No.

Republic of Uzbekistan
Preparatory Survey
on
Tashkent Heat Supply Power Plant
Modernization Project

Final Report
（Summary）

June, 2009

Japan International Cooperation Agency (JICA)

Tokyo Electric Power Services Co., LTD

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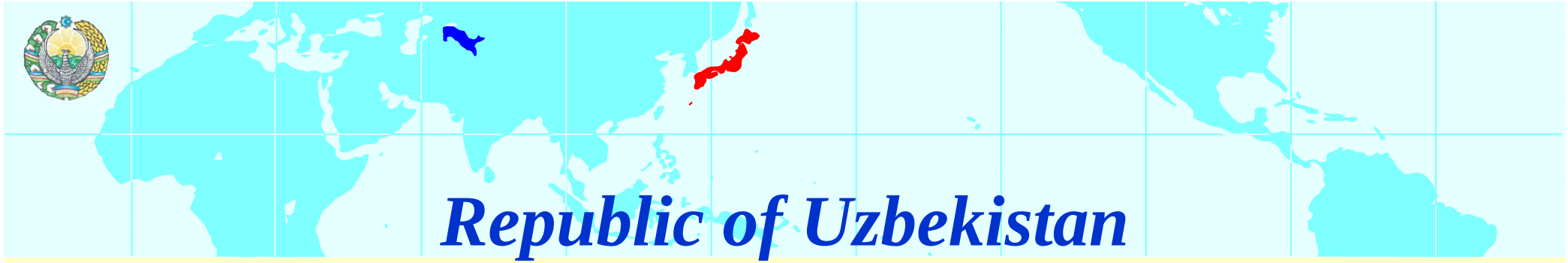

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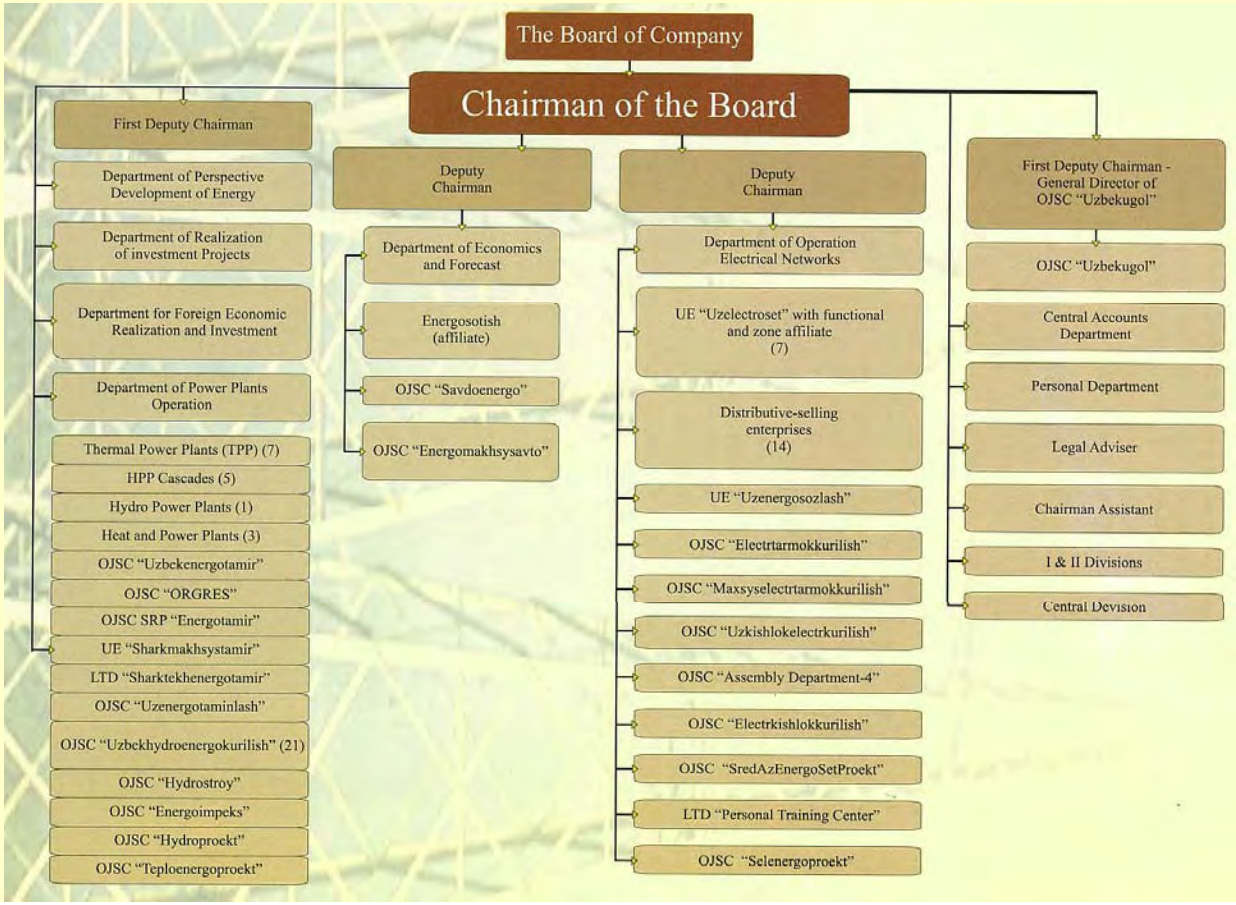
1.1 Power Sector in Uzbekistan

(1) Organization of Uzbekenergo



Chapter 1 Briefing of Heat and Power Sector in Uzbekistan

(2) Existing Thermal Power Plants

as of January 2009

No.	Name of Plant	Total Installed Capacity (MW)	Type of Fuel	Year of Initial Operation	Total Current Effective Capacity (MW)	Cumulative Operating Hours of All Unit (hours)
1	Syrdarya TPP	3,000	Gas,Oil	1972–1981	2,536	1,982,131
2	Novo-Angren TPP	2,100	Coal, Gas, Oil	1985–1995	1,381	627,188
3	Tashkent TPP	1,860	Gas,Oil	1963–1971	1,753	2,974,876
4	Navoi TPP	1,250	Gas,Oil	1963–1981	1,058	4,836,278
5	Takhiatash TPP	730	Gas,Oil	1967–1989	589	2,334,443
6	Angren TPP	484	Coal, Oil Coal gas	1957–1963	197	4,359,390
7	Fergana CHP	305	Gas,Oil	1956–1979	200	3,774,561
8	Mubarek CHP	120	Gas	1985–1986	120	5,141,650
9	Tashkent CHP	25	Gas	1937–1955	22.5	23,283,770
10	Talimardgan TPP	800	Gas	2004	800	29,869
	Total	**10,674**			**8,655**	

TPP: Thermal Power Plant

CHP: Combined Heat and Power

(source) Uzbekenergo

Almost TPPs have been operated for 40 – 50 years and those plants are needed to be replaced.

However there are no additional capacity after commercial operation of 800MW Tarimardjan TPP in 2004 and 300MW rehabilitation project of Sirdariya TPP Unit 7,8 in 2005.

Chapter 1 Briefing of Heat and Power Sector in Uzbekistan

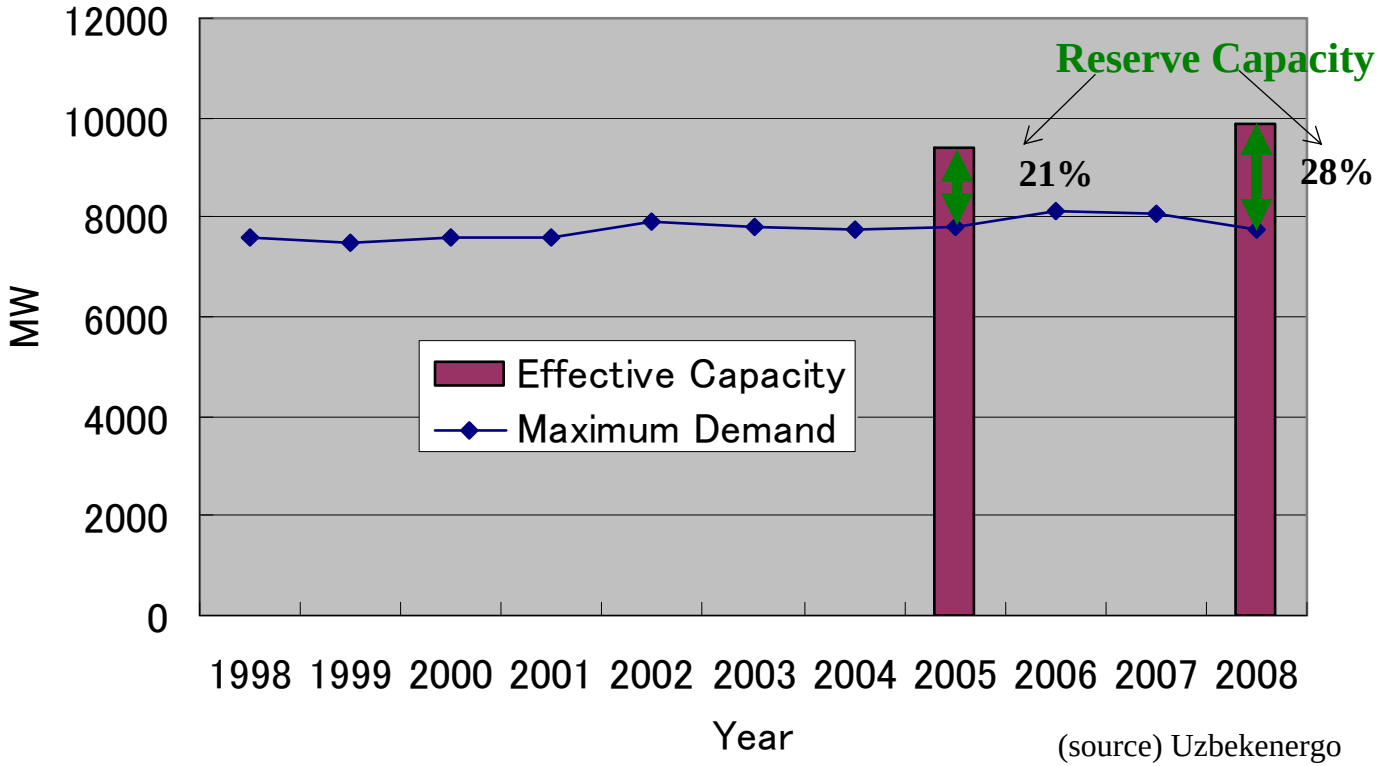
(3) Existing Hydro Power Plant

No.	Plant Name	Type	Location	No. of Unit	Total Capacity /MW		COD	Total Effective Capacity /MW
1	Charvak HPP	Hydo PP	Tashkent region	4	600	-	1970～1972	620.5
2	Khodjikent HPP	Hydo PP	Tashkent region	3	165	-	1976	165
3	Gazalkent HPP	Hydo PP	Tashkent region	3	120	-	1980	120
4	Chirchik GES	Hydo PP	Tashkent region	10	190.7	-	1941～1956	190.7
5	Kadyrya GES	Hydo PP	Tashkent region	8	44.6	-	1933～1946	44.6
6	Nizne-Bozsu GES	Hydo PP	Tashkent region	10	50.8	-	1943～1960	50.8
7	Tashkent GES	Hydo PP	Tashkent	10	29	-	1926～1954	29
8	Farkhad GES	Hydo PP	Syrdarya reg.	4	126	-	1948～1960	126
9	Sharikhan GES	Hydo PP	Andijan reg.	6	27.8	-	1943	27.8
10	Samarkand GES	Hydo PP	Samarkand reg.	9	40	-	1945	40

(source) Uzbekenergo

There are no additional capacity for over 35 years after commercial operation of Charvak HPP in 1972.

(4) Maximum Power Demand for Last Ten Years



(source) Uzbekenergo

During last 10 years, the power demand is stable and the reserve capacity is kept at enough level.

(5) Power Generation Development Plan

Name of Project Site	Type of Plant	Type of Fuel	Installed Capacity (MW)	Year of Initial Operation
Tashkent TPP	CC	Gas	370	2012
Navoi TPP	CC	Gas	400	2013
Tashkent CHP	GT	Gas	3 x 28	2015
TalimardganTPP	CC	Gas	2 x 400	2015
Total			1,654	

(source) Uzbekenergo

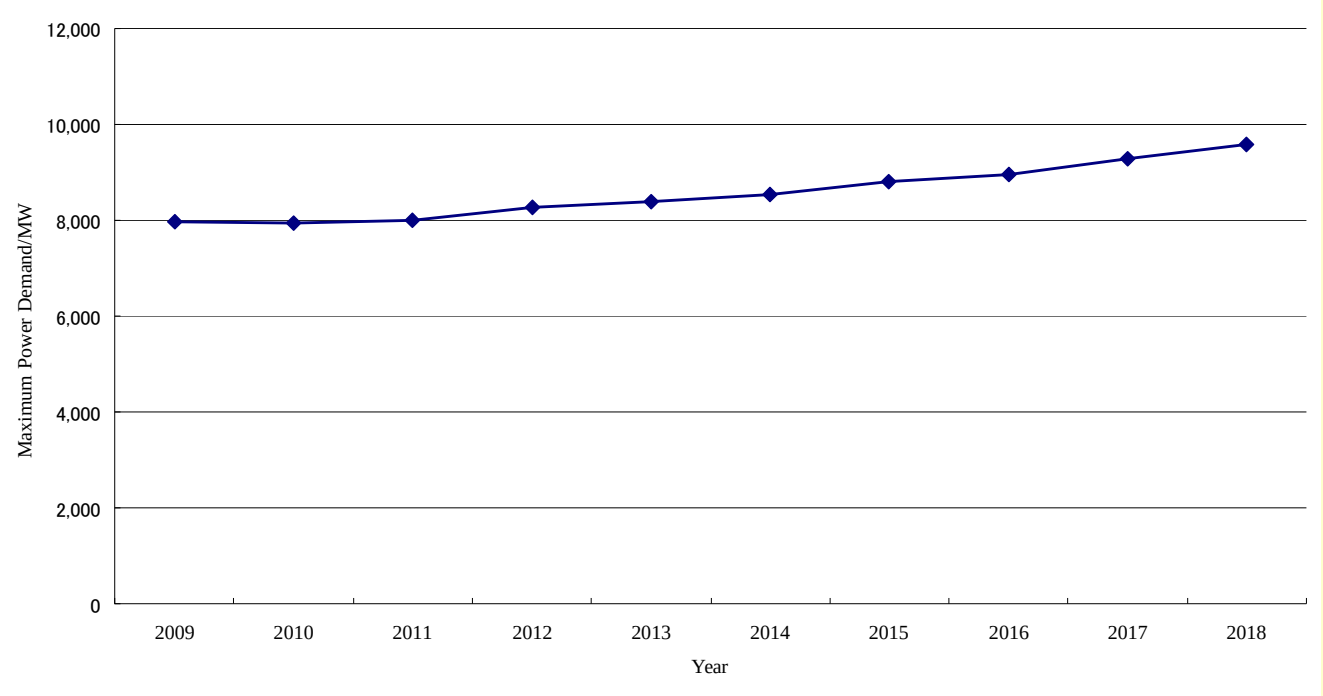
CC: Combined Cycle

GT: Gas Turbine

Due to recent progress of Thshkent TPP Project, movement for realization of other projects are activated.

Tashkent CHP is located in the center of Tashkent city and is not only important heat plant but also important power plant even though the power capacity is small.

