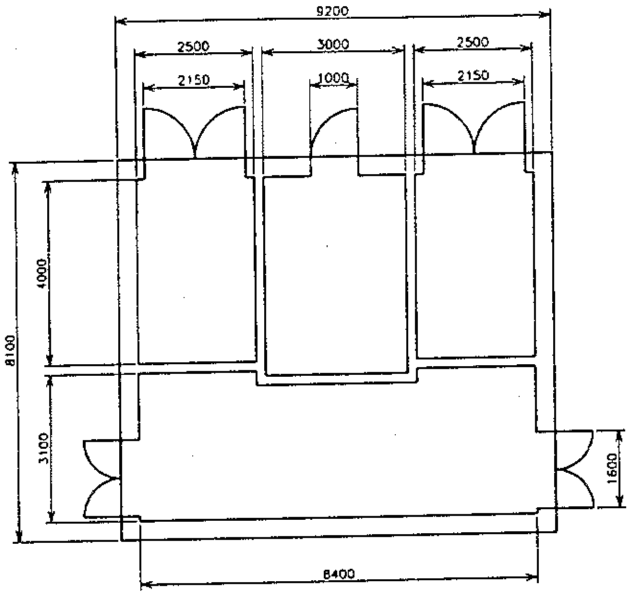
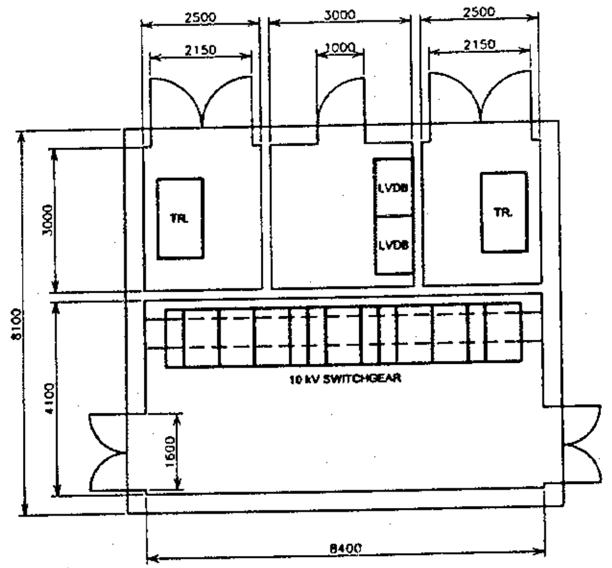
Figure / Рисунок No. III.6.3-1(3)

Title / Название Рисунка

Layout and single line diagram
of transformer station No. 6



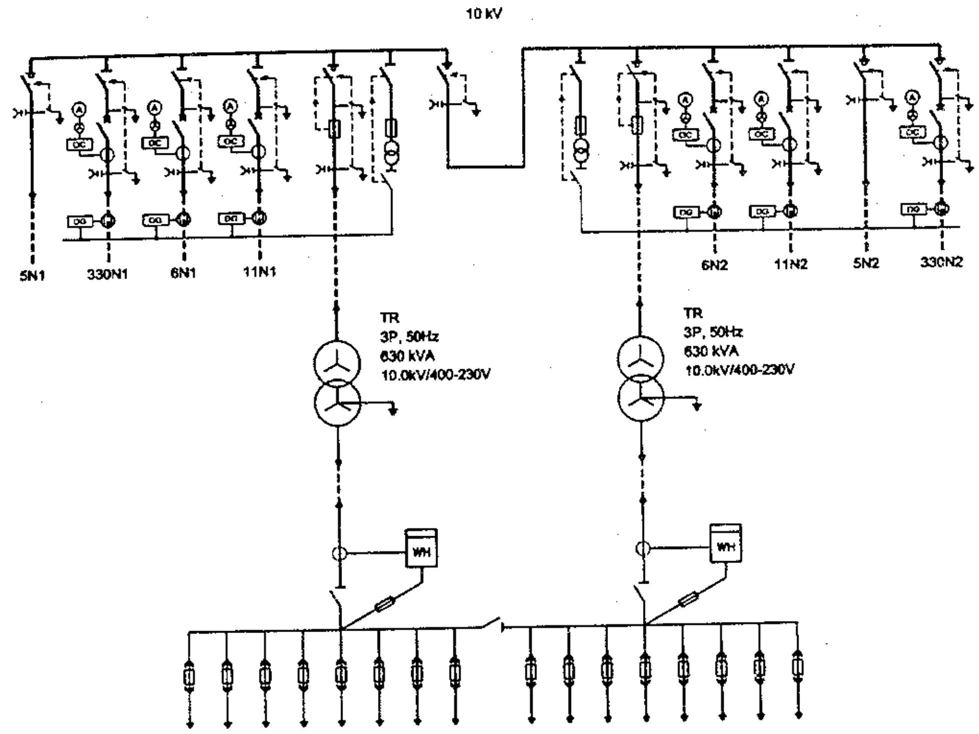
LAYOUT (Existing Equipment)



LAYOUT (New Equipment)

Scale 1: 100

0 1m 2m 3m 4m 5m



Note:
Current of transformer circuit will be measured at the low tension side.

LEGEND			
	Load Break Switch		Voltage Detector
	Disconnecting Switch		Cable Termination
	Circuit Breaker		A.C Ammeter
	Distribution Transformer		Electronic Watt-hour Meter
	Power Fuse		Current Transformer
	Earthing Switch		LV Fuse
	Earthing Voltage Transformer	OC	Over Current Relay
	Zero-phase Current Transformer	DG	Directional Ground Relay

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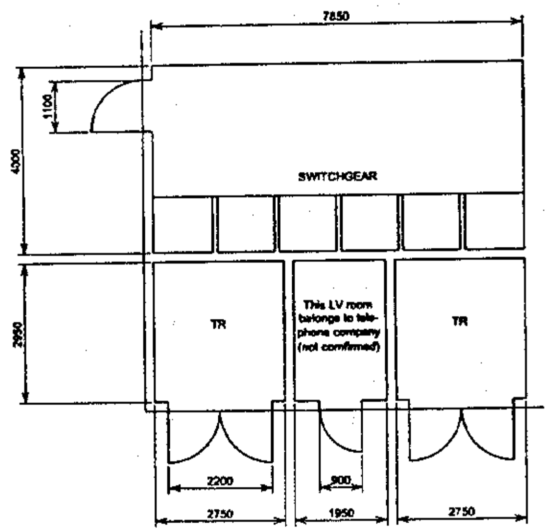
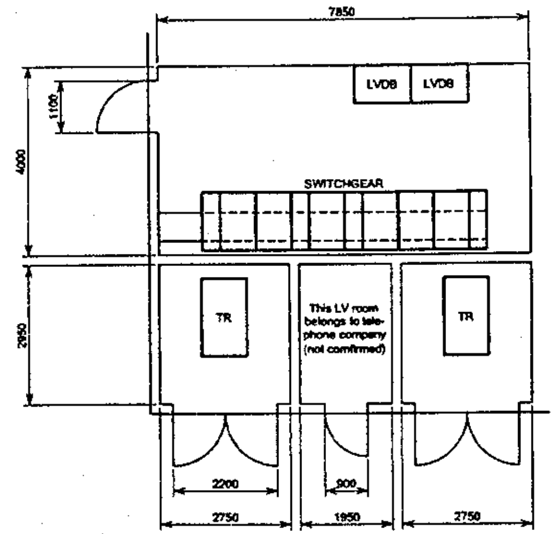
Figure / Рисунок No. III.6.3-1(4)

Title / Название Рисунка

Layout and single line diagram of transformer station No. 7



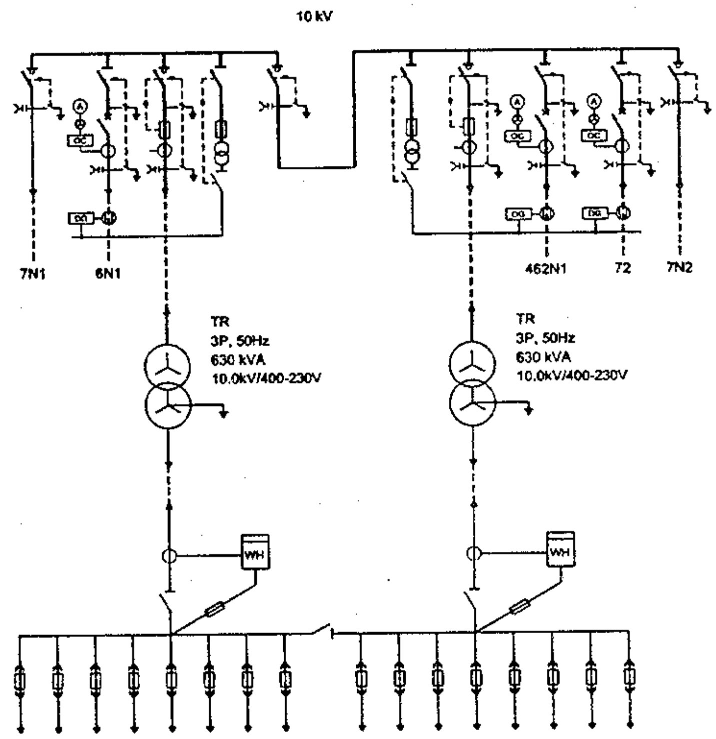
LAYOUT (Existing Equipment)



LAYOUT (New Equipment)

Scale 1: 100

0 1m 2m 3m 4m 5m



LEGEND	
Load Break Switch	Voltage Detector
Disconnecting Switch	Cable Termination
Circuit Breaker	A.C Ammeter
Distribution Transformer	Electronic Watt-hour Meter
Power Fuse	Current Transformer
Earthing Switch	LV Fuse
Earthing Voltage Transformer	Over Current Relay
Zero-phase Current Transformer	Directional Ground Relay

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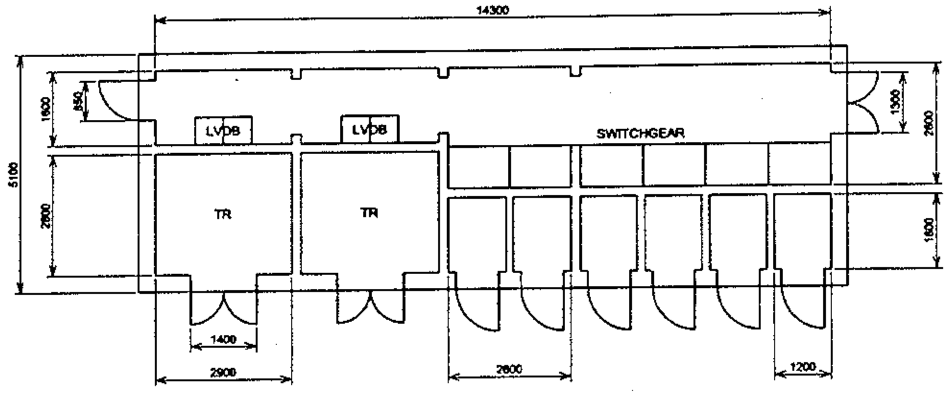
Joint Venture Nippon Koei Co., Ltd. & KRI International Corp.
Совместное предприятие НИППОН КОЕЙ и KRI Интернешнл Корп.

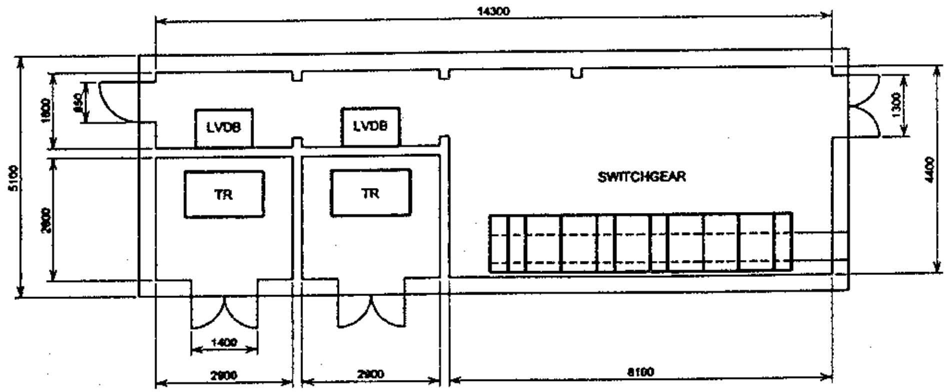
Figure / Рисунок No. III.6.3-1(5)

Title / Название Рисунка

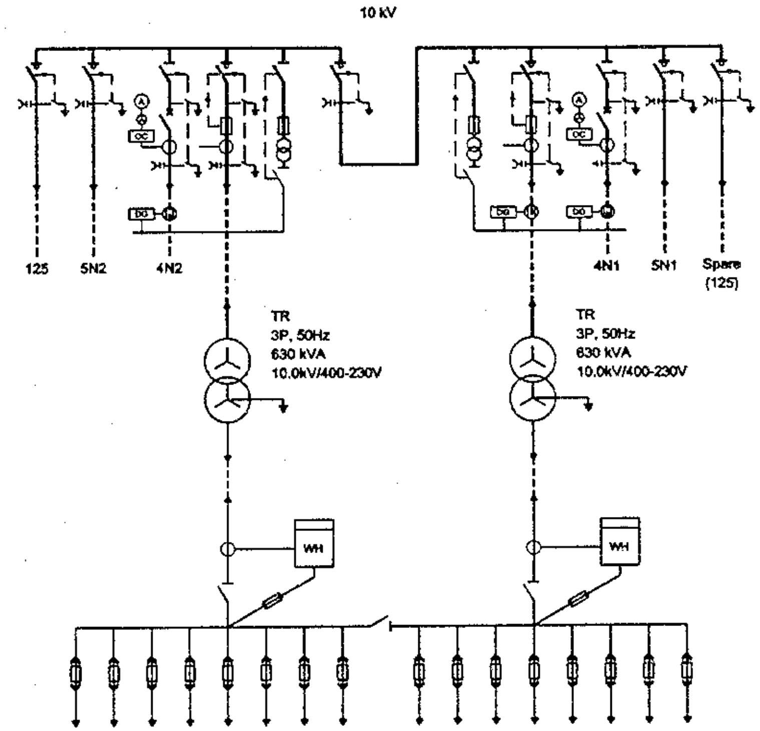
Layout and single line diagram of transformer station No. 11



LAYOUT (Existing Equipment)



LAYOUT (New Equipment)



LEGEND			
	Load Break Switch		Voltage Detector
	Disconnecting Switch		Cable Termination
	Circuit Breaker		Electronic Watt-hour Meter
	Distribution Transformer		Current Transformer
	Power Fuse		LV Fuse
	Earthing Switch	OC	Over Current Relay
	Earthing Voltage Transformer	DG	Directional Ground Relay
	Zero-phase Current Transformer		

Scale 1: 100

0 1m 2m 3m 4m 5m

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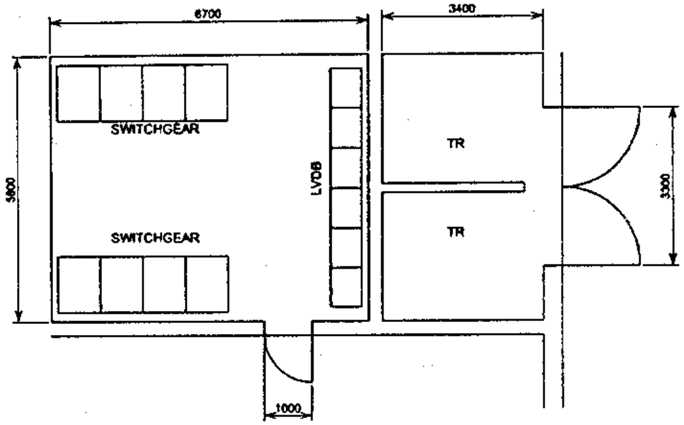
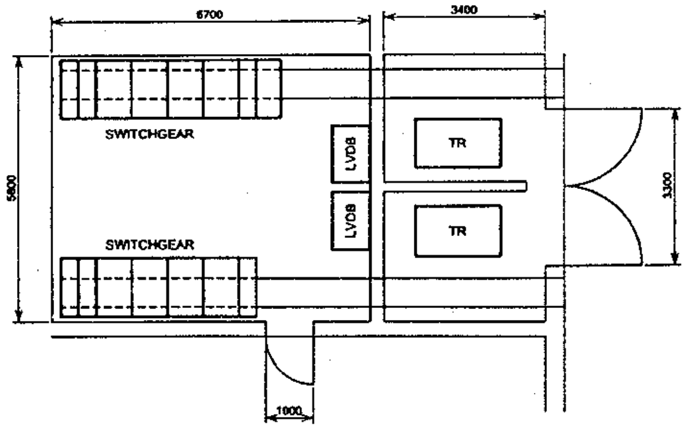
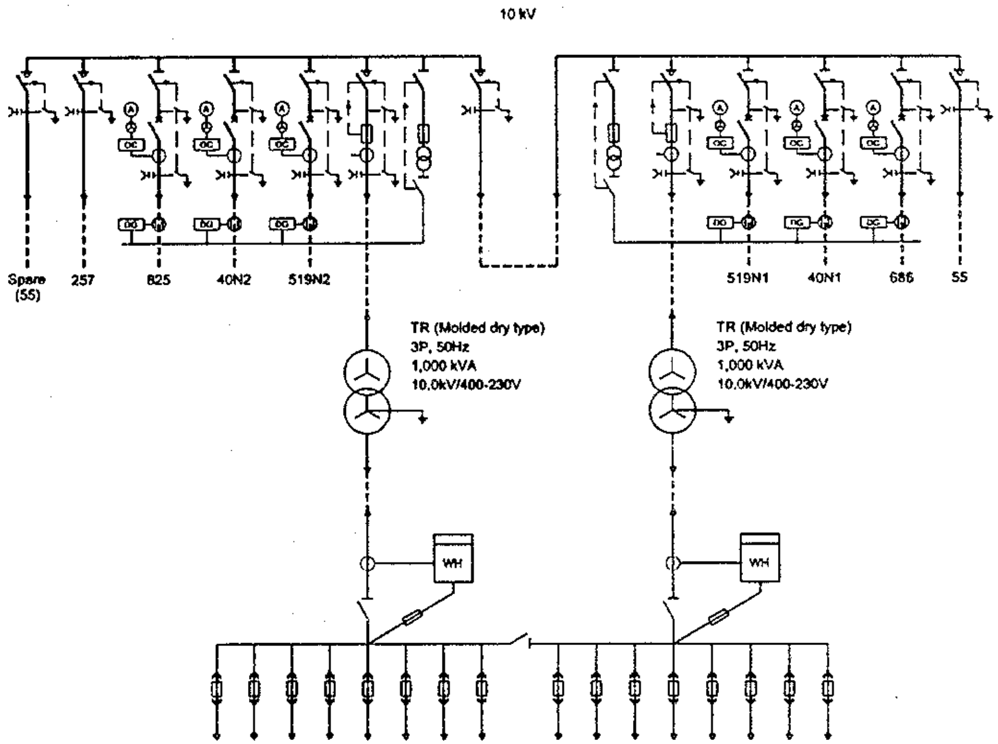
Baku Electric Network ПО "БАКЭЛЕКТРОСЕТЬ" / Japan International Cooperation Agency Японское Агентство Международного Сотрудничества	Title / Название Рисунка Layout and single line diagram of transformer station No. 17
Joint Venture Nippon Koei Co., Ltd. & KRI International Corp. Совместное предприятие НИППОН КОЕИ и KRI Интернешнл Корп.	



