BASIC DESIGN REPORT

ON

THE PROJECT

FOR

IMPROVEMENT OF MUSHVIQ SUBSTATION

IN

AZERBAIJAN REPUBLIC

MARCH 2006

JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

In response to a request from the Government of Republic of Azerbaijan, the Government of Japan decided to conduct a basic design study on the Project for Improvement of Mushviq Substation and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Azerbaijan a study team from August 28 to September 21, 2005.

The team held discussions with the officials concerned of the Government of Azerbaijan, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Azerbaijan in order to discuss a draft basic design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Republic of Azerbaijan for their close cooperation extended to the teams.

March 2006

Seiji KOJIMA
Vice-President
Japan International Cooperation Agency

March, 2006

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Improvement of Mushviq Substation in the Republic of Azerbaijan.

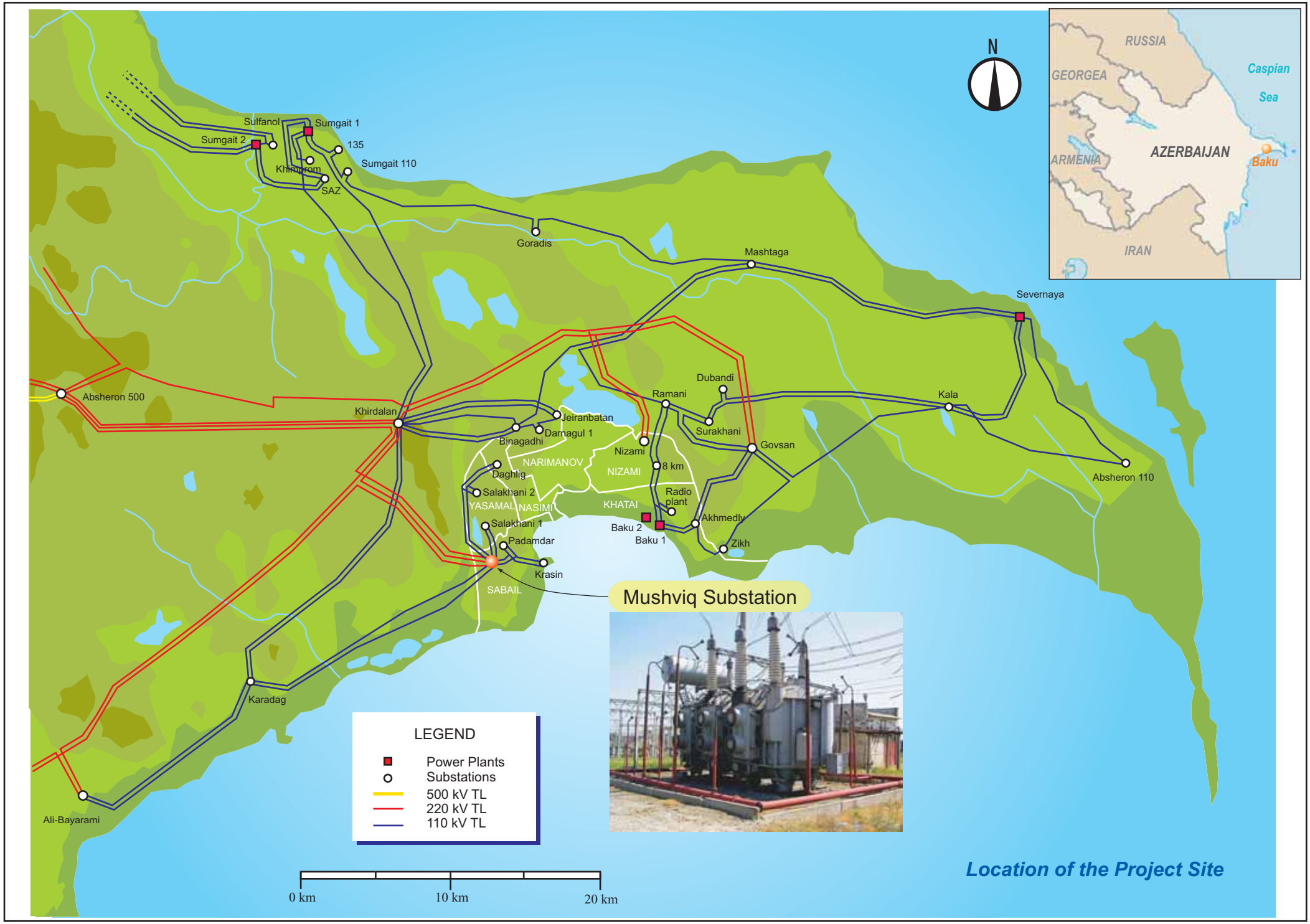
This study was conducted by Nippon Koei Co., Ltd., under a contract to JICA, during the period from August, 2005 to March, 2006. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Azerbaijan and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

Michio HASEGAWA

Chief Consultant,
Basic design study team on
The Project for Improvement of
Mushviq Substation
Nippon Koei Co., Ltd.


N
RUSSIA
GEORGEA
Caspian
Sea
AZERBAIJAN
ARMENIA
Baku
IRAN
Sulfanol
Sumgait 1
Sumgait 2
135
Khimprom
Sumgait 110
SAZ
Goradis
Mashtaga
Severnaya
Absheron 500
Khirdalan
Dubandi
Ramani
Kala
Jeiranbatan
Darnagul 1
Surakhani
Binagadhi
Nizami
Govsan
NARIMANOV
NIZAMI
8 km
Daghlig
Absheron 110
Salakhani 2
YASAMAL
NASIMI
KHATAI
Radio
plant
Salakhani 1
Baku 2
Baku 1
Akhmedly
Padamdar
Zikh
Krasin
SABAIL
Mushviq Substation
Karadag
LEGEND
Power Plants
Substations
500 kV TL
220 kV TL
110 kV TL
Ali-Bayarami
0 km
10 km
20 km
Location of the Project Site

РЕЗЮМЕ

РЕЗЮМЕ

Город Баку — столица Республики Азербайджан — является одним из крупнейших городов Кавказа. Его население составляет около двух миллионов человек. Подстанция Мушвиг — одна из наиболее важных подстанций в системе энергоснабжения центра Баку — расположена к юго-западу от города и снабжает электроэнергией Сабаильский, Ясамальский и Насиминский районы. В этих районах проживает примерно 550 тысяч человек, включая около 60 тысяч беженцев и переселенцев. Здесь расположено большинство важнейших государственных организаций, коммерческих предприятий, медицинских и образовательных учреждений.

Поскольку большинство объектов по выработке, передаче и распределению электроэнергии было построена во времена Советского Союза, и сейчас оборудование устарело и износилось, существует насущная потребность в совершенствовании системы электроснабжения и повышении ее надежности. Силовые трансформаторы (2 трансформатора по 200 MBA) на подстанции Мушвиг тоже были произведены в советское время и введены в эксплуатацию в 1986 году. Поскольку с момента ввода трансформаторов в эксплуатацию прошло почти 20 лет, иногда из-за износа оборудования возникают некоторые проблемы, например, утечка трансформаторного масла. Кроме того, учитывая недавние положительные изменения в экономике Азербайджана, спрос на электроэнергию в Баку растет быстрыми темпами. Ожидается, что за несколько лет этот спрос превысит номинальную мощность трансформаторов подстанции Мушвиг. В худшем случае при остановке подстанции Мушвиг центр Баку может остаться без электроэнергии.

Уже сейчас мощность одного из силовых трансформаторов (200 MBA) не соответствует пиковому спросу на электроэнергию в холодное время года. Если один из трансформаторов выйдет из строя, потребуется осуществить частичный плановый сброс нагрузки. Это может нанести значительный ущерб здоровью и нормальным условиям жизни горожан, включая беженцев и переселенцев, а также привести к перебоям в предоставлении коммунальных услуг, работе государственных, медицинских и образовательных учреждений.

Также, с каждым годом повышаются затраты на эксплуатацию и содержание устаревшего и изношенного оборудования «АЗЕРЭНЕРЖИ». Однако поскольку бюджет «АЗЕРЭНЕРЖИ» в значительной степени ограничен, в частности, из-за низких тарифов на электроэнергию, Бакинская высоковольтная электросеть, которая управляет подстанцией Мушвиг, получает ассигнования только на приобретение запасных частей и техническое обслуживание/ремонт

устаревшего и изношенного оборудования, а не на его замену.

В связи с этим Правительство Азербайджана подало в Правительство Японии заявку на получение безвозмездной помощи с целью модернизации силовых трансформаторов подстанции Мушвиг.

В ответ на эту заявку Правительство Японии решило провести Изучение базовой концепции, и в период с 28 августа по 21 сентября 2005 год от Японского агентства международного сотрудничества (JICA) в Азербайджан была направлена Группа изучения базовой концепции. Группа обсудила с азербайджанскими представителями составляющие Проекта и обследовала объект. Вернувшись в Японию, Группа изучения провела анализ полученных данных и подготовила проект Отчета о базовой концепции. После подготовки отчета JICA вновь направляет Группу изучения в Азербайджан в период с 29 января по 8 февраля 2006 года с целью разъяснения азербайджанским партнерам его содержания.

Заявка, представленная Правительством Азербайджана 11 декабря 2003 года, содержит следующие требования:

1)	Замена силового трансформатора 220/110/10 кВ, 250 МВА	2 трансформатора
2)	Укрепление фундамента трансформатора	2 комплекта
3)	Замена проводов (сторона 220 кВ и 110 кВ)	1 партия
4)	Замена контрольных и защитных панелей	2 комплекта
5)	Восстановление подъездной дороги к подстанции	1 партия
6)	Замена силовых и контрольных кабелей 10 кВ	1 партия
7)	Замена изоляторов и арматуры	1 партия
8)	Замена реакторов 10 кВ	2 комплекта
9)	Замена закрытого распределительного устройства 10 кВ	2 комплекта
10)	Работы по монтажу оборудования	1 партия

В результате обсуждения представленных выше требований с представителями «АЗЕРЭНЕРЖИ» в ходе проведения обследования объекта было установлено, что пункт 5) «Восстановление подъездной дороги к подстанции» не будет включен в Проект, поскольку «АЗЕРЭНЕРЖИ» уже выполнило эту задачу собственными силами.

Кроме того, представители «АЗЕРЭНЕРЖИ» попросили дополнительно включить в Проект следующие пункты:

1)	Система азотной противопожарной защиты	2 комплекта
2)	Запасные части	1 партия

Включение в Проект системы противопожарной защиты признается обоснованным, поскольку она представляет собой дополнительное оборудование для силового трансформатора и ее установка предусмотрена обязательными требованиями к электрооборудованию, существующими в Азербайджане. Включение минимального количества запасных частей в Проект также уместно, поскольку они чрезвычайно необходимы для осуществления «АЗЕРЭНЕРЖИ» долгосрочного технического обслуживания и ремонта подстанции Мушвиг после завершения Проекта.

Все основное электрооборудование, в частности, силовые трансформаторы, система противопожарной защиты, ЗРУ 10 кВ, контрольные и защитные панели и т.д., а также кабельно-проводниковое оборудование (провода, силовые кабели, контрольные кабели и арматура) будет приобретено и установлено в рамках Проекта японской стороной.

Азербайджанская сторона осуществит в рамках Проекта демонтаж и восстановление главных ворот подстанции Мушвиг для обеспечения возможности ввоза оборудования, отключение питания для проведения работ по монтажу оборудования и частичный плановый сброс нагрузки, при необходимости согласовав его с соответствующими организациями.

Расчетный срок реализации Проекта составляет примерно 21 месяц с момента обмена нотами между Правительством Азербайджана и Правительством Японии до полного завершения работ по Проекту.

Общая расчетная стоимость Проекта составляет примерно 871 миллионов японских йен (японская сторона: 870 миллиона йен, азербайджанская сторона: 1,4 миллиона йен).

Далее представлен прямой и косвенный положительный эффект от Проекта.

1) Прямой эффект

   Максимальный прямой эффект от Проекта — повышение мощности трансформатора с 400 MBA (2 трансформатора по 200 MBA) до 500 MBA (2 трансформатора по 250 MBA). Даже если один из трансформаторов подстанции Мушвиг выйдет из строя, аварийной разгрузки энергосистемы или длительного отключения электроснабжения можно будет избежать. Кроме того, увеличение мощностей по электроснабжению в рамках Проекта позволит достичь множества побочных результатов, в частности, обеспечить стабильность системы электроснабжения, повысить ее надежность, сократить продолжительность перебоев в снабжении энергией и т.п.

   Более того, реализация Проекта, т.е. замена устаревшего и изношенного оборудования на более надежное, позволит сократить затраты и время на ремонт и техническое обслуживание и снизить экологический риск, в частности, от загрязнения почв в

результате утечки трансформаторного масла.

Численность выгодополучателей по данному Проекту составляет около 550 тысяч человек, включая примерно 60 тысяч беженцев/ переселенцев, проживающих в Сабаильском, Ясамальском и Насиминском районах Баку.

2) Косвенный эффект

① Вклад в обеспечение основополагающих человеческих потребностей (ОЧП), в частности, улучшение возможностей функционирования медицинских и образовательных учреждений, а также условий жизни горожан и беженцев/ переселенцев, за счет обеспечения надежности системы электроснабжения.

② Активизация и стабилизация социально-экономической деятельности за счет бесперебойного электроснабжения центра Баку.

В настоящее время другими организациями-донорами не проводится никаких программ, связанных с Проектом, однако в 2002 году Европейская комиссия в рамках предоставления безвозмездной помощи подстанции Мушвиг реализовала проект по обеспечению стабильности электроснабжения районов проживания беженцев. Реализация Проекта в рамках программы предоставления безвозмездной помощи Правительства Японии, безусловно, позволит существенно улучшить условия жизни беженцев за счет синергетического эффекта от взаимодействия с результатами проекта Европейской комиссии.

Для максимизации положительных результатов азербайджанской стороне следует после завершения Проекта обеспечить соблюдение следующих требований, которые вполне осуществимы при существующей системе технического обслуживания/ремонта и бюджета «АЗЕРЭНЕРЖИ».

① Осуществлять надлежащее техническое обслуживание и обеспечить бюджет на приобретение запасных частей.

② Проводить регулярные проверки

③ Вести учет работы и технического обслуживания подстанции

Summary

SUMMARY

Baku City, the capital of the Republic of Azerbaijan (hereinafter referred to as Azerbaijan), has a population of about two million and is one of the major cities within Caucasia. Mushviq Substation, one of the most important substations within the power supply network of central Baku, is located southwest of the city and supplies electric power to Sabail, Yasamal and Nasimi districts. These districts have a population of around 550,000 including some 60,000 refugees and internally displaced persons (IDPs) with a concentration of major governmental agencies, commercial establishments, medical institutions and educational institutions.

Since most power generation, transmission and distribution facilities in Azerbaijan were constructed during the era of the former Soviet Union and are therefore aged and deteriorating, there is an urgent need for improvement to provide a reliable power transmission system. The main power transformers (200 MVA x 2 units) in Mushviq Substation were installed in 1986, again during the era of the former Soviet Union. As 20 years has elapsed since their installation, the transformers now exhibit problems such as leakage of insulation oil. Given the recent favorable economic conditions of Azerbaijan, electric power demand in Baku is increasing rapidly and is anticipated to exceed the rated capacity of these transformers within a few years. In the worst case, a shutdown of Mushviq Substation could therefore result in massive blackouts in the center of Baku.

Peak demand in winter already exceeds the capacity of one main transformer (200 MVA) under current conditions. If one unit of the transformer was disabled in this situation, scheduled partial load shedding will be necessary. This would have considerable impact on the health and stable livelihoods of inhabitants including refugees/IDPs in winter as well as on the public sector, such as governmental, medical and educational services.

The AZERENERJI's operation and maintenance cost for the aging equipment is increasing year by year. However, because the financial status of AZERENERJI is too tight by several issues such as negative net worth of electricity tariff, the operation and maintenance cost allocated to Baku High-voltage Electricity Network, which manages Mushviq Substation, is earmarked for the purchase of spare parts and maintenance/repair of the damaged/deteriorated equipment, not to the replacement.

Under these circumstances, the Government of Azerbaijan requested grant aid from the Government of Japan for improvement of the main transformers in Mushviq Substation.