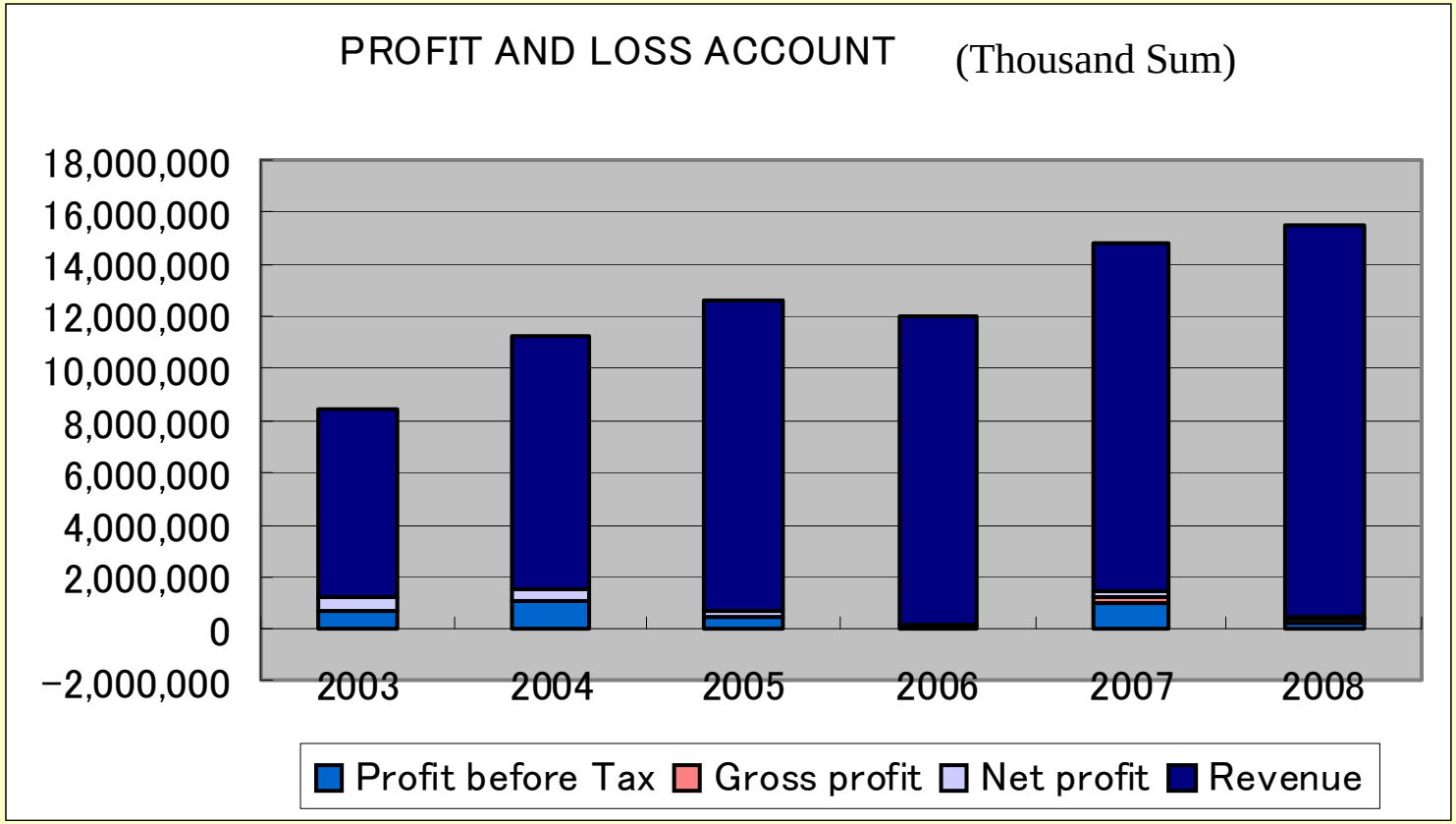
(6) Demand Forecast for Next 10 Years



(Source) Study Team assumption from the data provided by Uzbekenergo

Steady increase of demand is forecasted and thus the power generation development plan should be implemented as planned.

(7) Financial Condition of Tashkent Heat and Power Co.



(source) Tashkent Heat and Power Supply Plant

Chapter 1 Briefing of Heat and Power Sector in Uzbekistan

1.2 Heat Sector in Tashkent City

(1) Existing Heat Generating Plants

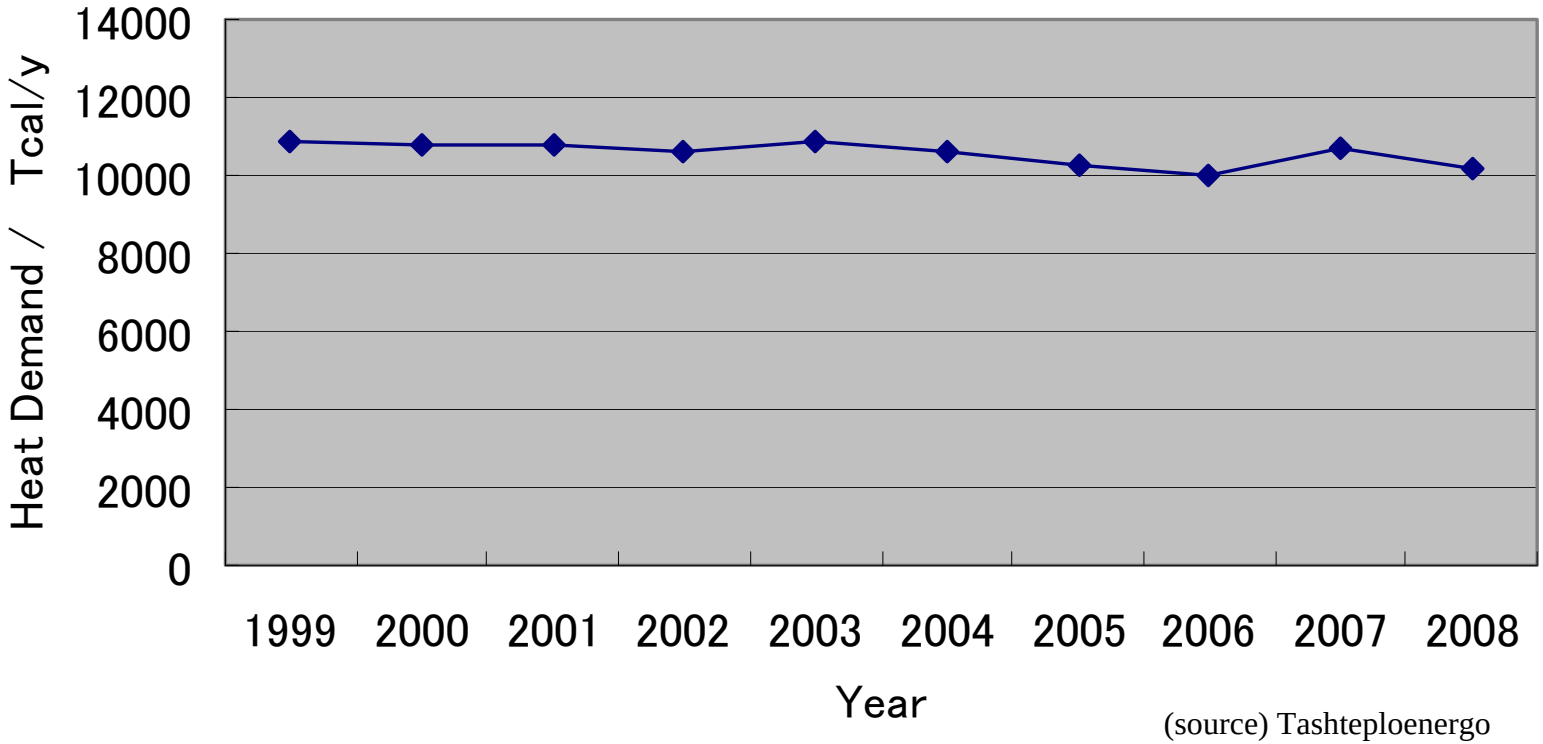
Name of Heat Generation Plant:		Number of Boilers	Type of Fuel	Total Installed Heating Capacity	Total Available Heating Capacity	Boiler No., Model, Installation Year									
				Hot Water	Hot Water										
1	HGP-1 North East Mirzo Ulugbek District	6	Natural Gas	500 (2x50+4x100)	400 (2x32+4x84)	No. 1 PTVM-50 1968	No. 2 PTVM-50 1969	No. 3 PTVM-100 1970	No. 4 PTVM-100 1975	No. 5 PTVM-100 1978	No. 6 PTVM-100 1999				
2	HGP-2 Karasu Mirzo Ulugbek District	3	Natural Gas	300 (3x100)	252 (3x84)	No. 1 PTVM-100 1978	No. 2 PTVM-100 1980	No. 3 PTVM-100 1997							
3	HGP-3 West Shaykhantohur District	5	Natural Gas	400 (2x50+3x100)	316 (2x32+3x84)	No. 1 PTVM-50 1971	No. 2 PTVM-50 1971	No. 3 PTVM-100 1972	No. 4 PTVM-100 1978	No. 5 PTVM-100 1978					
4	HGP-4 North Yunus Abad District	10	Natural Gas /Mazut Oil	900 (2x50+8x100)	832 (2x32+1x100+2x84+ 5x100)	No. 1 PTVM-50 1970	No. 2 PTVM-50 1970	No. 3 PTVM-100 1970	No. 4 PTVM-100 1975	No. 5 PTVM-100 1976	No. 6 PTVM-100 1981	No. 7 PTVM-100 1981	No. 8 PTVM-100 1991	No. 9 PTVM-100 1997	No. 10 PTVM-100 1998
5	HGP-5 Chilanzar Akmal Ikramov District	8	Natural Gas	700 (2x50+6x100)	568 (2x32+6x84)	No. 1 PTVM-50 1969	No. 2 PTVM-50 1970	No. 3 PTVM-100 1971	No. 4 PTVM-100 1975	No. 5 PTVM-100 1977	No. 6 PTVM-100 1981	No. 7 PTVM-100 1981	No. 8 PTVM-100 2001		
6	HGP-6 South East Mirabad District	4	Natural Gas	300 (2x50+2x100)	232 (2x32+2x84)	No. 1 PTVM-50 1973	No. 2 PTVM-50 1973	No. 3 PTVM-100 1981	No. 4 PTVM-100 2000						
7	HGP-7 Aviastroiteley Khamza District	5	Natural Gas	400 (2x50+3x100)	348 (2x32+1x82+2x100)	No. 1 PTVM-50 1976	No. 2 PTVM-50 1978	No. 3 PTVM-100 1980	No. 4 PTVM-100 1988	No. 5 PTVM-100 1997					
8	HGP-8 Sergeli Sergeli District	4	Natural Gas /Mazut	300 (2x50+2x100)	300 (2x50+2x100)	No. 1 PTVM-50 1980	No. 2 PTVM-50 1981	No. 3 KVGM-100 1990	No. 4 KVGM-100 1993						
9	HGP-9 Novo- Chilanzarskaya Tashkent Province	3	Natural Gas /Mazut	540 (3x180)	540 (3x180)	No. 1 KVGM-180 1986	No. 2 KVGM-180 1987	No. 3 KVGM-180 1988							
10	HGP-10 North West Tashkent Province	3	Natural Gas /Mazut	540 (3x180)	540 (3x180)	No. 1 KVGM-180 1986	No. 2 KVGM-180 1987	No. 3 KVGM-180 1988							
11	Tashkent HPGP Airport Area	7	Natural Gas /Mazut	650 (1x50+6x100)	437 (1x32+6x84)	No. 6 PTVM-50 1965	No. 7 PTVM-100 1968	No. 8 PTVM-100 1970	No. 9 PTVM-100 1970	No. 10 PTVM-100 1974	No. 11 PTVM-100 1977	No. 12 PTVM-100 1980			
Total		**58**	**-**	**5530**	**4765**										

(source) Tashteploenergo

Many plants have been operated for 20 – 30 years and those plants are needed to be replaced.

The total available capacity is decreased to 86% of the installed capacity.

(2) Heat Demand for Last Ten Years



(source) Tashteploenergo

During last 10 years, the heat demand has remained almost unchanged.

(3) Heat Generation Plant Development Plan

No.	Name of Heat Generation Plant:	Type of Plant	Installed Capacity (Gcal/h)	Type of Fuel	Year of Initial Operation
1	HGP-6	Rehabilitation of two boilers Installation of a new boiler	192	Natural gas	2011
2	HGP-7	Rehabilitation of two boilers	36	Natural gas	2012
3	HGP-8 (Plan 1)	Installation of three new boilers	250	Natural gas	2014
	HGP-8 (Plan 2)	Installation of a new GT cogeneration and Installation of two new boilers	271	Natural gas	2014
Total			**478 / 499**		

There is no replacement of old plants after 2001 and some action should be taken.

The plan introducing 9 GTCS to HGP-2,4,9,10 is not reflected in this official plan.

(source) Tashteploenergo

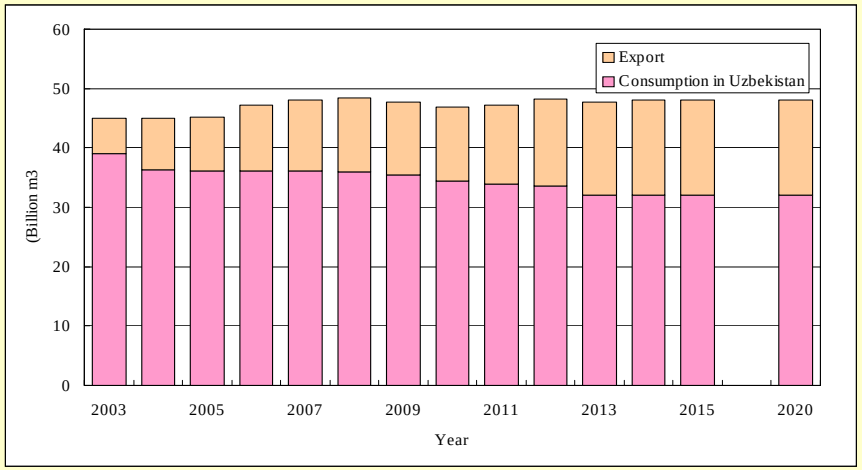
(4) Demand Forecast until 2015

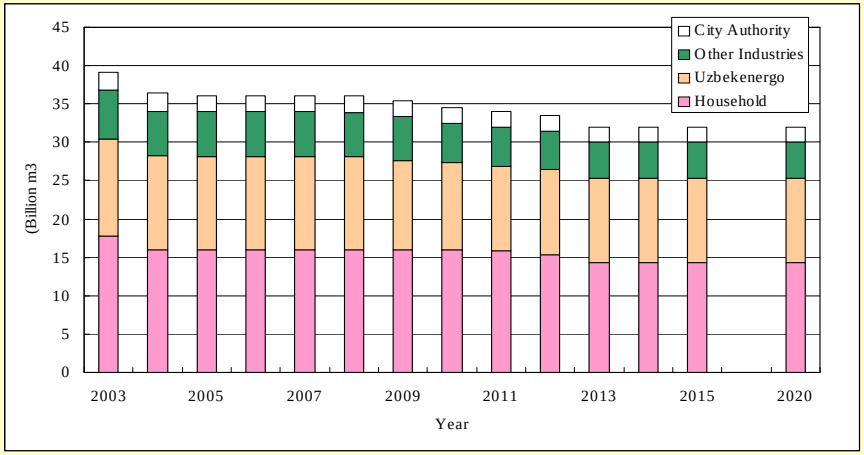
Year	Total Heat Energy Demand (Tcal/year)
2008	10167
2010	13943
2015	14407

(source) Tashteploenergo

This forecast shows 42% increase in next 7 years. Therefore it can be assured that the current district heating system will be maintained.

