No.

Japan International Cooperation Agency (JICA)

State Joint Stock Company "Uzbekenergo"

THE DETAILED DESIGN STUDY

FOR

MODERNIZATION OF TASHKENT THERMAL POWER PLANT

IN

THE REPUBLIC OF UZBEKISTAN

FINAL REPORT
(SUMMARY)

January 2004

Tokyo Electric Power Services Co., Ltd.

MPN
CR(1)
04-027

THE DETAILED DESIGN STUDY
FOR
MODERNIZATION OF TASHKENT THERMAL POWER PLANT
IN
THE REPUBLIC OF UZBEKISTAN

FINAL REPORT (SUMMARY)

CONTENTS

ABBREVIATIONS

JETRO	Japan External Trade Organization
JICA	Japan International Cooperation Agency
JBIC	Japan Bank for International Cooperation
S/W	Scope of Work
E/N	Exchange of Notes
L/A	Loan Agreement
EPC	Engineering, Procurement and Construction
DCS	Distributed Control System
FIRR	Financial Internal Rate of Return
EIRR	Economical Internal Rate of Return
ROE	Return of Equity
CDM	Clean Development Mechanism
UNDP	United Nations Development Programme
CIS	Commonwealth of Independent States
IMF	International Monetary Fund
GDP	Gross Domestic Product
DAC	Development Assistance Committee
CAOP	Central Asia Oil Pipeline
CAD	Computed Aimed Design
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
SEC	Statement of Environmental Consequences
CCPP	Combined Cycle Power Plant
NOx	Nitrogen Oxide
SO_2	Sulfur Dioxide
NDC	National Dispatching Center
CRIEPI	Central Research Institute of the Electric Power Industry in Japan
LGO	Line Ground Fault and Open
UDC	Unified Dispatch Center
UNFCCC	United Nations Framework Convention on Climate Change
GHG	Greenhouse Gas

UNITS

Prefixes

μ	:	micro- $= 10^{-6}$
m	:	milli- $= 10^{-3}$
c	:	centi- $= 10^{-2}$
d	:	deci- $= 10^{-1}$
da	:	deca- $= 10$
h	:	hecto- $= 10^{2}$
k	:	kilo- $= 10^{3}$
M	:	mega- $= 10^{6}$
G	:	giga- $= 10^{9}$

Units of Length

m	:	meter
mm	:	millimeter
cm	:	centimeter
km	:	kilometer
in	:	inch
ft	:	feet
yd	:	yard

Units of Area

cm^2	:	square centimeter
m^2	:	square meter
km^2	:	square kilometer
ft^2	:	square feet (foot)
yd^2	:	square yard
ha	:	hectare

Units of Volume

m^3	:	cubic meter
l	:	liter
kl	:	kiloliter

Units of Mass

g	:	gram
kg	:	kilogram
t	:	ton (metric)

lb	:	pound

Units of Density

kg/m^3	:	kilogram per cubic meter
t/m^3	:	ton per cubic meter
mg/m^3N	:	milligram per normal cubic meter
g/m^3N	:	gram per normal cubic meter
ppm	:	parts per million
μg/scm	:	microgram per standard cubic meter

Units of Pressure

kg/cm^2	:	kilogram per square centimeter (gauge)
lb/in^2	:	pound per square inch
mmHg	:	millimeter of mercury
mmHg abs	:	millimeter of mercury absolute
mAq	:	meter of aqueous
lb/in^2, psi	:	pounds per square inches
atm	:	atmosphere
Pa	:	Pascal
bara	:	bar absolute

Units of Energy

kcal	:	kilocalorie
Mcal	:	megacalorie
MJ	:	mega joule
TJ	:	tera joule
kWh	:	kilowatt-hour
MWh	:	megawatt-hour
GWh	:	gigawatt-hour
Btu	:	British thermal unit

Units of Heating Value

kcal/kg	:	kilocalorie per kilogram
kJ/kg	:	kilojoule per kilogram
Btu/lb	:	British thermal unit per pound

Units of Heat Flux

$kcal/m^2h$	:	kilocalorie per square meter hour
Btu/ft^2H	:	British thermal unit per square feet hour

Units of Temperature

deg	:	degree

°	:	degree
C	:	Celsius or Centigrade
°C	:	degree Celsius or Centigrade
F	:	Fahrenheit
°F	:	degree Fahrenheit

Units of Electricity

W	:	watt
kW	:	kilowatt
A	:	ampere
kA	:	kiloampere
V	:	volt
kV	:	kilovolt
kVA	:	kilovolt ampere
MVA	:	megavolt ampere
Mvar	:	megavar (mega volt-ampere-reactive)
kHz	:	kilohertz

Units of Time

s	:	second
min	:	minute
h	:	hour
d	:	day
y	:	year

Units of Flow Rate

t/h	:	ton per hour
t/d	:	ton per day
t/y	:	ton per year
m^3/s	:	cubic meter per second
m^3/min	:	cubic meter per minute
m^3/h	:	cubic meter per hour
m^3/d	:	cubic meter per day
lb/h	:	pound per hour
m^3N/s	:	cubic meter per second at normal condition
m^3N/h	:	cubic meter per hour at normal condition

Units of Conductivity

μS/cm	:	microSiemens per centimeter

Units of Sound Power Level

dB	:	deci-bell

Units of Currency

Sum	:	Uzbekistan Sum
US$	:	US Dollar
¥	:	Japanese Yen

Exchange Rate : US$ 1 = Sum 1,000

LIST OF TABLES

LIST OF FIGURE

LIST OF PICTURE

COMPREHENSIVE EVALUATION AND RECOMMENDATION

OVERALL EVALUATION AND RECOMMENDATION

I. Overall Evaluation

This is to report the results of the joint detailed design study works granted by JICA in relation to the Modernization Project of Tashkent Thermal Power Plant in Uzbekistan, which is scheduled as a loan aid program of the Japan Bank for International Cooperation (JBIC). The study was conducted for such main purposes as shown below:

- Preparation of tender documents for the international bidding of the project
- Detailed design of equipment of the power plant for the international bidding
- Assessment of the impact on the environment due to the introduction of the project
- Evaluation of effects on the electric power network system in Uzbekistan due to the introduction of the project
- Diagnosis of the operation and maintenance management methods of the existing Tashkent Thermal Plant and proposals for improvement.

In addition, Uzbekistan's efforts for establishment of CDM structure through preparation of the Project Design Document (PDD) as if the project were regarded to be a CDM project. The followings are the overall evaluation for each study item.

- The state-of-art highly efficient combined cycle power plant for the project is the first electric power generating facility in Republic of Uzbekistan. In the initial stage of the detailed design study, the counterpart voiced almost no opinion or demand on the examination and analysis results and the tender documents prepared by the study team. However, as the understanding of the counterpart on the power plant was deepened in the latter stage, they began to voice. We believe that the emergence of the new power generation technologies in the country through the joint preparation works of tender documents is a great achievement.

  If this power generation technology is recognized in the country through the project and such power plants are commonly introduced in future, it will lead to effective usage of energy resources and reduction of environmental impact and contribute to economic development.

- Uzbekistan is only the double locked country in the world surrounded by nations without any seacoast lines. Even if procured materials and equipment are transported by sea to a neighboring country, they need to be transported by land across two countries to the power plant site. In this study of transportation routes, we found out problems including the weight and dimension limits of large cargoes for land transportation. This inland

transportation survey results can be evaluated highly as they enable to provide useful information for bidders.

- A detailed survey of environmental impact assessment (EIA) to be caused by the introduction of the power generating facility was carried out by the Uzbekistan side in accordance with JBIC's environmental impact consideration guidelines. The result was approved by Uzbekistan's natural environment protection committee and agreed on by JBIC.

  A public hearing along the survey results was then held to ask local residents for their agreement on the introduction of the new power plant in accordance with the manner of Uzbekistan based on the recommendation of JICA and JBIC. The results of the public hearing was made public in a general newspaper (Pravda Vostoka) dated October 15, 2003, and the introduction of the power plant was also agreed with by the local residents.

  It was the first experience for Uzbekistan to introduce power plant through such procedures and this survey could be evaluated in that this experience will be useful for the introduction of such plant in the future.

- It was cleared that there would be no effect on the existing Uzbekistan's electrical power network system in the year 2002 as the analysis results of the effects on the network system due to the introduction of the power plant. As a result, regarding the basic technical requirements for electrical equipment of tender documents of the power plant, the considerations at the time of the feasibility study for the introduction of the power plant were employed as they were. However, the analysis results revealed that there are inherent problems with the existing network system and it was also recognized by the Uzbekistan side as their challenging issues in the future. Therefore, this analysis study is considered to have been useful.

- As the study results on the present status of the management system of existing Tashkent Thermal Power Plant, issues on repair plan, financial affairs, management organization and safety management were revealed, and items and contents to be improved were clarified. We are not told that such comprehensive studies have not been conducted in SJSC "Uzbekenergo" and the experience with such studies could be valued in that it will be believed to lead to the examinations of management situations of other power plants in the future.

- The financial internal rate of return (FIRR) of the new combined cycle power plant is calculated on the preliminary survey of the project when its introduction was decided.