In response to the request, the Government of Japan decided to conduct a basic design study and Japan International Cooperation Agency (JICA) dispatched the Basic Design Study Team to Azerbaijan from 28 August to 21 September 2005. The Study Team discussed with the officials of Azerbaijan on the components of the Project and conducted a site survey. Returning to Japan, the Study Team prepared the draft Basic Design Report through the examination in Japan based on the collected data. Following the completion of the report, JICA dispatched the Study Team to Azerbaijan again from 29 January to 8 February 2006 to explain the contents of the report.

Requested items in the application submitted by the Government of Azerbaijan dated 11 December 2003 are as follows:

1)	Replacement of 220/110/10 kV, 250 MVA main transformers	2 units
2)	Reinforcement of transformer foundations	2 sets
3)	Replacement of power conductors (220 kV and 110 kV side)	1 lot
4)	Replacement of control and protection panels	2 sets
5)	Rehabilitation of service road in the substation	1 lot
6)	Replacement of 10 kV power cables and control cables	1 lot
7)	Replacement of insulators and fittings	1 lot
8)	Replacement of 10 kV reactors	2 sets
9)	Replacement of 10 kV cubicles	2 sets
10)	Installation work	1 lot

As a result of discussions on the above items with AZERENERJI's officials during the site survey period, it was confirmed that item 5) "Rehabilitation of service road in the substation" would not be included in the Project because this had already been undertaken by AZERENERJI.

In addition, AZERENERJI requested the following additional items during the site survey period:

1)	Nitrogen-type fire prevention system	2 sets
2)	Spare parts	1 lot

Regarding the fire prevention system, its inclusion in the scope of the Project is considered appropriate because it is incidental equipment only for the main transformer and installation of such equipment is necessary under the electrical equipment standard of Azerbaijan, which has been succeeded since the era of the Soviet Union. Regarding spare parts, it is considered that including minimal amounts in the scope of the Project is also appropriate because they are absolutely imperative for long-term O&M of Mushviq Substation by AZERENERJI after the Project is completed.

All main electrical equipment such as main transformers, fire prevention system, 10 kV cubicles, control and protection panels, etc. and peripheral equipment such as power conductors, power cables, control cables, and accessories shall be procured and installed by the Japanese side under the Project.

The Azerbaijan side shall execute the demolition and restoration of the existing main gate of Mushviq Substation, the power cut for installation work and the scheduled partial load shedding after coordinating with concerned organizations, if necessary, under the Project.

The estimated period of the implementation schedule for the project is approximately 21 months from the exchange of notes between the Government of Azerbaijan and the Government of Japan to the completion of the Project.

The total project cost is estimated to be approximately 871 million Japanese Yen (Japanese side: approx. ¥870 million, Azerbaijan side: ¥1.4 million).

The direct and indirect positive effects of the Project are described below.

1) Direct Effect

   The maximum direct effect of the Project is to increase transformer capacity from 400 MVA (2 units×200 MVA) to 500 MVA (2 units×250 MVA). Even if one unit of the main transformer of Mushviq Substation fails causing a supply disruption, load shedding or long term blackouts will be averted and many effects such as stable power supply, improvement in reliability, reduction of power outage period, etc. will be expected with this increase in power supply capacity by the Project.

   Moreover, implementation of the Project and replacement of old and deteriorating equipment by more reliable units will lead to a reduction in the cost and time for repair and maintenance and less environmental risk such as soil contamination through leakage of insulation oil.

   The number of beneficiaries of the Project is about 550,000 people, including about 60,000 refugees and internally displaced persons (IDPs) living in Sabail, Yasamal and Nasimi districts.

2) Indirect Effect

   ① Contribution to Basic Human Needs (BHN) such as improvement of capability of medical and educational institutions and living of inhabitants and refugees/IDPs with the realization of a reliable electric power supply

② Activation and stabilization of the social and economic activities with the stable power supply in the center of Baku

In addition, although there are no other donor plans relating directly to the Project, the European Commission (EC) carried out a grant aid project for Mushviq Substation in 2002 to secure stable power supply to the refugee-inhabited area. It is believed that execution of the Project by Japan's grant aid system will contribute significantly to the improvement of living conditions of refugees and match closely the aims of the EC project.

To maximize and maintain the positive effect of the Project and to ensure the long-term operation of the equipment, the Azerbaijan side should meet the following requirements after completion of the Project:

① To execute proper maintenance and to secure the budget for procurement of the spare parts

② To conduct periodical inspection

③ To complete operation and maintenance records

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Abbreviations

CB	:	Circuit Breaker
CIS	:	Commonwealth of Independent States
CT	:	Current Transformer
DS	:	Disconnecting Switch
EBRD	:	European Bank for Reconstruction and Development
EC	:	European Commission
EU	:	European Union
FOB	:	Free on Board
FSU	:	Former Soviet Union
GDP	:	Gross Domestic Product
IBD	:	Islam Bank for Development
IEC	:	International Electro-technical Committee
IDP	:	Internally Dispatched Person
IMF	:	International Monetary Fund
JBIC	:	Japan Bank for International Cooperation
JICA	:	Japan International Cooperation Agency
JSC	:	Joint Stock Company
LDC	:	Load Dispatching Center
LLC	:	Limited Liability Company
LV	:	Low Voltage (400/220 V in Azerbaijan)
MV	:	Medium Voltage (35 kV, 20 kV, 10 kV and 6 kV in Azerbaijan)
O&M	:	Operation and Maintenance
SCADA	:	Supervisory Control And Data Acquisition
TR	:	Transformer
U/G	:	Underground (line)
UNDP	:	United Nations Development Program
UNHCR	:	United Nations High Commissioner for Refugees
USSR	:	Union of Soviet Socialist Republics
WB	:	World Bank
WB PHRD	:	World Bank Policy and Human Resource Development (Fund)

Units

Length	mm	:	Millimeters
	cm	:	Centimeters (10.0 mm)
	m	:	Meters (100.0 cm)
	km	:	Kilometers (1,000.0 m)
Area	cm^2	:	Square-centimeters (1.0 cm x 1.0 cm)
	m^2	:	Square-meters (1.0 m x 1.0 m)
	km^2	:	Square-kilometers (1.0 km x 1.0 km)
Volume	cm^3	:	Cubic-centimeters (1.0 cm x 1.0 cm x 1.0 cm)
	m^3	:	Cubic-meters (1.0 m x 1.0 m x 1.0 m)
Weight	g	:	grams
	kg	:	kilograms (1,000 g)
	ton	:	Metric ton (1,000 kg)
Time	sec.	:	Seconds
	min.	:	Minutes (60 sec.)
	hr.	:	Hours (60 min.)
Currency	AZM	:	Azerbaijan Manat
	US$	:	United State Dollars
	J¥	:	Japanese Yen
Electricity	V	:	Volts (Joule/coulomb)
	kV	:	Kilo volts (1,000 V)
	A	:	Amperes (Coulomb/second)
	kA	:	Kilo amperes (1,000 A)
	W	:	Watts (active power) (J/s: Joule/second)
	kW	:	Kilo watts (10^3 W)
	MW	:	Mega watts (10^6 W)
	Wh	:	Watt-hours (watt x hour)
	kWh	:	Kilo watt-hours (10^3 Wh)
	MWh	:	Mega watt-hours (10^6 Wh)
	GWh	:	Giga watt-hours (10^9 Wh)
	VA	:	Volt-amperes (apparent power)
	kVA	:	Kilo volt-amperes (10^3 VA)
	MVA	:	Mega volt-amperes (10^6 Wh)
	var	:	Volt-ampere reactive (reactive power)
	kvar	:	Kilo volt-ampere reactive (10^3 var)
	Mvar	:	Mega volt-ampere reactive (10^6 var)

Chapter 1

Background of the Project

CHAPTER 1 Background of the Project

Baku City, the capital of the Republic of Azerbaijan (hereinafter referred to as Azerbaijan), has a population of about two million and is one of the major cities within Caucasia. Mushviq Substation, one of the most important substations within the power supply network of central Baku, is located southwest of the city and supplies electric power to Sabail, Yasamal and Nasimi districts. These districts have a population of around 550,000 including some 60,000 refugees and internally displaced persons (IDPs) with a concentration of major governmental agencies, commercial establishments, medical institutions and educational institutions.

Since most power generation, transmission and distribution facilities in Azerbaijan were constructed during the era of the former Soviet Union and are therefore aged and deteriorating, there is an urgent need for improvement to provide a reliable power transmission system. The main power transformers (200 MVA x 2 units) in Mushviq Substation were installed in 1986, again during the era of the former Soviet Union. As 20 years has elapsed since their installation, the transformers now exhibit problems such as leakage of insulation oil. Given the recent favorable economic conditions of Azerbaijan, electric power demand in Baku is increasing rapidly and is anticipated to exceed the rated capacity of these transformers within a few years. In the worst case, a shutdown of Mushviq Substation could therefore result in massive blackouts in the center of Baku.

Peak demand in winter already exceeds the capacity of one main transformer (200 MVA) under current conditions. If one unit of the transformer was disabled in this situation, scheduled partial load shedding will be necessary. This would have considerable impact on the health and stable livelihoods of inhabitants including refugees/IDPs in winter as well as on the public sector, such as governmental, medical and educational services.

Under these circumstances, the Government of Azerbaijan requested grant aid from the Government of Japan for improvement of the main transformers in Mushviq Substation.

Chapter 2

Contents of the Project

Chapter 2 Contents of the Project

2.1 Basic Concept of the Project

(1) Overall Goal and Project Objectives

Since most power facilities in Azerbaijan were constructed during the Soviet era and are now outdated, their renovation to provide a stable power supply is recognized as a most important issue. Although new construction and renewal of power generating plants and improvement of the international transmission system between Russia and other countries are high priorities within the 5-year National Development Program, improvement of domestic transmission and substation systems is also urgently required. In particular, stable and high quality power supply to Baku City, which is the capital of Azerbaijan and its political and economic center, is the most important task of the country's power sector.

The main objectives of the Project are to strengthen the power supply capability of Baku, to provide a high quality and stable electricity system, and to facilitate stabilization of the population's livelihood and economic development of Azerbaijan through reinforcement of the main power transformers of Mushviq Substation.

(2) Outline of the Project

To achieve the overall goal and project objectives of this Project, the existing 2 x 200 MVA main power transformer units in Mushviq Substation will be upgraded to 2 x 250 MVA units. In addition, peripheral equipment of the main transformers such as 10 kV cubicles, fire-prevention system, control and protection panels, etc. will also be replaced. This will be expected to contribute to a drastic improvement in power supply capability and reliability in Baku.

2.2 Basic Design of the Requested Japanese Assistance

2.2.1 Design Policy

(1) Basic Policies

Since Mushviq Substation is one of the most important substations within the power supply network to the center of Baku, the substation is expected to supply high quality and reliable electricity.

Fundamental policies in executing the basic design for the Project are:

- To take into account the present remarkable economic growth of Baku,
- To take into account the likely long-term effect of the Project,
- To avoid excessive equipment, and
- To maximize project impact while minimizing investment.

To determine the unit capacity of the new main transformer, past trends in power demand and demand forecasts of AZERENERGY and BARMEK will be analyzed and examined. The total capacity would then, as a minimum, be based on a forecast power demand in 2020.

Since the design of the existing substation equipment was based on standards of the former Soviet Union (GOST), the equipment to be procured under the Project shall be designed with due consideration of interfacing between the procured and existing equipment, particularly the control and protection panels of main transformers.

From the environmental viewpoint, the equipment to be procured under the Project shall be designed to avoid environmental problems such as noise, soil contamination, etc.

(2) Natural Conditions

All equipment, materials and their arrangements shall be designed and manufactured to comply with the service conditions outlined below.

1) Ambient Air Temperature

The ambient air temperature does not exceed 40 °C.

The minimum ambient temperature does not fall below minus 20 °C.

The yearly average ambient temperature is 15 °C.

2) Altitude

The height above sea level of the project site is less than 1,000 m.

3) Relative Humidity

The average annual relative humidity is 65%.

4) Wind Speed

The maximum wind velocity for design is 25 m/sec.

Given these natural conditions, the materials and equipment to be procured under the Project do not require any special designs to be considered.

(3) Applied Standards and Regulations

The following standards and regulations will be applied in the design of electrical equipment to be procured under the Project.

1) Standards and Regulations

The design of all electrical equipment shall comply with the latest revision of the Russian Interstate Standards (GOST-R) and the International Electrotechnical Commission Standard (IEC). In the case of differences between both standards, AZERENERJI will prepare a comparison table and decide with the Consultant the prevailing standard and include these data or information in the Tender Documents.

In cases where GOST-R and IEC standards do not cover the conditions, Japanese Industrial Standard (JIS) or the Japanese Electrotechnical Committee (JEC) Standard can be applied.

2) Other Regulations

The national regulation for Installation of Automatic Fire Prevention System[1] shall be considered in equipment planning.

The international system of units (SI) shall be applied to the design.

(4) Use of Local Subcontractors

Construction and/or improvement of AZERENERJI's power facilities is to be conducted exclusively by two construction companies, "Azerenergy Special Maintenance and Service" and "Azerenergy Special Repair and Construction", under the umbrella of AZERENERJI. As a result of investigations into each company's profile, construction career, heavy equipment owned, etc., it is considered that both companies have sufficient capability to undertake the works for the

[1] Ministry of Power and Electrification of the Soviet Union, "Statement of Direction for Design of Firefighting Equipment in Power Utilities" No. 34.49.101.87 (1987)

Project as a subcontractor.

Heavy machinery and vehicles such as large-scale cranes, power shovels, etc. as well as construction materials such as cements, reinforcing bar, etc. can be locally procured.

(5) Operation and Maintenance Capability of Implementation Agency

The Power Transmission Department of AZERENERJI JSC is the implementation agency in charge of the Project. After completion of the Project, Baku High-voltage Electricity Network Limited Liability Company (LLC) under the umbrella of Power Transmission Dept. will carry out operation and maintenance work.

It is considered that special counterpart training, or a soft component, is unnecessary as AZERENERJI has sufficient capabilities with regard to O&M work post-Project.

O&M training for new equipment to be procured under the Project such as main transformers, 10 kV cubicles, relay panels, etc. shall be carried out through OJT and initial O&M guidance when installation work and tests on site are to be executed.

(6) Grade of the Equipment

The existing main transformers to be replaced in Mushviq Substation were manufactured by the Soviet Union in the Ukraine. To determine eligible countries from which the transformers would be procured under the Project, the Study Team has examined the transformers made in Ukraine, Europe and Japan in respect of price and technical performance.

The Study Team obtained price quotations from transformer manufacturers in the Ukraine, Europe and Japan to allow price comparisons. This indicated there is no price difference between Japanese and European manufacturers, while the price of transformers from Ukrainian manufacturers was about 20 percent lower.

For evaluation of the technical performance of the existing transformers, the Study Team attempted to collect the related documents and technical data from the AZERENERJI's relevant departments. However, most documents had been lost through a series of social conflicts arising from the collapse of the Soviet Union and independence of Azerbaijan. As a result of this situation, a quantitative evaluation on the technical performance of Ukraine, Europe and Japanese-made transformers is not possible and the evaluation undertaken in this Study was based on the following approach.

Compared with transformers made in Japan and Europe, Ukrainian-made transformers are

advantageous from the following viewpoints:

1) Spare parts can be easily obtained.

2) AZERENERJI's substation staff is highly familiar with O&M of Ukrainian-made transformers.

However, the average failure rate of the transformers manufactured in Japan and Europe was found to be far lower than for the Ukrainian-made items (based on actual technical performances reported world-wide) because of their sophisticated quality control system. Therefore, if such a transformer is installed, spare parts can be minimized and manpower and the cost required for O&M can also be substantially decreased. Moreover, since there are no substantial differences in the basic construction and mechanisms of autotransformers among manufacturers throughout the world, there are no serious problems relating to the execution of O&M by AZERENERJI's staff.

Conversely, the disadvantages of Ukrainian-made transformers are as follows:

1) Regarding the capacity of tertiary windings (10 kV side) of the transformer, there are only two standard ratings, 100 MVA or 150 MVA available, which exceed design requirements.

2) Because of the excessive capacity of tertiary windings, the ancillary facilities such as a 10 kV reactor to limit short-circuit current and its associated buildings become necessary.

3) Low reliability of the Ukrainian-made transformer with problems such as oil leakage immediately following installation being reported. The repair and maintenance costs for such transformers may be excessive compared with Japanese or European-made versions.