1.3 Gas and Coal Sector (1/2)





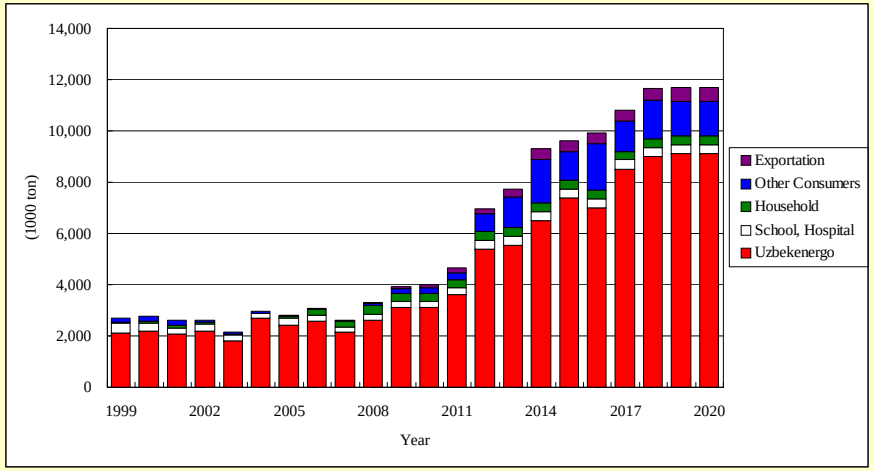
(source) Sector Study for Power Sector in Uzbekistan (2004, JBIC)

Figure 1-3-1 Production and Plan of Natural Gas

Figure 1-3-2 Consumption and Plan of Natural Gas

- ✓ **Uzbekistan has natural gas reserves estimated at 65 Trillion Cubic Feet on January.**
- ✓ **Uzbekistan exports natural gas to Kazakhstan, Kyrgyzstan, Tajikistan and Ukraine.**
- ✓ **The Uzbek government is strengthening energy saving and increase of production and consumption of coal as well as exploration and development of new gas fields in order to expand the natural gas export.**

1.3 Gas and Coal Sector (2/2)



(source) Ugol

Figure 1-3-3 Supply and Plan of Coal

- ✓ **The Republic of Uzbekistan Cabinet of Minister's resolution #196 Schedule is delayed.**
- ✓ **The new coal mining development program is applying and will be issued on March, 2009.**
- ✓ **The production of coal is 3.6million ton/year in 2008.**
- ✓ **The production of coal will be increased 6.4million ton/year in 2011, and 11.5million ton/year in 2014.**

1.4 Electricity and heat tariff system

Category		Basic change (Soum/kW/year)	Volume change (Soum/kWh)
Industry (750 or more kVA)		1000,000	47.55
Industry (less than 750kVA), agriculture, railroad, government organization, street light, heat supply		—	60.40
Commerce, teahouse, restaurant, other service industries		—	62.00
Home use for dwellings	Area with district heating available	—	60.40
	Area without district heating	—	30.20
Advertisement, lighting		—	110.00

(source) prepared by the survey team based on the SJSC Uzbekenergo data supplied

Before, such cost of electric power company was covered with collecting higher electricity bill from the commerce, however, politically low electricity bill for home use and for agriculture was abandoned. Such cross-subsidization existed between consumers is reviewed to improve a fair tariff system established by the principle of “beneficiary’s pay” in recent years.

1.5 Candidate Project for Yen Loan

1.5.1 Existing Facilities

	Angren Power Plant	Tarimardjan Power Plant	Heat Supply Station
Site	Southeast from the Tashkent City (100km)	Southwest from the Tashkent City (500km)	In the Tashkent City (No.2, No.4, No.9, No10)
Existing Facilities	Pulverized Coal Boiler: 11 Steam Turbine: 8 Generator: 8	Gas Fired Boiler: 1 Steam Turbine: 1 Generator: 1	No.2: 3 Boilers No.4: 10 Boilers No.9: 3 Boilers No.10: 3 Boilers
Capacity	484MW	800MW	No.2: 300Gcal/h No.4: 900Gcal/h No.9: 540Gcal/h No.10: 540Gcal/h
Maximum Operating Output (2008)	105MW	710MW	–

1.5 Candidate Project for Yen Loan

1.5.2 New Facilities (Summary (1/2))

	Angren Power Plant	Tarimardjan Power Plant	Heat Supply Station
Main New Facilities	Coal Fired Circulating Fluidized Bed Combustion Boiler: 2 Steam Turbine: 1 Generator: 1	Gas Fired Combined Cycle Gas Turbine: 2 HRSG: 2 Steam Turbine: 2 or 1 Generator: 2 or 3	Co-generation System No.2: GT, HRSG, GEN x 2 No.4: GT, HRSG, GEN x 3 No.9: GT, HRSG, GEN x 2 No.10: GT, HRSG, GEN x 2
Capacity	Power Supply: 150MW Heat Supply: 210Gcal/h	Power Supply: 750～800MW (250MW/GT unit) Heat Supply: 0Gcal/h	Power Supply: 50～75MW (25MW/GT unit) Heat Supply: 40Gcal/h
Layout Plan	The installation area which space removal of Nos. 12 and 13 boiler and space of removing of No. 11 boiler. (Refer to Page 21)	The construction plan is included to construct 4 units and 1 unit is constructed now, thus there is much area for new facilities. (Refer to Page 22)	Necessity area for 1 unit: 30m x 60m (Main Facility only) No.2: △ (1 unit only) No.4: △ (2 units only) No.9, No.10: ○ (Refer to Page 23 - Page 26)

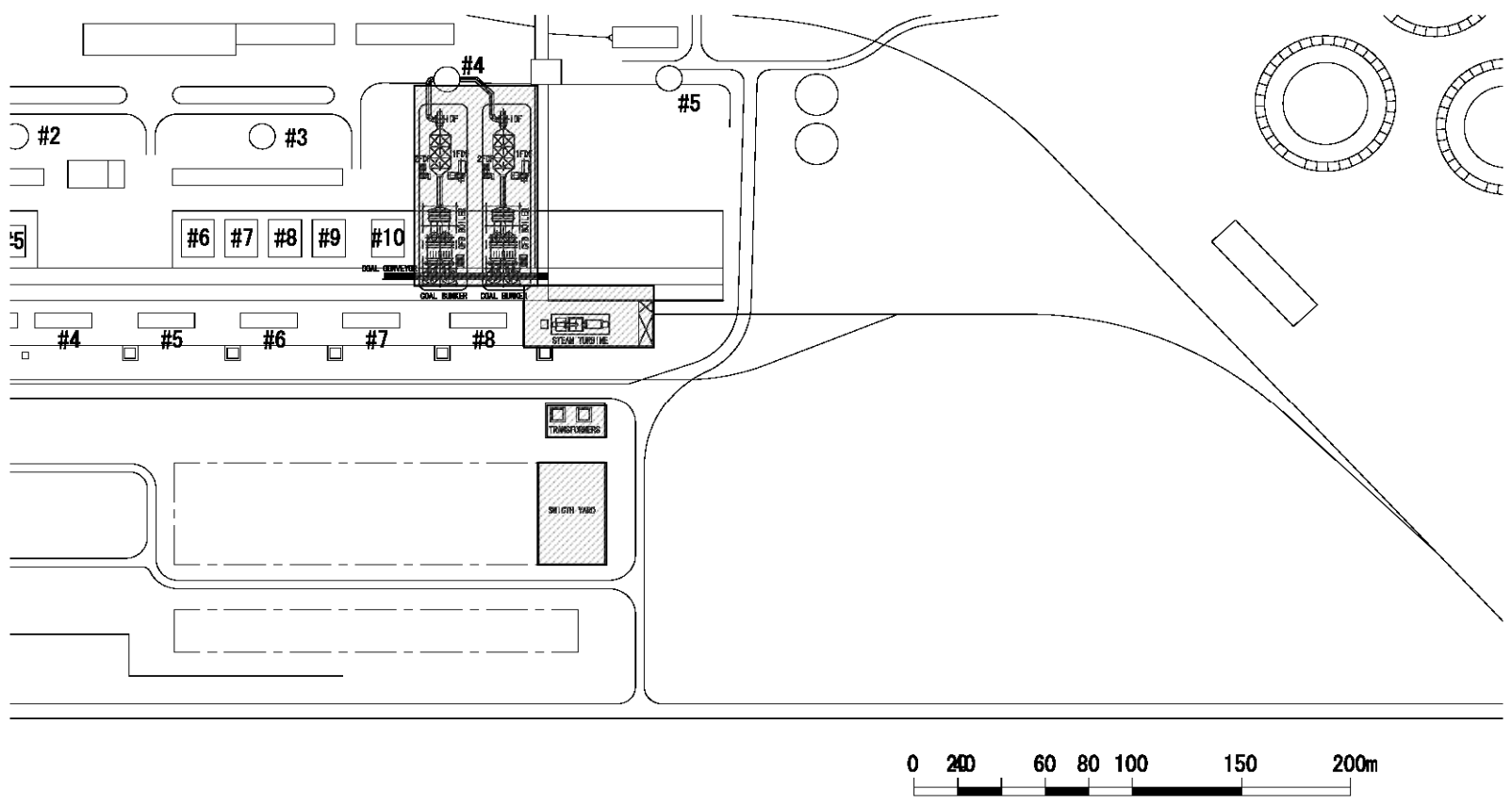
1.5 Candidate Project for Yen Loan

1.5.2 New Facilities (Summary (2/2))

	Angren Power Plant	Tarimardjan Power Plant	Heat Supply Station
Transmission Plan	Connected to existing 220kV transmission line	Connected to new 500kV substation	No.2: Connected to new 110kV transmission line No.4, No.9, No.10: Connected to 110kV transmission line
Environmental Impact	Additional construction site is already acquired without noise problem due to the fact that the surrounding area is the farm field without any residents. There is no particular issue relating to air pollution, since the site has less concentration of factories.		
	There is no impact to the fauna / flora and with no resident relocation since the land is already reclaimed. Appropriate management is conducted through monitoring on regular basis regarding any emissions from each existing power plant.		
Project Cost	250 - 300 Billion Yen	850 - 900 Billion Yen	550 - 600 Billion Yen