However, considering that the calculation conditions for the FIRR may have been changed after that, we conducted a sensitivity analysis of it for such changes. It was cleared as the analysis results that operational problems with the new power plant would be faced by SJSC "Uzbekenergo".

- The combined cycle power plant is the first experience with Uzbekistan. The basic concept related to the nature of operation and maintenance established based on experiences of many similar power plants in Japan will be significantly useful for SJSC "Uzbekenergo".

- Uzbekistan is a country that ratified the Kyoto Protocol on climate change earlier than many other countries and it has carried out many domestic activities such as examinations of the current levels and future trend prediction of greenhouse gases in relation to climate change. However, it has not yet created any practical system or laws and regulations for introduction of CDM. However, we recognized through this study that Uzbekistan has just undertaken to stipulate any system or laws and regulations required for CDM as Uzbekistan country, considering that the procedures to structure a CDM project were cleared by the United Nations Framework on Climate Change mechanism,.

II. Recommendations

Based on the results of this study, following recommendations could be suggested:

- Through the technical understanding and knowledge and the bid evaluation method of the combined cycle power plant gained and learned during the joint preparation of tender documents for international competitive bidding of this project, the actual bid evaluation should be conducted smoothly and impartially.

- The introduction of this project is also sanctioned by local residents as a result of a detailed EIA and a public hearing. We hope that the same procedures will be made as a rule to introduce any similar facility for Uzbekistan in the future.

- The analysis of Uzbekistan's electric power network system to assess the impact due to introduction of this project was conducted based on the data obtained in 2002. However, it is desirable that similar analysis shall be conducted based on the forecast data considering the electric power demand, power source development plans and power transmission and distribution facility development plans at the time of start of the project

A plan to increase the power transmission capacity should be embodied and undertaken for

the section of power transmission lines with very low system stability, which was revealed by the analysis.

- The repair works of facilities in Tashkent Thermal Power Plant are basically conducted based on yearly and long-term plans, however, it is difficult to say that the repair works are conducted in accordance with the results of advanced periodical inspection to evaluate the remaining life times of parts to avoid the unexpected failures, and the order of repair works considering the importance from the economical impact points of view, so called based on the concept of preventive maintenance. It doesn't look that In addition, no organization to create such a plan is structured. In order to have such a method of scheduled repair work for the preventive maintenance of facility make a routine rule for the power plants in the Uzbekistan, it should be necessary to realize the proposed recommendation by this study. For the purpose, further recognition and deeper understanding by the Uzbekistan side should be needed, and we propose to dispatch engineers with much experience of actual execution of scheduled repair works based on study results from various points of views of the power plant facilities. A scheduled repair plan of the facility for preventive maintenance is essential especially for the hot parts sections of the gas turbine and therefore this proposal is particularly important.

The local conditions for the Tashkent Thermal Power Plant is not always suitable for working of workers and awareness of safety and sanitation is not thought to be so high. Any section, which is responsible for the safety and sanitation, is not corporated in the organization of the Power Plant. Since the less consciousness against the safety and sanitation may cause loss of personal property and in turn lead to managerial losses of the power plant, we recommend the establishment of a section in charge of such issues as an organization directly related to the chief engineer.

- According to the results of the study, the profit contribution of the Tashkent Thermal Power Plant is 1.31 sums/kWh under the assumptions of the ratio of the cost of power generation facilities to the electricity tariff and the power transmission and distribution losses. It is also necessary to closely scrutinize such figures as previously assumed that were not clarified in this study and to aware of the profit contribution that is the closest to the real figure as a guideline for the power plant management.

- The financial internal rate of return and the return on equity of the new power plant are not necessarily attractive values for the new project. One reason is that most materials and equipment for the plant are procured from countries with market economy, while the electricity tariff is significantly lower. Uzbekistan intends to turn to a market economy

country and the electricity tariff should be legislated accordingly.

- For the introduction of a CDM project to Uzbekistan, we strongly recommend the creation of a system and laws and regulations required for the purpose and the legislation of appropriate electricity tariff as described above, as well as the improvement in the system to collect electricity fees, which was not included in this study.

CHAPTER 1 GENERAL

THE DETAILED DESIGN STUDY FOR

MODERNIZATION OF TASHKENT THERMAL POWER PLANT

IN THE REPUBLIC OF UZBEKISTAN

FINAL REPORT (SUMMARY)

CONTENTS

List of Table

CHAPTER 1 GENERAL

1.1 Background of the Study

1.1.1 General Background

The Republic of Uzbekistan (hereinafter called as Uzbekistan) is a land-locked country, which is located in the center of the Central Asia region of the former Soviet Union, and shares borders with the Republic of Kazakhstan to the north, Turkmenistan to the west, the Republic of Kyrgyz to the east, and the Republic of Tajikistan and Afghanistan to the south. With 24 million people, it is most populous in the five Central Asian nations.

Uzbekistan gained independence in August 1991, amidst the dismantling of the Soviet Union in the latter half of the 1980's, and is a republic with a president as its head of state. In addition to the traditional key industry of cotton growing, industries related to machinery and chemical fertilizers have been developed, and the country is also rich in non-ferrous metal resources, such as gold. There is an abundant of energy resources, such as petroleum, natural gas and coal. The gas production of Uzbekistan is 2.0×10^{15} BTU/year, which is second to Russia (20.8×10^{15} BTU/year) among the countries of the former Soviet Union. Striving for economic independence after the political independence from the former Soviet Union, objectives were set to gain energy and food self-sufficiency, with steady growth in the production of petroleum, gas and grain crops. Uzbekistan is going gradually but steadily on definite open market and liberalization of economy.

1.1.2 Background of the study

DC "TASHTPP" consists of twelve units of conventional type power plants and be an important power plant taking care of the metropolitan area. However, the plants have been in services for 30 ~ 40 years with considerable deteriorations here and there and their operating reliability and generation efficiency are lowered with resultant increase of air pollutant matters and greenhouse gases. In consideration of such situations, the Government of Uzbekistan made a modernization plan to install 370 MW class natural gas fired combined cycle plant (hereinafter called as "the Plant") with state-of-the art technology and higher thermal efficiency and requested the Government of Japan to study a feasibility of the modernization plan.

In reply to the above request of the Government of Uzbekistan, JETRO (Japan External Trade Organization) carried out the feasibility study to review the viability of the modernization plan in his "International Atmospheric and Environmental Research Development Program 1998". The plan was verified feasible through this study, and the cabinet of the Government of Uzbekistan decided to implement it.

Thus the Government of Uzbekistan filed the applications to the Government of Japan; i.e. the application of yen-credit for construction of the Plant by JBIC (Japan Bank for International Cooperation) loan in December 1999 and the technical assistance granted by JICA for the Detailed Design Study of the Plant in July 2001. In response to the above applications, JICA dispatched the Project Formulation Study Team to Uzbekistan in February 2002. Through the review results of the Team the Government of Japan decided to conduct the Study for Modernization of DC "TASHTPP" based on the request applied by the Government of Uzbekistan. The scope of work regarding the Study was determined through the discussion between the Uzbekistan side and the Preliminary Study Team of JICA, which was dispatched to Uzbekistan in June 2002.

The Exchange of Note (E/N) of the Study was concluded between both Governments and the Loan Agreement of yen-credit between JBIC and Uzbekistan Government in May 2002.

1.1.3 Objectives of the Study

The objectives of the Study are the followings:

(1) To prepare the tender documents for EPC*[1] contract of the Plant to be installed in DC "TASHTPP" under JBIC loan. The preparation will be accompanied by the detailed site survey, the detailed engineering and the detailed Environment Impact Assessment Report to be provided by Uzbekistan side. The Plant will be contracted through ICB*[2] and constructed as Full Turnkey base by a single EPC contractor with a single responsibility.

(2) To recommend an improvement plan of the existing DC "TASHTPP" with regard to operation, maintenance, financial matters, organization, environment,

etc.

In addition, a technology transfer to the staff concerned of Uzbekistan will be carried out by the JICA Study Team in the course of the Study and at Technology Transfer Seminar.

Note *1: Engineering, Procurement and Construction
*2: International Competitive Bidding

1.1.4 Areas to be Studied

The areas to be studied are the plant site of DC "TASHTPP" and its surrounding areas.

1.1.5 Scope of the Study

Based on the Minute of Meeting and Scope of Works which were signed on July 13, 2002 between the Preliminary Study Team of JICA and SJSC "Uzbekenergo", the following components of the Study will be carried out:

(1) Formulation of joint study team
(2) Review and reassess of the application letter submitted by Uzbekistan, the previous review and study results of the JBIC's Appraisal Mission for the Project, the information and data collected by the previous study teams of JICA and other related information and data
(3) Examination of the present structure and operating, maintenance, financial and environmental conditions of the existing DC "TASHTPP"
(4) Examination of the conditions of the new power plant site, including geological survey, access and transportation to the site, temporarily storage yard for the materials for election, etc.
SJSC "Uzbekenergo" will, at his expense, examine an existence of obstacles under the ground of the site, and remove them, if any, in due course for construction of the Plant.
(5) Establishment of the design conditions for the Plant, such as atmospheric conditions, fuel conditions, required performance for operation and maintenance, environmental protection measures, etc.
(6) Establishment of optimum plant configurations, including shaft arrangement of gas and steam turbines, bottoming cycle system, configuration of switchyard,

Distributed Control and Monitoring system (DCMS), etc.