4) According to AZERENERJI, Ukrainian-made transformers have a very low utilization due to a high degree of deterioration, even under appropriate levels of O&M.

Electrical equipment imported from Japan and Europe has been installed in the Severnaya Gas Combined Cycle Power Plant Project funded by JBIC. AZERENERJI intends to procure equipment from developed countries for future projects to the extent allowable within the budget. In addition, AZERENERJI strongly requested the installation of high quality and reliable transformers made in Japan or Europe under the Project.

The most important role of Mushviq Substation is to supply stable and high quality electric power to the center of Baku, to ensure sustainable economic growth can be achieved. As a result of an overall examination that considered not only initial cost of transformers but also O&M cost, quality, reliability, etc., it is concluded that main transformers for the Project shall be procured from Japan or Europe to maintain the recent steady economic growth of Baku.

The prices of Japanese-manufactured transformers are less than or equal to those of European manufacturers. Therefore, competitive bidding for Project implementation will be secured even though procurement of transformers is to be limited to Japanese-made items. It is confirmed that five or more Japanese manufacturers can produce autotransformers meeting the requirements of the Project. Therefore, it is recommended the main transformers for the Project be procured from Japanese manufacturers only.

For the fire-prevention system using nitrogen gas, a European-made system is acceptable because no Japanese manufacturers produce the same type of system.

(7) Construction and Procurement Method and Schedule

Considering the importance of Mushviq Substation, which is responsible for the power supply to about one-quarter of the area of Baku, it should maintain constant power supply without interruption. Thus, it is necessary to undertake the replacement of one main transformer and its peripheral equipment while supplying power through the other main transformer. In addition, it is necessary to strictly implement construction schedule control after formulating an efficient execution scheme with an exact power outage plan based on discussions with BARMEK and AZERENERJI's related organizations such as the Central Load Dispatching Center, the Power Transmission Dept., etc. This is because timing of the replacement is assumed to overlap with winter when substation loads are heavy. In addition, it is necessary to ensure the Contractor can formulate a detailed construction method, power outage procedure and safety measures that comply with a planned construction schedule. It must also provide evidence of ample experience in similar works to ensure the success of the installation works for the Project.

Therefore, the installation work for the Project shall be included in the scope of works of the Contractor. The Contractor shall dispatch procurement management staff and an installation instructor to the site from Japan to ensure quality of the equipment, with installation work being executed by the Contractor using suitably experienced local subcontractors.

Moreover, to minimize the power outage period, replacement work of the first transformer shall be executed in a minimum of 24 hours work in three shifts.

Regarding the implementation schedule of the Project, the work is expected to take about 10 months for design and manufacturing of materials and equipment, about 2 months for transportation and about 5 months for installation including preparatory work. By efficiently overlapping each work item, at least 15 months are necessary to complete the works after the contract for the Project is verified by the Government of Japan. Details of the implementation schedule are outlined in Section 2.2.4.

2.2.2 Basic Plan (Equipment Plan)

2.2.2.1 Total Plan

Requested items in the application submitted by the Government of Azerbaijan dated 11 December 2003 are as follows:

1)	Replacement of 220/110/10 kV, 250 MVA main transformers	2 units
2)	Reinforcement of transformer foundations	2 sets
3)	Replacement of power conductors (220 kV and 110 kV side)	1 lot
4)	Replacement of control and protection panels	2 sets
5)	Rehabilitation of service road in the substation	1 lot
6)	Replacement of 10 kV power cables and control cables	1 lot
7)	Replacement of insulators and fittings	1 lot
8)	Replacement of 10 kV reactors	2 sets
9)	Replacement of 10 kV cubicles	2 sets
10)	Installation work	1 lot

As a result of discussions on the above items with AZERENERJI's officials during the site survey period, it was confirmed that item 5) "Rehabilitation of service road in the substation" would not be included in the Project because this had already been undertaken by AZERENERJI.

In addition, AZERENERJI requested the following additional items during the site survey period:

1)	Nitrogen-type fire prevention system	2 sets
2)	Spare parts	1 lot

Regarding the fire prevention system, its inclusion in the scope of the Project is considered appropriate because it is incidental equipment only for the main transformer and installation of such equipment is necessary under the electrical equipment standard of Azerbaijan, which has been succeeded since the era of the Soviet Union. Regarding spare parts, it is considered that including minimal amounts in the scope of the Project is also appropriate because they are absolutely imperative for long-term O&M of Mushviq Substation by AZERENERJI after the Project is completed.

2.2.2.2 Equipment Plan

(1) Unit Capacity of the Main Power Transformers

1) Current load conditions of Mushviq Substation

Figures 2.2-1, 2.2-2 and 2.2-3 show yearly peak load, monthly peak load and daily load curve of Mushviq Substation, respectively.

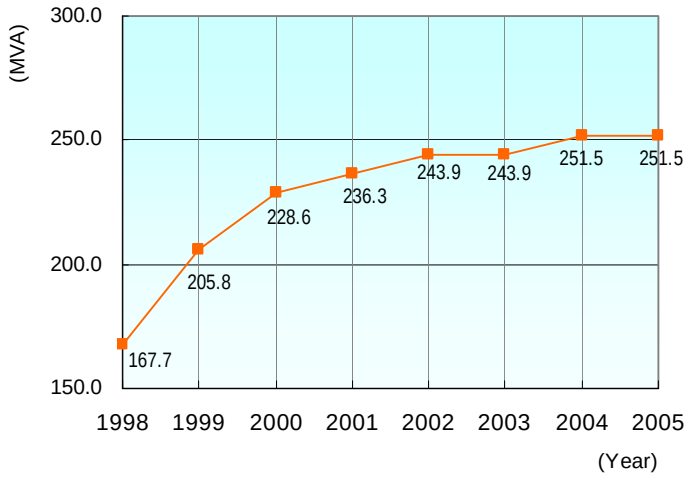


Figure 2.2-1 Yearly Peak Load of Mushviq S/S (1998 - 2005)

(Source: AZERENERJI, Note: Value for 2005 is a record of January.)

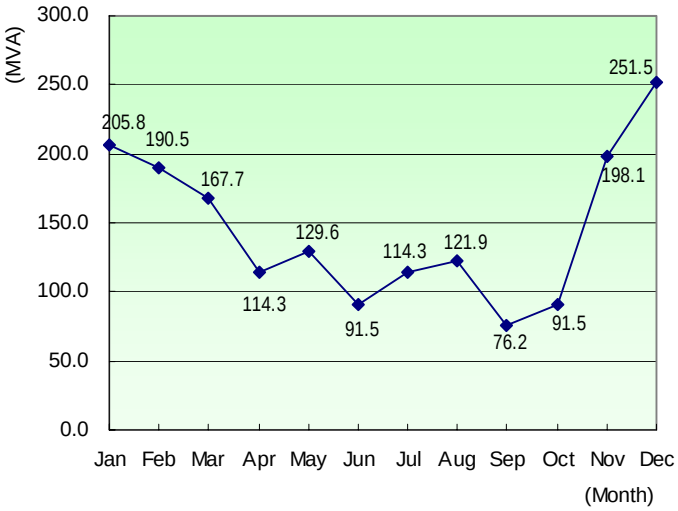


Figure 2.2-2 Monthly Peak Load of Mushviq S/S (2004)

(Source: AZERENERJI)

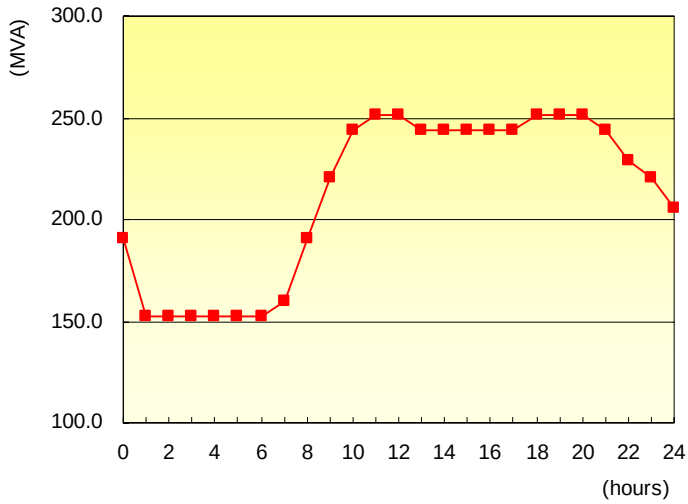


Figure 2.2-3 Daily Load Curve of Mushviq S/S (December 15, 2004)

(Source: AZERENERJI)

The above figures indicate:

- Peak load of Mushviq Substation is recorded in winter during December and January.
- Peak load, recorded in January 2005, was 251.5 MVA.
- From the daily load curve in winter, there are two peaks at 1100～1200 hours and 1800～2000 hours. These occur due to the use of electrical heaters for heating and cooking.

2) Electricity Demand Forecast of AZERENERJI

Although AZERENERJI carried out the national level demand forecast until 2013, there is no demand forecast for each substation under the control of AZERENERJI, which also includes Mushviq Substation. According to AZERENERJI, improvement and augmentation programs for AZERENERJI's substations are made based on an assumed 5% increase in peak demand for each substation, which conforms to customary practices during the era of the Soviet Union. However, considering the recent favorable economic conditions of Baku, a 5% increase is thought to be insufficient for Mushviq Substation.

Instead of the demand forecast, AZERENERJI defines a substation development program based on power supply applications submitted by new customers. In practice, when a new customer wants to be supplied with more than 100 kVA electric power, it shall submit an application for electricity supply directory to AZERENERJI and not to distribution companies like BARMEK. In the case of less than 100 kVA, a customer shall submit it to the distribution company. Although AZERENERJI defines the development program for supply capability after collecting applications, in actual fact there are many uncertainties such as cancellations and/or postponements of construction plans.

Although applications submitted to AZERENERJI amount to 160 MVA in total, with new customers during 2004-2005 accounting for more than 100 kVA, AZERENERJI cannot make a precise prediction because of the above uncertainties.

3) Electricity Demand Forecast by BARMEK

AZERENRJI and BARMEK share data regarding new consumers above 100 kVA. BARMEK carries out the electricity demand forecast for its supply area in conjunction with the shared data and applications for new electricity supply less than 100 kVA submitted to it.

Table 2.2-1 shows BARMEK's demand forecast for Sabail, Yasamal and Nasimi districts until 2020.

Table 2.2-1 Peak Demand Forecast for Sabail, Yasamal and Nasimi Districts

Districts	2010	2015	2020
Sabail	63.5 MVA	64.7 MVA	69.4 MVA
Yasamal	110.0 MVA	144.7 MVA	178.9 MVA
Nasimi	130.0 MVA	189.9 MVA	248.9 MVA
total	303.6 MVA	399.3 MVA	497.2 MVA

Source: BARMEK

From the above table, BARMEK forecasts a total peak demand in 2020 of 497.2 MVA for the three districts.

A proportion of the electricity demand of Nasimi district is, however, supplied by substations other than Mushviq Substation. According to BARMEK, about 80 % of the demand could be supplied by Mushviq Substation considering the system configurations although there is no exact data to confirm this.

To meet the rapidly increasing electricity demand shown in the above table, BARMEK plans to construct three 110 kV substations that will supply electric power directly from Mushviq Substation until 2020.

The requested transformer capacity, 500 MVA (2 x 250 MVA), is able to cover the demand until 2020. In accordance with the daily load curve shown in Figure 2.2-3, the peak demand of Mushviq Substation in winter already exceeds the capacity of one unit of the main transformer (200 MVA) under present conditions. Therefore if one unit of the transformer breaks down scheduled partial load shedding is unavoidable. On this basis the requested transformer capacity of 500 MVA (2 x 250 MVA) is considered reasonable and appropriate.

(2) Capacity of Tertiary Windings of Main Transformer

Regarding the capacity of 10 kV side tertiary winding, the capacity of the existing main transformer is 100 MVA. This is the standard capacity of ZAPAROZH, the transformer manufacturer, and is 50 % of the primary/secondary capacity (200 MVA) and is far in exceedance of the necessary capacity as a stabilizing winding of the transformer. With regard to the basic design, the capacity of the tertiary winding of the main transformer will be minimized to ensure its functional capability as a stabilizing winding.

(3) 10 kV Reactors

The existing 10 kV reactors are installed in the small building behind the existing main power transformer to limit a short circuit current of the 10 kV circuit. The reactors are designed to be installed inside the main power transformers to simplify operation and maintenance under the Project. This will contribute to minimizing project costs because a small building will not be necessary.

(4) 10 kV Cubicles

The existing 10 kV cubicle consists of the following components:

- Incoming feeder panel
- Outgoing feeder panel
- Voltage transformer panel

Metal-enclosed outdoor use-type 10 kV cubicles, which are of the same type of those existing, will be adopted for the Project.

(5) Technical Specifications

Technical specifications of main equipment are as follows:

1)	Main power transformers	2 units	
	i) Type	Three-phase, Oil-immersed type Auto-transformer	
	ii) Cooling	OFAF or ODAF cooling	
	iii) Rated voltage	230 / 121 / 10.5 kV	
	iv) Rated power	HV-MV:	250 MVA
		HV-LV:	25 MVA
		MV-LV:	25 MVA
	v) Rated frequency	50 Hz	
	vi) Connection	YNad11	

vii) Insulation levels

・	HV line terminal	SI / LI / AC	650 / 750 / 360 kV
・	MV line terminal	LI / AC	450 / 185 kV
・	HV / MV neutral	LI / AC	- / 85 kV
・	LV line terminal	LI / AC	75 / 28 kV

*note SI: Switching impulse withstand voltage
LI: Lightning impulse withstand voltage
AC: Short duration AC withstand voltage

viii) On-load tap changer ±6 X 2% (13 taps)

ix) Accessories

- 10 kV current-limiting reactors
- Bushing of each type
- Bushing type current transformers
- Cooling facilities (unit cooler)
- Protection relay of each type, etc.

2) Fire prevention system 2 sets

i) Type Automatic fire prevention system using nitrogen

ii) Service Conditions Outdoor

iii) Main equipment

- Nitrogen cylinder
- Control box, etc.

3) 10 kV Metal-enclosed Switchgear 2 sets

i) System Configurations
- Incoming feeder panel
- Outgoing feeder panel
- Voltage transformer panel

ii) Common Electrical Requirements

- Rated frequency: 50 Hz
- Rated voltage: 12 kV
- Rated normal current: 1,250 A
- Service location: Outdoor
- Degree of protection: IP44

iii) Incoming feeder panel

- Circuit breaker
- Current transformers
- Earthing switches

iv) Outgoing feeder panel

- Circuit breaker
- Current transformers
- Earthing switches

v) Voltage transformer panel
- Voltage transformer
- Power fuse
- Surge arrester

vi) Accessories
- Space heater
- Cooling fan
- Cable bracket, etc.

4) Control panels 2 sets

i) Service location Indoor

ii) Metering
- 220 kV line
  - Ampere with selector switch (Phase A, B and C)
- 110 kV line
  - Ampere with selector switch (Phase A, B and C)
  - Watt with maximum demand
  - Watt-hour
  - Var
  - Power factor
- 10 kV line
  - Ampere with selector switch (Phase A, B and C)
  - Voltage with selector switch (A-B, B-C and C-A)
- Tap position indicator (for OLTC)

iii) Equipment
- Mimic diagram
- Signal lamp
- Selector switch for each meter, etc.

5) Protection relay panels 2 sets

i) Service condition Indoor

ii) Protection
- Overall power transformer main protections
  - Ratio differential current protection (main protection)

- Earth fault protection
- Over current protection
- Short circuit over current protection
- Distance protection (backup protection)

・ Power transformer protection
- Buchholz relay
- Pressure relief device for transformer
- Oil and winding temperature
- Protection for OLTC
- Protection for oil circulation devices
- Protection for cooling fan, etc.

・ 10 kV feeder protection
- Over current protection
- Short circuit over current protection, etc.