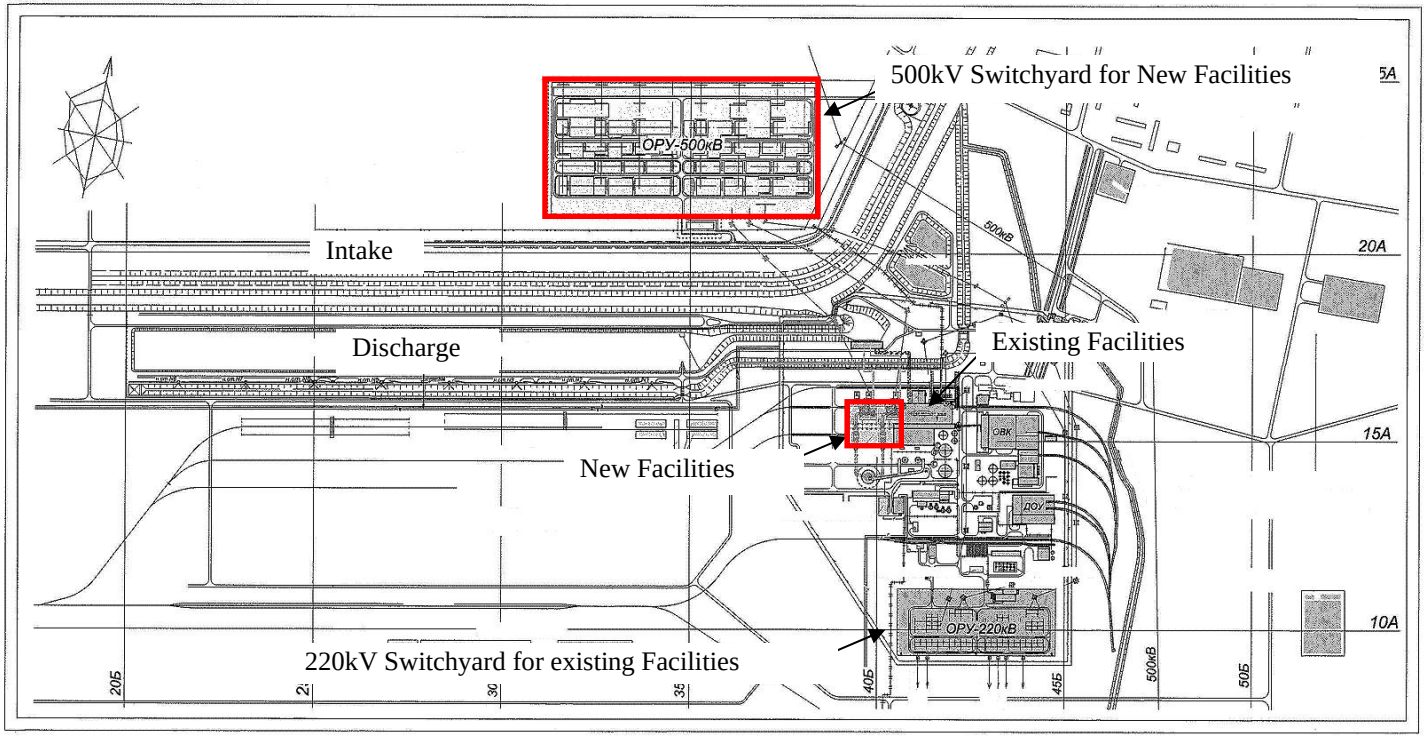
1.5 Candidate Project for Yen Loan

1.5.2 New Facilities (Layout of Angren Power Plant)

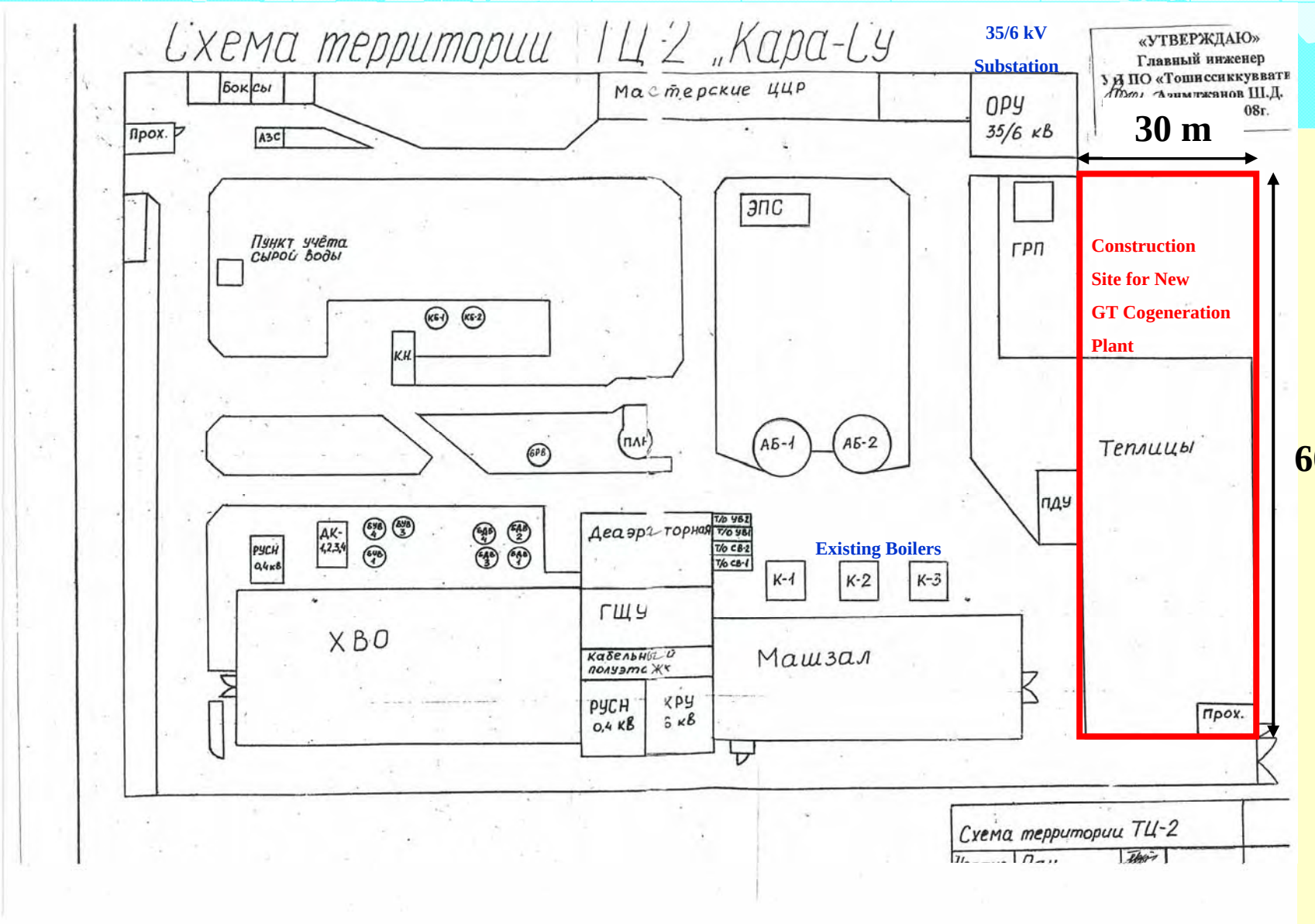


1.5 Candidate Project for Yen Loan

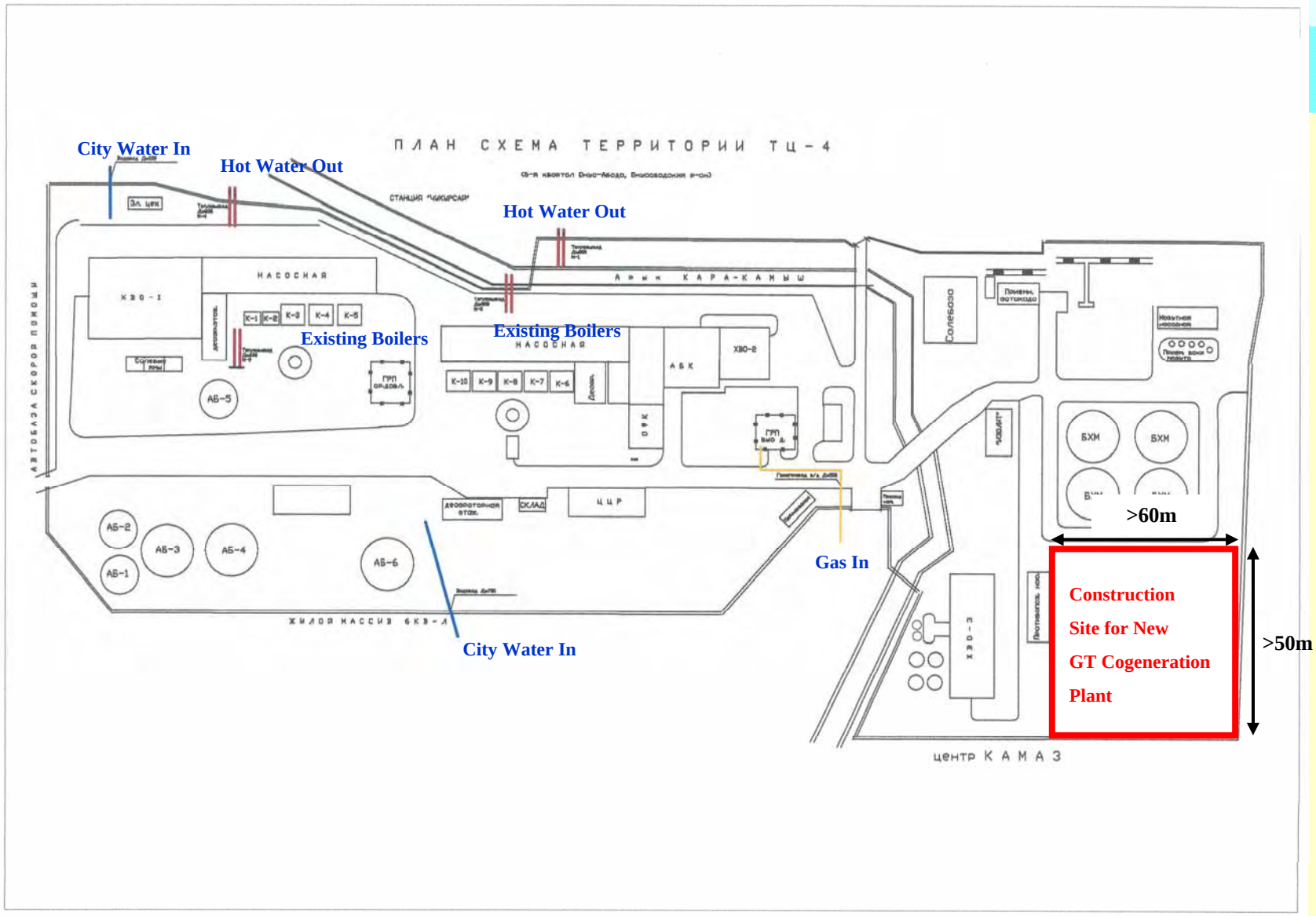
1.5.2 New Facilities (Layout of Tarimardjan Power Plant)



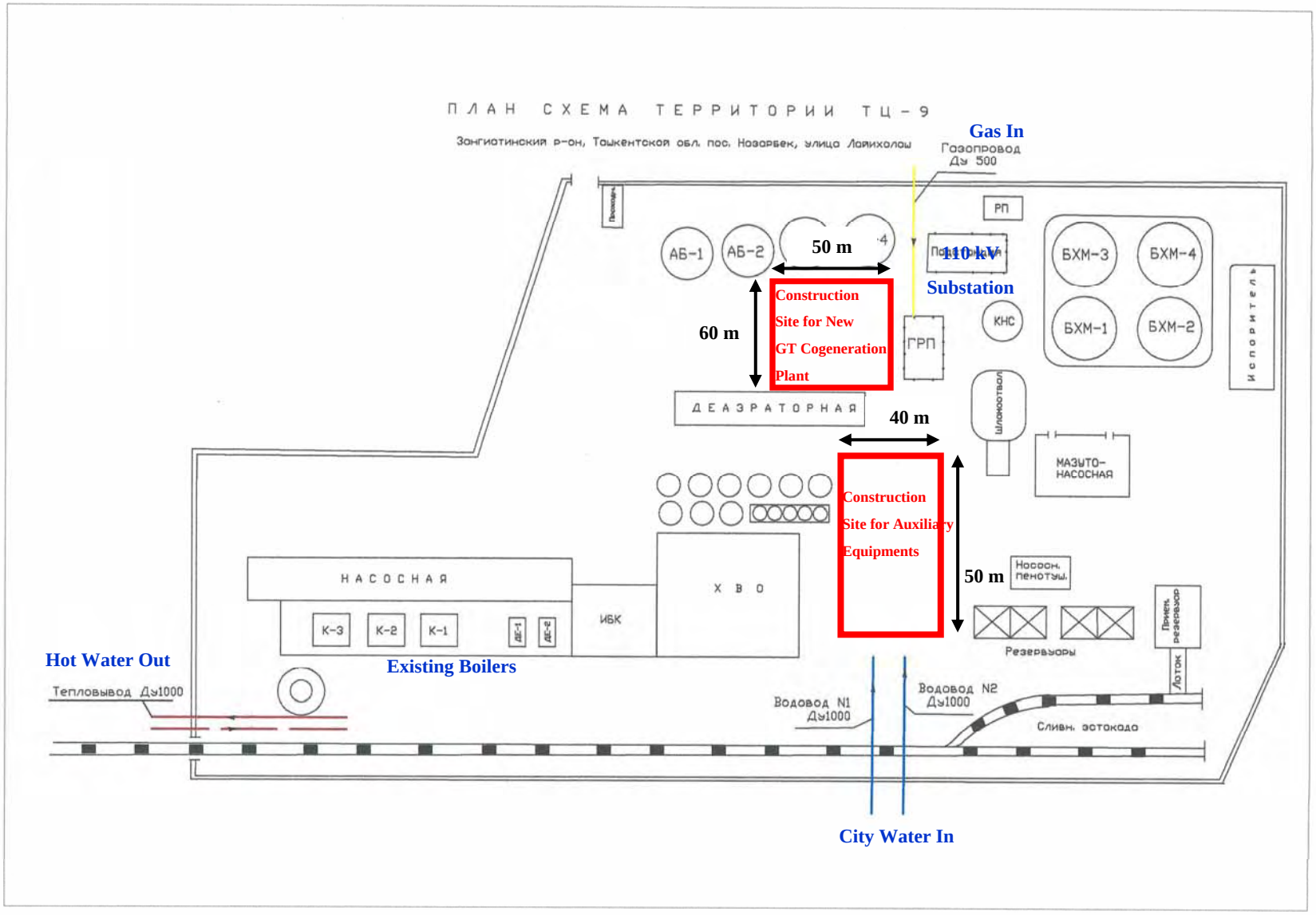
1.5.2 New Facilities (Layout of Heat Supply Station)(No.2)



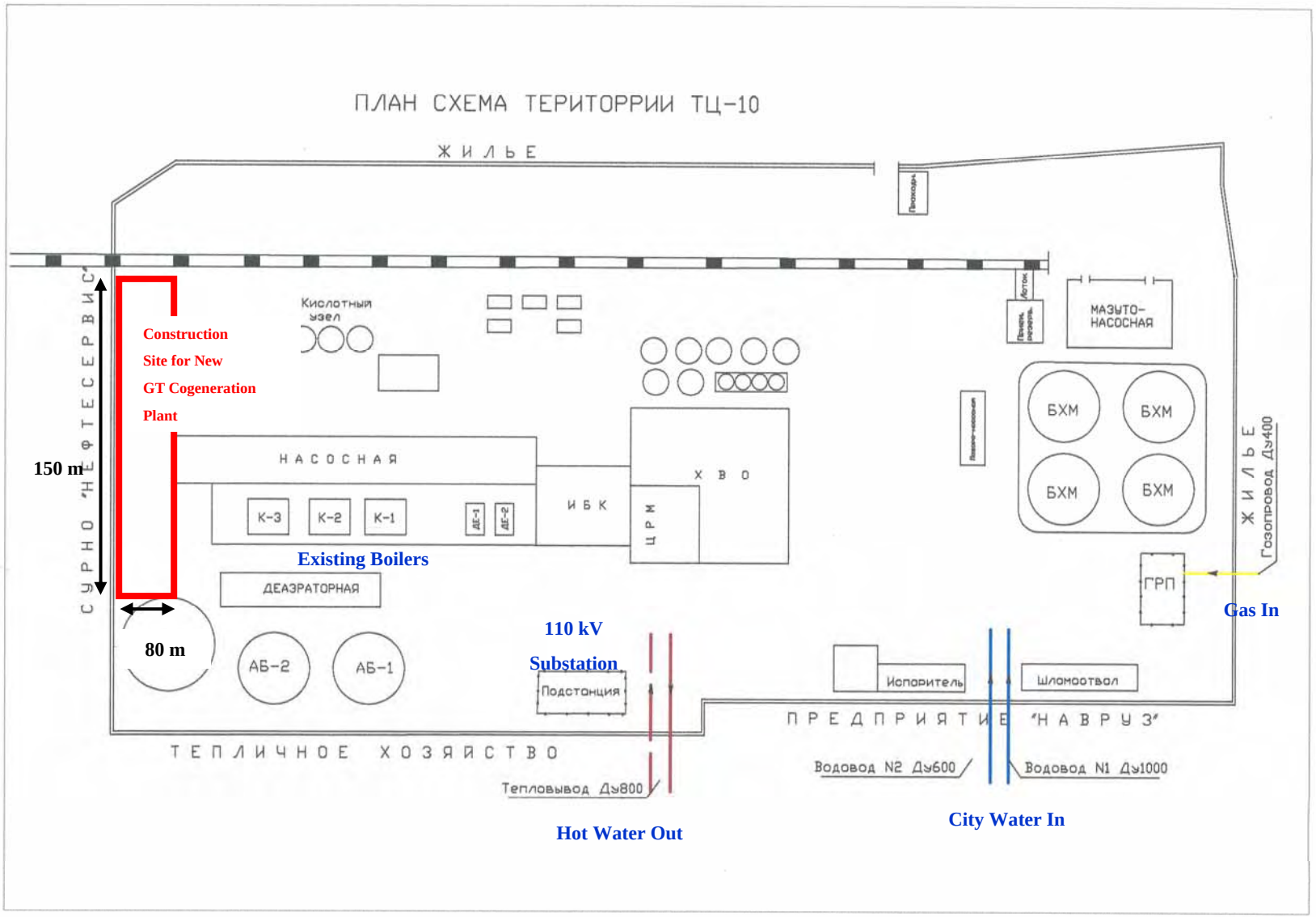
1.5.2 New Facilities (Layout of Heat Supply Station)(No.4)



1.5.2 New Facilities (Layout of Heat Supply Station)(No.9)



1.5.2 New Facilities (Layout of Heat Supply Station)(No.10)



2.1 Present Status of Project Site

2.1.1 Outline of Existing Plant

- **The Tashkent Heat and Power Supply Plant is one of the 11 heat & power generation facilities in Tashkent, the capital city of Uzbekistan.**
- **The Plant is located 2 km north of the Tashkent international airport and 4.5 km south of the city's central area, and faces on the trunk road connecting the airport and city.**
- **Around the Plant, there are a number of factories such as a textile factory, a railway factory, a reinforced concrete plant and chemical companies, and commercial buildings, shops, and houses are also located.**
- **The plant has a premise of 400 m wide and 200 m deep looking from the main gate facing on the west side of the trunk road mentioned above. This project area is at the deep corner of the left hand of the premise.**

2.1 Present Status of Project Site

2.1.2 Outline of Project Site

- **This project site is located on the south-west area in the Plant premises. Water treatment facilities are located on the north side, and the textile company on the south side borders.**
- **The project site is the vacant lot where a coal storage yard used to be, and rail ways for material transportation and wreckages of the coal storage facilities are remaining.**
- **The site area is 195m wide east to west and 76m deep south to north, where both of this project and NEDO project are planed to have their sites.**
- **A terminal point of natural gas supply line from the Gas Supply Sector is located on the south-east corner in the plant premises and future space for the fuel gas supply facilities such as gas compressors is prepared near there.**
- **110 kV transmission lines, which have been renewed in 2005, run from north to south 10m to 15m away from the west side border.**

2.1 Present Status of Project Site

2.1.3 Present Environmental Conditions

- **There is no impact to the fauna / flora since the land is already reclaimed.**
- **Appropriate management is conducted through monitoring on regular basis regarding any emissions from each existing Power plant.**

  (Recent Measuring Example)

  Emission Gas: NOx level is not complied with the regulation value.