LAYOUT (Existing Equipment)



LAYOUT (New Equipment)

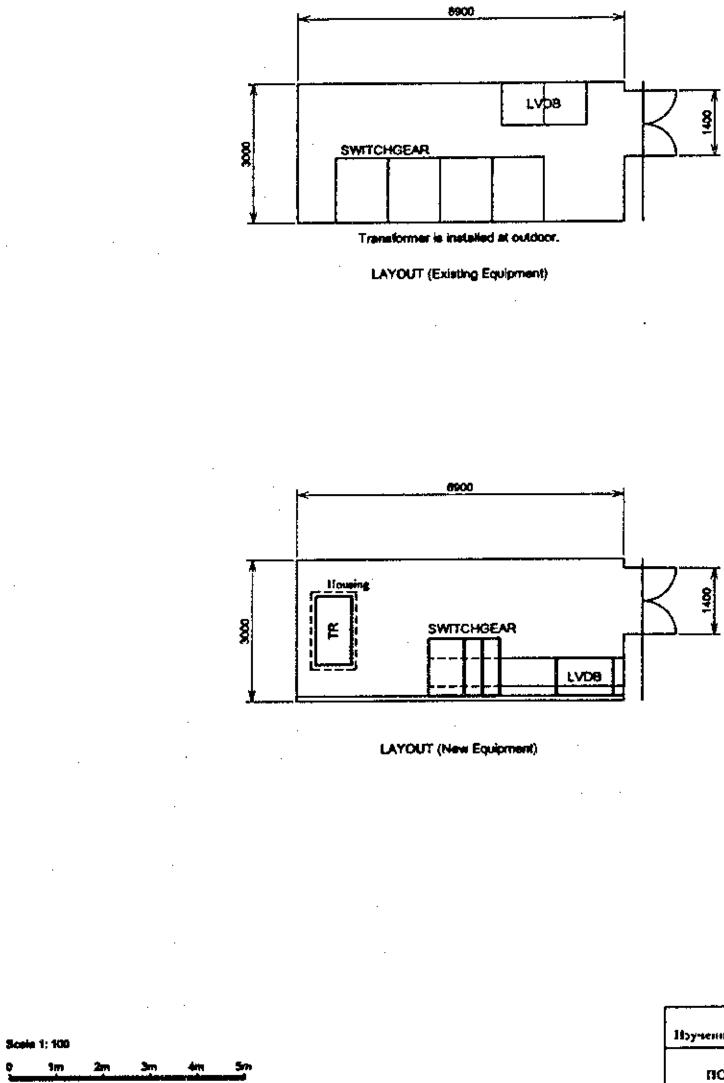


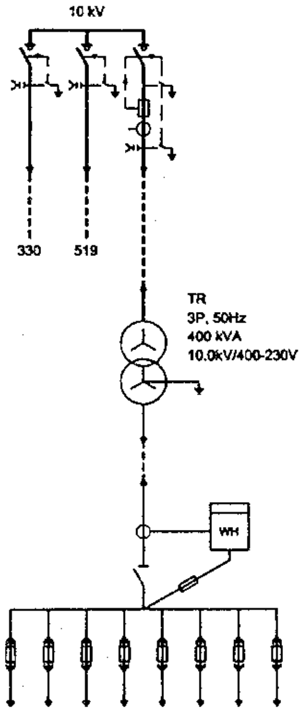
LEGEND			
	Load Break Switch		Voltage Detector
	Disconnecting Switch		Cable Termination
	Circuit Breaker		A.C Ammeter
	Distribution Transformer		Electronic Watt-hour Meter
	Power Fuse		Current Transformer
	Earthing Switch		LV Fuse
	Earthing Voltage Transformer	OC	Over Current Relay
	Zero-phase Current Transformer	DG	Directional Ground Relay

Scale 1: 100

0 1m 2m 3m 4m 5m

Master Plan Study on Rehabilitation and Reconstruction of Electric Supply in Baku Изучение Генерального Плана Восстановления И Реконструкции Электроснабжения Города Баку	Figure / Рисунок No. III.6.3-1(7)
Baku Electric Network ПО "БАКЭЛЕКТРОСЕТЬ" / Japan International Cooperation Agency Японское Агентство Международного Сотрудничества	Title / Название Рисунка Layout and single line diagram of transformer station No. 21
Joint Venture Nippon Koei Co., Ltd. & KRI International Corp. Совместное предприятие НИППОН КОЕИ и KRI Интернешнл Корп.	





LEGEND			
	Load Break Switch		Voltage Detector
	Disconnecting Switch		Cable Termination
	Circuit Breaker		A.C Ammeter
	Distribution Transformer		Electronic Watt-hour Meter
	Power Fuse		Current Transformer
	Earthing Switch		LV Fuse
	Earthing Voltage Transformer	OC	Over Current Relay
	Zero-phase Current Transformer	DG	Directional Ground Relay

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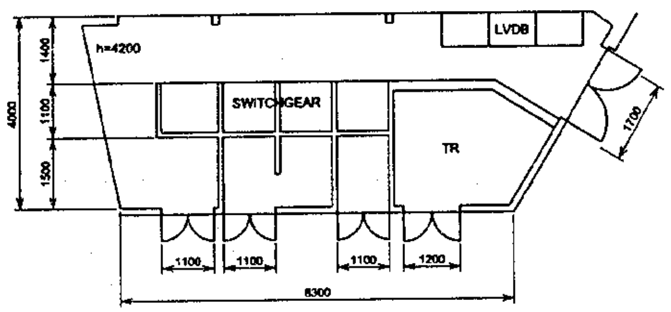
Совместное предприятие НИППОН КОЕИ и KRI Интернешнл Корп.

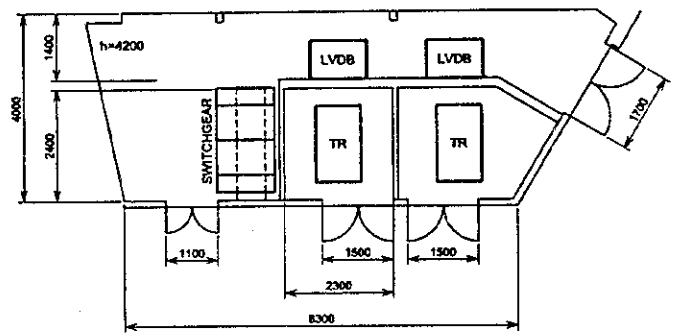
Figure / Рисунок No. III.6.3-1(8)

Title / Название Рисунка

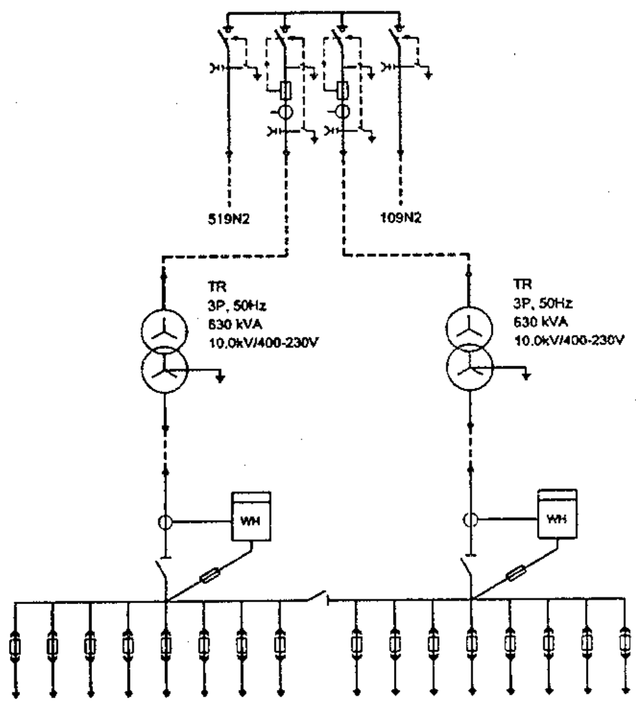
Layout and single line diagram of transformer station No. 22



LAYOUT (Existing Equipment)



LAYOUT (New Equipment)

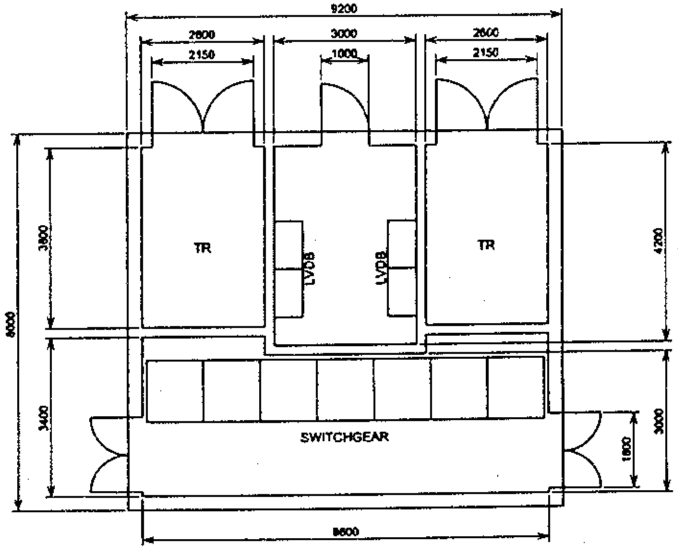


LEGEND			
	Load Break Switch		Voltage Detector
	Disconnecting Switch		Cable Termination
	Circuit Breaker		A.C Ammeter
	Distribution Transformer		Electronic Watt-hour Meter
	Power Fuse		Current Transformer
	Earthing Switch		LV Fuse
	Earthing Voltage Transformer	OC	Over Current Relay
	Zero-phase Current Transformer	DG	Directional Ground Relay

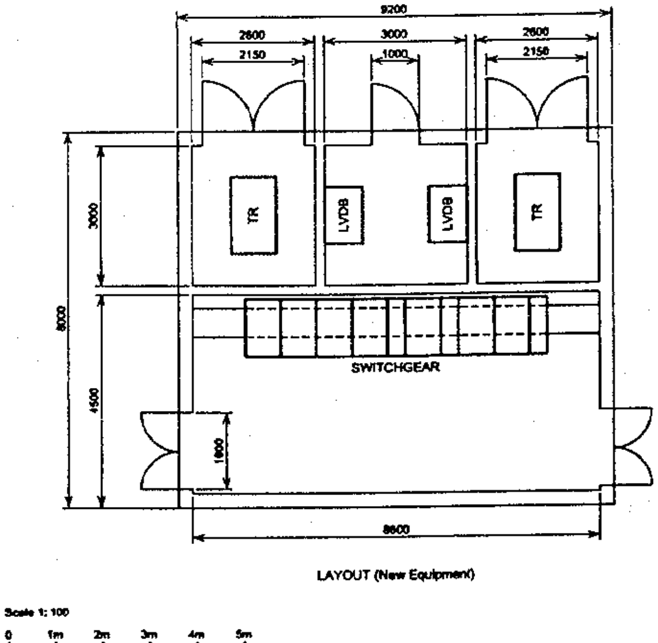
Scale 1: 100

0 1m 2m 3m 4m 5m

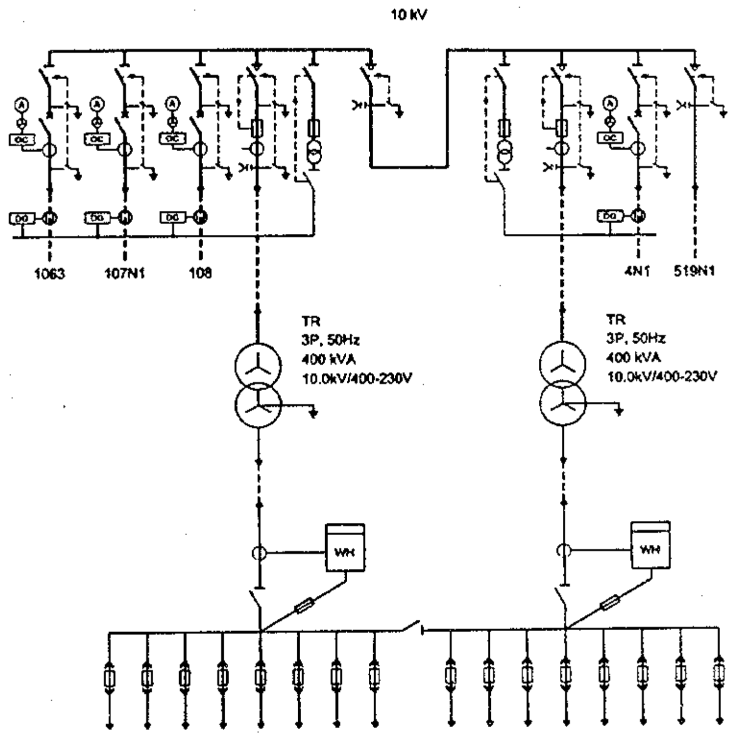
Master Plan Study on Rehabilitation and Reconstruction of Electric Supply in Baku Изучение Генерального Плана Восстановления И Реконструкции Электроснабжения Города Баку	Figure / Рисунок No. III.6.3-1(9)
Baku Electric Network ПО "БАКЭЛЕКТРОСЕТЬ" / Japan International Cooperation Agency Японское Агентство Международного Сотрудничества	Title / Название Рисунка Layout and single line diagram of transformer station No. 108
Joint Venture Nippon Koei Co., Ltd. & KRI International Corp. Совместное предприятие НИППОН КОЕИ и KRI Интернешнл Корп.	