6) Power conductors 1 lot

i) 220 kV and 110 kV power conductors are required to connect the main transformers to be supplied under the Project to the existing 220 kV and 132 kV bus conductors.

ii) 220 kV conductors AAC 300 mm^2 or equivalent

iii) 110 kV conductors AAC 400 mm^2 or equivalent

7) Medium voltage power cables 1 lot

i) Medium voltage three-core underground cables shall be supplied and installed to connect from 10 kV side of main transformer to the existing station service transformer via 10 kV metal-enclosed switchgear.

ii) Requirements

・ Type XLPE insulated, PVC sheathed, copper conductor, steel-wire armored cable

・ Cable size 150 mm^2

・ Nominal voltage 10 kV

・ Number of cores three cores

8) 600 V control cables 1 lot

i) 600 V control cables shall be supplied and installed to connect control devices of main transformer, 10 kV metal enclosed switchgear, control panels, protection panels, etc.

ii) Requirements

・ Type 600 V, PVC insulated and PVC sheathed cable with standard copper conductors

- Cable size 2.5, 4, 6, 10 and 50 mm^2
- Number of cores Single or multi cores

2.2.3 Basic Design Drawing

Table 2.2-2 shows the basic design drawings for the Project attached to this report.

Table 2.2-2 Basic Design Drawings

ID	No.	Title
1	AZ_BM_01	Mushviq Substation: Current Layout Drawing
2	AZ_BM_02	Mushviq Substation: Current Single Line Diagram
3	AZ_BM_03	Mushviq Substation: Existing Foundations of the Main Transformers
4	AZ_BM_04	Mushviq Substation: Layout Drawing after the Project
5	AZ_BM_05	Mushviq Substation: Section Drawing after the Project
6	AZ_BM_06	Mushviq Substation: Layout Drawing of the Control Building after the Project
7	AZ_BM_07	Mushviq Substation: Single Line Diagram after the Project

2.2.4 Implementation Plan

2.2.4.1 Implementation Policy

The implementation policy for the Project within the framework of the grant aid system of the Government of Japan is outlined below.

(1) Project Implementing Body

The organization responsible for the implementation of the Project from the Azerbaijan side is the Power Transmission Department of AZERENERJI. Following completion of the installation work of the new transformers under the Project, Baku High-voltage Electricity Network LLC will be responsible for the operation and maintenance of the transformers.

To ensure smooth implementation of the Project, the Power Transmission Department shall maintain close contact and consult with the Japanese Consultant and Contractor, both of which will be selected by the Government of Azerbaijan in accordance with Japan's grant aid system. For this purpose, the Power Transmission Department shall select a person to be responsible for the implementation of the Project. The selected person will be required to explain the contents of the Project to concerned authorities including BARMEK and peripheral people of Mushviq Substation as well as staff members of AZERENERJI with the aim of obtaining their cooperation for the implementation of the Project.

(2) Necessity to Dispatch Japanese Engineers

Since the planned work under the Project is broken into several facets such as temporary work, foundation work, removal and installation of main transformer, installation of peripheral equipment, and tests and commissioning of the equipment during a short construction period, these works must be coordinated efficiently so that periods of power outage can be minimized. Dispatching of a site manager from Japan for the Project will be absolutely essential to provide consistent management and instructions on schedule control, quality control and work safety, particularly as most works will be implemented in parallel.

(3) The Contractor and the Local Contractor

The Contractor, which will be a Japanese corporation selected by the Government of Azerbaijan through open tender in accordance with Japan's grant aid scheme, will conduct the procurement, installation, tests and commissioning of the equipment procured under the Project.

It is possible to utilize local construction companies with sufficient experience in areas such as temporary work, foundation work, installation work, etc. to act as a subcontractor for the Project under the control of Japanese engineers of the Contractor.

2.2.4.2 Implementation Conditions

(1) Points to be Considered for Installation Work

Two (2) main transformer units and peripheral equipment in Mushviq Substation will be replaced under the Project. It is impossible to interrupt the power supply from Mushviq Substation to its supply area for the entire construction period because based on the present power system configurations in Baku there is no alternative substation to supply power to the area. Thus, it is necessary to replace and commission the main transformers individually without power interruption in Mushviq Substation. For that purpose, it is also necessary to formulate a detailed power outage plan and installation plan after thorough discussions with concerned organizations of AZERENERJI.

Points to be considered in formulating the installation plan for the Project are as follows:

1) Both units of new main transformers shall be installed on the same foundations of the existing transformers. The content of the discussions between AZERENERJI and the Study Team on the installation positions of the new main transformers is presented in Appendix 6.

2) To implement the smooth replacement of the first transformer unit during the power outage

period, the work crew of the Contractor shall start the works, which will include land preparation, temporary work, foundation work, laying power and control cables, etc., two months before the outage. In addition, the crew will fabricate the first transformer at a position near the existing operational transformer.

3) To minimize the power outage period, the replacement work of the first transformer shall be executed over a 24-hour period in three shifts because the timing of the replacement is assumed to overlap winter when the load on Mushviq Substation is heavy. Following completion of the first replacement work, operation of the unit shall be started immediately to execute the replacement work for the second unit.

4) Replacement of the second transformer unit will be carried out only in the daytime because the larger capacity of the first transformer can meet power supply requirements without any outage.

5) The Contractor shall dispatch at least one site manager from Japan to provide total management on schedule control, installation work, quality control and work safety during the entire construction period. An additional two engineers shall be dispatched from Japan during the 24-hour periods for replacement. For the site tests and commissioning of the equipment, manufacturer's inspectors shall be dispatched.

(2) Points to be Considered for Procurement of Equipment

1) Equipment Design

In the design of the control panels and protection panels to be procured, a structural interface against the existing equipment shall be considered to secure consistency in performance. Since the foundations of main transformers will utilize those of the existing ones (after surface refurbishment), the transformers to be procured shall be designed based on the size and position of the existing foundations.

2) Procurement Management

For smooth implementation within the defined period of site works, it is absolutely necessary to transport on schedule the equipment and materials to be procured. Since the period for marine and inland transportation from Japan to Azerbaijan is expected to be about two months, the Contractor shall undertake procurement management paying careful attention to on-time procurement and manufacturing of equipment and materials. For example, all necessary documents for transportation shall be properly prepared to ensure smooth customs clearance at each customs checkpoint so as not to impact on the progress of the Project.

3) After-sales Services

As it is necessary for the Contractor to provide after-sales services in terms of supply of spare parts and repair of breakdowns associated with the new equipment, the Contractor must pay proper attention to continual liaison with AZERENERJI.

2.2.4.3 Scope of Works

Regarding the construction, procurement and installation under the Project, the scope of works for the Japanese and Azerbaijan sides is shown in Table 2.2-3.

Table 2.2-3 Scope of Works

Items	In Charge	Note
1. Procurement of Equipment		
1) 220/110/10 kV, 250 MVA Main Power Transformer	Japan	
2) Nitrogen Type Fire Prevention System	Japan	
3) 10 kV Metal-enclosed Switchgear	Japan	
4) Control Panels for TR	Japan	
5) Protection Panels for TR	Japan	
6) 220 kV & 110 kV Power Conductors with Accessories	Japan	
7) 10 kV Power Cables with Accessories	Japan	
8) 600 V Control Cables with Accessories	Japan	
9) Spare Parts	Japan	
2. Installation Work		
1) Installation, adjustment and tests of all the above equipment	Japan	
2) Reinforcement of transformer foundations	Japan	
3) Foundation work, temporary work, etc.	Japan	
4) Demolition and restoration of the existing main gate of Mushviq Substation, if necessary	Azeri	
5) Execution of the power cut for installation work	Azeri	
6) Execution of the scheduled partial load shedding, if necessary	Azeri	
7) Removal of the existing equipment, which is to be an obstacle against the installation work under the Project, such as the existing main transformers, fire fighting system, control panels, etc. and delivery of them to the appointed place	Japan	
8) Removal of the existing equipment, which is not to be a obstacle against the installation work under the Project, such as the existing 10 kV cubicles, 10 kV reactors and their small buildings, 10 kV cables, part of pipes of fire fighting system, etc. except the above item 7)	Azeri	This is out of the scope of works.

All main electrical equipment such as main transformers, fire prevention system, 10 kV cubicles, control and protection panels, etc. and peripheral equipment such as power conductors, power cables, control cables, and accessories shall be procured and installed by the Japanese side under the Project.

The Azerbaijan side shall execute the demolition and restoration of the existing main gate of Mushviq Substation, the power cut for installation work and the scheduled partial load shedding after coordinating with concerned organizations, if necessary, under the Project.

Removal of the existing equipment such as the existing main transformers, fire fighting system, control panels, which would otherwise be an obstacle during the installation work, shall be executed by the Japanese side. However, the existing equipment, which would otherwise be an obstacle to installation work such as the existing 10 kV cubicles, 10 kV reactors and their small buildings, 10 kV cables, parts of pipes of the fire fighting system, etc. shall be removed by the Azerbaijan side after the Project is completed. These works are not covered in the Project.

2.2.4.4 Consultant Supervision

(1) Basic Policy

The basic policy of consultant supervision for the Project is outlined below:

1) In accordance with Japan's grant aid scheme, the Consultant will organize the project supervision team to execute smooth implementation of the Project based on the basic design.

2) The Consultant will supervise the Contractor to ensure the performance and quality of the equipment indicated in the contract and punctual completion of the Project work within the scheduled period. The Consultant will also supervise the Contractor in safely executing site works.

(2) Consultant's Obligations

A Japanese consulting firm will conclude a consultancy agreement with the Government of Azerbaijan in accordance with Japan's grant aid scheme. The major obligations of the Consultant to be included in the agreement are as follows:

1) Detailed Design and Preparation of Tender Documents

i) Detailed Design

Based on the results of the basic design study, the Consultant will execute the detailed design for the Project through additional site survey. This will be discussed with AZERENERJI to confirm the Project costs and obligations of the Azerbaijan side. Prior to preparation of Tender Documents, the Consultant will confirm equipment design, estimation of Project costs and formulation of the implementation program.

ii) Preparation of Tender Documents

The Consultant will prepare Tender Documents for the Project in accordance with Japan's grant aid scheme.

2) Project Supervision

i) Works for Tender

On behalf of AZERENERJI, the Consultant will undertake the announcement, preparation of clarifications, tender opening, tender evaluation, contract negotiation with successful tenderers and assistance for conclusion of the Contract for the Project.

ii) Project Supervision

The Consultant will supervise the Project through a kick-off meeting, checking of shop drawings and specifications of the equipment, factory inspection before shipment, supervision of installation work on site, preparation of several reports, issuing the intermediate performance certificate, commissioning tests, etc. to ensure smooth execution of the Project.

iii) Works on and after Completion of the Project

On completion of the Project, the Consultant will issue the completion certificate, handover of equipment, and preparation of the completion report. One year later, the Consultant will carry out equipment inspections at the end of the defect liability period.

(3) Staffing Schedule of the Consultant

The staffing schedule of the Consultant to conduct the above works is as follows:

1) Detailed Design and Preparation of Tender Documents

The following staff of the Consultant will be necessary for the detailed design and preparation of Tender Documents.

Table 2.2-4 Staffing Schedule for Detailed Design and Preparation of the Tender Documents

Position	Works in Charge
Project Manager	Detailed design, Preparation of Tender Documents, Overall management regarding the Tender, Reviewing the Equipment Plan
Substation Design	Design of the electrical equipment including main transformers, peripheral equipment, etc.
Cost Estimate / Implementation Plan	Cost estimation, preparation of transportation and implementation plan
Interpreter (Japanese)	Interpretation of Russian to Japanese during site survey and the tender
Interpreter (Azeri)	Interpretation of Azeri/Russian to English during site survey

2) Project Supervision

The following staff of the Consultant will be necessary for Project supervision.

Table 2.2-5 Staffing Schedule for Project Supervision

Position	Works in Charge
Project Manager	Overall management of the Project
Substation Engineer-1 (on-site engineer)	Supervision of the works at site, payment procedure, management of the procurement of the equipment, control of the Project schedule, quality control and safety control
Substation Engineer-2	Supervision of the installation work during the power outage period
Substation Engineer -3	Supervision of the installation work during the power outage period
Inspection Engineer-1	Checking the shop drawings and specifications
Inspection Engineer-2	Attendance to the factory tests and commissioning tests
Interpreter	Interpretation of Azeri/Russian to English during site work period

2.2.4.5 Quality Control Plan

The quality control plans for the Project are as follows:

1) Check of design drawings

The Contractor shall submit the design drawings of all equipment and materials and drawings with regard to the installation work. The Consultant will check these drawings to ensure they meet the requirements described in the Contract documents.

2) Factory Tests

All equipment to be procured shall in principle be tested before shipment. The Consultant will witness the factory tests for major equipment including main power transformers to check the equipment conforms to the approved drawings and specifications.

3) Pre-ship Inspection

To ensure shipment of the equipment, a third inspection institute will carry out a pre-ship inspection, including checking of the packing lists at the shipping port.

4) Site Tests

Accomplishment of the installation work shall be checked through the site tests. The tests will include pre-commissioning tests to check the equipment before energizing and commissioning tests to check comprehensive performance after energizing. The Contractor shall carry out the tests in witness whereof the Consultant and AZERENERJI.

5) Defect liability period

All equipment to be procured under the Project shall be guaranteed against defects for one year.

2.2.4.6 Procurement Plan

(1) Utilization of Local Companies

There is a Turkish cable manufacturer in Baku who has exported to some Caucasian and Central Asian countries. To check on the possibility of local procurement of 10 kV and control cables under the Project, the study team visited the manufacturer and obtained a quotation. Based on this, it is thought to be difficult to procure the cables from this manufacturer because of quality and quantity issues in terms of meeting the manufacturing order.

Some construction materials for foundation work and temporary work such as concrete, reinforcing bar, steel plate, etc. are available locally. Heavy machinery and vehicles such as large-scale cranes, power shovels, etc., can be rented locally. Testing equipment necessary for the site tests will be brought from Japan.

(2) Eligible Countries

Regarding the eligible countries for the main transformers, the Study Team obtained price quotations from transformer manufacturers in Ukraine, Europe and Japan and closely examined each from the viewpoints of price and quality. As a result of the overall examination and considering not only initial cost but also O&M cost, quality, reliability, etc., there is considered to be no price difference between Japanese and European manufacturers. It is considered that the main transformers to be procured under the Project shall be Japanese-made although the Ukrainian-made transformer is about 20 percent cheaper than those made in Japan or Europe. In addition, competitive bidding for Project implementation can be realized even if the transformer is limited to those from Japan because it has been confirmed that five or more Japanese manufacturers can produce the autotransformer satisfying the requirements.

Other equipment such as 10 kV cubicle, control and protection panels, etc. shall also be Japanese-made from the viewpoint of quality. The only exception is the fire-prevention system using nitrogen. This can be European-made because no Japanese manufacturer produces the same type of system.

(3) Spare Parts

AZERENERJI requested spare parts for main transformers and peripheral equipment be add to the project requirements during the site survey period. Considering the importance of Mushviq Substation, it is considered that including a minimal amount of spare parts in the scope of the Project is appropriate because they are absolutely imperative for long-term O&M by AZERENERJI after completion of the Project. After examining the requested items and

quantities of spare parts, they are considered reasonable and acceptable.

(4) Transportation Plan

There are four possible alternative transportation routes from Japan to Azerbaijan as shown below:

① Landing at Bandar'abas in Iran, and to Baku via Teheran by road
② Transshipment at Antwerp and Saint Petersburg, and to Baku through the Volga and the Caspian Sea by ship
③ Transshipment at Antwerp, landing at Saint Petersburg and to Baku by rail
④ Transshipment at Istanbul, landing at Poti in Georgia, and to Baku by trailer and rail

Table 2.2-6 shows the comparison of the 4 alternatives.