(7) Study about a optimum erection method and construction schedule considering maximum size and weight limitations of transferred materials/equipment to be varied depending upon transportation routes

(8) Estimation of the cost of the Plant with referring to the loan amount from JBIC

(9) Study about the operation pattern of new power plant in relation with the existing plants

(10) Estimation of annual power generation and revenue by the Plant considering the power generation sharing between the existing power plants and the Plant.

(11) Estimation of operation, maintenance, personnel and other miscellaneous costs of the Plant.

(12) Economic and financial analyses, including calculation of FIRR*[3] and EIRR*[4], and sensitivity analysis of the Plant.

(13) Estimation of balance sheet, state of income and cash flow for a long term operation including construction period for the whole DC "TASHTPP" as well as for the Plant itself

(14) Preparation of pre-qualification documents and tender documents in conformity with "Guidelines for Procurement under JBIC ODA Loan". The tender documents consist of instruction to tenderer, general conditions of contract, project requirements, technical specification including conceptual drawings of layout, flow diagram, etc.

(15) Reviewing and analyzing the previous preliminary EIA, and supporting the Uzbekistan side to prepare the detailed EIA report in line with the JBIC's guidelines

(16) Coordination between Uzbekistan side and JBIC and assistance necessary for the preparation of tender documents

(17) Recommendation of improvement plan for operation, maintenance, financial matters, organization, environment, etc. of the whole DC "TASHTPP"

(18) Technology transfer to the staff concerned of Uzbekistan in the course of the Study and at Technology Transfer Seminar. The matters presented in the Seminar will include introduction of the latest power engineering technology, international tendering process, management technique of power plant, etc.

(19) Training in Japan for about two (2) weeks of one (1) person of SJSC "Uzbekenergo" during each fiscal year of 2002 and about three (3) weeks of four (4) persons of SJSC "Uzbekenergo" during each fiscal year 2003.

(20) Estimation of reduction effect of greenhouse-effect gasses due to introduction of the Project

(21) Preparation of PDD (Project Design Document) of CDM (Clean Development

Mechanism)

(22) Conducting power system analysis

Note *3: Financial Internal Rate of Return

*4: Economic Internal Rate of Return

1.2 Formation of the Study Team

Table 1.2-1 shows the name and task of members of the JICA Study Team.

Table 1.2-1 Formation of The JICA Study Team

Name	Task
Kenji MIKATA	Team Leader Overall Planning of Power Generation System Gas Turbine and its Auxiliaries
Hideyuki OKANO	Sub-Team Leader Steam Turbine and Plant Auxiliaries
Toshio SHIOMI	Boiler and Plant Auxiliaries
Hideya KANO	Civil and Architectural
Sachio KOSAKA	Power Plant Management Construction Plan Project Cost Estimates
Teizo AKIZUKI	Economic and Financial Analyses
Tetsuya USHIYAMA	Environmental Impact Assessment
Tadayoshi WAKITA	Control and Monitoring System
Shoichi KIMURA	Electrical System
Kenji HIRAMATSU	CDM
Kiyoshi NOMURA	Power System Analysis
Takashi CYUJYO	Power System Analysis
Misaki KITTAKA	Administration and coordination

1.3 Technology Transfer

1.3.1 Technology Transfer through On-Site Study Works

Based on the contents of Scope of Work, the cooperative on-site works between SJSC "Uzbekenergo" and the Study Team will be carried out during the study period. Such a manner will enable technology transfer smoothly and effectively. The technical transfer through on-site works is focused on the following technologies:

(1) Preparation of tender documents for international competitive bidding (general conditions of contract, particular specifications, technical specifications, etc)
(2) Modern combined cycle power plant
(3) The latest technologies about gas turbine, steam turbine and HRSG (Heat Recovery Steam Generator)
(4) DCMS system for operation of modern combined cycle power plant
(5) Environment impact evaluation for power plant
(6) Operation and maintenance of power plant
(7) Financial evaluation of new power plant
(8) CDM (Clean Development Mechanism)
(9) Power System Analysis
(10) Other items requested by SJSC "Uzbekenergo"

1.3.2 Technology Transfer through Seminar

The Technology transfer seminar was held at the site during the Fifth On-site Study. The contents presented in the seminar will include entirely the above-mentioned technologies.

1.3.3 Counterpart Training

The counterpart trainings were provided with one (1) trainee for about two (2) weeks during fiscal year of 2002 and four (4) trainees for about three (3) weeks during fiscal year of 2003.

CHAPTER 2 GENERAL STATUS OF THE REPUBLIC OF UZBEKISTAN

THE DETAILED DESIGN STUDY FOR

MODERNIZATION OF TASHKENT THERMAL POWER PLANT

IN THE REPUBLIC OF UZBEKISTAN

FINAL REPORT (SUMMARY)

CONTENTS

LIST OF TABLE

CHAPTER 2 PRESENT STATUS OF THE REPUBLIC OF UZBEKISTAN

2.1 Overview of the Republic of Uzbekistan

Uzbekistan, after its history over millennia, won independence from the ex-Soviet Union in 1991. The nation is now becoming open to the world with a view to developing a democratic society with a free market economy.

Uzbekistan is a nation of 447,400 km^2 situated in the middle of Central Asia, at the crossroad of ancient trade routes. With a population of over 24 million, the nation is the leading country of Central Asia in terms of economic and geopolitical influence. Its capital - Tashkent - a city with a 2000 year history, is the largest city in the region (about 2.3 million people), and is functioning as a national hub for political, industrial, financial and cultural activities. The socioeconomic indexes of the state are shown below.

Population growth:	2.3%(1995)
Infant mortality rate:	43 per 1,000 births
Average life:	male 70.7
	female 64.3
Adult literacy rate:	male 99.6%
	female 99.8%

Uzbekistan bordering all the other countries in Central Asia is playing an important part of the traffic and electric power network. About three-fifths of the land is desert steppe broken by irrigated, fertile oases along the banks of Amu-Darya and Syr-Darya rivers. Uzbekistan has mild winters and no more than 200 mm of rainfall per year, but its hot, dry summers in May through October create excellent growing conditions for warm weather crops such as cotton, tobacco, fruits and vegetables.

Uzbekistan's human resources potential is one of the highest in all of Asia, the country's advantage being the highest level of overall education and skills of the labor force. The country's ethnic makeup is Uzbek of 74.7%, Russian of 6.5%, Tajik of 4.8%, Kazak of 4.1% and others of 10.1%. The official state language is Uzbek, though Russian is more commonly spoken. The population density is 50.4 persons/km^2. More than 60% of the population are living in rural areas. The recent population growth is 2.3% that is very

higher than the global average. According to the current United Nations Development Program (UNDP), the population is expected to reach 25 million by 2000. This high growth in population, i.e. increase in the population of young generation, ensures Uzbekistan's continued status as the largest labor and consumer market in Central Asia.

The economy of the nation has been reviving for the past several years. Among the CIS countries, Uzbekistan stands out as the country with the most stable transition record, free from sharp slumps and extremities of poverty and inflation. Uzbekistan is the world's second largest exporter of cotton. In addition, its abundant mineral resources place it among the most attractive countries for international investors in the mining sector. Uzbekistan ranks among the top 10 producing countries in the world in the sphere of extraction of many non-ferrous metals. It holds the seventh place in the rank of gold producers, boasting over 70 tons of production a year. The natural gas resources are the world's tenth place in the rank of production.

The Government's privatization policies that have started soon after independence are still expanding: 82.7% of all enterprises belong to the non-state form of ownership, which produce about 70% of the nation's GDP.

Uzbekistan, now pursuing an "open-door" policy in attracting foreign direct investment, is truly an attractive site for investors.

2.2 Situation of Politics

In the process of the Soviet Union's collapse beginning in the late 1980's, the Soviet Republic of Uzbekistan declared an adoption of republicanism in June 1990, and then declared its independence on August 31, 1991 after the failure of the Moscow coup. With the collapse of the Soviet Union in the end of the year, Uzbekistan won actual independence, and adopted a new constitution on December 8, 1992.

The present president, Islam Karimov, has started his career as the present since March 1990 after taking the position of the leader of the former communist party since 1989.

He was elected the first President of the Republic of Uzbekistan by the direct election in December 1991 soon after independence. Then his presidency was decided to be extended to year 2000 by the national referendum in April 1995. In the direct presidential election in January 2000, he won reelection by polling as many as 92% of the total votes.

The People's Democratic Party, former Communist Party, renamed in August 1991, is still keeping its strongest power to support Karimov Administration. The leader of the party is Karimov himself. In December 1994, the post-independence first congress

members election was held. The People's Democratic Party and Homeland Progress Party won the election.

The next presidential and congress members elections are slated for January 2005 and December 2004 respectively.