LAYOUT (Existing Equipment)



LAYOUT (New Equipment)



LEGEND			
	Load Break Switch		Voltage Detector
	Disconnecting Switch		Cable Termination
	Circuit Breaker		Electronic Watt-hour Meter
	Distribution Transformer		Current Transformer
	Power Fuse		LV Fuse
	Earthing Switch	OC	Over Current Relay
	Earthing Voltage Transformer	DG	Directional Ground Relay
	Zero-phase Current Transformer		

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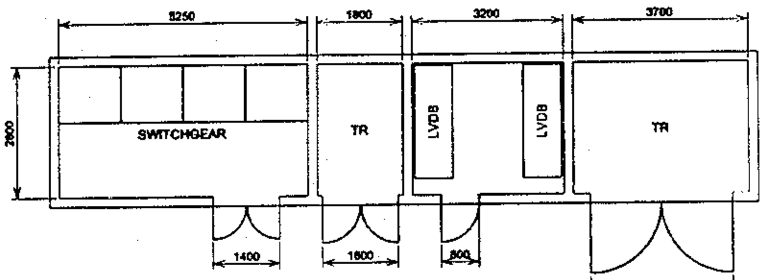
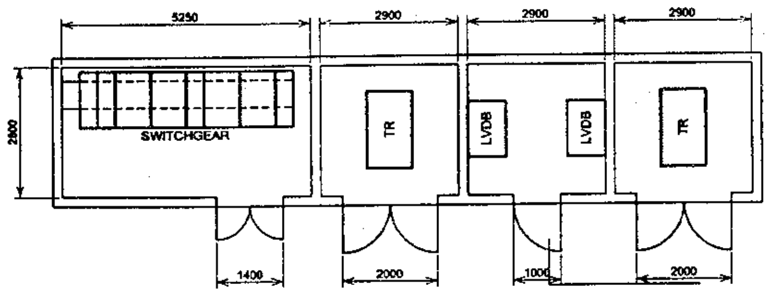
Figure / Рисунок No. III.6.3-1(10)

Title / Название Рисунка

Layout and single line diagram of transformer station No. 109



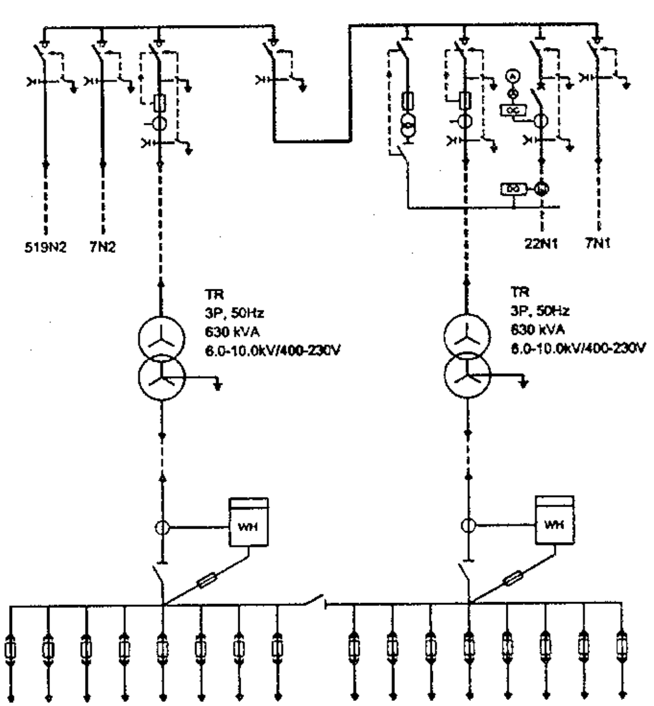
LAYOUT (Existing Equipment)



LAYOUT (New Equipment)

Scale 1: 100

0 1m 2m 3m 4m 5m



LEGEND			
	Load Break Switch		Voltage Detector
	Disconnecting Switch		Cable Termination
	Circuit Breaker		A.C Ammeter
	Distribution Transformer		Electronic Watt-hour Meter
	Power Fuse		Current Transformer
	Earthing Switch		LV Fuse
	Earthing Voltage Transformer	OC	Over Current Relay
	Zero-phase Current Transformer	DG	Directional Ground Relay

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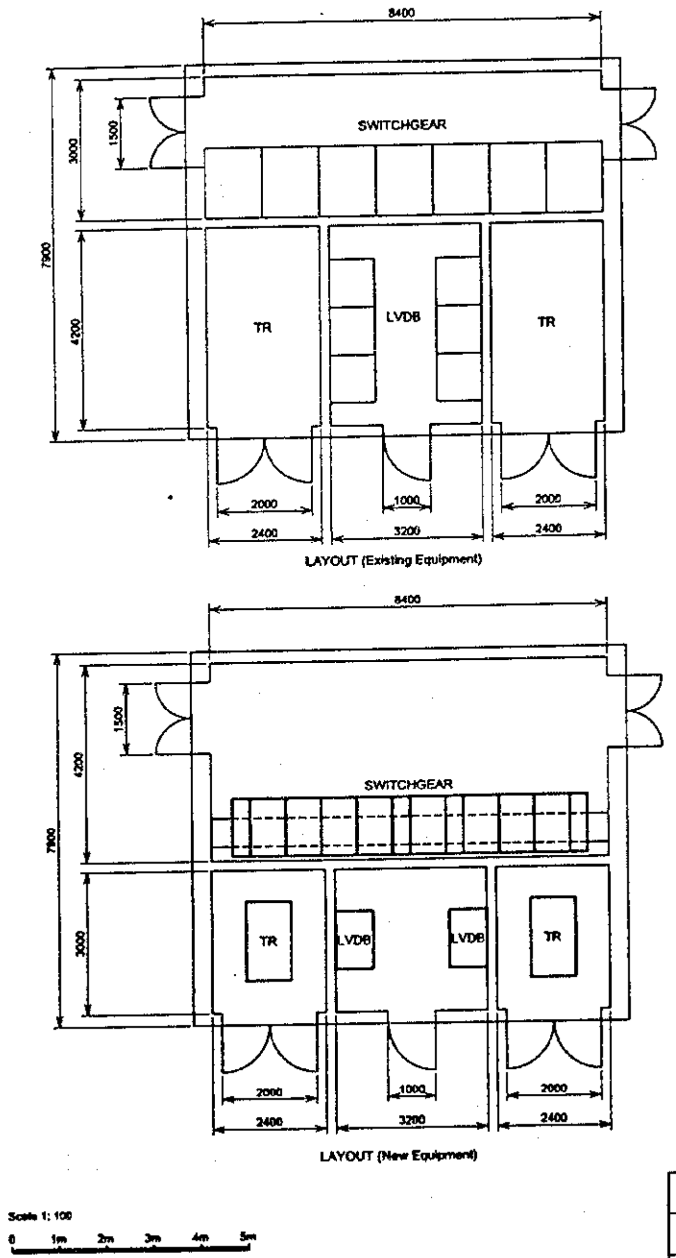
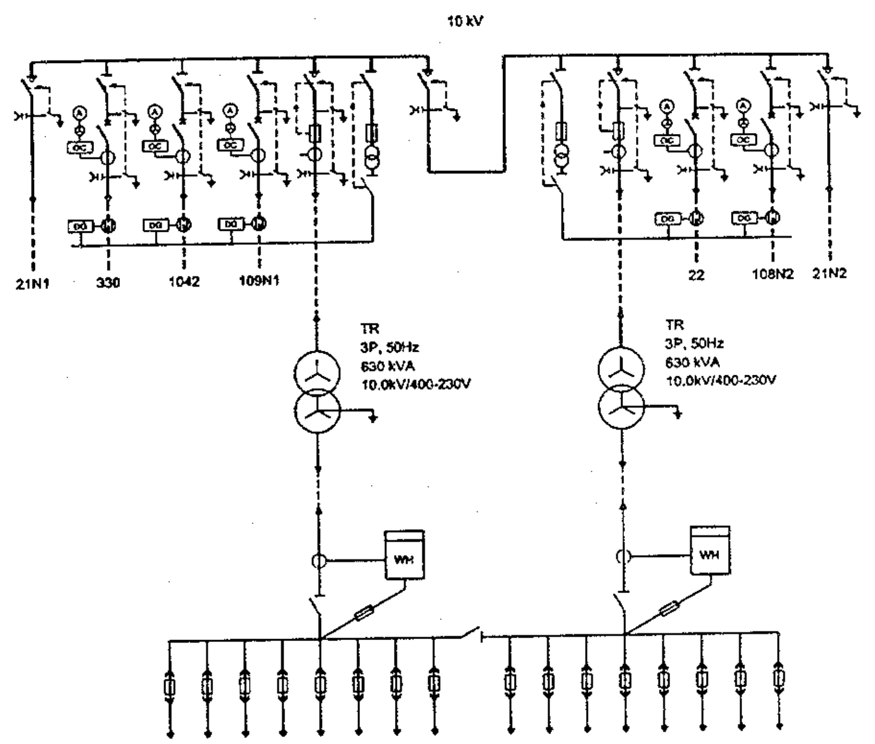
Figure / Рисунок No. III.6.3-1(11)

Title / Название Рисунка

Layout and single line diagram of transformer station No. 330





LEGEND			
	Load Break Switch		Voltage Detector
	Disconnecting Switch		Cable Termination
	Circuit Breaker		A.C Ammeter
	Distribution Transformer		Electronic Watt-hour Meter
	Power Fuse		Current Transformer
	Earthing Switch		LV Fuse
	Earthing Voltage Transformer	OC	Over Current Relay
	Zero-phase Current Transformer	DG	Directional Ground Relay

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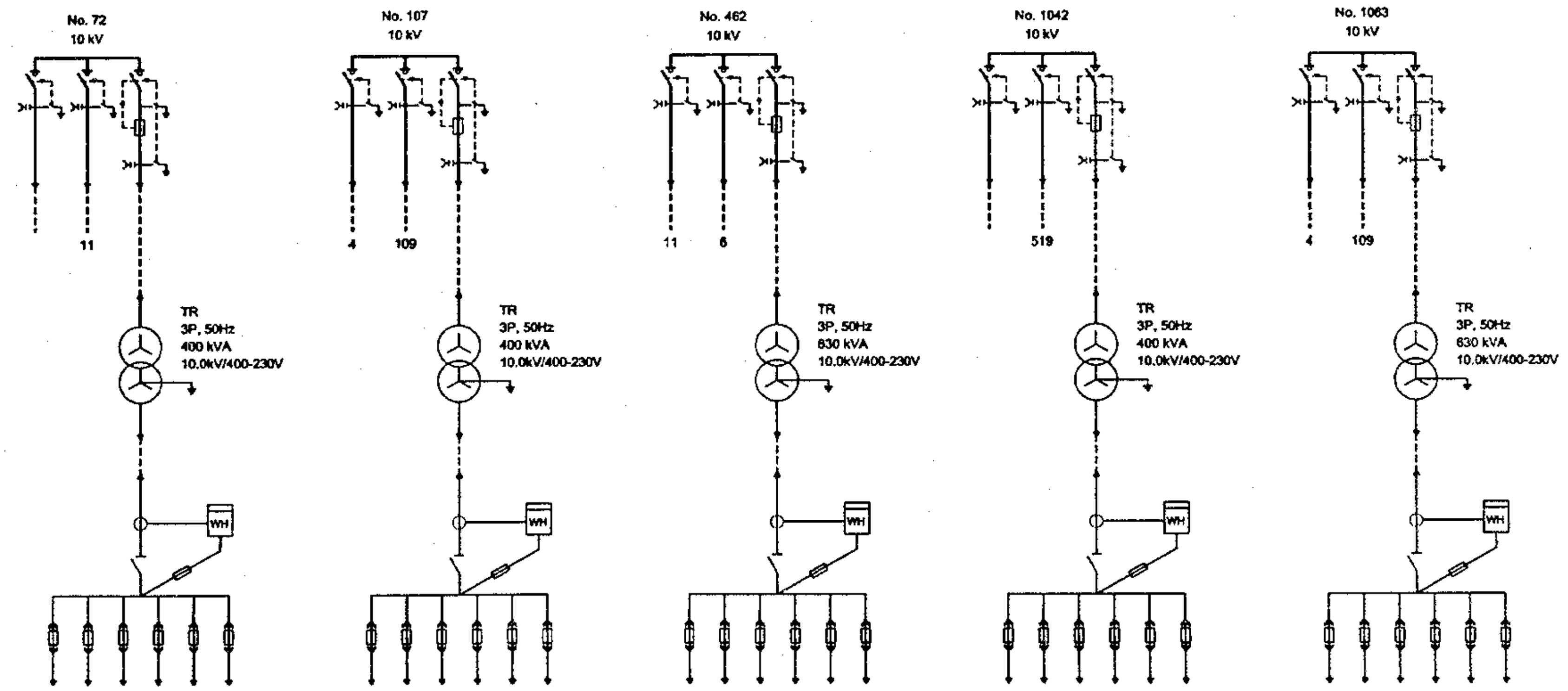
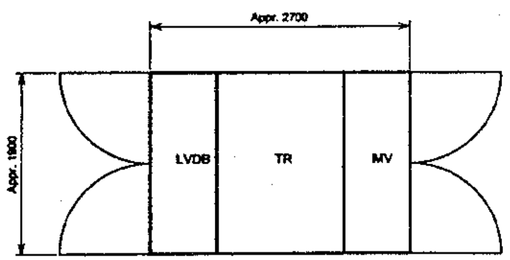
Baku Electric Network ПО "БАКЭЛЕКТРОСЕТЬ" / Japan International Cooperation Agency Японское Агентство Международного Сотрудничества	Title / Название Рисунка Layout and single line diagram of transformer station No. 519
Joint Venture Nippon Koei Co., Ltd. & KRI International Corp. Совместное предприятие НИППОН КОЕИ и KRI Интернешнл Корп.	





LAYOUT

LEGEND	
Load Break Switch	Voltage Detector
Disconnecting Switch	Cable Termination
Circuit Breaker	A.C Ammeter
Distribution Transformer	Electronic Watt-hour Meter
Power Fuse	Current Transformer
Earthing Switch	LV Fuse
Earthing Voltage Transformer	OC Over Current Relay
Zero-phase Current Transformer	DG Directional Ground Relay

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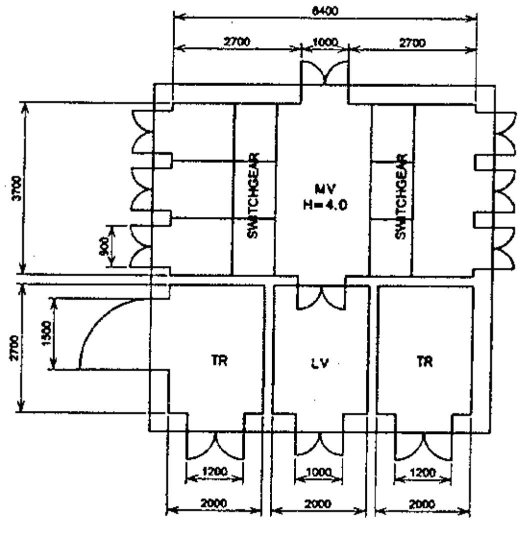
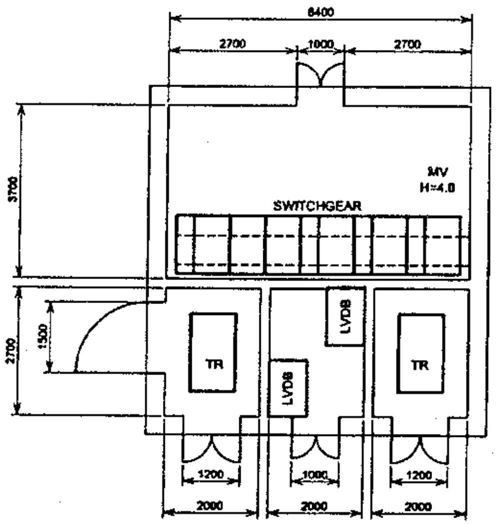
Figure / Рисунок No. III.6.3-1(13)

Title / Название Рисунка

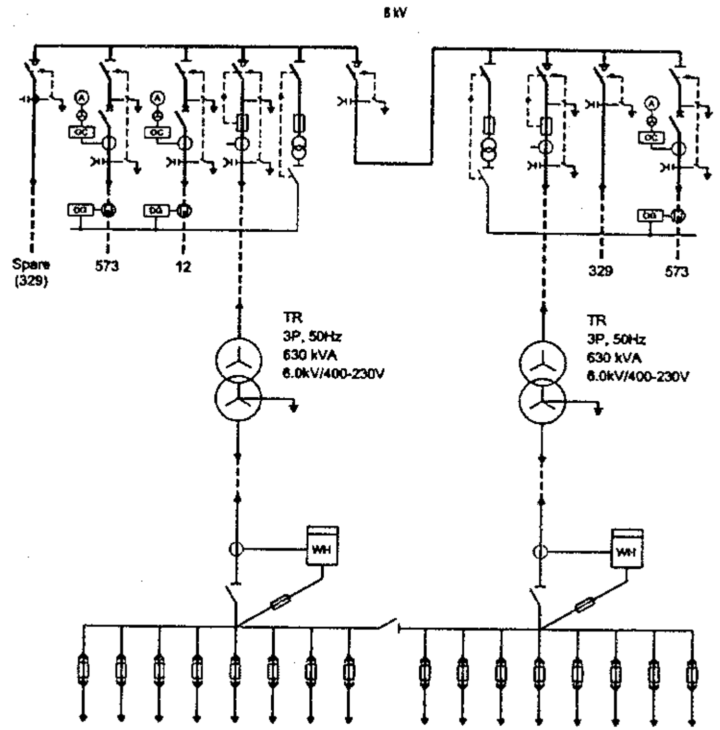
Layout and single line diagram of transformer station No. 72, 107, 462, 1042 and 1063



LAYOUT (Existing Equipment)



PLAN (New Equipment)



LEGEND			
	Load Break Switch		Voltage Detector
	Disconnecting Switch		Cable Termination
	Circuit Breaker		A.C Ammeter
	Distribution Transformer		Electronic Watt-hour Meter
	Power Fuse		Current Transformer
	Earthing Switch		LV Fuse
	Earthing Voltage Transformer	OC	Over Current Relay
	Zero-phase Current Transformer	DG	Directional Ground Relay