Table 2.2-6 Comparison of Transportation Routes

Routes	Conditions
① Landing at Bandar'abas (BA) in Iran, and to Baku via Teheran by road Min. period: 31 days Max. period: about 5 weeks	Marine transportation period: about 3 weeks (from Japan to BA) Inland transportation distance: about1,800 km (from BA to Baku) Conditions: It is very difficult to transport the main body of the transformer because of the road regulation of Iran Inland transportation period: 10-14 days Custom duty at BA: none (Transit Cargo) Custom clearance fee of Azerbaijan: 0.1- 0.3 % of CIF Custom duty of Azerbaijan: free upon application of tax exemption
② Transshipment at Antwerp and Saint Petersburg (SP), and to Baku through the Volga and the Caspian Sea by ship Min. period: about 8 weeks Max. period: about 8.5 weeks	Marine transportation period: about 2 months (from Japan to Baku) Close period of the Volga: from November to April Custom duty at SP: CIF 0.1% (Russian Tax) Custom clearance fee of Azerbaijan: 0.1- 0.3 % of CIF Custom duty of Azerbaijan: free upon application of tax exemption Inland transportation period: 2 days inside Baku. There is no problem on the road conditions.
③ Transshipment at Antwerp, landing at Saint Petersburg (SP), and to Baku by rail Min. period: about 6 weeks Max. period: about 6.5 weeks	Marine transportation period: about 1 months (from Japan to SP) Rail transportation period: about 10 to 14 days Custom duty at SP: CIF 0.1% (Russian Tax) Custom clearance fee of Azerbaijan: 0.1- 0.3 % of CIF Custom duty of Azerbaijan: free upon application of tax exemption Inland transportation period: 2 days inside Baku. There is no problem on the road conditions.
④ Transshipment at Istanbul, landing at Poti in Georgia, and to Baku by trailer and rail Min. period: about 7 weeks Max. period: about 7.5 weeks	Marine transportation period: about 40 days (from Japan to Poti) Rail transportation period: about 3 days Inland transportation period: about 12 days . There is no problem on the road conditions. Custom duty at Poti: none (Transit Cargo) Custom clearance fee of Azerbaijan: 0.1- 0.3 % of CIF Custom duty of Azerbaijan: free upon application of tax exemption

Item ①, although being the shortest in terms of time for transportation from Japan, is to be excluded because there are weight limits on the road for the cargo to third countries according to Iranian regulations. Item ② is also to be excluded because the Volga freezes during winter from November to April, which overlaps with the planned transportation time for the Project.

For items ③ and ④, although there are both good and bad points, item ④, which involves transshipment at Istanbul, landing at Poti in Georgia and then to Baku by trailer and rail, is the considered to be the optimum. This will be applied for the Project from the viewpoint of transportation costs, custom duties at the landing port, etc.

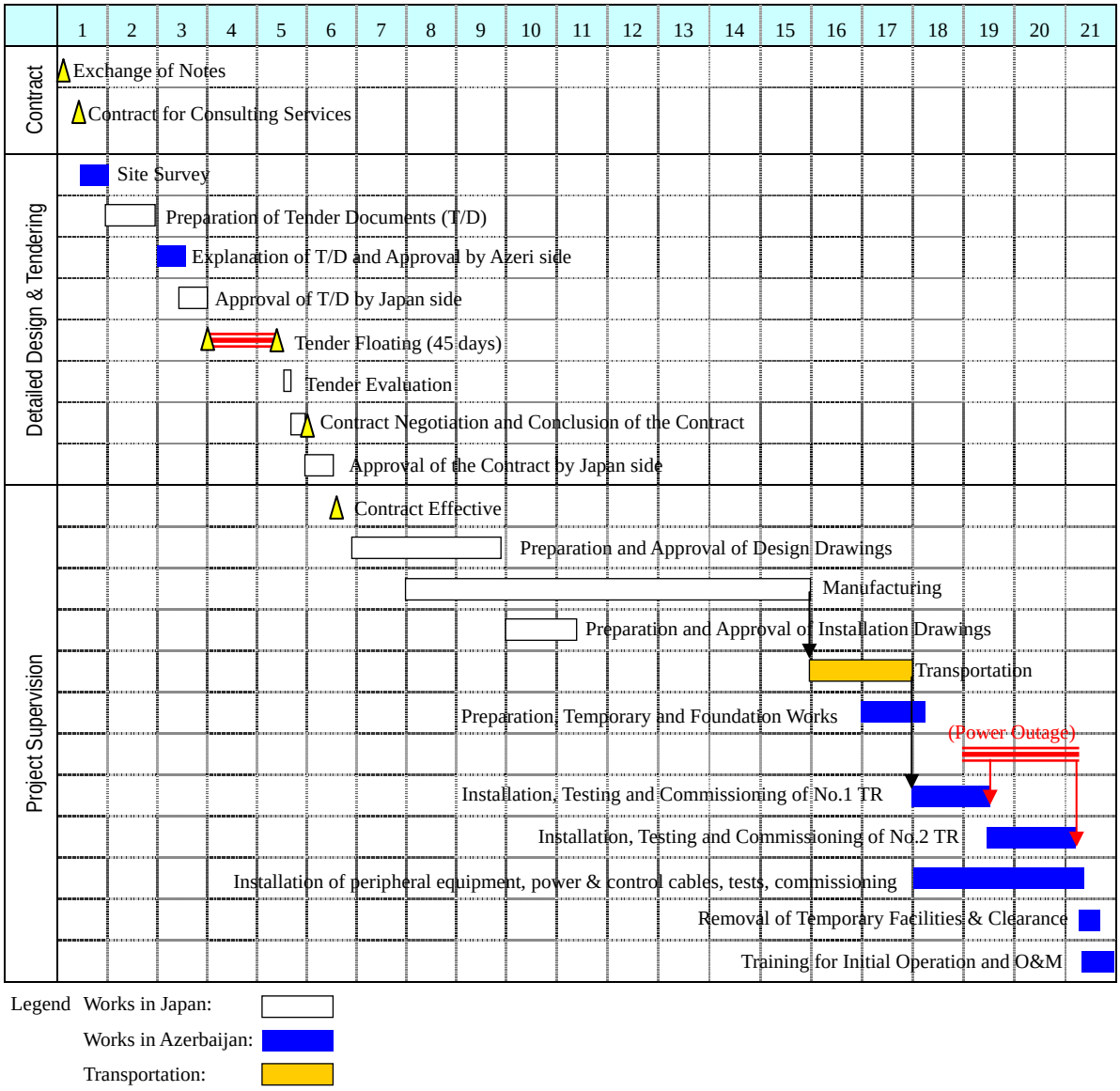
During the Soviet Union era, cargo destined for Azerbaijan was normally transported by rail from the landing port as the rail transport network was well developed. The cargo for the Project is to be transported from the landing port to Baku by rail using a special low-bed wagon and then transshipped to trailers using 200 ton cranes at the handling place. It will then be conveyed to Mushviq Substation taking a roundabout route of Baku City.

Figure 2.2-4 Transportation Route Alternatives

2.2.4.7 Implementation Schedule

The estimated period of the implementation schedule for the project is approximately 21 months from the exchange of notes between the Government of Azerbaijan and the Government of Japan to the completion of the Project as shown in Table 2.2-7.

Table 2.2-7 Implementation Schedule



2.3 Obligation of Recipient Country

In this Project, the following works are considered as obligations of the Azerbaijan side.

(1) Demolition and Restoration of Main Gate

Since the width of the existing main gate of Mushviq Substation is narrow (only 4.25 m), it could be an obstacle for carrying in the new main transformer. As a result of discussions during the site survey, AZERENERJI will carry out demolition and restoration of the gate.

(2) Execution of Power Outage and Load Shedding

AZERENERJI will execute power cuts for installation work to proceed responsibly. These will follow detailed discussions with the Consultant and the Contractor on the timing and period, and arrangements with concerned organizations including BARMEK.

It is necessary to execute the replacement work of the first main transformer unit while maintaining power supplies by using the one existing main transformer (with a capacity of 200 MVA). Even if the transformer load exceeds capacity, AZERENERJI will maintain power supplies from other substations in coordination with BARMEK to avoid scheduled partial load shedding to customers.

(3) Other Necessary Support

- To bear the advising commissions of Authorization to Pay (A/P) and the payment commissions to the Japanese bank for banking services based upon Banking Arrangement (B/A)
- To ensure unloading, customs clearance and tax exemption of equipment to be procured under the Project in Azerbaijan
- To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies, which may be imposed in Azerbaijan with respect to the supply of the products and services under the verified contracts
- To bear all expenses, other than those to be borne by the Grant Aid, necessary for the transportation and installation of the equipment

The Azerbaijan side shall remove the existing equipment, which would otherwise be an obstacle to the installation work, such as the existing 10 kV cubicles, 10 kV reactors and their small buildings, 10 kV cables, parts of pipes of the fire fighting system, etc., after the Project. This

work shall not be covered by the Project.

2.4 Project Operation Plan

(1) O&M Staff

Following completion of the Project, operation and maintenance staff in Mushviq Substation under the Baku High-voltage Electricity Network LLC will carry out O&M work for the substation equipment. There is a staff of 19 working at the substation in 12-hour shifts. This includes the director, operators and maintenance staff. Their work includes:

1) Recording of operation data in log sheet
   The operators record data such as voltage, current and active power, etc. in the prescribed log sheet every 30 minutes.

2) Network operations
   The operators carry out open-close operations of substation switchgear in accordance with orders from the Central Load Dispatching Center.

3) Response to trouble and accidents
   In the event of minor failure and accidents to the electrical equipment in Mushviq Substation, maintenance staff carries out urgent restoration work. When a heavy breakdown occurs, which is impossible to restore instantaneously, the recovery work is planned and executed under the Power Transmission Department of AZERENERJI headquarters and Baku High-voltage Electricity Network LLC.

4) Inspection and maintenance work
   The maintenance staff carries out daily and periodic checks/inspections demanded for the equipment.

It is judged that it is not necessary to increase the number of substation staff as the basic function of the equipment will not be changed from present and AZERENRJI has over 20 years of experience and sufficient staff in the operation and maintenance of Mushviq Substation.

(2) Inspection and Maintenance Works

Inspection works include daily and periodic inspections, which are carried out at 3 to 6 monthly intervals.

Table 2.4-1 shows items of daily and periodic inspections for the equipment.

Table 2.4-1 Items of Daily and Periodical Inspections

Equipment	Daily Inspection	3-monthly Inspection (unless otherwise mentioned)
Main transformer	・ Abnormal sound and vibration ・ Abnormal temperature rise ・ Insulation oil volume ・ Oil leakage	・ Absorbent condition (check and replace) ・ N_2 gas pressure ・ Deterioration test on insulation oil (every year)
Control and Protection panels	・ Conditions of meters and lamps	・ Cleaning ・ Relay test (5 – 6 years interval)
10 kV cubicles	・ Abnormal sound and vibration ・ Conditions of meters and lamps	・ Cleaning ・ Operation test on circuit breakers ・ Relay test (5 – 6 years interval)

The above works, including corrective maintenance work, can be undertaken by AZERENERJI from both the technical and financial viewpoints. To ensure the expected service life of the equipment after completion of the Project, as a minimum it is required to exchange the consumable and wearing parts of the equipment based on inspection and maintenance criteria. AZERNERJI is required to formulate the implementation plan for the works and to secure the necessary budget without any delay.

2.5 Estimated Project Cost

2.5.1 Estimated Project Cost

In the case of the Project's implementation under Japan's grant aid scheme, the total project cost is estimated to be approximately 871 million Japanese Yen (Japanese side: approx. ¥870 million, Azerbaijan side: ¥1.4 million). The cost breakdown based on the division of work between the Japanese and Azerbaijan sides is outlined in Clauses (1) and (2) below, respectively, based on the conditions listed in Clause (3) below.

This cost estimate, however, is provisional and would be further examined by the Government of Japan for approval of the Grant.

(1) Japanese Portion

The estimated cost of the Japanese Portion is shown in Table 2.5-1.

Table 2.5-1 Estimated Cost of Japanese Portion

Items		Estimate Cost
(1)	Procurement Cost	812 million Yen
	a) Equipment	(561 million Yen)
	b) Transportation & Installation, etc.	(251 million Yen)
(2)	Detailed Design and Work Supervision	58 million Yen
	Total	870 million Yen

(2) Azerbaijan Portion

① Removal and restoration of the main gate US$ 6,100
② B/A and A/P (0.1% of the procurement cost) US$ 8,100

Total US$14,200

(3) Estimation Conditions

① Date of Estimation: September 2005
② Foreign Exchange Rate: US$1 = JPY 109
③ Project Period As described in Sub-section 2.2.4.7
④ Others: The Project will be implemented in accordance with the Guidelines for Japan's Grant Aid Cooperation

2.5.2 Operation and Maintenance Cost

Table 2.5-2 shows the actual O&M cost for 2002 - 2004 and budget for 2005 allocated to Baku High-voltage Electricity Network Limited Liability Company, which manages seven substations including Mushviq Substation and related transmission lines in Baku.

Table 2.5-2 O&M Cost of Baku High-voltage Electricity Network LLC

2002	2003	2004	2005 (planned)
1,187 mil. AZM (US$258,000)	2,618 mil. AZM (US$569,100)	3,586 mil. AZM (US$779,500)	9,858 mil. AZM (US$2,143,000)

Source: AZERENERJI

O&M cost shown in the above table includes personnel cost of substation staff and maintenance staff for transmission lines, procurement cost for spare parts, cost for planned maintenance and repair, etc. Most of the O&M cost, which is increasing annually, is allocated to the purchase of spare parts and maintenance and repair of the damaged/deteriorating equipment and not for replacement.

Since O&M work for the equipment to be procured under the Project will be carried out by the existing staff of Mushviq Substation, it is not necessary to employ new O&M staff as part of the implementation of the Project. The annual personnel cost of the staff of 19 people in Mushviq Substation as of 2005 was about 156.4 million AZM (approx. US$34,000) in total, which accounts for only 1.6% of the overall budget. Moreover, it is difficult to identify the O&M cost including procurement cost for spare parts allocated separately to Mushviq Substation because the Company headquarters manages all spare parts for the substation equipment in a concentrated manner and not for each substation. It also makes an arrangement for delivery of newly purchased parts upon request from each substation.

To implement the Project will surely contribute to the reduction of costs allocated for the repair and maintenance of the damaged/deteriorating equipment because the requested equipment under the Project will be for replacement and not for new installation. Therefore, the O&M cost for the new equipment including procurement of the spare parts can be subsidized if the budget for the O&M is maintained in the future.

2.6 Other Relevant Issues

To realize the smooth implementation of the Project, the Azerbaijan side shall execute in a timely manner all obligations described in Section 2.3 in accordance with the progress of the Project. In particular, the most important item is “execution of the power outage” during the replacement work of the main transformers.

It is necessary to execute the replacement work of the first transformer unit while maintaining the power supply using only one existing 200 MVA transformer, since Mushviq Substation is one of the most important substations supplying power to the center of Baku. It is also impossible to interrupt the supply for the entire period of construction based on the system configurations. To minimize the period of power outage for the replacement work of the first unit, a 24-hour period based on three shifts work is planned because timing of the replacement is assumed to overlap with winter (when the load on Mushviq Substation is heavy). AZERENERJI shall execute the power outage responsibly and in accordance with detailed discussion with the Consultant and the Contractor on the timing and period, and arrangements with the concerned organizations including BARMEK.

Even if the load of the transformer exceeds the capacity, AZERENERJI shall maintain power supplies from the other substations in coordination with BARMEK to avoid scheduled partial load shedding to the customers.

Chapter 3

Project Evaluation and Recommendations

Chapter 3 Project Evaluation and Recommendation

3.1 Project Effect

The main objective of the Project is to strengthen the power supply capability of Baku by replacing the main power transformers and peripheral equipment of Mushviq Substation. The direct and indirect positive effects of the Project are described below.

(1) Direct Effect

The maximum direct effect of the Project is to increase transformer capacity from 400 MVA (2 units×200 MVA) to 500 MVA (2 units×250 MVA). Even if one unit of the main transformer of Mushviq Substation fails causing a supply disruption, load shedding or long term blackouts will be averted and many effects such as stable power supply, improvement in reliability, reduction of power outage period, etc. will be expected with this increase in power supply capacity by the Project.

Moreover, implementation of the Project and replacement of old and deteriorating equipment by more reliable units will lead to a reduction in the cost and time for repair and maintenance and less environmental risk such as soil contamination through leakage of insulation oil.

The number of beneficiaries of the Project is about 550,000 people, including about 60,000 refugees and internally displaced persons (IDPs) living in Sabail, Yasamal and Nasimi districts.

Table 3.1-1 summarizes the direct effects of the Project.

Table 3.1-1 Direct Effects of the Project

Current Status & Issues	Countermeasures	Direct Effects
Main power transformers in Mushviq S/S are FSU-made and were installed in 1986. Electric power demand in Baku is increasing rapidly and it is anticipated that the demand will exceed rated capacity of the transformers in a few years. In the worst case, massive blackouts in the center of Baku may occur due to a shutdown of the substation.	The existing 2 units of 200 MVA main transformers in Mushviq S/S will be upgraded to 2 units of 250 MVA and peripheral equipment will also be replaced under the Project.	Even if one unit of the main transformer of Mushviq S/S fails causing a supply disruption, load shedding or long term blackouts will be averted and many effects such as stable power supply, improvement in reliability, reduction of power outage period, etc. will be expected with increased transformer capacity from 400 MVA to 500 MVA.
Since most of AZERENERJI's electric power facilities were constructed in the FSU era and are now aged and deteriorating, the O&M cost for these facilities is increasing annually.	- ditto -	Replacement of old and deteriorated equipment by more reliable units will lead to reduction of the cost and time for repair and maintenance.
From the environmental viewpoint, there is a potential hazard of soil contamination by leakage of insulation oil from existing transformers.	- ditto -	Replacement of old and deteriorated equipment by more reliable units will lead to less environmental risk such as soil contamination by leakage of insulation oil.