After the collapse of the Soviet Union, Uzbekistan has been going its own way while continuing to emphasize the importance of renovation and national control, unlike other CIS nations such as Kazakstan and Kyrgyz who followed IMF recommendations to promote economic liberalization and structural reforms. During a period from the collapse of the Union to 1996, most of CIS nations had suffered from serious economic depressions, while Uzbekistan could manage to suppress the reduction of GDP to a minimum level thanks to the "gradual renovation" policies.

The President's strong leadership and "gradual renovation" policies since independence have been contributing to keeping its political and economic situations relatively stable. Karimov Administration is robust.

2.3 Situation of Economy

Relying on considerable natural resources and a highly educated labor force, the Government of Uzbekistan has attempted to craft a mechanism for economic development combining an emphasis on preserving macroscopic stability and industrial capacity with efforts to improve the level of foreign trade and investment.

Soon after declaring independence, the Government of Uzbekistan established economic policies that were unequivocally opposed to the "shock therapy" approach, favoring instead efforts to support state enterprises and shield consumers from inflation through a combination of state subsidies, strict price controls and periodic wage increases. Initially, these policies enabled the government to hold the 1991-1994 GDP decline to 17% compared to a CIS average near 40%. However, this conservative approach became increasingly untenable in 1993, following Uzbekistan's expulsion from the Russian ruble zone. Faced with mounting economic problems accented by soaring inflation of the transitional currency known as the "soum coupon," the government began a genuine economic reform program including stricter fiscal policies, freeing of prices on most commodities, cooperation with international financial institutions, modest steps toward privatization, overtures to foreign investors and institution of a permanent currency, the soum.

After instituting these policies, the government made impressive gains against inflation, an end-year inflation rate of 27.6% for 1997, down from 64.4% at the end of 1996. Similar progress was made in preserving the GDP which went from a 4.2% drop in 1994 to a 5.2% growth in 1997. Tables 2.1-2 and 2.1-3 show the real GDP (change in percentage compared to the previous year) and contribution of various sectors to the GDP in 1993 to 1997. In 1997, each sector's contribution to the GDP in real terms is 26% by agriculture, 17% by manufacturing, 8% by trade, 8% by construction, 6% by transportation and telecommunication and 24% by others. Agriculture accounts for the largest origin of GDP.

Table 2.3-1 Real GDP Growth (In percent over previous year)

Year	1995	1996	1997	1998	1999
Agriculture	2.0	-7.0	5.8	4.0	6.0
Industry	-5.6	1.7	2.2	2.3	1.0
Transport and communication	-5.0	-1.0	-1.0	5.0	3.3
Construction	-4.1	0.6	2.6	6.0	3.6
Trade	-6.2	19.5	17.1	10.3	7.3
Other Services	2.3	2.0	4.1	3.0	3.9
Indirect subsidies minus taxes	-0.4	14.1	8.1	4.8	2.9
Total	-0.9	1.6	5.2	4.4	4.1

Source : IMF Staff Country Report No.00/36

CHAPTER 3 PRESENT STATUS OF ELECTRIC POWER AND HEAT ENERGY SECTOR IN UZBEKISTAN

THE DETAILED DESIGN STUDY FOR

MODERNIZATION OF TASHKENT THERMAL POWER PLANT

IN THE REPUBLIC OF UZBEKISTAN

FINAL REPORT (SUMMARY)

CONTENTS

List of Table

List of Figures

CHAPTER 3 PRESENT STATUS OF ELECTRIC POWER AND HEAT ENERGY SECTOR IN UZBEKISTAN

3.1 Status of Electric Power Sector

3.1.1 Overview

The Ministry of Power Industry and Electrification (hereinafter referred to as SJSC "Uzbekenergo" collectively) possesses about 97% of the total generation and transmission capacity existing in Uzbekistan, while the remaining power generation of less than 300MW (3% of the national total) are industrial users' auto-production.

SJSC "Uzbekenergo" expects increase in power demand over 15% during the coming ten years. To meet this, SJSC "Uzbekenergo" will make efforts to maintain self-sufficiency, improve power supply reliability and quality, and improve the efficiency in the use of power and fuel. In addition, SJSC "Uzbekenergo" is promoting the development of small, dispersed power plants, and renewable energy resources with a view to preserving the ecology and global environment.

The Uzbekistan's power system consists of nine thermal power plants (three of them are heat & power generation plants) and 28 hydropower plants, totaling 1,126,000 MW (984,000 MW by thermal and 142,000 MW by hydropower). Of these, those having an installed capacity over one million kW are Syrdarya TPP (3,000 MW), Navo-Angren TPP (2,100 MW), Tashkent TPP (1,860 MW) and Navoi TPP (1,250 MW).

The total number of steam turbine sets installed at these TPPs is 64, including 37 units having a capacity over 150 thousand kW. The largest steam turbine generator of 800 MW is under construction at Talimarjan TPP.

Hydroelectric power plants are responsible mainly for making up a portion of demand exceeding the supply capability of TPPs. The largest plant is Charvak HPP with an installed capacity of 620 MW and reservoir of 2 billion tons. 67 hydropower units are installed on these HPPs, with a unit capacity of 1 to 165 MW.

The thermal power plants serve for district heating in 13 towns. The installed capacity of hot water boilers makes 6,300 Gcal/h.

In the structure of primary energy sources for producing electric heat and power, natural gas makes 84%, heavy oil makes 12%, and coal makes 4%. Note that environment-friendly natural gas is the main source of primary energy.

Power transmission and distribution is carried out by 15 network enterprises. The total length of all power lines is over 233 thousand km.

Long-term goals regarding the power industry include establishing energetic independence, satisfaction of growing demand, and reduction of fuel consumption, with major directions of further development of power industry:

- Reconstruction and technical re-equipment of existing power plants
- New construction on the basis of modern efficient condensation power units
- Upgrading existing equipment, implementation of modern power generating technologies on the basis of PGU and GTU
- Utilization of hydropower potential of large and medium rivers

In a short-term prospective, it is planned to start up the No.1 power unit with a capacity of 800 MW at Talimarjan TPP. It is also planned, during the same period, to re-equip and reconstruct existing power plants, and to upgrade TPPs by introduction of high-performance steam-gas blocks (PGU) with a unit capacity of 100 to 400 MW.

On the whole, it is planned to put into operation 1,620MW (including a combined cycle of 376MW at Tashkent TPP and 346MW at Navoi TPP) by 2005. These implementation will allow reducing fuel rate for power generation by 30 g/kWh. Moreover, during the next years up to 2010, it is planned to construct a 800MW steam cycle unit at Talimarjan TPP and 404MW unit at Pskem HPP. Table 3.1-1 shows the existing plans for construction of power generating facilities during the years up to 2010. The total installed capacity to be build during the years is 3,276MW.

Table 3.1-1 Power Generation Plant Development Program

Name of Plant Site	Type of Plant	Fuel	(MW)	Operation
plant	Steam power	Natural gas	800	2004
plant	Steam power	Natural gas	800	2009
Tashkent thermal power plant	sycle	Natural gas	376	2008
Navoi thermal power plant	sycle	Natural gas	346	2009
Mubarek cogeneration plant	sycle	Natural gas	100	2010
Tashkent cogeneration plant	sycle	Natural gas	60	2011
Navoi thermal power plant	sycle	Natural gas	330	2012
Fergana cogeneration plant	sycle	Natural gas	60	2013
Pskem hydro power plant	Hydro power	-	404	2015
Total			3276	

Source : Answer from SJSC "Uzbekenergo"

Power network development projects are also being implemented to ensure reliable and stable power supply for the growing economy and population. The new Sogdiana and Uzbekistanskaya substations of 500kV each will improve the reliability and stability of power supply to the customers in Samarkand, Bukhara and Ferugana, and facilitate the development of productive forces in these regions. The new Keles and Chapan-Ata substations of 220kV each will satisfy the growing power demand in Tashkent and Samarkand.

The present total installed capacity under the jurisdiction of SJSC "Uzbekenergo" of Power Industry is 11,263MW, including thermal generation of 9,844MW and hydropower generation of 1,419MW, producing over 50 billion kWh. Figure 3.1-1 shows Power Generation Plants and Transmission Lines in Uzbekistan. Table 3.1-2 shows the growth of total installed capacity during the past ten years. Since 1992, no additional capacity has been put into operation, partly because the power demand temporarily declined due to the economic depressions after independence.

As mentioned before, a gas-fired 800MW Talimardjan TPP under construction is slated for commissioning in this year.