  Discharged Water: It is complied with the regulation values. No degradation of water quality is observed around the drainage ditch.
- **Since the site is located in the center of Tashkent city in the industrial area near the airport, residential area are near side, so attention must be given to the noise control.**
- **Upon additional construction, detailed consideration has to be made not to increase the amount of emission air pollutants as a whole plant including demolition of the existing plants.**

2.2 Operating Status of Existing Plant

2.2.1 Outline of Existing Plant

- **The Tashkent Heat and Power Supply Plant is equipped with five (5) steam boilers, one (1) steam turbine generator, five (5) hot water heaters and seven (7) hot water boilers.**
- **The Plant receives tap water from the City water bureau (Tashvodakanal) and natural gas from the National Gas Supply Corporation (Uzbekneftegaz) via the Tashkent City Gas Supply Corporation (Tashgas).**
- **The Plant supplies electric power to the local state-owned distribution company (Tashgor PEC), hot water to the Tashkent City Heat Energy Supply Corporation (Tashteploenergo), and steam to various users including a textile company, wood processing plant, agricultural chemical plant, rolling stock maintenance company and ferroconcrete production plant.**
- **The equipment and facilities have continued operation for 40 to 70 years since their initial operations, and all of them have become too old.**

2.2 Operating Status of Existing Plant

2.2.2 Specification of Major Equipment

Table 2-2-1 Specification of Existing Major Equipment

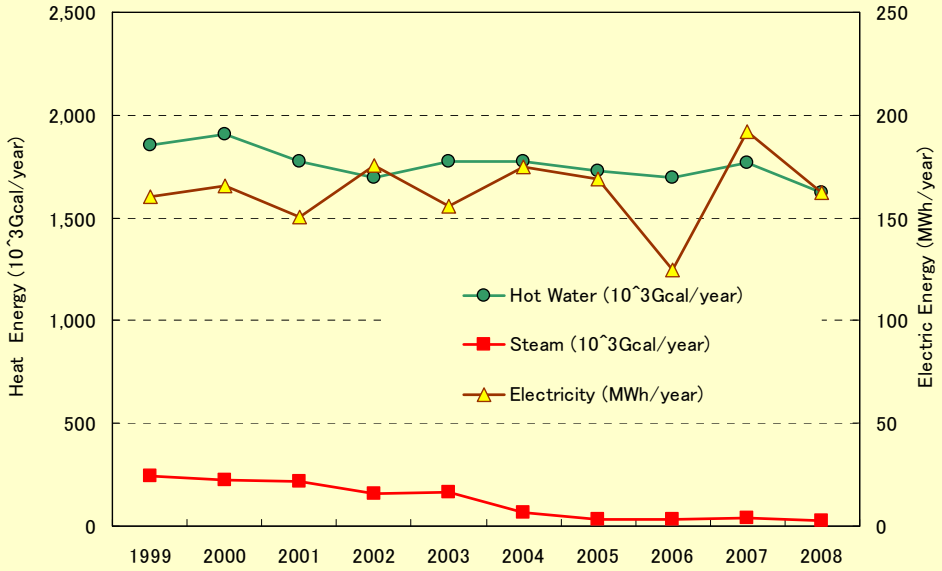
Item	Steam Boiler	Steam Turbine	Hot Water Boiler
Quantity	Five (5)	One (1)	Seven (7)
Capacity (Total)	Evaporation: 415t/h Heat: 280Gcal/h	Power: 22.5MW Swallowing: 350t/h	Heat: 650Gcal/h Water: 12,000t/h
Initial Operation	1939～1955	1954	1963～1969
Operating Hours (as of Jan. 1, 2009)	351,000～415,000hr	411,000hr	102,000～124,000hr

(source) Answer of Tashkent Heat and Power Supply Plant

2.2 Operating Status of Existing Plant

2.2.3 Yearly Production of Electric and Heat Energies during Last 10 Years

- Yearly amount of hot water heat energy, which accounts for 90% of total energy produced in this plant, has remained at the almost same level for a decade.
- Electric energy has been in the same situation as the hot water heat energy.
- Steam heat energy, on the other hand, has been decreased drastically in the last 5 years comparing with before.



(source) Answer of Tashkent Heat and Power Supply Plant

Figure 2-2-1 Yearly Production of Electric and Heat Energies during Last 10 Years

2.2 Operating Status of Existing Plant

2.2.4 Monthly Power, Electric Energy and Heat Energy Production in 2008

- Monthly production rate of hot water heat energy records at high levels between October and March when the central heating system is in service in Tashkent, and decreases drastically in the other months.
- Monthly electric power generation rate records at higher levels in the heating season and lower levels in the other season depending on the hot water supply quantity.

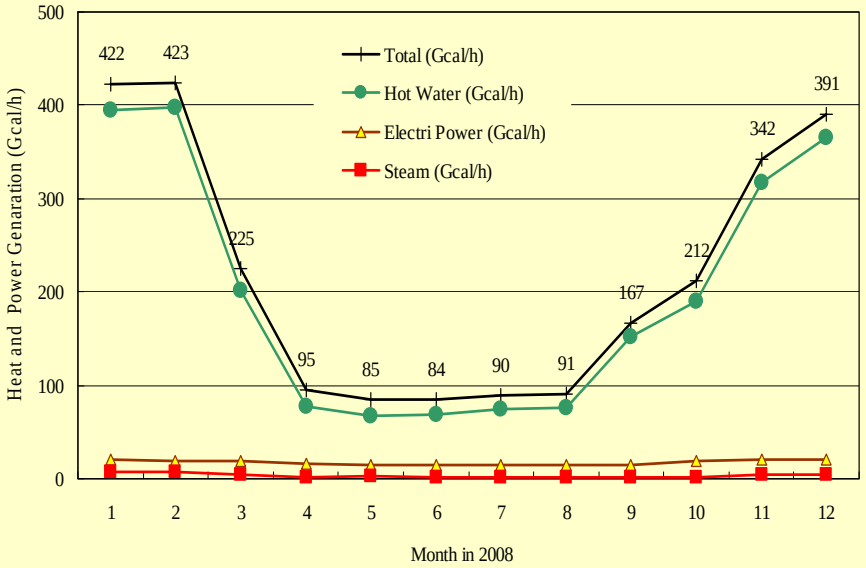


Figure 2-2-2 Monthly Break Down of Energy Production Rate in 2008

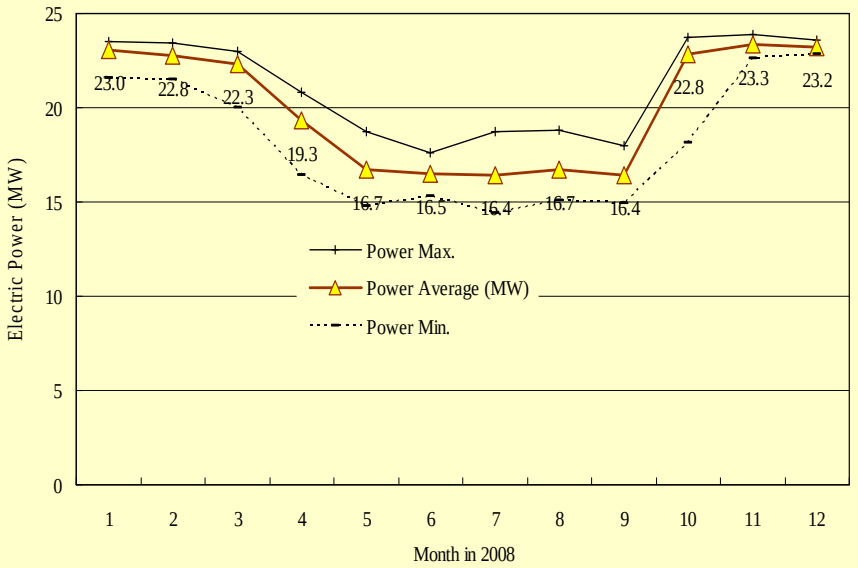


Figure 2-2-3 Monthly Record of Electric Power Generation Rate

(source) Answer of Tashkent Heat and Power Supply Plant

2.2 Operating Status of Existing Plant

2.2.5 Availability of Existing Equipment

- The steam turbine generator recorded 90% in availability, and 93% in operating load as an average during the last 5 years.
- Steam boilers recorded 62% and 72% respectively which are lower than those of the steam turbine generator because of higher redundancy in capacity than the steam turbine.
- Hot water boilers are recorded 38% and 35%, which are about half of the steam boilers because of only 5 to 6 months operation a year.

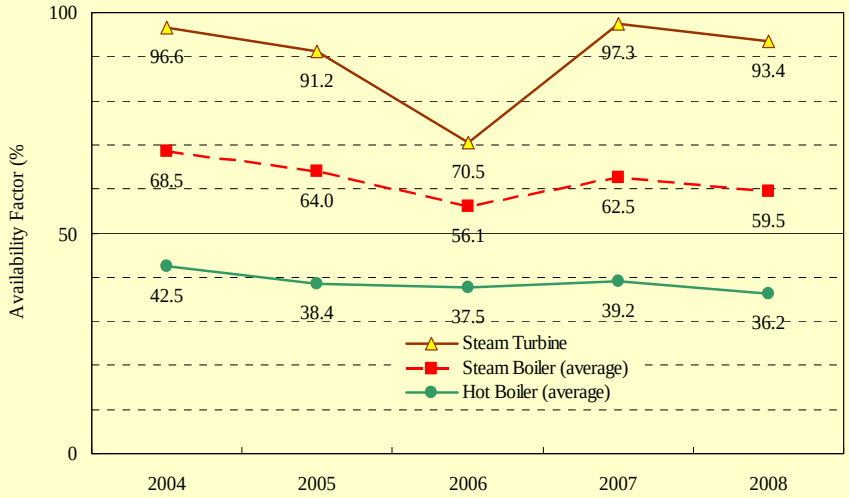


Figure 2-2-4 Availability of Major Equipment

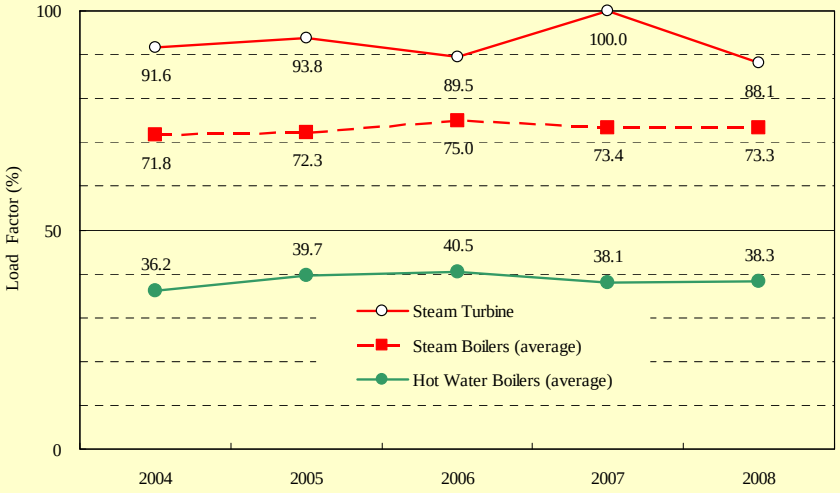


Figure 2-2-5 Operating Load of Major Equipment

(source) Answer of Tashkent Heat and Power Supply Plant

3.1 Design Concept

3.1.1 Precondition

- In the process of the modernization project using the GT cogeneration system (hereinafter referred to as "GTCS") of the Tashkent Heat and Power Supply Plant "Feasibility Study for Tashkent Heat and Power Plant Modernizing Project " by NEDO for the fiscal year 2000. Based on that, in fiscal 2004, the Republic of Uzbekistan applied a Japanese ODA Loan for the project. In fiscal 2006.
- Based on that, in fiscal 2004, the Republic of Uzbekistan applied a Japanese ODA Loan for the project.
- "Preliminary Feasibility Study of Investment Project of Construction of Gas Turbine Unit at Tashkent HPGP" (described hereafter as Pre-FS) was prepared by the Uzbekistan government in May 2006.
- This Pre-FS settled the particulars of the new facilities introduced for this project as that electricity generation capacity should be 80MW, heat production capacity 100Gcal/h, and that three (3) units of 25MW class gas turbine cogeneration system (described hereafter as "GTCS") should be introduced.
- After that, NEDO conducted further surveys and studies and prepared two reports that were " Feasibility Study of Model Project with Heat and Electricity Generation Plant for Energy-Saving in Uzbekistan (dated March 2008)" and " Feasibility Study of Model Project with High Efficiency Gas Turbine Co-Generation Plant (Uzbekistan)" dated March 2008,
- Now, a project for installing one (1) unit of 25 MW class GTCS to Tashkent CHP is being implemented by NEDO.
- Following the above circumstances, study in this report is conducted on the basis that two (2) units of 25MW class GTCS of which electricity generation capacity is 50 MW and heat producing capacity is 70 Gcal/h.

3.1 Design Concept

3.1.2 Outline

- **GTCS is the best as a distributed system, because that the system can generate electricity more efficiently than the other existing power plants as well as the states of the art gas turbine combined cycle generation system if it is integrated to the existing Tashkent CHP.**
- **Two (2) units of 25MW class Gas Turbines, Two (2) units of Heat Recovery Boilers will be installed.**
- **Power generated by the gas turbine generators will be transmitted to the outside through the existing 110 kV transmission lines and also connected with the existing switch yard of Tashkent CHP.**
- **High pressure steam produced by the heat recovery boilers will be used for driving the existing steam turbine, heating hot water system and supplying steam to the outside factories.**

3.1 Design Concept

3.1.3 Selection of Gas Turbine

- **The expected heat supply capacity is 70 to 100 Gcal/h (60 to 90 MW). Therefore, in case the total plant is comprised of 3 gas turbine units including 1 unit of NEDO project, the gas turbine unit capacity is to be 20 to 30 MW.**
- **Performance figures of 1300℃ and 25MW class standard gas turbine**
  The following performance figures are obtained correcting the figures specified in Gas Turbine World 2007-2008 GTW Handbook to the 500 m of site altitude.

Table 3-1-2 Performance Figures of 1300℃, 25MW Class Standard Gas Turbine

Manufacturer	BHE	Hitachi	Mitsubishi	SMS	SMS
Type of Model	PG5371(PA)	H-25	MF-221	STG-600	STG-700
Power Output (MW)	24.7	25.9	28.2	23.3	27.3
Thermal Efficiency (%)	28.5	33.8	32.0	34.2	36.0
Fuel Consumption (m^3/h)	9,250	8,190	9,410	7,270	8,100
Exhaust Gas Flow (ton/h)	423	323	396	295	335
Exhaust Gas Temp (℃)	487	555	533	543	518

3.1 Design Concept

3.1.4 Main Performance Figures of Gas Turbine Cogeneration System

Further study in this report will be promoted on the following expected performance figures of Hitachi H-25 Model gas turbine, which are predicted based on the performance figures of a similar project.