(2) Indirect Effect

Indirect effects expected by the implementation of the Project are as follows:

① Contribution to Basic Human Needs (BHN) such as improvement of capability of medical and educational institutions and living of inhabitants and refugees/IDPs with the realization of a reliable electric power supply

② Activation and stabilization of the social and economic activities with the stable power supply in the center of Baku

3.2 Recommendations

To maximize and maintain the positive effect of the Project and to ensure the long-term operation of the equipment, the Azerbaijan side should meet the following requirements after completion of the Project:

① AZERENERJI should secure the current level of budget for O&M, not only for the equipment to be procured under the Project, but also for the existing equipment to maintain normal operation of Mushviq Substation as the primary substation.

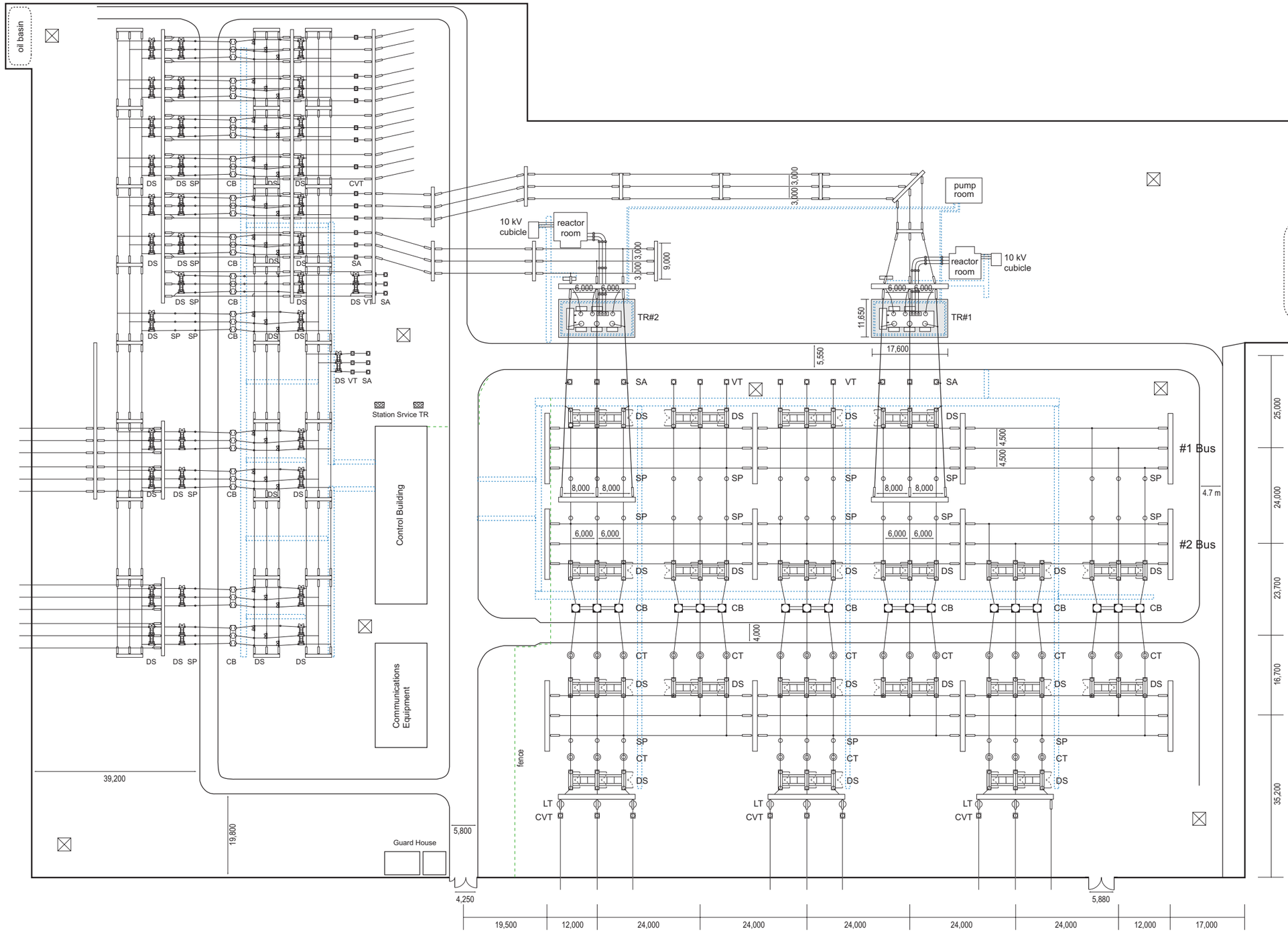
② AZERENERJI should systematically execute maintenance and checking for the purpose of maintaining the performance of the equipment, early detection of failures, and prevention of accidents. In addition, AZERENERJI will need to create a database to record all incidences of O&M, failures and accidents. The database will then need to be used as efficiently as possible to formulate the O&M plans and to secure a sufficient budget.

③ Training on preliminary operation and operation and maintenance of the equipment for the substation staff to be undertaken by the manufacturer's trainer will be executed during the site work period as part of the Project. To realize proper operation and maintenance of the equipment to be procured under the Project, it is necessary to ensure all substation staff undertake the necessary training.

In addition, although there are no other donor plans relating directly to the Project, the European Commission (EC) carried out a grant aid project for Mushviq Substation in 2002 to secure stable power supply to the refugee-inhabited area. It is believed that execution of the Project by Japan's grant aid system will contribute significantly to the improvement of living conditions of refugees and match closely the aims of the EC project.

Drawings

AZ_BM_01	Mushviq Substation: Current Layout Drawing
AZ_BM_02	Mushviq Substation: Current Single Line Diagram
AZ_BM_03	Mushviq Substation: Existing Foundations of the Main Transformers
AZ_BM_04	Mushviq Substation: Layout Drawing after the Project
AZ_BM_05	Mushviq Substation: Section Drawing after the Project
AZ_BM_06	Mushviq Substation: Layout Drawing of the Control Building after the Project
AZ_BM_07	Mushviq Substation: Single Line Diagram after the Project



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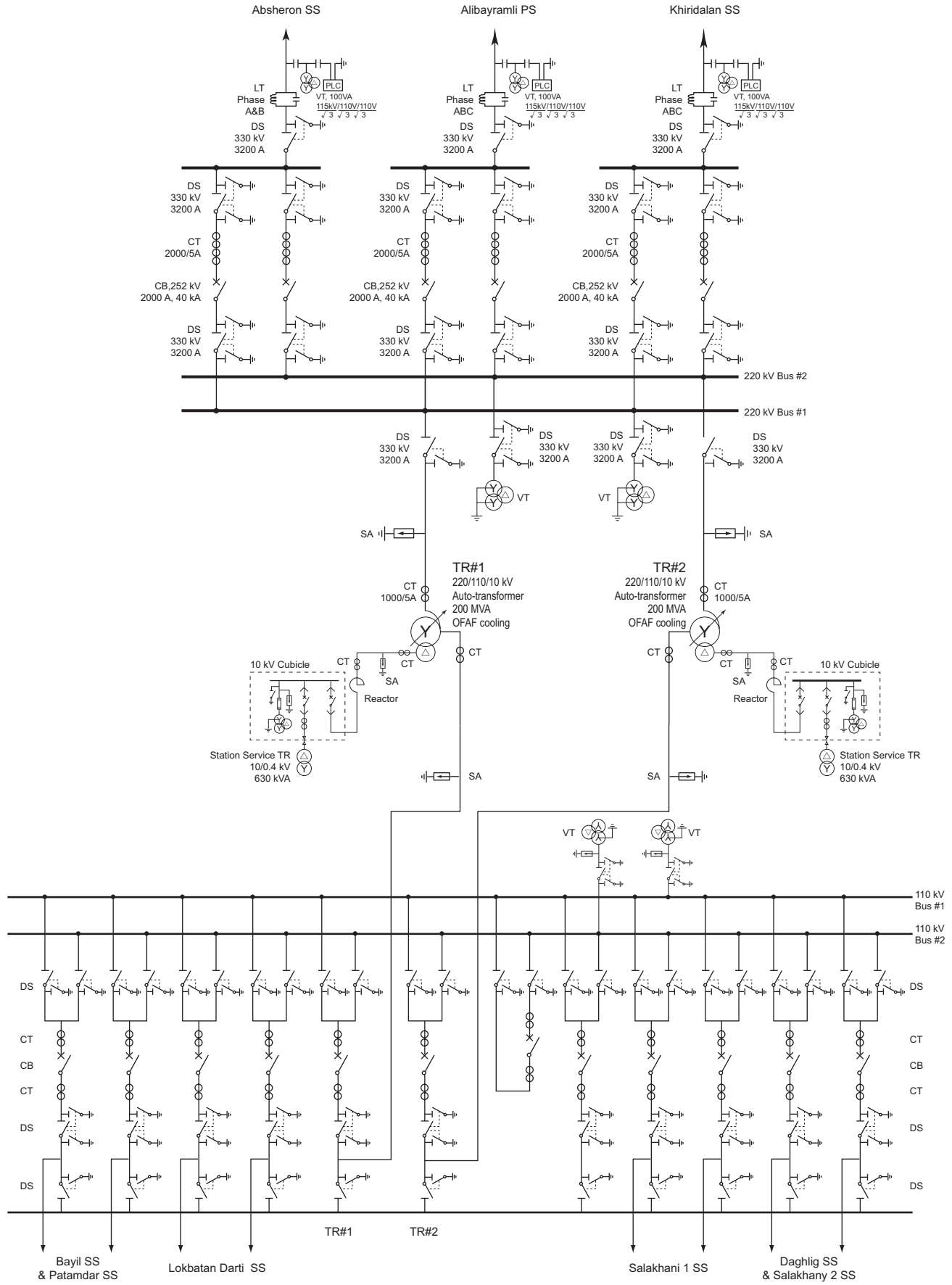
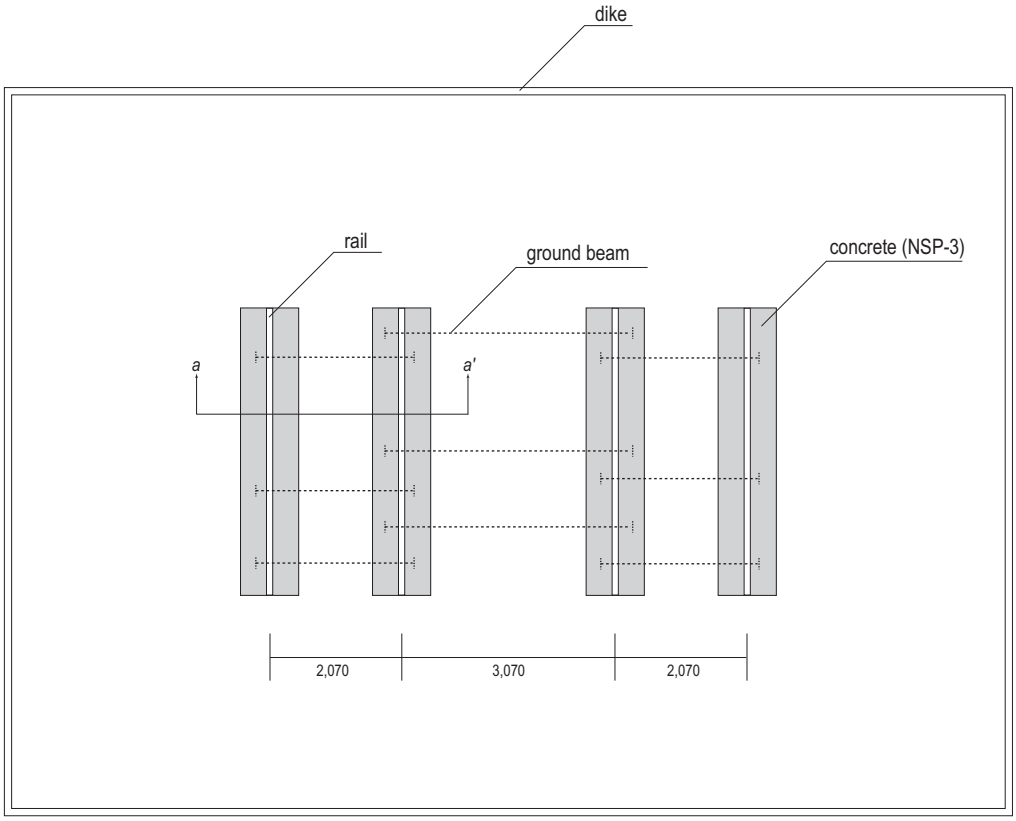
REFERENCE ONLY

The Basic Design Study on the Project for Improvement of Mushviq Substation in the Republic of Azerbaijan	AZERENERJI Joint Stock Company	Drawing No.	AZ_BM_01
	Japan Internatonal Cooperation Agency	Title	Mushviq Substation: Current Layout Drawing
	Nippon Koei Co., Ltd.		

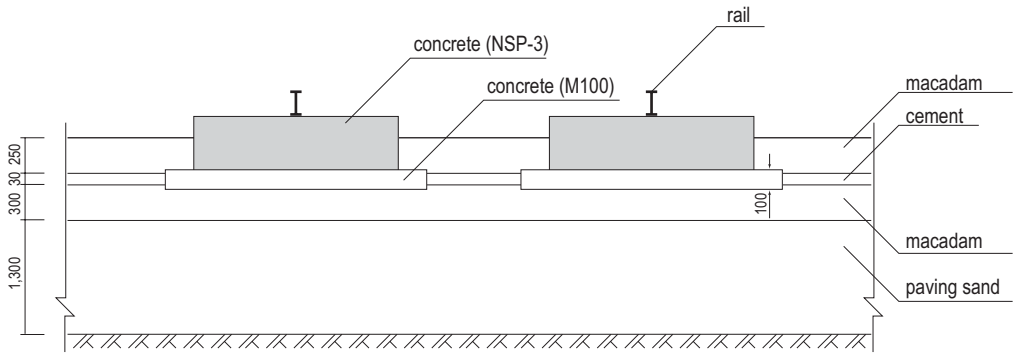


REFERENCE ONLY

The Basic Design Study on the Project for Improvement of Mushviq Substation in the Republic of Azerbaijan	**AZERENERJI Joint Stock Company**	**Drawing No.**	AZ_BM_02
	Japan Internatonal Cooperation Agency	**Title**	Mushviq Substation: Current Single Line Diagram
	Nippon Koei Co., Ltd.		