Scale 1: 100

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Baku Electric Network
ПО "БАКЭЛЕКТРОСЕТЬ"

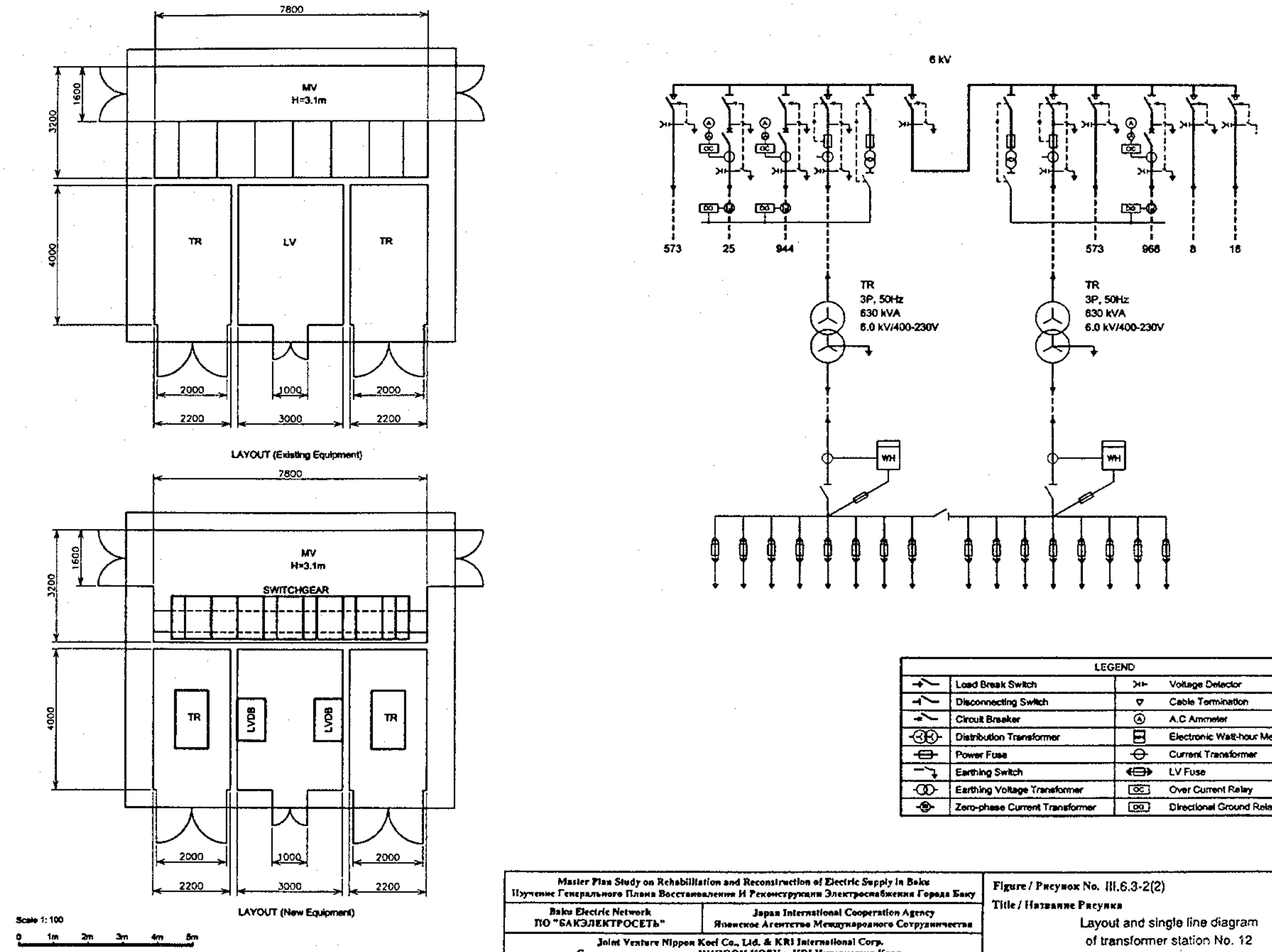
Japan International Cooperation Agency
Японское Агентство Международного Сотрудничества

Joint Venture Nippon Koei Co., Ltd. & KRI International Corp.
Совместное предприятие НИППОН КОЕИ и KRI Интернешнл Корп.

Figure / Рисунок No. III.6.3-2(1)

Title / Название Рисунка

Layout and single line diagram of transformer station No. 8



LEGEND			
	Load Break Switch		Voltage Detector
	Disconnecting Switch		Cable Termination
	Circuit Breaker		A.C Ammeter
	Distribution Transformer		Electronic Watt-hour Meter
	Power Fuse		Current Transformer
	Earthing Switch		LV Fuse
	Earthing Voltage Transformer	OC	Over Current Relay
	Zero-phase Current Transformer	DG	Directional Ground Relay

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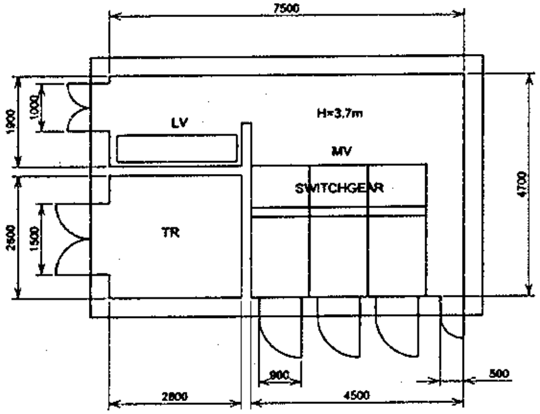
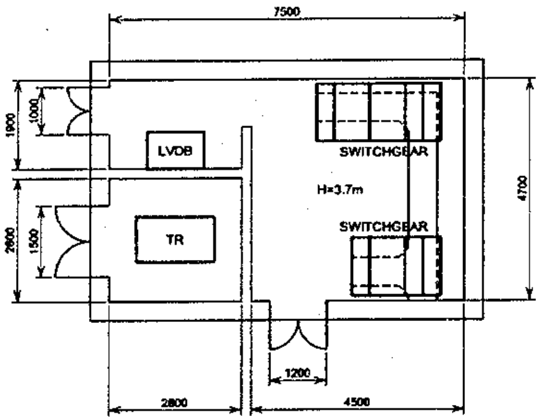
Figure / Рисунок No. III.6.3-2(2)

Title / Название Рисунка

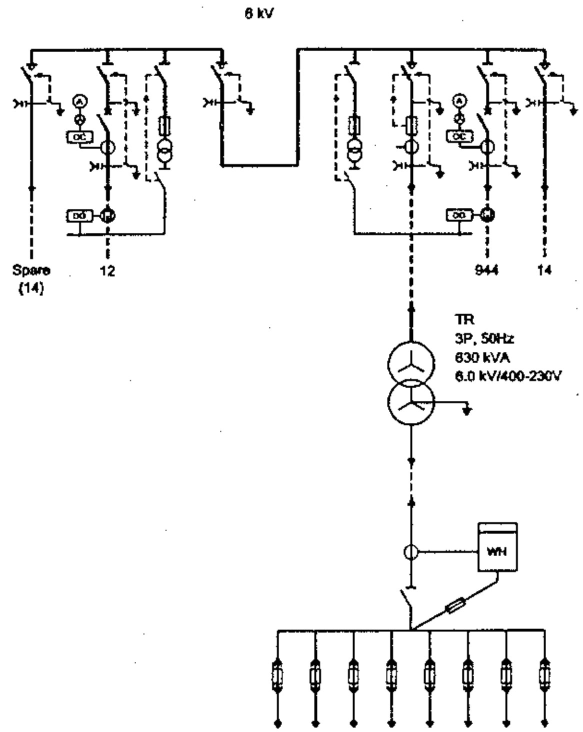
Layout and single line diagram of transformer station No. 12



LAYOUT (Existing Equipment)



LAYOUT (New Equipment)



LEGEND			
	Load Break Switch		Voltage Detector
	Disconnecting Switch		Cable Termination
	Circuit Breaker		A.C Ammeter
	Distribution Transformer		Electronic Watt-hour Meter
	Power Fuse		Current Transformer
	Earthing Switch		LV Fuse
	Earthing Voltage Transformer	OC	Over Current Relay
	Zero-phase Current Transformer	DG	Directional Ground Relay

Scale 1: 100
0 1m 2m 3m 4m 5m

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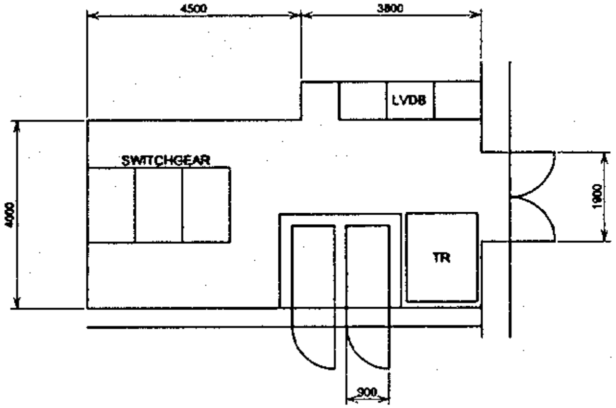
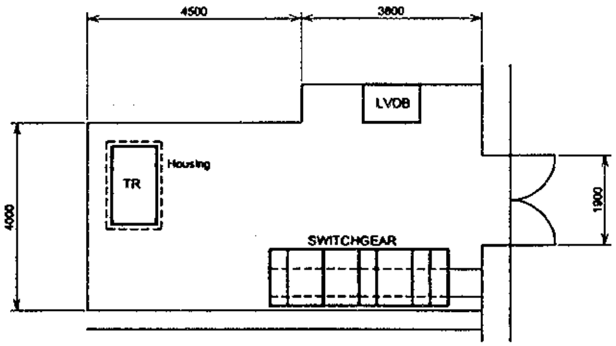
Figure / Рисунок No. III.6.3-2(3)

Title / Название Рисунка

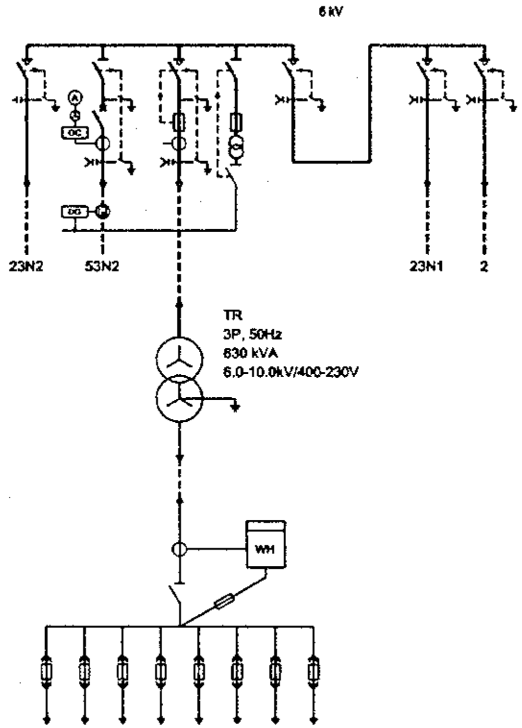
Layout and single line diagram
of transformer station No. 16



LAYOUT (Existing Equipment)



LAYOUT (New Equipment)



LEGEND			
	Load Break Switch		Voltage Detector
	Disconnecting Switch		Cable Termination
	Circuit Breaker		A.C Ammeter
	Distribution Transformer		Electronic Watt-hour Meter
	Power Fuse		Current Transformer
	Earthing Switch		LV Fuse
	Earthing Voltage Transformer	OC	Over Current Relay
	Zero-phase Current Transformer	DG	Directional Ground Relay

Scale 1: 100

0 1m 2m 3m 4m 5m

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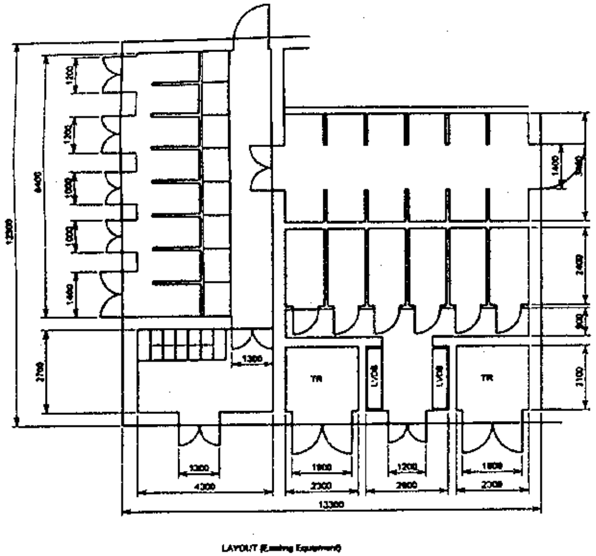
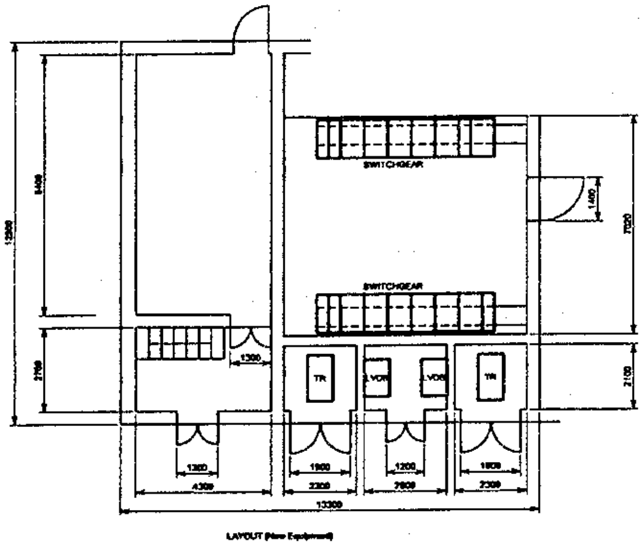
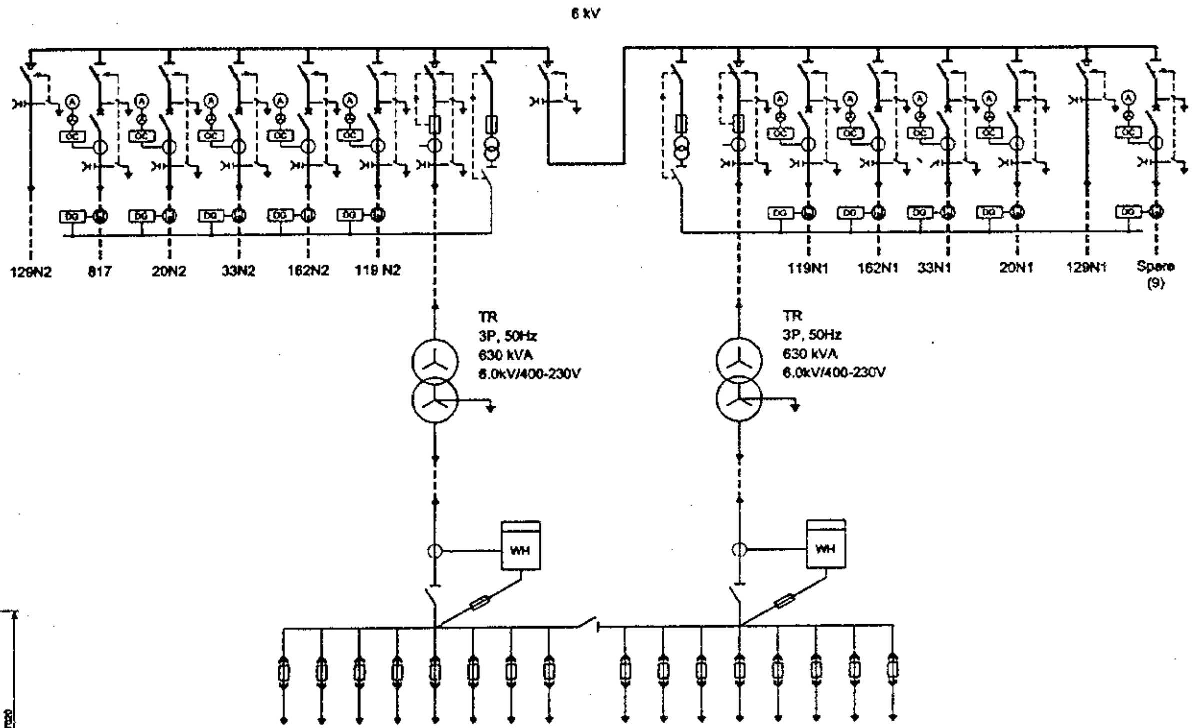
Figure / Рисунок No. III.6.3-2(4)

Title / Название Рисунка

Layout and single line diagram
of transformer station No. 20







LEGEND			
	Load Break Switch		Voltage Detector
	Disconnecting Switch		Cable Termination
	Circuit Breaker		A.C Ammeter
	Distribution Transformer		Electronic Watt-hour Meter
	Power Fuse		Current Transformer
	Earthing Switch		LV Fuse
	Earthing Voltage Transformer	OC	Over Current Relay
	Zero-phase Current Transformer	DG	Directional Ground Relay