Table 3.1-2 Maximum Power Demand for Last Ten Years

Year	Installed Capacity (MW)			Maximum Power Demand (MW)	Capacity of Largest Unit (MW)
	Hydro	Thermal	Total		
1990	1,399	9,452	10,851	8,374	300
1991	1,399	9,544	10,943	8,608	300
1992	1,419	9,544	10,963	7,873	300
1993	1,419	9,544	10,963	7,900	300
1994	1,419	9,544	11,263	7,556	300
1995	1,419	9,844	11,263	7,379	300
1996	1,419	9,844	11,263	7,478	300
1997	1,419	9,844	11,263	7,476	300
1998	1,419	9,844	11,263	7,579	300
1999	1,419	9,844	11,263	7,494	300

Source : Answer from SJSC "Uzbekenergo"

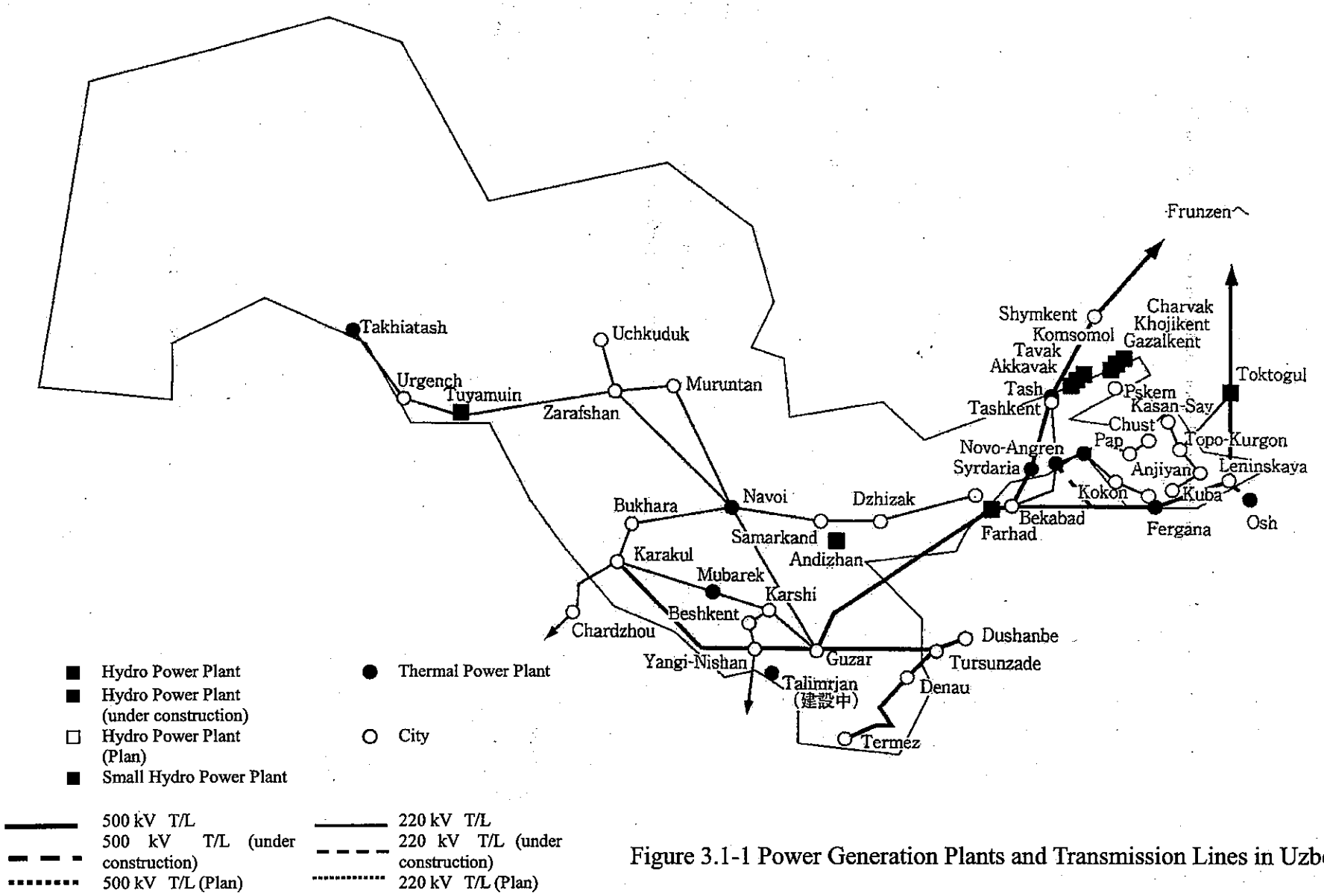


Figure 3.1-1 Power Generation Plants and Transmission Lines in Uzbekistan

3.1.2 Demand and Supply of Power

(1) Overview

Like other former Soviet countries, Uzbekistan's economy and industrial activities have been unstable and stagnant since independence. Power generation since independence in 1991 had been declining (by about 14%) till 1996, and then has remained almost unchanged at the level in 1996. As mentioned before, Uzbekistan and its neighboring countries are trading power within the region. Uzbekistan exports and imports power of 20-30% of its total generation. In every year up to 1997 since independence, Uzbekistan had continued to export power slightly larger than the amount of imports. However, since 1996, the import has been larger than export by about 2% of the total domestic generation. Figure 3.1-2 shows the power generation during the past ten years. Figure 3.1-3 shows the export and import amount of power. In 1999, the power generation by the facilities under the jurisdiction of SJSC "Uzbekenergo" of Power Industry was 5,326GWh by hydropower plus 38,607GWh by thermal generation; and the export and import was 11,090GWh and 12,305GWh respectively.

Annual peak demand in Uzbekistan had grown about 4% every year before independence. However, after independence, it had continued declining to about 86% of the ever largest annual peak demand recorded in 1991. After this smallest peak demand in 1995, it has been growing. Figure 3.1-4 shows the annual peak demand during the last 12 years.

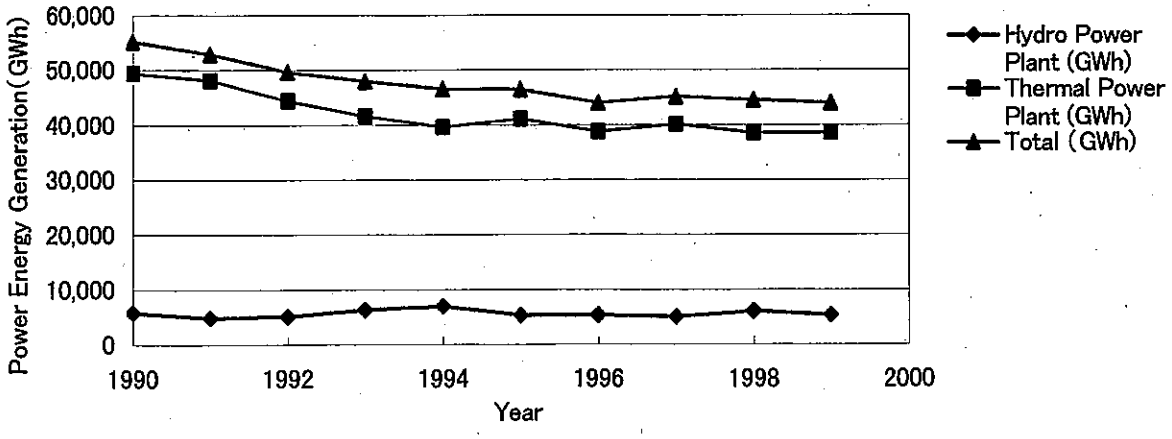
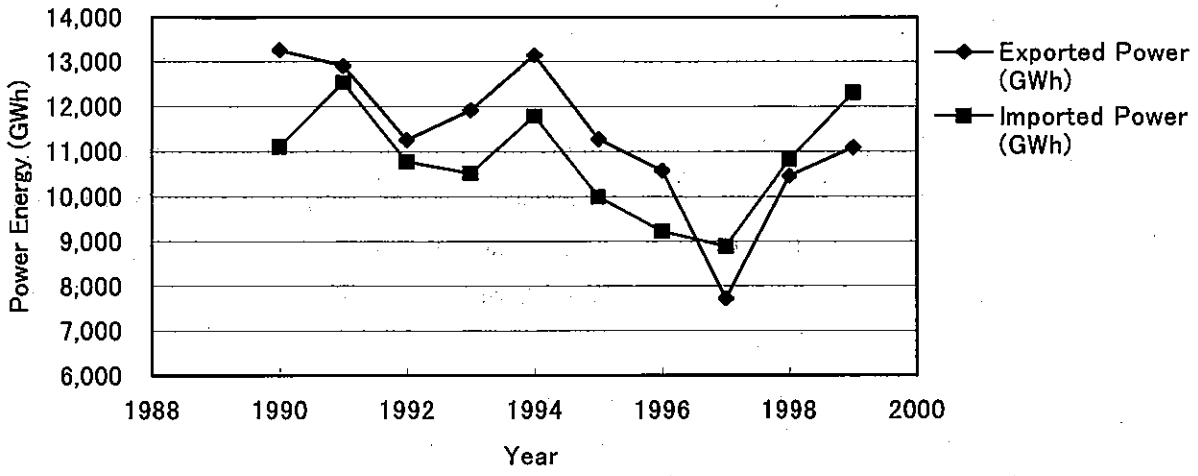