GT Model x Unit Number	Hitachi H25 x 2
Type of HRSG	Steam Recovery Type
Gross Power Output(@15℃, 963hPa, RH60%）	54,340 kW
Net Power Output(@15℃, 963hPa, RH60%）	48,340 kW
Net Heat Output of HRSG	73.9 Gcal/h
Fuel Flow Rate	17,160 Nm^3/h
Fuel Heat Input (LHV)	148.92 Gcal/h
Total Net Thermal Efficiency (LHV)	77.5%
Exhaust Gas Emission Level	
NOx	25 ppmv (Dry 15%O_2)
SOx	Negligible (depends on S in fuel)
PM_{10}	Less than 5 mg/Nm^3
Service Factor	85%
Plant Life	30 years

3.1 Design Concept

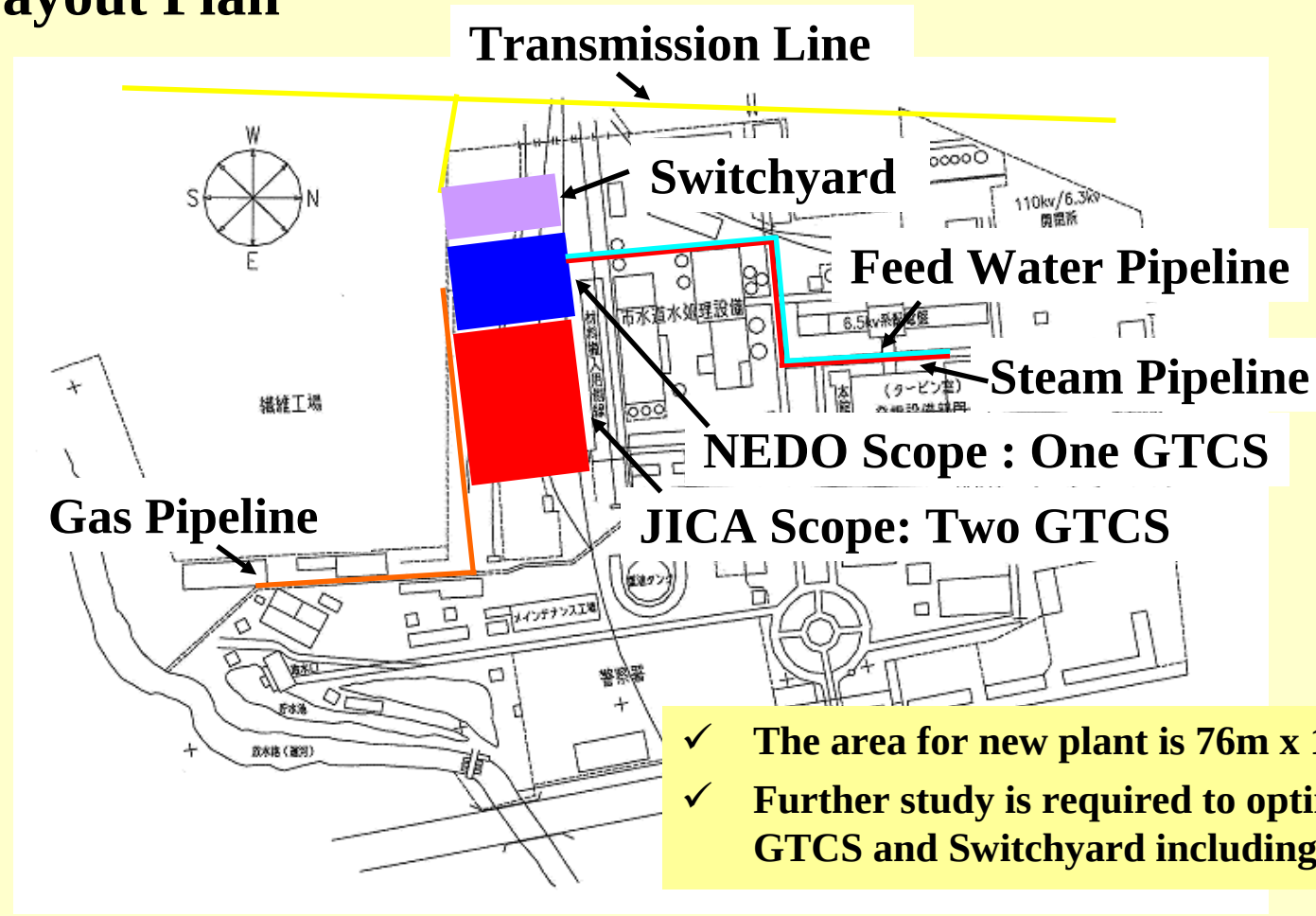
3.1.5 System Configuration

The following table shows main equipment to be installed by Japanese ODA Loan Project.

Table 3-1-3 Main Equipment to be Newly Installed

Name of Equipment	Specifications	Remarks
Gas Turbine/generator	25MW class x 2 units	with exhaust gas bypass system
HRSG	High pressure steam recovery type x 2 units	with 2 units of 50% capacity BFP
Fuel Gas Supply Equipment	Pre-treatment system：50% x 2 units Gas compressor：50% x 3 units	with fuel gas supply pipes
Electrical Equipment	Main transformer、unit transformer、switchyard	
Control/Monitoring System	DCS system	

3.2 Layout Plan



- ✓ The area for new plant is 76m x 195m.
- ✓ Further study is required to optimize layout of GTCS and Switchyard including NEDO scope.

3.3 Equipment and Material Transportation

- **The study is carried out on the conditions that all equipment required for the project are exported from Japan.**
- **Uzbekistan is a double land locked country and the equipment and material is transported to a neighboring country by sea and then to the site by railway and/or road.**
- **Candidate transportation route for heavy equipment: Ilychevsk (the Black Sea, Ukraine) → Turkmenbashi (the Caspian Sea, Turkmenistan) → Tashkent Heat and Power Supply Plant**
- **Candidate transportation route expected heavy equipment: Antwerp (Belgium) → Tashkent Heat and Power Supply Plant**
- **The routes are subject to change depending on the season when the transportation will be conducted.**

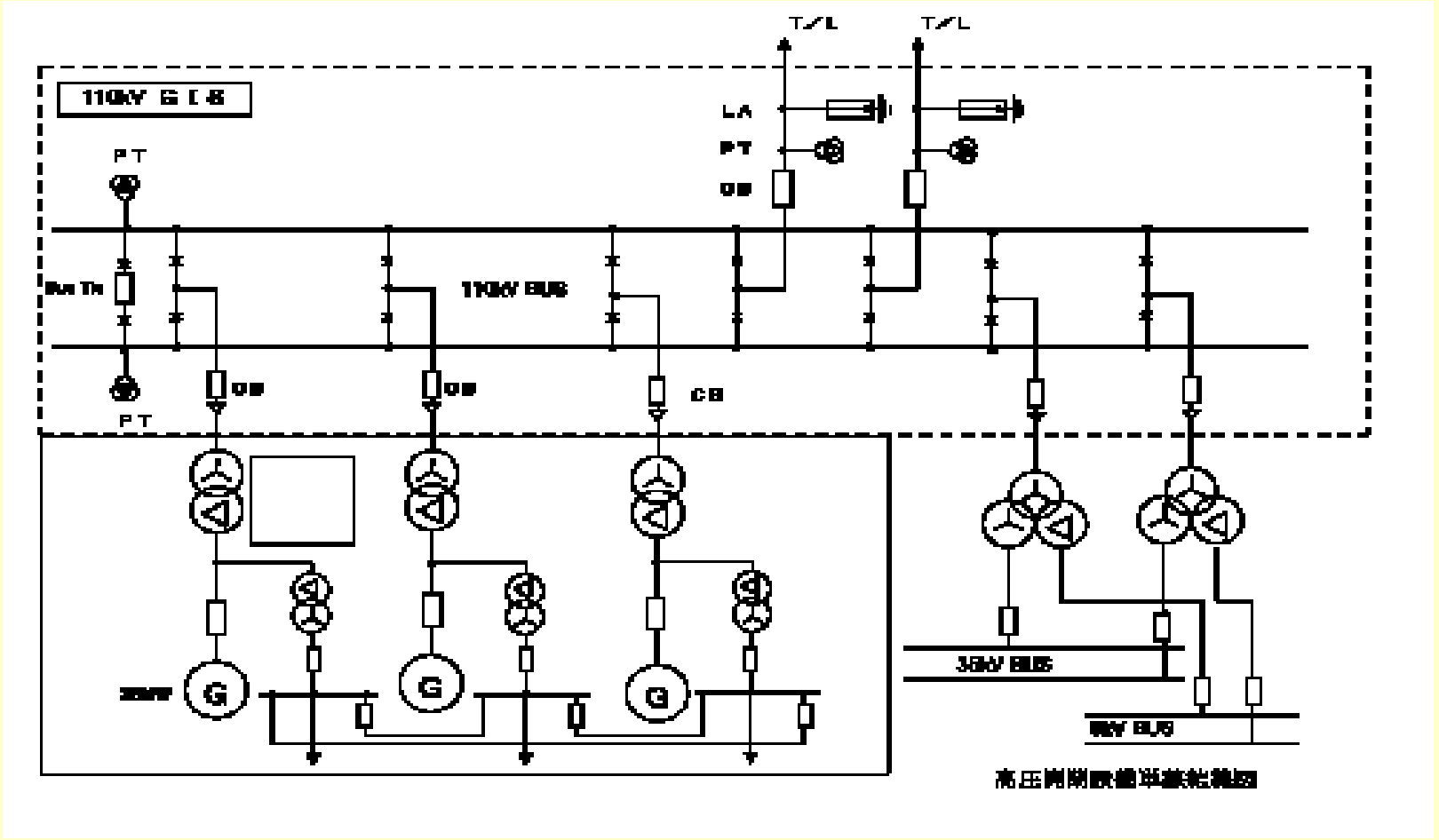
3.4 Fuel Supply Plan

- **The Tashkent Heat and Power Supply Plant uses gas from Bukhara field about 600km west-southwest of Tashkent city.**
- **The natural gas development and supply service is under the control of a gas development corporation (Uzgazbyt).**
- **The Tashkent Heat and Power Supply Plant receives the fuel gas at the pressure of 1kg/cm2(g).**
- **To operate gas turbine on natural gas, it is necessary to install gas compressor to pressurize the gas to approximately 1kg/cm2(g).**
- **According to the natural gas supply agreement with Uzgazbyt, the maximum contract flow rate to the plant is 130,000m3/h. The maximum supply record to the plant in 2008 was about 59,000m3/h.**
- **After introduction of this project, the peak consumption of natural gas will increase to about 12,000m3/h. The total value is still smaller than the maximum contract flow rate.**

3.5 Electric facilities plan

- Two circuits of 110kV transmission lines are renewed 2005.
- The electric power from New facilities 25MW × 3 including NEDO's plant of 25MW × 1 is stepped up to 110kV by the new step-up transformer and the some portion of the power will be transmitted to the net works through the two circuits of transmission lines. The remaining power is stepped down to 35kV and 6.3kV by the existing transformers. The 35kV and 6.3kVpowers are to be transmitted to Tashkent International Airport and the spinning mill adjacent to Tashkent CHP respectively.
- Present project candidate area seems to be small for installation of 3 GTCSs although the detailed study of equipment layout is not completed. The additional area for the new switchyard needs to be acquired, if required. For the purpose, Uzbekenergo has plan to acquire the necessary area in the premise of the spinning mill.
- Electrical equipment of existing and new plants are connected with the new 110kV switchyard by using overhead lines or underground cables.
- Single line diagram of new switchyard is as shown in the next slide.

New Plant Single Line Diagram



3.6 Coordination with NEDO Project

The NEDO project plans to install one new 25 MWGTCS to this project.

Two 25 MWGT GTCSs are planned to install on the same lot for this project, and therefore establishing and maintaining coordination with the NEDO project as much as possible is important with regard to equipment specification selection, layout planning, construction planning, and connection with the existing facilities.

The following are the items that require special consideration:

(1) Coordination for the layout of the main equipment, BOP equipment, and buildings

(2) Unification of the conditions for the generated steam and water supply connected to the existing facilities

(3) Shared use of the steam and water supply piping connected to the existing facilities

(4) Shared use of the fuel system

(5) Coordination for the layout of the power switchgear equipment

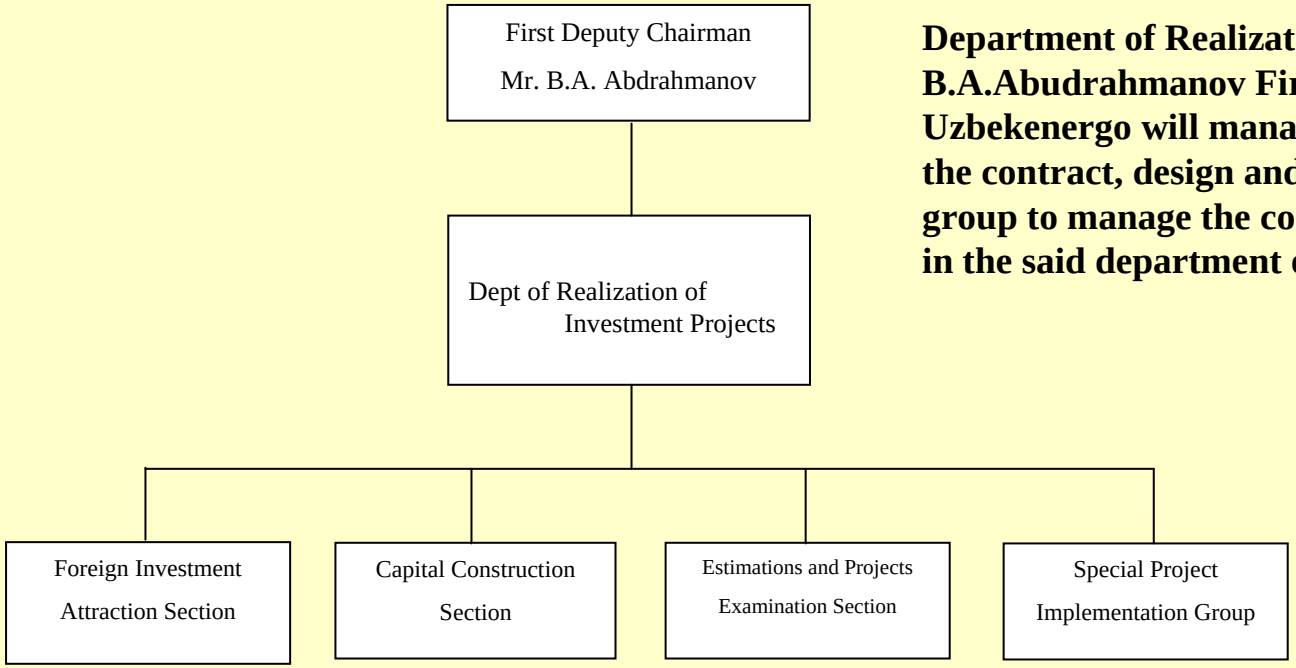
(6) Extraction of problems in power network connection.

(7) The future plan of existing electrical equipments

3.7 Project Implementation Schedule

- ✓ **'Selection periods of Consultant and Contractor' are based on JICA standard.**
- ✓ **'Selection period of Contractor' includes the preparation period of the bidding documents, floating period for bidding, and periods for technical evaluation, financial evaluation, contract negotiation and approval by Uzbek and Japanese government.**

3.8 Project Implementation Organization



Department of Realization of Investment Projects (Mr. B.A.Abudrahmanov First Deputy Chairman) of SJSC Uzbekenergo will manage the new power plant by controlling the contract, design and construction of the project. The group to manage the construction site office will be organized in the said department every project.