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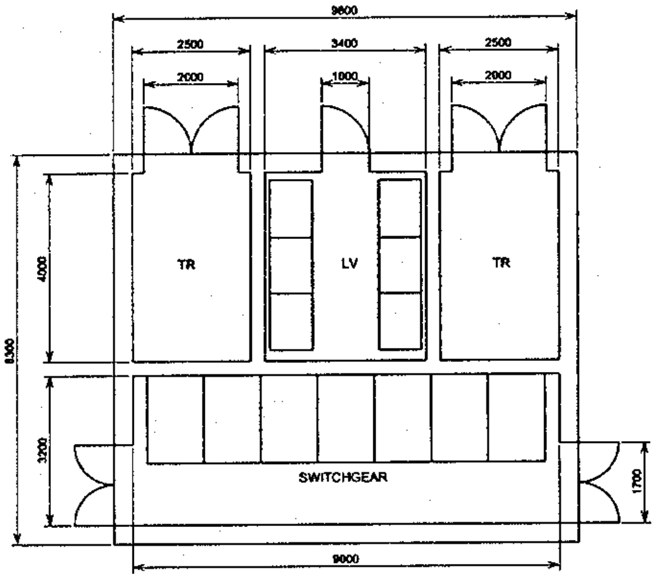
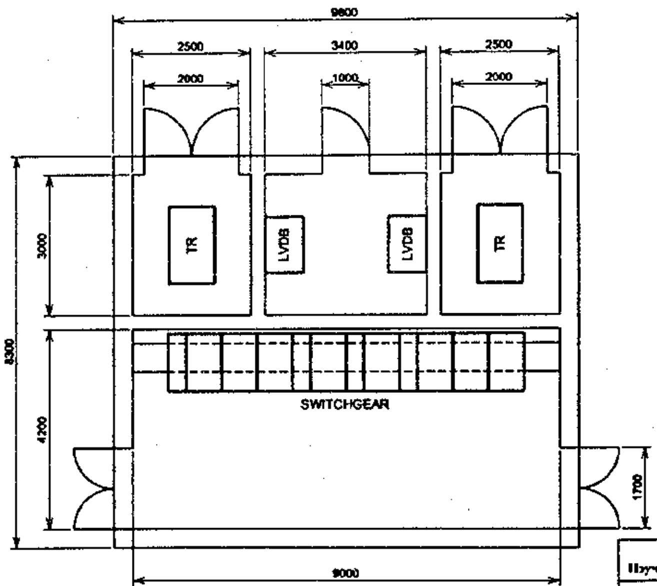
Figure / Рисунок No. III.6.3-2(5)

Title / Название Рисунка

Layout and single line diagram
of transformer station No. 23

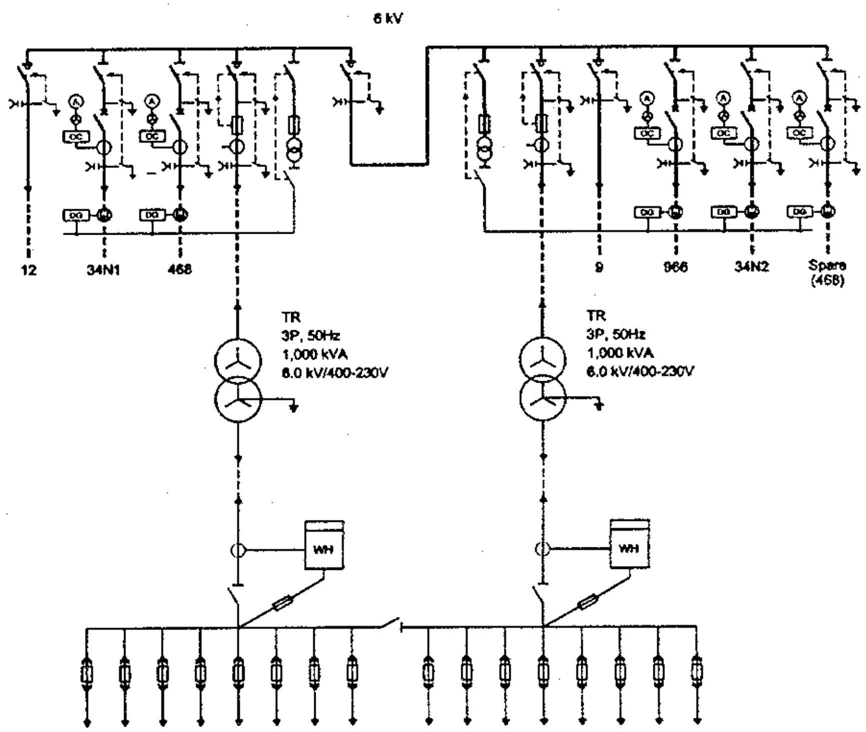


LAYOUT (Existing Equipment)



Scale 1: 100
0 1m 2m 3m 4m 5m

LAYOUT (New Equipment)



LEGEND			
(symbol)	Load Break Switch	›|‹	Voltage Detector
(symbol)	Disconnecting Switch	▽	Cable Termination
(symbol)	Circuit Breaker	Ⓐ	A.C Ammeter
(symbol)	Distribution Transformer	(symbol)	Electronic Watt-hour Meter
(symbol)	Power Fuse	(symbol)	Current Transformer
(symbol)	Earthing Switch	(symbol)	LV Fuse
(symbol)	Earthing Voltage Transformer	OC	Over Current Relay
(symbol)	Zero-phase Current Transformer	DG	Directional Ground Relay

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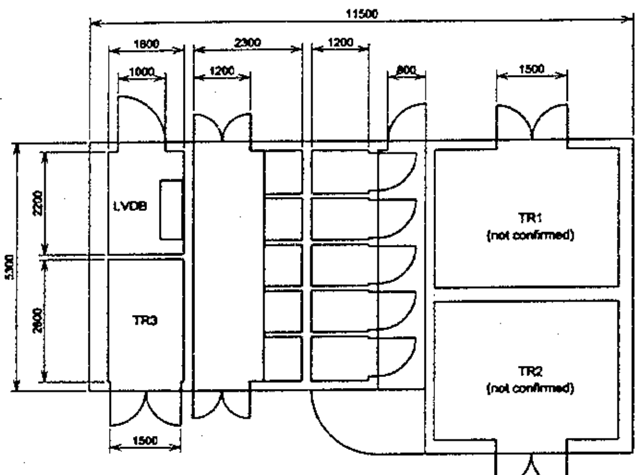
Joint Venture Nippon Koei Co., Ltd. & KRI International Corp.
Совместное предприятие НИППОН КОЕЙ и KRI Интернешнл Корп.

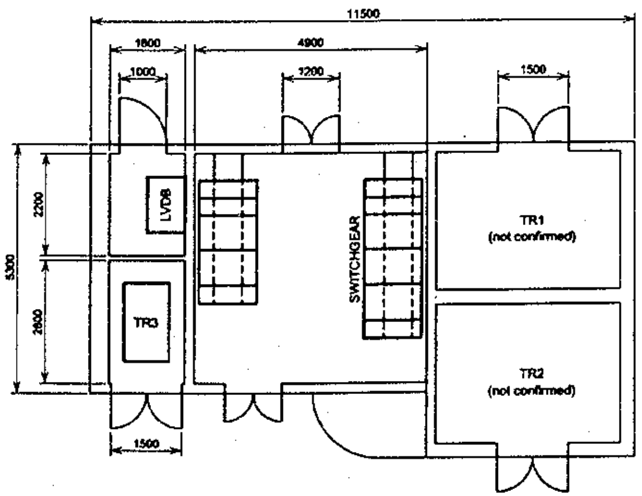
Figure / Рисунок No. III.6.3-2(6)

Title / Название Рисунка

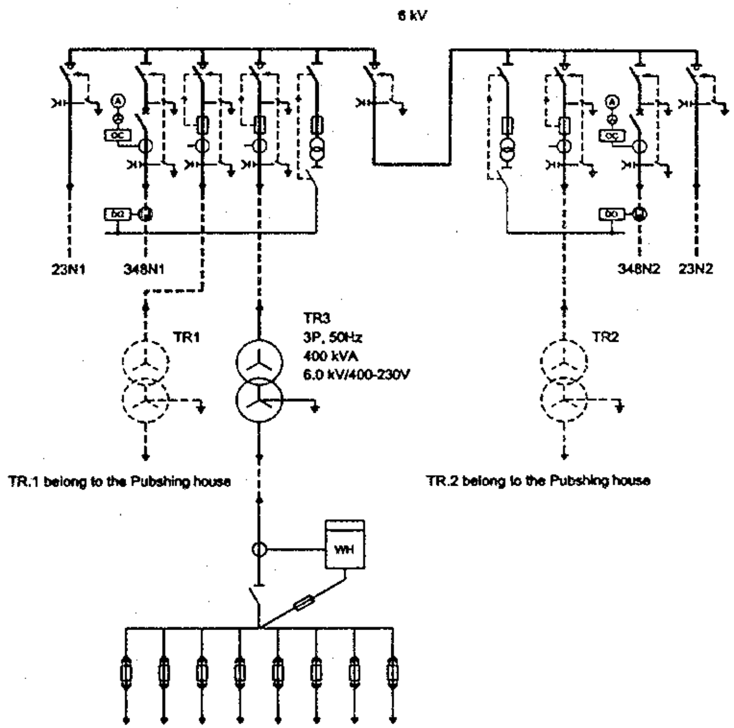
Layout and single line diagram
of transformer station No. 25



LAYOUT (Existing Equipment)



LAYOUT (New Equipment)

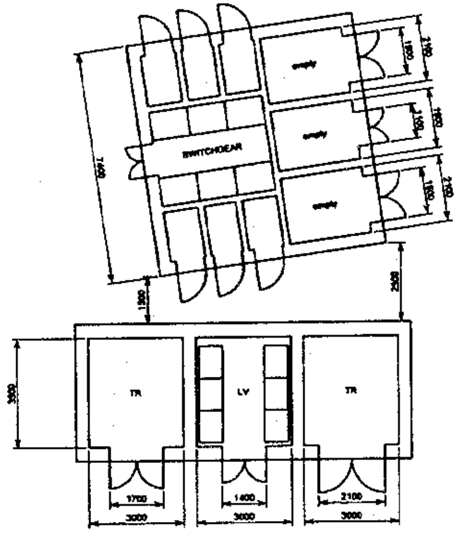


LEGEND			
	Load Break Switch		Voltage Detector
	Disconnecting Switch		Cable Termination
	Circuit Breaker		A.C Ammeter
	Distribution Transformer		Electronic Watt-hour Meter
	Power Fuse		Current Transformer
	Earthing Switch		LV Fuse
	Earthing Voltage Transformer	OC	Over Current Relay
	Zero-phase Current Transformer	DG	Directional Ground Relay

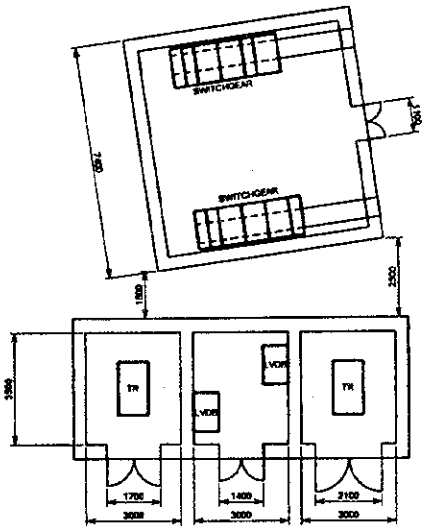
Scale 1: 100

0 1m 2m 3m 4m 5m

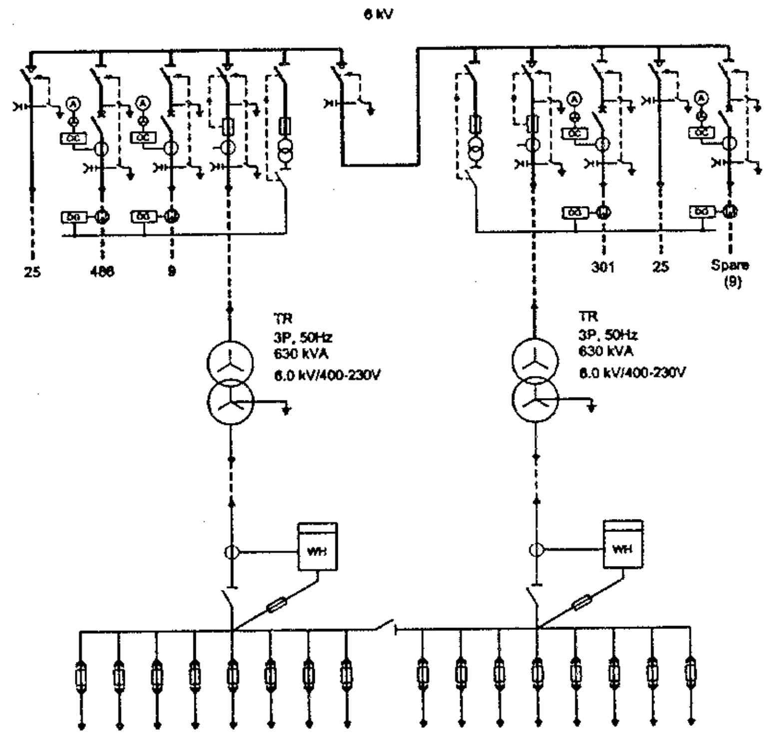
Master Plan Study on Rehabilitation and Reconstruction of Electric Supply in Baku Изучение Генерального Плана Восстановления И Реконструкции Электроснабжения Города Баку		Figure / Рисунок No. III.6.3-2(7)
Baku Electric Network ПО "БАКЭЛЕКТРОСЕТЬ"	Japan International Cooperation Agency Японское Агентство Международного Сотрудничества	Title / Название Рисунка Layout and single line diagram of transformer station No. 33
Joint Venture Nippon Koei Co., Ltd. & KRI International Corp. Совместное предприятие НИППОН КОЕЙ и KRI Интернешнл Корп.		



LAYOUT (Existing Equipment)



LAYOUT (New Equipment)



LEGEND			
	Load Break Switch		Voltage Detector
	Disconnecting Switch		Cable Termination
	Circuit Breaker		A.C Ammeter
	Distribution Transformer		Electronic Watt-hour Meter
	Power Fuse		Current Transformer
	Earthing Switch		LV Fuse
	Earthing Voltage Transformer	OC	Over Current Relay
	Zero-phase Current Transformer	DG	Directional Ground Relay

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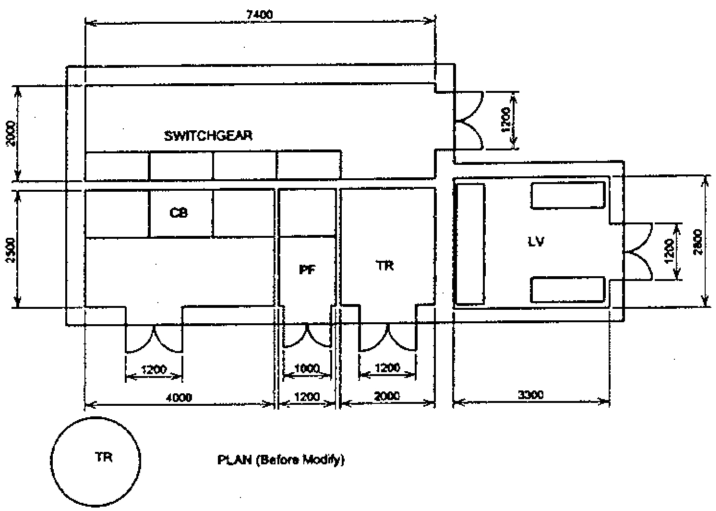
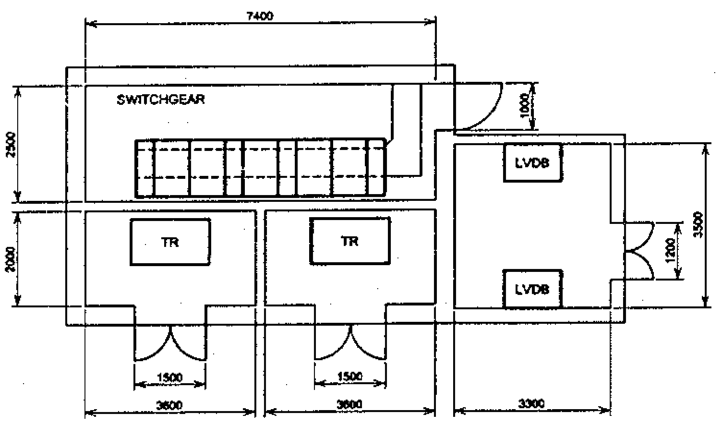
Figure / Рисунок No. III.6.3-2(8)