Figure 3.1-2 Power Energy Generation for Last Ten Years



. Figure 3.1-3 Export and Import Power Energy for Last Ten Years

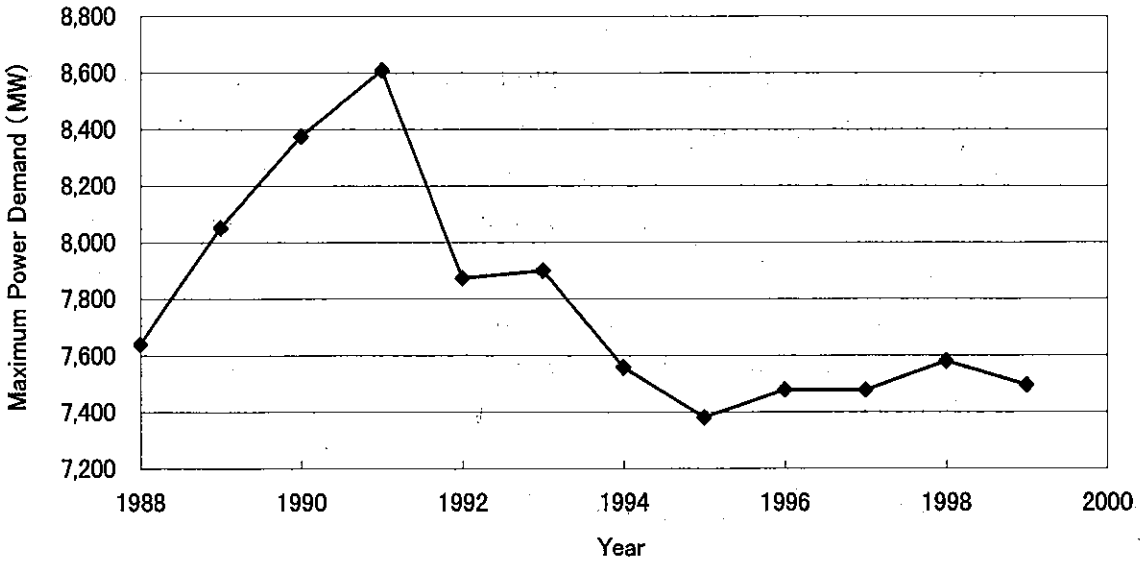


Figure 3.1-4 Maximum Power Demand for Last Twelve Years

(2) Present Status of Power Demand

Annual total demand (GWh) in Uzbekistan had been gradually increasing before independence. However, since independence in 1991, it had been declining to 14% down in 1995 due to the sluggish industrial activities. Since 1996, it has remained almost unchanged.

(3) Present Status of Power Supply

As shown in Table 3.1-2 Growth in Installed Capacity of Hydropower and Thermal Power Plants During Last Ten Years, Uzbekistan's power generating capacity grew only 4% during the last 10 years to the present capacity of 11,263MW: 1,419MW (12.6%) of hydropower plus 9,844MW (87.4%) of thermal power. The largest unit is the 300MW unit at Syrdarya TPP. Uzbekistan is abundant in natural gas so that many thermal power plants operating on natural gas have been developed.

Outline of the Existing Thermal Power and Hydropower Plants, thermal power generator units in operation number 64 including 17 units of 300MW or above, 29 units of 100-160MW and 18 units of 60MW or below. Smaller units have been operating as long as over 40 years. All of the thermal power units are of a steam turbine generator, including six gas-fired and three coal-fired units.

Outline of the Existing Hydropower Plants, 55 of the 67 units in operation are aged over 50 including ones aged over 70. All of these aged units are small in capacity as 3 to 30MW. Units constructed in the 1970's include large ones of over 90MW. As shown in Table 3.1-9 Capacity Factor and Availability Factor of Power Plants During Last Ten Years, many of the hydropower plants are also operating at high capacity factor and low availability factor, which indicates that they are aged. However, only Kadirin CHS is operating at high capacity factor and high availability factor (both 80%), which indicates that it is operating at high load factor.

(4) Future Plans for Power Generation Facilities

Due to the sluggish industrial activities, power consumption in Uzbekistan had declined by as large as 14.3% in 1995 compared to the level before independence (1990). However, since then the power consumption has remained on the same level. Meanwhile, the maximum power demand has been increasing since 1995. To meet this increasing peak value of demand and sustain the development of Uzbekistan's economy, SJSC "Uzbekenergo" of Power Industry is constructing a Central Asia's largest thermal power plant of 800MW operating on natural gas in the south of the country. The No.1 Unit is slated to complete in 2000. SJSC "Uzbekenergo" forecast the growth of maximum power demand in the coming ten years as shown in Figure 3.1-5. According to this figure, the power demand in 2010 will have increased by 2,320MW (=10,000 - 7,680) after an average growth of 3.0% per year.

Table 3.1-3 shows the growth of power consumption during 2000 to 2010 forecast by SJSC "Uzbekenergo".

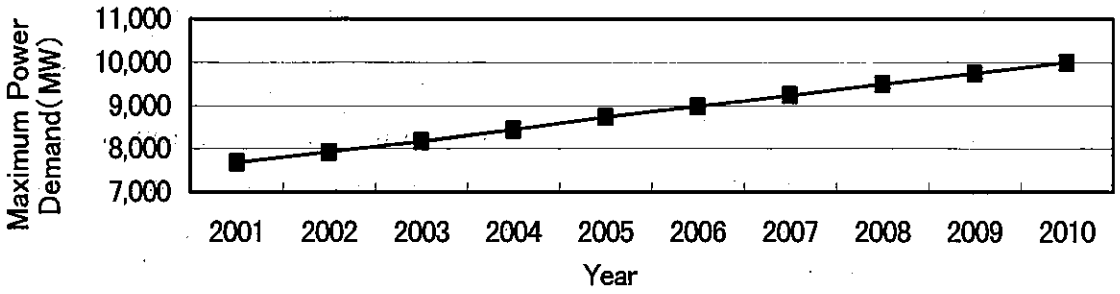


Figure 3.1-5 Maximum Power Demand for Next Ten Years

Table 3.1-3 Forecast of Annual Power Energy Consumption (GWh)

Year	Household	Commercial	Industries		Public Street	Other Public Authorities	Others	Total
			Small	Large				
2001	6,850	180	900	18,600	160	1,870	12,240	40,800
2002	7,070	190	920	19,200	160	1,930	12,630	42,100
2003	7,300	200	930	19,800	170	2,000	13,000	43,400
2004	7,540	200	980	20,500	180	2,100	13,400	44,900
2005	7,840	210	1,020	21,300	180	2,150	14,000	46,700
2006	8,100	210	1,060	22,000	200	2,210	14,420	48,200
2007	8,300	220	1,100	22,800	200	2,280	14,880	49,780
2008	8,600	230	1,120	23,300	210	2,330	15,310	51,100
2009	8,800	230	1,140	24,000	210	2,420	15,800	52,600
2010	9,100	250	1,200	24,600	220	2,500	16,230	54,100

Note 1) Source : Answer from SJSC "Uzbekenergo"

2) Industries Small : Less than 750 kW Large : 750 kW and more

As can be seen in the table, power consumption will annually grow by 3.2% on average with a slight difference in growth level depending on the sectors. This growth rate is slightly larger than that of the maximum power demand. To meet this increasing consumption and maximum demand, SJSC "Uzbekenergo" has plans for constructing new plants shown in Table 3.1-1. During the coming ten years, power generation facilities of 3,276MW will be constructed. The construction plans include two gas turbine heat and power generation plants of small capacity (60MW each), four combined cycle power generation plants (100 to 376MW each), two gas-fired thermal power plants of 800MW each, and a hydropower plant of 404MW.

(5) Demand Supply Balance

The newest power plant among those in operation in Uzbekistan is the one constructed 15 years ago. Most of them are aged 30 or more. Compared to hydropower plants, thermal power plants are more easily degraded in performance - generating capacity and energy conversion efficiency - with time elapsed. Degraded generating capacity means a lower supply capability, and degraded energy conversion efficiency means a larger consumption of fuel. Aged facilities suffer from these degradation in performance, and increase in maintenance cost and lower availability factor as well.

Therefore, construction plans for new facilities intended for meeting the increasing demand as forecast according to the economic growth should be determined in consideration of possible decommissioning or degradation in supply capability of existing aged facilities. Moreover, to preserve the global environment and save energy resources, facilities of a higher energy conversion efficiency should be chosen.

SJSC "Uzbekenergo" of Power Industry prepared three tables: new facilities construction plan, generating capacity after executing decommissioning programs for old facilities vs. maximum power demand up to 2010 and generating capacity vs. power consumption.

According to these tables, the reserve ratio - percentage of generating capacity to maximum power demand - is 15 to 23% in 2001 and later. This level of reserve may not be considered enough to ensure stable power supply, since many of the existing facilities have aged. Another reserve ratio - percentage of generating capacity to consumption - is 18 to 25%. This level of reserve may also not be considered enough for reason of the lower availability factor of aged facilities.

To ensure stable power supply and meet the maximum demand and consumption as forecast by SJSC "Uzbekenergo" of Power Industry, at least the construction projects shown in Table 3.1-1 should be implemented as planned. The table includes a plan for constructing by 2006 a 60MW cogeneration power unit at the Tashkent heat and power generation plant. The construction plan is a byproduct of a study for introducing newest heat supply systems to ensure stable and efficient supply of heat to Tashkent City. The plant is too small to meet the increasing demand.

3.2 Status of Heat Energy Sector

3.2.1 Overview

Heat supply service is placed under the jurisdiction of local governments' Heat Supply Corporations under SJSC "Uzbekenergo" of Utility. SJSC "Uzbekenergo" of Energy responsible for power generation supplies heat produced by power plants to the public Corporations. Of the nine power plants under the jurisdiction of SJSC "Uzbekenergo" of Kokand, Fergana, Mubarek and Tashkent plants supply heat (hot water) to the relevant Heat Supply Corporations.