3.9 Effect of Project

3.9.1 Energy Conservation

This project is situated as the plant that doesn't cope with the heat and power demands, but rather substitutes for the superannuated existing plant. The energy conservation effect is defined as a difference between energy consumptions when the outside existing plants and the new plant generate the same power respectively.

Table 3-9-1 Energy Conservation (Annual)

Item	Tashkent CHP			Other Power Stations	Total	Energy Conservation
	GTCS	Existing	Total			
Power Generation (GWh/y)	Δ 359.9	0	Δ 359.9	▲ 359.9	0	494 (10^3Gcal/y)
Heat Production (10^3Gcal/y)	Δ 550	▲550	0	0	0	
Energy Consumption (10^3Gcal/y)	Δ 1,109	▲ 598	Δ 511	▲ 1005	▲ 494	

Table 3-9-2 Breakdown of Energy Conservation (Annual)

Kind of Fuel	Tashkent CHP			Other Power Stations (Note 2)		Total
	GTCS	Existing	Total			
Natural Gas (10^3Gcal/y)	Δ 1,109	▲ 598	Δ511	▲ 945	(94.1%)	▲ 435
Heavy Oil (10^3Gcal/y)	0	0	0	▲ 18	(1.8%)	▲ 18
Coal (10^3Gcal/y)	0	0	0	▲ 41	(4.1%)	▲ 41
Total (10^3Gcal/y)	Δ 1,109	▲ 598	Δ511	▲1,005	(100.0 %)	▲ 494

(Note 1) Marks "Δ" and "▲" show respectively increase and decrease due to application of this project.

(Note 2) It is assumed that consumption ratios of natural gas, oil and coal do not vary before and after application of this project, and are the same as the results in 2008.

3.9 Effect of Project

3.9.2 Reduction of Fuel Consumption

(a) Reduction of Fuel Consumption in Case of "by Natural Gas only"

Kind of Fuel	Energy Conservation	Fuel Heat Value	Reduction of Fuel
Natural Gas	494,194 (Gcal/y)	8,159 (kcal/m^3)	60,571 (1000m^3/y)

(b) Reduction of Fuel Consumption in Case of "by Natural Gas, Heavy Oil and Coal"

Kind of Fuel	Energy Conservation	Fuel Heat Value	Reduction of Fuel
Natural Gas	434,708 (Gcal/y)	8,159 (kcal/m^3)	53,280 (1000m^3/y)
Heavy Oil	18,188 (Gcal/y)	9,571 (kcal/kg)	1,900 (ton/y)
Coal	41,299 (Gcal/y)	2,398 (kcal/kg)	17,222 (ton/y)

3.9 Effect of Project

3.9.3 Greenhouse Gas (CO_2) Reduction Effect

On the conditions that the generation of hot water, steam and power energy remains unchanged, the reduction effect of greenhouse gases due to project introduction can be defined by the difference between the baseline emission and the emission after the project implementation

(a) CO2 Reduction in Case of "By Natural Gas Only" (Annual)

Kind of Fuel	Energy Conservation	CO_2 Emission Factor x Carbon Oxidization Ratio Factor	Reduction of CO2
Natural Gas	2,069.1 (TJ/y)	56,100 (kg/TJ) x 0.995 (-)	115,496 (ton/y)

(b) CO2 Reduction in Case of "By Natural Gas, Heavy Oil and Coal" (Annual)

Kind of Fuel	Energy Conservation	CO2 Emission Factor x Oxidization Ratio Factor of Carbon	Reduction of CO2 Emission
Natural Gas	1,820.0 (TJ/y)	56,100 (kg-CO_2/TJ) x 0.995 (-)	101,593 (ton/y)
Heavy Oil	76.1 (TJ/y)	73,300 (kg-CO_2/TJ) x 0.99	5,526 (ton/y)
Coal	172.9 (TJ/y)	96,100 (kg-CO_2/TJ) x 0.98	16,284 (ton/y)
Total	2,069.1 (TJ/y)	—	123,404 (ton/y)

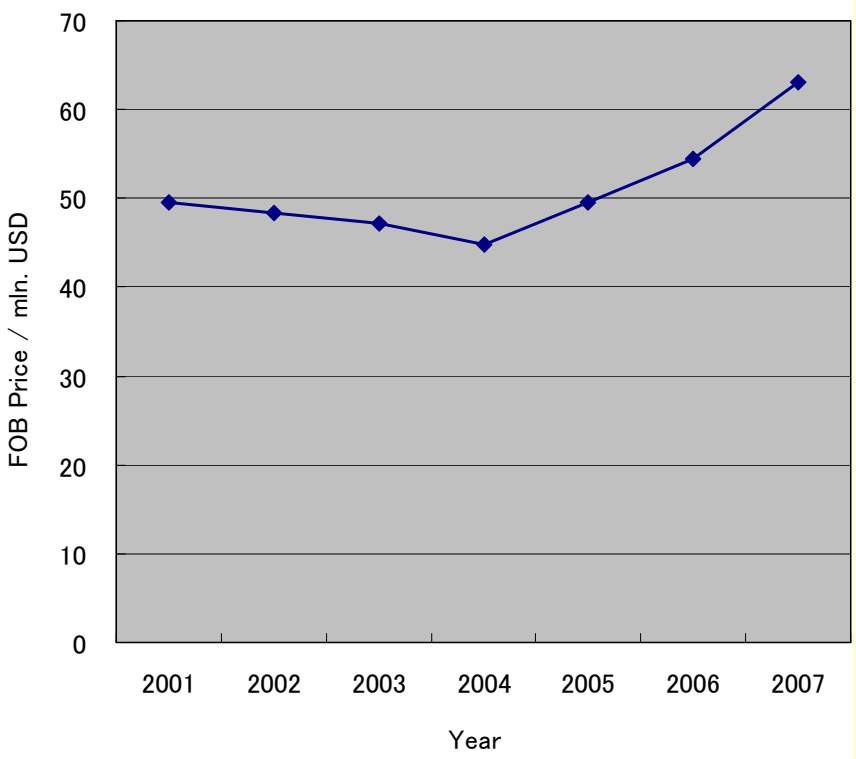
4.1 Operational Conditions of the Plant

H25 of Hitachi is selected as the model GT for this study.
Following operational conditions are assumed.

GT Model	**Hitachi H25 x 2**
Gross Power Output @15°C,963hPa, RH60%	**54,340 kW**
Net Power Output @15°C,963hPa, RH60%	**48,340 kW**
Net Heat Output	**73.9 Gcal/hr**
Total Net Thermal Efficiency (LHV)	**77.5%**
Construction Period	**39 months**
Plant Load Factor	**85%**
Project Life	**30 years**

4.2 Project Cost

(1) Price trend of the power plant



(source) Gas Turbine World GTW Handbook

Figure FOB price trend of the CCPP consisting two model GTs.

(Assumption)

The configuration of GT cogeneration plant is similar to CCPP. Therefore price trend of the CCPP consisting two model GTs was surveyed.

(Evaluation)

From 2004, the price was increased steeply and it was 1.41 times in 3years.

It is expected that the FOB price would reach around 100 Million USD in 2008.

(2) Estimation of the Project Cost

Category	Local Portion		Foreign Portion	Total	
	Bil. UZS	Eqv. MJPY	MJPY	Eqv. Bil. UZS	MJPY
A. Power Plant Construction and Associated Works		4,924	10,170	22,642	15,094
A1. FOB Price of Equipement	-	1,898	8,698	15,893	10,596
(1) Power Plant	2,600	1,734	8,042	14,663	9,776
(2) 110kV Substation	246	164	656	1,230	820
A2. Marine, Freight and Insurance		-	614	921	614
A3. Inland Transportation and Insurance	677	451	-	677	451
A4. Construction, Erection, Commissioning and Insurance	3,863	2,576	859	5,151	3,434
B. Consulting Services					
incl. Price Escalation and Physical Contingency	207	138	688	1,240	827
C. Contingency					
C1. Price Contingency on A (Foreign:2.6%/yr, Local: 8.1%/yr)	2,888	1,926	1,161	4,630	3,087
C1. Physical Contingency on the sum of A and C1 (5%)	514	342	567	1,364	909
D. Custom Duties, Tax, and VAT					
D1. Custom Duties (20% on sum of Foreign portion of A1 and A2)	2,794	1,862			1,862
D2. VAT (20% of sum of A and D1)	5,087	3,391			3,391
E. Interest During Construction (0.55%/yr on A)		26	53	118	79
F. Commitment Charge (0.1% on A through B, for 9 years)			114	171	114
Total	11,490	12,610	12,754	30,164	25,363

4.3 Financial Analysis

BENEFITS	Electric/Heat Revenue, Value of CO2 reduced
COSTS	Plant Construction, O&M

The make-up water treatment equipment for hot water supply and the hot water steam heater listed in the previous table 3-1-3 are not included in the project cost for financial analysis because these equipment should be considered as the total system of Tashkent Heat and power Supply Plant. Various kinds of taxes, interests under construction and any contingencies are also exempted from the project cost.

NPV(Discount Rate : 12%)		B/C(DC : 12%)	FIRR
-42.3	Mil. $	0.7	3.7%

4.4 Economic Analysis

BENEFITS	Economic Revenue, Value of CO2 reduced, Export of Natural Gas saved
COSTS	Economic Construction Cost, O&M

The make-up water treatment equipment for hot water supply and the hot water steam heater listed in the previous table 3-1-3 are not included in the project cost for financial analysis because these equipment should be considered as the total system of Tashkent Heat and power Supply Plant. Various kinds of taxes, interests under construction and any contingencies are also exempted from the project cost.

NPV(Discount Rate : 12%)		B/C(DC : 12%)	EIRR
121.8	Mil. $	2.0	14.8%

4.5 Conclusion of economic and financial analysis

- **In viewing from the national standpoint by various indicators including EIRR, it can be concluded that the selection of the project and the necessity of this project implementation will meet the optimum allocation of national resources.**
- **However, there is no secured endorsement that the financial viability of this project judging from those indicators of FIRR and others used as profitability parameters of project.**
- **Therefore, it will be recommended that the application for ODA loan which may offer lower interest rate and the grace period will be challenged in order to reduce the financial risk accompanying implementation of this project. Present annual interest of the Japanese ODA Loan by the Japanese government is 0.55% (preferential terms for least developed countries). In case this project is provisionally carried out by Japanese ODA Loan, FIRR indicators of this project sufficiently exceeds the annual interest rate of Japanese ODA Loan, and eventually the profitability of the implementing agency can be secured.**

4.6 Key Performance Indicators

(1) Operational Indicators

Name of Indicator	Target	Check Interval	Review Interval	Comments
Operational Indicators				
Rating Net Power Output	48.3 MW	Monthly	Yearly	The Rating Net Power Output shall be evaluated based on manufacturer's performance guarantee value considering the period from commercial operation date and operating condition etc. GT output will be in decline because of the degradation so that CCPP also will be in decline in the future. Therefore this is a significant indicator for check and review.
Rating Heat Output	73.9 Gcal/h	Monthly	Yearly	Because the main output of the plant is heat energy, the Rating Heat Output is important indicator as well as the Rating Net Power Output. The Rating Heat Output shall be evaluated based on manufacturer's performance guarantee value considering the period from commercial operation date and operating condition etc.
Net Overall Efficiency	77.5%	Monthly	Yearly	Net Overall Efficiency = (Rating Net Power Output + Rating Heat Output) / Annual Fuel Consumption This indicator shows plant overall performance. The Net Overall Efficiency shall be evaluated based on manufacturer's performance guarantee value considering the period from commercial operation date and operating condition etc.

Name of Indicator	Target	Check Interval	Review Interval	Comments
Plant Load Factor	85%	Monthly	Yearly	Plant Load Factor = Annual Heat Output / (Rating Heat Output x 24 x 365) x 100 Because the main output of the plant is heat energy, the Plant Load Factor shall be evaluated in view of heat supply. Although high efficiency GT cogeneration plant would be operated with high plant load factor, maintenance period should be considered which would greatly influence on plant load factor.
Outage by Human Errors	0 hr	Yearly	Yearly	The plant would be operated at base load. Therefore there is few chance to occur human errors.
Outage by Machine Failure	438 hr	Yearly	Yearly	Outage days by machine failure are assumed for 18 days (438 hours).
Planned Outage	240 hr	Yearly	Yearly	Planned Outage is changed depend on the menu of inspection. Combustor Inspection requires 240 hours outage for every 16,000 hours, Hot Gas Path Inspection requires 456 hours outage for every 32,000 hours and Major Inspection requires 672 hours outage for every 64,000hrs.

(2) Effect Indicators

Name of Indicator	Target	Check Interval	Review Interval	Comments
Rating Net Power Output	48.3 MW	Monthly	Yearly	The Rating Net Power Output shall be evaluated based on manufacturer's performance guarantee value considering the period from commercial operation date and operating condition etc. GT output will be in decline because of the degradation so that CCPP also will be in decline in the future. Therefore this is a significant indicator for check and review.
Annual Total Heat Output	550 Tcal	Yearly	Yearly	Annual Total Heat Output = 73.9 Gcal/hr x 8760 hours x 0.85 Maintenance period should be considered which would greatly influence on plant load factor.

5.1 Statutory System relating to Environment

- **Major Laws;**

Nature Conservation Law (1992), Atmospheric Protection Law (1996), Nature and Wildlife Utilization/Natural Plant life Protection and Utilization Law (1997), Environmental Investigation Law (2000) and such.

- **Implementing Agency**

Implementation of environmental protection is conducted mainly by the State Committee for Nature Protection with other organizations such as Industrial Labor and Safety Committee, Ministry of Health, and Ministry of Agricultural Water Utilization involved in the environmental management.

As for supervision of conditions on Air pollution and water quality, Hydro-meteorological Institution is responsible for the implementation.

Main Regulatory Standards

✓ Air quality

Environmental standard: maximum allowable concentration (MAC) (NO2, NO, CO, smoke etc.)

Emission Standard: Concentration of established factor x MAC as the maximum limit for each region, it will be confirmed and established using official diffusion estimation method at the final EIA. (Different from fixed base used by IFC or Japan)

✓ Water quality

Environmental standard: maximum allowable concentration (MAC) on utilization of water such as for drinking water and ration on recreation (SS, water temperature, pH, BOD, COD, DO, Oil, N, P and such)

Discharged Standard: Using MAC in the downstream basin at the drain outlet as the maximum limit, confirming and establishment will be done at the final EIA. (Different from fixed base used by IFC or Japan)

✓ Noise

Residential Area: 55dB(daytime), 45dB(night time)

Industrial Area: 80dB(almost as similar with the ones by IFC and Japan)

5.2 Outline on EIA Report

In Republic of Uzbekistan, major project activities such as for power plants, report relating to EA should be submitted to the State Committee for Nature Protection for approval prior to the commencement of the project under legislative decree No.491, Environmental Investigation Planning(2001) based on Environmental Investigation Law.

The actual procedure for receiving approval is handled in three processes as described below.