Title / Название Рисунка

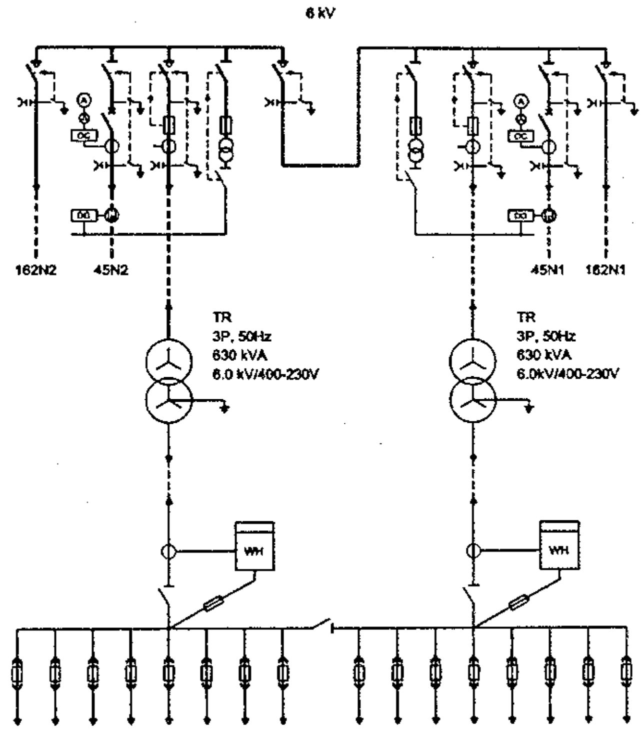
Layout and single line diagram of transformer station No. 34



PLAN (Before Modify)



PLAN (After Modified)



LEGEND			
	Load Break Switch		Voltage Detector
	Disconnecting Switch		Cable Termination
	Circuit Breaker		A.C Ammeter
	Distribution Transformer		Electronic Watt-hour Meter
	Power Fuse		Current Transformer
	Earthing Switch		LV Fuse
	Earthing Voltage Transformer	OC	Over Current Relay
	Zero-phase Current Transformer	DG	Directional Ground Relay

Scale 1: 100

0 1m 2m 3m 4m 5m

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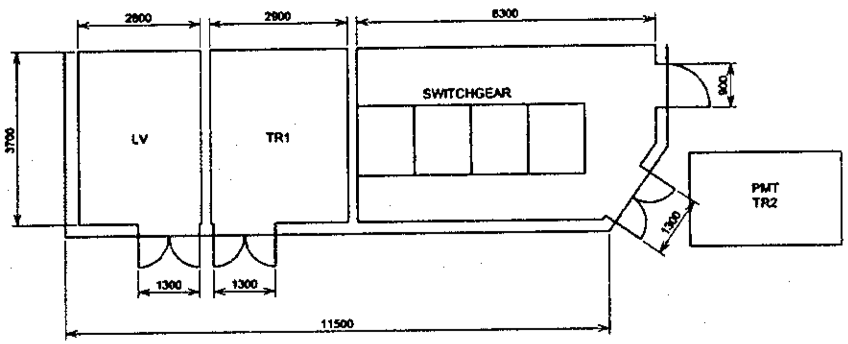
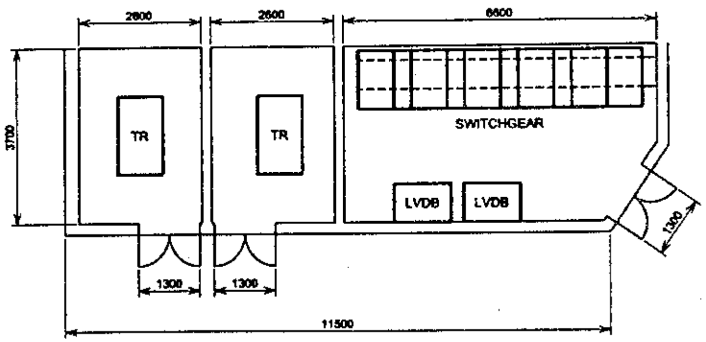
Figure / Рисунок No. III.6.3-2(9)

Title / Название Рисунка

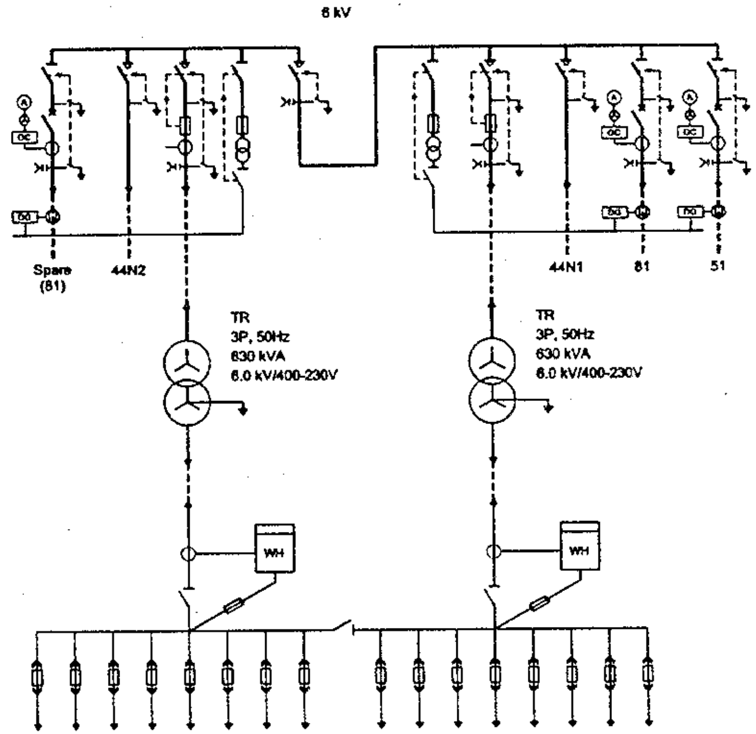
Layout and single line diagram
of transformer station No. 44



LAYOUT (Existing Equipment)



LAYOUT (New Equipment)



LEGEND			
	Load Break Switch		Voltage Detector
	Disconnecting Switch		Cable Termination
	Circuit Breaker		A.C Ammeter
	Distribution Transformer		Electronic Watt-hour Meter
	Power Fuse		Current Transformer
	Earthing Switch		LV Fuse
	Earthing Voltage Transformer	OC	Over Current Relay
	Zero-phase Current Transformer	DG	Directional Ground Relay

Scale 1: 100

0 1m 2m 3m 4m 5m

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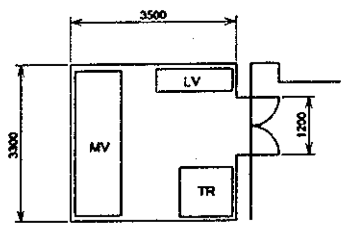
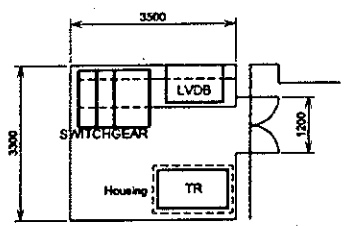
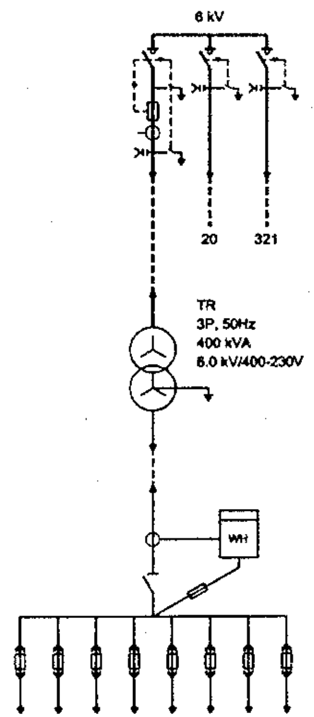
Baku Electric Network ПО "БАКЭЛЕКТРОСЕТЬ"	Japan International Cooperation Agency Японское Агентство Международного Сотрудничества	Title / Название Рисунка Layout and single line diagram of transformer station No. 45
Joint Venture Nippon Koei Co., Ltd. & KRI International Corp. Совместное предприятие НИППОН КОЕИ и KRI Интернешнл Корп.		



PLAN (Before Modify)



PLAN (After Modified)



LEGEND			
	Load Break Switch		Voltage Detector
	Disconnecting Switch		Cable Termination
	Circuit Breaker		A.C Ammeter
	Distribution Transformer		Electronic Watt-hour Meter
	Power Fuse		Current Transformer
	Earthing Switch		LV Fuse
	Earthing Voltage Transformer	OC	Over Current Relay
	Zero-phase Current Transformer	DG	Directional Ground Relay

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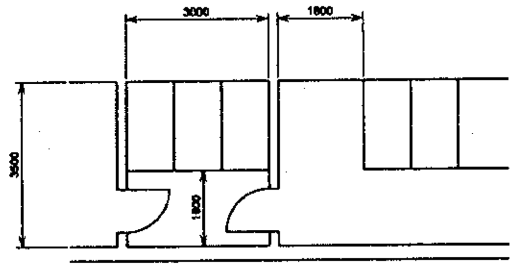
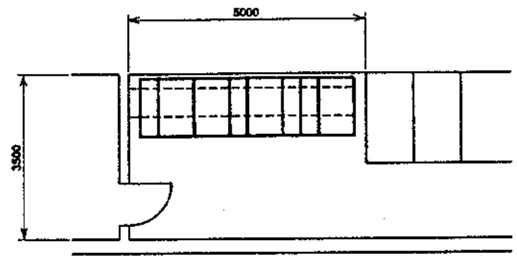
Figure / Рисунок No. III.6.3-2(11)

Title / Название Рисунка

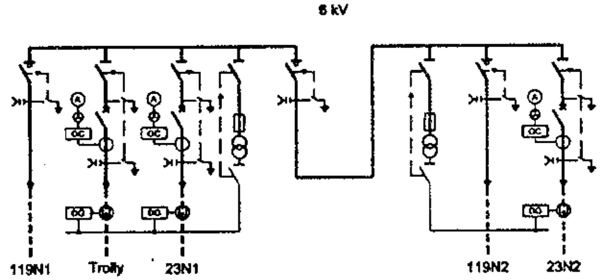
Layout and single line diagram
of transformer station No. 53



LAYOUT (Existing Equipment)



LAYOUT (New Equipment)



LEGEND			
	Load Break Switch		Voltage Detector
	Disconnecting Switch		Cable Termination
	Circuit Breaker		A.C Ammeter
	Distribution Transformer		Electronic Watt-hour Meter
	Power Fuse		Current Transformer
	Earthing Switch		LV Fuse
	Earthing Voltage Transformer	OC	Over Current Relay
	Zero-phase Current Transformer	DG	Directional Ground Relay

Scale 1: 100

0 1m 2m 3m 4m 5m

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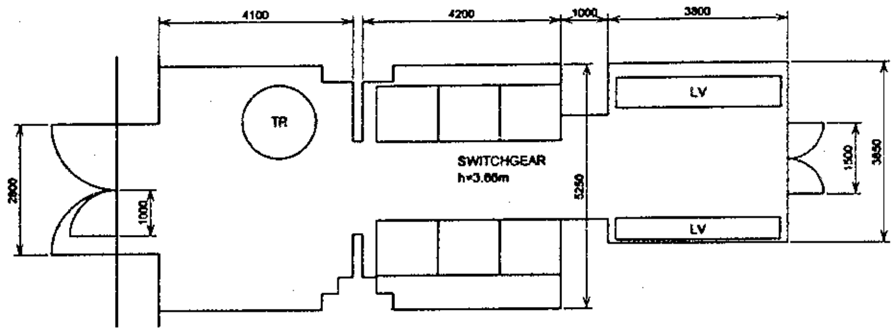
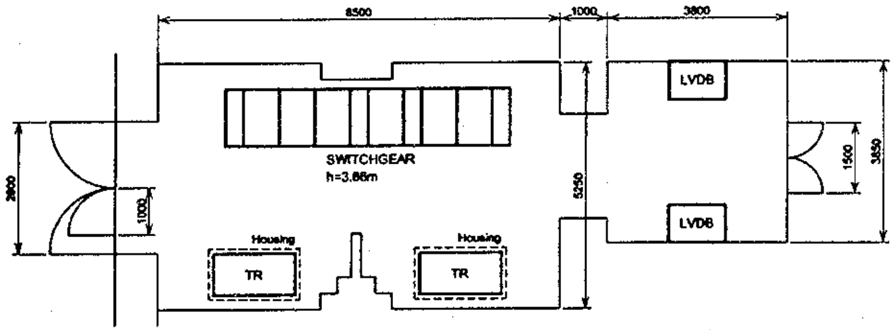
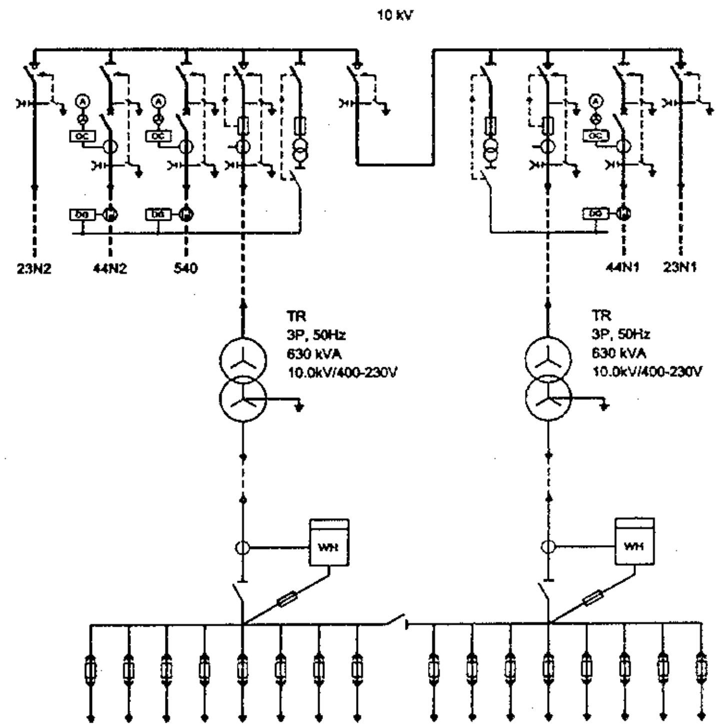
Baku Electric Network ПО "БАКЭЛЕКТРОСЕТЬ" / Japan International Cooperation Agency Японское Агентство Международного Сотрудничества	Title / Название Рисунка Layout and single line diagram of transformer station No. 129
Joint Venture Nippon Koei Co., Ltd. & KRI International Corp. Совместное предприятие НИППОН КОЕИ и KRI Интернешнл Корп.	



LAYOUT (Existing Equipment)



LAYOUT (New Equipment)



LEGEND			
	Load Break Switch		Voltage Detector
	Disconnecting Switch		Cable Termination
	Circuit Breaker		A.C Ammeter
	Distribution Transformer		Electronic Watt-hour Meter
	Power Fuse		Current Transformer
	Earthing Switch		LV Fuse
	Earthing Voltage Transformer	OC	Over Current Relay
	Zero-phase Current Transformer	DG	Directional Ground Relay

Scale 1: 100

0 1m 2m 3m 4m 5m

Master Plan Study on Rehabilitation and Reconstruction of Electric Supply in Baku
Изучение Генерального Плана Восстановления И Реконструкции Электроснабжения Города Баку

Baku Electric Network
ПО "БАКЭЛЕКТРОСЕТЬ"

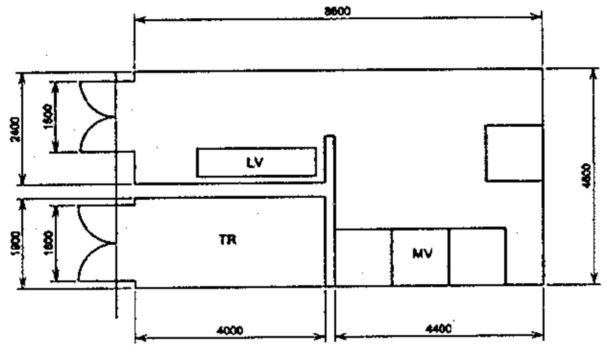
Japan International Cooperation Agency
Японское Агентство Международного Сотрудничества

Joint Venture Nippon Koei Co., Ltd. & KRI International Corp.
Совместное предприятие НИППОН КОЕЙ и KRI Интернешнл Корп.