Layout



Section a - a'

Source: AZERENERJI Joint Stock Company

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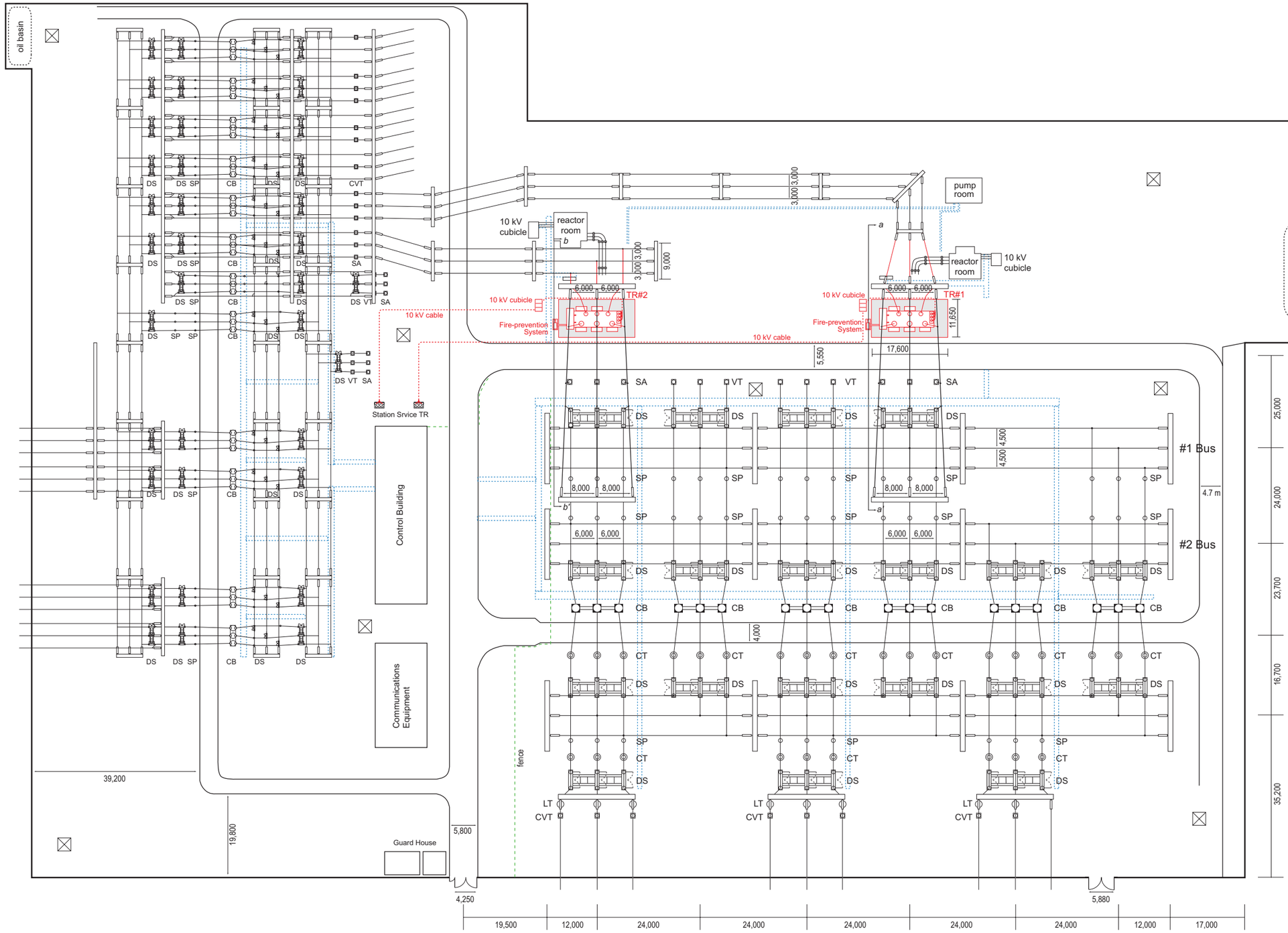
REFERENCE ONLY

The Basic Design Study on the Project for Improvement of Mushviq Substation in the Republic of Azerbaijan	**AZERENERJI Joint Stock Company**	**Drawing No.**	AZ_BM_03
	Japan Internatonal Cooperation Agency	**Title**	Mushviq Substation: Existing Foundation of the Main Transformer
	Nippon Koei Co., Ltd.		

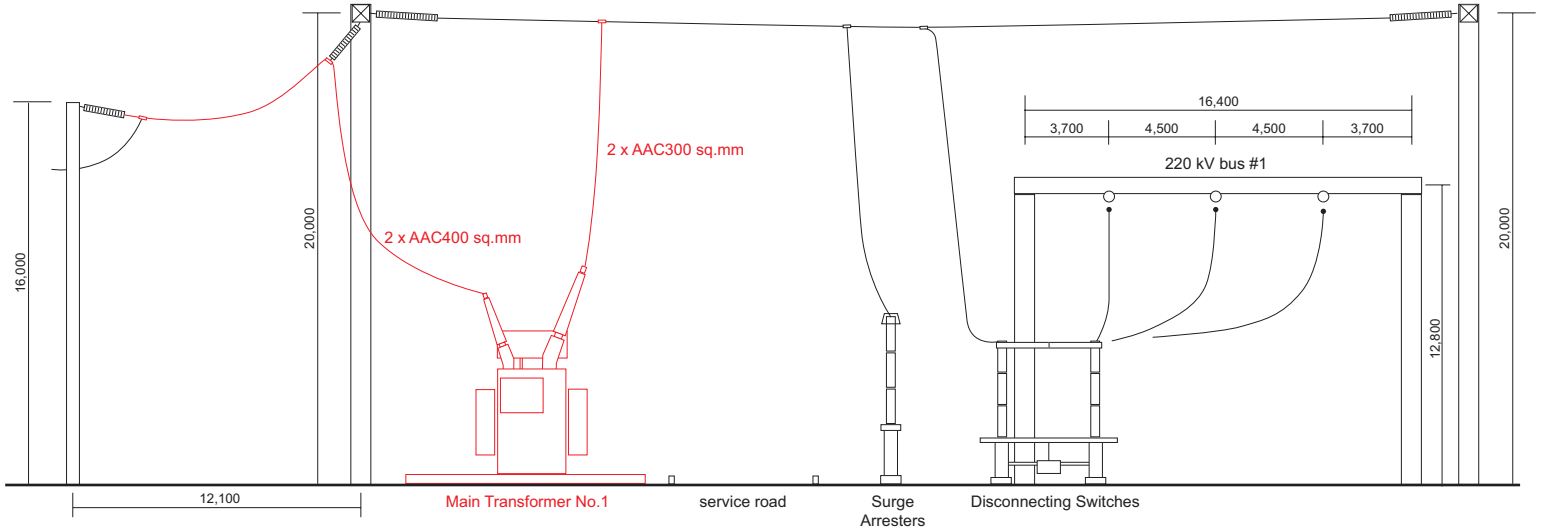


Not to scale

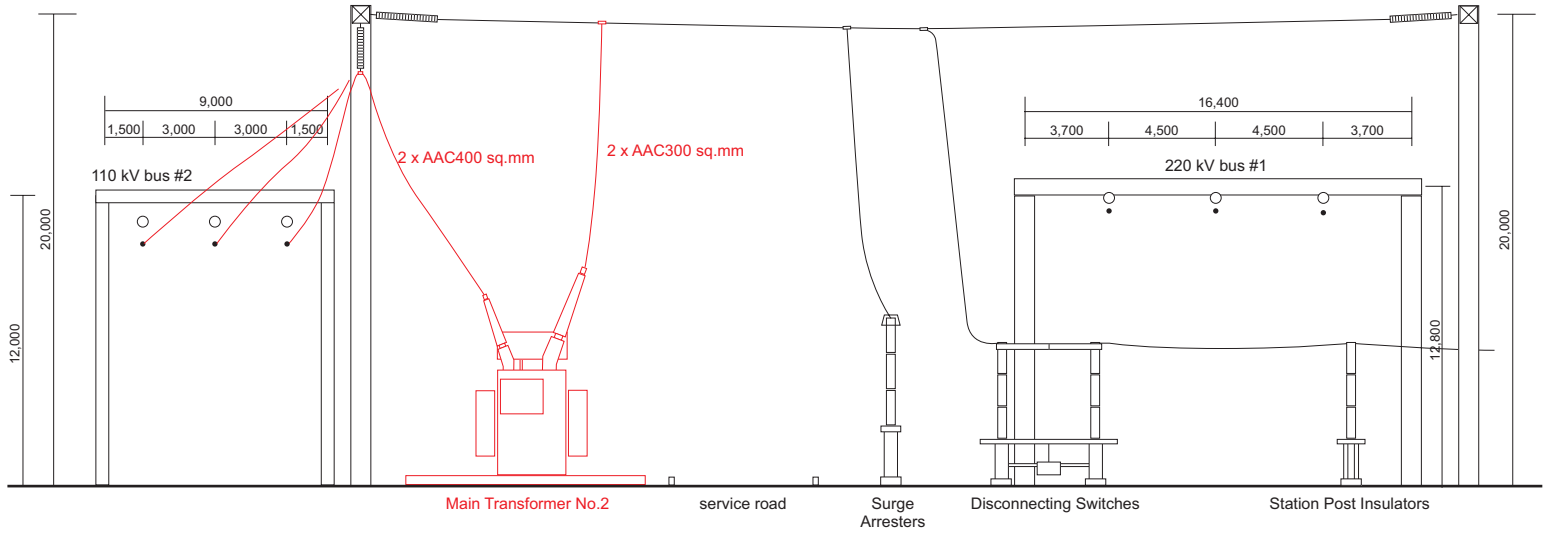
REFERENCE ONLY

赤字：本プロジェクトの調達・施工範囲

The Basic Design Study on the Project for Improvement of Mushviq Substation in the Republic of Azerbaijan	AZERENERJI Joint Stock Company	Drawing No.	AZ_BM_04
	Japan Internatonal Cooperation Agency	Title	Mushviq Substation: Layout Drawing after the Project
	Nippon Koei Co., Ltd.		



Section a - a'



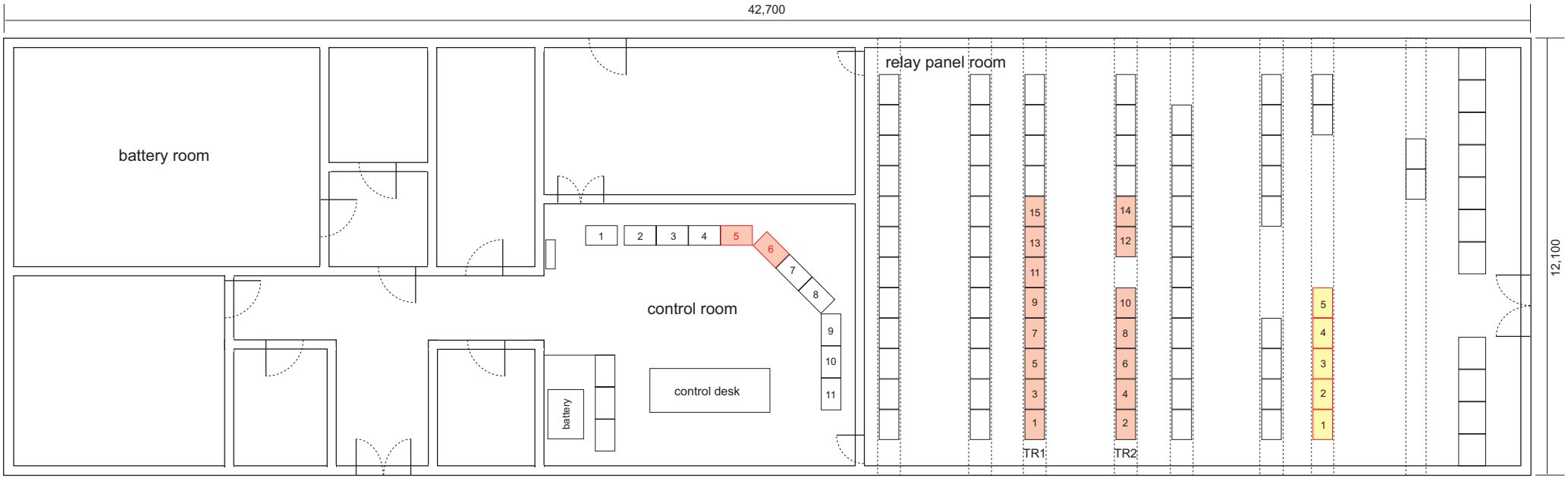
Section b - b'

Red Figure: Scope of the Project

Not to scale

REFERENCE ONLY

The Basic Design Study on the Project for Improvement of Mushviq Substation in the Republic of Azerbaijan	**AZERENERJI Joint Stock Company**	**Drawing No.**	AZ_BM_05
	Japan Internatonal Cooperation Agency	**Title**	Mushviq Substation: Section Drawing after the Project
	Nippon Koei Co., Ltd.		



control panels

1. Alarm
2. 220 kV Absheron SS
3. 220 kV Khirdalan SS & Alibayrami PS
4. 110 kV TR incoming feeders
5. Main Transformer #1
6. Main Transformer #2
7. 110 kV Bayil SS & Lokbatan Darti SS
8. 110 kV Salakhani 1 SS
9. 110 kV Daglig SS
10. Spair
11. Spair

existing relay & control panels

1. Main protection for TR1 (distance)
2. Main protection for TR2 (distance)
3. Main protection for TR1 (differential & gas)
4. Main protection for TR2 (differential & gas)
5. Back-up protection for TR1 (220 kV)
6. Back-up protection for TR2 (220 kV)
7. Back-up protection for TR1 (110 kV & 10 kV)
8. Back-up protection for TR2 (110 kV & 10 kV)
9. 220 kV bus protection (over-current relay for TR1)
10. 220 kV bus protection (over-current relay for TR2)
11. Cooling fan control for TR1
12. Cooling fan control for TR2
13. OLTC control for TR1
14. OLTC control for TR2
15. Fire fighting system control

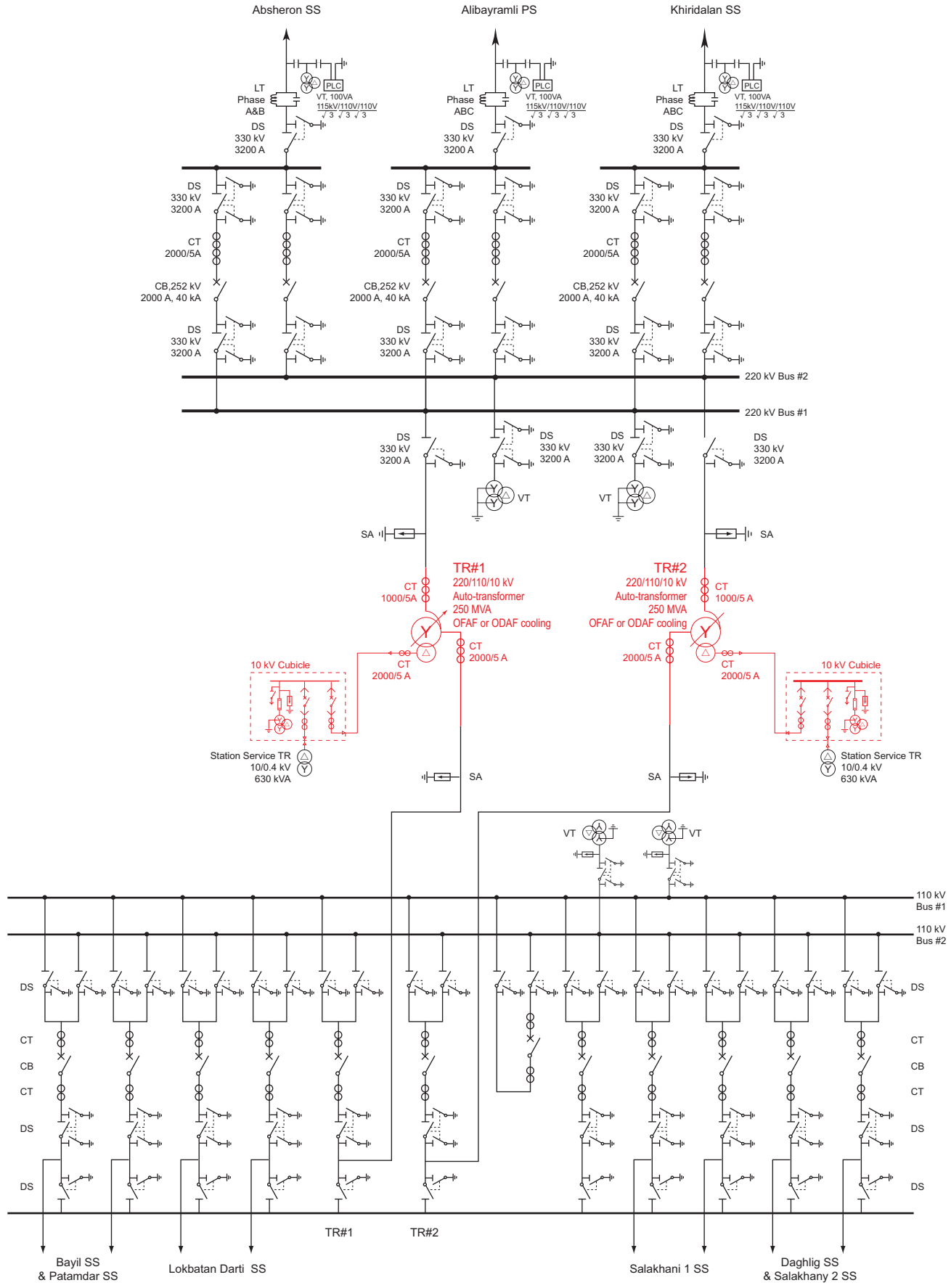
new relay & control panels

1. Digital relay panel for TR1
2. Digital relay panel for TR2
3. OLTC control for TR1
4. OLTC control for TR2
5. Fire fighting system control

Not to scale

REFERENCE ONLY

The Basic Design Study on the Project for Improvement of Mushviq Substation in the Republic of Azerbaijan	AZERENERJI Joint Stock Company	Drawing No.	AZ_BM_06
	Japan Internatonal Cooperation Agency	Title	Mushviq Substation: Layout Drawing of Control Building after the Project
	Nippon Koei Co., Ltd.		