This report describes the present condition of heat demand supply of Tashkent which investigated this time, and a future situation how.

3.2.2 Overview of Heat Generation Facilities in Tashkent

In Tashkent, there are ten heat generation plants (HP-1 through HP-10) and one heat & power generation plant. The latter covers the central areas of the city, while HP-1 through HP-10 cover other areas in the city. These plants supply both hot water and steam. Hot water, including that for room heating, is supplied to family users, office buildings and other commercial users. Steam is supplied to industrial users near the heat generation plants.

The city's total supply capacity is 4,462 Gcal/h for hot water and 288 Gcal/h for steam. The plants' total installed capacity is 5,650 Gcal/h in the total of hot water and steam. Table 3.2-1 shows the installed capacity of each plant.

Table 3.2-1 Equipment capacity of each heat supply place in Tashkent

	Name	Location	Number of Boiler	Total Heating Capacity (Gcal/h)	Boiler No., Model, Installation Year					
1	Severo-Vostochnaya	TashGRES district	6	500	No. 1 PTVM-100 1968	No. 2 PTVM-100 1969	No. 3 PTVM-100 1970	No. 4 PTVM-100 1975	No. 5 PTVM-100 1978	No. 6 PTVM-100 1999
2	Kara-Su	Kara-Su district	3	300	No. 1 PTVM-100 1978	No. 2 PTVM-100 1980	No. 3 PTVM-100 1999			
3	Zapadnaya	Kukcha district	5	400	No. 1 PTVM-50 1971	No. 2 PTVM-50 1971	No. 3 PTVM-100 1972	No. 4,5 PTVM-100 1978		
4	Severnaya	Yunus-Abad district	10	900	No. 1,2 PTVM-50 1970	No. 3 PTVM-100 1970	No. 4,5 PTVM100 1975-76	No. 6,7 KVGM-100 1981	No. 8,9 KVGM-100 1991,98	Other 100
5	Chilanarskaya	Chilanzar district	7	600	No. 1,2 PTVM-50 1969-70	No. 3 PTVM-100 1971	No. 4 PTVM-100 1975	No. 5 PTVM-100 1977	No. 6,7 PTVM-100 1981	
6	Yugo-Vostochaya	Kuiluk district	3	200	No. 1,2 PTVM-50 1973	No. 3 PTVM-100 1981				
7	Aviastroitelei	Aviastroi-Telei district	5	400	No. 1 PTVM-50 1976	No. 2 PTVM-50 1978	No. 3 PTVM-100 1980	No. 4 KVGM-100 1988	No. 5 KVGM-100 1998	
8	Sergili	Sergili district	4	300	No. 1 PTVM-50 1980	No. 2 PTVM-50 1981	No. 3 KVGM-100 1990	No. 4 KVGM-100 1993		
9	Novo-Chilanzarskaya	Nazarbek settlement	3	540	No. 1 KVGM-180 1986	No. 2 KVGM-180 1987	No. 3 KVGM-180 1988			
#	Severo-Zapadnaya	Near Medical University 2	3	540	No. 1 KVGM-180 1986	No. 2 KVGM-180 1987	No. 3 KVGM-180 1988			
#	TashTETs	Airport area	12	970	No. 1 PTVM-50 1965	No. 2,3 PTVM-100 1968-70	No. 4,5 PTVM-100 1970-74	No. 6,7 PTVM-100 1977-80	Others 5 320	
	Total		61	5,650						

The city's heat demand in 1999 is 10,867 Mcal/y with an hourly peak demand of 5,604 Gcal/h . Table 3.2-2 and Figure 3.2-3 show the annual heat demand during the past ten years. The almost constant demand since independence (1992), as shown in the figure, is an indication of the sound economic activities and larger share of family users. The relatively small variation in demand year by year is attributable probably to the variation in temperature during winter season.

Table 3.2-2 Heat Demand for Last Ten Years of Tashkent City

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Heat Demand ($x10^3$Gcal/year)	10,239	10,431	10,857	12,045	11,560	11,758	11,612	10,113	12,186	10,867

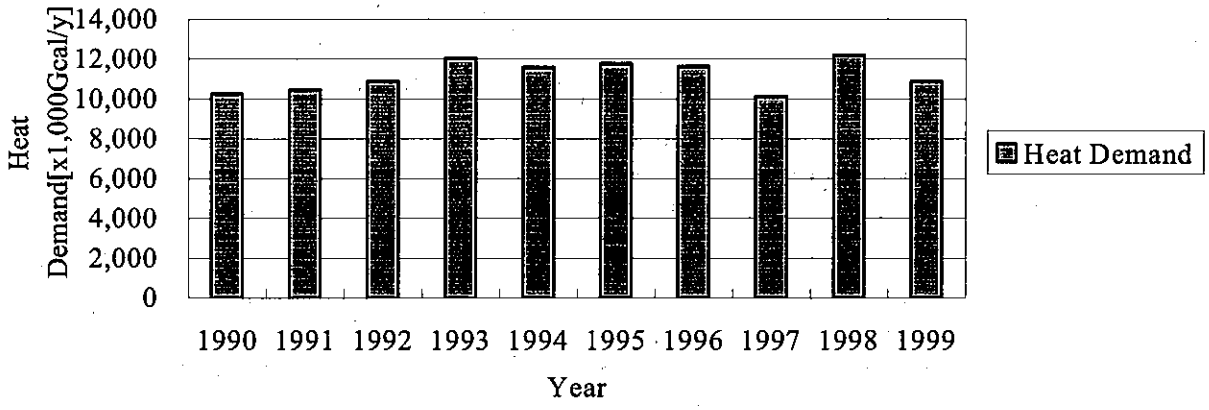


Figure 3.2-1 Heat Demand for Last Ten Years of Tashkent City

Monthly change in heat demand in the city is characterized by a larger demand in winter including hot water for room heating from November to March, e.g. 1,826 Mcal/month in January 1999, and a smaller demand in summer as evidenced by a hot water demand of as small as 351 Mcal/month in September 1999. (See Table 3.2-3 and Figure 3.2-2.)

Table 3.2-3 Monthly Heat Demand of Tashkent City (1999)

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Heat Demand ($x10^3$Gcal/month.)	1826	1348	1355	643.8	489.5	419.6	411.2	382.5	351.2	543.3	1342	1730

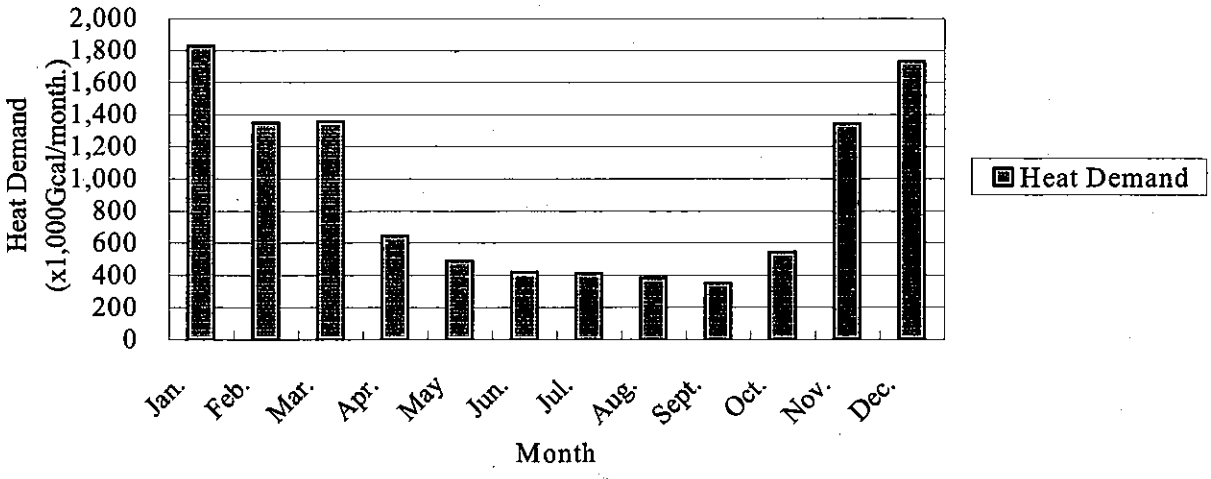


Figure 3.2-2 Heat Demand of Tashkent City

3.2.3 Forecast Heat Demand and Source Development Plans

The city's heat source development plan for the coming ten years describes a positive growth of demand along with increasing population: 18% increase in heat demand in 2005 and 23% increase in 2010 compared to the level in 2000. The forecast heat demand in 2010 is 13,398 Mcal/y as shown in Table 3.2-4 and Figure 3.2-3.