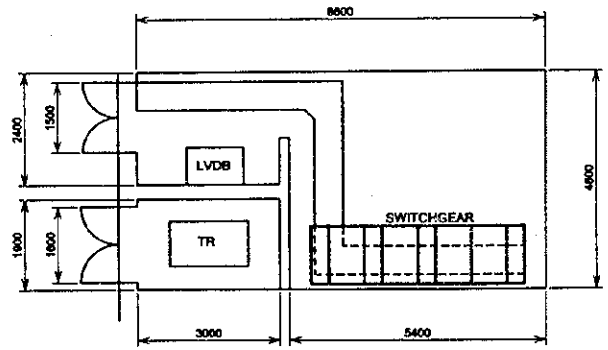
Figure / Рисунок No. III.6.3-2(13)

Title / Название Рисунка

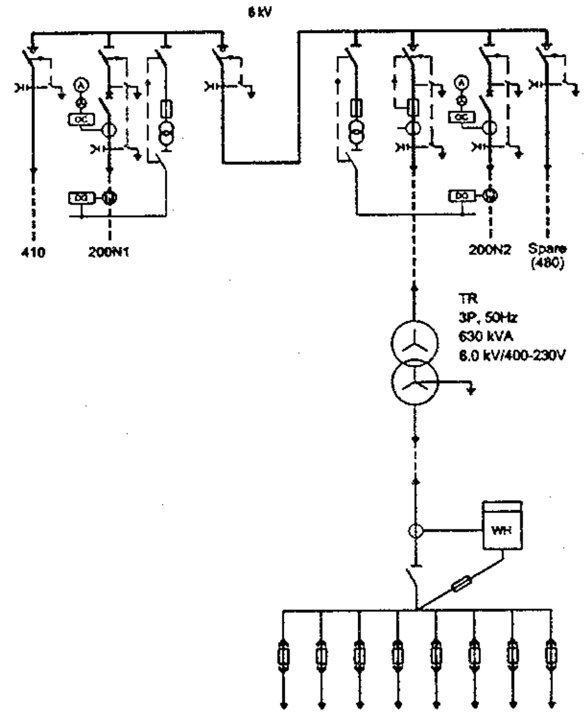
Layout and single line diagram of transformer station No. 162



LAYOUT (Existing Equipment)



LAYOUT (New Equipment)



LEGEND			
	Load Break Switch		Voltage Detector
	Disconnecting Switch		Cable Termination
	Circuit Breaker		A.C Ammeter
	Distribution Transformer		Electronic Watt-hour Meter
	Power Fuse		Current Transformer
	Earthing Switch		LV Fuse
	Earthing Voltage Transformer	OC	Over Current Relay
	Zero-phase Current Transformer	DG	Directional Ground Relay

Scale 1: 100

0 1m 2m 3m 4m 5m

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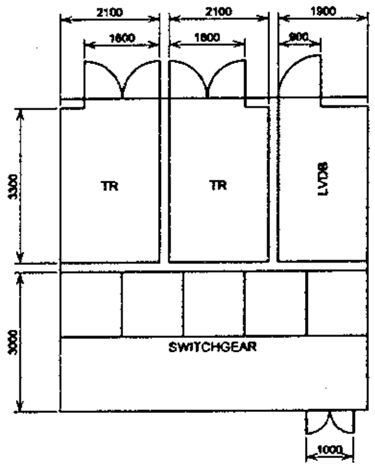
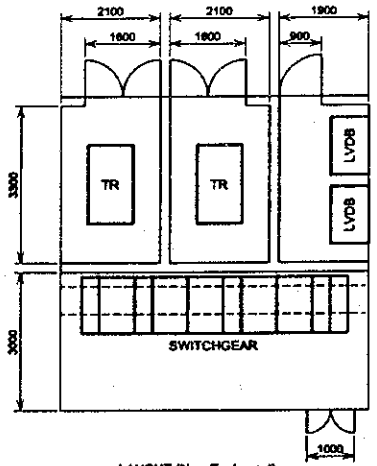
Figure / Рисунок No. III.6.3-2(14)

Title / Название Рисунка

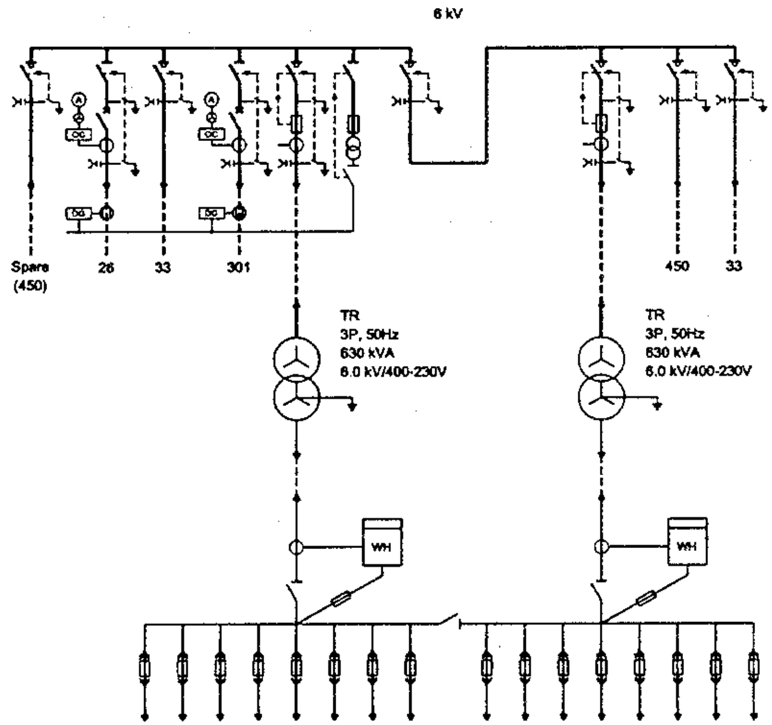
Layout and single line diagram of transformer station No. 291



LAYOUT (Existing Equipment)



LAYOUT (New Equipment)



LEGEND			
	Load Break Switch		Voltage Detector
	Disconnecting Switch		Cable Termination
	Circuit Breaker		A.C Ammeter
	Distribution Transformer		Electronic Watt-hour Meter
	Power Fuse		Current Transformer
	Earthing Switch		LV Fuse
	Earthing Voltage Transformer	OC	Over Current Relay
	Zero-phase Current Transformer	DG	Directional Ground Relay

Scale 1: 100

0 1m 2m 3m 4m 5m

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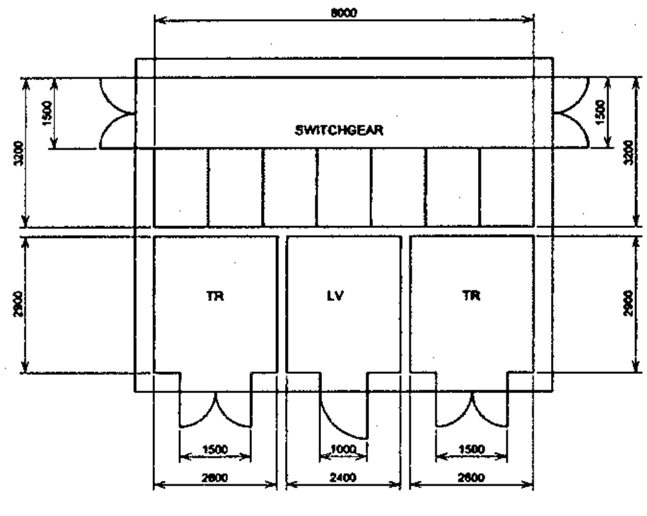
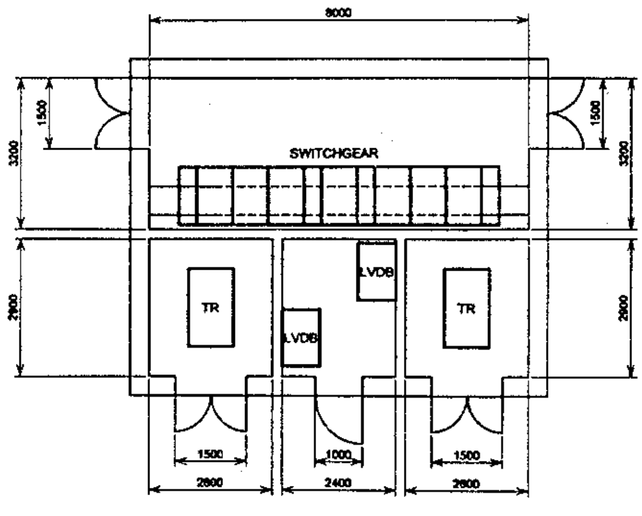
Figure / Рисунок No. III.6.3-2(15)

Title / Название Рисунка

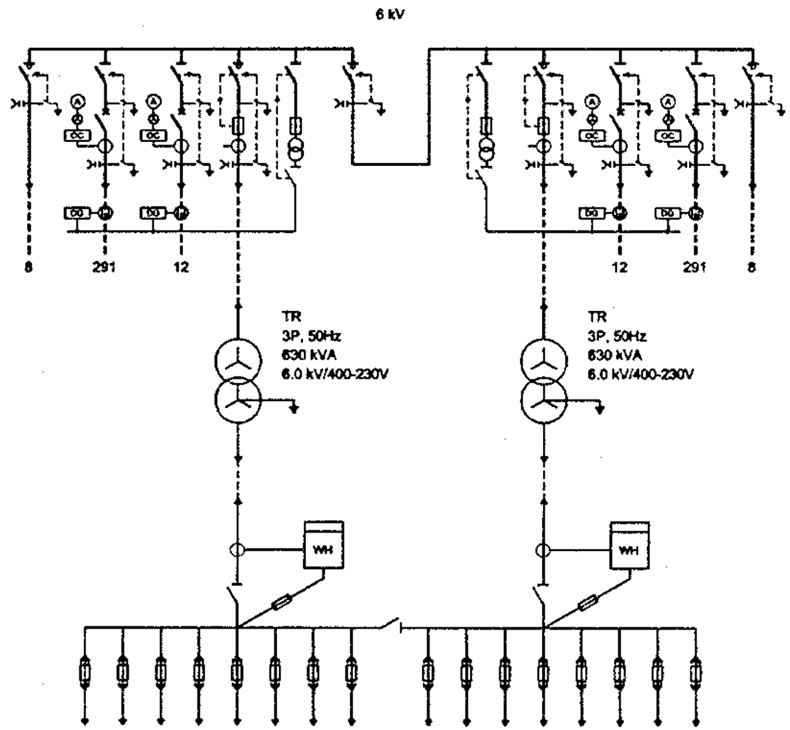
Layout and single line diagram of transformer station No. 348



LAYOUT (Existing Equipment)



LAYOUT (New Equipment)



LEGEND			
	Load Break Switch		Voltage Detector
	Disconnecting Switch		Cable Termination
	Circuit Breaker		A.C Ammeter
	Distribution Transformer		Electronic Watt-hour Meter
	Power Fuse		Current Transformer
	Earthing Switch		LV Fuse
	Earthing Voltage Transformer	OC	Over Current Relay
	Zero-phase Current Transformer	DG	Directional Ground Relay

Scale 1: 100

0 1m 2m 3m 4m 5m

Master Plan Study on Rehabilitation and Reconstruction of Electric Supply in Baku
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Baku Electric Network
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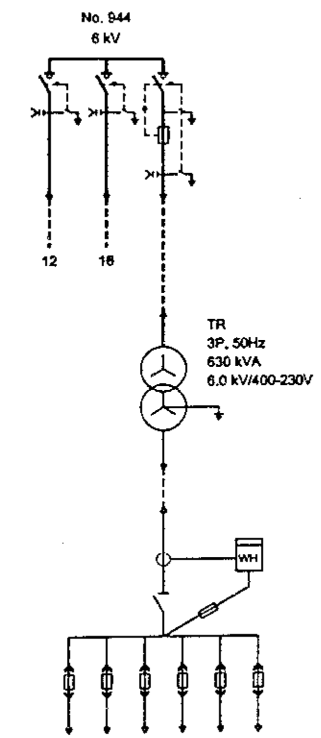
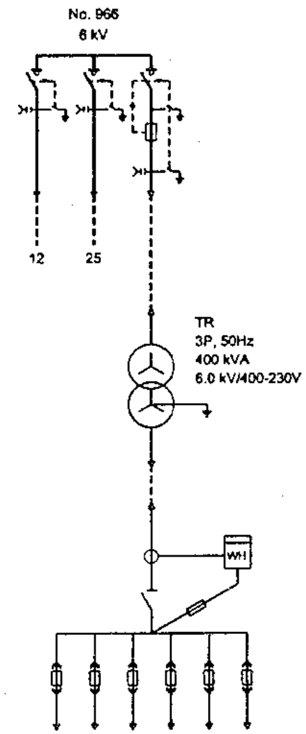
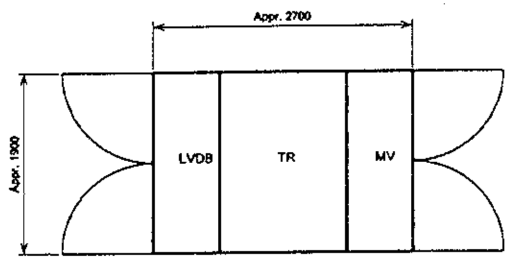
Figure / Рисунок No. III.6.3-2(16)

Title / Название Рисунка

Layout and single line diagram of transformer station No. 573







LAYOUT

LEGEND			
	Load Break Switch		Voltage Detector
	Disconnecting Switch		Cable Termination
	Circuit Breaker		A.C Ammeter
	Distribution Transformer		Electronic Watt-hour Meter
	Power Fuse		Current Transformer
	Earthing Switch		LV Fuse
	Earthing Voltage Transformer	OC	Over Current Relay
	Zero-phase Current Transformer	DG	Directional Ground Relay

Master Plan Study on Rehabilitation and Reconstruction of Electric Supply In Baku Изучение Генерального Плана Восстановления И Реконструкции Электроснабжения Города Баку		Figure / Рисунок No. III.6.3-2(17)
Baku Electric Network ПО "БАКЭЛЕКТРОСЕТЬ"	Japan International Cooperation Agency Японское Агентство Международного Сотрудничества	Title / Название Рисунка Layout and single line diagram of transformer station No. 944 and 966
Joint Venture Nippon Koei Co., Ltd. & KRI International Corp. Совместное предприятие НИППОН КОЕИ и KRI Интернешнл Корп.		

CHAPTER 7

IMPLEMENTATION PLAN

Chapter 7 IMPLEMENTATION PLAN

7.1 Construction Plan

7.1.1 Approach of Construction

Every equipment and materials, which constitute BEN's distribution network, have been those manufactured in the FSU countries, and BEN has no experience using European ones. The equipment and materials, which are to be adopted in this plan, are as follows:

Table III.7.1-1 Equipment and materials for distribution network

Items	Existing facilities	Facilities for rehabilitation
a) MV circuit breaker	minimum oil content type	SF6 gas type
b) Other MV feeder	disconnecting switch (DS)	SF6 gas type load break switch (LBS)
c) Switchgear for transformer's circuit	DS and power fuse	SF6 gas type LBS and Power fuse
d) MV underground cable	oil impregnated paper insulated cable	XLPE insulated PVC sheathed cable
e) LV underground cable	oil impregnated paper insulated cable	XLPE insulated PVC sheathed cable

So far, BEN has procured the equipment and materials shown in Table III.7.1-1, and local contractors selected through tenders or BEN itself has undertaken installing, adjusting and laying works. Local contractors as well as BEN have high technical skills and are considered as sufficiently qualified for the implementation of this plan. However, the equipment and materials to be procured for this plan are not familiar with them. Accordingly, the implementation works by only local contractors is not fully recommended.

In this plan, to ensure that the equipment suitable to local situation are procured under the condition stipulated in the tender document, and that those equipment are responsibly installed, adjusted and inspected, a turn-key contract, where a fully experienced foreign contractor will be in charge of all related works, is recommended. In view of technological transfer facilitation, however, all the implementation works will be undertaken by local staff under the supervision of foreign contractor. As laying works of MV and LV cables in particular are practically same as usual, this portion will be excluded from the scope of foreign contractor's responsibility and be implemented under BEN's responsibility. However, since the cables adopted in this plan are also new to BEN, the foreign contractor will arrange the technical training staff to facilitate technological transfer particularly for cable connection and cable terminal treatment.

Considering that BEN has not experienced any projects under the foreign financial assistance, the use of the experienced engineering consultant will be required. The consultant will be required to provide the regular reporting on the progress of the project works to the donor organization, trouble shooting, approval processing as well as general construction supervision. The major scope of works of the engineering consultant, foreign contractor and Azerbaijan participation is as follows:

(1) Scope of engineering consultant

(a) Home works

- Detail designing for transformer stations and distribution lines
- Preparing tender documents for procurement of equipment and construction works
- Supporting for tender works and appraisal of bidding
- Reviewing, checking, and approving design outputs prepared
- Presenting at inspection before loading
- Explaining, reporting and confirming for donor organization

(b) Site works

- Examining, adjusting and approving implementation schedule
- Supporting BEN for construction supervision
- Approving the implementation plan for inspection on acceptance and presenting at inspection
- Preparing monthly report on the project implementation
- Preparing completion record and report and so on

(2) Scope of foreign contractor

In according to the tender documents prepared by the engineering consultant, installation, adjustment and inspection for the equipment of transformer station as well as the designing, manufacturing, painting, inspecting, wrapping and transporting to the site of the equipment and materials shall be undertaken. In addition, installation of temporary distribution facilities, switching into the temporary facilities, renovations of transformer station house (including newly construction) and switching into the switchgears along with installing transformer station's equipment is also included.