- **EIA draft – At the planning process of the project**
- **EIA report – Reflection from investigation of the above draft**
- **EIA outcome report – Final plan on commencement of plant operation (reflecting resident opinion and such)**

5.3 EIA schedule for Tashkent Heat Supply Plant

Period	Point of consideration/EIA procedure	Japanese ODA Loan (tentative)
Till November 2009	Selection of EIA items based on JICA Environmental Checklist/development of mitigation measures and environmental monitoring plan (item, method)	
Till December 2009	Final confirmation of Environmental Checklist for Power Plant by JICA (temporal) (Annex-1)	Appraisal
Till January 2010	-	Pledge
Till March 2010	Completion of review of Environmental Impact Statement in Uzbekistan	E/N, L/A

Outline of EIA Report Contents and Data Required (1/3)

Chapters		Entry lists	Points to remember / data source
1. Introduction	・Background ・Regulation relating to environment	・Electrical demand and supply ・Regulation relating to EIA on air/water quality, noise and waste material, Regulation on safety of labor workers and facilities ・Outline of Guideline by JICA	―
2. Description of project and facility	・Necessity ・Plant plan	・Outline of existing power plant facility, necessity of new facility, reason for selecting the site and fuel ・Outline of the site, plan on fuel demand and supply, operational plan, plan on facility, irrigation plan, maintenance plan and time of implementation etc.	―
3. Condition of the site and area	・Physical condition ・Ecological condition ・Social and economic characteristic	・Climate, weather, geography, geology, hydrology, hydrometeor, water quality, air quality, noise condition and pollution source for air/water quality ・Soil, vegetation and animal ・Condition of population, language, religion, school, hospital and transportation	・Weather, Hydrology ,Air quality：Hydro-meteorological Institution ・Water Quality ：Hydro-meteorological Institution, the State Committee for Nature Protection, Ministry of Health ・Institute of Botany, Zoology and under the Academy of Sciences ・Statistical Department, city and district Governors’ offices

Outline of EIA report content and data required (2/3)

Chapter		Entry lists	Points to remember / data source
4. Impact During construction	・Outline of impact ・Air quality ・Water quality ・Noise and vibration ・Waste material and excavated sediment ・Social and economic	・Transportation of goods/facility and impact due to installation of facility. ・Mitigation measure ・Mitigation measure ・Mitigation measure, estimation by models if necessary ・Mitigation measure, appropriate disposal ・Mitigation measure, enhancing effect	
5. Impact during operation	・Outline of impact ・Air quality ・Water quality /utilization ・Noise and vibration ・Harmful /solid waste ・Plant, animal, land / aquatic ecosystem ・Social and economic ・Safety	・Transportation of material/facility, installation of facility ・Mitigation measure, estimation of diffusion model ・ Disposal of discharged water, mitigation measure, impact of discharged water ・Mitigation measure, estimation using models if necessary ・Mitigation measure, appropriate disposal ・Planting effect, disposal of discharged water ・Mitigation measure, enhancing effect ・ Consideration for accident and natural disaster	・Consideration is necessary not to increase the amount of emission as Tashkent CHP as a whole ・ Confirmation of Noise Level beside residential area of Tashkent CHP site for night ・ Recycles of coal ash in Angren

Outline of EIA report content and data required (3/3)

Chapter		Entry lists	Points to remember / data source
6. Mitigation measure for impact	・Exhaust gas control ・Discharged water control ・Harmful /solid waste control ・Noise/vibration control ・Accident and emergency response ・Environmental management plan ・Environmental monitoring plan	・Mitigation of pollutant in exhaust gas ・Disposal of discharged water from plant, cooling water, oil waste water, service waste water, storm sewage. ・Mitigation measure such as reuse, appropriate disposal ・Mitigation measure ・Management program, plan and schedule of all sorts, organization and training, work safety. ・System of organization/management measure during operation and construction ・Plan during construction/operation, system of organization, financial resource and reporting.	Same before Same before
Conclusion	―	・ Overall Impact Assessment	

6.1 Overview of CDM Procedure

Institutional Structure for CDM projects

Interagency Council

Established in 2006

Main functions

- **Identify CDM priority area;**
- **Approve rules/procedures for CDM project select/approval;**
- **Approve CDM projects at the national level;**
- **Approve draft Emission Reduction Purchase Agreement ;**

Designated National Authority (DNA)

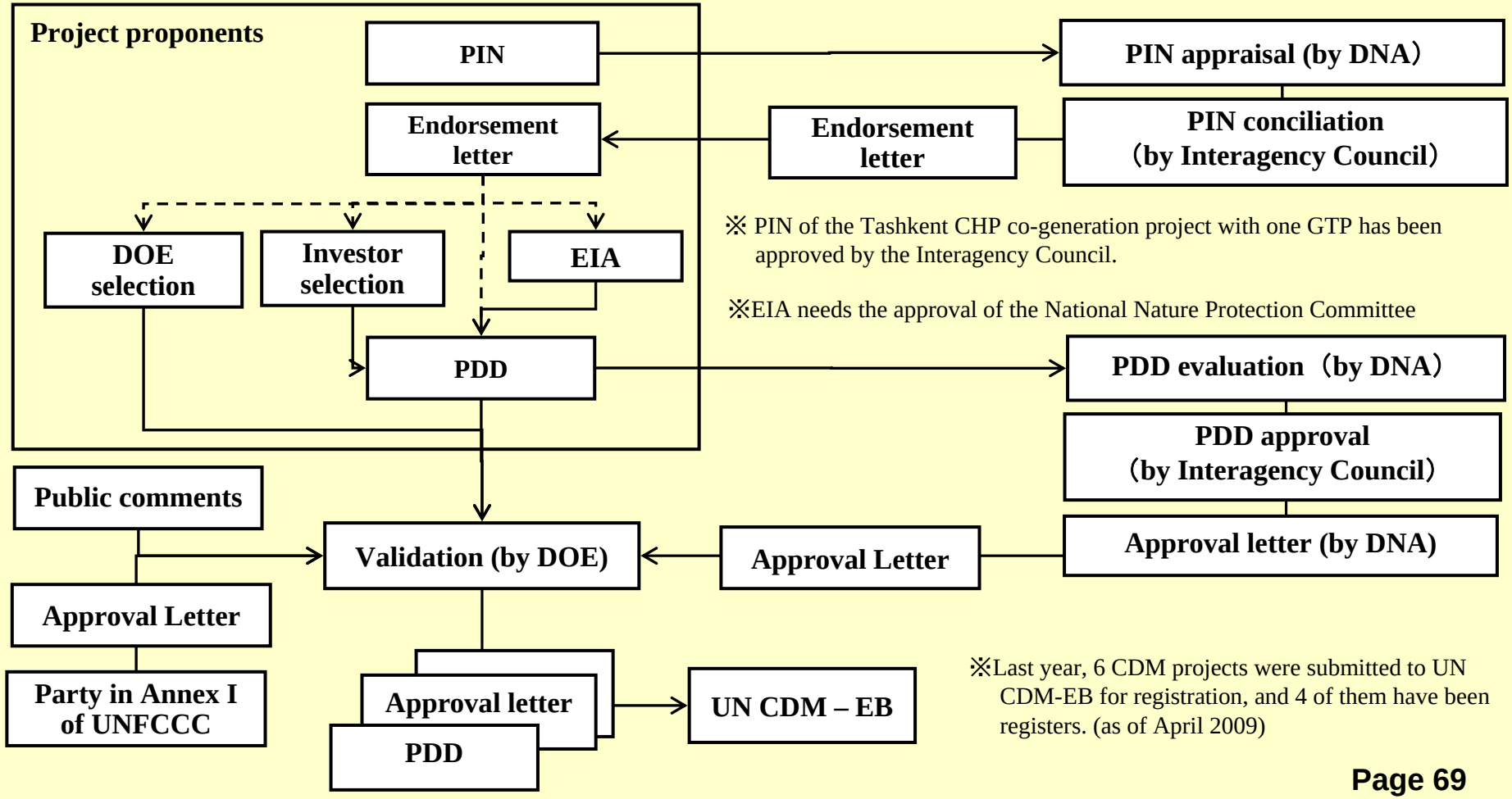
Ministry of Economy is designated in 2006 as the DNA

Main functions

- **Development and selection of CDM projects;**
- **Coordination for ministries and agencies on CDM project appraisal;**
- **Submission of CDM projects to Interagency Council;**
- **Submission of the CDM projects to UN-EB;**
- **Monitoring CDM projects implementation;**
- **Addressing other issues related to CDM projects;**

Secretariat

Procedure of CDM projects implementation



※ PIN of the Tashkent CHP co-generation project with one GTP has been approved by the Interagency Council.

※EIA needs the approval of the National Nature Protection Committee

※Last year, 6 CDM projects were submitted to UN CDM-EB for registration, and 4 of them have been registers. (as of April 2009)

6.2 Study on CDM Application

Tashkent Heat and Power Supply Plant

Input sources		Input	Project facility	Output	Output destinations (Customers)	
Outside of station	Inside of station		----------		Inside of station	Station outside
Gas supply system	None	Natural gas	•Gas Turbine Generator • Heat recovery boiler • Associated apparatus	Electricity	None	Power grid
None	Existing steam turbine power generation system	Water		Steam	Existing steam turbine power generation system	None

AM0048

approved methodology

※Among approved methodologies, AM0048 (New cogeneration facilities supplying electricity and/or steam to multiple customers and displacing grid/off-grid steam and electricity generation with more carbon-intensive fuels – Version2, approved by UN-EB) seems most applicable for the project.

※AM0048 might be applied to the project with requesting UN-EB deviation of methodology.

Input			Project facility	Output		
Input sources			----------		Output destination (Customers)	
Station outside	Station inside				Station inside	Station outside
Gas distribution system	None	Natural gas	• Gas turbine generator • Heat recovery boiler • Associated apparatus	Electricity	None	Power grid, Industry, Commercial, Houses
None	None	None		Steam	None	Stream grid, Industry, Commercial, Houses

Possibility of Applying CDM Scheme on the Project

Alternatives	•This project •Present system continuation	Continuation of present system is to be the baseline

Examining additionality of this project, with “Tool for the demonstration and assessment of additionality” approved by CDM-EB, and used in AM0048.

Investment analysis	Simple cost comparison, or Investment comparison analysis, or Benchmark analysis	FIRR of this project without CER is about 2%, that this project is not attractive for investment financially.	Additional ※Further analyses, including sensitivity analysis are required.	
Barrier analysis	Investment barriers	All power stations are property of public entities, that investments seems difficult.	Additional ※Further examine required.	Additional ※Barriers for this project will not be barriers for the present system continuation.
	Technological barriers	No gas-turbine co-generation system has been installed in Uzbekistan, thus technological capacity for it seems not high.	Additional ※Further examine required.	
	Barriers due to prevailing practice	No gas-turbine co-generation station in Uzbekistan.	Additional ※Further examine required.	
Common practice analysis		Same as above	N/A	

This project is possible to be a CDM project. ← GHG emission reduction (115 thousand tCO_2 a year) ← ↓ Additional

※”Additional” is assumed with information and data on hand.

I. Overall Evaluation

As the results of overall evaluation, it is feasible from the technical, economical and environmental points of view to promote this project.

1. Technical Feasibility

(1) Construction Plan

- ✓ **It is necessary to renew or replace the existing facilities to keep the operating reliabilities since almost of them have passed 40 to 50 years from commencement of commercial operation.**
- ✓ **During the last ten years, the maximum power demand has remained almost same, but in the future it is expected that the power demand will increase because the plant is located in the central area of Tashkent City and it is necessary to provide the important public facilities such as Tashkent Air Port with electric power. Thus it is necessary to develop the reliable and stable power resource in consideration of such situation.**
- ✓ **From the point of heat supply, it is significant to install higher efficient GTCS to cope with increasing heat demand due to population growth of Tashkent City and higher level of lifestyle of residents.**

(2) Installation System

- ✓ **The generated power output of GTCS is larger than existing boiler and turbine system for the same amount of heat supply capacity.**
- ✓ **As the result, the equivalent thermal efficiency of the part of power generation system is larger than the latest large capacity combined cycle power plant. It means that GTCS is suitable as distributed power source.**

Overall Evaluation and Recommendation

1. Technical Feasibility

(3) Layout Plan

- ✓ **The area for new plant is 76m x 195m, this area is enough for installation of two GTCS.**
- ✓ **But it is necessary to optimized study of layout included NEDO scope (total GTCSs are three) and 110kV switchyard.**

(4) Fuel Supply Plan

- ✓ **Uzbekistan has natural gas reserves estimated at 65 Trillion Cubic Feet on January.**
- ✓ **According to the natural gas supply agreement with Uzgazbyt, the maximum flow to the plant is 130,000m3/h. The maximum supply record to the plant in 2008 was about 59,000m3/h.**
- ✓ **After this project, the peak consumption of natural gas will increase to about 12,000m3/h. The total value is still smaller than the contracted maximum supply.**

(5) Connection Plans to the Power Network System

- ✓ **It makes judgments that it is possible to transmission in order to install new switchyard and 110kV transmission line already renewed on 2005.**

Overall Evaluation and Recommendation

2. Environmental and Social Consideration

- ✓ **There is no impact to the fauna / flora and with no resident relocation since the land is already reclaimed.**
- ✓ **Appropriate management is conducted through monitoring on regular basis regarding emission gas / discharged water at each existing power plant.**
- ✓ **Upon additional construction, detailed consideration is necessary not to increase the amount of emission air pollutants as power plant as a whole, including shutdown of the existing plant.**
- ✓ **The details with regard to this matter shall be properly studied at the stage of preparation of EIA. However, it can be judged that the impacts on circumferential environment and residents will be minimized as the study results at this stage.**

Overall Evaluation and Recommendation

3. Financial Feasibility

- **In viewing from the national standpoint by various indicators including EIRR, it can be concluded that the selection of the project and the necessity of this project implementation will meet the optimum allocation of national resources.**
- **However, there is no secured endorsement that the financial viability of this project judging from those indicators of FIRR and others used as profitability parameters of project.**
- **Therefore, it will be recommended that the application for ODA loan which may offer lower interest rate and the grace period will be challenged in order to reduce the financial risk accompanying implementation of this project. Present annual interest of the Japanese ODA Loan by the Japanese government is 0.55% (preferential terms for least developed countries). In case this project is provisionally carried out by Japanese ODA Loan, FIRR indicators of this project sufficiently exceeds the annual interest rate of Japanese ODA Loan, and eventually the profitability of the implementing agency can be secured.**

Overall Evaluation and Recommendation

4. CDM Application Feasibility

- ✓ **It is highly possible to apply AM0048 (New cogeneration facilities supplying electricity and/or steam to multiple customers and displacing grid/off-grid steam and electricity generation with more carbon-intensive fuels - Version2) for approved methodology of baseline monitoring.**
- ✓ **It can be judged that the application of CDM to this project is definitely possible as the results of investment analysis and barrier analysis of alternatives to this project in accordance with "Tool for the demonstration and assessment of alternatives" approved by EB.**

Overall Evaluation and Recommendation

II. Recommendation

- ✓ **It is necessary to promote this project in a coordinative manner with NEDO project. The following points have to be especially coordinated**

  - Total layout of equipment of both projects

  - Type of HRSG (High pressure steam or low pressure steam or hot water recovery)

  - Scope, specifications and layout of make-up water treatment facility and hot water steam heater to be renewed.

- ✓ **It is necessary to ensure the terminal pressure high enough to cope with the total fuel gas consumption including NEDO project.**

- ✓ **The pre-FS and EIA of NEDO project is to be soon approved by related governmental authorities of Uzbekistan. The pre-FS and EIA of the extension project by Japanese Soft Loan shall be prepared and approved in a similar manner.**