REFERENCE ONLY

The Basic Design Study on the Project for Improvement of Mushviq Substation in the Republic of Azerbaijan	**AZERENERJI Joint Stock Company**	**Drawing No.**	AZ_BM_07
	Japan Internatonal Cooperation Agency	**Title**	Mushviq Substation: Single Line Diagram after the Project
	Nippon Koei Co., Ltd.		

Appendixes

1. Member List of the Study Team
2. Study Schedule
3. List of Parties Concerned in the Recipient Country
4. Minutes of Discussions
5. Technical Note
6. Installation Position of the Main Transformers
7. Minutes of Discussions (Explanation of the Draft Report)

Member of the Study Team

The Basic Design Study on
the Project for Improvement of Mushviq Substation

1. Mr. Hiroyuki HAYASHI
   Leader
   Transportation and Electric Power Team, Project Management Group I, Grant Aid Management Department, JICA
2. Mr. Michio HASEGAWA
   Chief Consultant／Power Supply Planner／Substation Equipment Planner I
   NIPPON KOEI Co., Ltd.
3. Mr. Junichi FUKUNAGA
   Substation Equipment Planner II
   NIPPON KOEI Co., Ltd.
4. Mr. Masaaki KAMEDA
   Equipment Procurement Planner / Cost Estimator
   NIPPON KOEI Co., Ltd.
5. Ms. Masako MATSUDA
   Interpreter
   NIPPON KOEI Co., Ltd.

Study Schedule (the First Study): from August 28, 2005 to September 21, 2005

No.	day	date	Stay	JICA	Consultatns			
				Hayashi	Hasegawa	Fukunaga	Matsuda	Kameda
1	28-Aug	Sun	-	Travel: Narita (OS052/10:40)→Vienna (15:55) Vienna (OS881/21:00) →				
2	29-Aug	Mon	Baku	→Baku (04:10) Courtesy call on AZERENERJI and discussion, Courtesy call on Embassy of Japan				
3	30-Aug	Tue	Baku	Discussion with AZERENERJI on Inception Report Site survey at Mushviq Subsation				
4	31-Aug	Wed	Baku	Courtesy call on Ministry of Fuel and Energy Discussion with AZERENERJI on Inception Report				
5	1-Sep	Thu	Baku	Discussion with AZERENERJI on Minutes of Discussions				
6	2-Sep	Fri	Baku	Discussion with AZERENERJI on M/D and sign Courtecy call on General Manager of AZERENERJI, Report to EOJ				
7	3-Sep	Sat	Baku	Baku(OS882/05:05)→Vienna(06:20, OS051/14:00)→	Site survey, Internal meeting, Data collection and analysis			
8	4-Sep	Sun	Baku	→Narita (08:30)	Internal meeting, Data collection and analysis			
9	5-Sep	Mon	Baku		Meeting at Power Scientific Research and Energy Design Institute Detailed survey at Mushviq SS			Data collection Preparation for quatations
10	6-Sep	Tue	Baku		Meeting with Economy Dept. Data collection			Meeting with 2 transportation companies
11	7-Sep	Wed	Baku		Meeting with Power Transmission Dept. Meeting with Agency for Rehabilitation and Reconstruction of the Areas			Meeting with Economy Dept., Meeting with Construction Company
12	8-Sep	Thu	Baku		Meeting with Economy Dept. Meeting with BARMEK			Meeting with cable manufacturer
13	9-Sep	Fri	Baku		Meeting with Design Dept. and Economy Dept. Detailed survey at Mushviq SS			Collection of financial data
14	10-Sep	Sat	Baku		Survey on transportation route and landing port	Preparation of layout drawings	Survey on transportation route and landing port	
15	11-Sep	Sun	Baku		Internal meeting, data collection and analysis, Preparation of drawings and reports			
16	12-Sep	Mon	Baku		Data collection, Preparation of report	Survey at warehouse, Preparation of drawings	Survey at warehouse, Translation work	Survey at warehouse, Meeting with Accounting of AZE
17	13-Sep	Tue	Baku		Discussion on construction method Meeting with BARMEK			Marketing survey, survey at rail station
18	14-Sep	Wed	Baku		Discussion with Power Transmission Dept. Data collection and analysis, Preparation of drawings			Meeting with BP
19	15-Sep	Thu	Baku		Discussion with Power Transmission Dept. and Economy Dept. Meeting with BARMEK			Survey on heavy equipment and vehicles, meeting with ABB
20	16-Sep	Fri	Baku		Discussion with Power Transmission Dept. and Economy Dept. Report to EOJ			Meeting with SIMENS and Transportation company, Report to EOJ
21	17-Sep	Sat	Baku		Discussion on Technical Note Data collection and analysis, Preparation of drawings			
22	18-Sep	Sun	Baku		Internal meeting, Data collection and analysis, Preparation of drawings			
23	19-Sep	Mon	Baku		Sign onTechnical Note Site survey at Absheron SS and Khirdaran SS			
24	20-Sep	Tue	-		Baku (OS882/05:05) →Vienna (06:20) Vienna (OS051/14:00) →			
25	21-Sep	Wed			→Narita (08:30)			

Study Schedule (the Second Study): from January 29, 2006 to February 8, 2006

No.	day	date	Stay	JICA	Consultatns			
				Hayashi	Hasegawa	Fukunaga	Matsuda	Kameda
1	29-Jan	Sun	-	Narita (OS052/11:40)→Vienna (16:05) Vienna (OS881/20:25)→				
2	30-Jan	Mon	Baku	→Baku (03:30), Courtesy call on AZERENERJI and discussion, Courtesy call on Embassy of Japan				
3	31-Jan	Tue	Baku	Discussion with AZERENERJI on the draft Report				
4	1-Feb	Wed	Baku	Discussion with Mr. Oosugi of JICA Discussion with AZERENERJI on Minutes of Discussions and Technical matters				Meeting with trasnportation company, data collection
5	2-Feb	Thu	Baku	Amendment of the minutes Sign on M/D with AZERENERJI				
6	3-Feb	Fri	Baku	Discussion with AZERENERJI on technical matters Courtesy call on Cabint Ministers, Report on Embassy of Japan				
7	4-Feb	Sat	Baku	Baku (OS882/04:30) → Vienna (06:00), Vienna (OS051/13:40) →	Transpirtation route survey, Internal meeting, Data collection and analysis			
8	5-Feb	Sun	Baku	→Narita (09:25)	Internal meeting, Data collection and analysis			
9	6-Feb	Mon	Baku		Detailed site survey on Mushviq Substation (Cable route, protection relays, etc.)			Meeting with trasnportation company, data collection
10	7-Feb	Tue	-		Baku (OS882/04:30)→Vienna (06:00) Vienna (OS051/13:40) →			
11	8-Feb	Wed			→Narita (09:25)			

Person in Charge of the Project

Site Survey

1. Ministry of Fuel and Energy
   1) Mr. Idris Ibrahim Rzabeiyov — Chief of General Dept. for Fuel and Energy Operations
   2) Mr. Vibabi Hasanov — Manager of Electricity Section
   3) Mr. Islam Islamov — Deputy Manager of Dept. for Fuel and Energy

2. AZERENERJI Joint-Stock Company

   2-1 Headquarters
   1) Mr. Etibar S. Porverdiyev — President
   2) Mr. Marlen A. Askerov — Chief Engineer

   2-2 Power Transmission Dept.
   1) Mr. Hacimahmud M. Abdullaev — Chief
   2) Mr. Nazim Asker Askerov — Chief Engineer
   3) Mr. Shahin Magomed. Mehdiyev — Manager of Mushviq Substation
   4) Mr. Djakhid S. Bagirov — Director of Baku High-voltage Electricity Network Limited Liability Company (LLC)

   2-3 Azerbaijan Power Scientific Research and Energy Design Institute
   1) Mr. Raur I. Muemadaev — Director
   2) Mr. Mansur M. Adgezalov — Chief Engineer
   3) Mr. Yashar Miryusif Mamedov — Chief of Substation Section
   4) Ms. Ivetta Vashilievna Bernikova — Chief Engineer of Design
   5) Ms. Kadriya A. Ashrova — Chief Specialist of Relay Protection

   2-4 Economy Dept. and Accounting
   1) Mr. Hikmet Bahman Gasanov — Chief of Economy Dept.
   2) Ms. Zulifiya N. Namazova — Leading Economist of Economy Dept.
   3) Mr. Ramiz Mehdi Garayev — Chief Accountant

   2-5 Other Dept.
   1) Mr. Polad Guliev — Chief of Foreign Economic Relation Section
   2) Mr. Rauf Akhmedov — Chief of Dispatching Service
   3) Mr. Jakhongir Abdulakhmanov — Chief Engineer of “AZENCO” LLC

3. BARMEK Azerbaijan Electricity Network LTD
   1) Mr. Nuroddin Bafa Agaiev — Technical Director
   2) Mr. Vagab S. Ibragimov — Chief of Dispatching Dept.
   3) Mr. Kamil I. Guliev — Chief Dispatcher of City Central Dispatching Service

4. Agency for Rehabilitation and Reconstruction of the Areas of Azerbaijan
   1) Mr. Ali A. Mammadov — Director

5. Embassy of Japan
   1) Mr. Hideomi NAKAJIMA — Counsellor

2)	Mr. HARADA	First Secretary
3)	Mr. Seisuke SHIMIZU	First Secretary

6. JICA Expert

1)	Mr. Kenichi OSUGI	Japan's ODA Adviser

Explanation of the Draft Report

1. Cabinet of Ministers

1)	Mr. Yagub Eyyubov	First Deputy Prime Minister
2)	Mr. Nail S. Fataliyev	Deputy Head of Dept. of Economic and Finance credit policy

2. AZERENERJI Joint-Stock Company: AZERENERJI

2-1 Headquarters

1)	Mr. Marlen A. Askerov	Vice-President
2)	Mr. Selekh Mamedov	Chief Engineer

2-2 Power Transmission Dept.

1)	Mr. Hacimahmud M. Abdullaev	Chief
2)	Mr. Osman Ilyasov	Chief Engineer
3)	Mr. Shahin Magomed. Mehdiyev	Manager of Mushviq Substation

2-3 Other Dept.

1)	Mr. Polad Guliev	Chief of Foreign Economic Relationship Dept.
2)	Mr. Elman Suleymanov	Senior Specialist of Foreign Economic Relationship Dept.
3)	Mr. Nadir Sadigov	Deputy Chief of Relay Protection and Automation Service
4)	Mr. Shakhsuvar Mahommadaliyev	Chief of Protection Service of Baku High-voltage Electricity Network Limited Liability Company (LLC)
5)	Mr. Salie Melediyev	Deputy Chief Engineer of Baku High-voltage Electricity Network Limited Liability Company (LLC)
6)	Mr. Nazim Asker Askerov	Chief Engineer of "AZENCO" LLC

3. Embassy of Japan

1)	Mr. Tadahiro ABE	Ambassador
2)	Mr. Hideomi NAKAJIMA	Counsellor
3)	Mr. Mitsuhiro KOHNO	Counsellor

4. JICA Expert

1)	Mr. Kenichi OSUGI	Japan's ODA Adviser
2)	Mr. Ruslan M. Mustafaev	Program Coordinator

Minutes of Discussions
on the Basic Design Study
on the Project for Improvement of Mushviq Substation
in the Republic of Azerbaijan

In response to the request from the Government of the Republic of Azerbaijan (hereinafter referred to as "Azerbaijan"), the Government of Japan decided to conduct a Basic Design Study on the Project for Improvement of Mushviq Substation (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent to Azerbaijan the Basic Design Study Team (hereinafter referred to as "the Team"), headed by Mr. Hiroyuki Hayashi, Transportation and Electric Power Team of the Project Management Group I, the Grant Aid Management Department, JICA, and is scheduled to stay in the country from August 29 to September 20, 2005.

The Team held discussions with the concerned officials of the Government of Azerbaijan. In the course of the discussions, both sides have confirmed the main items described in the attached sheets. The Team will proceed to further works and prepare the Basic Design Study Report.

Baku, September 2, 2005

Hiroyuki Hayashi
Leader
Basic Design Study Team
Japan International Cooperation Agency

Marlen A. Askerov
Chief Engineer
AZERENERJI Joint-Stock Company
The Republic of Azerbaijan

ATTACHMENT

1. Objective of the Project

The objective of the Project is to ensure reliable and stable electricity supply to three regions i.e. Sabail, Yasamal and Nasimi of Baku City by the installation of new transformers at Mushuviq Substation.

2. Project Site

The Project site is shown in Annex-1.

3. Organizations

The owner of the project is the AZERENERJI Joint-Stock Company (AZERENERJI).

The organization chart of AZERENERJI is shown in Annex-2~~-1 & 2-2~~

4. Components Requested by the Government of Azerbaijan

After discussions with the Team, the following components were finally requested by the Azerbaijani side. JICA will assess the appropriateness of the request, prioritize each component, and will recommend to the Government of Japan for approval.

(1) Replacement of main transformers
- 220/110/10 kV 250 MVA auto transformer: 2 units
- Reinforcement of transformer foundations: 2 sets
- Replacement of control and protection relay panels for transformer: 2 sets
- Replacement of accessories such as gantries, insulators, fittings, etc.: 1 lot

(2) Replacement of 10 kV side of the transformers
- 10 kV reactors: 2 sets
- 10 kV metal-clad switchgear: 4 sets

(3) Conductors, power and control cables: 1 lot

(4) Spare parts: 1 lot

5. Japan's Grant Aid Scheme

(1) The Azerbaijani side understands the Japan's Grant Aid scheme and the necessary measures to be taken by the Government of Azerbaijan explained by the Team as described in Annex-3.

(2) The Azerbaijani side promised to take necessary measures, as described in Annex-4, for smooth implementation of the Project as a condition for the Japan's Grant Aid to be implemented.

6. Schedule of the study

(1) The consultants will conduct further studies in Azerbaijan until September 20, 2005.

(2) JICA will prepare a draft report in English and dispatch a mission to Azerbaijan in order to explain its contents around the end of January 2006.

(3) When the contents of the report are accepted in principle by the Government of Azerbaijan, JICA will complete the final report and send it to the Government of Azerbaijan around the end of March 2006.

7. Other Relevant Issues

(1) The Both sides confirmed that the component of the "Rehabilitation inside s/s and approach of roads" listed in the Application of the Project should be excluded from the Project.

(2) The Azerbaijani side shall submit answers to the Questionnaire and Materials to be collected, which is shown in the inception report, by September 10, 2005.

(3) The Azerbaijani side shall provide necessary number(s) of counterpart personnel to the Team during the period of their studies in Azerbaijan.

(4) The Azerbaijani side explained to the Team that according to the act(s)/guideline(s) concerning the environmental and social considerations, neither Environmental Impact Assessment (EIA) nor Initial Environmental Evaluation (IEE) is requested to be carried out.

(5) The Azerbaijani side should allocate necessary budget for undertakings to be done on a timely manner, based on the provisional amount, which will be shown in the final report.

(6) The Azerbaijani side should shift the existing 200MVA transformer(s) during off-peak period and re-operation so that new 250MVA transformer(s) can be installed on the existing 200MVA transformer's foundation to minimized the power interruption period, if necessary.

(7) The Azerbaijani side should remove and reconstruct the entrance gate of the substation for transportation of the transformers, if necessary.

(8) The Azerbaijani side requested the Team to cover internal transportation from the port of embarkation to the Project site by the Japan's Grant Aid as shown in Annex-4.

(9) The Azerbaijani side requested the Team to carry out the training to the AZERENERJI staffs in Japan on operation and maintenance of new facilities as technical cooperation by JICA. The Azerbaijani side should submit the official request regarding training with concrete contents of trainings through the Embassy of Japan before the end of June 2006.