(3) Scope of Azerbaijan side

- Support for clearance of equipment and materials except in Azerbaijan
- Obtaining import permit and shouldering necessary costs
- Exempting tax on the services and instruments/goods carried by foreigner engaged in the project
- Assuring entrance rights in the target area and facilities in the plan
- Obtaining the permit necessary for construction works from concerned bureaus

- Solving the troubles related to the residents
- Announcing and conducting energy stoppage in accordance to the implementation plan
- Securing the place for safekeeping of equipment and materials provided
- Laying MV underground cables and connecting them to the switchgears installed by the foreign contractor
- Laying LV underground and house flank cables

7.1.2 Construction Circumstance and Things to be Noted

The following points need to be taken into consideration to implement this plan:

(a) In the target area, there are a large number of residents, in addition to public facilities, offices of the government, Baku City, foreign governments, and international organizations. Therefore, the power outage due to repairing works of transformer stations is not avoidable. Under such circumstance, it is necessary to try to shorten energy cut duration, and minimize times of occurrence of outage. To do so, it is crucial to prepare detailed implementation plan, and have sufficient pre-discussion and confirmation on the implementation schedule among BEN, engineering consultant and contractors.

(b) It is considered very difficult to conduct timely replacement of the equipment by foreign contractors in good cooperation accordance with cable laying works by BEN. In this plan, supposing that the works for transformer stations and those for underground cable laying are undertaken independently, additional procurement for establishing temporal facilities become necessary during the transformer station works in view of minimizing energy stoppage. A work schedule, including (i) installation of temporary switchgears and transformers and connection with the existing cables, (ii) repairing works for transformer station house and installation-adjustment-inspection of the equipment, (iii) temporary connection of the installed equipment with the existing cables, and (iv) connection of transformer stations with the cables laid by BEN, is prepared.

(c) In general, underground cables are directly laid in the ground of sidewalks or roads. However, the buildings are extensively congested with rare roads vested with sufficient space in the target area. To carry out the works, it is necessary for BEN to obtain the permission for use of road and for cable laying from the relevant authorities in Baku City, and to shoulder the cost of digging and repairing works for sidewalks and roads on behalf of the road authority.

(d) In laying works for the underground cables, by regulation, bricks or blocks are laid to identify the lying point of the cables. For MV cables, it is planned that concrete plates will be laid to protect the MV cable and XLPE cables without steel armor will be procured in view of minimizing the cost. For LV cables, since a large number of LV cables will be installed, it is difficult to install the concrete plate for protection at the same manner of the MV cables. Accordingly, it is planned that steel tape armored cables will be procured same as previous manner.

(e) Against the issues anticipated in Chapter 11 in Volume II, thorough consideration and measures should be taken.

7.1.3 Construction Supervision Plan

As a major process to the privatization of energy distribution operation, the Presidential Decree was issued on June 14, 2000, stating a transition into Joint-Stock Company BEN (JSC BEN), incorporation of formerly separated functions (as a result of DEC's re-organization in 1999) into BEN, transfer of Azenerji's transmission/distribution facilities (below 35 kV) to BEN, and tender announcement on providing management/operation concession of JSC BEN with the private proponents. As a result, BEN is changed to JSC BEN, which handles a series of energy distribution business comprising planning, construction and operation of distribution facilities. BEN has so far been responsible for formulating and implementing the rehabilitation and expansion plan of the distribution facilities, and it is reasonably judged that BEN has sufficient capability to manage construction supervision of the implementation of this plan.

Since bidding preparation to provide the management/operation concession of BEN is currently underway, such matters as what new management company will be like and how Azerbaijan Government, JSC BEN and management company will engage in the implementation of the facility rehabilitation plan are not yet clear. However, though management/operation concession is awarded to the private proponents, the ownership of the distribution facilities remain in Azerbaijan Government. For the purpose of introducing and utilizing the public funds from international organizations/foreign governments, a clear responsibility demarcation in forwarding the rehabilitation plan needs to be assured, and impartial project implementation setup needs to be established. In this respect, it is judged as appropriate those JSC BEN functions as an implementing agency responsible for the rehabilitation and reconstruction plan of distribution facilities even after the concession is awarded to the private proponents.

It is imperative that JSC BEN organizes a special team for implementing this plan, and undertakes the construction supervision works under the cooperation of engineering consultant. Moreover, this team is required to take responsibility for obtaining various permits, laying works for underground cables undertaken by Azerbaijan side, arranging matters concerned with the governmental authorities, assisting the foreign contractors, and management of equipment and materials provided.

7.1.4 Procurement Plan for Equipment and Materials

It is assumed that procurement of equipment and materials applied to this plan will be carried out under international competition. Conditions of international competition are different among countries of the foreign governmental authorities, which offer financial assistance. Regarding the preparation of the Tender Document, it should be noted that (i) effective utilization of the existing facilities, (ii) saving of expenses, and (iii) reduction of work period for renewal of equipment of the transformer stations is necessary. Major equipment and materials to be procured are shown in Appendix III.7.1-1.

7.1.5 Works Undertaken by the Counterpart's Side

In the rehabilitation and reconstruction plan of the distribution network, scope of works which will be undertaken with the financial cooperation of foreign governments comprise the following items. These items include required local procurement of materials.

(a) Procurement of equipment and materials from international markets which are required to implement the works
(b) Transportation to Baku City
(c) Transportation insurance
(d) The erection, adjustment and test of the transformer facilities
(e) The newly-built, repaired, and reconstructed transformer station buildings
(f) Insurance for works, except for cable lines.

Accordingly, works to be conducted by Azerbaijan will be as follows:

(a) Laying of MV underground cables and procurement of materials except cables and accessories
(b) Laying of LV underground cables and procurement of materials except cables and accessories
(c) Laying of house flank cables including procurement of materials except cables
(d) Preparation of storage area and storage control of supplied materials and equipment

7.1.6 Implementation Schedule

We propose to implement the plan by dividing into two periods. Namely, we planned that in the first period, the rehabilitation works will be implemented to change the temporary 10 kV facilities in the boundary area of castle walls to the permanent facilities of 10 kV and that, in the second period, the remaining parts will be rehabilitated. The details of the facilities of the rehabilitation plan are shown in Chapters 5 and 6.

7.2 Project Cost Estimation

It is assumed that this project is undertaken with financial cooperation of foreign governments. The total amount of the project cost is estimated at about USD 14.95 million. The breakdown of the project cost, which needs to be prepared both by the donor country and Azerbaijan Government is estimated as follows:

(1) The works to be financed by the foreign donor countries (USD million)

Category	Phase I	Phase II	Total
(1) Equipment and materials	4.81	5.24	10.05
(2) Construction works	1.18	1.34	2.52
(3) Detail design and construction supervision	0.84	0.66	1.50
Total	6.83	7.24	14.07

(2) The works to be financed by Azerbaijan Government (USD million)

Category	Phase I	Phase II	Total
Cable Laying Works	0.39	0.49	0.88

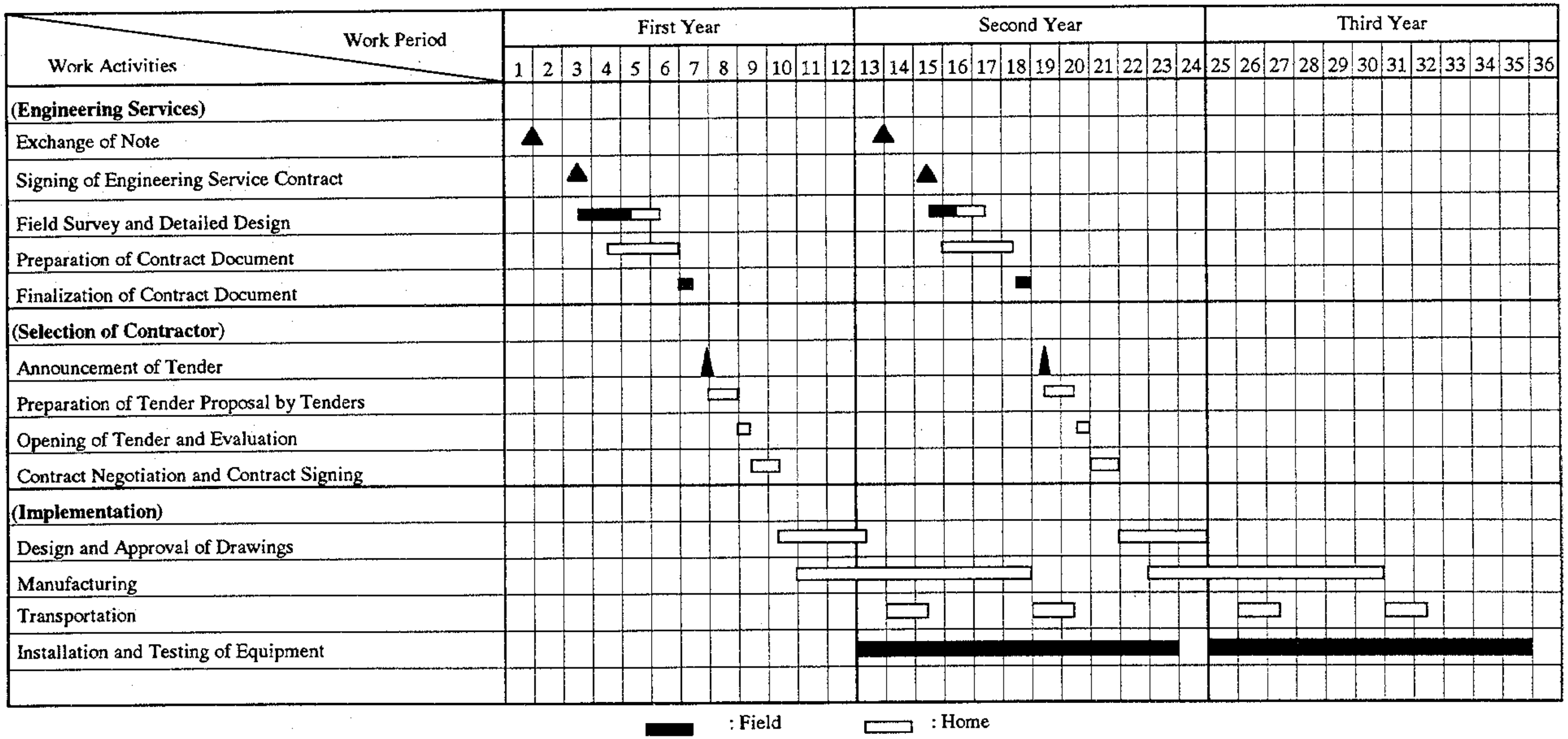
(3) Estimate conditions

(a) Base year/month : August 2000

(b) Exchange rate : USD 1 = AZM 4,456 = Yen 105.5

(c) Construction period : Two phases with the tentative schedule summarized in Figure III.7.2-1

Figure III.7.2-1 Construction Schedule



Appendix III.7.1-1 Major Facilities to be procured

Items	Unit	Phase I	Phase II	Total
A. Transformer Stations				
A.1 MV Cubicles				
a.1.1 Outgoing feeder (SF6 CB 630 A)	set	33	54	87
a.1.2 Incoming feeder (SF6 LBS 630 A)	set	37	42	79
a.1.3 Bus coupler (SF6 LBS 2000 A)	set	9	16	25
a.1.4 PT cubicles	set	17	30	47
a.1.5 Transformer circuit cubicle				
(a) SF6 LBS 200A w/fuse for 400kVA trans.	set	5	5	10
(b) SF6 LBS 200 A w/fuse for 630kVA trans.	set	15	21	36
(c) SF6 LBS 200 A w/fuse for 1,000kVA trans.	set	2	2	4
A.2 Distribution Transformers (10/0.4-0.23 kV))				
a.2.1 Oil filled type				
(a) 400 kVA	set	4	1	5
(b) 630 kVA	set	12	14	26
(c) 1,000 kVA	set	-	2	2
a.2.2 Molded dry type				
(a) 400 kVA	set	1	3	4
(b) 630 kVA	set	3	4	7
(c) 1,000 kVA	set	2	-	2
A.3 Low Voltage Distribution Board (LVDB)				
a.3.1 1,800 A capacity with 4 feeders of 400 A and 4				
feeders of 250 A	set	12	15	27
a.3.2 1,600 A capacity with 4 feeders of 400 A and 4				
feeders of 250 A, with bus-tie circuit breaker	set	11	10	21
A.4 Package Type Transformer Station				
(a) Transformer station with 400 kVA transformer	set	3	1	4
(b) Transformer station with 630 kVA transformer	set	2	1	3
B. Power Cable				
B.1 MV XLPE Underground Cable				
(a) 3x240 sq.mm	km	10.6	18.2	29
(b) 3x150 sq.mm	km	-	-	0
B.2 LV Cables				
b.2.1 LV XLPE underground cables				
(a) 3x240 + 1x95	km	9.2	9.8	19.0
(b) 3x150 +1x70	km	18.1	18.7	36.8
b.2.2 ABC cable on wall				
(a) 3x150+1x70	km	10.8	11.2	22.0
(b) 3x70+1x70	km	7.2	7.5	14.7
B.3 Wall Mounted Fuse Switch Box				
Main fuse of 400 A with 1x400+4x250 fuse switches	set	37	39	76
C. Temporary Facilities for Erection				
(a) SF6 LBS 630 A cubicle	set	15	—	15
(b) Transformer, 630 kVA	set	4	—	4

CHAPTER 8

EFFECTS OF THE PROJECT AND RECOMMENDATION

Chapter 8 EFFECTS OF THE PROJECT AND RECOMMENDATION

8.1 Effects of the Project

The target of this plan is the central area of Baku City (7.4 % of total Sabail district), with the highest demand density (16.8 MW/km^2, 66 % of the total energy demand in Sabail district are concentrated), where the first distribution system in Azerbaijan was developed. The distribution facilities are heavily out-dated and obsolete, 55 % of total 6 kV underground cables were laid before 1960 (30 % if including 10 kV cables). Recently, energy supply hindrance caused by faults of distribution facilities has been considerably increased, 84 % of the faults has been caused by the accidents concerned with the cables. Under the present situation, unless the rehabilitation and reconstruction plan for the distribution network is advanced, the supply capability will dramatically drop, thus bringing about impediments in the life of population, and recurring social problems.

For this area, the residential population is not accurately derived since reliable statistical data on the residential customer and population is not available. In Baku City, there is only a few residents living in detached house, and the majority resides in apartment complexes. This area is also not exceptional. In 1998, the population amounted to 1,788.6 thousand, and the number of residential customer (account) amounted to 357.6 thousand. Number of person per one residential customer account is about 5.0. As the target area of this project accounts for 66 % of total energy demand of Sabail district, and total residential customer (account) in the same district amounts to 26.9 thousand, the population in this project area can be estimated to 83.4 thousand.

On the other hand, average energy consumption (per capita) amounts to 1,678 kWh. From the estimated energy demand in this project area (150.0 GWh), the population in this project area can be also estimated, and derived as 89.4 thousand. It is estimated that more or less 9 million people reside in the said area. Furthermore, there are many number of central/regional governmental offices, international organization and foreign governmental branch offices, public facilities, shops, private business offices, bringing the resident in other areas into this area for working purposes. Those persons are also considered as the direct beneficiary of the stable energy supply by this project.

One of the problems in BEN's distribution network system is extensively high distribution loss of 17.0 % (in 1999). It is considered that this high distribution loss is explained by both technical and non-technical loss including poor metering and billing activities and illegal use of energy. The MV lines identified for rehabilitation have mainly comprised of overage facilities installed when power supply was initially commenced in Baku City. The size of those cables has been from 50mm^{2}to 95mm^2. On the other hand, the size of cables laid after the 1960's has been from 150mm^{2}to 185mm^2. It is accordingly supposed that the technical loss in the MV system of this area has been mostly brought about by the facilities installed before 1960 including distribution lines identified for rehabilitation in this plan. The LV distribution lines have been maintained on a patchwork basis, and a number of thin sized cables have been resultantly jumbled in the system. This has also enhanced the distribution loss.

The existing MV distribution lines, which are to be rehabilitated in this plan, are all composed by single circuit, with their average cross-sectional area of 106.1mm^2. This rehabilitation plan suggests that these lines are to be composed into double circuit ones to enhance the system reliability, and the cable with its cross-sectional area of 240mm^2 will be adopted to properly cope with a demand increase and avoid overload brought about by system change in the future. This bring about an effect of reducing loss in the distribution lines to be rehabilitated to around 22 % (1/4.5) of the present level under the same demand level. Also regarding the LV distribution lines (with their size of 20mm^2~70mm^2), the thin size cables, which are currently jumbled in the system, are to be removed and replaced with those of 150mm^2 and 70mm^2 in view of large reduction of distribution loss.

8.2 Recommendation

Since the distribution facilities in the target area are extensively obsolete, BEN strongly requests an urgent implementation of rehabilitation plan. In addition to the said direct beneficiary, it is considered that the entire national population will recognize indirect benefits by the project implementation, because a great number of office and facility, which function as the center of politics, economy, and culture in Azerbaijan is situated in this area. Therefore, this project is judged as presenting sufficiently positive effects and viability.

Regarding O&M for the distribution facilities after the project completion, as BEN has already long experience in undertaking O&M for the distribution facilities in Baku City, any problems, which need to be addressed, has not been taken up. Therefore, urgent implementation of this project is our recommendation.

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