Table 3.2-4 Heat Demand Forecast of Tashkent City

Year	Heat Demand (Mcal/y)	Population
1990	10,239	–
1995	11,758	–
2000	10,867	1,394,500
2005	12,858	1,535,000
2010	13,389	1,667,600

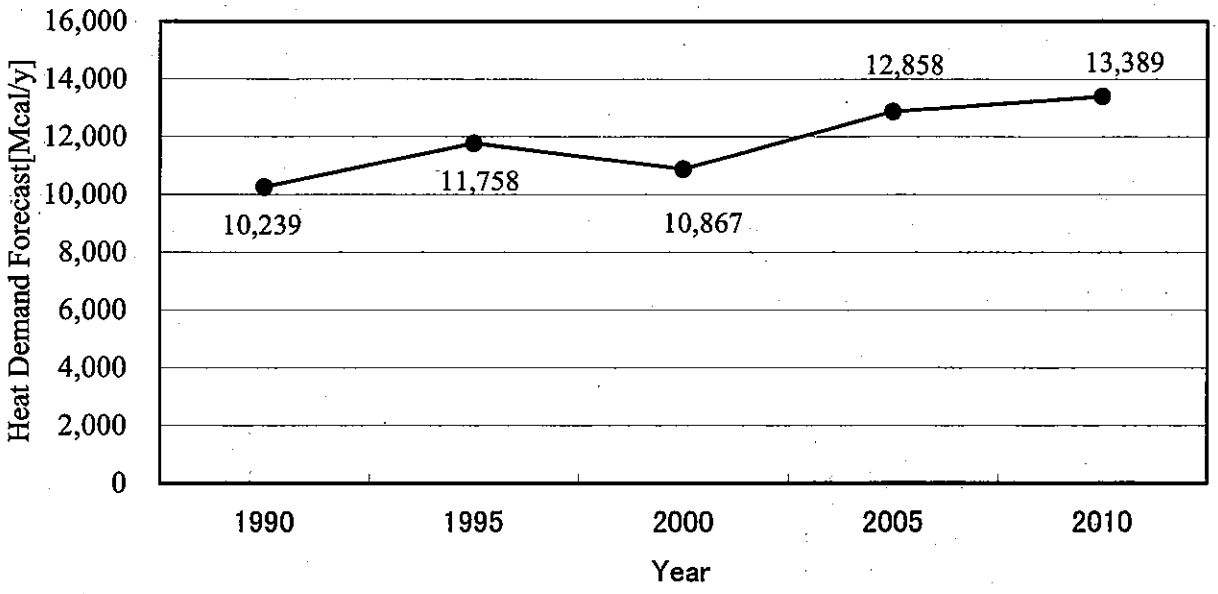


Figure 3.2-3 Heat Demand Forecast of Tashkent City

3.3 Electricity and Heat Energy Tariff

Electricity and heat energy tariff notified as applicable on and after April 1, 2003 is as per Table 3.3-1.

Table 3.3-1 Electricity and Heat Energy Tariff in Uzbekistan applicable on and after April 1, 2003

Group	Electricity Tariff	(Sum/kWh)	Group	Heat Energy Tariff	(Sum/Gcal)
I	Industrial user not less than 750kVA	*22,690	I	All Users except II and III	5,555
		10.65	II	Wholesale Users	4,710
II	Industrial user less than 750kVA	17.00	III	Energy System Use	4,080
III	Agriculture	12.10			
IV	Transport and City Transport	17.00			
V	Public Organization	13.85			
VI	Commercial User	34.00			
VII	Residential	12.10			
	Residential for Electric Stove	6.05			
VIII	Heating and Air conditioning	34.00			
IX	Advertisement	110.00			
X	Energy System Use	11.75			

(Note) Sum 22,690 for industrial user not less than 750kVa is payable per kW contract per year.
All tariffs are inclusive of VAT.

Weighted average electricity tariff including VAT is calculated as Sum 15.83/kWh at the same method applied at Table 5.3-12.

3.4 Current State in Power Transmission System

3.4.1 Current State in Power Transmission System

The electric power system of Central Asia was constructed to compose one electric power system gathered five countries (Uzbekistan, Kazakhstan, Kyrgyzstan, Tajikistan, and Turkmenistan) without considering the country border of today during the time of former Soviet Union.

The trunk transmission system is mostly composed of the one circuit 500kV and 220kV line, and maintains the reliability level by looping operating both. (Figure -3.4-1) The outline of the transmission lines and the substations in Uzbekistan as of 2002 are as follows.

Overhead transmission line

500kV	1,657.2	km
220kV	5,910.9	km
110kV	15,048.7	km
35kV	12,730.6	km
6kV-10kV	86,607.5	km
400V	100,092.7	km

Underground transmission line

110kV	19.8	km
35kV	281.5	km
6kV-10kV	7,56 .9	km
400V	2,640.6	km

Capacity of transformer

500kV	4,509.0	MVA
220kV	12,209.0	MVA
110kV	13,419.0	MVA
35kV	5,731.2	MVA

3.4.2 Export and import of electric power

Results of the importing and exporting of the electric power with neighboring countries in 2002 are as follows.

Import : From Turkmenistan 13 GWh

	From Kyrgyzstan	523 GWh
	From Tajikistan	72 GWh
Total		608 GWh
Export :	To Turkmenistan	6 GWh
	To Kyrgyzstan	267 GWh
	To Tajikistan	358 GWh
Total		631GWh

The electric power is exported total 23GWh in the balance of importing and exporting.

Power System Diagram of Central Asia

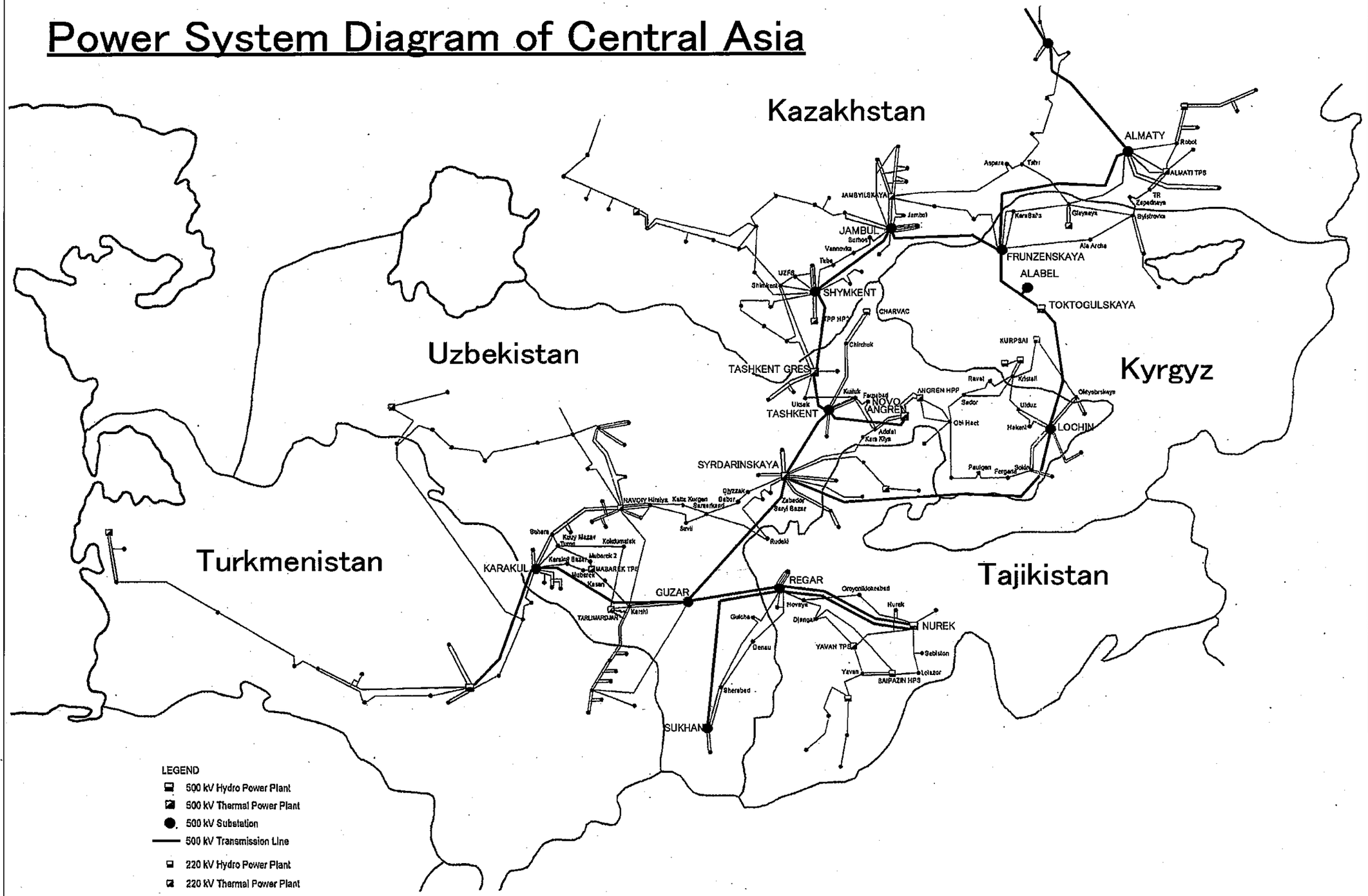


Figure 3.4-1 Power System Diagram of Central Asia